Tennessee Valley Authority, Post Office Box 2000, Soddy-Daisy, Tennessee 37379

November 15, 1999

10 CFR 50.50a(a)(3)(i)

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

Gentleman:

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

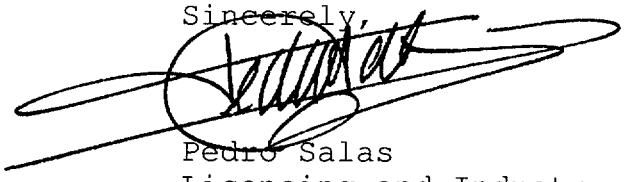
SEQUOYAH NUCLEAR PLANT (SQN) - REQUEST FOR APPROVAL OF RELIEF FROM AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME) CODE REQUIREMENTS - REQUEST FOR RELIEF RP-08 - RESIDUAL HEAT REMOVAL (RHR) PUMP VIBRATION MEASUREMENT

Enclosed is Request for Relief RP-08 for SQN's Second 10-Year Inservice Test Program. The proposed request for relief is applicable to SQN's RHR pumps and is associated with pump vibration measurement. TVA is submitting RP-08 pursuant to 10 CFR 50.55a(a)(3)(i) as a proposed alternative that would provide an acceptable level of quality and safety. The applicable sections of the ASME Code are contained in Operations and Maintenance Standard, Part 6 (OM-6), Paragraph 4.6.1.6. TVA's request for relief is similar to other utility requests described in Section 3.5 of NUREG/CR-6396, "Example, Clarifications, and Guidance on Preparing Requests for Relief from Pump and Valve Inservice Testing Requirements." Enclosure 1 provides the request for relief RP-08. Enclosure 2 provides the applicable sections of the ASME Code (OM-6).

A047

TVA is requesting NRC review and approval by June 2000 to support ongoing test activities associated with these pumps and to reduce the potential for unnecessary placement of RHR pumps on an increased frequency of testing. If you have any questions regarding this request, please contact me at extension (423) 843-7071 or Jim Smith at extension (423) 843-6672.

Sincerely,



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ENCLOSURE 1

TENNESSEE VALLEY AUTHORITY
SEQUOYAH NUCLEAR PLANT (SQN)
UNITS 1 AND 2
SECOND 10-YEAR INTERVAL
REQUEST FOR RELIEF NO. RP-08

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, Part 6 (OM-6). The provisions of OM-6 require the vibration measurements be taken in a frequency response 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). 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 and do not provide useful information for the assessment of pump performance and trending of pump vibration levels during quarterly pump tests.

This request for relief is submitted 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

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

Code Requirement: OM-6, Paragraph 4.6.1.6 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 vibration in the response range from one-third rotational speed up to one-half rotational speed.

Basis for Relief:

Background

The RHR system pumps for SQN are the typical design for 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. 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 Part 6 acceptable range limits. When applying the OM Part 6 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 the OM Part 6 acceptance criteria for pump vibration.

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.

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 contained 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 Part 6 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.

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.

Quarterly OM Part 6 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.

Vibration data obtained during full-flow testing shows that the vibration is greatly reduced. Values are, on the average, at 0.15 inches per second. This indicates that the higher measurements are obtained only during OM Part 6 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 reduced flow testing causes the motor structure to be excited and a higher vibration is present during the OM Part 6 quarterly pump tests only.

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

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 still 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: The vibration measurements of the upper motor bearing of the RHR pumps will be taken during the quarterly OM Part 6 pump test from one-half minimum pump shaft rotational speed to at least 1000 Hz.

Conclusion: SQN proposes to exclude from the OM Part 6 pump test the vibration measurement from the range of 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. By excluding this range of vibration measurements, this keeps SQN from placing the pumps in the "Alert Range" on a frequent basis when there is no real need or reason to do so. 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 of having to place the pumps on an increased frequency of testing resulting in additional wear on the equipment and potential challenges to the plant. If the pumps do start to degrade due to real physical problems, this will be more evident with the OM Part 6 pump test monitoring the representative pump/motor condition frequencies without being masked by the unrelated structural

resonant peak, and appropriate corrective actions will be taken.

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

Implementation of the proposed alternative is requested for SQN's second 10-year IST Program interval.

ENCLOSURE 2

ASME SECTION XI CODE

OPERATIONS AND MAINTAINENCE STANDARD

PART 6

(OM-6)

PART 6

(a)

Tables

PART 6
Inservice Testing of Pumps in Light-Water Reactor Power Plants

1 INTRODUCTION

1.1 Scope

This Part establishes the requirements for preservice and inservice testing to assess the operational readiness of certain centrifugal and positive displacement pumps used in nuclear power plants.

The pumps covered are those, provided with an emergency power source, which are required in shutting down a reactor to the cold shutdown condition, maintaining the cold shutdown condition, or mitigating the consequences of an accident.

This Part establishes test intervals, parameters to be measured and evaluated, acceptance criteria, corrective actions, and records requirements.

1.2 Exclusions

The following are excluded from this Part:

(*a*) drivers, except where the pump and driver form an integral unit and the pump bearings are in the driver;

(*b*) pumps that are supplied with emergency power solely for operating convenience.

1.3 Terminology

The following are provided to ensure a uniform understanding of select terms used in this Part.

inservice test — a test to determine the operational readiness of a pump

instrument accuracy — the allowable inaccuracy of an instrument loop based on the square root of the sum of the squares of the inaccuracies of each instrument or component in the loop

instrument loop — two or more instruments or components working together to provide a single output (e.g., a vibration probe and its associated signal conditioning and readout devices)

operational readiness — the ability of a pump to perform its intended function

preservice test period — the period of time following completion of construction activities related to the pump, and prior to first electrical generation by nuclear heat, in which component and system testing takes place

pump — a mechanical device used to move liquid

reference values — one or more values of test parameters measured or determined when the equipment is known to be operating acceptably

routine servicing — the performance of planned, preventive maintenance (e.g., replacing or adjusting valves in reciprocating pumps, changing oil, flushing the cooling system, adjusting packing, adding packing rings or mechanical seal maintenance or replacement)

system resistance — the hydraulic resistance to flow in a system

2 REFERENCE INFORMATION

2.1 Detection of Change

The hydraulic and mechanical condition of a pump relative to a previous condition can be determined by attempting to duplicate by test a set of reference values. Deviations detected are symptoms of changes and, depending upon the degree of deviation, indicate need for further tests or corrective action.

3 DESIGN REQUIREMENTS

3.1 Owner's Responsibility

(*a*) It is the Owner's responsibility to include in both the pump and plant design all necessary valving, instrumentation, test loops, required fluid inventory, or other provisions which are required to fully comply with the rules of this Part.

(*b*) Each pump to be tested in accordance with

the rules of this Part shall be identified by the Owner and listed in the plant records (see Section 7).

3.2 Bypass Loops

A bypass test loop may be used, provided the bypass is designed to recognize the pump manufacturer's operating conditions for minimum flow operation.

4 TESTING REQUIREMENTS

4.1 Preservice Testing

Each pump shall be tested during the preservice test period as required by this Part. This testing shall be conducted under conditions as near as practicable to those expected during subsequent inservice testing. Only one preservice test of each pump is required, except that the requirements of para. 4.4 shall be met.

4.2 Inservice Testing

Inservice testing in accordance with this Part shall commence when the pump(s) is required to be operable (see para. 1.1).

4.3 Reference Values

Reference values shall be determined from the results of preservice testing or from the results of the first inservice test. Reference values shall be at points of operation readily duplicated during subsequent tests. All subsequent test results shall be compared to these initial reference values or to new reference values established in accordance with paras. 4.4 and 4.5. Reference values shall only be established when the pump is known to be operating acceptably. If the particular parameter being measured or determined can be significantly influenced by other related conditions, then these conditions shall be analyzed.[1]

[1] Vibration measurements of pumps may be foundation, driver, and piping dependent. Therefore, if initial vibration readings are high and have no obvious relationship to the pump, then vibration measurements should be taken at the driver, at the foundation, and on the piping and analyzed to ensure that the reference vibration measurements are representative of the pump and that the measured vibration levels will not prevent the pump from fulfilling its function.

4.4 Effect of Pump Replacement, Repair, and Maintenance on Reference Values

When a reference value or set of values may have been affected by repair, replacement, or routine servicing of a pump, a new reference value or set of values shall be determined or the previous value reconfirmed by an inservice test run prior to declaring the pump operable. Deviations between the previous and new set of reference values shall be identified, and verification that the new values represent acceptable pump operation shall be placed in the record of tests (see Section 7).

4.5 To Establish an Additional Set of Reference Values

If it is necessary or desirable, for some reason other than stated in para. 4.4, to establish an additional set of reference values, an inservice test shall first be run at the conditions of an existing set of reference values and the results analyzed. If operation is acceptable per para. 6.1, a second test run at the new reference conditions shall follow as soon as practicable. The results of this test shall establish the additional set of reference values. Whenever an additional set of reference values is established, the reasons for so doing shall be justified and documented in the record of tests (see Section 7). The requirements of para. 4.3 apply.

4.6 Instrumentation

4.6.1 General

4.6.1.1 Quality. Instrument accuracy shall be within the limits of Table 1. Station instruments meeting these requirements are acceptable.

4.6.1.2 Range

(a) The full-scale range of each analog instrument shall be not greater than three times the reference value.

(b) Digital instruments shall be selected such that the reference value shall not exceed 70% of the calibrated range of the instrument.

(c) Vibration instruments are excluded from the range requirements of (a) and (b) above.

4.6.1.3 Instrument Location. The sensor location shall be established by the Owner, documented in the plant records (see Section 7), and shall be appropriate for the parameter being measured. The same location shall be used for subsequent tests. Instruments that are position

TABLE 1
ACCEPTABLE INSTRUMENT ACCURACY

Quantity	Percent [Note (1)]
Pressure	±2
Flow Rate	±2
Speed	±2
Vibration	±5
Differential Pressure	±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.

sensitive shall be either permanently mounted or provision shall be made to duplicate their position during each test.

4.6.1.4 Calibration. Instruments and instrument loops shall be calibrated in accordance with the Owner's quality assurance program. New or repaired instruments shall be calibrated prior to test use.

4.6.1.5 Fluctuations. Symmetrical damping devices or averaging techniques may be used to reduce instrument fluctuations. Hydraulic instruments may be damped by using gauge snubbers or by throttling small valves in instrument lines.

4.6.1.6 Frequency Response Range. 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.

4.6.2 Pressure Measurement

4.6.2.1 Gage Lines. If the presence or absence of liquid in a gage line could produce a difference of more than 0.25% in the indicated value of the measured pressure, means shall be provided to assure or determine the presence or absence of liquid as required for the static correction used.

4.6.2.2 Differential Pressure. When determining differential pressure across a pump, a differential pressure gauge, a differential pressure transmitter that provides direct measurement of pressure difference or the difference between the pressure at a point in the inlet pipe and the pressure at a point in the discharge pipe, may be used.

4.6.3 Rotational Speed Measurements. Rotational speed measurements of variable speed pumps shall be taken by a method which meets the requirements of para. 4.6.1.

4.6.4 Vibration Measurements

(a) On centrifugal pumps, measurements shall be taken in a plane approximately perpendicular to the rotating shaft in two orthogonal directions on each accessible pump bearing housing. Measurement also shall be taken in the axial direction on each accessible pump thrust bearing housing.

(*b*) On vertical line shaft pumps, measurements shall be taken on the upper motor bearing housing in three orthogonal directions, one of which is the axial direction.

(*c*) On reciprocating pumps, the location shall be on the bearing housing of the crankshaft, approximately perpendicular to both the crankshaft and the line of plunger travel.

(*d*) If a portable vibration indicator is used, the reference points must be clearly identified on the pump to permit subsequent duplication in both location and plane.

4.6.5 Flow Rate Measurement. When measuring flow rate, use 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.

5 TESTING METHODS

5.1 Frequency of Inservice Tests

An inservice test shall be run on each pump, nominally every 3 months, except as provided in paras. 5.3, 5.4, and 5.5.

5.2 Test Procedure

An inservice test shall be conducted with the pump operating at specified test reference conditions. The test parameters shown in Table 2 shall be determined and recorded as directed in this paragraph. The test shall be conducted as follows.

(a) The pump shall be operated at nominal motor speed for constant speed drives and at a speed adjusted to the reference speed for variable speed drives.

(*b*) The resistance of the system shall be varied until the flow rate equals the reference value. The pressure shall then be determined and compared

TABLE 2
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	
Vibration:	
Displacement, V_d	Peak-to-peak
Velocity, V_v	Peak

to its reference value. Alternatively, the flow rate can be varied until the pressure equals the reference value and the flow rate shall be determined and compared to the reference flow rate value.

(c) Where system resistance cannot be varied, flow rate and pressure shall be determined and compared to their respective reference values.

(d) Pressure, flow rate, and vibration (displacement or velocity) shall be determined and compared with corresponding reference values. All deviations from the reference values shall be compared with the limits given in Table 3 and corrective action taken as specified in para. 6.1.

Vibration measurements are to be broad band (unfiltered). If velocity measurements are used, they shall be peak. If displacement amplitudes are used, they shall be peak-to-peak.

5.3 Pumps in Regular Use

Pumps that are operated more frequently than every 3 months need not be run or stopped for a special test provided the plant records show each such pump was operated at least once every 3 months at the reference conditions, and the quantities specified were determined, recorded, and analyzed per Section 6.

5.4 Pumps in Systems Out of Service

For a pump in a system declared inoperable or not required to be operable, the test schedule need not be followed. Within 3 months prior to placing the system in an operable status, the pump shall be tested and the test schedule followed in accordance with the requirements of this Part. Pumps which can only be tested during plant operation shall be tested within 1 week following plant startup.

5.5 Pumps Lacking Required Fluid Inventory

Pumps lacking required fluid inventory, (e.g., pumps in dry sumps) need not be tested in accordance with this Part every 3 months. These pumps shall be tested at least once every 2 years except as provided in para. 5.4. The required fluid inventory shall be provided during this test.

5.6 Duration of Tests

After pump conditions are as stable as the system permits, each pump shall be run at least 2 min. At the end of this time at least one measurement or observation of each of the quantities required shall be made and recorded.

6 ANALYSES AND EVALUATION

6.1 Acceptance Criteria

If deviations fall within the alert range of Table 3, the frequency of testing specified in para. 5.1 shall be doubled until the cause of the deviation is determined and the condition corrected. If deviations fall within the required action range of Table 3, the pump shall be declared inoperable until the cause of the deviation has been determined and the condition corrected.

When a test shows deviations outside of the acceptable range of Table 3, the instruments involved may be recalibrated and the test rerun.

TABLE 3
RANGES FOR TEST PARAMETERS

TABLE 3a[1]

Pump Type	Pump Speed	Test Parameter	Acceptable Range	Alert Range	Required Action Range
Centrifugal and vertical line shaft [Note (2)]	<600 rpm	V_d or V_v	≤2.5 V_r	>2.5 V_r to 6 V_r or >10.5 mils	>6 V_r or >22 mils
Centrifugal and vertical line shaft [Note (2)]	≥600 rpm	V_v or V_d	≤2.5 V_r	>2.5 V_r to 6 V_r or >0.325 in./sec	>6 V_r or >0.70 in./sec
Reciprocating		V_d or V_v	≤2.5 V_r	>2.5 V_r to 6 V_r	>6 V_r

NOTES:
(1) Vibration parameter per Table 2. V_r is vibration reference value in the selected units.
(2) Refer to Fig. 1 to establish displacement limits for pumps with speeds ≥600 rpm or velocity limits for pumps with speeds <600 rpm.

see ERRATA (OMb-1989)

TABLE 3b

Test Parameter	Acceptable Range	Alert Range		Required Action Range	
		Low	High	Low	High
P (Positive displacement pumps)	0.93 to 1.10P_r	0.90 to <.93P_r	...	<0.90P_r	>1.10P_r
ΔP (Vertical line shaft pumps)	0.95 to 1.10ΔP_r	0.93 to <.95ΔP_r	...	<0.93ΔP_r	>1.10ΔP_r
Q (Positive displacement vertical line shaft pumps)	0.95 to 1.10Q_r	0.93 to <.95Q_r	...	<0.93Q_r	>1.10Q_r
ΔP (Centrifugal pumps)	0.90 to 1.10ΔP_r	...	...	<0.90ΔP_r	>1.10ΔP_r
Q (Centrifugal pumps)	0.90 to 1.10Q_r	...	...	<0.90Q_r	>1.10Q_r

GENERAL NOTE: The subscript r denotes reference value.

6.2 Time Allowed for Analysis of Tests

All test data shall be analyzed within 96 hr after completion of a test.

7 RECORDS AND REPORTS

7.1 Pump Records

The Owner shall maintain a record which shall include the following for each pump covered by this Part:

(a) the manufacturer and the manufacturer's model and serial or other identification number;

(b) a copy or summary of the manufacturer's acceptance test report if available;

(c) a copy of the pump manufacturer's operating limits.

7.2 Inservice Test Plans

The Owner shall maintain a record of test plans and procedures 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.

7.3 Record of Tests

The Owner shall maintain a record of each test 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*) comparisons with allowable ranges of test values and analysis of deviations;

(*g*) requirement for corrective action;

(*h*) evaluation and justification for changes to reference values;

(*i*) signature of the person or persons responsible for conducting and analyzing the test.

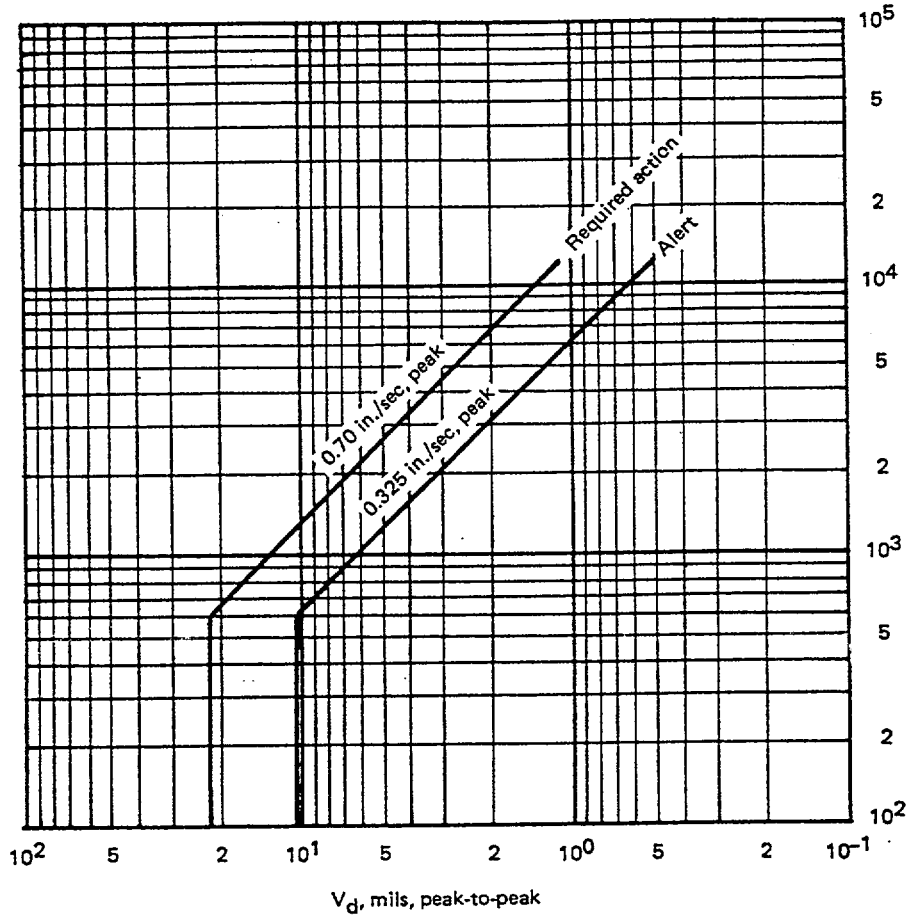
7.4 Record of Corrective Action

The Owner shall maintain records of corrective action which shall include a summary of the corrections made, the subsequent inservice tests and confirmation of operational adequacy (see para. 4.4), and the signature of the individual responsible for corrective action and verification of results.

OMb-1989

(b)

TABLE 3
RANGES FOR TEST PARAMETERS



added by errata

TABLE 3a[1]

Pump Type	Pump Speed	Test Parameter	Acceptable Range	Alert Range	Required Action Range
Centrifugal and vertical line shaft [Note (2)]	<600 rpm	V_d or V_v	≤2.5 V_r	>2.5 V_r to 6 V_r or >10.5 mils	>6 V_r or >22 mils
Centrifugal and vertical line shaft [Note (2)]	≥600 rpm	V_v or V_d	≤2.5 V_r	>2.5 V_r to 6 V_r or >0.325 in./sec	>6 V_r or >0.70 in./sec
Reciprocating		V_d or V_v	≤2.5 V_r	>2.5 V_r to 6 V_r	>6 V_r

(Table 3 continues on next page.)

(Notes follow at end of table.)