Tennessee Valley Authority, Post Office Box 2000, Soddy-Daisy, Tennessee 37384-2000

April 17, 2006

10 CFR 50.55a

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555-0001

Gentlemen:

In the Matter of) Docket Nos. 50-327
Tennessee Valley Authority) 50-328

SEQUOYAH NUCLEAR PLANT (SQN), RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION (RAI) ASSOCIATED WITH INSERVICE TEST (IST) PROGRAM AND ASSOCIATED RELIEF REQUESTS FOR THIRD 10-YEAR INTERVAL

Reference: 1) TVA letter to NRC dated January 10, 2006, "Sequoyah Nuclear Plant (SQN) - Inservice Test (IST) Program Update and Associated Relief Requests For Third Ten-Year Interval"

2) NRC letter to TVA dated March 14, 2006, "Sequoyah Nuclear Plant, Units 1 and 2 - Request for Additional Information Regarding Relief Requests for the Inservice Test Program for the Third 10-Year Interval (TAC NOS. MC9537 through MC9554)"

By the Reference 1 letter, TVA submitted the IST program for SQN that contained requests for relief from ASME code requirements. The staff has requested in Reference 2 additional information that is associated with TVA's proposed relief requests.

A telephone conference call between TVA and NRC staff was held on March 22, 2006, to clarify the additional information requested by the staff. Enclosure 1 provides the TVA responses to the RAI questions as discussed during the March conference call.

A047

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If you have any questions concerning this matter, please contact Jim Smith at (423) 843-6672.

Sincerely,

for

P. L. Pace
Manager, Site Licensing and
Industry Affairs

Enclosures
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ENCLOSURE 1

TENNESSEE VALLEY AUTHORITY (TVA)
SEQUOYAH NUCLEAR PLANT (SQN)

TVA Responses

1. **Pump Relief Request RP-01**

RAI RP-01-01

ISTB-3550 requires that when measuring flow rate, a rate or quantity meter be installed in the pump test circuit. Please address why relief was not requested from the requirements of ISTB-3500.

TVA Response

ISTB-3550 states: ". . .when measuring flow . . ." SQN's IST pump test program considers the screen wash pump system to be a fixed resistance system with no flow measurement. Because flow is not measured, TVA is not referencing ISTB-3550 with the proposed relief request. Accordingly, there is no change to TVA's relief request RP-01 as provided in Enclosure 2 (0-TI-SXI-000-200.P).

RAI RP-01-02

Please address the effect of potential flow degradation due to spray nozzle fouling on the quarterly test acceptance criteria and the comprehensive pump test acceptance criteria.

TVA Response

Actions were added to the IST program (see page 20 of Enclosure 2) to inspect the condition of the spray nozzles during testing and to initiate corrective actions as required.

RAI RP-01-03

The relief request states that the physical configuration of this piping is such that no portion of the piping meets the requirements for adequate installation of a permanent flow measuring device. Please provide additional information with regard to the

feasibility of installing flow instrumentation or using temporary flow instrumentation (i.e., modifications required, detailed description of piping runs with respect to installation of temporary flow instrumentation). Please discuss in greater detail the feasibility of installing temporary flow instrumentation during the comprehensive pump test.

TVA Response

Isometric drawings and photographs of the screen wash pump system are provided in Enclosure 2 to show piping configuration. TVA has determined that a significant plant modification would be required to install flow instrumentation for this system. A plant modification would include rerouting 3-inch diameter piping and the associated piping supports and rerouting heat trace equipment for four pumps.

The feasibility of installing temporary flow instrumentation was considered by TVA for utilizing portable ultrasonic flow instrumentation during testing. Accurate and repeatable flow measurement requires the ultrasonic flow sensor to be positioned on straight runs of piping (preferably horizontal). The standard recommendation for flow measuring devices requires placement of the measurement point 10 pipe diameters distance upstream and 5 pipe diameters distance downstream to allow for a straight undisturbed flowstream for accurate flow measurement. This requires a minimum run of piping of 45 inches in length. The current system piping configuration has no straight runs that provide for this measurement (see Enclosure 2 for isometric drawing and system photographs)

2. **Pump Relief Request RP-02**

RAI RP-02-01

ISTB-5121 requires that the parameters shown in Table ISTB-3000-1 be determined and recorded. Flow rate is one of the required parameters in Table ISTB-3000-1 for Group A pumps. Table ISTB-5100-1 identifies the acceptance criteria associated with pump testing. Please address why relief was requested from the requirements of Table ISTB-5100-1 and not from ISTB-5121 or Table ISTB-3000-1.

TVA Response

The relief request RP-02 has been revised to include references to ISTB-5121 and Table ISTB-3000-1 (see page 21 of Enclosure 2).

RAI RP-02-02

The submittal states that the relief request meets the intent of Position 9 in Generic Letter 89-04. Position 9 states in cases where flow can only be established through a non-instrumented minimum-flow path during quarterly testing and a path exists at cold shutdowns or refueling outages to perform a test of the pump under full or substantial flow conditions, the staff has determined that the increased interval is an acceptable alternative to the Code requirements. Please address why testing at substantial flow should not be performed during cold shutdown conditions.

TVA Response

The residual heat removal system is typically in service during cold shutdown conditions. Safe operation of the plant is impacted by changes to system configurations and flow adjustments required for testing (See page 21 of Enclosure 2).

3. **Pump Relief Request RP-03**

RAI RP-03-01

The Basis for Relief implies that relief is requested for the quarterly pump test based on the instrument accuracies identified in the Basis for Relief. Please verify that the relief is associated with the quarterly pump test only.

TVA Response

Clarifications were made to the IST program (see page 23 of Enclosure 2) to indicate that the request includes both quarterly and comprehensive testing. Quarterly tests are performed with a similar flow range as the comprehensive tests.

4. **Pump Relief Request RP-04**

RAI RP-04-01

The licensee is requesting generic relief for all pumps identified as smooth running pumps. As a general rule, the staff has not authorized on a generic basis the establishment of minimum vibration reference values. If a licensee intends to submit alternative requests to use minimum reference values, the request should be developed specifically for each pump, address the vibration levels experienced by each pump, include justification addressing the vibration levels experienced by each pump, and include justification addressing how the current IST methodology will detect pump degradation. Please provide the information requested.

TVA Response

TVA has reviewed similar industry submittals and has revised SQN's RP-04 relief request to be consistent with the Safety Evaluation Report for the North Anna Power Station - NRC letter dated January 28, 2002. Refer to page 25 of Enclosure 2.

RAI RP-04-02

Please describe the vibration monitoring and analysis performed as part of the Predictive Maintenance Program.

TVA Response

As discussed during the teleconference, additional details are added to the relief request to describe SQN's Predictive Maintenance Program (see page 27 of Enclosure 2).

5. **Pump Relief Request RP-05**

RAI RP-05-01

10 CFR 50.55(a)(3)(i) allows the NRC to authorize alternatives if "the proposed alternative would provide an acceptable level of quality and safety." NUREG 1482, Revision 1 identifies that the NRC will normally approve an alternative pursuant to this provision only if the licensee proposes a method of testing that is equivalent

to, or an improvement of the method specified by the code, or if testing will comply or is consistent with later Code editions approved by the NRC in 10 CFR 50.55a(b). It is not apparent that the alternative method of test is equivalent to or an improvement of the method specified by the code. If the reference value is set at 90% of the calibrated range of the instrument, it is not clear if high flow in excess of the instrument range will be detected so that corrective action will be initiated at greater than 110% of the reference value, as required by Table ISTB-5100-1 of the OM Code. The licensee is requested to clarify if the digital instrument is capable of detecting high flow in excess of 100% of the instrument range. Specifically, clarify if the digital instrument has a high flow alarm or cutoff so that flow in excess of 100% will be detected. If not, explain how high flow is detected so that appropriate corrective action required by Table ISTB-3000-1 can be taken.

TVA Response

TVA's request for relief is revised to limit relief to SQN's containment spray pumps (see page 29 of Enclosure 2).

6. **Pump Relief Request RP-06**

RAI RP-06-01

Please confirm that the proposed alternative only applies to quarterly group A pump testing activities and that the frequency response range of the vibration measuring transducers and their readout system shall be from one-third rotational speed to at least 1000 Hz for preservice and comprehensive pump tests.

TVA Response

Clarification is made (see page 32 of Enclosure 2) to limit applicability to quarterly pump tests.

ENCLOSURE 2

TENNESSEE VALLEY AUTHORITY (TVA)
SEQUOYAH NUCLEAR PLANT (SQN)

ASME IST Pump Testing Program (0-TI-SXI-000-200.P)

Sequoyah Nuclear Plant

Unit 0, 1, & 2

Technical Instruction

0-TI-SXI-000-200.P

ASME IST PUMP TESTING

Revision 0000

Quality Related

Level of Use: Reference Use

Effective Date:

Responsible Organization: SCE, System Eng - Component

Prepared By: LARRY ALEXANDER

Approved By: Gay Haliburton

Current Revision Description

NEW PROCEDURE.

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1.0 INTRODUCTION

1.1 Purpose

The purpose of this document is to provide technical requirements to assure compliance with the requirements of 10CFR50.55a and Sequoyah Nuclear Plant's (SQN) Technical Specifications (TS) which require that ASME inservice testing of pumps be met throughout the service life of the nuclear power plant and be updated at each 10 year interval. Interval extensions of as much as one year are allowed as long as successive intervals are not altered by more than one year from the original pattern of interval. The purpose of the inservice test program (IST)is to ensure operational readiness of ASME Code Class 1, 2 and 3 plant components which are required for a specific function in (1) shutting down the reactor to a safe shutdown condition (hot shutdown for SQN), (2) maintaining the safe shutdown condition, or (3) mitigating the consequences of an accident. Inservice tests are designed to detect component degradation by assessing component performance in relation to operating characteristics when the component was known to be operating acceptably. At no time will ASME requirements supersede SQN Technical Specification requirements. The rules for the in-service pump testing for Nuclear Power Plant Components for the Third Ten Year Interval, are contained in the ASME OM Code 2001 Edition, through the 2003 Addenda, approved Code cases, and approved relief requests. The milestone dates for SQN are:

Commercial Operation Unit1: 7/1981

Commercial Operation Unit2: 6/1982

Second 10 year interval start: 12/15/1995

Third 10 year interval start: 6/1/2006

1.2 Scope

The scope of this instruction applies to pumps determined to be ASME Code Class 1, 2, and 3 plant components which are required for a specific function in (1) shutting down the reactor to a safe shutdown condition (hot stand by for SQN), (2) maintaining the safe shutdown condition, or (3) mitigating the consequences of an accident and receive power from an emergency power service. The scope of this instruction applies to the applicable pumps within the ASME Section XI boundaries as defined by the SQN ASME Section XI Color Coded Boundary Drawings. All pumps which have been determined to meet ASME & Technical Specification requirements for inclusion in the test program are identified in Appendix A. General program requirements are included within this instruction with specific requirements listed in the individual implementing instructions.

1.2 Scope (continued)

The following are excluded from the requirements of this procedure

1. Fans and compressors are exempt from the ASME Code testing requirements.

2. Drivers are exempt from Code testing requirements except where the pump and driver form an integral unit and the pump bearings are located in the driver (RHR pumps at Sequoyah) and vertical line shaft pumps. The ASME OM Code does not define "integral unit". Vibration measurements on pump drivers, if not integral to the pump, are not currently considered to be within the scope of the ASME OM Code.

3. Pumps which do not perform a function within the scope of the ASME Code but are supplied with emergency power solely for operating convenience are exempt from ASME Code testing requirements.

4. Skid-mounted pumps that are tested as part of the major component and are determined by the Owner to be adequately tested are exempt from the requirements of ISTB.

Components outside the scope of the 10CFR50.55a program will be tested at a level commensurate with their intended function to demonstrate that they will perform satisfactorily when in service as required by 10CFR50 Appendix A, Appendix B, GDC-1, and NUREG 1482 R1. These components will be tested as specified in the SQN Augmented Test Program.

2.0 REFERENCES

A. 10CFR50.55a.

B. NRC Documents:

1. Inspection Manual, Temporary Instruction 2515/114, Inspection Requirements for Generic Letter 89-04, Acceptable Inservice Testing Programs.

2. NRC Generic Letter 89-04, Guidance on Developing Acceptable Inservice Testing Programs. April 3, 1989.

3. NRC letter on the "Minutes of the Public Meetings on Generic Letter 89-04 Oct 25, 1989.

4. NRC NUREG 1482 Rev 1, Guidelines for Inservice Testing at Nuclear Power Plants, January, 2005.

2.0 REFERENCES (continued)

5. Summary of Public Workshops Held in NRC Regions on Inspection Procedure 73756 "Inservice Testing of Pumps and Valves" and Answers to Panel Questions on IST Issues, July 18,1997.

6. NRC Information Notice 97-16: Preconditioning of Plant Structures, Systems, and Components Before ASME Code Inservice Testing OR Technical Specification Surveillance Testing.

7. Generic Letter 91-18 Information to Licensees Regarding Two NRC Inspection Manual Sections on Resolution of Degraded and nonconforming Conditions and on Operability.

8. Regulatory Guide 1.192 Operation and Maintenance Code Cases Acceptability, ASME OM Code.

9. Regulatory Guide 1.193 ASME Code Cases not Acceptable for Use.

10. Regulatory Guide 1.147 Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1.

11. NEI White Paper, Entitled "Standard Format for Relief Requests from Commercial Reactor Licensees Pursuant to 10CFR50.55a".

C. CODES and STANDARDS:

1. ASME OM Code, Inservice Testing of Pumps in Light-Water Reactor Nuclear Power Plants, OM-2001 Edition to the OMb-2003 Addenda.

2. ANSI/ASME N45.2.6-1978, Qualification of Inspection Examination and Testing Personnel for Nuclear Power Plants.

D. SPP-9.1, ASME Section XI.

E. TVA Calculation SQN-SQTP-002, ASME Section XI Pump and Augmented Pump Identification for Inservice Testing.

F. TVA Calculation SQN-SQTP-001, ASME Section XI Inservice Code Class Boundaries for Inservice Testing.

G. 0-SI-SXV-000-266.0, Summary of Pump And Valve Tests For ASME OM Code.

H. 0-TI-SXX-000-005.0, Augmented Pump and Valve Test Program.

I. Sequoyah Nuclear Plant Technical Specifications.

J. Sequoyah Nuclear Plant Design Criteria and Design Guides:

1. SQ-DC-V-3.0 Classification of Piping, Pumps, Valves and Vessels.

2.0 REFERENCES (continued)

2. SQ-DC-V-2.16 Single Failure Criteria.

3. SQ-DC-V-3.2 Classification of HVAC Systems.

K. TVA submittals to the NRC:

1. Second Ten Year Program Update submitted 11/21/95 RIMS S64951121800.

2. RAI response submitted 5/9/96 RIMS S64960509800.

3. RAI response submitted 3/4/97 RIMS S64970305800.

4. RAI response submitted 8/28/97 RIMS S64970829801.

L. SQN UFSAR Section 3.2 and 6.8.

M. NEI White Paper, Entitled "Standard Format for Relief Requests from Commercial Reactor Licensees Pursuant to 10CFR50.55a".

N. SQN ASME Section XI Color Coded Boundary Drawings.

O. ASME Section XI Programs for the Second Inspection Interval, Units1 & 2, RIMS S64 951121 800.

P. Revised Inservice Test (IST) Program, Second Ten-Year Interval, RIMS S649712228000.

Q. NRC documents to TVA:

Safety Evaluation Report on Sequoyah Inservice Test Programs for Pumps and Valves (IST) dated March 20, 1996 (TAC NOS. M94117 and M94118).

3.0 PERFORMANCE

3.1 Definitions

OPERABLE - OPERABILITY: - A system, subsystem, train, component or device shall be OPERABLE or have OPERABILITY when it is capable of performing its specified function(s), and all necessary attendant instrumentation, controls, a normal and emergency electrical power source, cooling or seal water, lubrication or other auxiliary equipment that are required for the system, subsystem, train, component or device to perform its function(s) are also capable of performing their related support function(s).

3.1 Definitions (continued)

ASME PUMP TEST PROGRAM: - The pump test program required by 10CFR50.55a(f) provides the testing requirements of ASME Code Class 1, 2, and 3 pumps by using the ASME OM Code. Those pumps with an emergency power supply that are required in shutting down the reactor to the safe shutdown condition, maintaining the safe shutdown condition, or mitigating the consequences of an accident are to be tested per ISTB of the OM Code.

AUGMENTED PUMP TEST PROGRAM: - The pumps that are outside the scope of ASME OM Code (and therefore outside the scope of 10CFR50.55a) will be tested at a level commensurate with their intended function. The intent of 10CFR50 Appendix A, GDC-1, and Appendix B, Criterion XI is that all components, such as pumps, necessary for safe operation are to be tested to demonstrate that they will perform satisfactorily in service. Therefore, while 10CFR50.55a provides the testing requirements for ASME Code Class 1, 2, and 3 pumps, the testing of pumps is not to be limited to only those covered by 10CFR50.55a (refer to item 11 of Generic Letter 89-04).

Comprehensive Pump Test: – An Inservice Test performed on both Group A and Group B pumps at least once every 2 years at +/- 20% of design flow conditions. This test measures hydraulic and vibration parameters with hydraulic parameter acceptance criteria more stringent than that imposed by the Group A and Group B Tests. In addition, accuracy of pressure instrument used for measuring pump differential pressure is more stringent.

Group A Pumps: - Pumps that are operated continuously or routinely during normal operation, cold shutdowns, or refueling operations.

Group A Pump Test: – A quarterly Inservice Test performed on pumps that are operated continuously or routinely during normal operation, cold shutdowns, or refueling operations. This test measures hydraulic and vibration parameters with hydraulic parameter acceptance criteria less stringent than that imposed by the Comprehensive Test.

Group B Pumps: - Pumps in standby systems that are not operated routinely except for testing.

Group B Pump Test: – A quarterly Inservice Test performed on pumps in standby systems that are not operated routinely except for testing. This test measures hydraulic parameters only with acceptance criteria less stringent than that imposed by the Comprehensive Test.

3.1 Definitions (continued)

Skid-Mounted Pumps and Valves: - Pumps and valves which are integral to or that support operation of major components, even though these pumps and valves may not be located on the skid. In general, these pumps and valves are supplied by the manufacturer of the major component. Examples include: diesel generator lube oil pumps and valves, steam admission and trip throttle valves for turbines, and solenoid operated pilot valves used to control air operated valves.

Vertical line shaft pumps: - A vertically suspended pump where the pump driver and pump element are connected by a line shaft with an enclosed column.

3.2 General Program Requirements

A. All components tested under the IST Pump Program and the test parameters to be measured are identified in Appendix B. Appendix A to this document contains requests for relief from code requirements.

B. The ASME Inservice Pump Tests shall be reviewed and approved by the Program Test Engineer.

C. The ASME Inservice Pump Test records shall be maintained in accordance with ISTB-9000 of the OM Code.

D. Pump Groups:

1. **Group A Pumps:** - The OM Code defines Group A pumps as those pumps that are operated continuously or routinely during normal operation, cold shutdown, or refueling operations. Sequoyah considers the following pumps to be Group A pumps. Basis for grouping are:

   a. Charging Pumps - The charging pumps are utilized during plant operation for normal charging and letdown activities.

   b. Motor Driven Auxiliary Feedwater Pumps – These pumps are utilized during startup from refueling outages to fill the steam generators and to maintain steam generator level prior to initiation of normal feedwater.

   c. Boric Acid Transfer Pumps – These pumps are in service for recirculation of the boric acid tanks during normal operation.

   d. Component Cooling Water Pumps - The CCW pumps operate continuously during normal plant operation to supply cooling water to non-essential heat loads as well as cooling water to the RCP motor bearings and thermal barriers.

   e. Chilled Water Pumps – These pumps are in service during normal operation to supply cooling to various loads.

3.2 General Program Requirements (continued)

f. Residual Heat Removal Pumps - The RHR pumps are required to operate when maintaining the plant in a cold shutdown condition.

g. ERCW Pumps - The cooling water vertical line shaft pumps operate continuously during normal plant operation to supply cooling water to non-essential heat loads.

h. ERCW Screen Wash Pumps - The vertical line shaft pumps operate intermittently during normal plant operation to maintain the screens clean.

2. **Group B Pumps** - The OM Code defines Group B pumps as those pumps in standby systems that are not operated routinely **except for testing.** SQN considers the following pumps Group B pumps:

a. Turbine Driven Auxiliary Feedwater Pump - This pump is not utilized during any plant operating evolution. The pump remains in standby during all operating Modes and is required to operate only during accident or transient conditions in which it is credited for accident mitigation.

b. Containment Spray Pumps - The spray pumps are not utilized during any plant operating evolution. The pumps remain in standby during all operating Modes. The pumps are required to operate only during a loss-of-coolant accident (LOCA) or main steam line break (MSLB) inside containment for containment heat removal and pressure suppression.

c. Safety Injection Pumps - The pumps remain in standby during all operating Modes, except during testing.

3.3 Pump Testing Frequency

A. Tech Spec frequency shall not be superseded by ASME frequency. The provisions of Tech Spec 4.0.2 allowing the use of a +/-25% tolerance to specified test frequencies listed in the Tech Spec may be applied.

B. When plant conditions restrict the availability of some components for testing, testing may be delayed until appropriate plant conditions are available.

C. Components tested during power ascension due to maintenance performed during the outage shall be considered inoperable until the post maintenance tests are completed.

D. ASME Inservice pump testing (in the as found condition where practical) shall be conducted quarterly (at least once every 92 days).

3.3 Pump Testing Frequency (continued)

E. A comprehensive pump test is performed every 2 years.

F. ASME pumps lacking required fluid inventory shall be tested at least once every two years (at least once every 24 months).

G. Pump testing shall continue through shutdown periods on operable equipment.

H. Pump performance which falls within the "Alert Range" may require doubling the test frequency.

I. Pumps in systems out of service for an extended period of time are not required to be tested but will be tested within the last 92 days of the outage or prior to being returned to service or entry into an operational mode which requires the pump to be OPERABLE unless technical specifications allows otherwise.

J. Pump testing is required prior to returning to service following maintenance activities which could affect pump performance.

K. Pumps that are discovered to be out of frequency shall be subject to the requirements of TS 4.0.3 and Generic letter 91-18.

3.4 Reference Values

A. Pump parameter reference values shall be established when the pump is known to be operating acceptably and at points of operation that are relatively stable and readily duplicated during subsequent tests. Reference values are found in implementing instructions.

B. Reference values for Group A and B pumps shall be established within +/- 20% of pump design flow, if practicable. If not practicable, then the reference point shall be established at the highest practicable flow.

C. Reference values shall be established within +/- 20% of design flow for the comprehensive pump test.

D. Following repair and/or replacement activities which may have affected established reference valves, the reference values shall be reconfirmed as acceptable or a new set of reference values shall be established.

E. A new set of reference values may be established for pumps in the Alert or Required Action Range when supported by an analysis which includes both the pump performance and the system requirements in accordance with ASME OM Code ISTB 6200(c).

3.4 Reference Values (continued)

F. When it is otherwise desirable to establish a new set of reference values, a Group A or comprehensive test shall be performed at the current reference values and determined to be acceptable prior to performing the test at the new reference values. A test shall be run to verify the new reference values before their implementation and the reasons for the change documented in the record of test.

G. Reference values shall be established using the most conservative values from Tech Specs, Code, or design limits.

3.5 Test Parameters

A. Speed - Pump speed is only measured for variable speed pumps.

B. Differential Pressure - Differential pressure is calculated from suction and discharge pressure or obtained by direct differential pressure measurement. Lake level and pump elevation are used to obtain suction pressure when necessary and the calculational method is included in the pump test procedure.

C. Discharge Pressure - The pump discharge pressure. Discharge pressure is to be measured for positive displacement pumps.

D. Flow Rate - Flow rate is measured using a rate or quantity meter installed in the pump test circuit. If a meter does not indicate the flow rate directly, the record shall include the method used to reduce the data. Internal recirculation flow is not required to be measured. External recirculation flow is not required to be measured when it has been evaluated and determined to not have a substantial effect on test results, has a fixed resistance, or is not practical to isolate.

E. Vibration - All centrifugal pumps will have vibration measurements taken in a plane approximately perpendicular to the rotating shaft in two orthogonal directions on each accessible pump bearing housing. Measurement will also be taken in the axial direction when accessible at the thrust bearing housing. Vertical line shaft pumps will have vibration measurements taken on the upper motor bearing housing in three orthogonal directions, one of which is the axial direction. Reciprocating pumps will have vibration measurements taken approximately perpendicular to the crankshaft and the line of plunger travel, including the axial direction when accessible on each bearing housing (vibration measurement is not required for Group B quarterly tests).

3.6 Allowable Ranges for Test Parameters

Tables ISTB-5100-1 and ISTB-5200-1 of OM Code provide the allowable ranges for pump testing parameters. Expanded ranges are not allowed without relief from the NRC. New reference values may be established as allowed by ISTB-3320 and ISTB-6200(c) of the ASME OM Code.

Requirements are developed from OM Code ISTB and approved Relief Requests.

A. Reference Values: The following table provides acceptable ranges of acceptance criteria. Values shall not exceed the more conservative of Design, Tech Spec, or Code limits.

PUMP VIBRATION TEST PARAMETERS (Quarterly and Comprehensive)					
PumpType	Pump Speed	Test Parameter	Acceptable Range	Alert Range	Required Action Range
Centrifugal and veritcal line shaft	<600 rpm	V_v	$\leq 2.5V_r$	$> 2.5V_r$ to $6V_r$	$> 6V_r$
Centrifugal and vertical line shaft	≥600 rpm	V_v	$\leq 2.5V_r$	$> 2.5V_r$ to $6V_r$ or > 0.325 in./sec	$> 6V_r$ or > 0.70 in./sec
Reciprocating		V_v	$\leq 2.5V_r$	$> 2.5V_r$ to $6V_r$	$> 6V_r$
NOTE: V_r is vibration reference value in the selected units.					

QUARTERLY PUMP TEST PERFORMANCE RANGES					
		Alert Range		Required Action Range	
Test Parameter	Acceptable Range	Low	High	Low	High
Vertical Line Shaft GroupA (No GroupB at Sequoyah)					
ΔP	0.95 to $1.10\Delta P_r$	0.93 to< $0.95\Delta P_r$	...	$< 0.93\Delta P_r$	$>1.10\Delta P_r$
Q	0.95 to $1.10Q_r$	0.93 to< $0.95Q_r$	...	$< 0.93Q_r$	$>1.10Q_r$
Centrifugal Group A and B Pumps					
ΔP	0.90 to $1.10\Delta P_r$	...	...	$< 0.90\Delta P_r$	$>1.10\Delta P_r$
Q	0.90 to $1.10Q_r$	...	...	$< 0.90Q_r$	$>1.10Q_r$
Positive Displacement Pumps (none at Sequoyah)					

3.6 Allowable Ranges for Test Parameters (continued)

COMPREHENSIVE PUMP TEST PERFORMANCE RANGES					
Pump Type	Test Parameter	Acceptable Range	Alert Range	Required Action Range	
				Low	High
Vertical Line Shaft	Q	0.95 to 1.03 Q_r	0.93 to < 0.95 Q_r	< 0.93 Q_r	> 1.03 Q_r
	ΔP	0.95 to 1.03 ΔP_r	0.93 to < 0.95ΔP_r	< 0.93 ΔP_r	> 1.03 ΔP_r
Centrifugal	Q	0.94 to 1.03 Q_r	0.90 to < 0.94 Q_r	< 0.90 Q_r	> 1.03 Q_r
	ΔP	0.93 to 1.03 ΔP_r	0.90 to < 0.93ΔP_r	< 0.90 ΔP_r	> 1.03 ΔP_r
NOTE: The subscript r denotes reference value.					

B. Instrumentation:

1. Instrumentation shall meet the requirements of the following table:

ACCEPTABLE INSTRUMENT ACCURACY		
Quantity	Group A and Group B Tests, %	Comprehensive and Preservice Tests, %
Pressure	± 2	± 1/2
Flow Rate	± 2	± 2
Speed	± 2	± 2
Vibration	± 5	± 5
Differential Pressure across pump	± 2	± 1/2
NOTE: (1) Percent of full scale for individual analog instruments, percent of total loop accuracy for a combination of instruments, or over the calibrated range for digital instruments.		

2. The full range of analog instruments shall not exceed three times the reference value.

3.6 Allowable Ranges for Test Parameters (continued)

3. Digital instruments shall not exceed 70% of the calibrated range of the instrument except where relief has been granted.

4. Vibration instruments are exempted from range requirements.

5. Measurement locations shall be repeated for subsequent testing. Vibration measurement locations are marked on the equipment and identified in plant procedures.

6. Throttling small instrumentation valves or the use of snubbers/damping devices is permissible.

7. Vibration ranges shall be from one third rotating speed to at least 1000Hz except where relief has been granted.

3.7 Pump Testing

A. Pumps shall be operated at nominal motor speed for constant speed drivers and at a speed adjusted to the reference value (+/-1%) for variable speed drivers.

B. Vibration measurements shall be taken and compared to their reference values.

NOTES

1) Option C, D, or E is acceptable.

2) When flowrate or pressure is a fixed value, it shall not vary by more than +/- 2% inclusive of total instrument accuracy unless a similar reduction in acceptance criteria is made.

C. System resistance shall be varied until the flow rate equals the reference value. The differential pressure shall be measured or determined and compared to its reference value.

D. System flow rate shall be varied until the differential pressure equals the reference value. The flow shall then be measured and compared to its reference value.

E. If system resistance cannot be varied, then flow rate and differential pressure shall be measured or determined and compared to their respective reference values except where relief is granted.

F. For Group A and the comprehensive tests, testing shall not begin until at least two minutes following system stabilization.

3.7 Pump Testing (continued)

INSERVICE TEST PARAMETERS	
Quantity	**Remarks**
Speed: N	If variable speed
Differential Pressure: ΔP	Centrifugal Pumps, including vertical line shaft pumps
Discharge Pressure: P	Positive Displacement Pumps
Flow Rate: Q	All
Vibration: Velocity, V_v	Peak

3.8 Relief Requests

In the event that compliance with a specific requirement of 10CFR50.55a or the ASME OM Code is determined; 1) to be impractical and cannot be met; 2) to result in undue difficulty without a compensating increase in quality or safety; or 3) to be less preferred than a specific proposed alternative, then relief may be granted by the NRC. A general request for a group of components may be submitted, or a specific request may be submitted for specific issues. Each relief request should follow the guidance of NEI White Paper, entitled "Standard Format for Relief Requests from Commercial Reactor Licensees Pursuant to 10CFR50.55a", identify as to whether the request was approved in the second interval, or whether it is a new relief request. Relief requests are to be submitted prior to the start of the third interval where possible, and not later 12 months following end of the current inspection interval in accordance with 10CFR50.55a(f)(5).

3.9 Data Analysis and Evaluation

If deviations fall within the alert range the frequency of testing is doubled until the cause of the deviation is determined and the condition corrected. If deviations fall within the required action range the pump is declared inoperable as soon as the data is recognized to be unacceptable until the cause of the deviation has been determined and the condition corrected or an appropriate analysis is completed and new reference values are established. The analysis shall include an evaluation of both the system and pump operational readiness, the cause of the change in pump performance, and an evaluation of all trends of available data. The results of this analysis shall be documented in the record of tests. If testing indicates that instruments are erratic, the test may be discontinued and the instruments recalibrated, or replaced, without declaring the pump inoperable.

3.9 Data Analysis and Evaluation (continued)

Upon finding a pump inoperable and entry into appropriate action statements of technical specifications, the test results may be reviewed and compared to previous test data to decide if a condition has or has not developed that will further degrade the pump and exceed the safety analysis limit. If the pump is found not in danger of further degradation over an acceptable period of time, an analysis and new reference values may be an acceptable alternative to pump repair or replacement until such time as repairs can be affected, as allowed by the code. If the analysis determines that the pump will soon degrade further, immediate action is required. The analysis must establish a basis for meeting the safety analysis limits/licensing basis and must assess the condition of the redundant train.

With the exception of the fixed parameter, test results shall be trended.

3.10 Augmented Pump Testing

The inservice operability testing of safety-related pumps associated with non-Code pumping systems are not tested per the ASME inservice test program. For example, the inservice operability testing of pumps associated with the emergency diesels do not meet the criteria for inclusion in the ASME pump test program. The fuel oil transfer pumps, and lube oil pumps are tested per the augmented test program. Other components are an integral part of the Emergency Diesel System and are functionally tested by the diesel engine tests. Thus, the functional operability testing of these pumps is performed at a frequency equal to that required by OM Code for pumps or at a frequency commensurate with their safety function. Additionally, the failure of a pump to perform its intended function will be identified by the failure of the associated Emergency Diesel to meet its functional requirements.

4.0 RECORDS

4.1 Pump Records

Records will be maintained for each pump included in the IST Program. This will include the following items and must be retained for the lifetime of the component:

A. Manufacturer's information, including:

   1. Manufacturer.

   2. Manufacturer's model and serial or other identification number.

B. A copy of summary of the manufacturer's acceptance test report, if available.

C. A copy of the pump manufacturer's operating limits.

4.2 Inservice Test Plans

A record of test plans and procedures shall be maintained which shall include the following:

A. The hydraulic circuit to be used.

B. The location and type of measurement for the required test parameters.

C. The reference values.

D. The method of determining reference values which are not directly measured by instrumentation.

E. The category of each pump.

4.3 Record of Tests

A record of each test shall be maintained which shall include the following:

A. Pump identification.

B. Date of test.

C. Reason for test (e.g., post-maintenance, routine inservice test, establishing reference values).

D. Values of measured parameters.

E. Identification of instruments used.

F. Calibration Records.

G. Comparisons with allowable ranges of test values and analysis of deviations.

H. Requirement for corrective action, if any.

I. Evaluation and justification for changes to reference values.

J. Signature of the person or persons responsible for conducting and analyzing the test.

4.4 Record of Corrective Action

Records of corrective action shall be maintained which shall include the following:

A. A summary of the corrections made.

B. The subsequent Inservice Test and confirmation of operational adequacy.

C. The signature of the individuals responsible for corrective actions and verification of results.

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REQUEST FOR RELIEF

Pump Relief Request - RP-01

ERCW SCREEN WASH PUMP FLOW MEASUREMENT

Affected Components

ERCW Screen Wash Pumps

Test Requirement

ISTB-5121(b) requires that the system resistance be varied until the flow rate equals the reference point, then differential pressure is measured and compared to the reference value.

Basis for Relief

No in-line instrumentation exists to measure flow and the physical configuration of the pump and piping does not allow the use of portable flow measuring equipment such as ultrasonic flow meters. These pumps take suction from the pump pit directly below the pump deck and are positioned on the deck adjacent to the traveling screens. The discharge piping for each pump is short and open ended containing several elbows, reducers, and valves prior to entering the traveling screen enclosure. The current configuration of this piping system does not provide straight lengths of piping that will support neither the installation of a permanent flow measuring device nor the utilization of a portable flow measuring device capable of providing accurate flow rate measurements. Significant costly modifications, requiring the design and installation of 3" diameter piping reroute, applicable piping supports, heat trace, and insulation would be required to provide a configuration that would provide reliable flow readings.

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Pump Relief Request - RP-01

ERCW SCREEN WASH PUMP FLOW MEASUREMENT

Alternative Test

SQN plans to perform the test by setting the system resistance to the same point for each test with the throttle valves full open. Flow will not be measured. The remaining variable that could affect system resistance is the spray nozzles. The condition of the spray nozzles will be inspected during each test performance with corrective action initiated as necessary, thus providing assurances that the spray nozzle condition will not affect flow. SQN has reviewed the maintenance history for nozzle plugging and determined that nozzle plugging is infrequent. The nozzles are inspected by operations personnel during spray operation with corrective maintenance initiated as required. With system resistance maintained constant for each test, pump degradation would be identified through changes in differential pressure. Differential pressure is calculated using inlet (based upon the lake level) and discharge pressure. The pump can be trended for degradation based on differential pressure at this point. Vibrations readings will also be taken at this reference point as well. The pumps will be tested in this manner for both the quarterly Group A test and the biennial Comprehensive test.

Conclusion

Based upon the above discussion, the alternative test provides an acceptable level of quality and safety. Authorization to implement the proposed alternative is requested in accordance with 10CFR50.55a(3)(i).

This is a new relief request. This relief request is similar to one approved for Watts Bar Nuclear Plant for their current interval TAC NOS. M89217, M89218, and M74801.

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Pump Relief Request - RP-02

RESIDUAL HEAT REMOVAL PUMP FLOW MEASUREMENT

Affected Components

Residual Heat Removal Pumps

Test Requirement

ISTB-5121 requires the parameters listed in Table ISTB-3000-1, including flow, to be determined and recorded. ISTB-5121(e) requires the flow rate to be compared to the ranges specified in Table ISTB-5100-1 and corrective action taken accordingly.

Basis for Relief

Residual Heat Removal Pumps are tested using the minimum flow recirculation line provided for pump protection. No other flow path is available to meet the Group A quarterly testing of ISTB. The miniflow path is of fixed resistance, instrumented, and limits flow to the minimum required flow for pump protection. The nominal miniflow rate is 500 gpm for pump protection.

Test results during previous ten-year inspection intervals have shown variations of recorded flow readings which exceed ISTB allowable range requirements. The Residual Heat Removal pump miniflow rate is measured using an installed flow measuring device in the 14 inch pump discharge header while flowing through the 3 inch miniflow line which includes a 2 inch miniflow return valve. The flow measuring device meets ISTB range and accuracy requirements, however, small changes in the differential pressure across the flow element equate to relatively large changes in the flow. A differential pressure change of 2 inches of water at the flow element would equal a 44 gpm change in flow.

While operating through the miniflow recirculation line, the pump is operating in the flat portion of the pump curve near shutoff head conditions. In this region of the pump's hydraulic curve, very small changes in the developed head correspond to large changes in produced flow. For example, a change in developed head of 0.15 psig would result in a change of approximately 52 gpm. A change in flow in excess of 3000 gpm would be required for the differential pressure to exceed the ISTB acceptable range of 0.9 times the reference value.

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Pump Relief Request - RP-02

RESIDUAL HEAT REMOVAL PUMP FLOW MEASUREMENT

With the configuration of the installed flow instrumentation and the resulting negligible effect that changes in the flow have on differential pressure while operating on minimum flow path, maintaining compliance to ISTB specified flow ranges is not practical. Additionally, SQN considered performing testing during cold shutdowns and determined it not prudent to perform testing during cold shutdown as the RHR system is typically inservice and relied upon for residual heat removal and safe operation of the plant. Flow adjustments for testing purposed could affect safe plant operation in maintaining the plant in cold shutdown state.

This relief request meets the intent of Position 9 in Generic Letter 89-04.

No other flow measurement means are available that will provide the repeatability necessary to meet ISTB ranges.

Alternative Test

The Residual Heat Removal Pumps will be Group A tested quarterly using the minimum flow recirculation line where differential pressure and vibration will be measured and trended. The Residual Heat Removal Pumps will be subject to a Comprehensive Pump test in accordance with ISTB requirements each refueling outage.

Conclusion

The alternative test provides an acceptable level of quality and safety. Authorization to implement the proposed alternative is requested in accordance with 10CFR50.55a(3)(i).

This relief request was approved for the Second Ten Year Interval by TAC NOS. M94117, M94118, MA0417, MA0418, MA1595, and MA1596. No changes in Code requirements have occurred affecting this relief request.

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Pump Relief Request - RP-03

Boric Acid Transfer Pumps

Affected Components

Boric Acid Transfer Pumps

Test Requirement

ISTB-3510 (b)(1) requires that the full-scale range of each analog instrument shall be not greater than three times the reference value.

Basis for Relief

These pumps have low suction pressure requirements where the pressure is as low as 1.5 psig. To meet the instrumentation requirements of ISTB, the maximum range at this suction pressure would be 4.5 psig (three times the measured suction pressure). To meet this requirement, SQN would have to purchase special low pressure gauges. The maximum error for a Group A test using a 2% accurate gauge would be 0.09 psig. Testing with a 0.05 accurate gauge would result in a maximum error of 0.02 psig. Using a 15 psig gauge which complies with Code accuracy requirements during testing would result in a maximum error of 0.3 psig for Group A testing and 0.075 psig for Comprehensive pump testing. The typical discharge pressure of the Boric Transfer pumps is in the 95-105 psig range. The discharge pressure becomes the controlling value in the differential pressure measurement which is typically 80-90 psid. The inaccuracies of the 15 psig suction pressure would have negligible affect on the calculation of the pump differential pressure. The effect would not be sufficient to mask pump degradation. Compliance with the Code required instrument range requirement does not provide an increase in the level of safety.

Alternative Test

Pump testing will be performed using 15 psig suction gauges in lieu of gauges of the range required by ISTB-3510 (b)(1).

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Pump Relief Request - RP-03

Boric Acid Transfer Pumps

Conclusion

The alternative test provides an acceptable level of quality and safety. Authorization to implement the proposed alternative is requested in accordance with 10CFR50.55a(3)(i).

This relief request was approved for the Second Ten Year Interval by TAC NOS. TAC NOS. M94117, M94118, MA0417, MA0418, MA1595, and MA1596. No changes in Code requirements have occurred affecting this relief request.

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Pump Relief Request - RP-04

Smooth Running Pump Vibration Acceptance Criteria

Affected Components

Pump ID	Pump Description	Code Class	OM Group
J-A K-A L-B M-B N-B P-B Q-A R-A	Essential Raw Cooling Water Pump	3	A
A-A B-B C-B D-A	Essential Raw Cooling Water Screen Wash Pump	3	A
C-S 1A-A 1B-B 2A-A 2B-B	Component Cooling Water Pumps	3	A
A-A B-B	Shut Down Board Room Chilled Water Pumps	3	A
1A-A 1B-B 2A-A 2B-B	Boric Acid Transfer Pumps	3	A
1A-A	Safety Injection Pump	2	B

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Pump Relief Request - RP-04

Smooth Running Pump Vibration Acceptance Criteria

Test Requirement

This request for relief applies only to vibration testing. ISTB-3300 require that vibration reference values be determined from the results of preservice testing or from the results of the first inservice test. Tables ISTB 5100-1 and ISTB-5200-1 establishes ranges of acceptability of reference values. Specifically, the tables require the use of 2.5 and 6 times the reference values in determining acceptable ranges of vibration unless those calculated values exceed the absolute limits specified in the Tables. ISTB 6200 requires action to be taken based upon ranges established in Tables ISTB 5100-1 and ISTB-5200-1.

Basis for Relief

The listed pumps have at least one vibration reference value (V_r) that is currently less than 0.05 inches per second (ips). Small values for V_r result in very small acceptable ranges for pump operation. The acceptable ranges are defined in Tables ISTB-5100-1 and ISTB 5200-1, as less than or equal to 2.5 V_r. Based on a small acceptable range, a smooth running pump could be subject to unnecessary corrective action.

For very small reference values, hydraulic noise and instrumentation error can be significant portion of the reading and affect the repeatability of subsequent measurements. Also, experience gathered from the preventative maintenance program has shown that changes in vibration levels in the range of 0.05 ips are not typically indicative of degradation in pump performance

To avoid unnecessary corrective action on pumps which are performing satisfactorily and with unusually low vibration, a minimum velocity measurement value of V_r of 0.05 ips will be established for velocity measurements. This minimum value will be applied to individual vibration locations where the measured reference value is less than 0.05 ips and utilized in the calculation of acceptable ranges specified in Tables ISTB 5100-1 and ISTB-5200-1

When new reference values are established per ISTB-3310, ISTB-3320 or ISTB-6200(c), the measured parameters will be evaluated for each location to determine if the provisions of this relief request still apply. If the measured V_r is greater than 0.05 ips, the requirements of ISTB-3300 will be applied even if the pump is included in the identified list of pumps. Conversely, if the measured V_r is less than 0.05 ips, a minimum value of 0.05 ips will be used for V_r even if the pump is is not currently included in the list of pumps.

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Pump Relief Request - RP-04

Smooth Running Pump VIBS Acceptance

In addition to the requirements of ISTB, the pumps in the ASME Inservice Testing Program are included in the Predictive Maintenance Program. The Predictive Maintenance Program currently employs predictive monitoring techniques such as:

Vibration monitoring and analysis beyond that required by ISTB. All data is collected currently utilizing a CSI 2120 meter, down loaded into the Predictive Maintenance Program, then analyzed for vibration magnitude and frequency. Components exceeding limits may be subjected to advanced diagnostics including impact testing and spectral analysis. Additional parameters monitored and trended are:

bearing temperature trending.

oil sampling and analysis.

If the measured parameters are outside the normal operating range or are determined by analysis to be trending toward an unacceptable degraded state, appropriate actions are taken that may include:

increased monitoring to establish rate of change,

review of component specific information to identify cause, and

removal of the pump from service to perform maintenance.

All of the pumps in the IST Program will remain in the Predictive Maintenance Program even if certain pumps have very low vibration readings and are considered to be smooth running pumps.

Periodic reports are generated from test data, both IST and Predictive Maintenance collected.

This alternative to the requirements of ISTB-3300 provides an acceptable level of quality and safety.

Alternative Actions

Pumps with a measured reference value below 0.05 ips for a specific vibration measurement location shall have subsequent test results for that location compared to an acceptable range based on 0.05 ips. This will result in a minimum alert range of 0.25 ips and required action range of 0.30 ips. In addition to the Code requirements, all pumps in the IST Program are included in and will remain in the Predictive Maintenance Program regardless of their smooth running status.

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Pump Relief Request - RP-04

Smooth Running Pump Vibration Acceptance Criteria

Conclusion

Using the provisions of this relief request as an alternative to the specific requirements of ISTB-3300, Tables ISTB 5100-1 and ISTB-5200-1, and ISTB 6200 will provide adequate indication of pump performance and continue to provide an acceptable level of quality and safety. Therefore, pursuant to 10 CFR 50.55a(a)(3)(i) authorization to implement the proposed alternative is requested.

This is a new relief request. This relief request is similar to one approved for North Anna Power Station TAC NOS MB2221 and MB2222 and approved for Watts Bar Nuclear Plant for their current interval TAC NO. M74801.

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Pump Relief Request - RP-05

Calibration Range of Digital Instrument

Affected Components

Containment Spray Pumps

Test Requirement

ISTB-3510 (b)(2) requires digital instruments to be calibrated such that the reference value does not exceed 70% of the calibrated range of the instrument.

Basis for Relief

Portable digital ultrasonic flow equipment is used to measure flow for the Containment Spray Pump tests with the current maximum allowable reference value for the flow at 4800 gpm. Following the calibrated range requirements of ISTB-3510 (b)(2), a reference value of 4800 gpm would require digital instrumentation with a calibrated range of 7104 gpm. This flow rate would equal an approximate velocity of 45.3 feet per second in the 8 inch diameter schedule 40 piping of the Containment Spray System. Per the specifications provided by the ultrasonic flow equipment manufacturer, the maximum flow velocity measurement capable is 40 feet per second or approximately 6237 gpm.

The ultrasonic flow equipment has a manufacturer's stated accuracy of +/- 1% and is calibrated to +/- 2% and has proven acceptable for use in determining flow measurements. Calibration of ultrasonic equipment to 7104 gpm would not provide any greater assurances that the equipment is in calibration at the reference value. SQN does not have installed instrumentation or other means to measure flow in the Containment Spray System to the required accuracy other than through the use of ultrasonic equipment. The inability to use ultrasonic equipment would require a modification to the piping system at considerable expense with no increase in accuracy. An installed flow measuring device in the Containment Spray System would not enhance the detection of pump degradation over that presently provided by ultrasonic flow equipment.

This request is similar to Code case OMN-6 which is scheduled for inclusion in the 2006 Addenda of the Code and is being revised to be applicable to Codes from 2004 through 2005.

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Pump Relief Request - RP-05

Calibration Range of Digital Instrument

Alternative Test

SQN proposes to calibrate ultrasonic flow equipment used in testing the Containment Spray Pump test such that the reference value for the parameter does not exceed 90% of the calibrated range. This alternative will apply to both the Group A or B quarterly test and the Comprehensive test.

Conclusion

Based upon the above discussion, the alternative test provides an acceptable level of quality and safety. Authorization to implement the proposed alternative is requested in accordance with 10CFR50.55a(3)(i).

This relief request was approved for use during the Second Ten Year Interval by TAC NOS. TAC NOS. M94117, M94118, MA0417, MA0418, MA1595, and MA1596 . No changes in Code requirements have occurred affecting this relief request.

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Pump Relief Request - RP-06

RHR Pump Vibration Measurements

Executive Summary:

TVA performs testing of safety-related pumps in accordance with American Society of Mechanical Engineers (ASME) Code, which endorses Operations and Maintenance Standard, ISTB. The provisions of ISTB require the vibration measurements to be broad band and unfiltered with instrumentation calibrated in a range from one-third minimum pump shaft rotational speed to at least 1000 hertz. TVA's proposed request for relief provides alternative testing to measure RHR pump vibration in the range from one-half pump shaft rotational speed to at least 1000 hertz (Hz) during Group A testing. The request is based on high natural vibration levels in the low frequency band (between one-third to one-half rotational speed) that is inherent to the pump/motor framework design. The inherent vibration levels at this frequency range are not representative of pump vibration trends and do not provide useful information for the assessment of pump performance and trending during quarterly pump tests.

TVA's request for relief includes consideration of four key components recommended by NRC NUREG/CP-0152. These key components include:

1) Pump vibration history
2) Information from pump manufacturer
3) Discussion of TVA attempts to lower vibration
4) Spectral analysis of the pump-driver system.

TVA's request for relief was approved for SQN's second 10-year inservice test (IST) interval. This relief request is provided for NRC review and approval in accordance with 10CFR50.55a(a)(3)(i).

Unit Affected: Units 1 and 2

System: Residual Heat Removal (RHR) System

Components: RHR Pumps 1A, 1B, 2A, and 2B.

Code Class: ASME Code Class 2

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Pump Relief Request - RP-06

RHR Pump Vibration Measurements

Component Function: Provides low-head safety injection during emergency core cooling and provides RHR for core cooling during unit shutdown.

Code Requirement: ISTB-5121(d) states "Vibration measurements are to be broad band (unfiltered)."

ISTB-3510 (e) states: "the frequency response range of the vibration measuring transducers and their readout system shall be from one-third minimum pump shaft rotational speed to at least 1000 Hz."

Code Requirement From Which Relief is Requested: Relief is requested to exclude the measurement of broad band (unfiltered) vibration in the response range from one-third rotational speed up to one-half rotational speed during Group A testing.

Basis for Relief: The following background information is provided in accordance with the guidance of NUREG/CP-0152.

Historical Data: Pump performance historical documents indicate that a high vibration condition has existed on SQN's RHR pumps since original installation of these pumps. This condition also existed prior to the ASME conversion to the ISTB pump criteria that incorporated an expanded frequency range for measurement of pump vibration (one-third to one-half rotational speed). TVA has monitored this condition for SQN's RHR pumps and concludes there is no degradation of the pump/motor/foundation assembly from the inherent high vibration in this range.

Manufacturer Data: Westinghouse Electric Company, provider of SQN's RHR pumps, issued a Technical Bulletin (NSID-TB-86-02) that advised utilities of the potential for a high vibration condition in vertical pump/motor/foundation support assemblies. The bulletin references the condition that SQN is experiencing. Consultation with Westinghouse and the results of TVA's evaluation of this issue are provided below.

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Pump Relief Request - RP-06

RHR Pump Vibration Measurements

Attempts to Correct Problem: In accordance with the vendor recommendations from NSID-TB-86-02, TVA inspected SQN's RHR pumps and pump supports to verify there were no loose supporting connections contributing to the vibration condition. Plant modifications to lower vibration by installing additional supports was not a preferred option based on a concern for relocation of the vibration to other points in the pump/motor/foundation. Attempts to relocate the vibration were found to have limited success at other utilities and in some instances vibration levels were increased.

Spectral Analysis: Analysis of the condition indicates that the vibration occurs in a low frequency range less than one-half rotational speed. Analysis indicates there are no problems with the bearings or rotating elements (i.e., imbalance or misalignment). TVA's request is restricted to those frequencies that exhibit the natural resonance vibration levels. The results and evaluation of TVA's spectral analysis were provided in the original relief request during the second ten year interval.

Pump/System Design: The RHR system pumps for SQN are the typical design for more recent Westinghouse four loop plants, which are centrifugal pumps with the motor in the vertical position. There is no typical bearing housing(s) associated with these pumps as there are with centrifugal pumps where the pump and the driver are in the horizontal position. The pump and motor utilize one continuous shaft. There is no coupling located along the shaft and all of the bearings for the pump/motor assembly are located in the motor. Although mounted vertically, these pumps are not vertical line shaft pumps. Two motor designs exists for this application with different bearing arrangements. In one design the bearing located in the upper motor housing acts as a thrust and upper radial bearing while the lower bearing is a radial bearing. In the other pump/motor design, the lower motor housing bearing acts as the thrust and lower radial bearing while the upper bearing is a radial bearing.

The pump support is designed to support the pump and the motor which rests on top of the pump. The motor is unrestrained and is in effect a large moment arm. The bearings for this pump are within the motor.

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Pump Relief Request - RP-06

RHR Pump Vibration Measurements

Compliance with ASME ISTB: The natural system frequency of 10 to 11 Hz exhibits sufficient force such that when measurements are taken during quarterly pump testing at the upper motor bearing, the vibration readings are outside of the OM Code acceptable range limits. When applying the OM Code criteria, the vibration limits will place the pump consistently in the "Alert Range" or the "Required Action Range."

SQN originally took a literal reading of OM Part 6 wording to determine if vibration testing is required for the RHR pumps. Since the bearings are part of the motor (i.e., pump driver), these vibration points were not included in SQN's IST program. Following a self-assessment of SQN's IST program, TVA determined that this is not the most conservative position. SQN now evaluates these measurements in accordance with ISTB acceptance criteria for pump vibration.

Plant Operation and Pump Vibration History: Prior to initial operation of either unit, a nonconformance report was written which identified a natural frequency of the RHR pumps of 10 to 11 Hz . At the time, the seismic qualification of the pump had been performed based upon no natural frequencies below 33 Hz . The safety implication was that the RHR pumps did not meet their design basis for seismic qualification. This was reported to the NRC . TVA performed design changes and reanalysis of the pump support structure and piping system to qualify the 10 to 11 Hz natural frequency condition. Westinghouse Electric Company reviewed and approved the changes.

Both units were shut down for approximately three years beginning in 1985. Both units remained on RHR at shut down cooling flow conditions (greater than 2,000 gallons per minute [gpm]) in order to maintain the RCS in accordance with the Technical Specifications. During this time, there were no problems with the RHR pumps. The pumps operated continuously with no adverse conditions identified.

Both units at SQN were again shut down in 1993 for approximately one year. During this time, both units remained on RHR with the pumps operating at full flow conditions. The pumps operated continuously with no adverse conditions identified.

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Pump Relief Request - RP-06

RHR Pump Vibration Measurements

Advanced Vibration Diagnostics: SQN has performed advanced vibration diagnostics to assess the condition on all four RHR pumps. The same 10 to 11 Hz natural frequency identified in the late 1970's was identified again.

Impact testing was performed on all four RHR pump/motor assemblies. The testing revealed the following data:

Pump ID	Natural Frequency of Motor Alone	Natural Frequency of Motor and Frame [1]
1A	14 to 16 Hz	120 to 350 Hz
1B	11 Hz	175 to 331 Hz
2A	10 Hz	287 to 356 Hz
2B	11 to 13 Hz	100 to 350 Hz

[1]Based on location on the frame.

For the 1B and 2A RHR pump motors, this data confirms the previous evaluation that a resonant condition exists at 10 and 11 Hz, respectively. The testing revealed that the motor upper bearing exhibited natural frequencies at approximately 10 and 11 Hz, respectively, which is coincident with the maximum amplitude vibration measurement for the same point found during OM Code quarterly pump testing.

The testing performed on the 1A RHR pump motor revealed a 14 to 16 Hz response frequency range on the motor and the motor/support frame frequency response is between 120 and 350 Hz . The overall vibration levels on 1A RHR pump are stable and below the alert range. However, the vibration occurring at the 14 Hz frequency is contributing to the overall levels.

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Pump Relief Request - RP-06

RHR Pump Vibration Measurements

The testing performed on the 2B RHR pump motor revealed a 11 to 13 Hz response frequency range on the motor and the motor support/frame frequency response is between 100 and 350 Hz . The overall vibration levels on 2B RHR pump are stable and below alert range. However, the vibration occurring at the 11 Hz frequency is contributing to the overall levels.

ISTB Group A pump testing is performed with the pump operating on miniflow, approximately 500 gpm. The pump operation flow characteristics create low frequency flow pulsations which tend to excite the structural resonant frequencies of the machine assembly. Spectra analysis of vibration data collected during pump testing activities indicates a dominant peak between 10 to 14 Hz for all RHR pump motors. To improve the vibration would require separating the low natural frequencies away from the operating frequency of 29.8 Hz. Physical modifications to drive the natural frequency up beyond 30 Hz (greater than 15 percent of operating frequency as a rule of thumb) can be unpredictable and difficult even when performed with detailed analysis. Efforts at other plants have been unsuccessful due to shifting the vibration to adjacent components such as the pump or piping.

Full Flow Testing: Near full flow vibration data obtained during refueling outages shows that the vibration is greatly reduced at near full flow conditions. This indicates that the higher test measurements occur only during the quarterly tests, which are conducted with the RHR pumps on miniflow. The pumps are designed to run at full-flow conditions for normal plant operations and for accident conditions. Thus, the minimum flow test configuration causes the motor structure to be excited and a higher vibration to be present during the quarterly pump tests.

This testing supports the expected results identified by Westinghouse in Technical Bulletin NSID-TB-86-02.

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Pump Relief Request - RP-06

RHR Pump Vibration Measurements

Civil/Structural Evaluations: TVA originally modeled the pump and its support as a rigid anchor. During the reanalysis discussed above, the pump and its support were modeled as a flexible member. The results of this analysis confirmed that the measured natural frequency of approximately 10 to 11 Hz was a system frequency, i.e., pump, pump support, and piping. The reanalysis changed the nozzle loads on the pump and on local pipe supports to meet the new support loads. The pump support was also stiffened, incidental to the vibration problem.

A Civil Engineering review has been performed on the results of the advanced vibration diagnostics with respect to the problem described above. The review determined that the new measurements reflect the problem identified during initial system operation and is not a new vibration problem. Based upon this analysis, the pump and its structure continue to meet the design requirements for acceptable operation.

ISI Examinations of the Piping and Supports: A review of ISI examinations of pipe welds and pipe supports in the area surrounding the pumps was performed. Of the examinations in this area which did not meet the acceptance criteria, all of them were minor indications and are characterized as typical indications found during inservice examinations following the completion of construction activities. No failures were associated with any of these indications. None of the indications could be characterized as defects due to pump vibration.

No further indications have been identified. The issues found by in-service examination are indicative that the vibration problems are a natural frequency of the system and not a destructive vibration force.

Alternative Testing: Vibration measurements of the upper motor bearing of the RHR pumps will be taken during the ISTB Group A pump tests in a range from one-half minimum pump shaft rotational speed to at least 1000 Hz.

Appendix A
(Page 20 of 20)

Pump Relief Request - RP-06

RHR Pump Vibration Measurements

Conclusion:

SQN proposes to exclude from the ISTB Group A pump test the vibration measurement in the range from one-third up to one-half pump shaft rotational speed. The exclusion of vibration measurements from one-third to one-half minimum pump shaft rotational speed will exclude the readings associated with the natural frequencies as described above. It has been shown that these frequencies do not affect pump performance. Excluding this range of vibration for test measurements would prevent placing the pumps in an "Increased Frequency" test status. Placing SQN's RHR pumps on an increase frequency test status provides no added value for monitoring pump performance. The dominant peak at one-third running speed masks data trending at the frequencies that represent actual pump/motor health. This places an unnecessary burden on SQN resources and of having to place the pumps on an increased frequency for testing resulting in additional wear on the equipment and potential challenges to the plant. Pump degradation due to real physical problems, will be evident with the pump test monitoring the representative pump/motor condition frequencies without being masked by the unrelated structural resonant peak. This will ensure appropriate corrective actions are taken to address those levels of vibration that could result in pump degradation.

Based upon the above, SQN concludes that the pumps operate acceptably and will perform their safety function as required during normal and accident conditions.

This relief request was approved during SQN's second 10-year IST Program interval by TAC NOS. MA7966 and MA7967. No changes in Code requirements have occurred affecting this relief request.

Appendix B
(Page 1 of 4)

ASME IST PUMP TEST PROGRAM

Summary of Information Provided:

The pump test table provides the following information on testing requirements:

1. Pump ID.
2. Pump Group.
3. Drawing on which the pump is depicted.
4. ASME Class.
5. Pump Type.
6. Differential Pressure.
7. Flow Rate.
8. Vibration Velocity.

General Notes:

1 Quarterly testing in accordance with the requirements of the OM Code is indicated by "Q", otherwise it is addressed in specific notes as indicated.

2 TVA Calculation SQN-SQTP-002 provides the basis for selection of pumps to be tested, their unique identification numbers, TVA Class, and basis for testing

3. RP refers to the associated relief request.

Specific Notes:

1.	Synchronous or induction motor driven pumps do not require speed check per Table ISTB-3000-1.
2.	RHR Suction and Discharge pressure gauge range requirements are selected based on the RHR suction and discharge pressures present at the time of testing (i.e. 3 times the referenced value). This is due to the significant variation in RHR suction pressures in the various plant modes.
3.	ERCW pump and ERCW screen wash pump suction pressure is derived in the pump test record from the elevation of Chickamauga Lake as allowed by Section 5.5.3 of NUREG-1482, Revision 1 and the OM Code.
4.	The SI and RHR recirculation miniflow test paths are fixed resistance flow paths.

Appendix B
(Page 2 of 4)

Pump ID	Pump Group	P&ID 47W	ASME Code Class	Pump Type	Diff Press Dp CPT Q		Flow Rate Q CPT		Vib (Vel) Q CPT		Pump Speed	Relief Requests & Technical Positions
Auxiliary Feed Water (Motor) 1A-A, 1B-B 2A-A, 2B-B	A	803-2	3	Centrifugal	Q	2Y	Q	2Y	Q	2Y	NR	4, 5
Auxiliary Feed Water (Steam) 1A-S, 2A-S	B	803-2	3	Centrifugal	Q	2Y	Q	2Y	NR	2Y	Q	4, 5
Centrifugal Charging 1A-A, 1B-B 2A-A, 2B-B	A	811-1	2	Centrifugal	Q	2Y	Q	2Y	Q	2Y	NR	4, 5
Boric Acid Transfer 1A-A, 1B-B 2A-A, 2B-B	A	809-5	3	Centrifugal	Q	2Y	Q	2Y	Q	2Y	NR	3, 4, 5

Appendix B
(Page 3 of 4)

Pump ID	Pump Group	P&ID 47W	ASME Code Class	Pump Type	Diff Press Dp CPT Q		Flow Rate Q CPT		Vib (Vel) Q CPT		Pump Speed	Relief Requests & Technical Positions
Safety Injection 1A-A, 1B-B 2A-A, 2B-B	B	811-1	2	Centrifugal	Q	2Y	Q	2Y	NR	2Y	NR	4, 5
Component Cooling 1A-A, 1B-B 2A-A, 2B-B C-S	A	859-1	3	Centrifugal	Q	2Y	Q	2Y	Q	2Y	NR	4, 5
Containment Spray 1A-A, 1B-B 2A-A, 2B-B	B	812-1	2	Centrifugal	Q	2Y	Q	2Y	NR	2Y	NR	4, 5

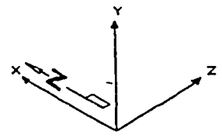
Appendix B
(Page 4 of 4)

Pump ID	Pump Group	P&ID 47W	ASME Code Class	Pump Type	Diff Press Dp CPT Q		Flow Rate Q CPT		Vib (Vel) Q CPT		Pump Speed	Relief Requests & Technical Positions
Residual Heat Removal 1A-A, 1B-B 2A-A, 2B-B	A	810-1	2	Centrifugal	Q	2Y	Q	2Y	Q	2Y	NR	2, 4, 5, 6
Essential Raw Cooling Water J-A, K-A, L-B, M-B, N-B, P-B, Q-A, R-A	A	845-5	3	Vertical Line Shaft	Q	2Y	Q	2Y	Q	2Y	NR	4, 5
ERCW Screen Wash A-A, B-B D-A, C-B	A	845-5	3	Vertical Line Shaft	Q	2Y	Q	2Y	Q	2Y	NR	1, 4, 5
Chilled Water A-A, B-B	A	865-8	3	Centrifugal	Q	2Y	Q	2Y	Q	2Y	NR	4, 5

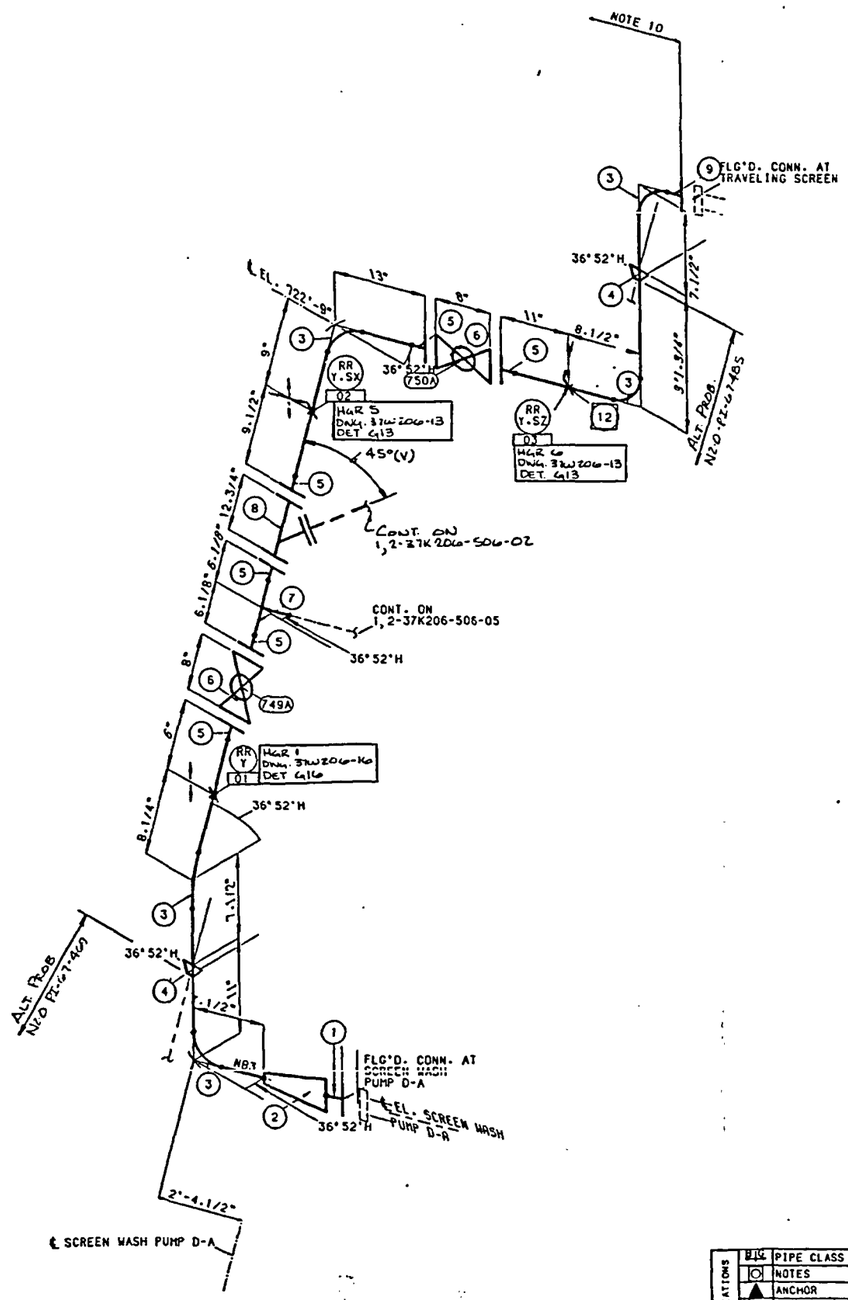
ENCLOSURE 3

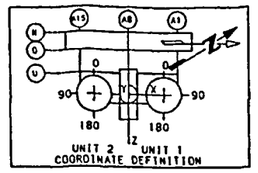
TENNESSEE VALLEY AUTHORITY (TVA)
SEQUOYAH NUCLEAR PLANT (SQN)

Isometric Drawing and Photographs



NOTES (CONT.)
10. CLASS C PIPING SUPPORTED TO CLASS C REQUIREMENTS.
11. UNLESS OTHERWISE NOTED, LOCAL COORDINATE SYSTEM IS AS FOLLOWS: SX IS PERPENDICULAR TO PIPE AXIS; AND Y IS UP.
12. SZ IS PERPENDICULAR TO PIPE AXIS AND Y IS UP.
13. FOR CROSS REFERENCE BETWEEN PREVIOUS CONSTRUCTION IDENTIFIER AND SUPPORT NUMBER SHOWN.SEE TABLE ON THIS SHEET.





SUPPORT NO. CROSS REF TABLE	
SUPPORT NO. 37B206-506-	CONSTRUCTION IDENTIFIER
01	*
02	*
03	*
04	*
05	*
06	*
07	NOT USED
08	2-ERCW-297-2
09	2-ERCW-297-1
10	*
11	*
12	*
13	*
14	*
15	*
16	2-ERCW-300-1

* ENG'D SUPPORT NO. NOTED ON ISO

ITEM	DESCRIPTION
3	3IN SCH40 BEVLD C-WELDED PIPE CS A106-GRB
7	3IN SCH40 B-W L-R-90DEG ELBOW CS A234-GRWPB
2	3IN SCH40 B-W EQUAL TEE CS A234-GRWPB
1	5IN*3IN 150LB PLAIN CONC RED. CS A105
5	5IN SCH40 150LB W-N R-F FLG CS A105
9	3IN SCH40 150LB W-N F-F FLG CS A105
4	4IN*3IN SCH40 150LB W-N R-F RED-FLG CS A105
8	8IN MAX*1/2IN 3000LB S-W SOCKOLET CS A105
6	3IN STRAINER MK NO. 37W206-19
	3IN 150LB FLGD-FF BALL VALVE CS

INSULATION THICKNESS & TYPE
1 1" FIBERGLASS W/AL. JKT
2 N/A
3 N/A
4 N/A
5 N/A

NOTES:
1. THIS DRAWING CONTROLS THE CONFIGURATION FOR THE FOLLOWING: -SUPPORT LOCATIONS. STRUCTURE TO WHICH ATTACHED
2. DASHED DIMENSION LINES. INSULATION IDENTIFIER HEXAGONS. PARENTHESES.BUBBLES.CLOUDS.ETC.INDICATE THE INFORMATION IS BASED ON DESIGN DRAWINGS AND IS NOT VERIFIED BY WALKDOWN.
3. DASHED LINES FOR PIPING OR FOR SUPPORT DESIGNATIONS INDICATE THAT THE PIPING OR SUPPORTS ARE "OUT OF FUNCTION" FOR THE PIPING ANALYSIS BUT ARE INCLUDED ON THIS DRAWING FOR INTERFACE REQUIREMENTS. THE CONFIGURATION FOR "OUT OF FUNCTION" PIPING AND SUPPORTS SHOWN ON THIS DRAWING IS CONTROLLED THE SAME AS FOR "IN FUNCTION" PIPING AND SUPPORTS.
4. VALVE TAG NOS ARE PRECEDED BY 0-67- EXCEPT AS NOTED.
5. SUPPORT DRAWING NOS ARE PRECEDED BY 37B206-506- EXCEPT AS NOTED.
6. SUPPORTS ARE ATTACHED TO THE ERCW EXCEPT AS NOTED.
7. PIPING IS LOW ENERGY EXCEPT AS NOTED.
8. DIMENSIONS TO COLUMN LINES. BUILDING RADII/AZIMUTHS AND ELEVATIONS ARE FOR REFERENCE ONLY.
9. WALKDOWN PER SM1-0-317-55

Typical Arrangement

DCN ORIGINAL

SYMBOLS & ABBREVIATIONS

	PIPE CLASS		
O	NOTES	ADCB	ADDITIONAL DCB
▲	ANCHOR	DCB	DIESEL GENERATOR BUILDING
CS	CONSTANT FORCE SUPPORT	IPS	INTAKE PUMPING STATION
DS	DYNAMIC SNUBBER	ERCW	ERCW PUMPING STATION
RR	RIGID RESTRAINT	ESVR	EAST STEAM VALVE ROOM
US	UNIDIRECTIONAL SUPPORT	AEB	ADDITIONAL EQPT BLDG
VS	VARIABLE SPRING SUPPORT	ACB	AUXILIARY CONTROL BLDG
⊙	SUPPORT DESIGNATION	SB	REACTOR BLDG-SHIELD BLDG
▭	SUPPORT DRAWING NUMBER	ICS	REACTOR BLDG-INT CONC STR

REFERENCES:
WALKDOWN PKGS: WO-N2-67-A-366PS
COMPANION DWGS: 1.2-37K206-506-02 THRU -05
BILL OF MATERIALS: 37M206 -SERIES
PHYSICAL DWGS: 37W206 -SERIES
FLOW DIAGRAMS: 47W845-5

ISSUED BY:

REV	ECN/DCN	CHG DOC	DRWN	CHKD	APPD	DATE
1	DCN 506123A	N/A	GM			11-26-90

REVISED PER THE REFERENCED CHANGE DOCUMENT.
INC: DCA 506123-29 RO.

SCALE: NOT TO SCALE EXCEPT AS NOTED

ERCW PUMPING STATION
UNIT COMMON

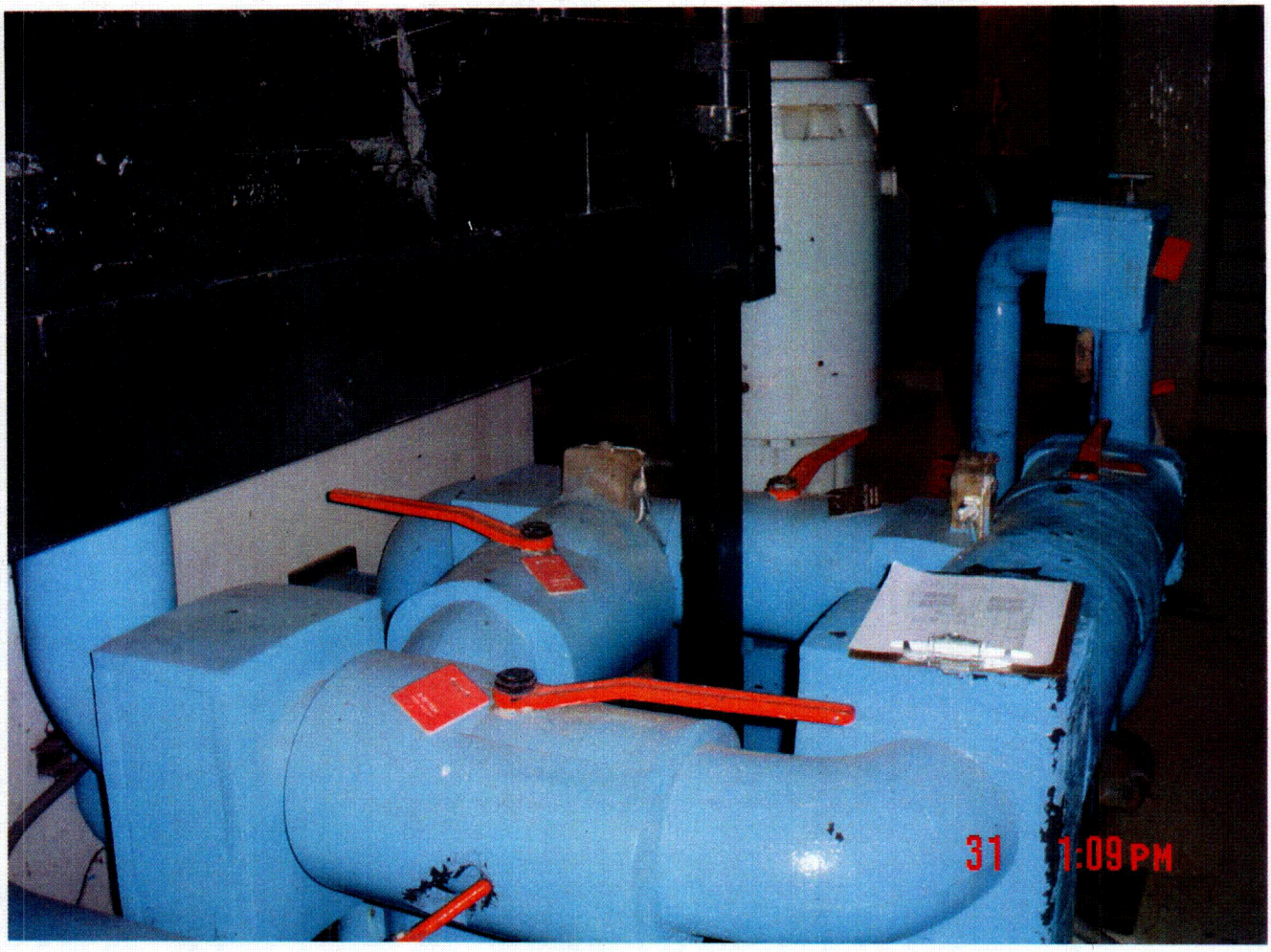
N2-67-A-366PS ISOMETRIC
ESSENTIAL RAW COOLING WATER SYSTEM CATEGORY 2

SEQUOYAH NUCLEAR PLANT
TENNESSEE VALLEY AUTHORITY

0

DESIGN		DISCIPLINE INTERFACE	ENGINEERING APPROVAL
DRAFTER MTS	CHECKER	INITIAL ISSUE - R 0	1
DESIGNER NA	REVIEWER	ISSUED PER ECN N/A CCD 10857 RIMS NO. B84 900228 017	2
DATE 3-8-90	AC-NONE AO-NONE		3

45 M 1.2-37K206-506-01 R1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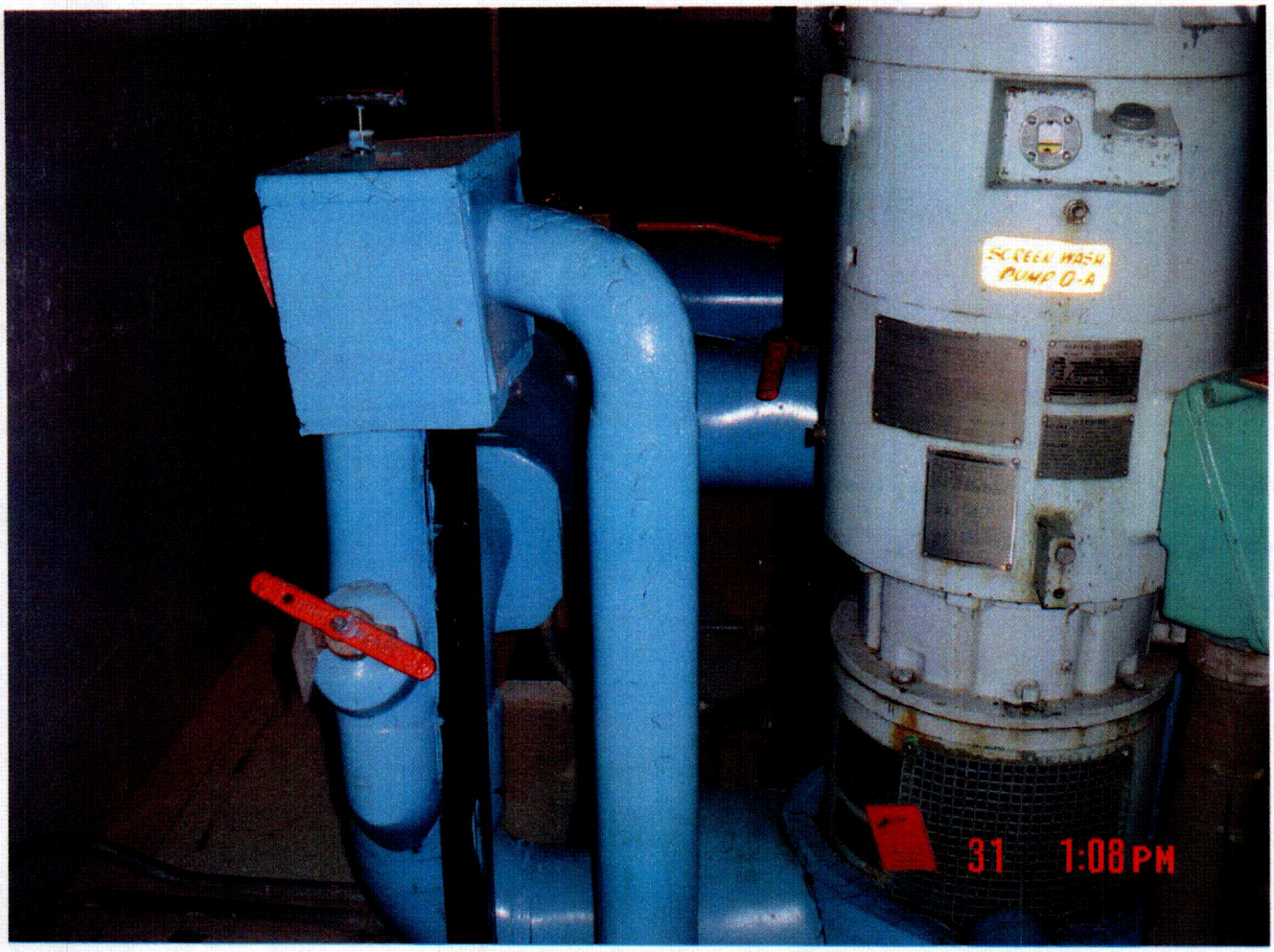
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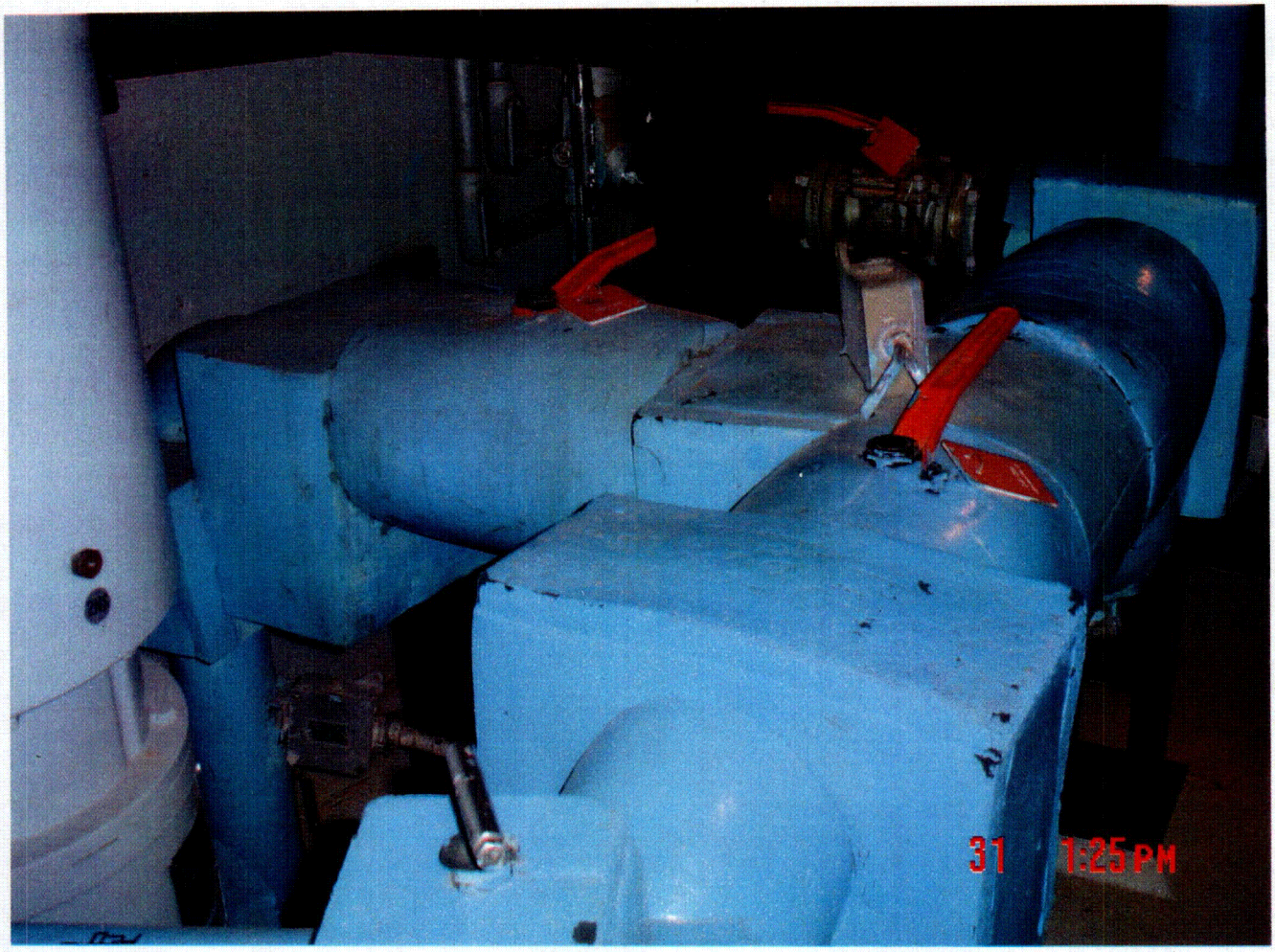
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