TVA

Tennessee Valley Authority, Post Office Box 2000, Spring City, Tennessee 37381

APR 2 8 1995

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

Gentlemen:

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

WATTS BAR NUCLEAR PLANT (WBN) - NRC INSPECTION REPORT NOS. 50-390/86-14 AND 50-391/86-14, REPLY TO NOTICE OF VIOLATION (NOV) 391/86-14-03 - FAILURE TO ESTABLISH MEASURES TO ENSURE THAT DEVIATIONS FROM THE QUALITY STANDARDS ARE CONTROLLED - REVISED RESPONSE

This letter supersedes TVA's letter dated September 1, 1994, concerning the subject NOV.

The commitment in TVA's response to the NOV dated September 7, 1988, "TVA will revise the Final Safety Analysis Report (FSAR) to remove references to implementing documents and properly characterize commitments as they relate to applicable codes, standards, and regulatory requirements," is hereby reinstated. TVA's letter dated September 1, 1994 identified the justification for rescinding this commitment. After additional reviews of this subject, TVA agrees that the commitment will be an enhancement and therefore, will be implemented as stated.

Enclosure 1 identifies, in draft, the applicable sections of the FSAR that will be revised under Amendment 89 by May 31, 1995.

Enclosure 2 lists the reaffirmed commitment.

JE01

APR 2 8 1995

If you should have any questions concerning this matter, please telephone J. Vorees (615) 365-8819.

Sincerely,

Raul R. Baron
Nuclear Assurance
and Licensing Manager (Acting)

cc (Enclosures):

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more than 6-inch layers, has a minimum required compaction of 95% of the maximum standard density at optimum moisture content. Class A1 backfill used in portions of the underground barrier trenches has the same requirements except it has a minimum required compaction of 100% of maximum density optimum moisture content.

The limits of excavation and the backfill placed around the Category I structures are shown in Figures 2.5-225, 2.5-226, and 2.5-226a.

Class B backfill is placed around non-Category I structures. This material, which is selected earth placed in not more than 9-inch layers, has a minimum required compaction of 90% of the maximum standard density at optimum moisture content.

A third class of fill is also used, Class C, using unclassified fills to be placed in approximately 12-inch layers and compacted with hauling equipment. This fill class is used in areas not requiring Class A or B fills, or highway and railroad fills, such as spoil areas.

The fill used to form the channel slopes in the intake channel is composed of material originally excavated from the intake channel. The material is compacted to 95% of maximum density at optimum moisture content.

Earthfill borrow areas are worked in a manner which ensures a suitable material for compaction. They are excavated in layers so that widely varying soil classes are not mixed during placement and compaction. Any conditioning which the soil requires is normally accomplished in the borrow areas prior to hauling it to the earthfill site. This conditioning includes control of moisture content and removal of deleterious materials. All borrow areas are maintained such that adequate drainage of ground water and surface runoff is provided. Drainage will be accomplished by sloping excavations, crowning, channels, dikes, sumps, and pumping, as necessary.

Compaction of large areas of earthfill is accomplished using crawler-drawn or self-propelled sheep-foot rollers. Soils in areas of limited access are compacted with small power tampers or rollers. Compaction and all other earthwork is suspended during periods of inclement weather.

In areas where earthfills with differing compaction requirements adjoin, the compacted fill with the higher degree of compaction is placed prior to the placement of fill of lower density requirements.

2.5.4.5.1.4 Construction Control

~~All~~ Earthfills [including engineered granular fills,] are placed, [tested, and controlled in general accordance with applicable ASTM standards. [172]] ~~in accordance with the provisions of TVA's General Construction Specification No. G-9 for Rolled Earthfill for Dams and Power Plants. The following information summarizes the construction control which is described in that document. This program is also applicable for all~~ engineered granular fills.

All fill operations are accomplished in the presence of a trained inspector. The inspector has the authority to suspend fill operations whenever weather or material conditions are judged unsuitable. His responsibilities include material quality, selection, excavation, hauling, placement, and compaction control. Placement is controlled either through the use of compaction control in-place density tests or by a procedural specification supplied by the engineer. This testing determines soil classification, moisture content, inplace density, relative density (granular fill only), and degree of compaction (earthfill only). The frequency of testing ~~is as specified~~ is in ~~General Construction Specification C-8 or as specified on design drawings~~ accordance with ASTM requirements. [172]. The inspector may require additional testing to conclusively identify material or check compaction. A project laboratory has been established at the plant site to perform the necessary testing. Project drawings and a series of construction control procedures relay unique construction requirements to the construction personnel.

2.5.4.5.2 Granular Fill

2.5.4.5.2.1 General

Granular fill materials are used at the site for several purposes, such as structural fill, backfill, to establish a working surface, and for road foundations. The material is obtained from offsite commercial sources. The location and use of any type of material is determined by the engineer for any safety-related feature.

2.5.4.5.2.2 Section 1032 Material

A granular fill material, consisting of crushed stone or sand and gravel, is placed around and below safety-related features in lieu of earthfill in certain locations. The granular fill material is suitable for compaction to a dense, stable mass and consists of sound, durable particles which are graded within the following limits:

	Percent by Weight	
Passing	Minimum	Maximum
1-1/4-inch Sieve	100	
1-inch Sieve	95	100
3/4-inch Sieve	70	100
3/8-inch Sieve	50	85
No. 4 Sieve	33	65
No. 10 Sieve	20	45
No. 40 Sieve	8	25
No. 200 Sieve	0	10

The material is free of soft friable particles, salt, alkali, organic matter or an adherent coating and reasonably free of thin, flat, or elongated pieces.

Laboratory shear strength tests were performed on the granular material to establish design properties. The testing consisted of triaxial (Q&R) and direct (S) shear tests. The tests were made on samples compacted to 70% and 80% of maximum relative density (ASTM D 2049). The samples composition were varied to provide three separate gradations for testing.

160. Seed, H. Bolton and Idriss, I. M., 'Simplified Procedure for Evaluating Soil Liquefaction Potential, ASCE, Journal of the Soil Mechanics and Foundations Division, September 1971.

161. NUREG-0026, 'Evaluation of Soil Liquefaction Potential for Level Ground During Earthquakes,' Prepared by Shannon & Wilson, Incorporated, and Agabian Associated for the U.S. Nuclear Regulatory Commission.

162. Seed, H. Bolton, Idriss, I. M., Makdisi, F., and Banerjee, N., 1975, 'Representation of Irregular Stress Time Histories by Equivalent Uniform Stress Series in Liquefaction Analyses,' Earthquake Engineering Research Center, Report No. EERC 75-29, University of California, Berkeley, October.

163. Silver, M. L., and Seed, H. Bolton, 1969, 'The Behavior of Sands under Seismic Loading Conditions,' Earthquake Engineering Research Center, Report No. EERC 69-16, University of California, Berkeley.

164. University of California, 1973, 'Computer Program for Slope Stability Analysis (STABR),' Civil Engineering Department, University of California, Berkeley.

165. Lee, K. L. and Albaise, A., 'Earthquake Induced Settlement in Saturated Sands,' ASCE, vol 100, GT4, April 1974.

166. TVA, 'Watts Bar Nuclear Plant - Liquefaction Evaluation of the ERCW Pipeline Route,' February 8, 1982.

167. TVA, 'Watts Bar Nuclear Plant - Liquefaction Evaluation of the ERCW Pipeline Route - Revision 1,' March 17, 1982.

168. TVA, 'Liquefaction Evaluation of the ERCW Pipeline Route Watts Bar Nuclear Plant - Task 9,' November 1982.

169. Bowles, J. E., 'Foundation Analysis and Design,' 1968.

170. Winterkorn, Hans F., and Hsai-Yang Fang, 'Foundation Engineering Handbook,' 1975.

171. Mooney, H. M., 'Seimic Shear Waves in Engineering,' Journal of the Geotechnical Division, ASCE, 1974, P. 912-916.

172. (See ATTACHED)

ADD REFERENCE , PAGE 2.5-137

172. **Additional Codes and Standard applicable to Construction Control and Granular Fills.**

Codes

Code of Federal Regulations Title 29, Sections 1910.109 and 1926.900, Title 10, Part 100, Appendix A.

Standards - ASTM - American Society for Testing and Materials

ASTM C 33-90	Concrete Aggregates
ASTM C 88-83	Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C 131-89	Standard Test Method for Resistance to Degradation of Small Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 535-89	Standard Test Method for Resistance to Degradation of Large Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM D 422-63	Standard Method for Particle-Size Analysis of Soils
ASTM D 698-78	Standard Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 5.5-Pound (2.49-kg) Rammer and 12-Inch (305 mm) Drop
ASTM D 1556-82	Standard Test Method for Density of Soils in Place by the Sand-Cone Method
ASTM D 2167-84	Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber-Balloon Method
ASTM D 2216-80	Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures
ASTM D 2487-85	Standard Test Method for Classification of Soils for Engineering Purposes
ASTM D 2922-81	Standard Test Methods for Density of Soil and Soil Aggregate in Place by Nuclear Methods
ASTM D 4253-83	Standard Test Methods for Maximum Index Density of Soils Using a Vibratory Table
ASTM D 4254-83	Standard Test Methods for Minimum Index Density of Soils and Calculation of Relative Density
ASTM D 4318-84	Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

3. Impact Barrier: An engineered structure located to limit pipe motion and designed to withstand the impact of a whipping pipe.

4. Pipe Sleeve: A metal sleeve that encloses a portion of a process pipe and is designed to restrict and redirect jet forces. (see 3.8.1.2, Item 2)

(see 3.8.1.2, Item 4).

Welding for protective structures designed to the requirements of AISC was in accordance with the American Welding Society, "Structural Welding Code," AWS D1.1~~1972 as implemented by TVA General Construction Specification G-29C when specified on the drawings.~~ Nuclear Construction Issues Group documents NCIG-01~~, Revision 2,~~ and NCIG-02, ~~Revision 0,~~ may be used after June 26, 1985, to evaluate weldments that were designed and fabricated to the requirements of AISC/AWS. ~~When invoked, NCIG provisions will be implemented as follows:~~ (See 3.8.1.2, Item 12)

~~1. An engineering evaluation of the structures will be performed and documented to determine that the provisions of NCIG-01 are consistent with the engineering considerations used for the design basis.~~

~~2. The applicability of the NCIG documents will be specified in controlled design output documents such as drawings and construction specifications.~~

~~3. Inspectors performing visual weld examination to the criteria of NCIG-01 will be trained in the subject criteria. Training of inspectors will be documented.~~

DELETE

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3.6A.1.2 Description of Piping System Arrangement

Separation was the primary consideration in the piping system layout and arrangement. Where physical separation is not feasible, protective devices shall be provided as required. Protection shall be provided such that the environmental design limits of mechanical and electrical equipment required for safe shutdown are not exceeded. Habitability is discussed in Section 6.4.

3.6A.1.3 Safety Evaluation

Safety functions shall be identified for each initiating event by means of shutdown logic diagrams (SLD). The SLD shall identify at least one success path from each postulated event to each protective function required to prevent the event's potentially unacceptable results. Each SLD shall include the set of all safety systems necessary to provide the protective function specified at the end of the success path. Shutdown logic diagrams may be supplemented by current system descriptions and equipment lists.

For each postulated pipe rupture, every credible unacceptable interaction shall be evaluated.

All possible interactions shall be evaluated to determine their credibility, damage potential, and acceptability from the standpoint of a safe shutdown capability.

In establishing system requirements for each postulated break, it is assumed that a single active component failure occurs concurrently with the postulated rupture.

3.7.3.17.1 Description of HVAC Duct and Duct Support Subsystems

HVAC duct and duct support subsystems consist of continuous runs of round and rectangular sheet metal ducts multiple supported along their lengths by structural steel support frames or rod hangers. Scheduled pipe and pipe supports functionally used for an HVAC purpose are treated as piping subsystems in accordance with Section 3.9.

For purpose of analysis, an HVAC duct and duct support subsystem is regarded as any continuous portion of a total duct run and its supports which may be conservatively modeled for evaluation of the loads and stresses within the portion of interest. Significant mass and mass eccentricities of in-line or attached mechanical and electrical components are accounted for in the subsystem model to represent their effects in structural qualifications of the ducts and duct supports in accordance with Sections 3.7.3.17.2 through 3.7.3.17.6. Qualification of the in-line or attached Category I mechanical or electrical equipment and components are in accordance with Sections 3.7.3.6, 3.7.3.16.5, 3.9, and 3.10.

3.7.3.17.2 Applicable Codes, Standards, and Specifications

The following codes, standards, and specifications are applicable to various portions of the HVAC duct and duct support subsystems:

* 1) SMACNA High Velocity Duct Construction Standards, 2nd Edition, 1969

* 2) ANSI/ASME N-509 Standard, "Nuclear Power Plant Air Cleaning Units and Components," 1976

* 3) ASTM Standards

* 4) AISI Specifications for the Design of Cold-Formed Steel Structural Members, 1986 Edition

* 5) AISC Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings, 7th and 8th Editions except welded construction is in accordance with Item 7 below.

* 6) Manufacturer's Standardization Society of the Valve and Fittings Industry, Standard Practice MSS-SP-58, "Pipe Hangers and Supports - Materials and Design," 1967 Edition

* 7) American Welding Society, AWS D1.1 Structural Welding Code (see 3.8.1.2, Item 4).

* 8) American Welding Society, AWS D1.3 Structural Welding Code for Sheet Metal

* 9) American Welding Society, AWS D9.1 Specifications for Welding Code for Sheet Metal

~~* TVA General Construction Specification G-29, "Process Specifications for Welding, Heat Treatments, Nondestructive Examination, and Allied Field Fabrication Operations"~~

- NRC Regulatory Guide 1.52, "Design, Testing, and Maintenance Criteria for Post Accident Engineered-Safety-Feature Atmosphere Cleanup System Air Filtration and Adsorption Units of Light-Water-Cooled Nuclear Power Plants," Revision 2

- ~~TVA Civil Design Standard DS-C1.7.1, "General Anchorage to Concrete"~~

- ~~TVA Construction Specification N3M-914, "Quality Assurance Requirement for Construction, Construction Testing, and Inspection of Safety-Related HVAC Systems"~~

3.7.3.17.3 <u>Loads and Load Combinations</u>

HVAC duct and duct support subsystems are designed for the following loads:

DL - Dead loads

OBE - Operating basis earthquake loads

SSE - Safe shutdown earthquake loads

T_o - Thermal effects and loads during normal operating or shutdown conditions based on the most critical transient or steady-state conditions

T_a - Time varying thermal loads under conditions generated by the design basis accident condition and including T_o

Note: The maximum value of T_a need not be considered simultaneously with the DBA if time phasing evaluation show that less than T_a maximum occurs during the DBA transient.

P_o - Operating pressure in the duct

P_j - Accident pressure external to the duct due to jet impingement loads from a pipe break. The ducts shall be protected against possible P_j loadings; therefore, this load need not be considered.

P_a - Compartmental pressure loads resulting from a design basis accident

DBA - Design basis accident dynamic loads due to pressure transient response

F - Airflow induced dynamic loads acting on turning vanes inside the ducts (dependent on the mean airflow velocity)

TABLE 3.7-26

ALLOWABLE STRESSES FOR DUCT SUPPORTS

Elements	Load Combination[(1)]	Allowables
Component Standard Supports	(1) and (2)	Factor of Safety of 5 against ultimate strength
	(3), (4), and (5)	0.90 F_y (F_y - minimum specified yield stress) or a minimum factor of safety of 2.5 against ultimate strength
Steel Structural Members and Connecting Welds (Linear Supports)	(1)	AISC allowables
	(2)	1.5 x AISC allowables but less than 0.90 F_y[(2)]
	(3) and (4)	1.6 x AISC allowables but less than 0.90 F_y[(2)]
	(5)	1.7 x AISC allowables but less than 0.90 F_y[(2)]
Anchorage in Hardened Concrete	(1), (2), (3), (4), and (5)	~~See DS-C1.7.1~~ Factor of Safety on Minimum Anchor Ultimate Tensile Capacity
• Expansion Anchors		
a) Shell type (SSD & SDI)		5
b) Other types (wedge)		4

NOTES:

(1) In applying the above load combinations for design, dead load and thermal effects may be combined directly, accounting for their signs. Seismic loads are reversing and their effects must be combined without sign with the other loads. The latter is also true for DBA loads. (See Section 3.7.3.17.3 for definition of loads and their combinations).

(2) But less than 0.52 F_y for shear stresses, and less than 0.90 F_{cr} for critical buckling stresses.

The doors are part of the airtight closure between the annulus surrounding the Containment Vessel and the inside of the Auxiliary Building. These doors are to remain closed during unit operation and will only be opened during unit shutdown.

Each set of doors is equipped with a limit switch which operates a visible indicator and audible alarm in the unit control room. The audible alarm sounds when the door is opened and the visible indicator indicates as long as the door remains open.

The door and sleeves will maintain their structural integrity and remain operational after being subjected to the environmental or accident conditions listed in Section 3.8.1.4.

3.8.1.2 Applicable Codes, Standards, and Specifications

The structural design of the reinforced concrete Shield Building is in compliance with the proposed ACI-ASME (ACI-359) Code for Concrete Reactor Vessels and Containment, Article CC-3000, as issued for trial use, April 1973, for the loading combinations defined in Table 3.8.1-1. Allowable stresses are based on this code with the exception of allowable tangential shear stresses in walls where the ACI 318-71 code is used. Detailing of reinforcing around opening of circular walls is based on the ACI Chimney Code (ACI 307-69), Sections 4.4.4 through 4.4.7. All reinforcing steel conforms to the requirements of ASTM Designation A615-72, Grade 60. ~~Construction was carried out under the requirements of TVA Construction Specification G-2, which implements the requirements of NRC Regulatory Guides 1.15 and 1.55. A comparison of G-2 and ANSI N45.2.5 and ACI 318-71 is in Section 3.8.3.2.~~

Unless otherwise indicated in the FSAR, the design and construction of the Shield Building is based upon the appropriate sections of the following codes, standards, and specifications. Modifications to these codes, standards, and specifications are made where necessary to meet the specific requirements of the structures.

Where date of edition, copyright, or addendum is specified, earlier versions of the listed documents were not used. In some instances, later revisions of the listed documents were used where design safety was not compromised.

1. American Concrete Institute (ACI)

ACI 214-77	Recommended Practice for Evaluation of Strength Test Results of Concrete
ACI 318-71	Building Code Requirements for Reinforced Concrete
ACI 359	Code for Concrete Reactor Vessels and Containments, (Proposed ACI-ASME Code ACI-359 (Article CC-3000) As issued for trial use April, 1973)
ACI 347-68	Recommended Practice for Concrete Formwork
ACI 305-72	Recommended Practice for Hot Weather Concreting

ACI 211.1-70	Recommended Practice for Selecting Proportions for Normal Weight Concrete
ACI 307-69	Specification For the Design and Construction of Reinforced Concrete Chimneys

2. American Institute of Steel Construction (AISC)

   'Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings,' adopted February 12, 1969, except welded construction is in accordance with Item 4 below.

3. American Society for Testing and Materials (ASTM), 1975 Annual Book of ASTM Standards. Specific standards are identified in Section 3.8.1.6.

4. American Welding Society (AWS) — REPLACE

   Structural Welding Code, AWS D1.1-72, as modified by TVA General Construction Specification G-29C.

   Structural Welding Code, AWS D1.1-Rev. 1-73, as modified by TVA General Construction Specification G-29C.

   Structural Welding Code, AWS D1.1-Rev. 2-74, as modified by TVA General Construction Specification G-29C.

   'Recommended Practice for Welding Reinforcing Steel, Metal Inserts, and Connections in Reinforced Concrete Connections,' AWS D12.1-61.

5. Uniform Building Code, International Conference of Building Officials, Los Angeles, 1970 edition.

6. Southern Standard Building Code, 1969 edition, 1971 Rev.

7. 'Nuclear Reactors and Earthquakes,' USAEC Report TID-7024, August 1963.

8. American Society of Civil Engineers Transactions, Volume 126, Part II, Paper No. 3269, 'Wind Forces on Structures,' 1961.

9. Code of Federal Regulations Title 29, Chapter XVII, "Occupational Safety and Health Standards," Part 1910.

10. NRC Regulatory Guides;

RG	1.10	Mechanical (Cadweld) Splices in Reinforcing Bars of Category I Concrete Structures
RG	1.12	Instrumentation for Earthquakes
RG	1.15	Testing of Reinforcing Bars for Category I Concrete Structures
RG	1.31	Control of Ferrite Content in Stainless Steel Weld Metal
RG	1.55	Concrete Placement in Category I Structures.

REPLACEMENT PARAGRAPH 3.8.1.2, PAGE 3.8-4

4. American Welding Society (AWS)

"Structural Welding Code," AWS D1.1-72 with Revisions 1-73 and 2-74 except later editions may be used for prequalified joint details, base materials, and qualification of welding procedures and welders.

Visual inspection of structural welds will meet the minimum requirements of Nuclear Construction Issues Group documents NCIG-01 and NCIG-02 as specified on the design drawings or other engineering design output. See Item 12 below.

REPLACE

11. TVA Construction Specifications

G-2 - TVA General Construction Specification for Plain and Reinforced Concrete

G-29 - TVA General Construction Specification Process Specification for Welding, Heat Treatment

G-30 - TVA General Construction Specification Fly Ash for Use as an Admixture in Concrete

G-32 - TVA General Construction Specification Bolt Anchors Set in Hardened Concrete

12. Nuclear Construction Issues Group (NCIG)

NCIG-01, Revision 2 - Visual Welding Acceptance Criteria (VWAC) for Structural Welding

NCIG-02, Revision 0 - Sampling Plan for Visual Reinspection of Welds

The referenced NCIG documents may be used after June 26, 1985, to evaluate weldments that were designed and fabricated to the requirements of AISC/AWS. When invoked, NCIG provisions will be implemented as indicated in Section 3.6A.1.1.4.

NCIG-02 Revision 0 was used as the original basis for the Department of Energy (DOE) Weld Evaluation Project (WEP), EG&G Idaho, Incorporated, statistical assessment of TVA performed welding at WBNP. Any further sampling reinspections of structural welds subsequent to issuance of NCIG-02, Revision 2 are performed in accordance with NCIG-02, Revision 2 requirements.

13. TVA Reports

CEB 86-12 Study of Long Term Concrete Strength at Sequoyah and Watts Bar Nuclear Plants

CEB 86-19-C Concrete Quality Evaluation

3.8.1.3 Loads and Loading Combinations

The Shield Building dome and cylinder wall are subjected to the following loads. Design loading combinations utilized to examine the effects of localized areas are shown in Tables 3.8.1-1 and 3.8.1-2.

Dead Load

This includes weight of the concrete structure plus any other permanent load contributing to stress, such as equipment, piping, and cable trays suspended from the structures.

REPLACEMENT PARAGRAPH, SECTION 3.8.1.2, PAGE 3.8-5, ITEMS 11 AND 12

11. DELETED BY AMENDMENT 89

12. <u>Nuclear Construction Issues Group (NCIG)</u>

NCIG-01, Revision 2 - Visual Welding Acceptance Criteria AC) for Structural Welding

NCIG-02, Revision 0 - Sampling Plan for Visual Reinspection of Welds

The referenced NCIG documents may be used after June 26, 1985 for weldments that were designed and fabricated to the requirements of AISC/AWS.

NCIG-02, Revision 0, was used as the original basis for the Department of Energy (DOE) Weld Evaluation Project (WEP) EG&G Idaho, Incorporated, statistical assessment of TVA performed welding at WBNP. Any further sampling reinspections of structural welds subsequent to issuance of NCIG-02, Revision 2, are performed in accordance with NCIG-02, Revision 2 requirements.

The applicability of the NCIG documents is specified in controlled design output documents such as drawings and construction specifications. Inspectors performing visual weld examination to the criteria of NCIG-01 are trained in the subject criteria.

The uplift on the equipment from the LOCA combined with the SSE controlled the design of the base slab.

Minimum steel requirements of 0.65 square inches per foot (minimum steel ratio of 0.0015 in each face and in both vertical and horizontal directions) controlled the inside face vertical steel requirements throughout the shell and the inside face horizontal steel requirements above grade.

The SSE in load combination 8 controlled the design of the outside face vertical reinforcement at the base of the cylinder wall. Due to earth and hydrostatic pressure, outside face horizontal reinforcement requirements were greatest 16 feet above the base of the cylinder wall at elevation 713.0.

The construction loading controlled the reinforcement design in the dome and the upper portion of the cylinder wall.

The SSE produced a maximum tangential shear stress at the base of the wall of 189.7 psi which was 76.8% of the allowable.

The effects of repeated reactor shutdowns and startups during the plant's life will not degrade the above margins of safety because the Shield Building is minimally affected by these operations. The only effects from normal operations are from interior temperature changes which are insignificant compared to normal exterior temperature variations.

Equipment Hatch Doors and Sleeves

Allowable stresses for all load combinations used for the various parts are given in Table 3.8.1-2. For normal load conditions, the allowable stresses provide safety factors of 1.67 ($F_y/0.6\ F_y$) to 1 on yield for structural parts and 5 to 1 on ultimate for mechanical parts. For limiting conditions such as an Operating Basis Earthquatke (OBE) or a Safe Shutdown Earthquake (SSE), stresses do not exceed 0.9 yield.

3.8.1.6 Materials, Quality Control and Special Construction Techniques

General

The principal materials used in the construction of the Shield Building base slab, wall, and dome were concrete and reinforcing steel. ~~Concrete was placed, inspected, and tested based upon the requirements in TVA General Construction Specification No. C-2 for Plain and Reinforced Concrete and to TVA QCP-2.2 Concrete Placement and Documentation (until 1975) and TVA WBN-QCP-2.02 (1975 and after).~~ Steel is used for the structural parts of the equipment hatch doors and sleeves with rubber used for the seals.

3.8.1.6.1 Materials

Concrete

Cement conformed to ASTM Specification C150-72 Type I. The guaranteed 28-day mortar strength was 5025 psi with a guaranteed standard deviation of 395 psi and a guaranteed maximum tricalcium aluminate content of 9.5%.

Aggregates conformed to ASTM Specification C-33-71a and were manufactured of crushed limestone.

REPLACE 1

Water for mixing concrete and also for washing the aggregates and curing concrete was tested prior to use in accordance with Corps of Engineers test method CRD-C400.

Fly ash conformed to TVA General Construction Specification No. G-30 for Fly Ash for Use as an Admixture in Concrete. This specification is more restrictive with respect to loss on ignition, but less restrictive with respect to fineness pozzolanic index than is ASTM C618-73 (see Section 3.8.3.2).

Air-entraining admixtures conformed to ASTM Specification C-260-69.

Water-reducing agent conformed to TVA specification 57-61595 which requires water reduction in a mixture containing fly ash.

REPLACE 2

Reinforcing Steel

Reinforcing steel conformed to ASTM Designation A615-72, Grade 60.

Equipment Hatch Sleeves and Doors

The structural parts of the sleeves and doors are fabricated from ASTM A36 steel.

3.8.1.6.2 Quality Control

Concrete

Concrete was produced in a central batch and mixing plant until 1977, and central batch and transit mix after 1977. A materials engineering unit was specifically responsible for control, documentation, and daily review of test data.

Aggregate gradation and deleterious material was checked daily. All coarse aggregate was rinsed and resized. The gradation of the fine aggregate and the amount finer than the No. 200 sieve conformed to specifications.

All other concrete material was also subject to periodic tests (see Section 3.8.3.2).

The specified strength of the concrete was 4000 psi at 28 days. Some concrete did not meet specification requirements. This was evaluated and documented in the Report CEB-86-19-C "Concrete Quality Evaluation." The results have been documented in affected calculation packages and drawings.

A testing program conducted at the site compared strengths of cylinders and concrete from 3-foot-thick wall sections subjected to exterior exposures. The results of this test program are documented in TVA report CEB 86-12, "Study of Long-Term Concrete Strength at Sequoyah and Watts Bar Nuclear Plants." These tests demonstrated the long term compressive strength gain with age which have occurred. The strength gain and age was generally 2600 psi beyond 28 days and 1300 psi beyond 90 days.

REPLACEMENT PARAGRAPHS FOR SECTION 3.8.1.6.1, PAGE 3.8-12

Replacement Paragraph 1

The fly ash used at Watts Bar is in general accordance with the ASTM C618-73, except for the loss of ignition and fineness of pozzolanic index parameters. TVA specific requirements for loss of ignition are more restrictive while the fineness pozzolanic index is less restrictive than the ASTM requirements (See Section 3.8.3.2.1.a for more details). Sampling and testing was performed in accordance with ASTM C311.

Replacement Paragraph 2

Water-reducing agent used for concrete mixtures containing fly ash was selected based on demonstrated achievement of TVA specified concrete strength of a control mix, by actual testing.

Nonpressure parts, such as supports, bracing, inspection platforms, walkways, and ladders were designed in accordance with the American Institute of Steel Construction (AISC) "Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings," Seventh Edition. The Eighth Edition is used for shapes not covered by the Seventh Edition.

(See 3.8.1.2, Item 12) (See 3.8.1.2, Item 4)

Welding for these nonpressure parts was in accordance with the American Welding Society (AWS), "Structural Welding Code," AWS D1.1~~-72 as implemented by TVA General Construction Specification G-29C when specified on the drawings.~~ Nuclear Construction Issues Group (NCIG) documents NCIG-01 ~~Revision 2,~~ and NCIG-02 ~~Revision 0,~~ may be used after June 26, 1985, to evaluate ~~welds in these items. When invoked, NCIC provisions will be implemented as indicated in Section 3.6A.1.1.4.~~ weldments that were designed and fabricated to the requirements of AISC/AWS.

The anchorage at the containment vessel meets the requirements of the ASME Code, Section III, with a maximum allowable stress for the anchor bolts of $2 \times S_m$.

All containment penetrations including the fuel transfer, purge, and mechanical within the jurisdiction of NE-1140 are designed to Section III, Class MC of the 1971 ASME Code. The penetration assemblies for those penetrations which attach to the nozzles out to and including the valve or valves required to isolate the system and provide a pressure boundary for the containment function are designed to Section III, Class 2 of the ASME Code. Spare penetrations including the nozzle caps are designed to Section III, Class MC of the ASME Code.

Two welds (1-074B-D045-01A and 1-G74B-D045-08A) in the containment sleeves at the Unit 1 RHR sump have radiographic indications which have been interpreted as exceeding the radiographic acceptance criteria of ASME Section III. TVA has performed calculations (WBN-MTB-025 and CEB-CQS-415) which document the basis for the acceptability of these welds.

3.8.2.2.2 Design Specification Summary

Design Criteria

The containment vessel, including access openings and penetrations, is designed so that the leakage of radioactive materials from the containment structure under conditions of pressure and temperature resulting from the largest credible energy release following a loss-of-coolant accident (LOCA), including the calculated energy from metal-water or other chemical reactions that could occur as a consequence of failure of any single active component in any emergency cooling system, will not result in undue risk to the health and safety of the public, and is designed to limit below 10 CFR 100 values the leakage of radioactive fission products from the containment under such LOCA conditions.

The basic structural elements considered in the design are the vertical cylinder and dome acting as one structure, and the bottom liner plate acting as another. The bottom liner plate is encased in concrete and is designed as a leak tight membrane only. The liner plate is anchored to the concrete by welding it continuously to steel members embedded and anchored in the concrete base mat.

(I.D.) circular openings with flanges on both sides to provide attachment for the ventilating ducts. The details of the penetrations are shown on Figures 3.8.3-15 and 3.8.3-16.

Pressurizer Enclosure Manway

The location and details of the manway are shown of Figure 3.8.3-20. The manway consists of a 30-inch diameter sleeve embedded in concrete at elevation 798.0 at the top of the pressurizer compartment. The manway cover is a circular steel plate that is bolted in place to provide adequate sealing between the upper and lower compartment.

3.8.3.2 Applicable Codes, Standards and Specifications

Structural design of the interior concrete structures is in compliance with the ACI 318-71 Building Code Requirements for Reinforced Concrete, and ACI-ASME (ACI 359) Article CC 3000 document, "Standard Code for Concrete Reactor Vessels and Containments."

All reinforcing steel conforms to the requirements of ASTM Designation A615, Grade 60. ~~Construction was carried out under the requirements of TVA Construction Specifications G-2 which implements the requirements of NRC Regulatory Guides 1.15 and 1.55.~~

TVA General Construction Specification G-2 for plain and reinforced concrete is used in the construction of Category I structures for installation, inspection, and testing of structural concrete. TVA's General Construction Specification G-30 is for fly ash used as an admixture in concrete. TVA has compared requirements of G-2 and G-30 with ANSI N45.2.5 and ACI 318-71 and the following exceptions were taken:

REPLACE

1. Required Qualification Tests

   a. Fly ash - TVA uses its own specification for fly ash rather than ASTM C 618. Significant differences occur in requirements for fineness, pozzolanic activity index, and loss or ignition. ASTM C 618 has two requirements for fineness. The first, a surface area obtained by an air permeability apparatus, is not conformed to by TVA. The second, the amount retained on a No. 325 sieve, is conformed to by TVA. TVA's requirement for pozzolanic activity index with portland cement is 65% of the ASTM C 618 requirement, but TVA's procedures result in substituting fly ash for fine aggregate in a mix and thus increase the quantity of fly ash available for reaction with the cement. TVA's limit on loss on ignition is 50% of that in ASTM C 618. The most recent addition to ASTM C 618 is a limit on the product of loss on ignition and the amount retained on the No. 325 sieve. This was added when a statistical analysis indicated that it correlated with the effect of fly ash in concrete. TVA's limits on the individual items will result in conformance to the ASTM C 618 limit on the product. TVA's experience at hydro, fossil, and nuclear plants indicates that their specification for fly ash produced acceptable concrete.

REPLACEMENT PARAGRAPH FOR SECTION 3.8.3.2, PAGE 3.8.3-8

Installation, inspection and testing requirements for plain and reinforced concrete used in the construction of Category I structures, as well as for fly ash used as an admixture in concrete, were in general accordance with the ASTM standards, ACI 318-71, ANSI N45.2.5, and Regulatory Guides 1.15 and 1.55, except for the following TVA specific requirements:

b. Water and ice - TVA complies with the suggested limits of CRD C 400 rather than the suggested limits of AASHO T-26. The suggested limits on compressive strength of mortar are the same. AASHO T-26 utilizes an autoclave soundness test developed specifically to test free lime or magnesia in cement. ASTM C 150 has a specified limit on autoclave expansion of 0.8%, but many elements exhibit less than 0.1%. The ASTM analysis for precision indicates that repeat tests by the same operator can differ 21% by their means. This illustrates that a clear indication of unsoundness due to water will be difficult to obtain. The test for soundness is not recommended in ASTM STP 169-A "Significance of Tests and Properties of Concrete-Making Materials."

c. Concrete mixes - TVA does not conform with two of the recommendations of ACI 211. The recommended limiting water-cement ratios were developed for Type 1 cements. ACI 211 recommendations do not agree with ACI 318. Where fly ash is utilized, neither can be directly applicable. The recommendation that trial batches for strength be made at maximum slump and air contents should not be applied where statistical analysis establishes an average over-strength requirement. Use of maximum air content and slump will offset the average strength and invalidate the analysis.

2. Required In-process Tests

a. The frequency of concrete material tests is not stated in the TVA General Construction Specification, but is required to be stated in a construction procedure for each project so that it may be adjusted for specific material properties. The construction procedure for this project is in substantial agreement with ANSI N45.2.5 frequencies for those tests required by TVA.

b. Mixer-uniformity - TVA's requirements for unit weight of air-free mortar and for coarse aggregate content are more restrictive than ASTM C 94.

c. Compressive strength - The sampling frequency for compressive strength provided by ANSI N45.2.5 appears to be intended for a transit mix operation. TVA purchase specifications for ready-mix are even more restrictive, however, the vast majority of TVA concrete is produced in a central mix plant where the provided frequency appears excessive. TVA varied the testing frequency requirements based on the specified strength of concrete with no one sample to represent more than:

- 300 cubic yards for a specified strength of 2000 psi.
- 175 cubic yards for specified 28 day strengths of 3000 psi or more.

These [test] frequencies were ~~specified in C-2 until Revision 2 (1-78) and were in effect~~ [in effect until January 1978] during the majority of concrete placement at WBN. ~~Revision 2 of C-2 changed~~ The testing frequency requirements [were then modified] such that no one sample represents more than:

- 300 cubic yards for a specified strength of 2000 psi,
- 200 cubic yards for a specified strength of 3000 psi,
- 150 cubic yards for specified strengths more than 3000 psi.

For actual application, the quantities of each mix produced per shift were such that the average quantities represented by test samples were less than that specified.

d. Aggregate - Tests are specified by ANSI N45.2.5 which appear inappropriate to certain aggregates. A carefully selected crushed limestone fine aggregate should not require testing for organic impurities. TVA required periodic reinspection of the quarry. The quarry strata and weathering effects did not change and therefore testing listed with 6-month frequency in ANSI N45.2.5 were not repeated.

e. Water and ice - (See 1.b above) The chemical tests in CRD C 400 were repeated every 2 months, and any time a change in the water was suspected. The strength test was repeated only when chemical tests results changed significantly.

f. Fly ash was sampled every 3 truck loads and tested for fineness. Six samples were combined and tested for total requirements, see 1.a above.

g. Cement - TVA accepted manufacturers' mill tests which represented no more than 400 tons. TVA made tests at greater intervals which checked manufacturers' strength test within 600 psi or duplicate tests were required.

3. TVA's concrete acceptance does not conform to ACI 318. It does conform to ACI 214. TVA requires that no more than 10% of the strength test results be below the specified strength for specified strengths equal to or greater than 3,000 psi. For lower strength concrete, 20% of the strength test results may be below the specified strength. Such concrete is used where a batch of somewhat lower strength concrete is not critical and where hydration temperature limitations are critical. ACI 318 applies the criteria that the averages of all sets of three consecutive strength test results at least equals the specified strength and that not more than 1 of 100 strengths test results will be more than 500 psi below the specified strength. If the standard deviation of the strength test results is 500 psi, the required over-strengths from the three criteria range between 640 psi and 670 psi. TVA does not believe that the three criteria produce significantly different results. ACI 318 states that acceptability is based on no strength test result being more than 500 psi below the specified strength, but its commentary and ACI 359 point out the probability that 1 test in 100 will have results outside the standard deviation and make the ACI criteria more severe. ~~However, G-2 will satisfactorily limit the number of low strength test results.~~

REPLACE 1

TVA specifications require 3-day tests and investigation if results are below a specified limit so as to prevent incorporation of very low strength concrete in a structure.

4. Personnel qualifications will be maintained as required by Nuclear Quality Assurance Plan [1].

TVA considers the applicability of ANSI N45.2.6 (Section 1.1, Scope) to be limited to those personnel performing inspection, examination, and test functions. Responsibility for examination and certification of these individuals has been established. These certifications do not correspond to the levels established in ANSI N45.2.6, except for NDE personnel who are certified in accordance with SNT-TC-1A. Construction site inspection, examination, and testing personnel are selected and assigned mechanical, electrical, instrumentation, civil, material, or welding classifications. Responsible supervisors in the respective areas perform the functions identified in Table 1 as L-III in ANSI N45.2.6. Inspection, examination, and testing personnel in the various classifications perform the functioning identified in Table 1 as L-I and L-II in ANSI N45.2.6.

REPLACE 2

TVA General Construction Specification G-32 "Bolts-Anchors Set in Hardened Concrete" prescribes material and methods for setting threaded anchoring devices for equipment and fixtures into concrete which has previously hardened. The specification includes installation and testing procedures for the bolt anchors. To TVA's knowledge there is no known equivalent specification in the public domain. However, where manufactured expansion anchors are used, the specification requires them to be installed according to the manufacturer's instructions.

TVA Construction Specification G-29 "Process Specification for Welding" is a specification that has been developed for welding, nondestructive examinations, heat treatment and all field fabrication procedures to be used during construction. G-29C conforms to the criteria in AWS D1.1-72 and G-29M conforms to the criteria in the ASME Boiler and Pressure Vessel Code. TVA referenced these codes in this section of the FSAR, Items 3 and 5 below.

REPLACE 3

Unless otherwise indicated in the FSAR, the design and construction of the interior structures are based upon the appropriate sections of the following codes, standards, and specifications. Modifications to these codes, standards and specifications are made where necessary to meet the specific requirements of the structures. Where date of edition, copyright, or addendum is specified, earlier versions of the listed documents were not used. In some instances, later revisions of the listed documents were used where design safety was not compromised.

1. American Concrete Institute (ACI)

ACI 214-77	Recommended Practices for Evaluation of Strength Test Results of Concrete
ACI 315-74	Manual of Standard Practice for Detailing Reinforced Concrete Structures

REPLACEMENT PARAGRAPHS FOR SECTION 3.8.3.2, ITEM 3, PAGE 3.8.3-8c

Replacement Paragraph 1

TVA's requirement for regular compressive strength tests at 3 days and thorough evaluation requirements if the tested concrete strength deviates from the specified limits provide reasonable assurance that the use of low strength concrete in structures is effectively prevented.

Replacement Paragraph 2

Bolts-anchors set in hardened concrete were installed in accordance with comprehensive TVA specified requirements developed for the material installation and testing of these anchors utilizing anchor manufacturer's instructions as applicable.

Replacement Paragraph 3

Welding non-destructive examinations, heat treatment, and field fabrication procedures used during construction was in accordance with the ASME Boiler and Pressure Vessel Code as applicable (see Item 3 below), and the American Welding Society (AWS) "Structural Welding Code," AWS D1.1 (see Item 5 below). Nuclear Construction Issues Group documents, NCIG-01 and NCIG-02 (see Section 3.8.1.2, Item 12) may be used after June 26, 1985, to evaluate weldments that were designed and fabricated to the requirements of AISC/AWS.

ACI 359	Standard Code for Concrete Reactor Vessels and Containments (Proposed ACI-ASME Code ACI-359 (Article CC-3300) as issued for trial use April 1973.
ACI 318-71	Building Code Requirements for Reinforced Concrete
ACI 347-68	Recommended Practice for Concrete Formwork
ACI 305-72	Recommended Practice for Hot Weather Concreting
ACI 211.1-70	Recommended Practice for Selecting Proportions for Normal Weight Concrete
ACI 304-73	Recommended Practice for Measuring Mixing, Transporting, and Placing Concrete

2. American Institute of Steel Construction (AISC) 'Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings,' adopted February 12, 1969.

3. American Society of Mechanical Engineers (ASME), Boiler and Pressure Vessel Code Sections II, III, V, VIII, and IX, 1971 Editions, as amended through summer 1972 Addenda.

4. American Society for Testing and Materials (ASTM), 1975 Annual Book of ASTM Standards.

5. American Welding Society (AWS)

AWS D1.1-72, 'Structural Welding Code,' as modified by TVA General Construction Specification G-29C.

1973 Revision to Structural Welding Code, AWS D1.1 as modified by TVA General Construction Specification G-29C.

1974 Revision to Structural Welding Code, AWS, D1.1 as modified by TVA General Construction Specification G-29C.

AWS D12.1-61, 'Recommended Practice for Welding Reinforcing Steel, Metal Inserts, and Connections in Reinforced Concrete Connections.'

REPLACE

6. Crane Manufacturers Association of America, Inc. C.M.A.A. No. 70, Specification for Electric Overhead Traveling Cranes, 1971.

7. 'Uniform Building Code,' International Conference of Building Officials, Los Angeles, 1970 Edition.

8. Southern Standard Building Code, 1969 Edition, 1971 Revision.

REPLACEMENT PARAGRAPH 3.8.3.2, ITEM 4 NUMBER 5, PAGE 3.8.3-8d

5. American Welding Society (AWS)

"Structural Welding Code," AWS D1.1-72 with Revisions 1-73 and 2-74 except later editions may be used for prequalified joint details, base materials, and qualification of welding procedures and welders.

Visual inspection of structural welds will meet the minimum requirements of Nuclear Construction Issues Group documents NCIG-01 and NCIG-02 as specified on the design drawings or other engineering design output. See Item 14 below.

9. 'Nuclear Reactors and Earthquakes,' USAEC Report TID-7024, August, 1963.

10. American Society of Civil Engineers Transactions Volume 126, Part II, Paper No. 3269, 'Wind Forces on Structures,' 1961.

11. Code of Federal Regulations Title 29, Chapter XVII, 'Occupational Safety and Health Standards,' Part 1910.

12. NRC Regulatory Guides (RG)

RG 1.12 Instrumentation for Earthquakes
RG 1.31 Control of Ferrite Content in Stainless Steel Weld Metal
RG 1.10 Mechanical (Cadweld) Splices in Reinforcing Bars of Category I Concrete Structures
RG 1.15 Testing of Reinforcing Bars for Category I Concrete Structures
RG 1.55 Concrete Placement in Category I Structures

13. Structural Engineer Association of California, 'Recommended Lateral Force Requirements and Commentary;' 1968 Edition.

14. Nuclear Construction Issues Group (NCIG)

- NCIG-01, Revision 2 - Visual Weld Acceptance Criteria (VWAC) for Structural Welding
- NCIG-02, Revision 0 - Sampling Plan for Visual Reinspection of Welds

The referenced NCIG documents may be used after June 26, 1985, to evaluate weldments that were designed and fabricated to the requirements of AISC/AWS. When invoked, NCIG provisions will be implemented as indicated in Section 3.6A.1.1.4.

REPLACE

15. TVA Reports

CEB 86-12 - Study of Long Term Concrete Strength at Sequoyah and Watts Bar Nuclear Plants

CEB 86-19-C - Concrete Quality Evaluation

16. NRC Standard Review Plan, NUREG-0800, Rev. 2, Section 6.2.1.2, "Subcompartment Analysis".

3.8.3.3 Loads and Loading Combinations

Loading combinations and allowable stresses are shown in Table 3.8.3-1. General loads are described below.

Dead Loads

These loads consist of the weight of the structure and equipment, plus any other permanent load contributing stress such as hydrostatic pressure.

REPLACEMENT PARAGRAPH FOR SECTION 3.8.3.2, ITEM 4 NUMBER 14, PAGE 3.8.3-9

14. <u>Nuclear Construction Issues Group (NCIG)</u>

NCIG-01, Revision 2 - Visual Welding Acceptance Criteria (VWAC) for Structural Welding

NCIG-02, Revision 0 - Sampling Plan for Visual Reinspection of Welds

The referenced NCIG documents may be used after June 26, 1985 for weldments that were designed and fabricated to the requirements of AISC/AWS.

NCIG-02, Revision 0, was used as the original basis for the Department of Energy (DOE) Weld Evaluation Project (WEP) EG&G Idaho, Incorporated, statistical assessment of TVA performed welding at WBNP. Any further sampling reinspections of structural welds subsequent to issuance of NCIG-02, Revision 2, are performed in accordance with NCIG-02, Revision 2 requirements.

The applicability of the NCIG documents is specified in controlled design output documents such as drawings and construction specifications. Inspectors performing visual weld examination to the criteria of NCIG-01 are trained in the subject criteria.

The ice baskets were made from perforated sheet material. The wall duct panels were made from sheet material and the cradle supports from structural sections and plates.

Structural Sections, Plates and Bar Flats

Structural sections, plates and bar flats are generally high-strength, low alloy steel selected for suitable strength, toughness, formability and weldability.

The high-strength low-alloy steels are A441, A588, A572 or A633. These steels are readily oxygen cut and possess good weldability.

Bolting

High-strength alloy steel Type A320 L7 bolting for low temperature service is used for the lower support structure. Stocked bolting made from A325, A449 and ASTM A354, Grade BD (SAE J429, Grade 8) materials are used for other parts. The above bolts met CVN 20 ft-lb at -20° F, for sizes greater than 1 inch in diameter.

Nonmetallic materials such as gaskets, insulation, adhesives and spacers are selected for specific uses. Freedom from detrimental radiation effects is required.

All structural welding was in accordance with the AWS Structural Code for Welding, D1.1 (AWS Code). The AWS Code is an overall welding system for the design of welded connections, technique, workmanship, qualification and inspection for buildings, bridges, and tubular structures. (See Section 3.8.3.2, Item 4, NUMBER 5).

The quality of welds for the ice condenser system is based on Paragraph 9.25 of the AWS Code. (See Section 3.8.3.2, Item 4, Number 5).

Resistance welding was in accordance with AWS, Recommended Practices for Resistance Welding, C1.1.

Magnetic particle examination was performed on at least 5% of the welds in each critical member of the lower support structure. Magnetic particle or liquid penetrant examinations, where applicable, were performed on 5% of the welds in each critical member of the balance of the ice condenser structure. The welds selected for examination were designated in the Design Specifications. The nondestructive examination methods and acceptance standards are given in Section 6 and Paragraph 9.25, Quality of Welds, of the AWS Code. (See Section 3.8.3.2, Item 4, Number 5).

ACI 318-63	Building Code Requirements for Reinforced Concrete. (See Section 3.8.4.2.2 for basis for use of this section.)
ACI 318-71	Building Code Requirements for Reinforced Concrete
ACI 347-68	Recommended Practice for Concrete Formwork
ACI 305-72	Recommended Practice for Hot Weather Concreting
ACI 211.1-70	Recommended Practice for Selecting Proportions for Normal Weight Concrete
ACI 304-73	Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete
ACI 349-76	Code Requirements for Nuclear Safety Related Concrete Structures, Appendix C only
ACI 531-79	Building Code Requirements for Concrete Masonry Structures

2. American Institute of Steel Construction (AISC), "Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings," adopted February 12, 1969, as amended through June 12, 1974, except welded construction is in accordance with Item 5 below.

3. Steel Structures Painting Council, Surface Preparation Specification No. 2, 'Hand Tool Cleaning.'

4. American Society for Testing and Materials (ASTM), 1975 Annual Book of ASTM Annual Standards.

5. American Welding Society (AWS)

'Structural Welding Code,' AWS D1.1-72 as modified by TVA General Construction Specification G-29C.

1973 Revision to Structural Welding Code, AWS D1.1-Rev. 1-73 as modified by TVA General Construction Specification G-29C.

1974 Revision to Structural Welding Code, AWS D1.1-Rev. 2-74 as modified by TVA General Construction Specification G-29C.

'Recommended Practice for Welding Reinforcing Steel, Metal Inserts, and Connections in Reinforced Concrete Connections,' AWS D12.1-61.

REPLACE

6. American Gear Manufacturers Association.

Standards for Helical and Herringbone Gears.

7. Uniform Building Code, International Conference of Building Officials, Los Angeles, 1970 Edition.

8. Southern Standard Building Code, 1969 Edition, 1971 Rev.

9. 'Nuclear Reactors and Earthquakes,' USAEC Report TID-7024, August 1963.

10. American Society of Civil Engineering Transactions, Vol. 126, Part II, Paper No. 3269, 'Wind Forces on Structures,' 1961.

11. Code of Federal Regulations, Title 29, Chapter XVII, "Occupational Safety and Health Administration, Dept. of Labor", Part 1910, 'Occupational Safety and Health Standards.'

12. Regulatory Guides (RG)

RG 1.10 Mechanical (Cadweld) Splices in Reinforcing Bars of Category I Concrete Structures

RG 1.13 Fuel Storage Facility Design

RG 1.15 Testing of Reinforcing Bars of Category I Concrete Structures

RG 1.31 Control of Stainless Steel Welding

RG 1.55 Concrete Placement in Category I Structures

REPLACEMENT PARAGRAPH 3.8.4.2.1, ITEM 5, PAGE 3.8.4-15

5. American Welding Society (AWS)

"Structural Welding Code," AWS D1.1-72 with Revisions 1-73 and 2-74 except later editions may be used for prequalified joint details, base materials, and qualification of welding procedures and welders.

Visual inspection of structural welds will meet the minimum requirements of Nuclear Construction Issues Group documents NCIG-01 and NCIG-02 as specified on the design drawings or other engineering design output. See Item 18 below.

13. TVA Reports Construction Specifications

G-2 TVA General Construction Specification for Plain and Reinforced Concrete

G-9 TVA General Construction Specification for Rolled Earthfill for Dams and Power Plants

G-29 TVA General Construction Specification - Process Specification for Welding, Heat Treatment

G-30 TVA General Construction Specification - Fly Ash for Use As An Admixture in Concrete

G-32 TVA General Construction Specification - Bolt Anchors Set in Hardened Concrete.

G-42 TVA General Construction Specification for Preparation of Concrete Surfaces for Special Coatings for Nuclear Plants

REPLACE

14. TVA Reports

TVA-TR-1 Pipe Whip Criteria, 1973.
TVA-TR-78-4 Design of Structures for Missile Impact.
TVA-CEB-86-12 Study of Long Term Concrete Strength at Sequoyah and Watts Bar Nuclear Plants
TVA-CEB-86-19-C Concrete Quality Evaluation

15. National Electrical Manufacturers Association, Motor and Generator Standards MG-1, 1970 Edition.

16. Structural Engineers Association of California, "Recommended Lateral Force Requirements and Commentary," 1968 Edition.

17. National Fire Protection Code (NFPA) 30.

REPLACE

18. Nuclear Construction Issues Group (NCIG)*

- NCIG-01, Revision 2 - Visual Weld Acceptance Criteria (VWAC) for Structural Welding
- NCIG-02, Revision 0 - Sample Plan for Visual Reinspection of Welds

* The referenced NCIG documents may be used after June 26, 1985, to evaluate weldments that were designed and fabricated to the requirements of AISC/AWS. When invoked, NCIG provisions will be implemented as indicated in Section 3.6A.1.1.4.

3.8.4.2.2 Basis for Use of the 1963 Edition of ACI 318

The reason for using the 1963 edition of the ACI 318 Code was that much of the Watts Bar Plant was a duplicate of the Sequoyah Plant, for which structures were designed using the 1963 edition. On that basis, design computations for the Sequoyah Plant were the initial design computations for the Watts Bar Plant.

REPLACEMENT PARAGRAPH, SECTION 3.8.4.1.1, PAGE 3.8.4-16, ITEMS 13 AND 18

13. DELETED BY AMENDMENT 89

18. <u>Nuclear Construction Issues Group (NCIG)</u>

NCIG-01, Revision 2 - Visual Welding Acceptance Criteria (VWAC) for Structural Welding

NCIG-02, Revision 0 - Sampling Plan for Visual Reinspection of Welds

The referenced NCIG documents may be used after June 26, 1985 for weldments that were designed and fabricated to the requirements of AISC/AWS.

NCIG-02, Revision 0, was used as the original basis for the Department of Energy (DOE) Weld Evaluation Project (WEP) EG&G Idaho, Incorporated, statistical assessment of TVA performed welding at WBNP. Any further sampling reinspections of structural welds subsequent to issuance of NCIG-02, Revision 2, are performed in accordance with NCIG-02, Revision 2 requirements.

The applicability of the NCIG documents is specified in controlled design output documents such as drawings and construction specifications. Inspectors performing visual weld examination to the criteria of NCIG-01 are trained in the subject criteria.

The floors and walls of the Auxiliary Building are continuous with the control bay north wall. Dowels and shear keys were provided in the wall in order to provide for this structural continuity.

Procedures used to design the structural steel framing were based on simple beam and column construction as covered in AISC 'Specification for the Design, Fabrication and Erection of Structural Steel for Buildings,' Part 1, with type 2 framing connections. The beams at elevation 755.0, between column lines C3 and C5, and between column lines C9 and C11, were designed to function compositely with the concrete slab through the use of headed concrete anchor studs welded through steel decking to the top beam flanges. The beam-to-beam and beam-to-column connections were typical AISC double angle connections as required by the beam reactions, using either rivets or high strength bolts. Between column lines C5 and C9 the beams were not designed to function compositely. For column line references, see Figures 3.8.4-3 and 3.8.4-4. In these areas horizontal bracing is used to resist the horizontal forces for the support of components such as cable trays, conduit, and pipe supports. At elevation 741.0, there were special connections required that were either bolted in accordance with the AISC specification (see Section 3.8.4.2) or welded in accordance with TVA Construction Specification G-29 and the AISC specification. Transfer of loads into the concrete structure was through bearing plates.

REPLACE

Reinforced concrete partition walls are shown in key plan on Figures 3.8.4-60 through 3.8.4-65. These walls were analyzed as free at the top, fixed at the base, and were designed to resist seismic stresses. A minimum steel percentage of .001 was provided horizontally for each face. A 2-inch space was left between the top of the walls and the bottom of the slab or beam above, in order to ensure that the walls do not act as structural components of the building frame. Each side of this space was filled with a minimum of 2-inch-wide grout.

All reinforced masonry walls are designed in accordance with ACI 531-79 and NUREG-0800, Section 3.8.4, Appendix A.

Control Room Shield Doors

The doors were designed assuming that the entire dead load is carried by the two vertical members in the door directly under the trolleys with the load from the lead shot acting as a fluid pressure load.

The end panels were designed as a fixed beam with uniform load, while the skinplate was designed as a square flat plate stayed at the four corners. The top and bottom members of the door were considered as simple beams.

Earthquakes are the only natural environmental condition which applies to the doors. Being inside the control room, the doors are protected from outside elements.

REPLACEMENT PARAGRAPH, SECTION 3.8.4.4.1, PAGE 3.8.4-21

At Elevation 741.0, there were special connections required that were either bolted or welded in accordance with the codes, standards, and specifications identified in Section 3.8.4.2.1. Transfer of loads into the concrete structure was through bearing plates.

TVA has generally installed, and will continue to install fillet welds to meet the minimum weld size specifications of Table 1.17.5 of AISC Manual of Steel Construction. Where TVA drawings have specified fillet welds below the minimum sizes specified by AISC, these welds do meet the allowable stress requirements identified above. Weld qualification testing has demonstrated the adequacy of all fillet welds that were installed below minimum AISC specifications.

The Additional Diesel Generator Building structural steel was proportioned to meet the applicable codes discussed in Appendix 3.8E and load combinations in Section 3.8.4.3.

Structural steel and miscellaneous steel, which is highly restrained and is located in a high temperature environment, is evaluated for effects of thermal loads.

3.8.4.5.3 <u>Miscellaneous Components of the Auxiliary Building</u>

<u>Control Room Shield Doors</u>

Allowable stresses for all load combinations used for the various parts of the door and dogs are given in Table 3.8.4-3. For normal load conditions the allowable stresses provide a safety factor of 2 to 1 on yield for structural parts and 5 to 1 on ultimate for mechanical parts. For the limiting condition of an OBE or SSE, stresses do not exceed 0.9 yield.

<u>Watertight Equipment Hatch Covers</u>

Allowable stresses for normal loading combinations are based on the AISC specification (see Section 3.8.4.2 and Table 3.8.4-23). For limiting conditions, such as ~~OBE,~~ SSE, tornado, and flood, stresses do not exceed 0.9 yield.

<u>Railway Access Hatch Covers</u>

Allowable stresses for all load combinations used for the various parts are given in Table 3.8.4-4. For normal load conditions, the allowable stresses provide safety factors of ~~1.67 (F_y/0.6 F_y)~~ 2 to 1 on yield for structural parts and 5 to 1 on ultimate for mechanical parts. For limiting conditions, such as an SSE, stresses do not exceed 0.9 yield.

<u>Railroad Access Door</u>

Allowable stresses for all load combinations used for the various parts of the door, embedded frame, and hoist enclosure are given in Table 3.8.4-5. For normal load conditions the allowable stresses provide a safety factor of ~~1.67 (F_y/0.6 F_y)~~ 2 to 1 on yield for structural parts and 5 to 1 on ultimate for mechanical parts. For limiting conditions such as an SSE and hoist stall, stresses do not exceed 0.9 yield.

APPENDIX 3.8E

CODES, LOAD DEFINITIONS AND LOAD COMBINATIONS FOR THE MODIFICATION AND EVALUATION OF EXISTING STRUCTURES AND FOR THE DESIGN OF NEW FEATURES ADDED TO EXISTING STRUCTURES AND THE DESIGN OF STRUCTURES INITIATED AFTER JULY 1979

3.8E.1 Application Codes and Standards

a. American Concrete Institute (ACI) 318-77, "Building Code Requirements for Reinforced Concrete"

b. American Institute of Steel Construction (AISC), "Specification for the Design Fabrication, and Erection of Structural Steel for Buildings," 7th edition adopted February 12, 1969, as amended through June 12, 1974 or later editions, except welded construction is in accordance with Item d. below.

c. American Society for Testing and Materials (ASTM) Standards

REPLACE d. ~~American Welding Society (AWS) D1.1-72, "Structural Welding Code" as modified by TVA General Construction Specification G-29~~

e. National Fire Protection Association Standard NFPA 13

f. National Fire Protection Association Standard NFPA 14

g. National Fire Protection Association Standard NFPA 15

h. National Fire Protection Association Standard NFPA 24

i. National Fire Protection Association Standard NFPA 30

j. American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Sections III, VIII, and IX

k. American Nuclear Standard Institute (ANSI) B31.1, "Power Piping"

l. AWS D1.1-81, "Structural Welding Code"

m. AISC-ANSI-N690-1984 "Nuclear Facilities Steel Safety-Related Structures for Design, Fabrication and Erection"

3.8.E.2 Load Definitions

The following terms are used in the load combination equations for structures.

Normal loads, which are those loads to be encountered during normal plant operation and shutdown, include:

D - Dead loads or their related internal moments and forces including any permanent equipment loads; all hydrostatic loads; and earth loads applied to horizontal surfaces.

L - Live loads or their related internal moments and forces including any movable equipment loads and other loads which vary with intensity and occurrence, such as lateral soil pressure.

REPLACEMENT PARAGRAPH 3.8E.1, ITEM d, PAGE 3.8E-1

d. American Welding Society (AWS)

"Structural Welding Code," AWS D1.1-72 with Revisions 1-73 and 2-74 except later editions may be used for prequalified joint details, base materials, and qualification of welding procedures and welders.

Visual inspection of structural welds will meet the minimum requirements of Nuclear Construction Issues Group documents NCIG-01 and NCIG-02 as specified on the design drawings or other engineering design output. (See Section 3.8.4.1.1, Number 18)

Valve Mark Number	Set Pressure (psig)	Accumulation Pressure to fully Open Valve (%)	Maximum Expected Accumulation Pressure at maximum Flow (%)	Pressure in Steam Header at Rated Relieving Flow (psig)	Rated Flow at Set Pressure + 3% Accumulation (lb/hr)	Blowdown[1] Pressure Below Set Pressure to Close (%)	Pressure In Steam Header at Valve Closing (psig)
47W400-101	1185	3	8.4	1284	791,563	10	1066.5
47W400-102	1195	3	7.5	1284	798,163	10	1075.5
47W400-103	1205	3	6.6	1284	804,764	10	1084.5
47W400-104	1215	3	5.8	1284	811,364	10	1093.5
47W400-105	1224	3	4.9	1284	817,304	10	1101.6

Note 1. ~~Design Specification WBNP-DS-3835-2508 R1 requires 4% maximum blowdown for contract 76K51-83082. The ASME Section III requirement is 5% maximum blowdown.~~ The licensing basis for the plant is 10% maximum blowdown.[13] This is more conservative than the 5% maximum blowdown specified by the ASME Section III requirements.

All valves are connected to a rigidly supported common header that is in turn connected to the main steam piping through branch piping equal in size to the main steam piping. The header and valves are located immediately outside containment in the main steam valve building.

The safety valves are mounted on the header such that they produce torsion, bending, and thrust loads in the header during valve operation. The header has been designed to accommodate both dynamic and static loading effects of all valves blowing down simultaneously.

The stress produced by the following loading effects assumed to act concurrently are within the code allowable.

1. Deadweight effects
2. Thermal loads and movements
3. Seismic loads and movements
4. Safety valve thrust, moments, torque loading[1]
5. Internal pressure

[1]The safety valve thrust loads are assumed to occur in the upset plant condition, and do not occur concurrently with an OBE.

d. Faulted - Section 5.2.1.10 specifies limits which assure that no large plastic deformations will occur (stress $\leq 1.2S_y$). If any inelastic behavior is considered in the design, detailed justification is provided for this limit. Otherwise, the supports for active components are designed so that stresses are less than or equal to S_y. Thus the operability of active components is not endangered by the supports during faulted conditions.

REPLACE

Welding was in accordance with the American Welding Society, "Structural Welding Code," AWS D1.1-72 as implemented by TVA General Construction Specification (G-29C) when specified on the drawings. Nuclear Construction Issues Group documents NCIG-01, Revision 2, and NCIG-02, Revision 0, are used after June 26, 1985, to evaluate weldments that were designed and fabricated to the requirements of AISC/AWS. When invoked, NCIG provisions are implemented as indicated in Section 3.6A.1.1.4.

B. Plates and Shells

The stress limits used for ASME Class 2 and 3 plate and shell component supports are identical to those used for the supported component. These allowed stresses are such that the design requirements for the components and the system structural integrity are maintained.

For active Class 2 or 3 pumps, support adequacy is proven by satisfying the criteria in Section 3.9.3.2.1. The requirements consist of both stress analysis and an evaluation of pump/motor support misalignment.

Active valves are, in general, supported only by the pipe attached to the body. Exterior supports on the valve are not used.

3.9.3.4.2 Subsystem and Component Supports Analyzed or Specified by TVA

1. ASME Code Class 1, 2, and 3 Piping Supports

a. Loading Conditions

The following conditions have been assigned for support load evaluation for Watts Bar Nuclear Plant

REPLACEMENT PARAGRAPH, SECTION 3.9.3.4.1, PAGE 3.9-48

Welding was in accordance with the American Welding Society, (AWS) "Structural Welding Code," AWS D1.1 with revision 1-73 and 1-74, except later editions may be used for prequalified joint details, base materials, and qualification of welding procedures and welders. Nuclear Construction Issues Group documents NCIG-01 and NCIG-02 may be used after June 26, 1985, for weldments that were designed and fabricated to the requirements of AISC/AWS. Visual inspection of structural welds will meet the minimum requirements of NCIG-01 and NCIG-02 as specified on the design drawings or other design output. Inspectors performing visual examination to the criteria of NCIG-01 are trained in the subject criteria.

support design (not including pipe whip restraints): normal, upset, emergency, faulted, and test condition. The piping support design loads and combinations are given in Table 3.9-13A.

b. Support Types, Loading Combinations, Stress Limits, and Applicable Codes

1) Linear Supports

The allowed stresses are defined in Table 3.9-21. The load combinations and allowable stresses are based on and exceed the requirements of NRC Regulatory Standard Review Plan, Directorate of Licensing, Section 3.9.3. The design load is determined by the condition yielding the most conservative support design.

Welding is in accordance with the American Welding Society, "Structural Welding Code," AWS D1.1-72 as implemented by TVA General Construction Specification when specified on the drawings. Nuclear Construction Issues Group documents NCIG-01, Revision 2, and NCIG-02 Revision 0, are used after June 26, 1985, to evaluate weldments that were designed and fabricated to the requirements of AISC/AWS. When invoked, NCIG provisions are implemented as indicated in Section 3.6A.1.1.4.

REPLACE

2) Standard Support

The allowable stresses are defined in Table 3.9-21. The load combinations consider all applicable load sources which induce load into the appropriate type support. The design conforms to the requirements of MSS-SP-58, 1967 edition or ASME Boiler and Pressure Vessel Code, Section III, subsection NF.

3) Pre-engineered Support Element

Pre-engineered support elements are defined as standard hardware items such as rods, clamps, clevises, and struts used in the installation of either a linear support or a standard support component.

The design load is determined from the tabulated loads described above for the linear or standard support component. The allowable loads are given in Table 3.9-21.

c. General Design Requirements

1) The gravitational or actual loads are considered to consist of pipe, fittings, pipe covering, contents of pipe systems, and valves.

REPLACEMENT PARAGRAPH, SECTION 3.9.3.4.2, PAGE 3.9-49

Welding was in accordance with the American Welding Society. (AWS) "Structural Welding Code," AWS D1.1 with revision 1-73 and 1-74, except later editions may be used for prequalified joint details, base materials, and qualification of welding procedures and welders. Nuclear Construction Issues Group documents NCIG-01 and NCIG-02 may be used after June 26, 1985, for weldments that were designed and fabricated to the requirements of AISC/AWS. Visual inspection of structural welds will meet the minimum requirements of NCIG-01 and NCIG-02 as specified on the design drawings or other design output. Inspectors performing visual examination to the criteria of NCIG-01 are trained in the subject criteria.

TABLE 3.9-21

SUPPORT DESIGN ALLOWABLE STRESSES FOR CATEGORY I PIPING SUPPORTS

Load Condition	Supplemental Structural Steel, Welds & Structural Bolts[(2)]	Component Standard Supports W/ LCDS' Except Unistrut Clamps	Component Standard Supports W/O LCDS' Except Unistrut Clamps[(1)]
Normal & Friction	Normal AISC Allowable	Manufacturer's LCDS for Level A	Manufacturer's Allowable Catalog Value
Upset	Normal AISC Allowable X 1.33	Manufacturer's LCDS for Level B	Manufacturer's Allowable Catalog Value X 1.2
Emergency	Normal AISC Allowable X 1.5	Manufacturer's LCDS for Level C	Manufacturer's Allowable Catalog Value X 1.5
Faulted	Normal AISC Allowable X 1.5	Manufacturer's LCDS for Level D	Manufacturer's Allowable Catalog Value X 1.5
Test	Normal AISC Allowable	Manufacturer's LCDS for Level A X 1.33	Manufacturer's Allowable Catalog Value X 1.33

Notes:

(1) ~~Civil Design Standard DS-C1.6.14 shall be used for the design of U-bolt clamps. Civil Design Standard DS-C1.6.14 is used for the design of unistrut and B-line clamps.~~ The allowable loads for both U-bolts and unistrut clamps were developed ~~using~~ based on load testing per the requirements of ASME Section III 1974, Subsection NF including Winter 1974, Addenda.

(2) Tensile stresses do not exceed $0.9F_y$ and shear stresses do not exceed $0.9F_y/\sqrt{3}$. For compressive loads, the stress does not exceed 2/3 critical buckling.

3.10.3.2 Cable Trays and Supports

3.10.3.2.1 Cable Trays

Cable trays containing Class 1E cables located in Category I structures are considered safety-related and are designed to resist gravity and SSE forces.

Cable tray acceptance criteria are derived from testing. A factor of safety of 1.25 against the tested capacity, is maintained for the vertical moment. A ductility factor of 3 is used to establish tray capacity in the transverse direction. These limits are used in an interaction equation to evaluate tray sections for the SSE loading condition. Seismic loadings are developed based on the applicable response spectra. In addition, all trays are evaluated to ensure a minimum factor of safety of 3 against test capacity for dead load only.

Figure 3.10-1 defines the orientation of the transverse and vertical moments.

Cable tray X and T fittings are evaluated for vertical loading to ensure a minimum factor of safety of 1.25 against the formation of a first hinge.

All other cable tray components are evaluated using AISI or AISC allowables (as applicable) with increase factors as allowed by Standard Review Plan Section 3.8.4. Where test data is used to establish capacities, a factor of safety of 1.5 is maintained against the ultimate test load for the SSE loading condition.

3.10.3.2.2 Supports

All cable tray supports located in Category I structures are designated Seismic Category I and designed to resist seismic forces applied to the weight of trays and cables. Each support in Category I structures is designed independently to support its appropriate length of tray. Seismic load inputs are based on the methods described in Section 3.7 and the damping requirements described in Table 3.7-2.

Trays are designed to carry a load of 30 pounds per square foot (which is equivalent to 45 pounds per linear foot for an 18 inch wide tray) and an additional construction load of 30 pounds per linear foot on the top tray. Actual tray loading may be used on a case by case basis.

For load combinations and allowables applicable for cable tray supports, see Table 3.10-5.

Welding for structural supports was in accordance with the American Welding Society (AWS), "Structural Welding Code," AWS D1.1-72 as implemented by TVA General Construction Specification, G-29C, when specified on the drawings. Nuclear Construction Issues Group documents NCIG-01, Revision 2, and NCIG-02, Revision 0, may be used after June 26, 1985 to evaluate weldments that were designed and fabricated to the requirements of AISC/AWS. When invoked, NCIC provisions will be implemented as indicated in Section 3.6A.1.1.4.

REPLACE

REPLACEMENT PARAGRAPH, SECTION 3.10.3.2.2, PAGE 3.10-5

Welding was in accordance with the American Welding Society, (AWS) "Structural Welding Code," AWS D1.1 with revision 1-73 and 1-74, except later editions may be used for prequalified joint details, base materials, and qualification of welding procedures and welders. Nuclear Construction Issues Group documents NCIG-01 and NCIG-02 may be used after June 26, 1985, for weldments that were designed and fabricated to the requirements of AISC/AWS. Visual inspection of structural welds will meet the minimum requirements of NCIG-01 and NCIG-02 as specified on the design drawings or other design output. Inspectors performing visual examination to the criteria of NCIG-01 are trained in the subject criteria.

3.10.3.3 Conduit and Supports

3.10.3.3.1 Conduit

Conduit containing Class 1E cables located in Category I structures are considered safety-related and designed to resist gravity and SSE forces applied to the conduit and cable. The seismic qualification utilizes the same analysis methods as Seismic Category I subsystems described in Section 3.7.3 and limits allowable stress to 90% of the yield stress of the conduit material. The applicable damping requirements are defined in Table 3.7-2.

3.10.3.3.2 Supports

All conduit supports in Category I structures are designed to resist gravity and SSE forces applied to the conduit and cables. Supports for conduit containing Class 1E cables are designated Category I and stresses are limited to 90% of the yield stress of the material involved. Seismic load inputs are based on methods described in Section 3.7 and damping requirements are defined in Table 3.7-2. Supports for conduit containing only non-Class 1E cables are designated Category I(L) and designed and constructed to preclude a failure which could reduce the ability of Category I structures, systems, and components to perform their intended safety function.

Welding for structural supports was in accordance with the AWS, "Structural Welding Code," AWS D1.1-72 as implemented by TVA General Construction Specification G-29C when specified on the drawings. Nuclear Construction Issues Group documents NCIG-01, Revision 2, and NCIG-02, Revision 0, may be used after June 26, 1985, to evaluate weldments that were designed and fabricated to the requirements of AISC/AWS. When invoked, NCIG provisions will be implemented as indicated in Section 3.6.... 1.4.

REPLACE

3.10.3.4 Conduit Banks

The Category I underground electrical conduit banks, which run from the Auxiliary Building to the Diesel Generator Building and to the Intake Pumping Station, were analyzed for seismic loads by the method outlined in Section 3.7.2.1.3. The conduit banks are designed in accordance with Section 3.8.4.2.

3.10.4 Operating License Review

3.10.4.1 TVA Supplied Instrumentation and Electrical Equipment

The results of the seismic qualification program for the Watts Bar Nuclear Plant described in Section 3.10.1, 3.10.2, and 3.10.3 are summarized by the following listing for Class 1E equipment and by Tables 3.10-1, 3.10-3, and 3.10-4.

REPLACEMENT PARAGRAPH, SECTION 3.10.3.3.2, PAGE 3.10-6

Welding was in accordance with the American Welding Society, (AWS) "Structural Welding Code," AWS D1.1 with revision 1-73 and 1-74, except later editions may be used for prequalified joint details, base materials, and qualification of welding procedures and welders. Nuclear Construction Issues Group documents NCIG-01 and NCIG-02 may be used after June 26, 1985, for weldments that were designed and fabricated to the requirements of AISC/AWS. Visual inspection of structural welds will meet the minimum requirements of NCIG-01 and NCIG-02 as specified on the design drawings or other design output. Inspectors performing visual examination to the criteria of NCIG-01 are trained in the subject criteria.

TABLE 3.10-3

(Sheet 35 of 35)

WATTS BAR SEISMIC QUALIFICATIONS (Cont'd)

Equipment: Electrical penetrations (all types and voltages used at Watts Bar).

Seismic Test: Seismic qualification was done by analysis. The seismic analysis done on the penetrations consider the seismic loads imposed for both a safe shutdown earthquake and a 1/2 safe shutdown earthquake in accordance with ~~TVA specification 2697.~~ paragraph NA-3250 of the ASME Boiler Pressure Vessel Code, Section III, Nuclear Power Plants.[2]

1. The analysis calculated the natural frequencies during a seismic event using standard formulas for stress and strain by the R. Roark or Rayleigh's methods.
2. Maximum stresses for the normal and seismic load conditions were calculated. Seismic loads were considered to act in the vertical direction and in two horizontal directions.

Results: The analysis indicated that the penetrations were able to withstand all seismic stresses from a one and a one-half safe shutdown earthquake without any loss of function.

Reference:

1. Conax Report IPS-212, Rev. A and addendum to IPS-212, Rev.A.
2. TVA Design Specification WBNP-DS-1805-2697-00

6.7 ICE CONDENSER SYSTEM

Figure 6.7-1 shows the general layout of the ice condenser system.

6.7.1 Floor Structure and Cooling System

6.7.1.1 Design Bases

The ice condenser floor is a concrete structure containing embedded refrigeration system piping.

Figure 6.7-2 shows the general layout of the floor structure. The functional requirements for both normal and accident conditions can be separated into five groups: wear slab, floor cooling, insulation section, subfloor, and floor drain. Each group is described in detail below.

Wear Slab and Floor Cooling System

1. Function

   The wear slab is a concrete structure whose function is to provide a cooled surface as well as to provide personnel access support for maintenance and/or inspection. The wear slab also serves to contain the floor cooling piping.

   The floor cooling system intercepts approximately 90% of the heat flowing toward the ice condenser compartments from the lower crane wall and equipment room during normal operation. The floor cooling system is designed with defrost capability. During periods of wall panel defrosting, it is necessary to heat the floor above 32 °F. During an accident, the floor cooling is terminated by the containment isolation valves which are closed automatically. The refrigeration system interface and cooling function is described in Section 6.7.6.2. The cavity below the wear slab is filled with an insulation material to resist the flow of heat into the ice bed during all operating conditions.

2. Design Criteria and Codes

   Refer to the discussion on ice condenser structural design in Section 6.7.16. The following codes are also used in the design:

   a. ANSI B31.5-66, including Addenda B31.5a-1968, Refrigeration Piping.

   b. American Welding Society Structural Welding Code-1972, AWS Publication D1.1-72. REPLACE

   c. ANSI Standard Code for Pressure Piping Refrigeration Piping, ANSI B31.5, including Addenda B31.5a-1968.

   d. AISC Manual of Steel Construction, Seventh Edition, 1970.

   e. (Insert attached)

REPLACEMENT PARAGRAPH 6.7.1.1, ITEM 2, Numbers b and e, PAGE 6.7-1

b. American Welding Society (AWS)

"Structural Welding Code," AWS D1.1-72 with Revisions 1-73 and 2-74 except later editions may be used for prequalified joint details, base materials, and qualification of welding procedures and welders.

Visual inspection of structural welds will meet the minimum requirements of Nuclear Construction Issues Group documents NCIG-01 and NCIG-02 as specified on the design drawings or other engineering design output. (See Item e below).

e. Nuclear Construction Issues Group (NCIG)

NCIG-01, Revision 2 - Visual Welding Acceptance Criteria (VWAC) for Structural Welding

NCIG-02, Revision 0 - Sampling Plan for Visual Reinspection of Welds

The referenced NCIG documents may be used after June 26, 1985 for weldments that were designed and fabricated to the requirements of AISC/AWS.

NCIG-02, Revision 0, was used as the original basis for the Department of Energy (DOE) Weld Evaluation Project (WEP) EG&G Idaho, Incorporated, statistical assessment of TVA performed welding at WBNP. Any further sampling reinspections of structural welds subsequent to issuance of NCIG-02, Revision 2, are performed in accordance with NCIG-02, Revision 2 requirements.

The applicability of the NCIG documents is specified in controlled design output documents such as drawings and construction specifications. Inspectors performing visual weld examination to the criteria of NCIG-01 are trained in the subject criteria.

Non-Metallic Materials

Non-metallic materials such as gaskets, insulation, adhesives and spacers are selected for specific uses. Freedom from detrimental radiation effects is required.

Welding

REPLACE

All structural welding is in accordance with the AWS Structural Code for Welding, D1.1 (AWS Code), latest edition as modified by TVA General Construction Specification G-29C. The AWS Code is an overall welding system for the design of welded connections, technique, workmanship, qualification and inspection for buildings, bridges, and tubular structures.

The quality of welds for the ice condenser system are based on Paragraph 9.25 of the AWS Code.

Resistance welding is in accordance with AWS, Recommended Practices for Resistance Welding, C1.1.

Magnetic particle examination is performed on at least 5% of the welds in each critical member of the lower support structure. Magnetic particle or liquid penetrant examinations where applicable, are performed on 5% of the welds in each critical member of the balance of the ice condenser structure. The welds selected for non-destructive test examination are designated on the component drawings or in the design specifications. ~~The NDE method and acceptance standards are shown in the AWS Code, Section 6 and Paragraph 9.2.5, Quality of Welds~~.

6.7.19 Tests and Inspections

The tests and inspections are given in the Technical Specifications.

REFERENCES

1. Deleted by Amendment 85.

2. Test Plans and Results for the Ice Condenser System, WCAP-8110, April 16, 1973.

3. Test Plans and Results for the Ice Condenser System, WCAP-8110, Supplement 1, April 30, 1973.

4. Test Plans and Results for the Ice Condenser System, WCAP-8110, Supplement 2, June 19, 1973.

5. Test Plans and Results for the Ice Condenser System, WCAP-8110, Supplement 3, July 19, 1973.

6. Test Plans and Results for the Ice Condenser System, WCAP-8110, Supplement 4, November 15, 1973.

REPLACEMENT PARAGRAPH, SECTION 6.7.18, PAGE 6.7-75

Welding was in accordance with the American Welding Society, (AWS) "Structural Welding Code," AWS D1.1 with revision 1-73 and 1-74, except later editions may be used for prequalified joint details, base materials, and qualification of welding procedures and welders. Nuclear Construction Issues Group documents NCIG-01 and NCIG-02 may be used after June 26, 1985, for weldments that were designed and fabricated to the requirements of AISC/AWS. Visual inspection of structural welds will meet the minimum requirements of NCIG-01 and NCIG-02 as specified on the design drawings or other design output. Inspectors performing visual examination to the criteria of NCIG-01 are trained in the subject criteria.

TABLE 10.1-1

(Sheet 6 of 6)

SUMMARY OF IMPORTANT COMPONENT DESIGN PARAMETERS

SAFETY VALVES

Number - 5 per steam generator
Mininum flow capacity, steam generator - 4,160,597 lb/hr

Valve No.	Set Press. (psig)	Accumulation Press. to fully Open Valve (%)	Max. Expected Accumulation Press. at max. Flow (%)	Press. in Steam Header at Rated Relieving Flow (psig)	Rated Flow at Set Pressure + 3% Accumulation (lb/hr)	Blowdown Press. Below Set Pressure to Close (%) (Note 1)	Press. In. Steam Header at Valve Closing (psig)
1	1185	3	8.4	1284	791,563	10	1066.5
2	1195	3	7.5	1284	798,163	10	1075.5
3	1205	3	6.6	1284	804,764	10	1084.5
4	1215	3	5.8	1284	811,364	10	1093.5
5	1224	3	4.9	1284	817,304	10	1101.6

Note 1 - ~~Design Specification WBNP-DS-3835-2598 R1 requires 4% maximum blowdown for contract 76K51 83082. The ASME Section III requirement is 5% maximum blowdown.~~ The licensing basis for the plant is 10% maximum blowdown ~~per Westinghouse letter WAT-D-7480~~ (Reference 13, Section 3.9). This is more conservative than the 5% maximum blowdown specified by the ASME Section III requirements

ATMOSPHERIC RELIEF VALVES

Number per steam generator - 1
Minimum capacity, lb/hr/inlet pressure - 64,000/85 psig
Maximum capacity, lb/hr/inlet pressure - 970,000/1185 psig
outlet pressure, psig - 0

TURBINE BYPASS VALVES

Number of valves - 12
Flow per valve, lb/hr - 532,170
Main steam pressure at valve inlet (for above flow) - 900 psig
Maximum flow per valve at 1100 psia inlet pressure - 970,000 lb/hr
Time to open (full stroke) - 3 seconds
Full stoke modulation - 20 seconds
Failure position - Closed

to the steam generator wet layup recirculation system for use during wet layup of the steam generators.

3. Auxiliary System Support:

The hydrazine and ammonia additions are capable of being fed to the auxiliary boiler feedwater pump suction. Thus, corrosion inhibitors are available to the auxiliary boiler system.

10.3.5.4 Effect of Water Chemistry on the Radioactive Iodine Partition Coefficient

As a result of the basicity of the secondary side water, the radioiodine partition coefficients for both the steam generator and the air ejector system are increased (i.e., a greater portion of radioiodine remains in the liquid phase). However, the lack of data on the exact iodine species and concentrations present prevents a quantitative determination of the coefficient increase for these systems. The partition coefficients used for site boundary dose calculations due to secondary side releases are those given in NUREG-0800, Revision 2. For the steam generators, a partition coefficient of 0.01 was used.

10.3.6 Steam and Feedwater System Materials

10.3.6.1 Fracture Toughness

All requirements of the ASME Boiler and Pressure Vessel Code, Section III, Articles NC-2310 and ND-2310 of the summer of 1973 Addenda for fracture toughness for ferritic materials are met in all Class 2 and 3 components. The main steam piping is impact tested at 40°F to the requirements of NC-2310, and feedwater piping is tested at 10°F per NC-2310. Impact testing is not specified for the auxiliary feedwater piping because the pipe wall thicknesses do not exceed 5/8-inch.

10.3.6.2 Materials Selection and Fabrication

All pressure boundary materials in this system are included in Appendix I to ASME Code Section III.

There are no austenitic stainless steel pressure boundary components in these systems. Therefore, conformance to Regulatory Guides 1.31, 1.36, and 1.44 is not required.

Topical Report TVA-NQA-PLN89-A contains the licensing commitments for the cleaning and handling of Class 2 and 3 components in accordance with Regulatory Guide 1.37. ~~WBN's Engineering Requirements Specification ER-WBN-MEB-004 contains requirements for all fluid handling components.~~ Cleaning and cleanliness of fluid systems and components shall be in accordance with ANSI N45-2-1-1973 or later.

Since there are no low-alloy pressure retaining materials used in the steam and feedwater systems, compliance with Regulatory Guide 1.50 is not required.

With the exception of Regulatory Position C-1 and C-2.a, this system complies with Regulatory Guid. 1.71, "Welder Qualification for Areas of Limited Accessibility."