ASME OMa Code-2005

# Addenda to ASME OM Code-2004

## Code for Operation and Maintenance of Nuclear Power Plants

AN AMERICAN NATIONAL STANDARD

The American Society of Mechanical Engineers

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# ASME OMa CODE-2005

Following approval by the ASME Committee on Operation and Maintenance of Nuclear Power Plants and ASME, and after public review, ASME OMa Code-2005 was approved by the American National Standards Institute on July 8, 2005.

Addenda to ASME OM Code-2004 are issued in the form of replacement pages. Revisions, additions, and deletions are incorporated directly into the affected pages. It is advisable, however, that this page, the Addenda title and copyright pages, and all replaced pages be retained for reference.

## SUMMARY OF CHANGES

This is the first Addenda to be published to ASME OM Code-2004.

Replace or insert the pages listed. Changes given below are identified on the pages by a margin note, **(a)**, placed next to the affected area. Revisions introduced in ASME OM Code-2004 are indicated by **(04)**. The pages not listed are the reverse sides of the listed pages and contain no changes.

| *Page* | *Location* | *Change* |
|---|---|---|
| vi | Contents | Updated to reflect Addenda |
| 2 | ISTA-2000 | Definitions of *hydraulic snubbers* and *mechanical snubbers* revised |
| 15 | ISTB-9200 | In the first paragraph, cross-references revised |
| 17 | ISTC-3521(a) | Revised |
| 20 | ISTC-5115(b) | First cross-reference revised |
| 26–29 | ISTD-1520 | First sentence revised |
| | ISTD-1620 | Second sentence revised |
| | ISTD-1750 | Revised |
| | ISTD-2000 | Definitions of *defined test plan group (DTPG)* and *transient dynamic event failure* revised |
| | ISTD-4110 | Revised |
| | ISTD-4130 | Revised in its entirety |
| | ISTD-4131 | First sentence revised |
| | ISTD-4220 | Revised in its entirety |
| | ISTD-4233 | Last sentence revised |
| | ISTD-4250 | Revised in its entirety |
| | ISTD-4270 | Revised |
| 31 | ISTD-5271 | First paragraph revised |
| 33 | ISTD-5424(c) | Revised |



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| *Page* | *Location* | *Change* |
|---|---|---|
| 34 | ISTD-6300 | Title and paragraph revised |
| 62, 63 | F-2100 | Revised |
| | F-3100 | Revised |
| | F-3200 | Editorially revised |
| | F-3210 | Revised |
| | F-3300 | Revised |
| | F-3310 | Revised |
| | F-3320 | Revised |
| | F-4000 | Last line editorially revised |
| | F-5000 | Revised |
| 64, 65 | G-3000 | Revised |
| | G-3100 | Revised |
| | G-3200 | Revised |
| | G-3300 | Paragraph below equation revised |
| | G-4000 | (1) In G-4200, first paragraph revised<br>(2) G-4300 deleted and G-4400 redesignated as G-4300 and revised |
| 66 | H-3200 | Last sentence editorially revised |
| | H-3220 | Last sentence added |
| | H-3230 | Last sentence added |

**SPECIAL NOTE:**

The Interpretations to ASME OM Code issued between January 9, 2004 and June 20, 2005 and Code Case (OMN-7) affected by this supplement (OMa Code-2005) follow the last page of this Addenda as separate supplements.



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# CODE FOR OPERATION AND MAINTENANCE OF NUCLEAR POWER PLANTS

# SUBSECTION ISTA
# General Requirements

## ISTA-1000 INTRODUCTION

### ISTA-1100 Scope

Section IST establishes the requirements for preservice and inservice testing and examination of certain components to assess their operational readiness in light-water reactor nuclear power plants. It identifies the components subject to test or examination, responsibilities, methods, intervals, parameters to be measured and evaluated, criteria for evaluating the results, corrective action, personnel qualification, and record keeping. These requirements apply to

*(a)* pumps and valves that are required to perform a specific function in shutting down a reactor to the safe shutdown condition, in maintaining the safe shutdown condition, or in mitigating the consequences of an accident

*(b)* pressure relief devices that protect systems or portions of systems that perform one or more of these three functions

*(c)* dynamic restraints (snubbers) used in systems that perform one or more of these three functions, or to ensure the integrity of the reactor coolant pressure boundary

### ISTA-1200 Jurisdiction

The jurisdiction of Section IST covers individual components that have met all the requirements of the construction code commencing at the time when the construction code requirements have been met, irrespective of the physical location. When portions of systems or plants are completed at different times, the jurisdiction of this Section shall cover only those components on which all construction related to the components has been completed.

### ISTA-1300 Application

**ISTA-1310 Components Subject to Testing and Examination.** Components identified in Section IST for testing or examination shall be included in the test plan (ISTA-3110). These components include nuclear power plant items such as pumps, valves, and dynamic restraints (snubbers).

**ISTA-1320 Classifications.** Optional construction of a component in a system boundary to a classification higher than the minimum class established in the component Design Specification (either upgrading from Class 2 to Class 1 or Class 3 to Class 2) shall not affect the overall system classification by which the applicable requirements of Section IST are determined.

**Table ISTA-1400-1 Referenced Standards and Specifications**

| Standard or Specification | Revision Date or Indicator |
|---|---|
| ANSI/ASME NQA-1 | 1979 |
| PTC 25 | 1994 |
| API RP-527 | 3rd edition, 1991 |

### ISTA-1400 Referenced Standards and Specifications

When standards and specifications are referenced in Section IST, their revision date or indicator shall be as shown in Table ISTA-1400-1.

### ISTA-1500 Owner's Responsibilities

The responsibilities of the Owner of the nuclear power plant shall include the following:

*(a)* determination of the appropriate Code Class for each component of the plant, identification of the system boundaries for each class of components subject to test or examination, and the components exempt from testing or examination requirements

*(b)* design and arrangement of system components to include allowance for adequate access and clearances for conduct of the tests and examinations

*(c)* preparation of plans and schedules

*(d)* preparation of written test and examination instructions and procedures



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*(e)* qualification of personnel who perform and evaluate examinations and tests in accordance with the Owner's quality assurance program

*(f)* performance of required tests and examinations

*(g)* recording of required test and examination results that provide a basis for evaluation and facilitate comparison with the results of subsequent tests or examinations

*(h)* evaluation of tests and examination results

*(i)* maintenance of adequate test and examination records such as test and examination data and description of procedures used

*(j)* retention of all test and examination records for the service lifetime of the component or system

*(k)* documentation of a quality assurance program in accordance with either of the following:

*(1)* Title 10, Code of Federal Regulations, Part 50

*(2)* ASME NQA-1, Parts II and III

### ISTA-1600 Accessibility

Provisions for examination shall include access for the examination personnel and equipment necessary to conduct the test or examination.

## (a) ISTA-2000 DEFINITIONS

*equipment dynamic restraint (snubber):* device that provides restraint to a component or system during the sudden application of forces, but allows essentially free motion during thermal movement.

*examination:* observing, visual monitoring, or measuring to determine conformance to Owner-specified requirements.

*exercising:* demonstration based on direct visual or indirect positive indications that the moving parts of a component function.

*hydraulic snubbers:* dynamic restraint devices in which load is transmitted through a hydraulic fluid.

*inservice test:* test to assess the operational readiness of a system, structure, or component after first electrical generation by nuclear heat.

*instrument loop:* two or more instruments or components working together to provide a single output.

*instrument loop accuracy:* accuracy 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 when considered separately. Alternatively, the allowable inaccuracy of the instrument loop may be based on the output for a known input into the instrument loop.

*maintenance:* replacement of parts, adjustments, and similar actions that do not change the design (configuration and material) of an item.

*mechanical snubbers:* dynamic restraint devices in which load is transmitted entirely through mechanical components.

*modification:* alteration in the design of a system, structure, or component.

*monitoring:* continuous or periodic observation or measurement to ascertain the performance or obtain characteristics of a system, structure, or component.

*nonintrusive testing:* testing performed on a component without disassembly or disturbing the boundary of the component.

*obturator:* valve closure member (disk, gate, plug, etc.).

*operational readiness:* the ability of a component to perform its specified functions.

*overpressure protection:* the means by which components are protected from overpressure by the use of pressure-relieving devices or other design provisions as required by the BPV Code, Section III, or other applicable construction codes.

*Owner:* an organization owning or operating a facility where items are installed or used.

*performance testing:* a test to determine whether a system or component meets specified acceptance criteria.

*plant operation:* the conditions of startup, operation at power, hot standby, and reactor cooldown, as defined by plant technical specifications.

*preservice test:* test performed after completion of construction activities related to the component and before first electrical generation by nuclear heat, or in an operating plant, before the component is initially placed in service.

*preservice test period:* the period of time following completion of construction activities related to the component and before first electrical generation by nuclear heat, in which component and system testing takes place, or in an operating plant prior to the component being initially placed in service.

*pump:* a mechanical device used to move fluid.

*qualitative testing:* testing performed to establish parameters without determining the specific measure of the parameter.

*quantitative testing:* testing performed to establish the specific measure or limit of a parameter, such as that required to establish that a parameter is within a specified range.

*reference point:* a point of operation at which reference values are established and inservice test parameters are measured for comparison with applicable acceptance criteria.

*reference values:* one or more values of parameters as measured or determined when the equipment is known to be operating acceptably.



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### ISTB-6200 Corrective Action

*(a) Alert Range.* If the measured test parameter values fall within the alert range of Table ISTB-5121-1, Table ISTB-5221-1, Table ISTB-5321-1, or Table ISTB-5321-2, as applicable, the frequency of testing specified in ISTB-3400 shall be doubled until the cause of the deviation is determined and the condition is corrected.

*(b) Action Range.* If the measured test parameter values fall within the required action range of Table ISTB-5121-1, Table ISTB-5221-1, Table ISTB-5321-1, or Table ISTB-5321-2, as applicable, the pump shall be declared inoperable until either the cause of the deviation has been determined and the condition is corrected, or an analysis of the pump is performed and new reference values are established in accordance with ISTB-6200(c).

*(c) New Reference Values.* In cases where the pump's test parameters are within either the alert or required action ranges of Table ISTB-5121-1, Table ISTB-5221-1, Table ISTB-5321-1, or Table ISTB-5321-2, as applicable, and the pump's continued use at the changed values is supported by an analysis, a new set of reference values may be established. This analysis shall include verification of the pump's operational readiness. The analysis shall include both a pump level and a system level evaluation of operational readiness, the cause of the change in pump performance, and an evaluation of all trends indicated by available data. The results of this analysis shall be documented in the record of tests (See ISTB-9000).

### ISTB-6300 Systematic Error

When a test shows measured parameter values that fall outside of the acceptable range of Table ISTB-5121-1, Table ISTB-5221-1, Table ISTB-5321-1, or Table ISTB-5321-2, as applicable, that have resulted from an identified systematic error, such as improper system lineup or inaccurate instrumentation, the test shall be rerun after correcting the error.

### ISTB-6400 Analysis of Related Conditions

If the reference value of a particular parameter being measured or determined can be significantly influenced by other related conditions, then these conditions shall be analyzed[1] and documented in the record of tests (see ISTB-9000).

## ISTB-7000 RESERVED

## ISTB-8000 RESERVED

## ISTB-9000 RECORDS AND REPORTS

### ISTB-9100 Pump Records

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

*(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

### ISTB-9200 Test Plans (a)

In addition to the requirements of ISTA-3110 and ISTA-3160, the test plans and procedures shall include the following:

*(a)* category of each pump

*(b)* the hydraulic circuit to be used

*(c)* the location and type of measurement for the required test parameters

*(d)* the method of determining test parameter values that are not directly measured by instrumentation

### ISTB-9300 Record of Tests

See ISTA-9230.

### ISTB-9400 Record of Corrective Action

See ISTA-9240.

[1] Vibration measurements of pumps may be foundation, driver, or 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 the measured vibration levels will not prevent the pump from fulfilling its function.



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# SUBSECTION ISTC
# Inservice Testing of Valves in Light-Water Reactor Nuclear Power Plants

## ISTC-1000 INTRODUCTION

### ISTC-1100 Applicability

The requirements of this Subsection apply to certain valves and pressure relief devices (and their actuating and position-indicating systems).

### ISTC-1200 Exemptions

The following are excluded from this Subsection, provided that the valves are not required to perform a specific function as described in ISTA-1100:

*(a)* valves used only for operating convenience such as vent, drain, instrument, and test valves

*(b)* valves used only for system control, such as pressure regulating valves

*(c)* valves used only for system or component maintenance

Skid-mounted valves are excluded from this Subsection, provided they are tested as part of the major component and are justified by the Owner to be adequately tested.

External control and protection systems responsible for sensing plant conditions and providing signals for valve operation are excluded from the requirements of this Subsection.

Category A and Category B safety and relief valves are excluded from the requirements of ISTC-3700, Valve Position Verification and ISTC-3500, Valve Testing Requirements.

Nonreclosing pressure relief devices (rupture disks) used in BWR Scram Accumulators are excluded from the requirements of this Subsection.

### ISTC-1300 Valve Categories

Valves within the scope of this Subsection shall be placed in one or more of the following categories. When more than one distinguishing category characteristic is applicable, all requirements of each of the individual categories are applicable, although duplication or repetition of common testing requirements is not necessary.

*(a) Category A:* valves for which seat leakage is limited to a specific maximum amount in the closed position for fulfillment of their required function(s), as specified in ISTA-1100.

*(b) Category B:* valves for which seat leakage in the closed position is inconsequential for fulfillment of the required function(s), as specified in ISTA-1100.

*(c) Category C:* valves that are self-actuating in response to some system characteristic, such as pressure (relief valves) or flow direction (check valves) for fulfillment of the required function(s), as specified in ISTA-1100.

*(d) Category D:* valves that are actuated by an energy source capable of only one operation, such as rupture disks or explosively actuated valves.

### ISTC-1400 Owner's Responsibility

In addition to the requirements of ISTA-1500, it is the Owner's responsibility to

*(a)* include in the plant design all necessary instrumentation, test connections, flow instruments, or any other provisions that are required to fully comply with the requirements of this Subsection.

*(b)* categorize (see ISTC-1300), and list in the plant records (see ISTC-9000) each valve to be tested in accordance with the rules of this Subsection, including Owner-specified acceptance criteria. The Owner shall specify test conditions.

*(c)* ensure that the application, method, and capability of each nonintrusive technique is qualified.

## ISTC-2000 SUPPLEMENTAL DEFINITIONS

The following are provided to ensure a uniform understanding of selected terms used in this Subsection:

*full-stroke time:* the time interval from initiation of the actuating signal to the indication of the end of the operating stroke

*power-operated relief valve (PORV):* a power-operated valve that can perform a pressure-relieving function and is remotely actuated by either a signal from a pressure-sensing device or a control switch. A power-operated relief valve is not capacity certified under ASME Section III overpressure protection requirements.

*reactor coolant system pressure isolation:* that function that prevents intersystem overpressurization between the reactor coolant system and connected low pressure systems.



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## ISTC-3000 GENERAL TESTING REQUIREMENTS

### ISTC-3100 Preservice Testing

Each valve shall be tested during the preservice test period as required by this Subsection. These tests shall be conducted under conditions as near as practicable to those expected during subsequent inservice testing. Only one preservice test of each valve is required with these exceptions.

*(a)* Any valve that has undergone maintenance that could affect its performance after the preservice test shall be tested in accordance with ISTC-3310.

*(b)* Safety and relief valves and nonreclosing pressure relief devices shall meet the preservice test requirements of Mandatory Appendix I.

### ISTC-3200 Inservice Testing

Inservice testing in accordance with this Subsection shall commence when the valves are required to be operable to fulfill their required function(s) (see ISTA-1100).

### ISTC-3300 Reference Values

Reference values shall be determined from the results of preservice testing or from the results of inservice testing. These tests shall be performed under conditions as near as practicable to those expected during subsequent inservice testing.

Reference values shall be established only when the valve is known to be operating acceptably. If the particular parameter being measured can be significantly influenced by other related conditions, then these conditions shall be analyzed.

**ISTC-3310 Effects of Valve Repair, Replacement, or Maintenance on Reference Values.** When a valve or its control system has been replaced, repaired, or has undergone maintenance[1] that could affect the valve's performance, a new reference value shall be determined or the previous value reconfirmed by an inservice test run before the time it is returned to service or immediately if not removed from service. This test is to demonstrate that performance parameters that could be affected by the replacement, repair, or maintenance are within acceptable limits. Deviations between the previous and new reference values shall be identified and analyzed. Verification that the new values represent acceptable operation shall be documented in the record of tests (see ISTC-9120). Safety and relief valves and nonreclosing pressure relief devices shall be tested as required by the replacement, repair, and maintenance requirements of Mandatory Appendix I.

[1] Adjustment of stem packing, limit switches, or control system valves, and removal of the bonnet, stem assembly, actuator, obturator, or control system components are examples of maintenance that could affect valve performance parameters.

**ISTC-3320 Establishment of Additional Set of Reference Values.** If it is necessary or desirable for some reason, other than stated in ISTC-3310, to establish additional reference values, an inservice test shall first be run at the conditions of an existing set of reference values, or, if impractical, at the conditions for which the new reference values are required, and the results analyzed. If operation is acceptable in accordance with the applicable requirements of ISTC-5100, a second test shall be performed under the new conditions as soon as practicable. The results of the second test shall establish the additional reference values. Whenever additional reference values are established, the reasons for doing so shall be justified and documented in the record of tests (see ISTC-9120).

### ISTC-3400 Reserved

### ISTC-3500 Valve Testing Requirements

Active and passive valves in the categories defined in ISTC-1300 shall be tested in accordance with the paragraphs specified in Table ISTC-3500-1 and the applicable requirements of ISTC-5100 and ISTC-5200.

**ISTC-3510 Exercising Test Frequency.** Active Category A, Category B, and Category C check valves shall be exercised nominally every 3 months, except as provided by ISTC-3520, ISTC-3540, ISTC-3550, ISTC-3570, ISTC-5221, and ISTC-5222. Power-operated relief valves shall be exercise tested once per fuel cycle.

### ISTC-3520 Exercising Requirements

**ISTC-3521 Category A and Category B Valves.** Category A and Category B valves shall be tested as follows:

*(a)* full-stroke exercising of Category A and Category B valves during operation at power to the position(s) required to fulfill its function(s). (a)

*(b)* if full-stroke exercising during operation at power is not practicable, it may be limited to part-stroke during operation at power and full-stroke during cold shutdowns.

*(c)* if exercising is not practicable during operation at power, it may be limited to full-stroke exercising during cold shutdowns.

*(d)* if exercising is not practicable during operation at power and full-stroke during cold shutdowns is also not practicable, it may be limited to part-stroke during cold shutdowns, and full-stroke during refueling outages.

*(e)* if exercising is not practicable during operation at power or cold shutdowns, it may be limited to full-stroke during refueling outages.

*(f)* valves full-stroke exercised at cold shutdowns shall be exercised during each cold shutdown, except as specified in ISTC-3521(g). Such exercise is not required if



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**Table ISTC-3500-1 Inservice Test Requirements**

| Category (See ISTC-1300) | Valve Function | Leakage Test Procedure and Frequency | Exercise Test Procedure and Frequency | Special Test Procedure [Note (1)] | Position Indication Verification and Frequency |
|---|---|---|---|---|---|
| A | Active | See ISTC-3600 | See ISTC-3510 | None | See ISTC-3700 |
| A | Passive | See ISTC-3600 | None | None | See ISTC-3700 |
| B | Active | None | See ISTC-3510 | None | See ISTC-3700 |
| B | Passive | None | None | None | See ISTC-3700 |
| C (Safety and relief) [Note (3)] | Active | None [Notes (2), (3)] | See ISTC-5230, ISTC-5240 | None | See ISTC-3700 |
| C (Check) [Note (4)] | Active | None [Note (3)] | See ISTC-3510 | None | See ISTC-3700 |
| D | Active | None [None (3)] | None | See ISTC-5250, ISTC-5260 | None |

NOTES:
(1) Note additional requirement for fail-safe valves, ISTC-3560.
(2) Leak test as required for Mandatory Appendix I.
(3) When more than one distinguishing category characteristic is applicable, all requirements of each of the individual categories are applicable, although duplication or repetition of common testing requirements is not necessary.
(4) If a check valve used for a pressure relief device is capacity certified, then it shall be classified as a pressure or vacuum relief device. If a check valve used to limit pressure is not capacity certified, then it shall be classified as a check valve.

the time period since the previous full-stroke exercise is less than 3 months. During extended shutdowns, valves that are required to perform their intended function (see ISTA-1100) shall be exercised every 3 months, if practicable.

*(g)* valve exercising during cold shutdown shall commence within 48 hr of achieving cold shutdown and continue until all testing is complete or the plant is ready to return to operation at power. For extended outages, testing need not be commenced in 48 hr, provided all valves required to be tested during cold shutdown will be tested before or as part of plant startup. However, it is not the intent of this Subsection to keep the plant in cold shutdown to complete cold shutdown testing.

*(h)* all valve testing required to be performed during a refueling outage shall be completed before returning the plant to operation at power.

**ISTC-3522 Category C Check Valves.** Category C check valves shall be exercised as follows:

*(a)* During operation at power, each check valve shall be exercised or examined in a manner that verifies obturator travel by using the methods in ISTC-5221.

Each check valve exercise test shall include open and close tests. Open and close tests need only be performed at an interval when it is practicable to perform both tests. Test order (e.g., whether the open test precedes the close test) shall be determined by the Owner. Open and close tests are not required to be performed at the same time if they are both performed within the same interval.

*(b)* If exercising is not practicable during operation at power, it shall be performed during cold shutdowns.

*(c)* If exercising is not practicable during operation at power and cold shutdowns, it shall be performed during refueling outages.

*(d)* Valves exercised at shutdowns shall be exercised during each shutdown, except as specified in ISTC-3522(e). Such exercise is not required if the interval since the previous exercise is less than 3 months. During extended shutdowns, valves that are required to perform their intended function (see ISTA-1100) shall be exercised every 3 months, if practicable.

*(e)* Valve exercising shall commence within 48 hr of achieving cold shutdown and continue until all testing is complete or the plant is ready to return to operation at power. For extended outages, testing need not be commenced in 48 hr if all valves required to be tested during cold shutdown will be tested before or as part of plant start-up. However, it is not the intent of this Subsection to keep the plant in cold shutdown to complete cold shutdown testing.

*(f)* All valve testing required to be performed during a refueling outage shall be completed before returning the plant to operation at power.

**ISTC-3530 Valve Obturator Movement.** The necessary valve obturator movement shall be determined by exercising the valve while observing an appropriate indicator, such as indicating lights that signal the required changes of obturator position, or by observing other evidence, such as changes in system pressure, flow rate, level, or temperature, that reflects change of obturator position.

**ISTC-3540 Manual Valves.** Manual valves shall be full-stroke exercised at least once every 5 years, except



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where adverse conditions[2] may require the valve to be tested more frequently to ensure operational readiness. Any increased testing frequency shall be specified by the Owner. The valve shall exhibit the required change of obturator position.

**ISTC-3550 Valves in Regular Use.** Valves that operate in the course of plant operation at a frequency that would satisfy the exercising requirements of this Subsection need not be additionally exercised, provided that the observations otherwise required for testing are made and analyzed during such operation and recorded in the plant record at intervals no greater than specified in ISTC-3510.

**ISTC-3560 Fail-Safe Valves.** Valves with fail-safe actuators shall be tested by observing the operation of the actuator upon loss of valve actuating power in accordance with the exercising frequency of ISTC-3510.

**ISTC-3570 Valves in Systems Out of Service.** For a valve in a system declared inoperable or not required to be operable, the exercising test schedule need not be followed. Within 3 months before placing the system in an operable status, the valves shall be exercised and the schedule followed in accordance with requirements of this Subsection.

## ISTC-3600 Leak Testing Requirements

**ISTC-3610 Scope of Seat Leakage Rate Test.** Category A valves shall be leakage tested, except that valves which function in the course of plant operation in a manner that demonstrates functionally adequate seat leak-tightness need not be additionally leakage tested. In such cases, the valve record shall provide the basis for the conclusion that operational observations constitute satisfactory demonstration.

(04) **ISTC-3620 Containment Isolation Valves.** Containment isolation valves with a leakage rate requirement based on Appendix J program commitment shall be tested in accordance with the Owner's 10 CFR 50, Appendix J program. Containment isolation valves with a leakage requirement based on other functions shall be tested in accordance with ISTC-3630. Examples of these other functions are reactor coolant system pressure isolation valves and certain Owner-defined system functions such as inventory preservation, system protection, or flooding protection.

(04) **ISTC-3630 Leakage Rate for Other Than Containment Isolation Valves.** Category A valves with a leakage requirement not based on an Owner's 10 CFR 50, Appendix J program, shall be tested to verify their seat leakages within acceptable limits. Valve closure before seat leakage testing shall be by using the valve operator with no additional closing force applied.

*(a) Frequency.* Tests shall be conducted at least once every 2 years.

*(b) Differential Test Pressure.* Valve seat tests shall be made with the pressure differential in the same direction as when the valve is performing its function, with the following exceptions:

*(1)* Globe-type valves may be tested with pressure under the seat.

*(2)* Butterfly valves may be tested in either direction, provided their seat construction is designed for sealing against pressure on either side.

*(3)* Double-disk gate valves may be tested by pressurizing between the disks.

*(4)* Leakage tests involving pressure differential lower than function pressure differentials are permitted in those types of valves in which service pressure will tend to diminish the overall leakage channel opening, as by pressing the disk into or onto the seat with greater force. Gate valves, check valves, and globe-type valves, having function pressure differential applied over the seat, are examples of valve applications satisfying this requirement. When leakage tests are made in such cases using pressures lower than function maximum pressure differential, the observed leakage shall be adjusted to the function maximum pressure differential value. The adjustment shall be made by calculation appropriate to the test media and the ratio between the test and function pressure differential, assuming leakage to be directly proportional to the pressure differential to the one-half power.

*(5)* Valves not qualifying for reduced pressure testing as defined above shall be tested at full maximum function pressure differential.

*(c) Seat Leakage Measurement.* Valve seat leakage shall be determined by one of the following methods:

*(1)* measuring leakage through a downstream telltale connection while maintaining test pressure on one side of the valve

*(2)* measuring the feed rate required to maintain test pressure in the test volume or between two seats of a gate valve, provided the total apparent leakage rate is charged to the valve or valve combination or gate valve seat being tested and the conditions required by ISTC-3630(b) are satisfied

*(3)* determining leakage by measuring pressure decay in the test volume, provided the total apparent leakage rate is charged to the valve or valve combination or gate valve seat being tested and the conditions required by ISTC-3630(b) are satisfied

*(d) Test Medium.* The test medium shall be specified by the Owner.

*(e) Analysis of Leakage Rates.* Leakage rate measurements shall be compared with the permissible leakage

[2] Harsh service environment, lubricant hardening, corrosive or sediment-laden process fluid, or degraded valve components are some examples of adverse conditions.



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rates specified by the plant Owner for a specific valve or valve combination. If leakage rates are not specified by the Owner, the following rates shall be permissible:

(1) for water, $0.5D$ gal/min ($12.4d$ ml/sec) or 5 gal/min (315 ml/sec), whichever is less, at function pressure differential

(2) for air, at function pressure differential, $7.5D$ standard $ft^3$/day ($58d$ std. cc/min)

where

$D$ = nominal valve size, in.
$d$ = nominal valve size, cm

(f) *Corrective Action.* Valves or valve combinations with leakage rates exceeding the valves specified by the Owner per ISTC-3630(e) shall be declared inoperable and either repaired or replaced. A retest demonstrating acceptable operation shall be performed following any required corrective action before the valve is returned to service.

### ISTC-3700 Position Verification Testing

Valves with remote position indicators shall be observed locally at least once every 2 years to verify that valve operation is accurately indicated. Where practicable, this local observation should be supplemented by other indications such as use of flowmeters or other suitable instrumentation to verify obturator position. These observations need not be concurrent. Where local observation is not possible, other indications shall be used for verification of valve operation.

### ISTC-3800 Instrumentation

Instrumentation accuracy shall be considered when establishing valve test acceptance criteria.

## ISTC-4000 RESERVED

## ISTC-5000 SPECIFIC TESTING REQUIREMENTS

### ISTC-5100 Power-Operated Valves (POVs)

All valves shall be tested in accordance with the applicable requirements of ISTC-3000, and as identified below.

**ISTC-5110 Power-Operated Relief Valves (PORVs).** Power-operated relief valves shall meet the requirements of ISTC-5100 for the specific Category B valve type and ISTC-5240 for Category C valves.

#### ISTC-5111 Valve Testing Requirements

(a) Testing shall be performed in the following sequence or concurrently. If testing in the following sequence is impractical, it may be performed out of sequence, and a justification shall be documented in the record of tests for each test or in the test plan:

(1) leakage testing
(2) stroke testing
(3) position indication testing

(b) The pressure-sensing device shall be calibrated in accordance with the Owner's quality assurance program.

**ISTC-5112 Leak Testing.** Seat tightness of the PORV shall be verified by leak testing in accordance with the requirements of Mandatory Appendix I.

#### ISTC-5113 Valve Stroke Testing

(a) Active valves shall have their stroke times measured when exercised in accordance with ISTC-3500.

(b) The limiting value(s) of full-stroke time of each valve shall be specified by the Owner.

(c) The stroke time of all valves shall be measured to at least the nearest second.

(d) Any abnormality or erratic action shall be recorded (see ISTC-9120) and an evaluation shall be made regarding need for corrective action.

(e) Stroke testing shall be performed during normal operating conditions for temperature and pressure if practicable.

**ISTC-5114 Stroke Test Acceptance Criteria.** Test results shall be compared to the reference values established in accordance with ISTC-3300, ISTC-3310, or ISTC-3320. (04)

(a) Valves with reference stroke times of greater than 10 sec shall exhibit no more than ±25% change in stroke time when compared to the reference value.

(b) Valves with reference stroke times of less than or equal to 10 sec shall exhibit no more than ±50% change in stroke time when compared to the reference value.

(c) Valves that stroke in less than 2 sec may be exempted from ISTC-5114(b). In such cases the maximum limiting stroke time shall be 2 sec.

#### ISTC-5115 Corrective Action (04)

(a) If a valve fails the applicable leak test acceptance criteria, to exhibit the required change of obturator position or exceeds the limiting values of full-stroke time [see ISTC-5113(b)], the valve shall be immediately declared inoperable.

(b) Valves with measured stroke times that do not meet the acceptance criteria of ISTC-5114 shall be immediately retested or declared inoperable. If the valve is retested and the second set of data also does not meet the acceptance criteria, the data shall be analyzed within 96 hr to verify that the new stroke time represents acceptable valve operation, or the valve shall be declared inoperable. If the second set of data meets the acceptance criteria, the cause of the initial deviation shall be analyzed and the results documented in the record of tests (see ISTC-9120). (a)

(c) Valves declared inoperable may be repaired, replaced, or the data may be analyzed to determine



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*(c)* preservice test results

*(d)* limiting value of full-stroke time specified in ISTC-5113(b), ISTC-5121(b), ISTC-5131(b), ISTC-5141(b), and ISTC-5151(b)

**ISTC-9120 Record of Tests.** See ISTA-9230.

**ISTC-9130 Record of Corrective Action.** See ISTA-9240.

(04) **ISTC-9200 Test Plans**

In addition to the requirements of ISTA-3110, the Owner shall maintain a record of test plans that shall include the following:

*(a)* category of each valve

*(b)* justification for deferral of stroke testing in accordance with ISTC-3520

*(c)* details and bases of the check valve sample disassembly examination program, such as grouping characteristics, frequency, and justification for not performing an exercise test to at least a partially open position after reassembly or periodic exercising in accordance with ISTC-3520

*(d)* bases for testing series check valve pairs as a unit in accordance with ISTC-5223



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# SUBSECTION ISTD
# Preservice and Inservice Examination and Testing of Dynamic Restraints (Snubbers) in Light-Water Reactor Nuclear Power Plants

## ISTD-1000 INTRODUCTION

### ISTD-1100 Applicability

The requirements of this Subsection apply to certain dynamic restraints (snubbers).

### ISTD-1200 Design and Operating Information

Design and operating information necessary for the performance of the examination and testing program shall be available for use during the program. Nonmandatory Appendix C contains a list of typical information that may be useful in the program.

### ISTD-1300 Examination and Test Results

In addition to the requirements of ISTA-9230, the results of examination and test data shall include manufacturer's model number, serial number, type, and unique location identification or Owner's identification of the snubber, as applicable.

### ISTD-1400 Reserved

### ISTD-1500 Snubber Maintenance or Repair

**ISTD-1510 Maintenance or Repair Before Examination or Testing.** Snubbers shall not be adjusted, maintained, or repaired before an examination or test specifically to meet the examination or test requirements.

(a) **ISTD-1520 Post-Maintenance or Repair Examination and Testing.** Snubbers that are maintained or repaired by removing or adjusting a snubber part that can affect the results of tests required by ISTD-5120 shall be tested in accordance with the applicable requirements of ISTD-5120 before returning to service. Additionally, the requirements of ISTD-4110 shall be met. The requirements selected shall ensure that the parameters that may have been affected are verified to be acceptable by suitable examination and tests.[1]

[1] Examples of parts and activities that can affect the test results of ISTD-5120 are as follows:

(a) mechanical or hydraulic snubber internal moving parts

(b) hydraulic snubber internal seals (i.e., where bypass can affect test results)

(c) activities that can permit air to be entrapped in the main cylinder or the control valve of a hydraulic snubber

(d) hydraulic control valve adjustment

### ISTD-1600 Snubber Modification and Replacement

**ISTD-1610 Suitability.** Replacement or modified snubber(s) shall have a proven suitability for the application and environment.

**ISTD-1620 Examination and Testing.** Replacement or modified snubbers shall be examined and tested in accordance with written procedures. The applicable requirements of ISTD-4100, ISTD-4200, and ISTD-5200, and ISTD-5500 shall be included in these procedures. The requirements selected shall ensure that the criteria of ISTD-4110, ISTD-4230, and ISTD-5210 can be satisfied. (a)

### ISTD-1700 Deletions of Unacceptable Snubbers

Snubbers may be deleted from the plant based on analysis of the affected piping system. When an unacceptable snubber is deleted, the deleted snubber shall nevertheless be considered in its respective examination population, examination category, or failure mode group (FMG) for determining the corrective action.

**ISTD-1750 Transient Dynamic Event.** If an unanticipated system transient dynamic event (e.g., water hammer, steam hammer) occurs that may affect snubber operability, then the affected snubbers and systems shall be reviewed and any appropriate corrective action taken. Any action so taken shall be considered independent of the requirements of ISTD-4100, ISTD-4200, ISTD-5100, and ISTD-5200. (a)

### ISTD-1800 Supported Component(s) or System Evaluation

An evaluation shall be performed of the system(s) or components of which an unacceptable snubber is a part, for possible damage to the supported system or component.

## ISTD-2000 DEFINITIONS (a)

The following list of definitions is provided to ensure a uniform understanding of selected terms as used in this Subsection.

*activation:* the change of condition from passive to active, in which the snubber resists rapid displacement of the attached pipe or component.



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*application-induced failures:* failures resulting from environmental conditions or application of the snubber for which it has not been designed or qualified.

*defined test plan group (DTPG):* a population of snubbers from which samples are selected for testing.

*design or manufacturing failure:* failures resulting from a potential defect in manufacturing or design that give cause to suspect other similar snubbers. This includes failures of any snubber that fails to withstand the environment or application for which it was designed.

*diagnostic testing:* testing to determine the cause or mechanism associated with failure, degradation, or performance anomaly of a snubber.

*drag force:* the force that will sustain low-velocity snubber movement without activation throughout the working range of the snubber stroke.

*failure mode group (FMG):* a group of snubbers that have failed and those other snubbers that have similar potential for similar failure.

*inaccessible snubbers:* snubbers that are in a high radiation area or other conditions that would render it impractical for the snubbers to be examined under normal plant operating conditions without exposing plant personnel to undue hazards.

*isolated failure:* a failure that does not cause other snubbers to be suspect.

*maintenance, repair, and installation-induced failures:* failures that result from damage during maintenance, repair, or installation activities, the nature of which causes other snubbers to be suspect.

*normal operating conditions:* operating conditions during reactor startup, operating at power, hot standby, reactor cooldown, and cold shutdown.

*operating temperature:* the temperature of the environment surrounding a snubber at its installed plant location during the phase of plant operation for which the snubber is required.

*operational readiness testing:* measurement of the parameters that verify snubber operational readiness.

*release rate:* the rate of the axial snubber movement under a specified load after activation of the snubber takes place.

*replacement snubber:* any snubber other than the snubber immediately previously installed at a given location.

*service life:* the period of time an item is expected to meet the operational readiness requirements without maintenance.

*service life population:* those snubbers for which the same service life has been established.

*swing clearance:* the movement envelope within which the snubber must operate without restriction, from the cold installed position to the hot operating position.

*test temperature:* the temperature of the environment surrounding the snubber at the time of the test.

*transient dynamic event failure:* inability of a snubber to perform its intended function due to an unanticipated transient dynamic event.

*unacceptable snubbers:* snubbers that do not meet examination or testing requirements.

*unexplained failure:* failure for which the cause has not been determined.

## ISTD-3000 GENERAL REQUIREMENTS

### ISTD-3100 General Examination Requirements

The following requirements apply to both the preservice and inservice examination programs.

**ISTD-3110 Examination Boundary.** The examination boundaries shall include the snubber assembly from pin to pin, inclusive.

### ISTD-3200 General Testing Requirements

The following requirements apply to both the preservice and inservice testing programs.

**ISTD-3210 Operational Readiness Testing Loads.** Snubbers shall be tested at a load sufficient to verify the test parameters specified in ISTD-5100 and ISTD-5200, ISTD-5300, or ISTD-5400 and ISTD-5500. Testing at less than rated load must be correlated to test parameters at rated load.

**ISTD-3220 Test Correction Factors.** This Subsection recognizes that there may be differences between the installed operating conditions and the conditions under which a snubber is tested. In such cases, correction factors shall be established and test results shall be correlated to operating conditions, as appropriate.

**ISTD-3230 Snubber Test Parameters and Methods.** Guidelines for establishing snubber functional test methods are given in Nonmandatory Appendix H, Test Parameters and Methods.

## ISTD-4000 SPECIFIC EXAMINATION REQUIREMENTS

### ISTD-4100 Preservice Examination

**ISTD-4110 Preservice Examination Requirements.** A preservice examination shall be performed on all snubbers during initial plant startup. For new and modified systems, preservice examination shall be performed after placing the systems in service. For operating plants implementing ISTD, these requirements shall not be (a)



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applicable if preservice examinations have been performed. Typical items to be considered are listed in Nonmandatory Appendix B. The initial examination shall, as a minimum, verify the following:

*(a)* no visible signs of damage or impaired operational readiness exist as a result of storage, handling, or installation.

*(b)* the snubber load rating, location, orientation, position setting, and configuration (e.g., attachments and extensions) are in accordance with design drawings and specifications. Installation records (based on physical examinations) of verification that the snubbers were installed according to the design drawings and specifications shall be acceptable in meeting this requirement.

*(c)* adequate swing clearance is provided to allow snubber movement.

*(d)* if applicable, fluid is at the recommended level, and fluid is not leaking from the snubber system.

*(e)* structural connections, such as pins, bearings, studs, fasteners, lock nuts, tabs, wire, and cotter pins, are installed correctly.

**ISTD-4120 Reexamination.** If the period between the preservice examination and initial system preoperational test exceeds 6 months, reexamination shall be performed in accordance with ISTD-4110(a), ISTD-4110(d), and ISTD-4110(e). This reexamination may be accomplished in conjunction with ISTD-4130.

(a) **ISTD-4130 Preservice Thermal Movement Examination Requirements.** Snubber thermal movement shall be verified as indicated in ISTD-4131 through ISTD-4133.

(a) **ISTD-4131 Incremental Movement Verification.** During system heatup and cooldown at temperature plateaus specified by the Owner, record the thermal movement. Verify that the snubber movement during the thermal movement examination is within the design-specified range. Any discrepancies or inconsistencies shall be evaluated to determine the movement acceptability before proceeding to the next specified plateau.

**ISTD-4132 Swing Clearance.** Verify that swing clearance exists at specified heatup and cooldown plateaus.

**ISTD-4133 Total Movement Verification.** The total thermal movement from cold to hot at full operating temperature shall be recorded. This value may be measured directly if maximum operating temperature was attained, or it may be extrapolated from lower temperature readings. The cold or hot position setting shall be evaluated and adjusted if necessary, to ensure adequate snubber clearance from fully extended or retracted positions.

**ISTD-4140 Preservice Examination Corrective Action.** Snubbers that are installed incorrectly or otherwise fail to meet the requirements of ISTD-4110 shall be installed correctly, adjusted, repaired, or replaced. The installation-corrected, adjusted, repaired, or replacement snubber shall be examined in accordance with, and shall meet the requirements of ISTD-4110. Also, replacement snubbers shall meet the requirements of ISTD-5120.

## ISTD-4200 Inservice Examination

Snubbers shall be visually examined on the required schedule and evaluated to determine their operational readiness.

**ISTD-4210 Method and Objective.** Inservice examination shall be a visual examination to identify physical damage, leakage, corrosion, or degradation that may have been caused by environmental exposure or operating conditions. External characteristics that may indicate operational readiness of the snubber shall be examined. An examination checklist shall be used. Typical items are listed in Nonmandatory Appendix B.

**ISTD-4220 Snubber Categorization** (a)

*(a)* All of the snubbers shall be categorized as one population for examination or they may be categorized as accessible and inaccessible populations.

*(b)* The decision to categorize the snubbers as one population or as separate populations may be made during or after the examination.

*(c)* If combining accessible and inaccessible populations into one population, the shorter interval shall be used for subsequent examination.

**ISTD-4230 Visual Examination Requirements.** Snubber installations shall meet all of the requirements of ISTD-4231 through ISTD-4233.

**ISTD-4231 Restrained Movement.** Snubbers shall be installed so they are capable of restraining movement when activated. Examinations shall include observations for the following and the conditions shall be evaluated when found:

*(a)* loose fasteners, or members that are corroded or deformed

*(b)* disconnected components or other conditions that might interfere with the proper restraint of movement

Snubbers evaluated to be incapable of restraining movement shall be classified unacceptable.

**ISTD-4232 Thermal Movement.** Snubber installations shall not restrain thermal movement to an extent that unacceptable stresses could develop in the snubber, the pipe, or other equipment that the snubber is designed to protect or restrain. This requirement is satisfied if no indication of binding, misalignment, or deformation of the snubber is observed.

**ISTD-4233 Design-Specific Characteristics.** Snubbers shall be free of defects that may be generic to particular designs as may be detected by visual examination. For example, fluid supply or content for hydraulic snubbers shall be observed. An observation that the fluid (a)



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level is equal to or greater than the minimum specified amount that is sufficient for actuation at its operating extension is considered to satisfy this requirement. If the fluid is less than the minimum amount, the installation shall be identified as unacceptable, unless a test establishes that the performance of the snubber is within specified limits. Tests shall be performed in accordance with ISTD-5210.

**ISTD-4240 Operational Readiness Test Evaluation.** A snubber that requires further evaluation or is classified as unacceptable during inservice examination may be tested in accordance with the requirements of ISTD-5210. Results that satisfy the operational readiness test criteria of ISTD-5210 shall be used to accept the snubber, provided the test demonstrates that the unacceptable condition did not affect operational readiness.

(a) **ISTD-4250 Inservice Examination Intervals**

**ISTD-4251 Initial Examination Interval.** The initial examination interval of snubbers shall begin no sooner than 2 months after attaining 5% reactor power operation and shall be completed by the end of first refueling outage. The initial interval shall not extend longer than 24 months after attaining 5% reactor power operation.

**ISTD-4252 Subsequent Examination Intervals**

*(a)* Subsequent examination intervals shall begin at the end of the previous examination interval, and conclude at the end of the next refueling outage.

*(b)* Intervals prior to the completion of the second refueling outage shall not exceed one fuel cycle in duration.

*(c)* The duration of examination intervals following the completion of the second refueling outage shall be in accordance with Table ISTD-4252-1. Examples of the application of Table ISTD-4252-1 are provided in Nonmandatory Appendix G.

*(d)* When examinations have been performed after the first refueling outage in accordance with a schedule requirement other than those in Table ISTD-4252-1, the interval preceding the most recently completed examination shall be used as the previous interval for the first application of Table ISTD-4252-1.

*(e)* Snubbers determined to be unacceptable based on the visual examination acceptance criteria at any time during the interval shall be counted in determining the subsequent examination interval in accordance with Table ISTD-4252-1.

**ISTD-4260 Inservice Examination Sample Size.** Inservice examination of snubbers required by ISTD-4251 and ISTD-4252 shall include all snubbers based either on the whole population or on the accessibility categories, as established according to the provisions of ISTD-4220.

(a) **ISTD-4270 Inservice Examination Failure Evaluation.** Snubbers that do not meet examination requirements of ISTD-4230 shall be evaluated to determine the cause of the unacceptability.

**ISTD-4280 Inservice Examination Corrective Action.** Unacceptable snubbers shall be adjusted, repaired, modified, or replaced. Additional action regarding the examination interval shall be taken as indicated in Table ISTD-4252-1.

## ISTD-5000 SPECIFIC TESTING REQUIREMENTS

### ISTD-5100 Preservice Operational Readiness Testing

**ISTD-5110 General.** Preservice operational readiness testing shall be performed on all snubbers. Testing may be performed at the manufacturer's facility.

**ISTD-5120 Test Parameters.** Tests shall verify the following:

*(a)* activation is within the specified range of velocity or acceleration in tension and in compression.

*(b)* release rate, when applicable, is within the specified range in tension and in compression. For units specifically required not to displace under continuous load, ability of the snubber to withstand load without displacement.

*(c)* for mechanical snubbers, drag force is within specified limits in tension and in compression.

*(d)* for hydraulic snubbers, if required to verify proper assembly, drag force is within specified limits in tension and in compression.

### ISTD-5130 Preservice Operational Readiness Testing Failures Corrective Action

**ISTD-5131 Test Failure Evaluations.** Snubbers that fail the preservice operational readiness test shall be evaluated for the cause(s) of failure(s).

**ISTD-5132 Design Deficiency.** If a design deficiency in a snubber is found, it shall be corrected by changing the design or specification, or by other appropriate means.

**ISTD-5133 Other Deficiencies.** Other deficiencies shall be resolved by adjustment, modification, repair, replacement, or other appropriate means.

**ISTD-5134 Retest Requirements.** Adjusted, modified, repaired, or replacement snubbers shall be tested to meet the requirements of ISTD-5120.

### ISTD-5200 Inservice Operational Readiness Testing

Snubbers shall be tested for operational readiness during each fuel cycle. Tests are required to be in accordance with a specified sampling plan. Testing shall be performed during normal system operation, or during system or plant outages. The Owner's administrative



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**Table ISTD-4252-1 Visual Examination Table**

| Population or Category [Note (1)] | Number of Unacceptable Snubbers | | |
|---|---|---|---|
| | Column A for Extended Interval [Notes (2), (3)] | Column B for Interval Same as Previous [Notes (2), (4), (5)] | Column C for Interval Reduction to 2/3 [Notes (2), (5), (6)] |
| 1 | 0 | 0 | 1 |
| 80 | 0 | 0 | 2 |
| 100 | 0 | 1 | 4 |
| 150 | 0 | 3 | 8 |
| 200 | 2 | 5 | 13 |
| 300 | 5 | 12 | 25 |
| 400 | 8 | 18 | 36 |
| 500 | 12 | 24 | 48 |
| 750 | 20 | 40 | 78 |
| ≥ 1000 | 29 | 56 | 109 |

NOTES:

(1) Interpolation between population or category sizes and the number of unacceptable snubbers is permissible. The next lower integer shall be used when interpolation results in a fraction.

(2) The basic interval shall be the normal fuel cycle up to 24 months. The examination interval may be as great as twice, the same, or as small as fractions of the previous interval as required by the following Notes. The examination interval may vary ±25% of the current interval.

(3) If the number of unacceptable snubbers is equal to or less than the number in Column A, then the next examination interval may be increased to twice the previous examination interval, not to exceed 48 months. In that case, the next examination according to the previous interval may be skipped.

(4) If the number of unacceptable snubbers exceeds the number in Column A, but is equal to or less than the number in Column B, then the next visual examination shall be conducted at the same interval as the previous interval.

(5) If the number of unacceptable snubbers exceeds the number in Column B, but is equal to or less than the number in Column C, then the next examination interval shall be decreased to two-thirds of the previous examination interval or, in accordance with the interpolation between Columns B and C, in proportion to the exact number of unacceptable snubbers.

(6) If the number of unacceptable snubbers exceeds the number in Column C, then the next examination interval shall be decreased to two-thirds of the previous interval.

procedures shall govern removing snubbers from operable system(s). For each snubber determined to be unacceptable by operational readiness testing, additional snubbers shall be tested as determined by the type of failure and the corrective action taken.

**ISTD-5210 Test Parameters.** Snubber operational readiness tests shall verify the following:

*(a)* activation is within the specified range of velocity or acceleration in tension and in compression.

*(b)* release rate, when applicable, is within the specified range in tension and in compression. For units specifically required not to displace under continuous load, ability of the snubber to withstand load without displacement.

*(c)* for mechanical snubbers, drag force is within specified limits, in tension and in compression.

### ISTD-5220 Test Methods

**ISTD-5221 Test as Found.** Snubbers shall be tested in their as-found condition regarding the parameters to be tested to the fullest extent practicable.

**ISTD-5222 Restriction.** Test methods shall not alter the condition of a snubber to the extent that the results do not represent the as-found snubber condition.

**ISTD-5223 In-Place Test.** Snubbers may be tested in their installed location by using Owner-approved test methods and equipment.

**ISTD-5224 Bench Test.** Snubbers may be removed and bench tested in accordance with Owner-approved procedures. After reinstallation, the snubbers shall meet the requirements of ISTD-4110(a), ISTD-4110(c), ISTD-4110(d), and ISTD-4110(e). Also, the position setting shall be verified.

**ISTD-5225 Subcomponent Test.** When snubber size, test equipment limitations, or inaccessibility prevents use of methods in ISTD-5223 and ISTD-5224, snubber subcomponents that control the parameters to be verified shall be examined and tested in accordance with Owner-approved test methods. Reassembly shall be in accordance with approved procedures that include the requirements of ISTD-4110(a), (d), and (e). Service life



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monitoring requirements are specified in ISTD-6400.

**ISTD-5226 Correlation of Indirect Measurements.** When test methods are used that either measure parameters indirectly, or measure parameters other than those specified, the results shall be correlated with specified parameters through established methods.

**ISTD-5227 Parallel and Multiple Installations.** Each snubber in a parallel or multiple installation shall be identified and counted individually.

**ISTD-5228 Fractional Sample Sizes.** Fractional sample sizes shall be rounded up to the next integer.

**ISTD-5230 Qualitative Tests.** Qualitative tests may be used instead of quantitative measurements to meet the requirements of ISTD-5210, if adequate justification is presented and is acceptable to the regulatory authority having jurisdiction over the facility. The Owner shall obtain sufficient data, based upon service history or life cycle testing, to demonstrate the ability of the parameter in question to conform to the specification over the life of the snubber (e.g., that activation takes place — without measuring the activation level). A test report that confirms the parameter was within specifications shall be available for each snubber exempted from an inservice quantitative test requirement.

**ISTD-5240 Test Frequency.** Tests of snubbers from the facility shall be performed every fuel cycle. Snubber testing may begin no earlier than 60 days before a scheduled refueling outage.

### ISTD-5250 Defined Test Plan Group (DTPG)

**ISTD-5251 DTPGs General Requirement.** The DTPGs shall include all snubbers except replacement snubbers and snubbers repaired or adjusted as a result of not meeting the examination acceptance requirements of ISTD-4200. These snubbers shall be exempt for the concurrent test interval.

**ISTD-5252 DTPG Alternatives.** Except as required by ISTD-5253, the total snubber population may be considered one DTPG, or alternatively, differences in design, application, size, or type may be considered in establishing DTPGs.

**ISTD-5253 Additional DTPG Requirements for Pressurized Water Reactors.** Snubbers attached to the steam generator and snubbers attached to the reactor coolant pump shall be at least one, separate DTPG.

### ISTD-5260 Testing Sample Plans

**ISTD-5261 Sample Plans.** The snubbers of each DTPG shall be tested using either of the following:

*(a)* the 10% testing sample plan

*(b)* the 37 testing sample plan

Nonmandatory Appendix D includes a comparison of sample plans. Snubber testing plans are presented in flow chart form in Nonmandatory Appendix E.

**ISTD-5262 Plan Selection.** A test plan shall be selected for each DTPG before the scheduled testing begins.

**ISTD-5263 Plan Application.** The test plan selected for a DTPG shall be used throughout the refueling outage tests for that DTPG and any failure mode group (FMG) that is derived from it.

**ISTD-5270 Continued Testing.** For unacceptable snubber(s), the additional testing shall continue in the DTPG or FMG per ISTD-5330 or ISTD-5430.

**ISTD-5271 Test Failure Evaluation.** Snubbers that do not meet test requirements specified in ISTD-5210 or ISTD-5230 shall be evaluated to determine the cause of the failure. (a)

*(a)* The evaluation shall include review of information related to other unacceptable snubbers found during testing that refueling outage.

*(b)* The evaluation results shall be used, as applicable, to determine FMGs to which snubbers should be assigned. Additional justifying information should be used to assign snubbers with failures previously identified as unexplained or isolated to an appropriate FMG.

**ISTD-5272 FMGs.** Snubbers found unacceptable according to operational readiness test requirements should be assigned to FMGs unless the failure is isolated or unexplained. FMGs shall include all unacceptable snubbers with the same failure mode and all other snubbers with similar potential for similar failure. The following FMGs shall be used:

*(a)* design or manufacturing

*(b)* application induced

*(c)* maintenance, repair, or installation

*(d)* transient dynamic event

### ISTD-5273 FMG Boundaries

*(a)* When snubbers have been tested as a part of DTPG test requirements and found to be unacceptable, and evaluation establishes an FMG based on the failure of certain snubbers, the number of those unacceptable snubbers shall be used in determining testing in the FMG in accordance with ISTD-5320 and ISTD-5330, or ISTD-5420 and ISTD-5430. However, those snubbers shall be counted only in the value of $N$ of ISTD-5331(a) or ISTD-5431(a) as completed tests in the DTPG.

*(b)* When snubbers have been found to be acceptable when tested as part of DTPG test requirements and subsequent evaluation establishes an FMG that would include those snubbers, those snubbers shall not be counted in the value of $N_F$ in ISTD-5331(b) or ISTD-5431(b) when counting FMG tests.

*(c)* An FMG shall remain as defined until corrective action is complete.



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**ISTD-5274 Snubbers in More Than One FMG.** When a snubber is assigned to more than one FMG, it shall be counted in each of those FMGs and shall be included in corrective action for each of those FMGs.

**ISTD-5275 Additional FMG Review.** After the requirements of ISTD-5250, ISTD-5260, ISTD-5270, ISTD-5320, and ISTD-5420 are satisfied for a DTPG, any separate and additional FMG review or testing does not require additional tests in the DTPG.

**ISTD-5280 Corrective Action.** Unacceptable snubbers shall be adjusted, repaired, modified, or replaced. The provisions of ISTD-1620 and ISTD-1700 also apply. Snubbers that do not meet the test requirements of ISTD-5210 or ISTD-5230 shall be tested in accordance with ISTD-5320 or ISTD-5420, as applicable.

## ISTD-5300 The 10% Testing Sample

### ISTD-5310 The 10% Testing Sample Plan, Sample Size, and Composition

**ISTD-5311 Initial Sample Size and Composition.** The initial sample shall be 10% of the DTPG, composed according to either ISTD-5311(a) or ISTD-5311(b).

*(a)* As practicable, the sample shall include representation from the DTPG based on the significant features (i.e., the various designs, configurations, operating environments, sizes, and capacities) and based on the ratio of the number of snubbers of each significant feature, to the total number of snubbers in the DTPG. Selection of the representative snubbers shall be random.

*(b)* The sample shall be generally representative as specified in ISTD-5311(a), but may also be selected from snubbers concurrently scheduled for seal replacement or other similar activity related to service life monitoring. The snubbers shall be tested on a generally rotational basis to coincide with the service life monitoring activity.

**ISTD-5312 Additional Sample Size.** When additional samples are required by ISTD-5320, they shall be at least one-half the size of the initial sample from that DTPG.

**ISTD-5313 Additional DTPG Sample Composition.** When an unacceptable snubber has not been assigned to an FMG, the additional sample required by ISTD-5320 shall be taken from the DTPG. As practicable, the additional sample shall include the following:

*(a)* snubbers of the same manufacturer's design

*(b)* snubbers immediately adjacent to those found unacceptable

*(c)* snubbers from the same piping system

*(d)* snubbers from other piping systems that have similar operating conditions such as temperature, humidity, vibration, and radiation

*(e)* snubbers that are previously untested

**ISTD-5314 FMG Sample Composition.** When samples from an FMG are required, they shall be selected randomly from untested snubbers in the FMG.

### ISTD-5320 The 10% Testing Sample Plan Additional Testing and Alternatives

**ISTD-5321 Unexplained Failures.** When an applicable FMG has not been established, the number of unacceptable snubbers shall determine the additional testing samples in accordance with ISTD-5312 and ISTD-5330.

**ISTD-5322 Isolated Failure.** Additional tests are not required for an isolated failure.

**ISTD-5323 Design or Manufacturing and Application-Induced FMGs Alternatives to Testing.** When the corrective action of ISTD-5323(a) or ISTD-5323(b) is taken, no additional testing is required for the applicable FMGs.

*(a)* All snubbers in these FMGs shall be replaced or modified in accordance with ISTD-1600; or

*(b)* The unacceptable snubbers in an application-induced FMG shall be replaced or repaired to an acceptable condition, and the environment or applications shall be made compatible with the design parameters for all snubbers in this FMG.

**ISTD-5324 Design or Manufacturing; Maintenance, Repair, or Installation; and Application-Induced FMGs Tests.** When the corrective actions of ISTD-5323 are not applicable, or are not taken, the following apply:

*(a)* Tests in the FMG shall be based both on the number of unacceptable snubbers found in the DTPG and determined by the evaluation of ISTD-5271 to be appropriate for establishing the FMG, and on the number of unacceptable snubbers subsequently found in the FMG.

*(b)* Testing shall continue until the mathematical expression of ISTD-5331(b) is satisfied or all snubbers in the FMG have been tested.

**ISTD-5325 Transient Dynamic Event FMG Additional Tests.** Although additional tests are not required for transient dynamic event FMG failures, the operational readiness of all snubbers in this FMG shall be evaluated by stroking or testing. All operationally ready snubbers in this FMG remain eligible for selection and tests for other appropriate FMGs and the DTPG in accordance with ISTD-5313 and ISTD-5314.

**ISTD-5330 The 10% Testing Sample Plan Completion.** The snubbers of each DTPG and FMG shall be tested as required. Testing is complete when the mathematical expressions of ISTD-5331 are satisfied, or all snubbers in the DTPG or FMG have been tested.

**ISTD-5331 Testing Plan Mathematical Expression.** Testing shall satisfy the mathematical expressions as follows:



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(a) for each DTPG

$$N \geq 0.1n + C(0.1n/2)$$

where

$N$ = total number of snubbers tested that were selected from the DTPG
$n$ = number of snubbers in the DTPG
$C$ = total number of unacceptable snubbers found in the DTPG (excluding those counted for FMG tests)

(b) for each FMG

$$N_F \geq C_F(0.1n/2)$$

where

$N_F$ = all snubbers selected and tested from the FMG after the FMG was established from the DTPG
$C_F$ = total number of unacceptable snubbers in the FMG, plus those found in the DTPG and used to establish the FMG
$n$ = number of snubbers in the DTPG

## ISTD-5400 The 37 Testing Sample Plan

### ISTD-5410 The 37 Testing Sample Plan, Sample Size, and Composition

**ISTD-5411 Initial Sample Size and Composition.** An initial sample of 37 snubbers shall be selected randomly from each 37 plan DTPG.

**ISTD-5412 Additional Sample Size.** When additional samples are required by ISTD-5420, the samples shall be either 18 or 19 snubbers to satisfy the requirement of ISTD-5431.

**ISTD-5413 Additional Sample Selection.** Additional samples, if required, shall be selected randomly from the remaining population of the DTPG, or from untested snubbers of the FMG as applicable.

### ISTD-5420 The 37 Testing Sample Plan Additional Testing and Alternatives

**ISTD-5421 Unexplained Failure.** When an applicable FMG has not been established, the number of unacceptable snubbers shall determine additional samples in accordance with ISTD-5412. The additional samples shall be selected randomly from the remaining untested snubbers of the DTPG.

**ISTD-5422 Isolated Failure.** Additional tests are not required for an isolated failure.

**ISTD-5423 Design or Manufacturing and Application-Induced FMGs Alternatives to Testing.** When the corrective action of ISTD-5423(a) or ISTD-5423(b) is taken, no additional testing is required for the applicable FMGs.

(a) All snubbers in these FMGs shall be replaced or modified in accordance with ISTD-1600; or

(b) the unacceptable snubbers in an application-induced FMG shall be replaced or repaired to an acceptable condition, and the environment or applications shall be made compatible with the design parameters for all snubbers in this FMG.

**ISTD-5424 Design or Manufacturing; Maintenance, Repair, or Installation; and Application-Induced FMGs Additional Testing.** When the corrective actions of ISTD-5423 are not applicable, or are not taken, the following apply:

(a) Tests in an FMG shall be based both on the number of unacceptable snubbers found in the DTPG and determined by the evaluation of ISTD-5271 to be appropriate for establishing the FMG, and on the number of unacceptable snubbers subsequently found in the FMG.

(b) Failures in an FMG shall require additional tests in the FMG unless an evaluation indicates that another grouping is appropriate for additional tests.

(c) A supplemental sample of snubbers (to satisfy ISTD-5431) for each FMG established shall be tested from the applicable DTPG. Failures in the supplemental sample require additional tests in the DTPG unless an evaluation indicates that another grouping is appropriate for additional testing. (a)

**ISTD-5425 Transient Dynamic Event FMG Additional Testing.** Although additional tests are not required for transient dynamic event FMG failures, the operational readiness of all snubbers in this FMG shall be evaluated by stroking or testing. All operationally ready snubbers in this FMG remain eligible for selection and tests for other appropriate FMGs and the DTPG in accordance with ISTD-5413.

**ISTD-5430 The 37 Testing Sample Plan Completion.** The snubbers of each DTPG and FMG shall be tested as required. Testing is complete when the mathematical expressions of ISTD-5431 are satisfied, or all snubbers in the DTPG or FMG have been tested.

**ISTD-5431 Testing Plan Mathematical Expressions.** Testing shall satisfy the mathematical expressions as follows:

(a) for each DTPG

$$N \geq 36.49 + 18.18C \text{ (Fig. ISTD-5431-1)}$$

where

$N$ = total number of snubbers tested that were selected from the DTPG
$C$ = total number of unacceptable snubbers found in the DTPG (excluding those counted in FMG tests), plus one for each applicable FMG requiring additional tests in accordance with ISTD-5424

(b) for each FMG requiring additional tests

$$N_F \geq 18.18C_F$$



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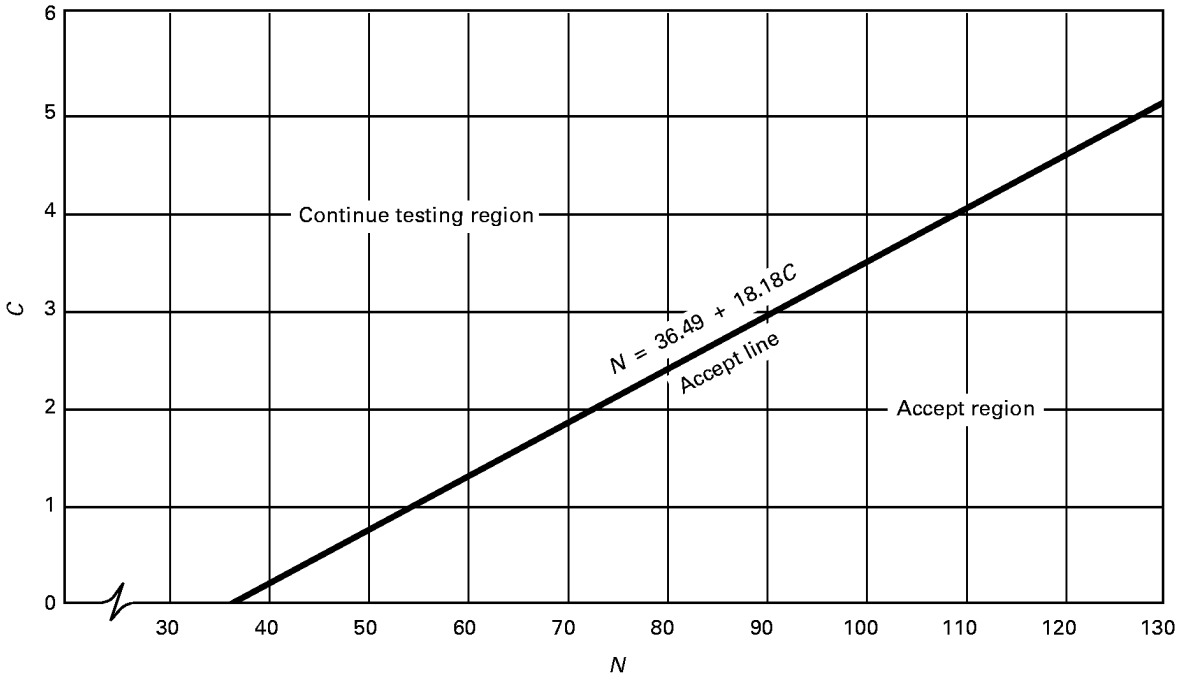


**Fig. ISTD-5431-1 The 37 Testing Sample Plan**

where

$N_F$ = all snubbers selected and tested after the FMG was established from DTPG

$C_F$ = total number of unacceptable snubbers in the FMG, plus those found in the DTPG and used to establish the FMG

### ISTD-5500 Retests of Previously Unacceptable Snubbers

Snubbers placed in the same location as snubbers that failed the previous inservice operational readiness test shall be retested at the time of next operational readiness testing unless the cause of the failure is clearly established and corrected. Any retest in accordance with this paragraph shall not be considered a part of inservice operational readiness testing sample selection requirements of ISTD-5200, ISTD-5300, or ISTD-5400. In addition, failures found by these retest shall not require additional testing in accordance with ISTD-5320 or ISTD-5420, but shall be evaluated for appropriate corrective action.

## ISTD-6000 SERVICE LIFE MONITORING

### ISTD-6100 Predicted Service Life

Initial snubber service life shall be predicted based on manufacturer's recommendation or design review. Methods for predicting service life are given in Nonmandatory Appendix F.

### ISTD-6200 Service Life Evaluation

Service life shall be evaluated at least once each fuel cycle, and increased or decreased, if warranted. Evaluation shall be based upon technical data from representative snubbers that have been in service in the plant, or other information related to service life. Examples of methods that can be used to obtain such data are described in Nonmandatory Appendix F. If the evaluation indicates that service life will be exceeded before the next scheduled system or plant outage, one of the following actions shall be taken:

*(a)* the snubber shall be replaced with a snubber for which the service life will not be exceeded before the next scheduled system or plant outage

*(b)* technical justification shall be documented for extending the service life to or beyond the next scheduled system or plant outage

*(c)* the snubber shall be reconditioned such that its service life will be extended to or beyond the next scheduled system or plant outage

### ISTD-6300 Cause Determination (a)

Causes for any examination or testing failures shall be determined and considered in establishing or reestablishing service life.



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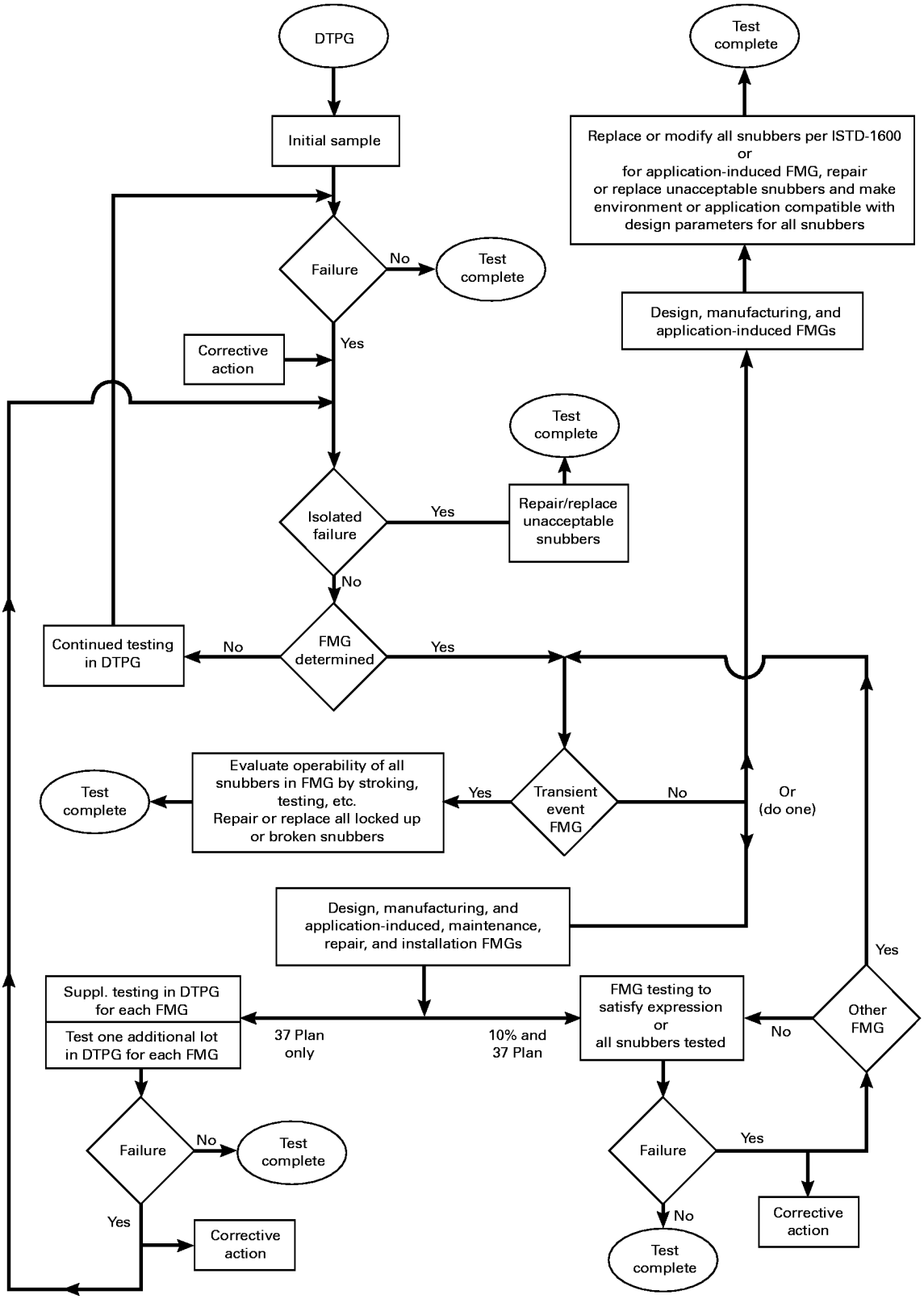


**Fig. E-1000-1 Flowchart for 10% and 37 Snubber Testing Plans**



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# NONMANDATORY APPENDIX F[1]
# Dynamic Restraints (Snubbers) Service Life Monitoring Methods

## F-1000 PURPOSE

Degradation due to service environment and maintenance errors can adversely affect snubber performance. This Appendix discusses methods and considerations that can be used to predict and reevaluate snubber service life to optimize snubber availability during plant operation. The service life monitoring program should be based on knowledge of the operating environment, snubber design limits, and service records.

## F-2000 PREDICTED SERVICE LIFE

Before start of service, snubber service life should be conservatively predicted, based on manufacturer recommendations or design review.

### (a) F-2100 Manufacturer Recommendations

Manufacturer recommendations may include seal and fluid replacement intervals for hydraulic snubbers or intervals for replacement of critical parts and/or lubricant for mechanical snubbers. Such intervals may vary, depending upon the application.

### F-2200 Design Review

Snubber design review should consider materials, design features, and the plant operating environment. Evaluation of the effects of the environment on critical snubber parts such as seals, hydraulic fluids, lubricants, platings, etc., should be particularly emphasized.

## F-3000 SERVICE LIFE REEVALUATION

Service life reevaluation should include the considerations discussed in F-3100 through F-3320.

### (a) F-3100 Knowledge of the Operating Environment

Actual plant operating environments can differ significantly from original plant design specifications. Some snubbers may be subjected to localized high temperatures that are not representative of the general snubber population. Such applications may require augmented inspections or more frequent snubber overhaul or replacement than originally predicted.

On the other hand, the operating environment for the majority of snubbers may be significantly less severe than described in plant design specifications. Unnecessary overhaul or replacement of such snubbers may increase the incidence of snubber failure by introducing handling or maintenance errors.

It is important, therefore, that the operating environment be identified and an appropriate service life established. Environmental parameters may include the following:

(a) temperature
(b) vibration
(c) transient loading
(d) radiation
(e) humidity
(f) airborne contaminants
(g) leakage of adjacent components

Severe environments may be identified by plant operating data, direct measurement of environmental parameters, evaluation of the installed location, e.g., proximity to high-temperature components, or by examination of snubbers (or snubber parts).

**F-3110 Direct Measurement of Environmental Parameters.** Various types of instrumentation and equipment are available for direct measurement of environmental parameters such as temperature, vibration, radiation, and humidity. Such equipment may be used for specific snubber locations where severe environments are expected or as an aid in determining the cause of snubber degradation.

**F-3120 As-Found Testing.** As-found testing of snubbers removed from service can identify degradation due to severe operating environments.

### F-3200 Knowledge of Operating Environment Effects (a)

Reevaluation of a snubber service life should include a thorough knowledge of the effects of various operating environments on snubber performance. Such knowledge may not be readily available from the manufacturer and may require engineering evaluation, including monitoring of trendable degradation parameters for snubbers removed from service. This might include periodic measurement of potentially trendable test parameters, e.g.,

[1] This Appendix is included for informational purposes only. While it is related to Subsection ISTD, Preservice and Inservice Examination and Testing of Dynamic Restraints (Snubbers) in Light-Water Reactor Nuclear Power Plants, it is not part of that Subsection.



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drag force for selected snubbers. Periodic disassembly and evaluation of snubber internal parts, e.g., seals, springs fluid, etc., may also be required.

(a) **F-3210 Identification of Degraded Snubbers.** Degraded snubbers may often be identified by visual examination of snubbers or snubber parts, by sampling of hydraulic fluid, or by evaluation of functional test data.

**F-3220 Trending.** The following should be considered for trending:

*(a)* establishment of trending parameters and associated baseline data

*(b)* trending parameters should relate directly to the anticipated failure mode

*(c)* reservoir fluid level is the most appropriate trending parameter for monitoring snubber leakage

*(d)* trends may be more effectively identified using average rather than peak drag force

## (a) F-3300 Cause Evaluation of Degraded or Failed Snubbers

Failures often result from influences not related to service time or service environment. Such influences include maintenance activities, construction activities, and manufacturing defects. It is important to ensure that service life is not unjustifiably influenced by such failures or degradation. Therefore, snubbers that failed inservice examinations or tests, and snubbers removed from service due to excessive degradation, should be evaluated to determine the cause of the degradation or failure.

**F-3310 Failure Evaluation Data Sheet.** Failure evaluation data sheets should include information pertaining to failure mode, failure mechanism, environment, service time, abnormal conditions, visual observations, test results, and test observations. (a)

**F-3320 Diagnostic Testing.** Diagnostic testing may be useful in identifying the failure or degradation mechanism. (a)

## F-4000 SHORTENED SERVICE LIFE (a)

It may be necessary to shorten the service life of snubbers subjected to severe environments, such as excessively high temperatures and vibration. Snubbers in severe environments may require augmented surveillance, including "hands-on" evaluations, e.g., stroking or in-situ monitoring.

## F-5000 SERVICE LIFE EXTENSION (a)

In many cases, where there has been minimal degradation due to the service environment, it may be appropriate to extend the previously established service life. Service life extension should be based on a technical evaluation of snubber performance that includes the current level of service-related degradation as well as the degradation rate.

## F-6000 SEPARATE SERVICE LIFE POPULATIONS

Depending on the significance of environmental extremes from one area in the plant to another, separate and distinct service life populations may be appropriate.



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# NONMANDATORY APPENDIX G[1]
# Application of Table ISTD-4252-1, Snubber Visual Examination

## G-1000 PURPOSE

This Appendix provides guidance for use of Table ISTD-4252-1 to determine subsequent snubber examination interval.

## G-2000 ASSUMPTIONS

The assumptions used are as follows:

*(a)* snubber population = 750 snubbers installed in the unit

*(b)* accessible portion of the population = 300

*(c)* inaccessible portion of the population = 450

*(d)* normal fuel cycle = 12 months

NOTE: Examination intervals may vary by ±25%, i.e., examination can be performed between 9 and 15 months.

## (a) G-3000 CASE 1: EXAMINE ACCESSIBLE AND INACCESSIBLE SNUBBERS JOINTLY

If the decision is made to examine the snubber population without categorizing snubbers as accessible or inaccessible in accordance with ISTD-4220, then the total number of snubbers unacceptable to the visual examination requirement is used in Table ISTD-4252-1 to determine the next examination interval.

### (a) G-3100 Application of Column A

If the total number of unacceptable snubbers found during current examination is twenty or less, referring to population line for 750 snubbers and Column A, then, in accordance with Note (3) of Table ISTD-4252-1, the next examination interval is twice the previous interval but not greater than 48 months. If the previous examination interval was the normal fuel cycle, the examination during the next fueling outage may be skipped. Thus, the next examination is due at 24 months ±6 months (±25% of 24 months). If the number of unacceptable snubbers found at the next examination is equal to or less than the number in Column A, the interval may be doubled again, but not to exceed 48 months.

[1] This Appendix is included for informational purposes only. While it is related to Subsection ISTD, Preservice and Inservice Examination and Testing of Dynamic Restraints (Snubbers) in Light-Water Reactor Nuclear Power Plants, it is not part of that Subsection.

### G-3200 Application of Column B (a)

On the 750 population line, if the number of unacceptable snubbers is greater than 20 but less than or equal to 40, referring to Column B and Note (4), the next examination interval is the same as the previous interval (12 months).

### G-3300 Application of Less Than or Equal to Column C and Recovery (a)

If the number of unacceptable snubbers is greater than 40, but less than or equal to 78 (say 60), referring to Columns B and C and Note (5), then interpolation may be used or the interval is reduced to two-thirds of the previous interval. If the previous interval was the 12-month normal fuel cycle, then the next examination interval is $\frac{2}{3} \times 12 = 8$ months. Alternatively, for 60 unacceptable snubbers, interpolate between Columns B and C, i.e., examination interval

$$= \frac{2}{3} \times 12 + \left[ \frac{(12 - 8)}{(78 - 40)} \times (78 - 60) \right]$$
$$= 8 + 1.89 = 9.89 \text{ months}$$

However, for determining the subsequent examination interval, use the previous interval as 8 months without interpolation, or 9.89 months when interpolation is used.

The number of unacceptable snubbers found during the subsequent examination done at an 8 or 9.89 month interval will determine the next examination interval as follows.

If the number of unacceptable snubbers is

*(a)* less than or equal to Column A, the next examination interval is 2 × 8 or 2 × 9.89 months

*(b)* greater than Column A but less than or equal to Column B, the next examination interval is 8 or 9.89 months

*(c)* greater than Column B but less than or equal to Column C, the next examination interval is two-thirds of 8 or two-thirds of 9.89 months, or interpolate between Columns B and C

### G-3400 Application of Table When Number Exceeds Column C

For a population of 750 snubbers, if the number of unacceptable snubbers is greater than 78 (i.e., the number shown in Column C), then the next examination



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interval is two-thirds of the previous interval. If the previous interval was the normal fuel cycle of 12 months, the calculation is $\frac{2}{3} \times 12 = 8$ months.

## (a) G-4000 CASE 2: EXAMINE ACCESSIBLE AND INACCESSIBLE SNUBBERS SEPARATELY

If the decision was made to examine the accessible and inaccessible snubbers as separate categories, results are used separately in Table ISTD-4252-1.

### G-4100 Determine the Values From Columns A, B, and C

The values for 300 snubbers are given in Table ISTD-4252-1. However, for the 450 inaccessible snubbers, interpolate to determine the number of unacceptable snubbers for each column. The interpolation may be applied whenever the exact population or category quantity is not given in Table ISTD-4252-1.

| | Column A | Column B | Column C |
|---|---|---|---|
| 300 Accessible | 5 | 12 | 25 |
| 450 Inaccessible | 10 | 21 | 42 |

### G-4200 Determine Subsequent Interval Separately

The number of unacceptable snubbers found in the accessible or inaccessible category shall determine the next examination interval for each category separately. The process for each is the same as discussed in G-3000. For example:

*(a)* if the number of unacceptable snubbers in the accessible category is 10 (greater than Column A but less than or equal to Column B), then the next examination interval for the accessible category is the previous interval

*(b)* if the number of unacceptable snubbers in the inaccessible category is 6 (less than or equal to Column A, which is 10 for 450 snubbers), then the next interval for the inaccessible category is twice the previous interval

### G-4300 Recombining Categories Into One Population

If the accessible and inaccessible categories have different intervals for the subsequent examination, they may be examined jointly at the shorter examination interval required by either category. Use the shorter interval as the previous interval in determining the subsequent examination interval for the entire population.



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# NONMANDATORY APPENDIX H[1]
# Test Parameters and Methods

## H-1000 PURPOSE

This Appendix provides guidelines for establishing snubber functional test methods that will produce information compatible with Subsection ISTD requirements. These guidelines do not preclude any particular test equipment or method. Manufacturer recommendations should be considered. EPRI Report No. TR-102363, Evaluation of Snubber Functional Test Methods, July 1993, provides additional guidance.

## H-2000 TEST VARIABLES

Snubber functional testing involves three test variables. These variables are force, displacement, and time. All snubber test parameters are measured in terms of one or more of these variables. For example, velocity is measured as change in displacement per unit time, acceleration is measured as change in velocity per unit time.

Snubber functional tests involve measuring at least one of these variables as a dependent variable, while controlling at least one of the other variables.

## H-3000 TEST PARAMETER MEASUREMENT

Subsection ISTD requires measurement of one or more of the following parameters:

*(a)* drag force
*(b)* activation
*(c)* release rate

### H-3100 Drag Force Measurement

Drag force is measured by controlling the snubber stroke displacement while measuring the resulting resistance force. Generally, the rate of change in displacement (velocity) is also controlled.

(a) **H-3200 Activation Measurement**

Activation applies to snubbers that have two distinct operating modes (i.e., activated and inactivated). Activation may involve control valve closure for a hydraulic snubber or engagement of a braking mechanism for a mechanical snubber. The three activation parameters are discussed in H-3210 through H-3230.

**H-3210 Locking Velocity.** Locking velocity is measured by stroking the snubber at a gradually increasing velocity. Generally, the rate of change in velocity (ramp rate) is also controlled. Locking velocity is determined by recording stroke velocity at the point of control valve closure. Control valve closure may be identified using a number of indicators including the point of sudden force increase.

**H-3220 Velocity Threshold.** Velocity threshold is measured by stroking the snubber at a velocity sufficient to activate the velocity limiting mechanism. After activation, a specified constant force is applied. Velocity threshold is determined by recording the average stroke velocity over a specified time period or stroke distance, after the force stabilizes at the specified value. This applies to a velocity-limiting device. (a)

**H-3230 Acceleration Threshold.** Acceleration threshold is measured by stroking at an acceleration sufficient to activate the acceleration limiting mechanism. After activation, a specified force is applied. Acceleration threshold is determined by recording the average acceleration over a specified time period or stroke distance, after the force stabilizes at the specified value. This applies to an acceleration-limiting device. (a)

### H-3300 Release Rate Measurement

Release rate is measured by applying a specified constant force to the snubber while measuring the resulting stroke velocity. Release rate is determined by recording the average stroke velocity over a specified time period or stroke distance, after the force stabilizes at the specified value.

## H-4000 GENERAL TESTING CONSIDERATIONS

Snubber functional testing may involve the use of more than one test machine. Test results are subject to some variation due to a number of influences, including differences in instrumentation, the magnitude of controlled variables, variations in test machine control methods, environmental influences, and variations in data interpretations.

### H-4100 Drag Test Velocity

For some snubber models, drag force is sensitive to test velocity. Test velocity should therefore be representative of the anticipated thermal movement rate of the

[1] This Appendix is included for informational purposes only. While it is related to Subsection ISTD, Preservice and Inservice Examination and Testing of Dynamic Restraints (Snubbers) in Light-Water Reactor Nuclear Power Plants, it is not part of that Subsection.



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# ASME OMa CODE-2005 INTERPRETATIONS

## Replies to Technical Inquiries
## January 9, 2004 through June 20, 2005

### FOREWORD

This publication includes all of the written replies issued between the indicated dates by the Secretary, speaking for the ASME Committee on Operation and Maintenance, to inquiries concerning interpretations of technical aspects of ASME OM Code.

These replies are taken verbatim from the original letters, except for a few typographical corrections and some minor editorial corrections made for the purpose of improved clarity.

These interpretations were prepared in accordance with the accredited ASME procedures. ASME procedures provide for reconsideration of these interpretations when or if additional information is available which the inquirer believes might affect the interpretation. Further, persons aggrieved by this interpretation may appeal to the cognizant ASME Committee or Subcommittee. ASME does not "approve," "certify," "rate," or "endorse" any item, construction, proprietary device, or activity.

An interpretation applies to the edition or addenda stated in the interpretation itself, or, if none is stated, to the latest published edition and addenda at the time it is issued. Subsequent revisions to the rules may have superseded the reply.

For detailed instructions on the preparation of technical inquiries, refer to Preparation of Technical Inquiries to the Committee on Operation and Maintenance of Nuclear Power Plants (p. viii of ASME OM Code-2004).



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**Interpretation: 04-01**

Subject: ASME/ANSI OM Code 1990, ISTC 4.6

Date Issued: October 27, 2004

File: OMI 04-02

Question: Is it a requirement of ISTC 4.6(c) to test 20% of all charges that are currently in service rather than 20% of charges in an individual explosively actuated valve?

Reply: Yes.

**Interpretation: 04-02**

Subject: ASME/ANSI OM Code-2004, ISTB-3510, Digital Vibration Instruments

Date Issued: December 10, 2004

File: OMI 04-04

Question: Is it a requirement of the OM Code to restrict overall vibration readings to include only the vibration energy from the frequency range of the instrument that can be calibrated to ±5% of reading accuracy?

Reply: No. The OM Code provides minimum requirements only. The Owner's test program may include additional or greater requirements than those required by the OM Code.

**Interpretation: 04-03**

Subject: ASME/ANSI OM Code-1998; ISTB-5122(c), ISTB-5222(c), and ISTB-5322(c), Group B Test Procedure

Date Issued: December 10, 2004

File: OMI 04-05

Question (1): Is it a requirement of ISTB-5122(c) that the position of valves used to vary system resistance to achieve the reference point be determined and documented during inservice testing of Group B Pumps?

Reply (1): No.

Question (2): Is it a requirement of ISTB-5222(c) that the position of valves used to vary system resistance to achieve the reference point be determined and documented during inservice testing of Group B Pumps?

Reply (2): No.

Question (3): Is it a requirement of ISTB-5322(c) that the position of valves used to vary system resistance to achieve the reference point be determined and documented during inservice testing of Group B pumps?

Reply (3): No.



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**Interpretation: 04-04**

Subject: ASME/ANSI OM Code 1995 and Later Editions, Subsection ISTB, Comprehensive Pump Testing, Group B Pumps

Date Issued: December 10, 2004

File: OMI 04-07

Question: Is it acceptable per Subsection ISTB that if a constant speed centrifugal Group B pump is operated at stable conditions within 10% of the reference differential pressure or flow, that no other determinations, measurements, or actions are required for the Group B pump test?

Reply: Yes.

**Interpretation: 04-05**

Subject: ASME/ANSI OM Code 2001 Edition through OMb Code-2003 Addenda, ISTC-3620 and ISTC-3630, Reference to Appendix J

Date Issued: December 10, 2004

File: OMI 04-08

Question: Is it the intent of ISTC-3620 and ISTC-3630 to reference the Nonmandatory Appendix J, Check Valve Testing Following Valve Reassembly, as shown in the back of the referenced OM Code Edition and Addenda?

Reply: No. The references in ISTC-3620 and ISTC-3630 are intended to refer to the requirements of 10 CFR 50 (Title 10 of the Code of Federal Regulations, Part 50), Appendix J, Primary Reactor Containment Leakage Testing for Water-Cooled Power Reactors.

**Interpretation: 04-06**

Subject: ASME/ANSI OMa Code-1988, Part 6, paras. 4.3, 4.4, and 4.5, Testing Requirements: Reference Values

Date Issued: June 3, 2005

File: OMI 05-03

Question: If previous inservice testing conducted in accordance with Part 6, paras. 4.3 and 4.4 was based on operation at only one pump operating condition, is it a requirement of Part 6, paras. 4.3 and 4.4 to establish, or reconfirm, reference values at more than one pump operating condition following maintenance?

Reply: No.

**Interpretation: 04-07**

Subject: ASME/ANSI OM Code 2001 and Later Editions and Addenda; ISTA-2000, Definitions; ISTB-3500, Data Collection; and ISTB-3520(b), Differential Pressures

Date Issued: June 20, 2005

File: OMI 05-02

Question: Is it a requirement of ISTB-3510(a) that when pump differential pressure is determined by paras. (a) through (c) below, the pressure instruments utilized must be considered an *instrument loop* as defined by ISTA-2000, Definitions?

*(a)* reading pump discharge pressure on an analog or digital pressure indicator
*(b)* reading pump suction pressure on an analog or digital pressure indicator, and then
*(c)* subtracting the suction pressure reading from the discharge pressure reading

Reply: No.



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# OM CODE CASES

A Code Case is the official method of handling a reply to an inquiry when study indicates that the Code wording needs clarification, or when the reply modifies the existing requirements of the Code, or grants permission to use alternative methods.

ASME has agreed to publish Cases issued by the Operation and Maintenance Committee concerning the OM Code as part of the update service to the OM Code. A notice appears in *Mechanical Engineering* when new and revised Cases are approved, as well as announcements of approval of reaffirmed Cases and annulments. All Code Case actions then appear in the next update. Cases currently in effect at the time of publication of a new edition of the Code are included with it as a supplement.

The Case affected by this supplement (OMa Code-2005) is as follows:

| *Page* | *Location* | *Change* |
|---|---|---|
| C-25 | OMN-7 | New expiration date: January 30, 2008 |

The change given above is identified on the page by a margin note, **(a)**, placed next to the affected area. The page not listed is the reverse side of the listed page and contains no changes.



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# CODE CASE OMN-7
# Alternative Requirements for Pump Testing

(a)

This Case shall expire on January 30, 2008 unless previously annulled or reaffirmed.

*Inquiry:* What alternative to the requirements of ASME OM Code, Subarticle ISTB-5.1 may be used in conjunction with Code Case OMN-3, Requirements for Safety Significance Categorization of Components Using Risk Insights for Inservice Testing of LWR Power Plants, for inservice testing to assess the operational readiness of pumps in light water reactor power plants?

*Reply:* It is the opinion of the Committee that, in lieu of the rules of ASME OM Code, Subsection ISTB, Subarticle ISTB-5.1, the following alternative requirements may be applied.

## 1 APPLICABILITY

The pumps covered by this Code Case are all those pumps determined to be within the scope of the risk-informed IST Program in accordance with Code Case OMN-3, Requirements for Safety Significance Categorization of Components Using Risk Insights for Inservice Testing of LWR Power Plants.

## 2 REQUIREMENTS

### 2.1 Related Requirements

Use of this Code Case also requires compliance with the requirements of ASME Code Case OMN-3 (risk ranking). Code Case OMN-3 groups components into one of two categories:

*(a)* high safety significant component (HSSC).

*(b)* low safety significant component (LSSC). Trending of parameters according to OM Code-1995 with OMa Code-1996 meets the performance monitoring requirements of Code Case OMN-3, para. 4.6.

### 2.2 HSSC Testing Requirements

Group A and Group B pumps categorized as HSSCs shall meet all the requirements of OM Code-1995 with OMa Code-1996.

### 2.3 LSSC Testing Requirements

Group A and Group B pumps categorized as LSSCs shall meet all the requirements of OM Code-1995 with OMa Code-1996, except that the testing requirements identified in this paragraph and in the table below may be substituted for those in ISTB 5.1 (Table ISTB 5.1-1). All Group A and Group B LSSC pumps shall receive an initial Group A test conducted within ±20% of pump design flow rate as soon as practical and no later than the first refueling outage following implementation of this Code Case. Thereafter, all Group A and Group B LSSC pumps shall be Group A tested within ±20% of pump design flow rate at least once every 5 years or three refueling outages, whichever is longer.

| Pump Group | Group A Test | Group B Test | Comprehensive Test |
|---|---|---|---|
| Group A (routinely or continuously operated pumps) | 6 months [Note (1)] | Not required | Not required |
| Group B (standby pumps) | 2 years | 6 months [Note (1)] | Not required |

NOTE:

(1) To meet vendor recommendations, pump operation may be required more frequently than the specified test frequency.

## 3 ADDITIONAL REQUIREMENTS

*(a)* The Owner shall develop a transition plan and implementation schedule for this Code Case.

*(b)* Feedback and corrective actions shall be taken in accordance with Code Case OMN-3, para 4.7.

*(c)* If the maximum test interval as determined from the aggregate risk assessment of Code Case OMN-3, para. 4.5.2, for a specific component is more limiting than the test frequency of para. 2.2 or 2.3 above (as applicable), the most limiting test interval shall be used for that component. A Group A or Group B test, as applicable, shall be performed to satisfy the increased test frequency requirements.



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## CODE CASE OMN-8
## Alternative Rules for Preservice and Inservice Testing of Power-Operated Valves That Are Used for System Control and Have a Safety Function Per OM-10

This Case shall expire on November 20, 2006 unless previously annulled or reaffirmed.

*Inquiry:* What alternative requirements to those of ASME/ANSI OMa-1988, Part 10, para. 4.2 through OM Code-1995, ISTC 4.2 may be used for power-operated control valves that have only a fail safe safety function?

*Reply:* It is the opinion of the Committee that the requirements of ASME/ANSI OMa-1988, Part 10, para. 4.2.1.4, Power-Operated Valve Stroke Testing; para. 4.2.1.8, Stroke Time Acceptance Criteria; and para. 4.2.1.9(b) need not be met. All other applicable requirements of para. 4.2 shall be met for ASME/ANSI OMa-1988, Part 10.

Further, the requirements of OM Code-1995, ISTC 4.2.4, Power-Operated Valve Stroke Testing; ISTC 4.2.8, Stroke Time Acceptance Criteria; and ISTC 4.2.9(b) need not be met. All other applicable requirements of the paragraph shall be met.

Any abnormality or erratic action experienced during valve exercising shall be recorded in the record of tests, and an evaluation shall be made regarding need for corrective action.



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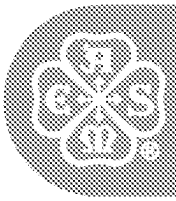

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# Code for Operation and Maintenance of Nuclear Power Plants

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The 2004 edition of this Code is being issued with an automatic addenda subscription service. The use of addenda allows revisions made in response to public review comments or committee actions to be published on a regular yearly basis; revisions published in addenda will become effective 6 months after the Date of Issuance of the addenda. The next edition of this Standard is scheduled for publication in 2007.

ASME issues written replies to inquiries concerning interpretations of technical aspects of this Code. The interpretations will be included with the above addenda service.

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# SECTION IST
# RULES FOR INSERVICE TESTING OF LIGHT-WATER REACTOR POWER PLANTS

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# FOREWORD

The Committee on Operation and Maintenance of Nuclear Power Plants (O&M Committee) was formed in June 1975 when the N45 Committee was disbanded. The N45 Committee was established by the American National Standards Institute (ANSI) and was officially known as the Committee N45 on Reactor Plants and Their Maintenance. The N45 Committee was chartered to promote the development of standards for the location, design, construction, and maintenance of nuclear reactors and plants embodying nuclear reactors, including equipment, methods, and components. ASME assumed the secretariat of several of the N45 committees that related to the requirements contained in Sections III and XI of the ASME Boiler and Pressure Vessel (BPV) Code.

The charter of the O&M Committee, as approved by the ASME Board on Nuclear Codes and Standards, is as follows: To develop, revise, and maintain codes, standards, and guides applicable to the safe and reliable operation and maintenance of nuclear power plants.

The O&M Committee was given responsibility to review Section XI and determine where O&M standards could replace current Section XI requirements. The major areas in Section XI identified as requiring O&M standards development were Article IWP, Inservice Testing of Pumps, and Article IWV, Inservice Testing of Valves. To facilitate development of standards in these areas, Section XI, Subgroup on Pumps and Valves, was transferred to the O&M Committee in 1979 as the O&M Working Group on Pumps and Valves under the Subcommittee on Performance Testing. A new Section XI, Working Group on Pumps and Valves, was established in 1984 to review the O&M standards on pumps and valves to assure that they will be acceptable to Section XI.

Five separate standards published in 1981 and 1982 were consolidated into a single publication, ASME/ANSI OM-1987.

The ASME Board on Nuclear Codes and Standards recognized that O&M is the appropriate committee to establish inservice testing (IST) requirements and voted to proceed with making the O&M Standard stand on its own, with the objective of eventual deletion of IST from Section XI of the Boiler and Pressure Vessel Code when appropriate. A transition was implemented in which Parts 1, 4, 6, and 10 of ASME/ANSI OM-1987 (with the three published Addenda, ASME/ANSI OMa-1988, ASME/ANSI OMb-1989, and ASME/ANSI OMc-1990) were incorporated into ASME OM Code-1990, Code for Operation and Maintenance of Nuclear Power Plants. Parts 2, 3, 5, 7, 8, 13, and 16 were incorporated into ASME OM-S/G-1990, Standards and Guides for Operation and Maintenance of Nuclear Power Plants. The transition did not result in technical changes to the existing IST requirements. In ASME OMa-S/G-1991, Parts 11 and 12 were added. In ASME OMb-S/G-1992, Part 14 was added. In ASME OMc-S/G-1993, Part 8 was added as a Standard. In OM-S/G-1994, Part 21 was added as a Standard.

This publication was developed and is maintained by the ASME Committee on Operation and Maintenance of Nuclear Power Plants. The Committee operates under procedures accredited by the American National Standards Institute as meeting the criteria of consensus procedures for American National Standards. It was approved by the ASME Board on Nuclear Codes and Standards and subsequently approved by the American National Standards Institute on July 23, 2004.



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# PREPARATION OF TECHNICAL INQUIRIES TO THE COMMITTEE ON OPERATION AND MAINTENANCE OF NUCLEAR POWER PLANTS

## INTRODUCTION

The ASME Committee on Operation and Maintenance of Nuclear Power Plants meets regularly to conduct standards development business. This includes consideration of written requests for interpretations, Code Cases, and revisions to Operation and Maintenance Code and development of new requirements as dictated by technological development. This supplement provides guidance to Code users for submitting technical inquiries to the Committee. Technical inquiries include requests for revisions or additions to the Code requirements, requests for Code Cases, and requests for Code interpretations.

Code Cases may be issued by the Committee when the need is urgent. Code Cases clarify the intent of existing Code requirements or provide alternative requirements. Code Cases are written as a question and a reply and are usually intended to be incorporated into the Code at a later date. Code interpretations provide the meaning of or the intent of existing requirements in the Code and are also presented as a question and reply. Both Code Cases and Code interpretations are published by the Committee.

The Code requirements, Code Cases, and Code interpretations established by the Committee are not to be considered as approving, recommending, certifying, or endorsing any proprietary or specific design or as limiting in any way the freedom of manufacturers or constructors to choose any method of design or any form of construction that conforms to the Code requirements.

Moreover, ASME does not act as a consultant on specific engineering problems or on the general application or understanding of the Code requirements. If, based on the inquiry information submitted, it is the opinion of the Committee that the inquirer should seek assistance, the inquiry will be returned with the recommendation that such assistance be obtained.

As an alternate to the requirements of this Supplement, members of the Committee and its subcommittees, subgroups, and working groups may introduce requests for Code revisions or additions, Code Cases, and Code interpretations at their respective Committee meetings or may submit such requests to the secretary of a subcommittee, subgroup, or working group.

All inquiries that do not provide the information needed for the Committee's full understanding will be returned.

## INQUIRY FORMAT

Submittals to the Committee shall include:

*(a) Purpose.* Specify one of the following:

*(1)* revision of present Code requirement(s)

*(2)* new or additional Code requirement(s)

*(3)* Code Case

*(4)* Code interpretation

*(b) Background.* Provide the information needed for the Committee's understanding of the inquiry, being sure to include reference to the applicable Code subsection, appendix, edition, addenda, paragraphs, figures, and tables. Preferably, provide a copy of the specific referenced portions of the Code.

*(c) Presentations.* The inquirer may desire or be asked to attend a meeting of the Committee to make a formal presentation or to answer questions from the Committee members with regard to the inquiry. Attendance at a committee meeting shall be at the expense of the inquirer. The inquirer's attendance or lack of attendance at a meeting shall not be a basis for acceptance or rejection of the inquiry by the Committee.



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## CODE REVISIONS AND ADDITIONS

Requests for Code revisions or additions shall provide the following:

*(a) Proposed Revision(s) or Addition(s).* For revisions, identify the requirements of the Code that require revision and submit a copy of the appropriate requirements as they appear in the Code marked up with the proposed revision. For additions, provide the recommended wording referenced to the existing Code requirements.

*(b) Statement of Need.* Provide a brief explanation of the need for the revision(s) or addition(s).

*(c) Background Information.* Provide background information to support the revision(s) or addition(s) including any data or changes in technology that form the basis for the request that will allow the Committee to adequately evaluate the proposed revision(s) or addition(s). Sketches, tables, figures, and graphs should be submitted as appropriate. When applicable, identify any pertinent paragraph in the Code that would be affected by the revision(s) or addition(s) and paragraphs in the Code that reference the paragraphs that are to be revised or added.

## CODE CASES

Requests for Code Cases shall provide a *Statement of Need* and *Background Information* similar to that defined in subparas. (b) and (c) of "Code Revisions or Additions" section. The proposed Code Case should identify the Code Section and Division and be written as a *Question* and *Reply* in the same format as existing Code Cases. Requests for Code Cases should also indicate the applicable Code edition(s) and addenda to which the proposed Code Case applies.

## CODE INTERPRETATIONS

Requests for Code interpretations shall provide the following:

*(a) Inquiry.* Provide a condensed and precise question, omitting superfluous background information, and, when possible, composed in such a way that a "yes" or a "no" *Reply,* possibly with brief provisos, is acceptable. The question should be technically and editorially correct.

*(b) Reply.* Provide a proposed *Reply* that will clearly and concisely answer the *Inquiry* question. Preferably, the *Reply* should be "yes" or "no" possibly with brief provisos.

*(c) Background Information.* Provide any background information that will assist the Committee in understanding the proposed *Inquiry* and *Reply.*

## SUBMITTALS

Submittals to and responses from the Committee shall meet the following:

*(a) Submittal.* Inquiries from Code users shall preferably be submitted in typewritten form; however, legible handwritten inquiries will also be considered. They shall include the name, address, telephone number, and fax number, if available, of the inquirer and be mailed to the following address:

Secretary
Committee on Operation and Maintenance of
Nuclear Power Plants
The American Society of Mechanical Engineers
Three Park Avenue
New York, NY 10016-5990

*(b) Response.* The Secretary of the Operation and Maintenance Committee shall acknowledge receipt of each properly prepared inquiry and shall provide a written response to the inquirer upon completion of the requested action by the Committee.



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(04)

# PREFACE

## ORGANIZATION OF THIS CODE

This Code is published with one Section, entitled Section IST, Rules for Inservice Testing of Light-Water Reactor Nuclear Power Plants. Section IST is divided into Subsections, mandatory appendices, and nonmandatory appendices. Provisions for adding future Sections exist.

Parts 1, 4, 6, and 10 from ASME/ANSI OM-1987, Operation and Maintenance of Nuclear Power Plants, are incorporated into this Code as shown below:

| OM Code Designation | Previous OM-1987 Designation | |
|---|---|---|
| Appendix I | Part 1 | Requirements for Inservice Performance Testing of Nuclear Power Plant Pressure Relief Devices |
| Subsection ISTD | Part 4 | Examination and Performance Testing of Nuclear Power Plant Dynamic Restraints (Snubbers) |
| Subsection ISTB | Part 6 | Inservice Testing of Pumps in Light-Water Reactor Power Plants |
| Subsection ISTC | Part 10 | Inservice Testing of Valves in Light-Water Reactor Power Plants |

Parts 2, 3, 5, 7, 8, 11, 12, 13, 14, 15, 16, and 21 are published in a separate document entitled ASME OM-S/G-2003, Standards and Guides for Operation and Maintenance of Nuclear Power Plants.

The contents of this Code are arranged as follows:

| | |
|---|---|
| Subsection ISTA | General Requirements |
| Subsection ISTB | Inservice Testing of Pumps in Light-Water Reactor Nuclear Power Plants |
| Subsection ISTC | Inservice Testing of Valves in Light-Water Reactor Nuclear Power Plants |
| Subsection ISTD | Preservice and Inservice Examination and Testing of Dynamic Restraints (Snubbers) in Light-Water Reactor Nuclear Power Plants |
| Mandatory Appendix I | Inservice Testing of Pressure Relief Devices in Light-Water Reactor Nuclear Power Plants |
| Mandatory Appendix II | Check Valve Condition Monitoring Program |
| Nonmandatory Appendix A | Preparation of Test Plans |
| Nonmandatory Appendix B | Dynamic Restraint Examination Checklist Items |
| Nonmandatory Appendix C | Dynamic Restraint Design and Operating Information |
| Nonmandatory Appendix D | Comparison of Sampling Plans for Inservice Testing of Dynamic Restraints |
| Nonmandatory Appendix E | Flowchart for 10% and 37 Snubber Testing Plans |
| Nonmandatory Appendix F | Dynamic Restraint (Snubbers) Service Life Monitoring Methods |
| Nonmandatory Appendix G | Application of Table ISTD-4252-1, Snubber Visual Examination |
| Nonmandatory Appendix H | Test Parameters and Methods |
| Nonmandatory Appendix J | Check Valve Testing Following Valve Reassembly |



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## DESCRIPTION OF SUBSECTIONS AND MANDATORY APPENDICES

The following description is intended to provide the reader with general information on the scope of coverage and rationale for development of each item described.

### Subsection ISTA: General Requirements

This Subsection is derived from the ASME Boiler and Pressure Vessel Code, Section XI, Division 1, Subsection IWA, and contains requirements directly applicable to inservice testing. Included are Owner's responsibility, duties of Inspector, and records.

### Subsection ISTB: Inservice Testing of Pumps in Light-Water Reactor Nuclear Power Plants

This Subsection establishes the requirements for inservice testing of pumps in light-water reactor nuclear power plants. The pumps covered are those provided with an emergency power source, that are required in shutting down a reactor to the safe shutdown condition, in maintaining the safe shutdown condition, or in mitigating the consequences of an accident. These pumps are either centrifugal or positive displacement-type pumps.

The ASME Boiler and Pressure Vessel (BPV) Code and other American National Standards have been considered in the development of this Subsection, and this Subsection is intended to be compatible with their requirements. The major interface with this Subsection is Subsection IWP (Inservice Testing of Pumps in Nuclear Power Plants) of Section XI of the BPV Code.

### Subsection ISTC: Inservice Testing of Valves in Light-Water Reactor Nuclear Power Plants

This Subsection establishes the requirements for inservice testing of valves in light-water reactor nuclear power plants. The valves covered include those which provide overpressure protection (and their actuating and position-indicating systems) and are required to perform a specific function, either actively by changing valve obturator position or passively by effectively maintaining required obturator position in shutting down a reactor to the safe shutdown condition, in maintaining the safe shutdown condition, or in mitigating the consequences of an accident.

The ASME Boiler and Pressure Vessel (BPV) Code and other American National Standards have been considered in the development of this Subsection, and this Subsection is intended to be compatible with their requirements. The major interface with this Subsection is Subsection IWV (Inservice Testing of Valves in Nuclear Power Plants) of Section XI, Division 1, of the BPV Code.

### Subsection ISTD: Preservice and Inservice Examination and Testing of Dynamic Restraints (Snubbers) in Light-Water Reactor Nuclear Power Plants

This Subsection establishes the examination and testing requirements of nuclear power plant equipment dynamic restraints (snubbers) throughout the life of the plant. This Subsection covers the preservice and inservice examination and testing intervals, criteria, and data requirements. The requirements are applicable to examination and testing of Classes 1, 2, and 3, and MC component snubbers.

### Mandatory Appendix I: Inservice Testing of Pressure Relief Devices in Light-Water Reactor Nuclear Power Plants

This Appendix provides the requirements for performance testing and monitoring of nuclear power plant pressure relief devices. Methods, intervals, and record requirements for monitoring and testing are established, as well as guidelines for the evaluation of results. The criteria presented shall apply to pressure relief devices utilized in nuclear power plant systems included in Section III of the ASME Boiler and Pressure Vessel (BPV) Code, which are required to perform a specific function in shutting down a reactor to the safe shutdown condition, in maintaining the safe shutdown condition, or in mitigating the consequences of an accident. This Appendix may be applied to safety valves, safety relief valves, relief valves, pilot-operated pressure relief valves, power-actuated pressure relief valves, nonreclosing pressure relief devices, and vacuum relief devices, including all accessories and appurtenances. Accessories and appurtenances include,



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but are not limited to, solenoid valves, air actuators, cylinders, and pressure switches. Earlier, as an OM Part, it was referenced in Section XI, Division 1, IWV-1000, in the Winter 1985 Addenda, replacing the old reference in BPV Section XI to PTC 25.3.

### Mandatory Appendix II: Check Valve Condition Monitoring Program

As an alternative to the testing or examination requirements of ISTC-3510 through ISTC- 5221, the Owner may establish a condition monitoring program. The purpose of this program is both to improve valve performance and to optimize testing, examination, and preventive maintenance activities in order to maintain the continued acceptable performance of a select group of check valves. The Owner may implement this program on a valve or a group of similar valves. This Appendix establishes the requirements for implementing and maintaining a check valve condition monitoring program as discussed in ISTC-5222.



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# ASME OM CODE-2004
# SUMMARY OF CHANGES

Following approval by the ASME Committee on Operation and Maintenance of Nuclear Power Plants and ASME, and after public review, ASME OM Code-2004 was approved by the American National Standards Institute on July 23, 2004.

The ASME OM Code-2004 consists of OM Code-2001, OMa Code-2002, and OMb Code-2003, as well as the following additional changes.

Changes given below are identified on the indicated pages by a margin note, **(04)**, placed next to the affected area. The pages not listed are the reverse sides of the listed pages and contain no changes.

| *Page* | *Location* | *Change* |
|---|---|---|
| xii | Preface | Revised |
| 8 | Table ISTB-3510-1 | Former Table ISTB-3500-1 redesignated |
| 10 | Table ISTB-5121-1 | (1) Former Table ISTB-5100-1 redesignated<br>(2) Note (2) revised |
| 12 | Table ISTB-5221-1 | (1) Former Table ISTB-5200-1 redesignated<br>(2) Note (2) revised |
| 13 | Fig. ISTB-5223-1 | Former Fig. ISTB-5200-1 redesignated |
| 14 | Table ISTB-5321-1 | (1) Former Table ISTB-5300-1 redesignated<br>(2) Note (2) revised |
| | Table ISTB-5321-2 | Former Table ISTB-5300-2 redesignated |
| 18 | Table ISTC 3500-1 | Note (1) revised |
| 19, 20 | ISTC-3620 | Revised |
| | ISTC-3630 | (1) First paragraph revised<br>(2) Second sentence of subpara. (b)(4) revised<br>(3) Subparagraphs (e)(1) and (2) revised |
| | ISTC-5114 | In subpara. (c), reference revised |
| | ISTC-5115 | In subpara. (a), reference revised |
| 23–25 | ISTC-5222 | References revised |
| | ISTC-9110 | In subpara. (d), references revised |
| | ISTC-9200 | In the first paragraph and subpara. (d), references revised |
| 40 | I-3300 | References revised |
| 41 | I-3360 | Reference revised |
| | I-3410 | Subparagraphs (a) and (d) revised |



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| *Page* | *Location* | *Change* |
|---|---|---|
| 42 | I-3460 | Reference revised |
| 43 | I-4120 | Subparagraph (h) revised |
| 44 | I-4320 | In subpara. (a), second reference revised |
| 46 | I-7300 | References revised |
| 47 | I-7370 | Reference revised |
| 48 | I-7470 | Reference revised |
| 50, 51 | I-8320 | In Subpara. (a), references revised |

**SPECIAL NOTE:**

The Interpretations to ASME OM Code issued between June 1, 2003 and January 8, 2004, and current approved Code Cases to the OM Code follow the last page of this edition as separate supplements.



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# CODE FOR OPERATION AND MAINTENANCE OF NUCLEAR POWER PLANTS

# SUBSECTION ISTA
# General Requirements

## ISTA-1000 INTRODUCTION

### ISTA-1100 Scope

Section IST establishes the requirements for preservice and inservice testing and examination of certain components to assess their operational readiness in light-water reactor nuclear power plants. It identifies the components subject to test or examination, responsibilities, methods, intervals, parameters to be measured and evaluated, criteria for evaluating the results, corrective action, personnel qualification, and record keeping. These requirements apply to

*(a)* pumps and valves that are required to perform a specific function in shutting down a reactor to the safe shutdown condition, in maintaining the safe shutdown condition, or in mitigating the consequences of an accident

*(b)* pressure relief devices that protect systems or portions of systems that perform one or more of these three functions

*(c)* dynamic restraints (snubbers) used in systems that perform one or more of these three functions, or to ensure the integrity of the reactor coolant pressure boundary

### ISTA-1200 Jurisdiction

The jurisdiction of Section IST covers individual components that have met all the requirements of the construction code commencing at the time when the construction code requirements have been met, irrespective of the physical location. When portions of systems or plants are completed at different times, the jurisdiction of this Section shall cover only those components on which all construction related to the components has been completed.

### ISTA-1300 Application

**ISTA-1310 Components Subject to Testing and Examination.** Components identified in Section IST for testing or examination shall be included in the test plan (ISTA-3110). These components include nuclear power plant items such as pumps, valves, and dynamic restraints (snubbers).

**ISTA-1320 Classifications.** Optional construction of a component in a system boundary to a classification higher than the minimum class established in the component Design Specification (either upgrading from Class 2 to Class 1 or Class 3 to Class 2) shall not affect the overall system classification by which the applicable requirements of Section IST are determined.

**Table ISTA-1400-1 Referenced Standards and Specifications**

| Standard or Specification | Revision Date or Indicator |
|---|---|
| ANSI/ASME NQA-1 | 1979 |
| PTC 25 | 1994 |
| API RP-527 | 3rd edition, 1991 |

### ISTA-1400 Referenced Standards and Specifications

When standards and specifications are referenced in Section IST, their revision date or indicator shall be as shown in Table ISTA-1400-1.

### ISTA-1500 Owner's Responsibilities

The responsibilities of the Owner of the nuclear power plant shall include the following:

*(a)* determination of the appropriate Code Class for each component of the plant, identification of the system boundaries for each class of components subject to test or examination, and the components exempt from testing or examination requirements

*(b)* design and arrangement of system components to include allowance for adequate access and clearances for conduct of the tests and examinations

*(c)* preparation of plans and schedules

*(d)* preparation of written test and examination instructions and procedures



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*(e)* qualification of personnel who perform and evaluate examinations and tests in accordance with the Owner's quality assurance program

*(f)* performance of required tests and examinations

*(g)* recording of required test and examination results that provide a basis for evaluation and facilitate comparison with the results of subsequent tests or examinations

*(h)* evaluation of tests and examination results

*(i)* maintenance of adequate test and examination records such as test and examination data and description of procedures used

*(j)* retention of all test and examination records for the service lifetime of the component or system

*(k)* documentation of a quality assurance program in accordance with either of the following:

*(1)* Title 10, Code of Federal Regulations, Part 50

*(2)* ASME NQA-1, Parts II and III

### ISTA-1600 Accessibility

Provisions for examination shall include access for the examination personnel and equipment necessary to conduct the test or examination.

## ISTA-2000 DEFINITIONS

*equipment dynamic restraint (snubber):* device that provides restraint to a component or system during the sudden application of forces, but allows essentially free motion during thermal movement.

*examination:* observing, visual monitoring, or measuring to determine conformance to Owner-specified requirements.

*exercising:* demonstration based on direct visual or indirect positive indications that the moving parts of a component function.

*hydraulic snubbers:* equipment dynamic restraints in which load is transmitted through a hydraulic fluid.

*inservice test:* test to assess the operational readiness of a system, structure, or component after first electrical generation by nuclear heat.

*instrument loop:* two or more instruments or components working together to provide a single output.

*instrument loop accuracy:* accuracy 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 when considered separately. Alternatively, the allowable inaccuracy of the instrument loop may be based on the output for a known input into the instrument loop.

*maintenance:* replacement of parts, adjustments, and similar actions that do not change the design (configuration and material) of an item.

*mechanical snubbers:* equipment dynamic restraints in which load is transmitted entirely through mechanical components.

*modification:* alteration in the design of a system, structure, or component.

*monitoring:* continuous or periodic observation or measurement to ascertain the performance or obtain characteristics of a system, structure, or component.

*nonintrusive testing:* testing performed on a component without disassembly or disturbing the boundary of the component.

*obturator:* valve closure member (disk, gate, plug, etc.).

*operational readiness:* the ability of a component to perform its specified functions.

*overpressure protection:* the means by which components are protected from overpressure by the use of pressure-relieving devices or other design provisions as required by the BPV Code, Section III, or other applicable construction codes.

*Owner:* an organization owning or operating a facility where items are installed or used.

*performance testing:* a test to determine whether a system or component meets specified acceptance criteria.

*plant operation:* the conditions of startup, operation at power, hot standby, and reactor cooldown, as defined by plant technical specifications.

*preservice test:* test performed after completion of construction activities related to the component and before first electrical generation by nuclear heat, or in an operating plant, before the component is initially placed in service.

*preservice test period:* the period of time following completion of construction activities related to the component and before first electrical generation by nuclear heat, in which component and system testing takes place, or in an operating plant prior to the component being initially placed in service.

*pump:* a mechanical device used to move fluid.

*qualitative testing:* testing performed to establish parameters without determining the specific measure of the parameter.

*quantitative testing:* testing performed to establish the specific measure or limit of a parameter, such as that required to establish that a parameter is within a specified range.

*reference point:* a point of operation at which reference values are established and inservice test parameters are measured for comparison with applicable acceptance criteria.

*reference values:* one or more values of parameters as measured or determined when the equipment is known to be operating acceptably.



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*repair:* the process of restoring a degraded item to its original design requirements.

*routine servicing:* performance of planned, preventive maintenance.

*skid-mounted pumps and valves:* pumps and valves integral to or that support operation of major components, even though these pumps and valves may not be located directly on the skid. In general, these pumps and valves are supplied by the manufacturer of the major component. Examples include

*(a)* diesel fuel oil pumps and valves

*(b)* steam admission and trip throttle valves for high-pressure coolant injection turbine-driven pumps

*(c)* steam admission and trip throttle valves for auxiliary feedwater turbine-driven pumps

*(d)* solenoid-operated valves provided to control an air-operated valve

*system resistance:* hydraulic resistance to flow.

*trending:* a comparison of current data to previous data obtained under similar conditions for the same equipment.

*valves, active:* valves that are required to change obturator position to accomplish a specific function in shutting down a reactor to the safe shutdown condition, maintaining the safe shutdown condition, or mitigating the consequences of an accident.

*valves, passive:* valves that maintain obturator position and are not required to change obturator position to accomplish the required function(s) in shutting down a reactor to the safe shutdown condition, maintaining the safe shutdown condition, or mitigating the consequences of an accident.

## ISTA-3000 GENERAL REQUIREMENTS

### ISTA-3100 Test and Examination Program

**ISTA-3110 Test and Examination Plans.** Test plans shall be prepared for the preservice test period, initial inservice, and subsequent inservice test intervals.[1] Each inservice test plan shall include the following:

*(a)* the edition and addenda of this Section that apply to the required tests and examinations

*(b)* the classification of the components and the boundaries of system classification

*(c)* identification of the components subject to tests and examination

*(d)* the Code requirements for each component and the test or examination to be performed

*(e)* the Code requirements for each component that are not being satisfied by the tests or examinations; and justification for substitute tests or examinations

*(f)* Code Cases proposed for use and the extent of their application

*(g)* test or examination frequency or a schedule for performance of tests and examinations, as applicable

**ISTA-3120 Inservice Test Interval**

*(a)* The frequency for inservice testing shall be in accordance with the requirements of Section IST.

*(b)* The inservice test interval shall be determined by calendar years following placement of the unit into commercial service.

*(c)* The inservice test intervals shall comply with the following, except as modified by ISTA-3120(d) and ISTA-3120(e):

*(1) Initial Test Interval:* 10 years following initial start of unit commercial service

*(2) Successive Test Intervals:* 10 years following the previous test interval

*(d)* Each of the inservice test intervals may be extended or decreased by as much as 1 year. Adjustments shall not cause successive intervals to be altered by more than 1 year from the original pattern of intervals.

*(e)* In addition to ISTA-3120(d), for units that are out of service continuously for 6 months or more, the inservice test interval during which the outage occurred may be extended for a period equivalent to the outage and the original pattern of intervals extended accordingly for successive intervals.

*(f)* The inservice test intervals for component replacements, additions, and alterations that may be required during the service lifetime of the unit shall coincide with the remaining intervals, as determined by the calendar years of unit service at the time of replacement, addition, or alteration.

**ISTA-3130 Application of Code Cases**

*(a)* Code Cases to be used during a preservice or inservice test or examination shall be identified in the test plan.

*(b)* Code Cases shall be applicable to the edition and addenda specified in the test plan.

*(c)* Code Cases shall be in effect at the time the test plan is filed, except as provided in ISTA-3130(d).

*(d)* Code Cases issued subsequent to filing the test plan may be proposed for use in amendments to the test plan.

**ISTA-3140 Application of Revised Code Cases.** Superseded Code Cases approved for use in accordance with ISTA-3130 may continue to be used.

**ISTA-3150 Application of Annulled Code Cases.** Code Cases approved for use in accordance with ISTA-3130 or ISTA-3140 may be used after annulment for the duration of that test plan.

**ISTA-3160 Test and Examination Procedures.** Tests and examinations shall be performed in accordance with

[1] Guidance for the preparation of test plans is in Nonmandatory Appendix A.



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written procedures. The procedures shall contain the Owner-specified reference values and acceptance criteria.

### ISTA-3200 Administrative Requirements

*(a)* IST Plans shall be filed with the regulatory authorities having jurisdiction at the plant site.

*(b)* The selection of components included in the test plan is subject to review by the regulatory authorities having jurisdiction at the plant site.

*(c)* Application of the requirements of this Section shall be governed by group classification criteria of the regulatory authority having jurisdiction at the plant site.

*(d)* The use of any Code Case is subject to acceptance by the regulatory authorities having jurisdiction at the plant site.

*(e)* Revisions to a previously approved Code Case may be substituted for that Code Case with the acceptance of the regulatory authorities having jurisdiction at the plant site.

*(f)* Tests and examinations shall meet the requirements of the edition and addenda of this Section specified in the following paragraphs:

*(1) Preservice Test Period.* The test plan for the preservice test period shall comply with the edition and addenda of this Section that has been adopted by the regulatory authority 36 months prior to the docket date of the unit's construction permit, or subsequent editions and addenda that have been adopted by the regulatory authority. Specific portions of such subsequent editions and addenda may be used, provided all related requirements are met.

*(2) Initial Inservice Test Interval.* The test plan for the initial inservice test interval shall comply with the edition and addenda of the Section that have been adopted by the regulatory authority 12 months prior to the issuance of the operating license, or subsequent editions and addenda that have been adopted by the regulatory authority. Specific portions of such subsequent editions or addenda may be used, provided all related requirements are met.

*(3) Successive Inservice Test Intervals.* The test plan for each successive inservice test interval shall comply with the edition and addenda of the Section that have been adopted by the regulatory authority 12 months prior to the start of the inservice test interval, or subsequent editions and addenda that have been adopted by the regulatory authority. Specific portions of such subsequent editions or addenda may be used, provided all related requirements are met.

### ISTA-3300 Corrective Actions

Corrective actions requiring repair/replacement activities shall be performed in accordance with ASME Section XI, as applicable. Other corrective actions shall be performed in accordance with the Owner's quality assurance program.

## ISTA-4000 INSTRUMENTATION AND TEST EQUIPMENT

### ISTA-4100 Range and Accuracy

Instrumentation and test equipment used in performing the examination and testing program shall have the range and accuracy necessary to demonstrate conformance to specific examination or test requirements.

### ISTA-4200 Calibration

All instruments and test equipment used in performing the examination and testing program shall be calibrated and controlled in accordance with the Owner's administrative procedures or a quality assurance program approved by the Owner.

## ISTA-5000 RESERVED

## ISTA-6000 RESERVED

## ISTA-7000 RESERVED

## ISTA-8000 RESERVED

## ISTA-9000 RECORDS AND REPORTS

### ISTA-9100 Scope

The requirements for retention of records apply to those records generated in the course of performing preservice and inservice tests and examinations required by Section IST.

### ISTA-9200 Requirements

#### ISTA-9210 Owner's Responsibility

*(a)* The Owner shall prepare plans for preservice and inservice tests and examinations to meet the requirements of Section IST.

*(b)* The Owner shall prepare and retain records of the preservice and inservice tests and examinations.

#### ISTA-9220 Preparation

*(a)* Test and examination records shall be prepared in accordance with the requirements of this article in conjunction with the Subsection applicable to the test requirements.

*(b)* Plans and records shall have a cover sheet providing the following information:

*(1)* date of document completion

*(2)* name and address of Owner

*(3)* name and address of plant



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(4) name and number designation of the unit

(5) commercial service date for the unit

**ISTA-9230 Inservice Test and Examination Results.** The results of tests and examinations shall be documented and shall include the following, as a minimum:

(a) equipment identification

(b) date of test or examination

(c) reason for test or examination (e.g., post-maintenance, routine inservice test or examination, establishing reference values, etc.)

(d) test or examination procedure used

(e) identification of test equipment used

(f) calibration records

(g) values of measured parameters

(h) comparison with allowable ranges of test and examination values, and analysis of deviations

(i) requirement for corrective action

(j) printed (or typed) name and signature of the person(s) responsible for conducting and analyzing the test and examination

**ISTA-9240 Record of Corrective Actions.** The Owner shall maintain records of corrective action that shall include a summary of the corrective actions made, the subsequent inservice test or examination, confirmation of operational adequacy, and the printed (or typed) name and signature of the person(s) responsible for the corrective action and verification of results.

## ISTA-9300 Retention

**ISTA-9310 Maintenance of Records.** The Owner shall retain records identified in ISTA-9330 as a minimum. The records shall be filed and maintained. The Owner shall provide suitable protection from deterioration and damage for all records, in accordance with the Owner's quality assurance program for the service lifetime of the component or system. Storage shall be either at the plant site or at another location that will meet the access and quality assurance program requirements.

**ISTA-9320 Reproduction.** Records shall be either the original or a legible copy.

**ISTA-9330 Test and Examination Records.** The Owner shall be responsible for designating the records to be maintained. Such records shall include the following as a minimum:

(a) an index to record file

(b) test plans (see ISTA-3110)

(c) test and examination results

(d) records of corrective actions



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# SUBSECTION ISTB
# Inservice Testing of Pumps in Light-Water Reactor Nuclear Power Plants

## ISTB-1000 INTRODUCTION

### ISTB-1100 Applicability

The requirements of this Subsection apply to certain centrifugal and positive displacement pumps that have an emergency power source.

### ISTB-1200 Exclusions

The following are excluded from this Subsection:

*(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

*(c)* skid-mounted pumps that are tested as part of the major component and are justified by the Owner to be adequately tested

### ISTB-1300 Pump Categories

All pumps within the scope of ISTA-1100 and ISTB-1100 shall be categorized as either a Group A or Group B pump.

### ISTB-1400 Owner's Responsibility

In addition to the requirements of ISTA-1500, it is the Owner's responsibility to

*(a)* include in both the pumps and plant design all necessary valving, instrumentation, test loops, required fluid inventory, or other provisions that are required to fully comply with the requirements of this Subsection.

*(b)* identify each pump to be tested in accordance with the rules of this Subsection and categorize it as either a Group A or Group B pump and list the pumps in the plant records (see ISTB-9000). A pump that meets both Group A and Group B pump definitions shall be categorized as a Group A pump.

## ISTB-2000 SUPPLEMENTAL DEFINITIONS

The following are provided to ensure a uniform understanding of selected terms used in this Subsection.

*Group A pumps:* pumps that are operated continuously or routinely during normal operation, cold shutdown, or refueling operations.

*Group B pumps:* pumps in standby systems that are not operated routinely except for testing.

*vertical line shaft pump:* a vertically suspended pump where the pump driver and pump element are connected by a line shaft within an enclosed column.

## ISTB-3000 GENERAL TESTING REQUIREMENTS

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.

The parameters to be measured during preservice and inservice testing are specified in Table ISTB-3000-1.

### ISTB-3100 Preservice Testing

During the preservice test period or before implementing inservice testing, an initial set of reference values shall be established for each pump. These tests shall be conducted under conditions as near as practicable to those expected during subsequent inservice testing. Except as specified in ISTB-3310, only one preservice test is required for each pump. A set of reference values shall be established in accordance with ISTB-3300 for each pump required to be tested by this Subsection. Preservice testing shall be performed in accordance with the requirements of the following paragraphs:

*(a)* centrifugal pump tests (except vertical line shaft centrifugal pumps) in accordance with ISTB-5110

*(b)* vertical line shaft centrifugal pump tests in accordance with ISTB-5210

*(c)* positive displacement pump (except reciprocating) tests in accordance with ISTB-5310

*(d)* reciprocating positive displacement pump tests in accordance with ISTB-5310

### ISTB-3200 Inservice Testing

Inservice testing of a pump in accordance with this Subsection shall commence when the pump is required to be operable (see ISTB-1100). Inservice testing shall be performed in accordance with the requirements of the following paragraphs:

*(a)* centrifugal pump tests (except vertical line shaft centrifugal pumps) in accordance with ISTB-5120

*(b)* vertical line shaft centrifugal pump tests in accordance with ISTB-5220



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**Table ISTB-3000-1 Inservice Test Parameters**

| Quantity | Preservice Test | Group A Test | Group B Test | Comprehensive Test | Remarks |
|---|---|---|---|---|---|
| Speed, $N$ | X | X | X | X | If variable speed |
| Differential Pressure, $\Delta P$ | X | X | X [Note (1)] | X | Centrifugal pumps, including vertical line shaft pumps |
| Discharge Pressure, $P$ | X | X | . . . | X | Positive displacement pumps |
| Flow Rate, $Q$ | X | X | X [Note (1)] | X | . . . |
| Vibration | X | X | . . . | X | Measure either $V_d$ or $V_v$ |
| Displacement, $V_d$ | . . . | . . . | . . . | . . . | Peak-to-peak |
| Velocity, $V_v$ | . . . | . . . | . . . | . . . | Peak |

NOTE:
(1) For positive displacement pumps, flow rate shall be measured or determined; for all other pumps, differential pressure or flow rate shall be measured or determined.

*(c)* positive displacement pump (except reciprocating) tests in accordance with ISTB-5320

*(d)* reciprocating positive displacement pump tests in accordance with ISTB-5320

## ISTB-3300 Reference Values

Reference values shall be obtained as follows:

*(a)* Initial reference values shall be determined from the results of testing meeting the requirements of ISTB-3100, Preservice Testing, or from the results of the first inservice test.

*(b)* New or additional reference values shall be established as required by ISTB-3310, ISTB-3320, or ISTB-6200(c).

*(c)* Reference values shall be established only when the pump is known to be operating acceptably.

*(d)* Reference values shall be established at a point(s) of operation (reference point) readily duplicated during subsequent tests.

*(e)* Reference values shall be established in a region(s) of relatively stable pump flow.

*(1)* Reference values shall be established within ±20% of pump design flow rate for the comprehensive test.

*(2)* Reference values shall be established within ±20% of pump design flow for the Group A and Group B tests, if practicable. If not practicable, the reference point flow rate shall be established at the highest practical flow rate.

*(f)* All subsequent test results shall be compared to these initial reference values or to new reference values established in accordance with ISTB-3310, ISTB-3320, or ISTB-6200(c).

*(g)* Related conditions that can significantly influence the measurement or determination of the reference value shall be analyzed in accordance with ISTB-6400.

**ISTB-3310 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 in accordance with ISTB-3300, or the previous value reconfirmed by a comprehensive or Group A test run before declaring the pump operable. The Owner shall determine whether the requirements of ISTB-3100, to reestablish reference values, apply. Deviations between the previous and new set of reference values shall be evaluated, and verification that the new values represent acceptable pump operation shall be placed in the record of tests (see ISTB-9000).

**ISTB-3320 Establishment of Additional Set of Reference Values.** If it is necessary or desirable, for some reason other than stated in ISTB-3310, to establish an additional set of reference values, a Group A or comprehensive test shall be run at the conditions of an existing set of reference values and the results analyzed. If operation is acceptable per ISTB-6200, an additional set of reference values may be established as follows:

*(a)* For centrifugal and vertical line shaft pumps, the additional set of reference values shall be determined from the pump curve established in ISTB-5110 or ISTB-5210, as applicable. Vibration acceptance criteria shall be established by a Group A or comprehensive test at the new reference point. If vibration data was taken at all points used in determining the pump curve, an interpolation of the new vibration reference value is acceptable.

*(b)* For positive displacement pumps, the additional set of reference values shall be established per ISTB-5310.

A test shall be run to verify the new reference values before their implementation. 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 ISTB-9000). The requirements of ISTB-3300 apply.

## ISTB-3400 Frequency of Inservice Tests

An inservice test shall be run on each pump as specified in Table ISTB-3400-1.



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**Table ISTB-3400-1 Inservice Test Frequency**

| Pump Group | Group A Test | Group B Test | Comprehensive Test |
|---|---|---|---|
| Group A | Quarterly | N/A | Biennially |
| Group B | N/A | Quarterly | Biennially |

GENERAL NOTE: N/A = Not applicable.

(04) **Table ISTB-3510-1 Required Instrument Accuracy**

| Quantity | Group A and Group B Test, % | Comprehensive and Preservice Tests, % |
|---|---|---|
| Pressure | ±2 | ±½ |
| Flow rate | ±2 | ±2 |
| Speed | ±2 | ±2 |
| Vibration | ±5 | ±5 |
| Differential pressure | ±2 | ±½ |

**ISTB-3410 Pumps in Regular Use.** Group A 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 the pump was operated at least once every 3 months at the reference conditions, and the quantities specified were determined, recorded, and analyzed per ISTB-6000.

**ISTB-3420 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 before the system is placed in an operable status, the pump shall be tested and the test schedule followed in accordance with the requirements of this Subsection. Pumps that can only be tested during plant operation shall be tested within 1 week following plant startup.

**ISTB-3430 Pumps Lacking Required Fluid Inventory.** Group B pumps lacking required fluid inventory (e.g., pumps in dry sumps) shall receive a comprehensive test at least once every 2 years except as provided in ISTB-3420. The required fluid inventory shall be provided during this test. A Group B test is not required.

## ISTB-3500 Data Collection

### ISTB-3510 General

*(a) Accuracy.* Instrument accuracy shall be within the limits of Table ISTB-3510-1. If a parameter is determined by analytical methods instead of measurement, then the determination shall meet the parameter accuracy requirement of Table ISTB-3510-1 (e.g., flow rate determination shall be accurate to within ±2% of actual). For individual analog instruments, the required accuracy is percent of full-scale. For digital instruments, the required accuracy is over the calibrated range. For a combination of instruments, the required accuracy is loop accuracy.

*(b) Range*

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

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

*(3)* Vibration instruments are excluded from the range requirements of ISTB-3510(b)(1) and ISTB-3510(b)(2).

*(c) Instrument Location.* The sensor location shall be established by the Owner, documented in the plant records (see ISTB-9000), and shall be appropriate for the parameter being measured. The same location shall be used for subsequent tests. Instruments that are position sensitive shall be either permanently mounted, or provision shall be made to duplicate their position during each test.

*(d) Fluctuations.* Symmetrical damping devices or averaging techniques may be used to reduce instrument fluctuations. Hydraulic instruments may be damped by using gage snubbers or by throttling small valves in instrument lines.

*(e) 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.

### ISTB-3520 Pressure

*(a) 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 ensure or determine the presence or absence of liquid as required for the static correction used.

*(b) Differential Pressure.* When determining differential pressure across a pump, a differential pressure gage or a differential pressure transmitter that provides direct measurement of the pressure difference or the difference between the pressure at a point in the inlet and the pressure at a point in the discharge pipe shall be used.

**ISTB-3530 Rotational Speed.** Rotational speed measurements of variable speed pumps shall be taken by a method that meets the requirements of ISTB-3510.

### ISTB-3540 Vibration

*(a)* On centrifugal pumps, except vertical line shaft pumps, measurements shall be taken in a plane approximately perpendicular to the rotating shaft in two approximately orthogonal directions on each accessible pump-bearing housing. Measurement shall also 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 approximately orthogonal directions, one of which is the axial direction.



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*(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 measurement points shall be clearly identified on the pump to permit subsequent duplication in both location and plane.

**ISTB-3550 Flow Rate.** When measuring flow rate, a rate or quantity meter shall be 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 recirculated flow is not required to be measured. External recirculated flow is not required to be measured if it is not practical to isolate, has a fixed resistance, and has been evaluated by the Owner to not have a substantial effect on the results of the test.

## ISTB-4000 RESERVED

## ISTB-5000 SPECIFIC TESTING REQUIREMENTS

This Subsection defines requirements for Group A, Group B, and comprehensive tests. When a Group A test is required, a comprehensive test may be substituted. When a Group B test is required, a Group A or comprehensive test may be substituted. A preservice test may be substituted for any inservice test.

### ISTB-5100 Centrifugal Pumps (Except Vertical Line Shaft Centrifugal Pumps)

*(a) Duration of Tests*

*(1)* For the Group A test and the comprehensive test, 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 determination of each of the quantities required by Table ISTB-3000-1 shall be made and recorded.

*(2)* For the Group B test, after pump conditions are stable, at least one measurement or determination of the quantity required by Table ISTB-3000-1 shall be made and recorded.

*(b) Bypass Loops*

*(1)* A bypass test loop may be used for a Group A test or comprehensive test, provided the flow rate through the loop meets the requirements as specified in ISTB-3300.

*(2)* A bypass test loop may be used for Group B tests if it is designed to meet the pump manufacturer's operating specifications (e.g., flow rate, time limitations) for minimum flow operation.

**ISTB-5110 Preservice Testing.** The parameters to be measured are specified in Table ISTB-3000-1.

*(a)* In systems where resistance can be varied, flow rate and differential pressure shall be measured at a minimum of five points. If practicable, these points shall be from pump minimum flow to at least pump design flow. A pump curve shall be established based on the measured points. At least one point shall be designated as the reference point(s). Data taken at the reference point will be used to compare the results of inservice tests. A pump curve need not be established for pumps in systems where resistance cannot be varied.

*(b)* Vibration measurements are only required to be taken at the reference point(s).

### ISTB-5120 Inservice Testing

**ISTB-5121 Group A Test Procedure.** Group A tests shall be conducted with the pump operating at a specified reference point. The test parameters shown in Table ISTB-3000-1 shall be determined and recorded as required by this paragraph. The test shall be conducted as follows:

*(a)* The pump shall be operated at nominal motor speed for constant speed drives or at a speed adjusted to the reference point (±1%) for variable speed drives.

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

*(c)* Where it is not practical to vary system resistance, flow rate and pressure shall be determined and compared to their respective reference values.

*(d)* Vibration (displacement or velocity) shall be determined and compared with the reference value. Vibration measurements shall be broad band (unfiltered). If velocity measurements are used, they shall be peak. If displacement amplitudes are used, they shall be peak-to-peak.

*(e)* All deviations from the reference values shall be compared with the ranges of Table ISTB-5121-1 and corrective action taken as specified in ISTB-6200. Vibration measurements shall be compared to both the relative and absolute criteria shown in the alert and required action ranges of Table ISTB-5121-1. For example, if vibration exceeds either $6V_r$ or 0.7 in./sec (1.7 cm/sec) the pump is in the required action range.

**ISTB-5122 Group B Test Procedure.** Group B tests shall be conducted with the pump operating at a specified reference point. The test parameter value identified in Table ISTB-3000-1 shall be determined and recorded as required by this paragraph. The test shall be conducted as follows:

*(a)* The pump shall be operated at nominal motor speed for constant speed drives or at a speed adjusted to the reference point (±1%) for variable speed drives.



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**Table ISTB-5121-1 Centrifugal Pump Test Acceptance Criteria**

| Test Type | Pump Speed | Test Parameter | Acceptable Range | Alert Range | Required Action Range Low | Required Action Range High |
|---|---|---|---|---|---|---|
| Group A Test [Notes (1), (2)] | N/A | $Q$ | 0.90 to 1.10$Q_r$ | None | < 0.90$Q_r$ | > 1.10$Q_r$ |
| | N/A | $\Delta P$ | 0.90 to 1.10$\Delta P_r$ | None | < 0.90$\Delta P_r$ | > 1.10$\Delta P_r$ |
| | < 600 rpm | $V_d$ or $V_v$ | ≤ 2.5$V_r$ | > 2.5$V_r$ to 6$V_r$ or > 10.5 to 22 mils (266.7 to 558.8 μm) | None | > 6$V_r$ or > 22 mils (558.8 μm) |
| | ≥ 600 rpm | $V_v$ or $V_d$ | ≤ 2.5$V_r$ | > 2.5$V_r$ to 6$V_r$ or > 0.325 to 0.7 in./sec (0.8 to 1.7 cm/sec) | None | > 6$V_r$ or > 0.7 in./sec (1.7 cm/sec) |
| Group B Test | N/A | $Q$, or | 0.90 to 1.10$Q_r$ | None | < 0.90$Q_r$ | > 1.10$Q_r$ |
| | N/A | $\Delta P$ | 0.90 to 1.10$\Delta P_r$ | None | < 0.90$\Delta P_r$ | > 1.10$\Delta P_r$ |
| Comprehensive Test [Notes (1), (2)] | N/A | $Q$ | 0.94 to 1.03$Q_r$ | 0.90 to < 0.94$Q_r$ | < 0.90$Q_r$ | > 1.03$Q_r$ |
| | N/A | $\Delta P$ | 0.93 to 1.03$\Delta P_r$ | 0.90 to < 0.93$\Delta P_r$ | < 0.90$\Delta P_r$ | > 1.03$\Delta P_r$ |
| | < 600 rpm | $V_d$ or $V_v$ | ≤ 2.5$V_r$ | > 2.5$V_r$ to 6$V_r$ or > 10.5 to 22 mils (266.7 to 558.8 μm) | None | > 6$V_r$ or > 22 mils (558.8 μm) |
| | ≥ 600 rpm | $V_v$ or $V_d$ | ≤ 2.5$V_r$ | > 2.5$V_r$ to 6$V_r$ or > 0.325 to 0.7 in./sec (0.8 to 1.7 cm/sec) | None | > 6$V_r$ or > 0.7 in./sec (1.7 cm/sec) |

GENERAL NOTE: The subscript $r$ denotes reference value, the subscript $v$ denotes vibration velocity reference value, and the subscript $d$ denotes displacement.

NOTES:

(1) Vibration parameter per Table ISTB-3000-1. $V_r$ is vibration reference value in the selected units.

(2) Refer to Fig. ISTB-5223-1 to establish displacement limits for pumps with speeds ≥ 600 rpm or velocity limits for pumps with speeds < 600 rpm.

*(b)* The differential pressure or flow rate shall be determined and compared to its reference value.

*(c)* System resistance may be varied as necessary to achieve the reference point.

*(d)* All deviations from the reference values shall be compared with the ranges of Table ISTB-5121-1 and corrective action taken as specified in ISTB-6200.

**ISTB-5123 Comprehensive Test Procedure.** Comprehensive tests shall be conducted with the pump operating at a specified reference point. The test parameters shown in Table ISTB-3000-1 shall be determined and recorded as required by this paragraph. The test shall be conducted as follows:

*(a)* The pump shall be operated at nominal motor speed for constant speed drives or at a speed adjusted to the reference point (±1%) for variable speed drives.

*(b)* For centrifugal and vertical line shaft pumps, the resistance of the system shall be varied until the flow rate equals the reference point. The differential pressure shall then be determined and compared to its reference value. Alternatively, the flow rate shall be varied until the differential pressure equals the reference point and the flow rate determined and compared to the reference flow rate value.

*(c)* Where it is not practical to vary system resistance, flow rate and pressure shall be determined and compared to their respective reference values.

*(d)* Vibration (displacement or velocity) shall be determined and compared with corresponding reference values. 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.

*(e)* All deviations from the reference values shall be compared with the ranges of Table ISTB-5121-1 and corrective action taken as specified in ISTB-6200. The vibration measurements shall be compared to both the relative and absolute criteria shown in the alert and required action ranges of Table ISTB-5121-1. For example, if vibration exceeds either 6$V_r$ or 0.7 in./sec (1.7 cm/sec), the pump is in the required action range.

## ISTB-5200 Vertical Line Shaft Centrifugal Pumps

*(a) Duration of Tests*

*(1)* For the Group A test and the comprehensive test, 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 determination of each of the quantities required by Table ISTB-3000-1 shall be made and recorded.

*(2)* For the Group B test, after pump conditions are stable, at least one measurement or determination of the quantity required by Table ISTB-3000-1 shall be made and recorded.



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*(b) Bypass Loops*

*(1)* A bypass test loop may be used for a Group A test or comprehensive test, provided the flow rate through the loop meets the requirements as specified in ISTB-3300.

*(2)* A bypass test loop may be used for Group B tests if it is designed to meet the pump manufacturer's operating specifications (e.g., flow rate, time limitations) for minimum flow operation.

**ISTB-5210 Preservice Testing.** The parameters to be measured are specified in Table ISTB-3000-1.

*(a)* In systems where resistance can be varied, flow rate and differential pressure shall be measured at a minimum of five points. If practicable, these points shall be from pump minimum flow to at least pump design flow. A pump curve shall be established based on the measured points. At least one point shall be designated as the reference point(s). Data taken at the reference point will be used to compare the results of inservice tests. A pump curve need not be established for pumps in systems where resistance cannot be varied.

*(b)* Vibration measurements are only required to be taken at the reference point(s).

### ISTB-5220 Inservice Testing

**ISTB-5221 Group A Test Procedure.** Group A tests shall be conducted with the pump operating at a specified reference point. The test parameters shown in Table ISTB-3000-1 shall be determined and recorded as required by this paragraph. The test shall be conducted as follows:

*(a)* The pump shall be operated at nominal motor speed for constant speed drives or at a speed adjusted to the reference point (±1%) for variable speed drives.

*(b)* The resistance of the system shall be varied until the flow rate equals the reference point. The differential pressure shall then be determined and compared to its reference value. Alternatively, the flow rate shall be varied until the differential pressure equals the reference point and the flow rate 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)* Vibration (displacement or velocity) shall be determined and compared with the reference value. Vibration measurements shall be broad band (unfiltered). If velocity measurements are used, they shall be peak. If displacement amplitudes are used, they shall be peak-to-peak.

*(e)* All deviations from the reference values shall be compared with the ranges of Table ISTB-5221-1 and corrective action taken as specified in ISTB-6200. Vibration measurements shall be compared to both the relative and absolute criteria shown in the alert and required action ranges of Table ISTB-5221-1. For example, if vibration exceeds either $6V_r$ or 0.7 in./sec (1.7 cm/sec), the pump is in the required action range.

**ISTB-5222 Group B Test Procedure.** Group B tests shall be conducted with the pump operating at a specified reference point. The test parameter value identified in Table ISTB-3000-1 shall be determined and recorded as required by this paragraph. The test shall be conducted as follows:

*(a)* The pump shall be operated at nominal motor speed for constant speed drives or at a speed adjusted to the reference point (±1%) for variable speed drives.

*(b)* The differential pressure or flow rate shall be determined and compared to its reference value.

*(c)* System resistance may be varied as necessary to achieve the reference point.

*(d)* All deviations from the reference values shall be compared with the ranges of Table ISTB-5221-1 and corrective action taken as specified in ISTB-6200.

**ISTB-5223 Comprehensive Test Procedure.** Comprehensive tests shall be conducted with the pump operating at a specified reference point. The test parameters shown in Table ISTB-3000-1 shall be determined and recorded as required by this paragraph. The test shall be conducted as follows:

*(a)* The pump shall be operated at nominal motor speed for constant speed drives or at a speed adjusted to the reference point (±1%) for variable speed drives.

*(b)* The resistance of the system shall be varied until the flow rate equals the reference point. The differential pressure shall then be determined and compared to its reference value. Alternatively, the flow rate shall be varied until the differential pressure equals the reference point and the flow rate 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)* Vibration (displacement or velocity) shall be determined and compared with corresponding reference values. 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. (See Fig. ISTB-5223-1.)

*(e)* All deviations from the reference values shall be compared with the ranges of Table ISTB-5221-1 and corrective action taken as specified in ISTB-6200. The vibration measurements shall be compared to both the relative and absolute criteria shown in the alert and required action ranges of Table ISTB-5221-1. For example, if vibration exceeds either $6V_r$ or 0.7 in./sec (1.7 cm/sec), the pump is in the required action range.

### ISTB-5300 Positive Displacement Pumps

*(a) Duration of Tests*

*(1)* For the Group A test and the comprehensive test, after pump conditions are as stable as the system



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(04)

**Table ISTB-5221-1 Vertical Line Shaft and Centrifugal Pumps Test Acceptance Criteria**

| Test Type | Pump Speed | Test Parameter | Acceptable Range | Alert Range | Required Action Range | |
|---|---|---|---|---|---|---|
| | | | | | Low | High |
| Group A Test | N/A | $Q$ | 0.95 to 1.10$Q_r$ | 0.93 to < 0.95$Q_r$ | < 0.93$Q_r$ | > 1.10$Q_r$ |
| [Notes (1), (2)] | N/A | $\Delta P$ | 0.95 to 1.10$\Delta P_r$ | 0.93 to < 0.95$\Delta P_r$ | < 0.93$\Delta P_r$ | > 1.10$\Delta P_r$ |
| | < 600 rpm | $V_d$ or $V_v$ | ≤ 2.5$V_r$ | > 2.5$V_r$ to 6$V_r$ or > 10.5 to 22 mils (266.7 to 558.8 μm) | None | > 6$V_r$ or > 22 mils (558.8 μm) |
| | ≥ 600 rpm | $V_v$ or $V_d$ | ≤ 2.5$V_r$ | > 2.5$V_r$ to 6$V_r$ or > 0.325 to 0.7 in./sec (0.8 to 1.7 cm/sec) | None | > 6$V_r$ or > 0.7 in./sec (1.7 cm/sec) |
| Group B Test | N/A | $Q$, or | 0.90 to 1.10$Q_r$ | None | < 0.90$Q_r$ | > 1.10$Q_r$ |
| | N/A | $\Delta p$ | 0.90 to 1.10$\Delta P_r$ | None | < 0.90$\Delta P_r$ | > 1.10$\Delta P_r$ |
| Comprehensive Test | N/A | $Q$ | 0.95 to 1.03$Q_r$ | 0.93 to < 0.95$Q_r$ | < 0.93$Q_r$ | > 1.03$Q_r$ |
| [Notes (1), (2)] | N/A | $\Delta P$ | 0.95 to 1.03$\Delta P_r$ | 0.93 to < 0.95$\Delta P_r$ | < 0.93$\Delta P_r$ | > 1.03$\Delta P_r$ |
| | < 600 rpm | $V_d$ or $V_v$ | ≤ 2.5$V_r$ | > 2.5$V_r$ to 6$V_r$ or > 10.5 to 22 mils (266.7 to 558.8 μm) | None | > 6$V_r$ or > 22 mils (558.8 μm) |
| | ≥ 600 rpm | $V_v$ or $V_d$ | ≤ 2.5$V_r$ | > 2.5$V_r$ to 6$V_r$ or > 0.325 to 0.7 in./sec (0.8 to 1.7 cm/sec) | None | > 6$V_r$ or > 0.7 in./sec (1.7 cm/sec) |

GENERAL NOTE: The subscript $r$ denotes reference value, the subscript $v$ denotes vibration velocity reference value, and the subscript $d$ denotes displacement.

NOTES:

(1) Vibration parameter per Table ISTB-3000-1. $V_r$ is vibration reference value in the selected units.

(2) Refer to Fig. ISTB-5223-1 to establish displacement limits for pumps with speeds ≥ 600 rpm or velocity limits for pumps with speeds < 600 rpm.

permits, each pump shall be run at least 2 min. At the end of this time at least one measurement or determination of each of the quantities required by Table ISTB-3000-1 shall be made and recorded.

*(2)* For the Group B test, after pump conditions are stable, at least one measurement or determination of the quantity required by Table ISTB-3000-1 shall be made and recorded.

*(b) Bypass Loops.* A bypass test loop may be used for a Group A test or comprehensive test, provided the flow rate through the loop meets the requirements as specified in ISTB-3300. A bypass test loop may be used for Group B tests if it is designed to meet the pump manufacturer's operating specifications (e.g., flow rate, time limitations) for minimum flow operation.

**ISTB-5310 Preservice Testing.** The parameters to be measured are specified in Table ISTB-3000-1.

*(a)* For positive displacement pumps, reference values shall be taken at or near pump design pressure for the parameters specified in Table ISTB-3000-1.

*(b)* Vibration measurements are only required to be taken at the reference point(s).

### ISTB-5320 Inservice Testing

**ISTB-5321 Group A Test Procedure.** Group A tests shall be conducted with the pump operating at a specified reference point. The test parameters shown in Table ISTB-3000-1 shall be determined and recorded as required by this paragraph. The test shall be conducted as follows:

*(a)* The pump shall be operated at nominal motor speed for constant speed drives or at a speed adjusted to the reference point (±1%) for variable speed drives.

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

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

*(d)* Vibration (displacement or velocity) shall be determined and compared with the reference value. Vibration measurements shall be broad band (unfiltered). If velocity measurements are used, they shall be peak. If displacement amplitudes are used, they shall be peak-to-peak.

*(e)* All deviations from the reference values shall be compared with the ranges of Table ISTB-5321-1 or Table ISTB-5321-2, as applicable, and corrective action taken as specified in ISTB-6200. For reciprocating positive displacement pumps, vibration measurements shall be compared to the relative criteria shown in the alert and required action ranges of Table ISTB-5321-2. For all other positive displacement pumps, vibration measurements



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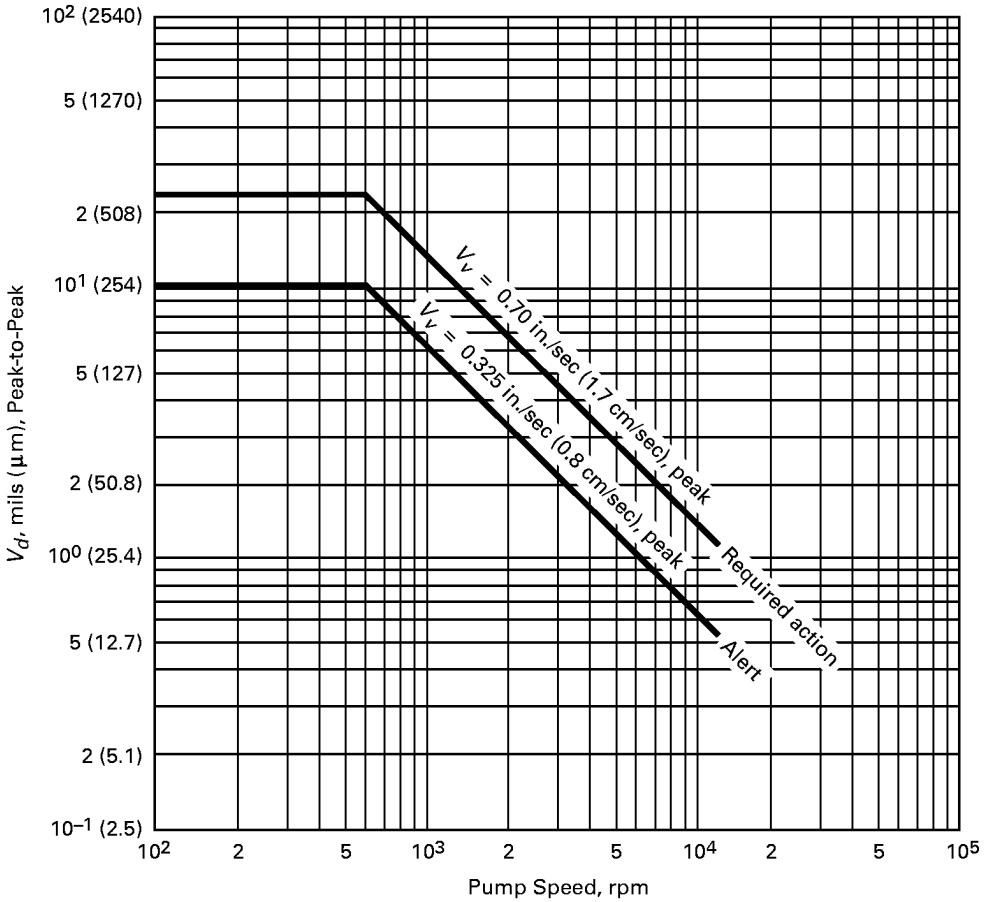


**Fig. ISTB-5223-1 Vibration Limits** (04)

shall be compared to both the relative and absolute criteria shown in the alert and required action ranges of Table ISTB-5321-1. For example, if vibration exceeds either $6V_r$ or 0.7 in./sec (1.7 cm/sec), the pump is in the required action range.

**ISTB-5322 Group B Test Procedure.** Group B tests shall be conducted with the pump operating at a specified reference point. The test parameter value identified in Table ISTB-3000-1 shall be determined and recorded as required by this paragraph. The test shall be conducted as follows:

*(a)* The pump shall be operated at nominal motor speed for constant speed drives or at a speed adjusted to the reference point (±1%) for variable speed drives.

*(b)* The flow rate shall be determined and compared to its reference value.

*(c)* System resistance may be varied as necessary to achieve the reference point.

*(d)* All deviations from the reference values shall be compared with the ranges of Table ISTB-5321-1 or ISTB-5321-2, as applicable, and corrective action taken as specified in ISTB-6200.

**ISTB-5323 Comprehensive Test Procedure.** Comprehensive tests shall be conducted with the pump operating at a specified reference point. The test parameters shown in Table ISTB-3000-1 shall be determined and recorded as required by this paragraph. The test shall be conducted as follows:

*(a)* The pump shall be operated at nominal motor speed for constant speed drives or at a speed adjusted to the reference point (±1%) for variable speed drives.

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

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

*(d)* Vibration (displacement or velocity) shall be determined and compared with corresponding reference values. 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.



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(04)

**Table ISTB-5321-1 Positive Displacement Pump (Except Reciprocating) Test Acceptance Criteria**

| Test Type | Pump Speed | Test Parameter | Acceptable Range | Alert Range | Required Action Range | |
|---|---|---|---|---|---|---|
| | | | | | Low | High |
| Group A Test | N/A | $Q$ | 0.95 to 1.10$Q_r$ | 0.93 to < 0.95$Q_r$ | < 0.93$Q_r$ | > 1.10$Q_r$ |
| [Notes (1), (2)] | N/A | $P$ | 0.93 to 1.10$P_r$ | 0.90 to < 0.93$P_r$ | < 0.90$P_r$ | > 1.10$P_r$ |
| | < 600 rpm | $V_d$ or $V_v$ | ≤ 2.5$V_r$ | > 2.5$V_r$ to 6$V_r$ or > 10.5 to 22 mils (266.7 to 558.8 μm) | None | > 6$V_r$ or > 22 mils (558.8 μm) |
| | ≥ 600 rpm | $V_v$ or $V_d$ | < 2.5$V_r$ | > 2.5$V_r$ to 6$V_r$ or > 0.325 to 0.7 in./sec (0.8 to 1.7 cm/sec) | None | > 6$V_r$ or > 0.7 in./sec (1.7 cm/sec) |
| Group B Test | N/A | $Q$ | 0.90 to 1.10$Q_r$ | None | < 0.90$Q_r$ | > 1.10$Q_r$ |
| Comprehensive Test | N/A | $Q$ | 0.95 to 1.03$Q_r$ | 0.93 to < 0.95$Q_r$ | < 0.93$Q_r$ | > 1.03$Q_r$ |
| [Notes (1), (2)] | N/A | $P$ | 0.93 to 1.03$P_r$ | 0.90 to < 0.93$P_r$ | < 0.90$P_r$ | > 1.03$P_r$ |
| | < 600 rpm | $V_d$ or $V_v$ | ≤ 2.5$V_r$ | > 2.5$V_r$ to 6$V_r$ or > 10.5 to 22 mils (266.7 to 558.8 μm) | None | > 6$V_r$ or > 22 mils (558.8 μm) |
| | ≥ 600 rpm | $V_v$ or $V_d$ | ≤ 2.5$V_r$ | > 2.5$V_r$ to 6$V_r$ or > 0.325 to 0.7 in./sec (0.8 to 1.7 cm/sec) | None | > 6$V_r$ or > 0.7 in./sec (1.7 cm/sec) |

GENERAL NOTE: The subscript $r$ denotes reference value, the subscript $v$ denotes vibration velocity reference value, and the subscript $d$ denotes displacement.

NOTES:

(1) Vibration parameter per Table ISTB-3000-1. $V_r$ is vibration reference value in the selected units.

(2) Refer to Fig. ISTB-5223-1 to establish displacement limits for pumps with speeds ≥ 600 rpm or velocity limits for pumps with speeds < 600 rpm.

(04)

**Table ISTB-5321-2 Reciprocating Positive Displacement Pump Test Acceptance Criteria**

| Test Type | Pump Speed | Test Parameter | Acceptable Range | Alert Range | Required Action Range | |
|---|---|---|---|---|---|---|
| | | | | | Low | High |
| Group A Test | N/A | $Q$ | 0.95 to 1.10$Q_r$ | 0.93 to < 0.95$Q_r$ | < 0.93$Q_r$ | > 1.10$Q_r$ |
| | N/A | $P$ | 0.93 to 1.10$P_r$ | 0.90 to < 0.93$P_r$ | < 0.90$P_r$ | > 1.10$P_r$ |
| | N/A | $V_d$ or $V_v$ | ≤ 2.5$V_r$ | > 2.5$V_r$ to 6$V_r$ | None | > 6$V_r$ |
| Group B Test | N/A | $Q$ | 0.90 to 1.10$Q_r$ | None | < 0.90$Q_r$ | > 1.10$Q_r$ |
| Comprehensive Test | N/A | $Q$ | 0.95 to 1.03$Q_r$ | 0.93 to < 0.95$Q_r$ | < 0.93$Q_r$ | > 1.03$Q_r$ |
| | N/A | $P$ | 0.93 to 1.03$P_r$ | 0.90 to < 0.93$P_r$ | < 0.90$P_r$ | > 1.03$P_r$ |
| | N/A | $V_d$ or $V_v$ | ≤ 2.5$V_r$ | > 2.5$V_r$ to 6$V_r$ | None | > 6$V_r$ |

GENERAL NOTE: The subscript $r$ denotes reference value, the subscript $v$ denotes vibration velocity reference value, and the subscript $d$ denotes displacement.

*(e)* All deviations from the reference values shall be compared with the ranges of Table ISTB-5321-1 or Table ISTB-5321-2, as applicable, and corrective action taken as specified in ISTB-6200. For reciprocating positive displacement pumps, vibration measurements shall be compared to the relative criteria shown in the alert and required action ranges of Table ISTB-5321-1. For all other positive displacement pumps, vibration measurements shall be compared to both the relative and absolute criteria shown in the alert and required action ranges of Table ISTB-5321-2. For example, if vibration exceeds either 6$V_r$ or 0.7 in./sec (1.7 cm/sec), the pump is in the required action range.

## ISTB-6000 MONITORING, ANALYSIS, AND EVALUATION

### ISTB-6100 Trending

Test parameters shown in Table ISTB-3000-1, except for fixed values, shall be trended.



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### ISTB-6200 Corrective Action

*(a) Alert Range.* If the measured test parameter values fall within the alert range of Table ISTB-5121-1, Table ISTB-5221-1, Table ISTB-5321-1, or Table ISTB-5321-2, as applicable, the frequency of testing specified in ISTB-3400 shall be doubled until the cause of the deviation is determined and the condition is corrected.

*(b) Action Range.* If the measured test parameter values fall within the required action range of Table ISTB-5121-1, Table ISTB-5221-1, Table ISTB-5321-1, or Table ISTB-5321-2, as applicable, the pump shall be declared inoperable until either the cause of the deviation has been determined and the condition is corrected, or an analysis of the pump is performed and new reference values are established in accordance with ISTB-6200(c).

*(c) New Reference Values.* In cases where the pump's test parameters are within either the alert or required action ranges of Table ISTB-5121-1, Table ISTB-5221-1, Table ISTB-5321-1, or Table ISTB-5321-2, as applicable, and the pump's continued use at the changed values is supported by an analysis, a new set of reference values may be established. This analysis shall include verification of the pump's operational readiness. The analysis shall include both a pump level and a system level evaluation of operational readiness, the cause of the change in pump performance, and an evaluation of all trends indicated by available data. The results of this analysis shall be documented in the record of tests (See ISTB-9000).

### ISTB-6300 Systematic Error

When a test shows measured parameter values that fall outside of the acceptable range of Table ISTB-5121-1, Table ISTB-5221-1, Table ISTB-5321-1, or Table ISTB-5321-2, as applicable, that have resulted from an identified systematic error, such as improper system lineup or inaccurate instrumentation, the test shall be rerun after correcting the error.

### ISTB-6400 Analysis of Related Conditions

If the reference value of a particular parameter being measured or determined can be significantly influenced by other related conditions, then these conditions shall be analyzed[1] and documented in the record of tests (see ISTB-9000).

## ISTB-7000 RESERVED

## ISTB-8000 RESERVED

## ISTB-9000 RECORDS AND REPORTS

### ISTB-9100 Pump Records

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

*(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

### ISTB-9200 Test Plans

In addition to the requirements of ISTA-3120 and ISTA-3170, the test plans and procedures shall include the following:

*(a)* category of each pump

*(b)* the hydraulic circuit to be used

*(c)* the location and type of measurement for the required test parameters

*(d)* the method of determining test parameter values that are not directly measured by instrumentation

### ISTB-9300 Record of Tests

See ISTA-9230.

### ISTB-9400 Record of Corrective Action

See ISTA-9240.

[1] Vibration measurements of pumps may be foundation, driver, or 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 the measured vibration levels will not prevent the pump from fulfilling its function.



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# SUBSECTION ISTC
# Inservice Testing of Valves in Light-Water Reactor Nuclear Power Plants

## ISTC-1000 INTRODUCTION

### ISTC-1100 Applicability

The requirements of this Subsection apply to certain valves and pressure relief devices (and their actuating and position-indicating systems).

### ISTC-1200 Exemptions

The following are excluded from this Subsection, provided that the valves are not required to perform a specific function as described in ISTA-1100:

*(a)* valves used only for operating convenience such as vent, drain, instrument, and test valves

*(b)* valves used only for system control, such as pressure regulating valves

*(c)* valves used only for system or component maintenance

Skid-mounted valves are excluded from this Subsection, provided they are tested as part of the major component and are justified by the Owner to be adequately tested.

External control and protection systems responsible for sensing plant conditions and providing signals for valve operation are excluded from the requirements of this Subsection.

Category A and Category B safety and relief valves are excluded from the requirements of ISTC-3700, Valve Position Verification and ISTC-3500, Valve Testing Requirements.

Nonreclosing pressure relief devices (rupture disks) used in BWR Scram Accumulators are excluded from the requirements of this Subsection.

### ISTC-1300 Valve Categories

Valves within the scope of this Subsection shall be placed in one or more of the following categories. When more than one distinguishing category characteristic is applicable, all requirements of each of the individual categories are applicable, although duplication or repetition of common testing requirements is not necessary.

*(a) Category A:* valves for which seat leakage is limited to a specific maximum amount in the closed position for fulfillment of their required function(s), as specified in ISTA-1100.

*(b) Category B:* valves for which seat leakage in the closed position is inconsequential for fulfillment of the required function(s), as specified in ISTA-1100.

*(c) Category C:* valves that are self-actuating in response to some system characteristic, such as pressure (relief valves) or flow direction (check valves) for fulfillment of the required function(s), as specified in ISTA-1100.

*(d) Category D:* valves that are actuated by an energy source capable of only one operation, such as rupture disks or explosively actuated valves.

### ISTC-1400 Owner's Responsibility

In addition to the requirements of ISTA-1500, it is the Owner's responsibility to

*(a)* include in the plant design all necessary instrumentation, test connections, flow instruments, or any other provisions that are required to fully comply with the requirements of this Subsection.

*(b)* categorize (see ISTC-1300), and list in the plant records (see ISTC-9000) each valve to be tested in accordance with the rules of this Subsection, including Owner-specified acceptance criteria. The Owner shall specify test conditions.

*(c)* ensure that the application, method, and capability of each nonintrusive technique is qualified.

## ISTC-2000 SUPPLEMENTAL DEFINITIONS

The following are provided to ensure a uniform understanding of selected terms used in this Subsection:

*full-stroke time:* the time interval from initiation of the actuating signal to the indication of the end of the operating stroke

*power-operated relief valve (PORV):* a power-operated valve that can perform a pressure-relieving function and is remotely actuated by either a signal from a pressure-sensing device or a control switch. A power-operated relief valve is not capacity certified under ASME Section III overpressure protection requirements.

*reactor coolant system pressure isolation:* that function that prevents intersystem overpressurization between the reactor coolant system and connected low pressure systems.



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## ISTC-3000 GENERAL TESTING REQUIREMENTS

### ISTC-3100 Preservice Testing

Each valve shall be tested during the preservice test period as required by this Subsection. These tests shall be conducted under conditions as near as practicable to those expected during subsequent inservice testing. Only one preservice test of each valve is required with these exceptions.

*(a)* Any valve that has undergone maintenance that could affect its performance after the preservice test shall be tested in accordance with ISTC-3310.

*(b)* Safety and relief valves and nonreclosing pressure relief devices shall meet the preservice test requirements of Mandatory Appendix I.

### ISTC-3200 Inservice Testing

Inservice testing in accordance with this Subsection shall commence when the valves are required to be operable to fulfill their required function(s) (see ISTA-1100).

### ISTC-3300 Reference Values

Reference values shall be determined from the results of preservice testing or from the results of inservice testing. These tests shall be performed under conditions as near as practicable to those expected during subsequent inservice testing.

Reference values shall be established only when the valve is known to be operating acceptably. If the particular parameter being measured can be significantly influenced by other related conditions, then these conditions shall be analyzed.

**ISTC-3310 Effects of Valve Repair, Replacement, or Maintenance on Reference Values.** When a valve or its control system has been replaced, repaired, or has undergone maintenance[1] that could affect the valve's performance, a new reference value shall be determined or the previous value reconfirmed by an inservice test run before the time it is returned to service or immediately if not removed from service. This test is to demonstrate that performance parameters that could be affected by the replacement, repair, or maintenance are within acceptable limits. Deviations between the previous and new reference values shall be identified and analyzed. Verification that the new values represent acceptable operation shall be documented in the record of tests (see ISTC-9120). Safety and relief valves and nonreclosing pressure relief devices shall be tested as required by the replacement, repair, and maintenance requirements of Mandatory Appendix I.

[1] Adjustment of stem packing, limit switches, or control system valves, and removal of the bonnet, stem assembly, actuator, obturator, or control system components are examples of maintenance that could affect valve performance parameters.

**ISTC-3320 Establishment of Additional Set of Reference Values.** If it is necessary or desirable for some reason, other than stated in ISTC-3310, to establish additional reference values, an inservice test shall first be run at the conditions of an existing set of reference values, or, if impractical, at the conditions for which the new reference values are required, and the results analyzed. If operation is acceptable in accordance with the applicable requirements of ISTC-5100, a second test shall be performed under the new conditions as soon as practicable. The results of the second test shall establish the additional reference values. Whenever additional reference values are established, the reasons for doing so shall be justified and documented in the record of tests (see ISTC-9120).

### ISTC-3400 Reserved

### ISTC-3500 Valve Testing Requirements

Active and passive valves in the categories defined in ISTC-1300 shall be tested in accordance with the paragraphs specified in Table ISTC-3500-1 and the applicable requirements of ISTC-5100 and ISTC-5200.

**ISTC-3510 Exercising Test Frequency.** Active Category A, Category B, and Category C check valves shall be exercised nominally every 3 months, except as provided by ISTC-3520, ISTC-3540, ISTC-3550, ISTC-3570, ISTC-5221, and ISTC-5222. Power-operated relief valves shall be exercise tested once per fuel cycle.

#### ISTC-3520 Exercising Requirements

**ISTC-3521 Category A and Category B Valves.** Category A and Category B valves shall be tested as follows:

*(a)* full-stroke exercising of Category A and Category B valves during operation at power to the position(s) required to fulfill its function(s), and exercising or examining check valves during plant operation in a manner that verifies obturator travel to the closed, full-open, or partially open position required to fulfill its function(s).

*(b)* if full-stroke exercising during operation at power is not practicable, it may be limited to part-stroke during operation at power and full-stroke during cold shutdowns.

*(c)* if exercising is not practicable during operation at power, it may be limited to full-stroke exercising during cold shutdowns.

*(d)* if exercising is not practicable during operation at power and full-stroke during cold shutdowns is also not practicable, it may be limited to part-stroke during cold shutdowns, and full-stroke during refueling outages.

*(e)* if exercising is not practicable during operation at power or cold shutdowns, it may be limited to full-stroke during refueling outages.

*(f)* valves full-stroke exercised at cold shutdowns shall be exercised during each cold shutdown, except as specified in ISTC-3521(g). Such exercise is not required if



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(04)

**Table ISTC-3500-1 Inservice Test Requirements**

| Category (See ISTC-1300) | Valve Function | Leakage Test Procedure and Frequency | Exercise Test Procedure and Frequency | Special Test Procedure [Note (1)] | Position Indication Verification and Frequency |
|---|---|---|---|---|---|
| A | Active | See ISTC-3600 | See ISTC-3510 | None | See ISTC-3700 |
| A | Passive | See ISTC-3600 | None | None | See ISTC-3700 |
| B | Active | None | See ISTC-3510 | None | See ISTC-3700 |
| B | Passive | None | None | None | See ISTC-3700 |
| C (Safety and relief) [Note (3)] | Active | None [Notes (2), (3)] | See ISTC-5230, ISTC-5240 | None | See ISTC-3700 |
| C (Check) [Note (4)] | Active | None [Note (3)] | See ISTC-3510 | None | See ISTC-3700 |
| D | Active | None [None (3)] | None | See ISTC-5250, ISTC-5260 | None |

NOTES:

(1) Note additional requirement for fail-safe valves, ISTC-3560.

(2) Leak test as required for Mandatory Appendix I.

(3) When more than one distinguishing category characteristic is applicable, all requirements of each of the individual categories are applicable, although duplication or repetition of common testing requirements is not necessary.

(4) If a check valve used for a pressure relief device is capacity certified, then it shall be classified as a pressure or vacuum relief device. If a check valve used to limit pressure is not capacity certified, then it shall be classified as a check valve.

the time period since the previous full-stroke exercise is less than 3 months. During extended shutdowns, valves that are required to perform their intended function (see ISTA-1100) shall be exercised every 3 months, if practicable.

*(g)* valve exercising during cold shutdown shall commence within 48 hr of achieving cold shutdown and continue until all testing is complete or the plant is ready to return to operation at power. For extended outages, testing need not be commenced in 48 hr, provided all valves required to be tested during cold shutdown will be tested before or as part of plant startup. However, it is not the intent of this Subsection to keep the plant in cold shutdown to complete cold shutdown testing.

*(h)* all valve testing required to be performed during a refueling outage shall be completed before returning the plant to operation at power.

**ISTC-3522 Category C Check Valves.** Category C check valves shall be exercised as follows:

*(a)* During operation at power, each check valve shall be exercised or examined in a manner that verifies obturator travel by using the methods in ISTC-5221.

Each check valve exercise test shall include open and close tests. Open and close tests need only be performed at an interval when it is practicable to perform both tests. Test order (e.g., whether the open test precedes the close test) shall be determined by the Owner. Open and close tests are not required to be performed at the same time if they are both performed within the same interval.

*(b)* If exercising is not practicable during operation at power, it shall be performed during cold shutdowns.

*(c)* If exercising is not practicable during operation at power and cold shutdowns, it shall be performed during refueling outages.

*(d)* Valves exercised at shutdowns shall be exercised during each shutdown, except as specified in ISTC-3522(e). Such exercise is not required if the interval since the previous exercise is less than 3 months. During extended shutdowns, valves that are required to perform their intended function (see ISTA-1100) shall be exercised every 3 months, if practicable.

*(e)* Valve exercising shall commence within 48 hr of achieving cold shutdown and continue until all testing is complete or the plant is ready to return to operation at power. For extended outages, testing need not be commenced in 48 hr if all valves required to be tested during cold shutdown will be tested before or as part of plant start-up. However, it is not the intent of this Subsection to keep the plant in cold shutdown to complete cold shutdown testing.

*(f)* All valve testing required to be performed during a refueling outage shall be completed before returning the plant to operation at power.

**ISTC-3530 Valve Obturator Movement.** The necessary valve obturator movement shall be determined by exercising the valve while observing an appropriate indicator, such as indicating lights that signal the required changes of obturator position, or by observing other evidence, such as changes in system pressure, flow rate, level, or temperature, that reflects change of obturator position.

**ISTC-3540 Manual Valves.** Manual valves shall be full-stroke exercised at least once every 5 years, except



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where adverse conditions[2] may require the valve to be tested more frequently to ensure operational readiness. Any increased testing frequency shall be specified by the Owner. The valve shall exhibit the required change of obturator position.

**ISTC-3550 Valves in Regular Use.** Valves that operate in the course of plant operation at a frequency that would satisfy the exercising requirements of this Subsection need not be additionally exercised, provided that the observations otherwise required for testing are made and analyzed during such operation and recorded in the plant record at intervals no greater than specified in ISTC-3510.

**ISTC-3560 Fail-Safe Valves.** Valves with fail-safe actuators shall be tested by observing the operation of the actuator upon loss of valve actuating power in accordance with the exercising frequency of ISTC-3510.

**ISTC-3570 Valves in Systems Out of Service.** For a valve in a system declared inoperable or not required to be operable, the exercising test schedule need not be followed. Within 3 months before placing the system in an operable status, the valves shall be exercised and the schedule followed in accordance with requirements of this Subsection.

## ISTC-3600 Leak Testing Requirements

**ISTC-3610 Scope of Seat Leakage Rate Test.** Category A valves shall be leakage tested, except that valves which function in the course of plant operation in a manner that demonstrates functionally adequate seat leak-tightness need not be additionally leakage tested. In such cases, the valve record shall provide the basis for the conclusion that operational observations constitute satisfactory demonstration.

(04) **ISTC-3620 Containment Isolation Valves.** Containment isolation valves with a leakage rate requirement based on Appendix J program commitment shall be tested in accordance with the Owner's 10 CFR 50, Appendix J program. Containment isolation valves with a leakage requirement based on other functions shall be tested in accordance with ISTC-3630. Examples of these other functions are reactor coolant system pressure isolation valves and certain Owner-defined system functions such as inventory preservation, system protection, or flooding protection.

(04) **ISTC-3630 Leakage Rate for Other Than Containment Isolation Valves.** Category A valves with a leakage requirement not based on an Owner's 10 CFR 50, Appendix J program, shall be tested to verify their seat leakages within acceptable limits. Valve closure before seat leakage testing shall be by using the valve operator with no additional closing force applied.

*(a) Frequency.* Tests shall be conducted at least once every 2 years.

*(b) Differential Test Pressure.* Valve seat tests shall be made with the pressure differential in the same direction as when the valve is performing its function, with the following exceptions:

*(1)* Globe-type valves may be tested with pressure under the seat.

*(2)* Butterfly valves may be tested in either direction, provided their seat construction is designed for sealing against pressure on either side.

*(3)* Double-disk gate valves may be tested by pressurizing between the disks.

*(4)* Leakage tests involving pressure differential lower than function pressure differentials are permitted in those types of valves in which service pressure will tend to diminish the overall leakage channel opening, as by pressing the disk into or onto the seat with greater force. Gate valves, check valves, and globe-type valves, having function pressure differential applied over the seat, are examples of valve applications satisfying this requirement. When leakage tests are made in such cases using pressures lower than function maximum pressure differential, the observed leakage shall be adjusted to the function maximum pressure differential value. The adjustment shall be made by calculation appropriate to the test media and the ratio between the test and function pressure differential, assuming leakage to be directly proportional to the pressure differential to the one-half power.

*(5)* Valves not qualifying for reduced pressure testing as defined above shall be tested at full maximum function pressure differential.

*(c) Seat Leakage Measurement.* Valve seat leakage shall be determined by one of the following methods:

*(1)* measuring leakage through a downstream telltale connection while maintaining test pressure on one side of the valve

*(2)* measuring the feed rate required to maintain test pressure in the test volume or between two seats of a gate valve, provided the total apparent leakage rate is charged to the valve or valve combination or gate valve seat being tested and the conditions required by ISTC-3630(b) are satisfied

*(3)* determining leakage by measuring pressure decay in the test volume, provided the total apparent leakage rate is charged to the valve or valve combination or gate valve seat being tested and the conditions required by ISTC-3630(b) are satisfied

*(d) Test Medium.* The test medium shall be specified by the Owner.

*(e) Analysis of Leakage Rates.* Leakage rate measurements shall be compared with the permissible leakage

[2] Harsh service environment, lubricant hardening, corrosive or sediment-laden process fluid, or degraded valve components are some examples of adverse conditions.



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rates specified by the plant Owner for a specific valve or valve combination. If leakage rates are not specified by the Owner, the following rates shall be permissible:

(1) for water, $0.5D$ gal/min ($12.4d$ ml/sec) or 5 gal/min (315 ml/sec), whichever is less, at function pressure differential

(2) for air, at function pressure differential, $7.5D$ standard $ft^3$/day ($58d$ std. cc/min)

where

$D$ = nominal valve size, in.
$d$ = nominal valve size, cm

(f) *Corrective Action.* Valves or valve combinations with leakage rates exceeding the valves specified by the Owner per ISTC-3630(e) shall be declared inoperable and either repaired or replaced. A retest demonstrating acceptable operation shall be performed following any required corrective action before the valve is returned to service.

### ISTC-3700 Position Verification Testing

Valves with remote position indicators shall be observed locally at least once every 2 years to verify that valve operation is accurately indicated. Where practicable, this local observation should be supplemented by other indications such as use of flowmeters or other suitable instrumentation to verify obturator position. These observations need not be concurrent. Where local observation is not possible, other indications shall be used for verification of valve operation.

### ISTC-3800 Instrumentation

Instrumentation accuracy shall be considered when establishing valve test acceptance criteria.

## ISTC-4000 RESERVED

## ISTC-5000 SPECIFIC TESTING REQUIREMENTS

### ISTC-5100 Power-Operated Valves (POVs)

All valves shall be tested in accordance with the applicable requirements of ISTC-3000, and as identified below.

**ISTC-5110 Power-Operated Relief Valves (PORVs).** Power-operated relief valves shall meet the requirements of ISTC-5100 for the specific Category B valve type and ISTC-5240 for Category C valves.

#### ISTC-5111 Valve Testing Requirements

(a) Testing shall be performed in the following sequence or concurrently. If testing in the following sequence is impractical, it may be performed out of sequence, and a justification shall be documented in the record of tests for each test or in the test plan:

(1) leakage testing
(2) stroke testing
(3) position indication testing

(b) The pressure-sensing device shall be calibrated in accordance with the Owner's quality assurance program.

**ISTC-5112 Leak Testing.** Seat tightness of the PORV shall be verified by leak testing in accordance with the requirements of Mandatory Appendix I.

#### ISTC-5113 Valve Stroke Testing

(a) Active valves shall have their stroke times measured when exercised in accordance with ISTC-3500.

(b) The limiting value(s) of full-stroke time of each valve shall be specified by the Owner.

(c) The stroke time of all valves shall be measured to at least the nearest second.

(d) Any abnormality or erratic action shall be recorded (see ISTC-9120) and an evaluation shall be made regarding need for corrective action.

(e) Stroke testing shall be performed during normal operating conditions for temperature and pressure if practicable.

**ISTC-5114 Stroke Test Acceptance Criteria.** Test results shall be compared to the reference values established in accordance with ISTC-3300, ISTC-3310, or ISTC-3320. (04)

(a) Valves with reference stroke times of greater than 10 sec shall exhibit no more than ±25% change in stroke time when compared to the reference value.

(b) Valves with reference stroke times of less than or equal to 10 sec shall exhibit no more than ±50% change in stroke time when compared to the reference value.

(c) Valves that stroke in less than 2 sec may be exempted from ISTC-5114(b). In such cases the maximum limiting stroke time shall be 2 sec.

#### ISTC-5115 Corrective Action (04)

(a) If a valve fails the applicable leak test acceptance criteria, to exhibit the required change of obturator position or exceeds the limiting values of full-stroke time [see ISTC-5113(b)], the valve shall be immediately declared inoperable.

(b) Valves with measured stroke times that do not meet the acceptance criteria of ISTC-5113(b) shall be immediately retested or declared inoperable. If the valve is retested and the second set of data also does not meet the acceptance criteria, the data shall be analyzed within 96 hr to verify that the new stroke time represents acceptable valve operation, or the valve shall be declared inoperable. If the second set of data meets the acceptance criteria, the cause of the initial deviation shall be analyzed and the results documented in the record of tests (see ISTC-9120).

(c) Valves declared inoperable may be repaired, replaced, or the data may be analyzed to determine



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the cause of the deviation and the valve shown to be operating acceptably.

*(d)* Valve operability based upon analysis shall have the results of the analysis recorded in the record of tests (see ISTC-9120).

*(e)* Before returning a repaired or replacement valve to service, a test demonstrating satisfactory operation shall be performed.

### ISTC-5120 Motor-Operated Valves

#### ISTC-5121 Valve Stroke Testing

*(a)* Active valves shall have their stroke times measured when exercised in accordance with ISTC-3500.

*(b)* The limiting value(s) of full-stroke time of each valve shall be specified by the Owner.

*(c)* The stroke time of all valves shall be measured to at least the nearest second.

*(d)* Any abnormality or erratic action shall be recorded (see ISTC-9120), and an evaluation shall be made regarding need for corrective action.

**ISTC-5122 Stroke Test Acceptance Criteria.** Test results shall be compared to the initial reference values or reference values established in accordance with ISTC-3300, ISTC-3310, or ISTC-3320.

*(a)* Valves with reference stroke times of greater than 10 sec shall exhibit no more than ±15% change in stroke time when compared to the reference value.

*(b)* Valves with reference stroke times of less than or equal to 10 sec shall exhibit no more than a ±25% nor ±1 sec change in stroke time, whichever is greater, when compared to the reference value.

*(c)* Valves that stroke in less than 2 sec may be exempted from ISTC-5122(b). In such cases the maximum limiting stroke time shall be 2 sec.

#### ISTC-5123 Stroke Test Corrective Action

*(a)* If a valve fails to exhibit the required change of obturator position or exceeds the limiting values of full-stroke time [see ISTC-5121(b)], the valve shall be immediately declared inoperable.

*(b)* Valves with measured stroke times that do not meet the acceptance criteria of ISTC-5122 shall be immediately retested or declared inoperable. If the valve is retested and the second set of data also does not meet the acceptance criteria, the data shall be analyzed within 96 hr to verify that the new stroke time represents acceptable valve operation, or the valve shall be declared inoperable. If the second set of data meets the acceptance criteria, the cause of the initial deviation shall be analyzed and the results documented in the record of tests (see ISTC-9120).

*(c)* Valves declared inoperable may be repaired, replaced, or the data may be analyzed to determine the cause of the deviation and the valve shown to be operating acceptably.

*(d)* Valve operational readiness based upon analysis shall have the results of the analysis recorded in the record of tests (see ISTC-9120).

*(e)* Before returning a repaired or replacement valve to service, a test demonstrating satisfactory operation shall be performed.

### ISTC-5130 Pneumatically Operated Valves

#### ISTC-5131 Valve Stroke Testing

*(a)* Active valves shall have their stroke times measured when exercised in accordance with ISTC-3500.

*(b)* The limiting value(s) of full-stroke time of each valve shall be specified by the Owner.

*(c)* The stroke time of all valves shall be measured to at least the nearest second.

*(d)* Any abnormality or erratic action shall be recorded (see ISTC-9120), and an evaluation shall be made regarding need for corrective action.

**ISTC-5132 Stroke Test Acceptance Criteria.** Test results shall be compared to the reference values established in accordance with ISTC-3300, ISTC-3310, or ISTC-3320.

*(a)* Valves with reference stroke times of greater than 10 sec shall exhibit no more than ±25% change in stroke time when compared to the reference value.

*(b)* Valves with reference stroke times of less than or equal to 10 sec shall exhibit no more than ±50% change in stroke time when compared to the reference value.

*(c)* Valves that stroke in less than 2 sec may be exempted from ISTC-5132(b). In such cases the maximum limiting stroke time shall be 2 sec.

#### ISTC-5133 Stroke Test Corrective Action

*(a)* If a valve fails to exhibit the required change of obturator position or exceeds the limiting values of full-stroke time [see ISTC-5131(b)], the valve shall be immediately declared inoperable.

*(b)* Valves with measured stroke times that do not meet the acceptance criteria of ISTC-5132 shall be immediately retested or declared inoperable. If the valve is retested and the second set of data also does not meet the acceptance criteria, the data shall be analyzed within 96 hr to verify that the new stroke time represents acceptable valve operation, or the valve shall be declared inoperable. If the second set of data meets the acceptance criteria, the cause of the initial deviation shall be analyzed and the results documented in the record of tests (see ISTC-9120).

*(c)* Valves declared inoperable may be repaired, replaced, or the data may be analyzed to determine the cause of the deviation and the valve shown to be operating acceptably.

*(d)* Valve operability based upon analysis shall have the results of the analysis recorded in the record of tests (see ISTC-9120).



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*(e)* Before returning a repaired or replacement valve to service, a test demonstrating satisfactory operation shall be performed.

### ISTC-5140 Hydraulically Operated Valves

#### ISTC-5141 Valve Stroke Testing

*(a)* Active valves shall have their stroke times measured when exercised in accordance with ISTC-3500.

*(b)* The limiting value(s) of full-stroke time of each valve shall be specified by the Owner.

*(c)* The stroke time of all valves shall be measured to at least the nearest second.

*(d)* Any abnormality or erratic action shall be recorded (see ISTC-9120), and an evaluation shall be made regarding need for corrective action.

**ISTC-5142 Stroke Test Acceptance Criteria.** Test results shall be compared to reference values established in accordance with ISTC-3300, ISTC-3310, or ISTC-3320.

*(a)* Valves with reference stroke times of greater than 10 sec shall exhibit no more than ±25% change in stroke time when compared to the reference value.

*(b)* Valves with reference stroke times of less than or equal to 10 sec shall exhibit no more than ±50% change in stroke time when compared to the reference value.

*(c)* Valves that stroke in less than 2 sec may be exempted from ISTC-5142(b). In such cases the maximum limiting stroke time shall be 2 sec.

#### ISTC-5143 Stroke Test Corrective Action

*(a)* If a valve fails to exhibit the required change of obturator position or exceeds the limiting values of full-stroke time [see ISTC-5141(b)], the valve shall be immediately declared inoperable.

*(b)* Valves with measured stroke times that do not meet the acceptance criteria of ISTC-5142 shall be immediately retested or declared inoperable. If the valve is retested and the second set of data also does not meet the acceptance criteria, the data shall be analyzed within 96 hr to verify that the new stroke time represents acceptable valve operation, or the valve shall be declared inoperable. If the second set of data meets the acceptance criteria, the cause of the initial deviation shall be analyzed and the results documented in the record of tests (see ISTC-9120).

*(c)* Valves declared inoperable may be repaired, replaced, or the data may be analyzed to determine the cause of the deviation and the valve shown to be operating acceptably.

*(d)* Valve operability based upon analysis shall have the results of the analysis recorded in the record of tests (see ISTC-9120).

*(e)* Before returning a repaired or replacement valve to service, a test demonstrating satisfactory operation shall be performed.

### ISTC-5150 Solenoid-Operated Valves

#### ISTC-5151 Valve Stroke Testing

*(a)* Active valves shall have their stroke times measured when exercised in accordance with ISTC-3500.

*(b)* The limiting value(s) of full-stroke time of each valve shall be specified by the Owner.

*(c)* Stroke time shall be measured to at least the nearest second.

*(d)* Any abnormality or erratic action shall be recorded (see ISTC-9120), and an evaluation shall be made regarding need for corrective action.

**ISTC-5152 Stroke Test Acceptance Criteria.** Test results shall be compared to reference values established in accordance with ISTC-3300, ISTC-3310, or ISTC-3320.

*(a)* Valves with reference stroke times of greater than 10 sec shall exhibit no more than ±25% change in stroke time when compared to the reference value.

*(b)* Valves with reference stroke times of less than or equal to 10 sec shall exhibit no more than ±50% change in stroke time when compared to the reference value.

*(c)* Valves that stroke in less than 2 sec may be exempted from ISTC-5152(b). In such cases the maximum limiting stroke time shall be 2 sec.

#### ISTC-5153 Stroke Test Corrective Action

*(a)* If a valve fails to exhibit the required change of obturator position or exceeds the limiting values of full-stroke time [see ISTC-5151(b)], the valve shall be immediately declared inoperable.

*(b)* Valves with measured stroke times that do not meet the acceptance criteria of ISTC-5152 shall be immediately retested or declared inoperable. If the valve is retested and the second set of data also does not meet the acceptance criteria, the data shall be analyzed within 96 hr to verify that the new stroke time represents acceptable valve operation, or the valve shall be declared inoperable. If the second set of data meets the acceptance criteria, the cause of the initial deviation shall be analyzed and the results documented in the record of tests (see ISTC-9120).

*(c)* Valves declared inoperable may be repaired, replaced, or the data may be analyzed to determine the cause of the deviation and the valve shown to be operating acceptably.

*(d)* Valve operability based upon analysis shall have the results of the analysis recorded in the record of tests (see ISTC-9120).

*(e)* Before returning a repaired or replacement valve to service, a test demonstrating satisfactory operation shall be performed.



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## ISTC-5200 Other Valves

**ISTC-5210 Manually Operated Valves.** Valve testing shall be in accordance with ISTC-3500. If a valve fails to exhibit the required change of obturator position, the valve shall be immediately declared inoperable. Valves equipped with remote position indication shall be tested in accordance with ISTC-3700.

### ISTC-5220 Check Valves

#### ISTC-5221 Valve Obturator Movement

*(a)* The necessary valve obturator movement during exercise testing shall be demonstrated by performing both an open and a close test.

*(1)* Check valves that have a safety function in both the open and close directions shall be exercised by initiating flow and observing that the obturator has traveled to either the full open position or to the position required to perform its intended function(s) (see ISTA-1100), and verify that on cessation or reversal of flow, the obturator has traveled to the seat.

*(2)* Check valves that have a safety function in only the open direction shall be exercised by initiating flow and observing that the obturator has traveled either the full open position or to the position required to perform its intended function(s) (see ISTA-1100), and verify closure.

*(3)* Check valves that have a safety function in only the close direction shall be exercised by initiating flow and observing that the obturator has traveled at least the partially open position,[3] and verify that on cessation or reversal of flow, the obturator has traveled to the seat.

Observations shall be made by observing a direct indicator (e.g., a position-indicating device) or by other positive means (e.g., changes in system pressure, flow rate, level, temperature, seat leakage, testing, or nonintrusive testing results).

*(b)* If a mechanical exerciser is used to exercise the valve, the force(s) or torque(s) required to move the obturator and fulfill its safety function(s) shall meet the acceptance criteria specified by the Owner.[4]

*(1)* Exercise test(s) shall detect a missing obturator, sticking (closed or open), binding (throughout obturator movement) and the loss or movement of any weight(s). Both an open and close test may not be required.

*(2)* Acceptance criteria shall consider the specific design, application, and historical performance.

*(3)* If impracticable to detect a missing obturator or the loss or movement of any weight(s) using a mechanical exerciser, other positive means may be used (e.g., seat leakage tests and visual observations to detect obturator loss and the loss or movement of external weight(s), respectively).

*(c)* If the test methods in ISTC-5221(a) and ISTC-5221(b) are impractical for certain check valves, or if sufficient flow cannot be achieved or verified, a sample disassembly examination program shall be used to verify valve obturator movement. If maintenance is performed on one of these valves that could affect its performance, the postmaintenance testing shall be conducted in accordance with ISTC-5221(c)(4).

The sample disassembly examination program shall group check valves of similar design, application, and service condition and require a periodic examination of one valve from each group. The details and bases of the sampling program shall be documented and recorded in the test plan (see ISTC-9200).

*(1)* Grouping[5] of check valves for the sample disassembly examination program shall be technically justified and shall consider, as a minimum,[6] valve manufacturer, design, service, size, materials of construction, and orientation.

*(2)* During the disassembly process, the full-stroke motion of the obturator shall be verified. Full-stroke motion of the obturator shall be reverified immediately prior to completing reassembly. Check valves[7] that have their obturator disturbed before full-stroke motion is verified shall be examined to determine if a condition exists that could prevent full opening or reclosure of the obturator.

*(3)* At least one valve from each group shall be disassembled and examined at each refueling outage; all valves in each group shall be disassembled and examined at least once every 8 years.

*(4)* Before return to service, valves that were disassembled for examination or that received maintenance that could affect their performance, shall be exercised full- or part-stroke, if practicable, with flow in accordance with ISTC-3520.[7] Those valves shall also be tested for other requirements (e.g., closure verification or leak rate testing) before returning them to service.

**ISTC-5222 Condition-Monitoring Program.** As an alternative to the testing or examination requirements of ISTC-3510, ISTC-3520, ISTC-3530, ISTC-3550, and ISTC-5221, the Owner may establish a condition-monitoring program. The purpose of this program is both to improve (04)

[3] The partially open position should correspond to the normal or expected system flow.

[4] If practicable, the force(s) or torque(s) required to move the obturator and fulfill any nonsafety function should be evaluated to detect abnormality or erratic action for corrective action.

[5] Maintenance and modification history should be considered in the grouping process.

[6] Valve grouping should also consider potential flow instabilities, required degree of disassembly, and the need for tolerance or critical dimension checks.

[7] Examples are spring-loaded lift check valves, or check valves with the obturator supported from the bonnet.



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valve performance[8] and to optimize testing, examination, and preventive maintenance activities[9] in order to maintain the continued acceptable performance of a select group of check valves. The Owner may implement this program on a valve or a group of similar valves. The program shall be implemented in accordance with Mandatory Appendix II, Check Valve Condition-Monitoring Program. If the condition-monitoring program for a valve or valve group is discontinued, then the testing or examination requirements of ISTC-3510, ISTC-3520, ISTC-3530, ISTC-3550, and ISTC-5221 shall apply.

**ISTC-5223 Series Valves in Pairs.** If two check valves are in a series configuration without provisions to verify individual reverse flow closure (e.g., keepfill pressurization valves) and the plant safety analysis assumes closure of either valve (but not both), the valve pair may be operationally tested closed as a unit.

If the plant safety analysis assumes that a specific valve or both valves of the pair close to perform the safety function(s), the required valve(s) shall be tested to demonstrate individual valve closure.

**ISTC-5224 Corrective Action.** If a check valve fails to exhibit the required change of obturator position, it shall be declared inoperable. A retest showing acceptable performance shall be run following any required corrective action before the valve is returned to service.

Check valves in a sample disassembly program that are not capable of full-stroke movement (i.e., due to binding) or have failed or have unacceptably degraded valve internals, shall have the cause of failure analyzed and the condition corrected. Other check valves in the sample group that may also be affected by this failure mechanism shall be examined or tested during the same refueling outage to determine the condition of internal components and their ability to function.[10]

[8] Examples of candidates for improved valve performance are check valves that

(a) have an unusually high failure rate during inservice testing or operations

(b) cannot be exercised under normal operating conditions or during shutdown

(c) exhibit unusual, abnormal, or unexpected behavior during exercising or operation, or

(d) the Owner elects to monitor for improved valve performance.

[9] Examples of candidates for optimization of testing, examination, and preventive maintenance activities are check valves with documented acceptable performance that

(a) have had their performance improved under the Condition Monitoring Program

(b) cannot be exercised or are not readily exercised during normal operating conditions or during shutdown

(c) can only be disassembled and examined, or

(d) the Owner elects to optimize all of the associated activities of the valve group in a consolidated program.

[10] An evaluation should be made to determine if there are valves outside of the sampling group that could be affected by the failure mechanism. Valves that are determined to be directly affected by the failure mechanism should be examined or tested.

Series valve pairs tested as a unit in accordance with ISTC-5223 that fail to prevent reverse flow shall be declared inoperable, and both valves shall be either repaired or replaced.

**ISTC-5230 Vacuum Breaker Valves.** Vacuum breakers shall meet the applicable inservice test requirements of ISTC-5220 and Mandatory Appendix I.

**ISTC-5240 Safety and Relief Valves.** Safety and relief valves shall meet the inservice test requirements of Mandatory Appendix I.

**ISTC-5250 Rupture Disks.** Rupture disks shall meet the requirements for nonreclosing pressure relief devices of Mandatory Appendix I.

**ISTC-5260 Explosively Actuated Valves**

(a) A record of the service life of each charge in each valve shall be maintained. This record shall include the date of manufacture, batch number, installation date, and the date when service life expires based on manufacturer's recommendations. In no case shall the service life exceed 10 years.

(b) Concurrent with the first test and at least once every 2 years, the service life records of each valve shall be reviewed to verify that the service lives of the charges have not been exceeded and will not be exceeded before the next refueling. The Owner shall take appropriate actions to ensure charge service lives are not exceeded.

(c) At least 20% of the charges in explosively actuated valves shall be fired and replaced at least once every 2 years. If a charge fails to fire, all charges with the same batch number shall be removed, discarded, and replaced with charges from a different batch.

(d) Replacement charges shall be from batches from which a sample charge shall have been tested satisfactorily and with a service life such that the requirements of ISTC-5260(b) are met.

## ISTC-6000 MONITORING, ANALYSIS, AND EVALUATION

## ISTC-7000 RESERVED

## ISTC-8000 RESERVED

## ISTC-9000 RECORDS AND REPORTS

### ISTC-9100 Records

**ISTC-9110 Valve Records.** The Owner shall maintain (04)
a record that shall include the following for each valve covered by this Subsection:

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

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



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*(c)* preservice test results

*(d)* limiting value of full-stroke time specified in ISTC-5113(b), ISTC-5121(b), ISTC-5131(b), ISTC-5141(b), and ISTC-5151(b)

**ISTC-9120 Record of Tests.** See ISTA-9230.

**ISTC-9130 Record of Corrective Action.** See ISTA-9240.

(04) **ISTC-9200 Test Plans**

In addition to the requirements of ISTA-3110, the Owner shall maintain a record of test plans that shall include the following:

*(a)* category of each valve

*(b)* justification for deferral of stroke testing in accordance with ISTC-3520

*(c)* details and bases of the check valve sample disassembly examination program, such as grouping characteristics, frequency, and justification for not performing an exercise test to at least a partially open position after reassembly or periodic exercising in accordance with ISTC-3520

*(d)* bases for testing series check valve pairs as a unit in accordance with ISTC-5223



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# SUBSECTION ISTD
# Preservice and Inservice Examination and Testing of Dynamic Restraints (Snubbers) in Light-Water Reactor Nuclear Power Plants

## ISTD-1000 INTRODUCTION

### ISTD-1100 Applicability

The requirements of this Subsection apply to certain dynamic restraints (snubbers).

### ISTD-1200 Design and Operating Information

Design and operating information necessary for the performance of the examination and testing program shall be available for use during the program. Nonmandatory Appendix C contains a list of typical information that may be useful in the program.

### ISTD-1300 Examination and Test Results

In addition to the requirements of ISTA-9230, the results of examination and test data shall include manufacturer's model number, serial number, type, and unique location identification or Owner's identification of the snubber, as applicable.

### ISTD-1400 Reserved

### ISTD-1500 Snubber Maintenance or Repair

**ISTD-1510 Maintenance or Repair Before Examination or Testing.** Snubbers shall not be adjusted, maintained, or repaired before an examination or test specifically to meet the examination or test requirements.

**ISTD-1520 Post-Maintenance or Repair Examination and Testing.** Snubbers that are maintained or repaired by removing or adjusting a snubber part that can affect the results of tests required by ISTD-5120 shall be examined and tested in accordance with the applicable requirements of ISTD-5120 before returning to service. Additionally, the requirements of ISTD-4110 shall be met. The requirements selected shall ensure that the parameters that may have been affected are verified to be acceptable by suitable examination and tests.[1]

[1] Examples of parts and activities that can affect the test results of ISTD-5120 are as follows:

(*a*) mechanical or hydraulic snubber internal moving parts

(*b*) hydraulic snubber internal seals (i.e., where bypass can affect test results)

(*c*) activities that can permit air to be entrapped in the main cylinder or the control valve of a hydraulic snubber

(*d*) hydraulic control valve adjustment

### ISTD-1600 Snubber Modification and Replacement

**ISTD-1610 Suitability.** Replacement or modified snubber(s) shall have a proven suitability for the application and environment.

**ISTD-1620 Examination and Testing.** Replacement or modified snubbers shall be examined and tested in accordance with written procedures. The applicable requirements of ISTD-4100, ISTD-4200, and ISTD-5200, ISTD-5300, or ISTD-5400, and ISTD-5500 shall be included in these procedures. The requirements selected shall ensure that the criteria of ISTD-4110, ISTD-4230, and ISTD-5210 can be satisfied.

### ISTD-1700 Deletions of Unacceptable Snubbers

Snubbers may be deleted from the plant based on analysis of the affected piping system. When an unacceptable snubber is deleted, the deleted snubber shall nevertheless be considered in its respective examination population, examination category, or failure mode group (FMG) for determining the corrective action.

**ISTD-1750 Transient Dynamic Event.** If a transient dynamic event (e.g., water hammer, steam hammer) occurs that may affect snubber operability, then the affected snubbers and systems shall be reviewed and any appropriate corrective action taken. Any action so taken shall be considered independent of the requirements of ISTD-4100, ISTD-5100, ISTD-4200, and ISTD-5200, ISTD-5300, or ISTD-5400, and ISTD-5500.

### ISTD-1800 Supported Component(s) or System Evaluation

An evaluation shall be performed of the system(s) or components of which an unacceptable snubber is a part, for possible damage to the supported system or component.

## ISTD-2000 DEFINITIONS

The following list of definitions is provided to ensure a uniform understanding of selected terms as used in this Subsection.

*activation:* the change of condition from passive to active, in which the snubber resists rapid displacement of the attached pipe or component.



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*application-induced failures:* failures resulting from environmental conditions or application of the snubber for which it has not been designed or qualified.

*defined test plan group (DTPG):* a population of snubbers selected for testing in accordance with the 10% or 37 testing sample plan.

*design or manufacturing failure:* failures resulting from a potential defect in manufacturing or design that give cause to suspect other similar snubbers. This includes failures of any snubber that fails to withstand the environment or application for which it was designed.

*diagnostic testing:* testing to determine the cause or mechanism associated with failure, degradation, or performance anomaly of a snubber.

*drag force:* the force that will sustain low-velocity snubber movement without activation throughout the working range of the snubber stroke.

*failure mode group (FMG):* a group of snubbers that have failed and those other snubbers that have similar potential for similar failure.

*inaccessible snubbers:* snubbers that are in a high radiation area or other conditions that would render it impractical for the snubbers to be examined under normal plant operating conditions without exposing plant personnel to undue hazards.

*isolated failure:* a failure that does not cause other snubbers to be suspect.

*maintenance, repair, and installation-induced failures:* failures that result from damage during maintenance, repair, or installation activities, the nature of which causes other snubbers to be suspect.

*normal operating conditions:* operating conditions during reactor startup, operating at power, hot standby, reactor cooldown, and cold shutdown.

*operating temperature:* the temperature of the environment surrounding a snubber at its installed plant location during the phase of plant operation for which the snubber is required.

*operational readiness testing:* measurement of the parameters that verify snubber operational readiness.

*release rate:* the rate of the axial snubber movement under a specified load after activation of the snubber takes place.

*replacement snubber:* any snubber other than the snubber immediately previously installed at a given location.

*service life:* the period of time an item is expected to meet the operational readiness requirements without maintenance.

*service life population:* those snubbers for which the same service life has been established.

*swing clearance:* the movement envelope within which the snubber must operate without restriction, from the cold installed position to the hot operating position.

*test temperature:* the temperature of the environment surrounding the snubber at the time of the test.

*transient dynamic event failure:* failure of snubber to stroke because of jammed condition, or to actuate, resulting from water hammer or steam hammer overload.

*unacceptable snubbers:* snubbers that do not meet examination or testing requirements.

*unexplained failure:* failure for which the cause has not been determined.

## ISTD-3000 GENERAL REQUIREMENTS

### ISTD-3100 General Examination Requirements

The following requirements apply to both the preservice and inservice examination programs.

**ISTD-3110 Examination Boundary.** The examination boundaries shall include the snubber assembly from pin to pin, inclusive.

### ISTD-3200 General Testing Requirements

The following requirements apply to both the preservice and inservice testing programs.

**ISTD-3210 Operational Readiness Testing Loads.** Snubbers shall be tested at a load sufficient to verify the test parameters specified in ISTD-5100 and ISTD-5200, ISTD-5300, or ISTD-5400 and ISTD-5500. Testing at less than rated load must be correlated to test parameters at rated load.

**ISTD-3220 Test Correction Factors.** This Subsection recognizes that there may be differences between the installed operating conditions and the conditions under which a snubber is tested. In such cases, correction factors shall be established and test results shall be correlated to operating conditions, as appropriate.

**ISTD-3230 Snubber Test Parameters and Methods.** Guidelines for establishing snubber functional test methods are given in Nonmandatory Appendix H, Test Parameters and Methods.

## ISTD-4000 SPECIFIC EXAMINATION REQUIREMENTS

### ISTD-4100 Preservice Examination

**ISTD-4110 Preservice Examination Requirements.** A preservice examination shall be performed on all snubbers. This examination shall be conducted after installation. Typical items to be considered are listed in Nonmandatory Appendix B. The initial examination shall, as a minimum, verify the following:



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*(a)* no visible signs of damage or impaired operational readiness exist as a result of storage, handling, or installation.

*(b)* the snubber load rating, location, orientation, position setting, and configuration (e.g., attachments and extensions) are in accordance with design drawings and specifications. Installation records (based on physical examinations) of verification that the snubbers were installed according to the design drawings and specifications shall be acceptable in meeting this requirement.

*(c)* adequate swing clearance is provided to allow snubber movement.

*(d)* if applicable, fluid is at the recommended level, and fluid is not leaking from the snubber system.

*(e)* structural connections, such as pins, bearings, studs, fasteners, lock nuts, tabs, wire, and cotter pins, are installed correctly.

**ISTD-4120 Reexamination.** If the period between the preservice examination and initial system preoperational test exceeds 6 months, reexamination shall be performed in accordance with ISTD-4110(a), ISTD-4110(d), and ISTD-4110(e). This reexamination may be accomplished in conjunction with ISTD-4130.

**ISTD-4130 Preservice Thermal Movement Examination Requirements.** During initial system heatup and cooldown, snubber thermal movement for systems whose design operating temperature exceeds 250°F (121°C) shall be verified as indicated in ISTD-4131 through ISTD-4133.

**ISTD-4131 Incremental Movement Verification.** During initial system heatup and cooldown at temperature plateaus specified by the Owner, record the thermal movement. Verify that the snubber movement during the thermal movement examination is within the design-specified range. Any discrepancies or inconsistencies shall be evaluated to determine the movement acceptability before proceeding to the next specified plateau.

**ISTD-4132 Swing Clearance.** Verify that swing clearance exists at specified heatup and cooldown plateaus.

**ISTD-4133 Total Movement Verification.** The total thermal movement from cold to hot at full operating temperature shall be recorded. This value may be measured directly if maximum operating temperature was attained, or it may be extrapolated from lower temperature readings. The cold or hot position setting shall be evaluated and adjusted if necessary, to ensure adequate snubber clearance from fully extended or retracted positions.

**ISTD-4140 Preservice Examination Corrective Action.** Snubbers that are installed incorrectly or otherwise fail to meet the requirements of ISTD-4110 shall be installed correctly, adjusted, repaired, or replaced. The installation-corrected, adjusted, repaired, or replacement snubber shall be examined in accordance with, and shall meet the requirements of ISTD-4110. Also, replacement snubbers shall meet the requirements of ISTD-5120.

## ISTD-4200 Inservice Examination

Snubbers shall be visually examined on the required schedule and evaluated to determine their operational readiness.

**ISTD-4210 Method and Objective.** Inservice examination shall be a visual examination to identify physical damage, leakage, corrosion, or degradation that may have been caused by environmental exposure or operating conditions. External characteristics that may indicate operational readiness of the snubber shall be examined. An examination checklist shall be used. Typical items are listed in Nonmandatory Appendix B.

**ISTD-4220 Snubber Categorization**

*(a)* All of the snubbers shall be considered one population for examination. Alternatively, they may be categorized individually as accessible or inaccessible. The categories of accessible and inaccessible snubbers shall be considered separately for examination.

*(b)* The decision to examine the snubbers as one population or as separate categories shall be made and documented before the scheduled examination begins and shall not be changed during the examination.

*(c)* When recombining categories into one population, the shorter interval of the categories shall be used.

**ISTD-4230 Visual Examination Requirements.** Snubber installations shall meet all of the requirements of ISTD-4231 through ISTD-4233.

**ISTD-4231 Restrained Movement.** Snubbers shall be installed so they are capable of restraining movement when activated. Examinations shall include observations for the following and the conditions shall be evaluated when found:

*(a)* loose fasteners, or members that are corroded or deformed

*(b)* disconnected components or other conditions that might interfere with the proper restraint of movement

Snubbers evaluated to be incapable of restraining movement shall be classified unacceptable.

**ISTD-4232 Thermal Movement.** Snubber installations shall not restrain thermal movement to an extent that unacceptable stresses could develop in the snubber, the pipe, or other equipment that the snubber is designed to protect or restrain. This requirement is satisfied if no indication of binding, misalignment, or deformation of the snubber is observed.

**ISTD-4233 Design-Specific Characteristics.** Snubbers shall be free of defects that may be generic to particular designs as may be detected by visual examination.



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For example, fluid supply or content for hydraulic snubbers shall be observed. An observation that the fluid level is equal to or greater than the minimum specified amount that is sufficient for actuation at its operating extension is considered to satisfy this requirement. If the fluid is less than the minimum amount, the installation shall be identified as unacceptable, unless a test establishes that the performance of the snubber is within specified limits. Tests shall be performed in accordance with ISTD-5210(b) and ISTD-5210(c). The initial test shall start with the piston at the as-found setting and be performed in the extension (tension) direction, or in a mode that more closely resembles the operating and design requirements of the snubber.

**ISTD-4240 Operational Readiness Test Evaluation.** A snubber that requires further evaluation or is classified as unacceptable during inservice examination may be tested in accordance with the requirements of ISTD-5210. Results that satisfy the operational readiness test criteria of ISTD-5210 shall be used to accept the snubber, provided the test demonstrates that the unacceptable condition did not affect operational readiness.

### ISTD-4250 Inservice Examination Intervals

**ISTD-4251 Initial Examination.** Initial inservice examination of snubbers shall be started not less than 2 months after attaining 5% reactor power operation and shall be completed within 12 calendar months after attaining 5% reactor power operation.

### ISTD-4252 Subsequent Examination Intervals

*(a)* The second inservice examination shall be conducted at the first refueling outage.

*(b)* The third inservice examination shall be conducted at the second refueling outage, and subsequent examinations shall be conducted in accordance with Table ISTD-4252-1. Examples of the application of Table ISTD-4252-1 are provided in Nonmandatory Appendix G.

*(c)* When examinations have been performed after the first refueling outage in accordance with a schedule requirement other than those in Table ISTD-4252-1, the interval preceding the most recently completed examination shall be used as the previous interval for the first application of Table ISTD-4252-1.

*(d)* Snubbers determined to be unacceptable based on the visual examination acceptance criteria at any time during the interval shall be counted in determining the subsequent examination interval in accordance with Table ISTD-4252-1.

**ISTD-4260 Inservice Examination Sample Size.** Inservice examination of snubbers required by ISTD-4251 and ISTD-4252 shall include all snubbers based either on the whole population or on the accessibility categories, as established according to the provisions of ISTD-4220.

**ISTD-4270 Inservice Examination Failure Evaluation.** Snubbers that do not meet examination requirements of ISTD-4230 shall be evaluated to determine the root cause of the unacceptability.

**ISTD-4280 Inservice Examination Corrective Action.** Unacceptable snubbers shall be adjusted, repaired, modified, or replaced. Additional action regarding the examination interval shall be taken as indicated in Table ISTD-4252-1.

## ISTD-5000 SPECIFIC TESTING REQUIREMENTS

### ISTD-5100 Preservice Operational Readiness Testing

**ISTD-5110 General.** Preservice operational readiness testing shall be performed on all snubbers. Testing may be performed at the manufacturer's facility.

**ISTD-5120 Test Parameters.** Tests shall verify the following:

*(a)* activation is within the specified range of velocity or acceleration in tension and in compression.

*(b)* release rate, when applicable, is within the specified range in tension and in compression. For units specifically required not to displace under continuous load, ability of the snubber to withstand load without displacement.

*(c)* for mechanical snubbers, drag force is within specified limits in tension and in compression.

*(d)* for hydraulic snubbers, if required to verify proper assembly, drag force is within specified limits in tension and in compression.

### ISTD-5130 Preservice Operational Readiness Testing Failures Corrective Action

**ISTD-5131 Test Failure Evaluations.** Snubbers that fail the preservice operational readiness test shall be evaluated for the cause(s) of failure(s).

**ISTD-5132 Design Deficiency.** If a design deficiency in a snubber is found, it shall be corrected by changing the design or specification, or by other appropriate means.

**ISTD-5133 Other Deficiencies.** Other deficiencies shall be resolved by adjustment, modification, repair, replacement, or other appropriate means.

**ISTD-5134 Retest Requirements.** Adjusted, modified, repaired, or replacement snubbers shall be tested to meet the requirements of ISTD-5120.

### ISTD-5200 Inservice Operational Readiness Testing

Snubbers shall be tested for operational readiness during each fuel cycle. Tests are required to be in accordance with a specified sampling plan. Testing shall be performed during normal system operation, or during system or plant outages. The Owner's administrative



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**Table ISTD-4252-1 Visual Examination Table**

| Population or Category [Note (1)] | Number of Unacceptable Snubbers | | |
|---|---|---|---|
| | Column A for Extended Interval [Notes (2), (3)] | Column B for Interval Same as Previous [Notes (2), (4), (5)] | Column C for Interval Reduction to 2/3 [Notes (2), (5), (6)] |
| 1 | 0 | 0 | 1 |
| 80 | 0 | 0 | 2 |
| 100 | 0 | 1 | 4 |
| 150 | 0 | 3 | 8 |
| 200 | 2 | 5 | 13 |
| 300 | 5 | 12 | 25 |
| 400 | 8 | 18 | 36 |
| 500 | 12 | 24 | 48 |
| 750 | 20 | 40 | 78 |
| ≥ 1000 | 29 | 56 | 109 |

NOTES:

(1) Interpolation between population or category sizes and the number of unacceptable snubbers is permissible. The next lower integer shall be used when interpolation results in a fraction.

(2) The basic interval shall be the normal fuel cycle up to 24 months. The examination interval may be as great as twice, the same, or as small as fractions of the previous interval as required by the following Notes. The examination interval may vary ±25% of the current interval.

(3) If the number of unacceptable snubbers is equal to or less than the number in Column A, then the next examination interval may be increased to twice the previous examination interval, not to exceed 48 months. In that case, the next examination according to the previous interval may be skipped.

(4) If the number of unacceptable snubbers exceeds the number in Column A, but is equal to or less than the number in Column B, then the next visual examination shall be conducted at the same interval as the previous interval.

(5) If the number of unacceptable snubbers exceeds the number in Column B, but is equal to or less than the number in Column C, then the next examination interval shall be decreased to two-thirds of the previous examination interval or, in accordance with the interpolation between Columns B and C, in proportion to the exact number of unacceptable snubbers.

(6) If the number of unacceptable snubbers exceeds the number in Column C, then the next examination interval shall be decreased to two-thirds of the previous interval.

procedures shall govern removing snubbers from operable system(s). For each snubber determined to be unacceptable by operational readiness testing, additional snubbers shall be tested as determined by the type of failure and the corrective action taken.

**ISTD-5210 Test Parameters.** Snubber operational readiness tests shall verify the following:

*(a)* activation is within the specified range of velocity or acceleration in tension and in compression.

*(b)* release rate, when applicable, is within the specified range in tension and in compression. For units specifically required not to displace under continuous load, ability of the snubber to withstand load without displacement.

*(c)* for mechanical snubbers, drag force is within specified limits, in tension and in compression.

### ISTD-5220 Test Methods

**ISTD-5221 Test as Found.** Snubbers shall be tested in their as-found condition regarding the parameters to be tested to the fullest extent practicable.

**ISTD-5222 Restriction.** Test methods shall not alter the condition of a snubber to the extent that the results do not represent the as-found snubber condition.

**ISTD-5223 In-Place Test.** Snubbers may be tested in their installed location by using Owner-approved test methods and equipment.

**ISTD-5224 Bench Test.** Snubbers may be removed and bench tested in accordance with Owner-approved procedures. After reinstallation, the snubbers shall meet the requirements of ISTD-4110(a), ISTD-4110(c), ISTD-4110(d), and ISTD-4110(e). Also, the position setting shall be verified.

**ISTD-5225 Subcomponent Test.** When snubber size, test equipment limitations, or inaccessibility prevents use of methods in ISTD-5223 and ISTD-5224, snubber subcomponents that control the parameters to be verified shall be examined and tested in accordance with Owner-approved test methods. Reassembly shall be in accordance with approved procedures that include the requirements of ISTD-4110(a), (d), and (e). Service life



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monitoring requirements are specified in ISTD-6400.

**ISTD-5226 Correlation of Indirect Measurements.** When test methods are used that either measure parameters indirectly, or measure parameters other than those specified, the results shall be correlated with specified parameters through established methods.

**ISTD-5227 Parallel and Multiple Installations.** Each snubber in a parallel or multiple installation shall be identified and counted individually.

**ISTD-5228 Fractional Sample Sizes.** Fractional sample sizes shall be rounded up to the next integer.

**ISTD-5230 Qualitative Tests.** Qualitative tests may be used instead of quantitative measurements to meet the requirements of ISTD-5210, if adequate justification is presented and is acceptable to the regulatory authority having jurisdiction over the facility. The Owner shall obtain sufficient data, based upon service history or life cycle testing, to demonstrate the ability of the parameter in question to conform to the specification over the life of the snubber (e.g., that activation takes place — without measuring the activation level). A test report that confirms the parameter was within specifications shall be available for each snubber exempted from an inservice quantitative test requirement.

**ISTD-5240 Test Frequency.** Tests of snubbers from the facility shall be performed every fuel cycle. Snubber testing may begin no earlier than 60 days before a scheduled refueling outage.

### ISTD-5250 Defined Test Plan Group (DTPG)

**ISTD-5251 DTPGs General Requirement.** The DTPGs shall include all snubbers except replacement snubbers and snubbers repaired or adjusted as a result of not meeting the examination acceptance requirements of ISTD-4200. These snubbers shall be exempt for the concurrent test interval.

**ISTD-5252 DTPG Alternatives.** Except as required by ISTD-5253, the total snubber population may be considered one DTPG, or alternatively, differences in design, application, size, or type may be considered in establishing DTPGs.

**ISTD-5253 Additional DTPG Requirements for Pressurized Water Reactors.** Snubbers attached to the steam generator and snubbers attached to the reactor coolant pump shall be at least one, separate DTPG.

### ISTD-5260 Testing Sample Plans

**ISTD-5261 Sample Plans.** The snubbers of each DTPG shall be tested using either of the following:

*(a)* the 10% testing sample plan

*(b)* the 37 testing sample plan

Nonmandatory Appendix D includes a comparison of sample plans. Snubber testing plans are presented in flow chart form in Nonmandatory Appendix E.

**ISTD-5262 Plan Selection.** A test plan shall be selected for each DTPG before the scheduled testing begins.

**ISTD-5263 Plan Application.** The test plan selected for a DTPG shall be used throughout the refueling outage tests for that DTPG and any failure mode group (FMG) that is derived from it.

**ISTD-5270 Continued Testing.** For unacceptable snubber(s), the additional testing shall continue in the DTPG or FMG per ISTD-5330 or ISTD-5430.

**ISTD-5271 Test Failure Evaluation.** Snubbers that do not meet test requirements specified in ISTD-5210 or ISTD-5230 shall be evaluated to determine the root cause of the failure.

*(a)* The evaluation shall include review of information related to other unacceptable snubbers found during testing that refueling outage.

*(b)* The evaluation results shall be used, as applicable, to determine FMGs to which snubbers should be assigned. Additional justifying information should be used to assign snubbers with failures previously identified as unexplained or isolated to an appropriate FMG.

**ISTD-5272 FMGs.** Snubbers found unacceptable according to operational readiness test requirements should be assigned to FMGs unless the failure is isolated or unexplained. FMGs shall include all unacceptable snubbers with the same failure mode and all other snubbers with similar potential for similar failure. The following FMGs shall be used:

*(a)* design or manufacturing

*(b)* application induced

*(c)* maintenance, repair, or installation

*(d)* transient dynamic event

### ISTD-5273 FMG Boundaries

*(a)* When snubbers have been tested as a part of DTPG test requirements and found to be unacceptable, and evaluation establishes an FMG based on the failure of certain snubbers, the number of those unacceptable snubbers shall be used in determining testing in the FMG in accordance with ISTD-5320 and ISTD-5330, or ISTD-5420 and ISTD-5430. However, those snubbers shall be counted only in the value of $N$ of ISTD-5331(a) or ISTD-5431(a) as completed tests in the DTPG.

*(b)* When snubbers have been found to be acceptable when tested as part of DTPG test requirements and subsequent evaluation establishes an FMG that would include those snubbers, those snubbers shall not be counted in the value of $N_F$ in ISTD-5331(b) or ISTD-5431(b) when counting FMG tests.

*(c)* An FMG shall remain as defined until corrective action is complete.



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**ISTD-5274 Snubbers in More Than One FMG.** When a snubber is assigned to more than one FMG, it shall be counted in each of those FMGs and shall be included in corrective action for each of those FMGs.

**ISTD-5275 Additional FMG Review.** After the requirements of ISTD-5250, ISTD-5260, ISTD-5270, ISTD-5320, and ISTD-5420 are satisfied for a DTPG, any separate and additional FMG review or testing does not require additional tests in the DTPG.

**ISTD-5280 Corrective Action.** Unacceptable snubbers shall be adjusted, repaired, modified, or replaced. The provisions of ISTD-1620 and ISTD-1700 also apply. Snubbers that do not meet the test requirements of ISTD-5210 or ISTD-5230 shall be tested in accordance with ISTD-5320 or ISTD-5420, as applicable.

## ISTD-5300 The 10% Testing Sample

### ISTD-5310 The 10% Testing Sample Plan, Sample Size, and Composition

**ISTD-5311 Initial Sample Size and Composition.** The initial sample shall be 10% of the DTPG, composed according to either ISTD-5311(a) or ISTD-5311(b).

*(a)* As practicable, the sample shall include representation from the DTPG based on the significant features (i.e., the various designs, configurations, operating environments, sizes, and capacities) and based on the ratio of the number of snubbers of each significant feature, to the total number of snubbers in the DTPG. Selection of the representative snubbers shall be random.

*(b)* The sample shall be generally representative as specified in ISTD-5311(a), but may also be selected from snubbers concurrently scheduled for seal replacement or other similar activity related to service life monitoring. The snubbers shall be tested on a generally rotational basis to coincide with the service life monitoring activity.

**ISTD-5312 Additional Sample Size.** When additional samples are required by ISTD-5320, they shall be at least one-half the size of the initial sample from that DTPG.

**ISTD-5313 Additional DTPG Sample Composition.** When an unacceptable snubber has not been assigned to an FMG, the additional sample required by ISTD-5320 shall be taken from the DTPG. As practicable, the additional sample shall include the following:

*(a)* snubbers of the same manufacturer's design

*(b)* snubbers immediately adjacent to those found unacceptable

*(c)* snubbers from the same piping system

*(d)* snubbers from other piping systems that have similar operating conditions such as temperature, humidity, vibration, and radiation

*(e)* snubbers that are previously untested

**ISTD-5314 FMG Sample Composition.** When samples from an FMG are required, they shall be selected randomly from untested snubbers in the FMG.

### ISTD-5320 The 10% Testing Sample Plan Additional Testing and Alternatives

**ISTD-5321 Unexplained Failures.** When an applicable FMG has not been established, the number of unacceptable snubbers shall determine the additional testing samples in accordance with ISTD-5312 and ISTD-5330.

**ISTD-5322 Isolated Failure.** Additional tests are not required for an isolated failure.

**ISTD-5323 Design or Manufacturing and Application-Induced FMGs Alternatives to Testing.** When the corrective action of ISTD-5323(a) or ISTD-5323(b) is taken, no additional testing is required for the applicable FMGs.

*(a)* All snubbers in these FMGs shall be replaced or modified in accordance with ISTD-1600; or

*(b)* The unacceptable snubbers in an application-induced FMG shall be replaced or repaired to an acceptable condition, and the environment or applications shall be made compatible with the design parameters for all snubbers in this FMG.

**ISTD-5324 Design or Manufacturing; Maintenance, Repair, or Installation; and Application-Induced FMGs Tests.** When the corrective actions of ISTD-5323 are not applicable, or are not taken, the following apply:

*(a)* Tests in the FMG shall be based both on the number of unacceptable snubbers found in the DTPG and determined by the evaluation of ISTD-5271 to be appropriate for establishing the FMG, and on the number of unacceptable snubbers subsequently found in the FMG.

*(b)* Testing shall continue until the mathematical expression of ISTD-5331(b) is satisfied or all snubbers in the FMG have been tested.

**ISTD-5325 Transient Dynamic Event FMG Additional Tests.** Although additional tests are not required for transient dynamic event FMG failures, the operational readiness of all snubbers in this FMG shall be evaluated by stroking or testing. All operationally ready snubbers in this FMG remain eligible for selection and tests for other appropriate FMGs and the DTPG in accordance with ISTD-5313 and ISTD-5314.

**ISTD-5330 The 10% Testing Sample Plan Completion.** The snubbers of each DTPG and FMG shall be tested as required. Testing is complete when the mathematical expressions of ISTD-5331 are satisfied, or all snubbers in the DTPG or FMG have been tested.

**ISTD-5331 Testing Plan Mathematical Expression.** Testing shall satisfy the mathematical expressions as follows:



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(a) for each DTPG

$$N \geq 0.1n + C(0.1n/2)$$

where

$N$ = total number of snubbers tested that were selected from the DTPG
$n$ = number of snubbers in the DTPG
$C$ = total number of unacceptable snubbers found in the DTPG (excluding those counted for FMG tests)

(b) for each FMG

$$N_F \geq C_F(0.1n/2)$$

where

$N_F$ = all snubbers selected and tested from the FMG after the FMG was established from the DTPG
$C_F$ = total number of unacceptable snubbers in the FMG, plus those found in the DTPG and used to establish the FMG
$n$ = number of snubbers in the DTPG

## ISTD-5400 The 37 Testing Sample Plan

### ISTD-5410 The 37 Testing Sample Plan, Sample Size, and Composition

**ISTD-5411 Initial Sample Size and Composition.** An initial sample of 37 snubbers shall be selected randomly from each 37 plan DTPG.

**ISTD-5412 Additional Sample Size.** When additional samples are required by ISTD-5420, the samples shall be either 18 or 19 snubbers to satisfy the requirement of ISTD-5431.

**ISTD-5413 Additional Sample Selection.** Additional samples, if required, shall be selected randomly from the remaining population of the DTPG, or from untested snubbers of the FMG as applicable.

### ISTD-5420 The 37 Testing Sample Plan Additional Testing and Alternatives

**ISTD-5421 Unexplained Failure.** When an applicable FMG has not been established, the number of unacceptable snubbers shall determine additional samples in accordance with ISTD-5412. The additional samples shall be selected randomly from the remaining untested snubbers of the DTPG.

**ISTD-5422 Isolated Failure.** Additional tests are not required for an isolated failure.

**ISTD-5423 Design or Manufacturing and Application-Induced FMGs Alternatives to Testing.** When the corrective action of ISTD-5423(a) or ISTD-5423(b) is taken, no additional testing is required for the applicable FMGs.

(a) All snubbers in these FMGs shall be replaced or modified in accordance with ISTD-1600; or

(b) the unacceptable snubbers in an application-induced FMG shall be replaced or repaired to an acceptable condition, and the environment or applications shall be made compatible with the design parameters for all snubbers in this FMG.

**ISTD-5424 Design or Manufacturing; Maintenance, Repair, or Installation; and Application-Induced FMGs Additional Testing.** When the corrective actions of ISTD-5423 are not applicable, or are not taken, the following apply:

(a) Tests in an FMG shall be based both on the number of unacceptable snubbers found in the DTPG and determined by the evaluation of ISTD-5271 to be appropriate for establishing the FMG, and on the number of unacceptable snubbers subsequently found in the FMG.

(b) Failures in an FMG shall require additional tests in the FMG unless an evaluation indicates that another grouping is appropriate for additional tests.

(c) A supplemental sample of snubbers (18 or 19, to satisfy ISTD-5431) for each FMG established shall be tested from the applicable DTPG. Failures in the supplemental sample require additional tests in the DTPG unless an evaluation indicates that another grouping is appropriate for additional testing.

**ISTD-5425 Transient Dynamic Event FMG Additional Testing.** Although additional tests are not required for transient dynamic event FMG failures, the operational readiness of all snubbers in this FMG shall be evaluated by stroking or testing. All operationally ready snubbers in this FMG remain eligible for selection and tests for other appropriate FMGs and the DTPG in accordance with ISTD-5413.

**ISTD-5430 The 37 Testing Sample Plan Completion.** The snubbers of each DTPG and FMG shall be tested as required. Testing is complete when the mathematical expressions of ISTD-5431 are satisfied, or all snubbers in the DTPG or FMG have been tested.

**ISTD-5431 Testing Plan Mathematical Expressions.** Testing shall satisfy the mathematical expressions as follows:

(a) for each DTPG

$$N \geq 36.49 + 18.18C \text{ (Fig. ISTD-5431-1)}$$

where

$N$ = total number of snubbers tested that were selected from the DTPG
$C$ = total number of unacceptable snubbers found in the DTPG (excluding those counted in FMG tests), plus one for each applicable FMG requiring additional tests in accordance with ISTD-5424

(b) for each FMG requiring additional tests

$$N_F \geq 18.18C_F$$



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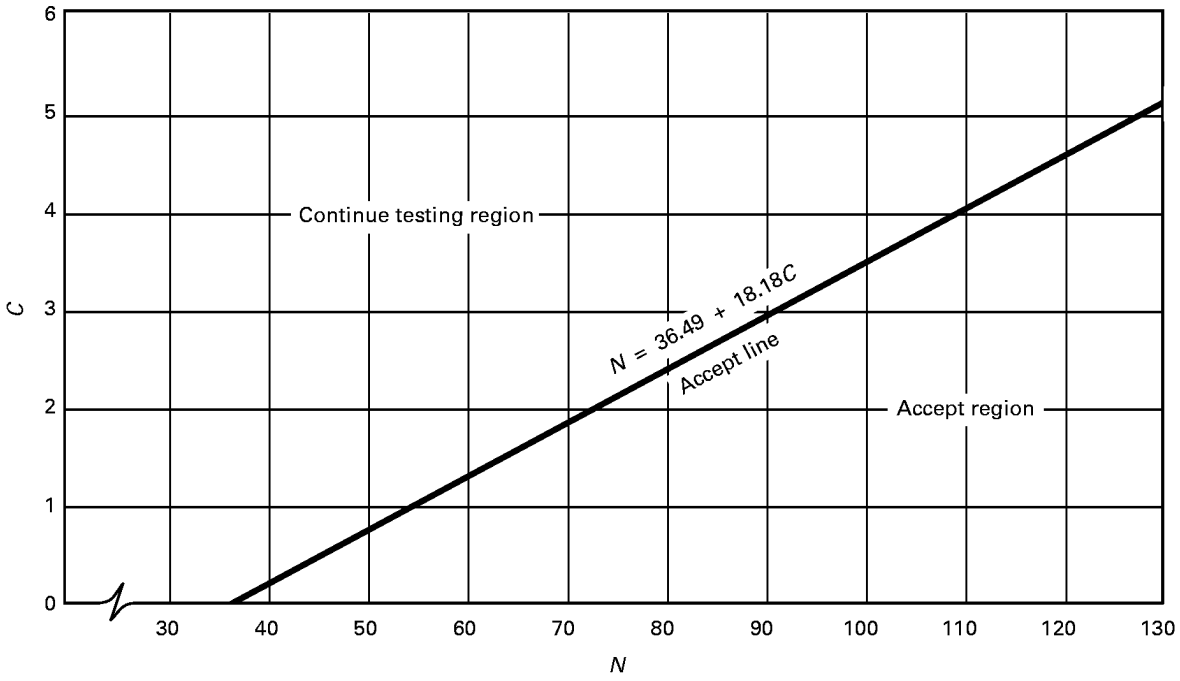


**Fig. ISTD-5431-1 The 37 Testing Sample Plan**

where

$N_F$ = all snubbers selected and tested after the FMG was established from DTPG

$C_F$ = total number of unacceptable snubbers in the FMG, plus those found in the DTPG and used to establish the FMG

### ISTD-5500 Retests of Previously Unacceptable Snubbers

Snubbers placed in the same location as snubbers that failed the previous inservice operational readiness test shall be retested at the time of next operational readiness testing unless the cause of the failure is clearly established and corrected. Any retest in accordance with this paragraph shall not be considered a part of inservice operational readiness testing sample selection requirements of ISTD-5200, ISTD-5300, or ISTD-5400. In addition, failures found by these retest shall not require additional testing in accordance with ISTD-5320 or ISTD-5420, but shall be evaluated for appropriate corrective action.

## ISTD-6000 SERVICE LIFE MONITORING

### ISTD-6100 Predicted Service Life

Initial snubber service life shall be predicted based on manufacturer's recommendation or design review. Methods for predicting service life are given in Nonmandatory Appendix F.

### ISTD-6200 Service Life Evaluation

Service life shall be evaluated at least once each fuel cycle, and increased or decreased, if warranted. Evaluation shall be based upon technical data from representative snubbers that have been in service in the plant, or other information related to service life. Examples of methods that can be used to obtain such data are described in Nonmandatory Appendix F. If the evaluation indicates that service life will be exceeded before the next scheduled system or plant outage, one of the following actions shall be taken:

*(a)* the snubber shall be replaced with a snubber for which the service life will not be exceeded before the next scheduled system or plant outage

*(b)* technical justification shall be documented for extending the service life to or beyond the next scheduled system or plant outage

*(c)* the snubber shall be reconditioned such that its service life will be extended to or beyond the next scheduled system or plant outage

### ISTD-6300 Root Cause Determination

Root causes for any examination or testing failures shall be determined and considered in establishing or reestablishing service life.



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### ISTD-6400 Additional Monitoring Requirements for Snubbers That Are Tested Without Applying a Load to the Snubber Piston Rod

The service life evaluation, for hydraulic snubbers that are tested without applying a load to the snubber piston rod, shall consider the results of the following requirements:

*(a)* monitoring the particulate, viscosity, and moisture content of one or more samples of hydraulic fluid from the main cylinder of the snubber. This may be accomplished using snubbers of the same design in a similar or more severe environment.

*(b)* monitoring of piston seal, piston rod seal, and cylinder seal integrity. If seal integrity is monitored by pressurization, pressures less than the snubber's rated load pressure may be used. Minimum pressure allowed shall be specified by the Owner.

### ISTD-6500 Testing for Service Life Monitoring Purposes

If testing is conducted specifically for service life monitoring purposes, the results of such testing do not require testing of additional snubbers in accordance with ISTD-5320 or ISTD-5420, but shall be evaluated for appropriate corrective action.



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# MANDATORY APPENDIX I[1]
# Inservice Testing of Pressure Relief Devices in Light-Water Reactor Nuclear Power Plants

## I-1000 GENERAL REQUIREMENTS

### I-1100 Applicability

The requirements of this Appendix apply to certain pressure relief devices (included in Section III of the ASME Boiler and Pressure Vessel Code, hereafter known as the BPV Code).

### I-1120 Limitations

*(a)* The requirements of this Appendix recognize differences between the installed operating conditions and the conditions under which a pressure relief device may be tested. For a specific pressure relief device design, if the parameter to be tested is dependent on conditions not specifically addressed by these requirements, the installed operating condition and the test condition shall be comparable, or proven correlations shall be applied.

*(b)* The requirements of this Appendix apply only to pressure relief devices required for overpressure protection.

*(c)* The requirements of this Appendix are not intended to demonstrate conformance to design specification requirements.

*(d)* The requirements of this Appendix are not intended to verify or demonstrate all aspects of pressure relief device operation.

### I-1200 Definitions

The following definitions are provided to ensure a uniform understanding of select terms used in this Appendix. Definitions for other related pressure relief device terms can be found in Appendix I of ANSI/ASME PTC 25, Pressure Relief Devices.

*ambient temperature:* the temperature of the environment surrounding a pressure relief device at its installed plant location during the phase of plant operation for which the device is required for overpressure protection.

*assist device:* a pneumatic, hydraulic, or mechanical device applied to a pressure relief valve for set-pressure testing to assist inlet static pressure in opening the valve.

*auxiliary actuating device:* a device requiring an external energy source to provide inservice remote actuation capability of a pressure relief valve with inlet static pressure below set-pressure.

*bellows alarm switch:* an electropneumatic switch used in pilot-operated pressure relief valves to detect a failure of the pressure integrity of the pilot bellows, the failure of which may prevent opening of the primary valve.

*control rings:* internal rings used to adjust the opening characteristic, blowdown, and lift of a pressure relief valve.

*gag:* a mechanical device installed on a pressure relief valve to restrict or prevent lift.

*historical data form:* a form for recording test results and maintenance history of a pressure relief device.

*normal system operating conditions (fluid, pressure, temperature):* system fluid, pressure, and temperature during the phase of plant operation for which that system is intended to function.

*overpressure protection:* the means by which components are protected from overpressure by the use of pressure relieving devices or other design provisions as required by the BPV Code, Section III, or other applicable construction codes.

*power-actuated relief valve:* a relief valve in which the major relieving device is combined with and controlled by a device requiring an external source of energy.

*remote actuation:* actuation of a pressure relief device through a generated signal rather than by inlet static pressure.

*thermal relief application:* a relief device whose only overpressure protection function is to protect isolated components, systems, or portions of systems from fluid expansion caused by changes in fluid temperature.

*valve group:* valves of the same manufacturer, type, system application, and service media.

### I-1300 Guiding Principles

#### I-1310 General

*(a) Operation and Maintenance Instructions.* Complete operation and maintenance instructions shall be available for each device. This Appendix shall be supplemented by these operating and maintenance instructions.

[1] This Appendix contains requirements to augment the rules of Subsection ISTC, Inservice Testing of Valves in Light-Water Reactor Nuclear Power Plants.



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*(b) Valve Testing Frequency.* A frequency for valve testing is required by this Appendix to provide assurance of the valve operational readiness.

*(c) Valve Disassembly.* This Appendix does not require valves or accessories to be disassembled or removed from their installed position.

*(d) Visual Examination.* Visual examinations shall be performed in accordance with the Owner's examination procedures and shall be documented.

*(e) Acceptance Criteria.* The Owner, based upon system and valve design basics or technical specification, shall establish and document acceptance criteria for tests required by this Appendix.

### I-1320 Test Frequencies, Class 1 Pressure Relief Valves

*(a) 5-Year Test Interval.* Class 1 pressure relief valves shall be tested at least once every 5 years, starting with initial electric power generation. No maximum limit is specified for the number of valves to be tested within each interval; however, a minimum of 20% of the valves from each valve group shall be tested within any 24-month interval. This 20% shall consist of valves that have not been tested during the current 5-year interval, if they exist. The test interval for any individual valve shall not exceed 5 years.

*(b) Replacement With Pretested Valves.* The Owner may satisfy testing requirements by installing pretested valves to replace valves that have been in service, provided that:

*(1)* for replacement of a partial complement of valves, the valves removed from service shall be tested prior to resumption of electric power generation; or

*(2)* for replacement of a full complement of valves, the valves removed from service shall be tested within 12 months of removal from the system.

*(c) Requirements for Testing Additional Valves.* Additional valves shall be tested in accordance with the following requirements:

*(1)* For each valve tested for which the as-found set-pressure (first test actuation) exceeds the greater of either the ±tolerance limit of the Owner-established set-pressure acceptance criteria of I-1310(e) or ±3% of valve nameplate set-pressure, two additional valves shall be tested from the same valve group.

*(2)* If the as-found set-pressure of any of the additional valves tested in accordance with I-1320 (c)(1) exceeds the criteria noted therein, then all remaining valves of that same valve group shall be tested.

*(3)* The Owner shall evaluate the cause and effect of valves that fail to comply with the set-pressure acceptance criteria established in I-1320(c)(1) or the Owner-established acceptance criteria for other required tests, such as the acceptance of auxiliary actuating devices, compliance with Owner's seat tightness criteria, etc. Based upon this evaluation, the Owner shall determine the need for testing in addition to the minimum tests specified in I-1320(c) to address any generic concerns that could apply to valves in the same or other valve groups.

**I-1330 Test Frequency, Class 1 Nonreclosing Pressure Relief Devices.** Class 1 nonreclosing pressure relief devices shall be replaced every 5 years unless historical data indicates a requirement for more frequent replacement.

**I-1340 Test Frequency, Class 1 Pressure Relief Valves That Are Used for Thermal Relief Application.** Tests shall be performed in accordance with I-1320, Test Frequencies, Class 1 Pressure Relief Valves.

### I-1350 Test Frequency, Classes 2 and 3 Pressure Relief Valves

*(a) 10-year Test Interval.* Classes 2 and 3 pressure relief valves, with the exception of PWR main steam safety valves, shall be tested every 10 years, starting with initial electric power generation. No maximum limit is specified for the number of valves to be tested during any single plant operating cycle; however, a minimum of 20% of the valves from each valve group shall be tested within any 48-month interval. This 20% shall consist of valves that have not been tested during the current 10-year test interval, if they exist.

The test interval for any individual valve shall not exceed 10 years. PWR main steam safety valves shall be tested in accordance with I-1320.

*(b) Replacement With Pretested Valves.* The Owner may satisfy testing requirements by installing pretested valves to replace valves that have been in service, provided that

*(1)* for replacement of a partial complement of valves, the valves removed from service shall be tested within 3 months of removal from the system or before resumption of electric power generation, whichever is later; or

*(2)* for replacement of a full complement of valves, the valves removed from service shall be tested within 12 months of removal from the system.

*(c) Requirements for Testing Additional Valves.* Additional valves shall be tested in accordance with the following requirements.

*(1)* For each valve tested for which the as-found set-pressure (first test actuation) exceeds the greater of either the ±tolerance limit of the Owner-established set-pressure acceptance criteria of I-1310(e) or ±3% of valve nameplate set-pressure, two additional valves shall be tested from the same valve group.

*(2)* If the as-found set-pressure of any of the additional valves tested in accordance with I-1350(c)(1) exceeds the criteria noted therein, then all remaining valves of that same valve group shall be tested.

*(3)* The Owner shall evaluate the cause and effect of valves that fail to comply with the set-pressure acceptance criteria established in I-1350(c)(1) or the Owner-established acceptance criteria for other required tests,



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such as the acceptance of auxiliary actuating devices, compliance with the Owner's seat tightness criteria, etc. Based upon this evaluation, the Owner shall determine the need for testing in addition to the minimum tests specified in I-1350(c) to address any generic concerns that could apply to valves in the same or other valve groups.

**I-1360 Test Frequency, Classes 2 and 3 Nonreclosing Pressure Relief Devices.** Classes 2 and 3 nonreclosing pressure relief devices shall be replaced every 5 years, unless historical data indicates a requirement for more frequent replacement.

**I-1370 Test Frequency, Classes 2 and 3 Primary Containment Vacuum Relief Valves**

*(a)* Tests shall be performed on all Classes 2 and 3 containment vacuum relief valves at each refueling outage or every 2 years, whichever is sooner, unless historical data requires more frequent testing.

*(b)* Leak tests shall be performed on all Classes 2 and 3 containment vacuum relief valves at a frequency designated by the Owner in accordance with Table ISTC-3500-1.

**I-1380 Test Frequency, Classes 2 and 3 Vacuum Relief Valves, Except for Primary Containment Vacuum Relief Valves.** All Classes 2 and 3 vacuum relief valves shall be tested every 2 years, unless performance data suggest the need for a more appropriate test interval.

**I-1390 Test Frequency, Classes 2 and 3 Pressure Relief Devices That Are Used for Thermal Relief Application.** Tests shall be performed on all Classes 2 and 3 relief devices used in thermal relief application every 10 years, unless performance data indicate more frequent testing is necessary. In lieu of tests the Owner may replace the relief devices at a frequency of every 10 years, unless performance data indicate more frequent replacements are necessary.

### I-1400 Instrumentation

**I-1410 Set-Pressure Measurement Accuracy.** Test equipment (e.g., gages, transducers, load cells, calibration standards) used to determine valve set-pressure, shall have an overall combined accuracy not to exceed ±1% of the indicated (measured) set-pressure.

## I-2000 BOILING WATER REACTORS (BWR) — INTRODUCTION

I-3000, I-4000, and I-5000 define the requirements for performance testing of pressure relief devices for boiling water reactor nuclear power plants. The valves subject to examination and tests are categorized. Responsibilities, examination methods, examination techniques, test methods, examination and test frequencies, records, and maintenance requirements are defined. Replacement valves of the same valve group shall be tested to the requirements of I-3100 and I-3400. Replacement valves, not of the same valve group previously used, shall be tested to the requirements of I-3100 and I-3200.

## I-3000 BWR PRESSURE RELIEF DEVICE TESTING

### I-3100 Testing Before Initial Installation

**I-3110 Class 1 Main Steam Pressure Relief Valves With Auxiliary Actuating Devices.** Tests shall be performed in the following sequence, or manufacturer's production tests may be accepted for I-3110(b), (c), and (d), provided the valve passes visual examination in accordance with the Owner's examination procedures:

*(a)* visual examination
*(b)* set-pressure determination
*(c)* accessories [see I-3310(d) through (h)]
*(d)* determination of compliance with the Owner's seat tightness criteria

**I-3120 Class 1 Main Steam Pressure Relief Valves Without Auxiliary Actuating Devices.** Tests shall be performed in the following sequence, or manufacturer's production tests may be accepted for I-3120(b) and (c), provided the valve passes visual examination in accordance with the Owner's examination procedures:

*(a)* visual examination
*(b)* set-pressure determination
*(c)* determination of compliance with the Owner's seat tightness criteria

**I-3130 Other Class 1 Pressure Relief Valves.** Tests shall be performed in the following sequence, or manufacturer's production tests may be accepted for I-3130(b) and (c), provided the valve passes visual examination in accordance with the Owner's examination procedures:

*(a)* visual examination
*(b)* set-pressure determination
*(c)* determination of compliance with the Owner's seat tightness criteria

**I-3140 Class 1 Nonreclosing Pressure Relief Devices.** The device shall pass visual examination in accordance with the Owner's examination procedures.

**I-3150 Classes 2 and 3 Pressure Relief Valves.** Tests shall be performed in the following sequence, or manufacturer's production tests may be accepted for I-3150(b) and (c), if the valve passes visual examination in accordance with the Owner's examination procedures:

*(a)* visual examination
*(b)* set-pressure determination
*(c)* determination of compliance with the Owner's seat tightness criteria

**I-3160 Classes 2 and 3 Nonreclosing Pressure Relief Devices.** The devices shall pass visual examination in accordance with the Owner's examination procedures.



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**I-3170 Classes 2 and 3 Vacuum Relief Valves.** The valves shall pass visual examination in accordance with the Owner's examination procedures.

## I-3200 Testing Before Initial Electric Power Generation

**I-3210 Class 1 Main Steam Pressure Relief Valves With Auxiliary Actuating Devices.** After installation, safety valves and pilot-operated pressure relief valves equipped with auxiliary actuating devices shall be remotely actuated at reduced or normal system operating pressure to verify open and close capability. Set-pressure verification is not required. Actuation pressure of the auxiliary actuating device sensing element, where applicable, and electrical continuity shall have been verified.

**I-3220 Class 1 Main Steam Pressure Relief Valves Without Auxiliary Actuating Devices.** Within 6 months before initial reactor criticality, each valve shall have its set-pressure verified.

**I-3230 Other Class 1 Pressure Relief Valves.** Functional testing is not required. The device shall pass visual examination in accordance with the Owner's examination procedures.

**I-3240 Class 1 Nonreclosing Pressure Relief Devices.** Functional testing is not required. The device shall pass visual examination in accordance with the Owner's examination procedures.

**I-3250 Classes 2 and 3 Pressure Relief Valves.** Functional testing is not required. The device shall pass visual examination in accordance with the Owner's examination procedures.

**I-3260 Classes 2 and 3 Nonreclosing Pressure Relief Devices.** Functional testing is not required. The device shall pass visual examination in accordance with the Owner's examination procedures.

**I-3270 Classes 2 and 3 Vacuum Relief Valves**

*(a)* After installation, these valves shall be actuated to verify open and close capability and performance of any pressure- and position-sensing accessories.

*(b)* Compliance with the Owner's seat tightness criteria shall be verified.

## (04) I-3300 Periodic Testing

Periodic testing of all pressure relief devices is required. No maintenance, adjustment, disassembly, or other activity that could affect "as found" set-pressure or seat tightness data is permitted prior to testing. Control ring adjustment is permitted per I-4110(g) and I-4120(g). Test frequencies are specified in I-1320, I-1330, I-1340, I-1350, I-1360, I-1370, I-1380, and I-1390. When on-line testing is performed to satisfy periodic testing requirements, visual examination may be performed out of sequence.

**I-3310 Class 1 Main Steam Pressure Relief Valves With Auxiliary Actuating Devices.** Tests before maintenance or set-pressure adjustment, or both, shall be performed for I-3310(a), (b), and (c) in sequence. The remaining shall be performed after maintenance or set-pressure adjustments:

*(a)* visual examination

*(b)* seat tightness determination,[2] if practicable

*(c)* set-pressure determination

*(d)* determination of electrical characteristics and pressure integrity of solenoid valve(s)

*(e)* determination of pressure integrity and stroke capability of air actuator

*(f)* determination of operation and electrical characteristics of position indicators

*(g)* determination of operation and electrical characteristics of bellows alarm switch

*(h)* determination of actuating pressure of auxiliary actuating device sensing element, where applicable, and electrical continuity

*(i)* determination of compliance with the Owner's seat tightness criteria

**I-3320 Class 1 Main Steam Pressure Relief Valves Without Auxiliary Actuating Devices.** Tests before maintenance or set-pressure adjustment, or both, shall be performed for I-3320(a), (b), and (c) in sequence. The remaining shall be performed after maintenance or set-pressure adjustment:

*(a)* visual examination

*(b)* seat tightness determination,[2] if practicable

*(c)* set-pressure determination

*(d)* determination of operation and electrical characteristics of position indicators

*(e)* determination of compliance with the Owner's seat tightness criteria

**I-3330 Other Class 1 Pressure Relief Valves.** Tests before maintenance or set-pressure adjustment, or both, shall be performed for I-3330(a), (b), and (c) in sequence. The remaining shall be performed after maintenance or set-pressure adjustment:

*(a)* visual examination

*(b)* seat tightness determination,[2] if practicable

*(c)* set-pressure determination

*(d)* verification of the integrity of the balancing device on balanced valves

*(e)* determination of operation and electrical characteristics of position indicators

*(f)* determination of compliance with the Owner's seat tightness criteria

[2] This test need not be performed at the same pressure as the final seat tightness test. This test may be quantitative or qualitative, dependant on the observed condition. This test is primarily for gross determination of "as found" seat tightness.



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**I-3340 Class 1 Nonreclosing Pressure Relief Devices.** The device shall be periodically replaced in accordance with I-1330. The replacement device shall be visually examined at the time of installation and shall meet the acceptance criteria established by the Owner's examination procedure.

**I-3350 Classes 2 and 3 Pressure Relief Valves.** Tests before maintenance or set-pressure adjustment, or both, shall be performed for I-3350(a), (b), and (c) in sequence. The remaining shall be performed after maintenance or set-pressure adjustment:

*(a)* visual examination

*(b)* seat tightness determination,[2] if practicable

*(c)* set-pressure determination

*(d)* verification of the integrity of the balancing device on balanced valves

*(e)* determination of compliance with the Owner's seat tightness criteria

(04) **I-3360 Classes 2 and 3 Nonreclosing Pressure Relief Devices.** The device shall be periodically replaced in accordance with I-1360. The replacement device shall be visually examined at the time of installation and shall meet the acceptance criteria established by the Owner's examination procedure.

**I-3370 Classes 2 and 3 Vacuum Relief Valves**

*(a)* The valves shall be actuated to verify open and close capability, set-pressure, and performance of any pressure and position-sensing accessories.

*(b)* Compliance with the Owner's seat tightness criteria shall be determined.

## I-3400 Disposition After Testing or Maintenance

(04) **I-3410 Class 1 Main Steam Pressure Relief Valves With Auxiliary Actuating Devices**

*(a)* Valves and accessories that comply with their respective acceptance criteria for the tests specified may be returned to service without further testing, except as required by I-3410(d).

*(b)* Valves and accessories that do not comply with their respective acceptance criteria shall be adjusted, refurbished, or replaced, in accordance with written procedures. Valves shall be adjusted to meet the acceptance criteria of I-1310(e).

*(c)* Refurbished equipment shall be subjected to the test(s) specified in I-3310, as applicable. If disassembly includes valve disk (main) components, then valve disk stroke capability shall be verified by mechanical examination or tests.

*(d)* Each valve with an auxiliary actuating device that has been removed for maintenance or testing and reinstalled after meeting the requirements of I-3310, shall have the electrical and pneumatic connections verified either through mechanical/electrical inspection or test prior to the resumption of electric power generation. Main disc movement and set-pressure verification are not required.

*(e)* Valves and accessories that do not comply with their respective acceptance criteria, whether the problem is associated with the component, the system, or associated equipment, shall be evaluated to determine the ability of the valve to perform its intended function until the next testing interval or maintenance opportunity. Corrective actions shall be taken, as appropriate, to ensure valve operability.

**I-3420 Class 1 Main Steam Pressure Relief Valves Without Auxiliary Actuating Devices**

*(a)* Valves that comply with their respective acceptance criteria for the tests specified may be returned to service without further testing.

*(b)* Valves that do not comply with their respective acceptance criteria shall be adjusted, refurbished, or replaced in accordance with written procedures. Valves shall be adjusted to meet the acceptance criteria of I-1310(e).

*(c)* Refurbished equipment shall be subjected to the test(s) specified in I-3320, as applicable. If disassembly includes valve disk (main) components, then valve disk stroke capability shall be verified by mechanical examination or tests.

*(d)* Valves and accessories that do not comply with their respective acceptance criteria, whether the problem is associated with the component, the system, or associated equipment, shall be evaluated to determine the ability of the valve to perform its intended function until the next testing interval or maintenance opportunity. Corrective actions shall be taken, as appropriate, to ensure valve operability.

**I-3430 Other Class 1 Pressure Relief Valves**

*(a)* Valves that comply with their respective acceptance criteria for the tests specified may be returned to service without further testing.

*(b)* Valves that do not comply with their respective acceptance criteria shall be adjusted, refurbished, or replaced in accordance with written procedures. Valves shall be adjusted to meet the acceptance criteria of I-1310(e).

*(c)* Refurbished equipment shall be subjected to the test(s) specified in I-3330, as applicable. If disassembly includes valve disk (main) components, then valve disk stroke capability shall be verified by mechanical examination or tests.

*(d)* Valves and accessories that do not comply with their respective acceptance criteria, whether the problem is associated with the component, the system, or associated equipment, shall be evaluated to determine the ability of the valve to perform its intended function until



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the next testing interval or maintenance opportunity. Corrective actions shall be taken, as appropriate, to ensure valve operability.

**I-3440 Class 1 Nonreclosing Pressure Relief Devices.** The device shall be periodically replaced in accordance with I-1330. The replacement device shall be visually examined at the time of installation and shall meet the acceptance criteria established by the Owner's examination procedure.

**I-3450 Classes 2 and 3 Pressure Relief Valves**

*(a)* Valves that comply with their respective acceptance criteria for the tests specified may be returned to service without further testing.

*(b)* Valves that do not comply with their respective acceptance criteria shall be adjusted, refurbished, or replaced in accordance with written procedures. Valves shall be adjusted to meet the acceptance criteria of I-1310(e).

*(c)* Refurbished equipment shall be subjected to the test(s) specified in I-3350, as applicable. If disassembly includes valve disk (main) components, then valve disk stroke capability shall be verified by mechanical examination or tests.

*(d)* Valves and accessories that do not comply with their respective acceptance criteria, whether the problem is associated with the component, the system, or associated equipment, shall be evaluated to determine the ability of the valve to perform its intended function until the next testing interval or maintenance opportunity. Corrective actions shall be taken, as appropriate, to ensure valve operability.

(04) **I-3460 Classes 2 and 3 Nonreclosing Pressure Relief Devices.** The device shall be periodically replaced in accordance with I-1360. The replacement device shall be visually examined at the time of installation and shall meet the acceptance criteria established by the Owner's examination procedure.

**I-3470 Classes 2 and 3 Vacuum Relief Valves**

*(a)* Valves that comply with their respective acceptance criteria for the tests specified may be returned to service without further testing.

*(b)* Valves that do not comply with their respective acceptance criteria shall be adjusted, refurbished, or replaced in accordance with written procedures. Valves shall be adjusted to meet the acceptance criteria of I-1310(e).

*(c)* Valves that have been refurbished shall be subjected to test(s) specified in I-3370.

*(d)* Valves and accessories that do not comply with their respective acceptance criteria, whether the problem is associated with the component, the system, or associated equipment, shall be evaluated to determine the ability of the valve to perform its intended function until the next testing interval or maintenance opportunity. Corrective actions shall be taken, as appropriate, to ensure valve operability.

## I-4000 BWR TEST METHODS

### I-4100 Set-Pressure Testing

**I-4110 Steam Service**

*(a) Test Media.* Valves designed to operate on steam shall be set-pressure tested with saturated steam. Alternative compressive fluids may be used as the test media, if correlation data between the alternative fluid and steam have been established. The requirements of I-4300 shall apply for testing with alternative test media.

*(b) Accumulator Volume.* The volume of the accumulator drum and the pressure source flow rate shall be sufficient to determine the valve set-pressure. Valves may have their lifts restricted during set-pressure testing.

*(c) Assist Devices.* Assist devices may be used for set-pressure testing, provided the accuracy complies with the requirements of I-1400.

*(d) Thermal Equilibrium.* Ambient temperature and test media temperature shall be established and valve thermal equilibrium confirmed before starting set-pressure testing. The valve shall be considered at thermal equilibrium only when the valve body temperature has stabilized and does not change more than 10°F (5.5°C) in 30 min as measured directly or determined by correlation from other valve temperature measurements. Valves insulated in service shall be insulated in a like manner during testing.

Verification of thermal equilibrium is not required for valves that are tested at ambient temperature using a test medium at ambient temperature.

*(e) Ambient Temperature.* The ambient temperature of the operating environment shall be simulated during the set-pressure test. If the effect of ambient temperature on set-pressure can be established for a particular valve type, then the valve may be set-pressure tested using an ambient temperature different from the operating ambient temperature. Correlations between the operating and testing ambient temperatures shall comply with the requirements of I-4320 and I-4330.

*(f) Superimposed Back Pressure*

*(1)* Consideration of variable or constant back pressure in set-pressure setting is not required for balanced pressure relief valves, if the back pressure does not exceed 50% of the valve set-pressure. However, the set-pressure shall consider the effects of bonnet pressure when the bonnet vent is piped to a pressure or vacuum discharge other than atmospheric.

*(2)* Constant superimposed back pressure in set-pressure setting shall be considered for nonbalanced pressure relief valves when the back pressure exceeds 1% of the set-pressure. For conventional nonbalanced valves with constant superimposed back pressure, the



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required set-pressure shall be calculated by subtracting the superimposed back pressure from the stamped set-pressure.

*(g) Control Rings.* Adjustment of control rings to ensure valve action is permitted. For set-pressure acceptance testing, control ring positions shall not be altered between successive openings. Adjusted control rings shall be returned to their proper operating position prior to return to service, as documented by the Owner.

*(h) Time Between Valve Openings.* A minimum of 5 min shall elapse between successive openings.

*(i) Number of Tests.* The number of openings at set-pressure shall be sufficient to demonstrate satisfactory repeatability with a minimum of two consecutive openings within acceptance criteria. Any subsequent openings at the same set point adjustment shall be within acceptance criteria.

(04) **I-4120 Compressible Fluid Services Other Than Steam**

*(a) Test Media.* Valves shall be tested with the normal system operating fluid and temperature for which they are designed. Alternative compressible fluids and different temperatures may be used, provided the requirements of I-4300 are met. Air or nitrogen may be substituted at the same temperature without alternative media testing per I-4300.

*(b) Accumulator Volume.* The volume of the accumulator drum and the pressure source flow rate shall be sufficient to determine the valve set-pressure. Valves may have their lifts restricted during set-pressure testing.

*(c) Assist Devices.* Assist devices may be used for set-pressure testing, provided the accuracy complies with the requirements of I-1400.

*(d) Thermal Equilibrium.* Ambient temperature and test media temperature shall be established and valve thermal equilibrium confirmed before starting set-pressure testing. The valve shall be considered at thermal equilibrium only when the valve body temperature has stabilized and does not change more than 10°F (5.5°C) in 30 min as measured directly or determined by correlation from other valve temperature measurements. Valves insulated in service shall be insulated in a like manner during testing.

Verification of thermal equilibrium is not required for valves that are tested at ambient temperature using a test medium at ambient temperature.

*(e) Ambient Temperature.* The ambient temperature of the operating environment shall be simulated during the set-pressure test. If the effect of ambient temperature on set-pressure can be established for a particular valve type, then the valve may be set-pressure tested using an ambient temperature different from the operating ambient temperature. Correlations between the operating and testing ambient temperatures shall comply with the requirements of I-4320 and I-4330.

*(f) Superimposed Back Pressure*

*(1)* Consideration of variable or constant back pressure in set-pressure setting is not required for balanced pressure relief valves, if the back pressure does not exceed 50% of the valve set-pressure. However, the set-pressure shall consider the effects of bonnet pressure when the bonnet vent is piped to a pressure or vacuum discharge other than atmospheric.

*(2)* Constant superimposed back pressure in set-pressure setting shall be considered for nonbalanced pressure relief valves when the back pressure exceeds 1% of the set-pressure. For conventional nonbalanced valves with constant superimposed back pressure, the required set-pressure shall be calculated by subtracting the superimposed back pressure from the stamped set-pressure.

*(g) Control Rings.* Adjustment of control rings to ensure valve action is permitted. For set-pressure acceptance testing, control ring positions shall not be altered between successive openings. Adjusted control rings shall be returned to their proper operating position prior to return to service, as documented by the Owner.

*(h) Time Between Valve Openings.* A minimum of 5 min shall elapse between successive openings.

*(i) Number of Tests.* The number of openings at set-pressure shall be sufficient to demonstrate satisfactory repeatability with a minimum of two consecutive openings within acceptance criteria. Any subsequent openings at the same set point adjustment shall be within acceptance criteria.

**I-4130 Liquid Service**

*(a) Test Media.* Valves shall be tested with the normal system operating fluid and temperature for which they are designed. Alternative liquids and different temperatures may be used, provided the requirements of I-4300 are met.

*(b) Accumulator Volume.* There is no requirement of minimum accumulator volume; however, the pressure tap for determining set-pressure shall be located at the valve inlet.

*(c) Assist Devices.* Assist devices to determine set-pressure are not permitted for liquid service pressure relief valves.

*(d) Thermal Equilibrium.* Ambient temperature and test media temperature shall be established and valve thermal equilibrium confirmed before starting set-pressure testing. The valve shall be considered at thermal equilibrium only when the valve body temperature has stabilized and does not change more than 10°F (5.5°C) in 30 min as measured directly or determined by correlation from other valve temperature measurements. Valves insulated in service shall be insulated in a like manner during testing.

Verification of thermal equilibrium is not required for valves that are tested at ambient temperature using a test medium at ambient temperature.



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*(e) Ambient Temperature.* The ambient temperature of the operating environment shall be simulated during the set-pressure test. If the effect of ambient temperature on set-pressure can be established for a particular valve type, then the valve may be set-pressure tested using an ambient temperature different from the operating ambient temperature. Correlations between the operating and testing ambient temperatures shall comply with the requirements of I-4320 and I-4330.

*(f) Superimposed Back Pressure*

*(1)* Consideration of variable or constant back pressure in set-pressure setting is not required for balanced pressure relief valves, if the back pressure does not exceed 50% of the valve set-pressure. However, the set-pressure shall consider the effects of bonnet pressure when the bonnet vent is piped to a pressure or vacuum discharge other than atmospheric.

*(2)* Constant superimposed back pressure in set-pressure setting shall be considered for nonbalanced pressure relief valves when the back pressure exceeds 1% of the set-pressure. For conventional nonbalanced valves with constant superimposed back pressure, the required set-pressure shall be calculated by subtracting the superimposed back pressure from the stamped set-pressure.

*(g) Time Between Valve Openings.* A minimum of 5 min shall elapse between successive openings.

*(h) Number of Tests.* The number of openings at set-pressure shall be sufficient to demonstrate satisfactory repeatability with a minimum of two consecutive openings within acceptance criteria. Unless otherwise stated in the test procedure, valve opening pressure shall be that inlet pressure when a continuous, unbroken stream of liquid is emanating from the valve outlet.

## I-4200 Seat Tightness Testing

Seat tightness testing shall be performed in accordance with the Owner's valve test procedure. Consideration shall be given to test media, temperature stability, and ambient temperature, as required in I-4100.

Seat tightness testing shall be performed using the same fluid used for set-pressure testing, except as provided by I-4300.

**I-4210 Inlet Pressure.** The inlet pressure for seat leak testing shall be in accordance with one of the following:

*(a)* maximum system operating pressure

*(b)* 90% of spring setting or 5 psig (34 kPa) below spring setting for valves having a spring set-pressure less than 50 psig (344 kPa)

*(c)* pressure established in Owner's valve test procedure

**I-4220 Acceptable Seat Tightness Testing Methods.** Table I-4220-1 provides acceptable methods. Other methods may be determined by the Owner.

**I-4230 Acceptance Criteria for Seat Leakage Testing.** Either the original valve equipment design specification criteria or acceptance criteria established by the Owner in the valve test procedure shall be used for valve seat leakage acceptance criteria.

## I-4300 Alternative Test Media

Pressure relief devices may be subjected to set-pressure tests and seat tightness tests using a test medium (fluid and temperature) other than that for which they are designed, provided the testing complies with I-4310, I-4320, and I-4330.

**I-4310 Correlation.** Correlation of pressure relief device operation, with respect to the parameter under test, shall be established for the specified alternative media, as compared with the operating media.

**I-4320 Certification of Correlation Procedure.** The Owner shall ensure that the correlation established in accordance with the procedure will be of sufficient accuracy such that the pressure relief devices tested or adjusted, or both, using the alternate media, will comply with the acceptance criteria of the following: (04)

*(a)* I-1320(c) or I-1350(c) for determining the need to test additional valves

*(b)* I-4110(i), I-4120(i), or I-4130(h) for testing or adjusting valves, or both, for reuse

*(c)* I-4230 for determining seat tightness

Results of the tests performed to verify the adequacy of the alternate test media correlation shall be documented.

**I-4330 Procedure.** A written procedure shall be prepared by the Owner or the Owner's designee and certified in accordance with the requirements of I-4320. The procedure shall specify all test parameters that affect correlation and shall include, but not be limited to, the following:

*(a)* specific description of test setup

*(b)* specific requirements for instrumentation

*(c)* specific requirements for assist equipment (if any)

*(d)* specific requirements for test operating conditions, i.e., device temperature, ambient temperature, ambient pressure, etc.

Test parameters shall be listed, i.e., time between openings, number of tests, etc.

## I-5000 BWR RECORDS AND RECORD KEEPING

## I-5100 Requirements

The Owner shall maintain a record that shall include the following for each valve covered by this Appendix:

*(a)* the manufacturer and manufacturer's model and serial number, or other identifiers

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

*(c)* preservice test results



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**Table I-4220-1 Seat Tightness Testing Methods for Pressure Relief Devices Used in Boiling Water Reactors**

| Test Method | Service Fluid | | | Remarks |
|---|---|---|---|---|
| | Steam | Air/Gas | Liquids | |
| Audible/visible | X | X | X | ... |
| API RP-527 | X [Note (1)] | X [Note (1)] | ... | ... |
| Air/gas under water | X | X | ... | ... |
| Downstream temperature measurement | X | X | X | Installed valves only |
| Weighed condensate | X [Note (1)] | ... | ... | Min. 10 min test |
| Volumetric or weight measurement | ... | ... | X | Min. 10 min test |
| Cold bar | X [Note (2)] | ... | ... | ... |
| Acoustic emission | X | X | X | ... |

NOTES:
(1) On exposed spring valves, care must be exercised to ensure against leakage past the valve stem and adjacent valve pieces.
(2) Defined as 1 in. diameter polished stainless steel bar at a temperature less than 100°F passed in the plane parallel to the outlet flange face.

## I-5200 Record of Test

In addition to the requirements of ISTA-9230, if testing is performed in accordance with I-4300, a copy of the alternate test media correlation, test procedure, and documentation of results of test performed to verify the adequacy of the alternate test media shall be retained.

## I-5300 Record of Modification and Corrective Action

In addition to the requirements of ISTA-9240, the following requirements shall be met:

*(a)* The Owner shall document all modifications performed or corrective actions taken that affect the set-pressure of pressure relief devices or valves. The documentation shall also include any recommendations or modifications suggested by the manufacturer. Modification or corrective action, as outlined, shall be recorded and maintained for the period of time as outlined in the Owner's technical specifications.

*(b)* Any device modification or adjustment that affects nameplate data shall be recorded on a data sheet. The modification or adjustment shall be made in accordance with the manufacturer's published information or shall have the concurrence of the manufacturer.

An additional nameplate, not bearing a Code symbol stamp, shall be installed to reflect the new data and reference to records maintained by the Owner outlining the modification.

# I-6000 PRESSURIZED WATER REACTORS (PWR) — INTRODUCTION

I-7000, I-8000, and I-9000 define the requirements for performance testing of pressure relief devices for pressurized water reactor nuclear power plants. The valves subject to examinations and tests are categorized. Responsibilities, examination methods, examination techniques, test methods, examination and test frequencies, records, and maintenance requirements are defined. Replacement valves of the same valve group shall be tested to the requirements of I-7100 and I-7400. Replacement valves not of the same valve group previously used shall be tested to the requirements of I-7100 and I-7200.

# I-7000 PWR PRESSURE RELIEF DEVICE TESTING

## I-7100 Testing Before Initial Installation

**I-7110 Class 1 Safety Valves.** Tests shall be performed in the following sequence, or manufacturer's production tests may be accepted for I-7110(b), (c), and (d), provided the valve passes visual examination in accordance with the Owner's examination procedures:

*(a)* visual examination
*(b)* set-pressure determination
*(c)* testing of accessories [see I-7310(d), (e), and (f)]
*(d)* determination of compliance with the Owner's seat tightness criteria

**I-7120 Class 1 Power Actuated Relief Valves.** Tests shall be performed in the following sequence, or manufacturer's production tests may be accepted for I-7120(b), (c), and (d), provided the valve passes visual examination in accordance with the Owner's examination procedures:

*(a)* visual examination
*(b)* determination of functional capability
*(c)* testing of accessories [see I-7320(d) and (e)]
*(d)* determination of compliance with the Owner's seat tightness criteria



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**I-7130 Other Class 1 Pressure Relief Valves.** Tests shall be performed in the following sequence, or manufacturer's production tests may be accepted for I-7130(b) and (c), provided the valve passes visual examination in accordance with the Owner's examination procedures:

*(a)* visual examination

*(b)* set-pressure determination

*(c)* determination of compliance with the Owner's seat tightness criteria

**I-7140 Class 1 Nonreclosing Pressure Relief Devices.** The devices shall pass visual examination in accordance with the Owner's examination procedures.

**I-7150 Classes 2 and 3 Pressure Relief Valves.** Tests shall be performed in the following sequence, or manufacturer's production tests may be accepted for I-7150(b) and (c), provided the valve passes visual examination in accordance with the Owner's examination procedures:

*(a)* visual examination

*(b)* set-pressure determination

*(c)* determination of compliance with the Owner's seat tightness criteria

**I-7160 Classes 2 and 3 Nonreclosing Pressure Relief Devices.** The devices shall pass visual examination in accordance with the Owner's examination procedures.

**I-7170 Classes 2 and 3 Vacuum Relief Valves.** The valves shall pass visual examination in accordance with the Owner's examination procedures.

## I-7200 Testing Before Initial Electric Power Generation

**I-7210 Class 1 Safety Valves.** Within 6 months before initial reactor criticality, each valve shall have its set-pressure verified. Set-pressure verification shall be determined by pressurizing the system up to the valve set-pressure and opening the valve, or the valve may be tested at or below normal system operating pressures with an assist device.

**I-7220 Class 1 Power-Actuated Relief Valves.** After installation, each valve shall be remotely actuated at normal system operating pressure to verify open and close capability.

**I-7230 Other Class 1 Pressure Relief Valves.** Functional testing is not required. The device shall pass visual examination in accordance with the Owner's examination procedure.

**I-7240 Class 1 Nonreclosing Pressure Relief Devices.** Functional testing is not required. The device shall pass visual examination in accordance with the Owner's examination procedures.

**I-7250 Classes 2 and 3 Pressure Relief Valves**

*(a) Main Steam Safety Valves.* Either before or after installation and within 6 months before initial reactor criticality, each valve shall be subjected to the following tests:

*(1)* verification of compliance with the Owner's set-pressure criteria

*(2)* verification of compliance with the Owner's seat tightness criteria

*(b) Other Pressure Relief Valves.* Functional testing is not required.

**I-7260 Classes 2 and 3 Nonreclosing Pressure Relief Devices.** Functional testing is not required. The device shall pass visual examination in accordance with the Owner's examination procedures.

**I-7270 Classes 2 and 3 Vacuum Relief Valves**

*(a)* After installation, these valves shall be actuated to verify open and close capability and performance of any pressure- and position-sensing accessories.

*(b)* Compliance with the Owner's seat tightness criteria shall be verified.

## I-7300 Periodic Testing (04)

Periodic testing of all pressure relief devices is required. No maintenance, adjustment, disassembly, or other activity that could affect "as-found" set-pressure or seat tightness data is permitted before testing. Control ring adjustments are permitted per I-8110(g) and I-8120(g). Test frequencies are specified in I-1320, I-1330, I-1340, I-1350, I-1360, I-1370, I-1380, and I-1390. When on-line testing is performed to satisfy periodic testing requirements, visual examination may be performed out of sequence.

**I-7310 Class 1 Safety Valves.** Tests before maintenance or set-pressure adjustment, or both, shall be performed for I-7310(a), (b), and (c) in sequence. The remaining shall be performed after maintenance or set-pressure adjustment:

*(a)* visual examination

*(b)* seat tightness determination,[2] if practicable

*(c)* set-pressure determination

*(d)* determination of operation and electrical characteristics of bellows alarm switch

*(e)* verification of the integrity of the balancing device on balanced valves

*(f)* determination of operation and electrical characteristics of position indicators

*(g)* determination of compliance with Owner's seat tightness criteria

**I-7320 Class 1 Power Actuated Relief Valves.** Tests before maintenance shall be performed for I-7320(a), (b), and (c) in sequence. The remaining shall be performed after maintenance or set-pressure adjustment:

*(a)* visual examination

*(b)* seat tightness determination,[2] if practicable

*(c)* set-pressure determination



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*(d)* verification of the integrity of the balancing device on balanced valves

*(e)* determination of operation and electrical characteristics of position indicators

*(f)* determination of compliance with the Owner's seat tightness criteria

**I-7330 Other Class 1 Pressure Relief Valves.** Tests before maintenance or set-pressure adjustment, or both, shall be performed for I-7330(a), (b), and (c) in sequence. The remaining shall be performed after maintenance or set-pressure adjustment:

*(a)* visual examination

*(b)* seat tightness determination,[2] if practicable

*(c)* set-pressure determination

*(d)* verification of the integrity of the balancing device on balanced valves

*(e)* determination of operation and electrical characteristics of position indicators

*(f)* determination of compliance with the Owner's seat tightness criteria

**I-7340 Class 1 Nonreclosing Pressure Relief Devices.** The device shall be periodically replaced in accordance with I-1330. The replacement device shall be visually examined at the time of installation and shall meet the acceptance criteria established by the Owner's examination procedure.

**I-7350 Classes 2 and 3 Main Steam Safety Valves.** Tests before maintenance or set-pressure adjustment, or both, shall be performed for I-7350(a), (b), and (c) in sequence. The remaining shall be performed after maintenance or set-pressure adjustment:

*(a)* visual examination

*(b)* seat tightness determination,[2] if practicable

*(c)* set-pressure determination

*(d)* verification of the integrity of the balancing device on balanced valves

*(e)* determination of compliance with the Owner's seat tightness criteria

**I-7360 Other Classes 2 and 3 Pressure Relief Valves.** Tests before maintenance or set-pressure adjustment, or both, shall be performed for I-7360(a), (b), and (c) in sequence. The remaining shall be performed after maintenance or set-pressure adjustment:

*(a)* visual examination

*(b)* seat tightness determination,[2] if practicable

*(c)* set-pressure determination

*(d)* verification of the integrity of the balancing device on balanced valves

*(e)* determination of compliance with Owner's seat tightness criteria

(04) **I-7370 Classes 2 and 3 Nonreclosing Pressure Relief Devices.** The device shall be periodically replaced in accordance with I-1360. The replacement device shall be visually examined at the time of installation and shall meet the acceptance criteria established by the Owner's examination procedure.

**I-7380 Classes 2 and 3 Vacuum Relief Valves**

*(a)* These valves shall be actuated to verify open and close capability, set-pressure, and performance of any pressure- and position-sensing accessories.

*(b)* Compliance with the Owner's seat tightness criteria shall be verified.

## I-7400 Disposition After Testing or Maintenance

### I-7410 Class 1 Safety Valves

*(a)* Valves and accessories that comply with their respective acceptance criteria for the tests specified may be returned to service without further testing.

*(b)* Valves and accessories that do not comply with their respective acceptance criteria shall be adjusted, refurbished, or replaced in accordance with written procedures. Valves shall be adjusted to meet the acceptance criteria of I-1310(e).

*(c)* Refurbished equipment shall be subjected to test(s) specified in I-7310, as applicable. If disassembly includes valve disk (main) components, then valve disk stroke capability shall be verified by mechanical examination or tests.

*(d)* Valves and accessories that do not comply with their respective criteria, whether the problem is associated with the component, the system, or associated equipment, shall be evaluated to determine the ability of the valve to perform its intended function until the next testing interval or maintenance opportunity. Corrective actions shall be taken, as appropriate, to ensure valve operability.

### I-7420 Class 1 Power-Actuated Relief Valves

*(a)* Valves and accessories that comply with their respective acceptance criteria for the tests specified may be returned to service without further testing.

*(b)* Valves that do not comply with their respective acceptance criteria shall be adjusted, refurbished, or replaced in accordance with written procedure. Valves shall be adjusted to meet the acceptance criteria of I-1310(e).

*(c)* Refurbished equipment shall be subjected to test(s) specified in I-7320, as applicable. If disassembly includes valve disk (main) components, then valve disk stroke capability shall be verified by mechanical examination or tests.

*(d)* Valves and accessories that do not comply with their respective acceptance criteria, whether the problem is associated with the component, the system, or associated equipment, shall be evaluated to determine the ability of the valve to perform its intended function until the next testing interval or maintenance opportunity. Corrective actions shall be taken, as appropriate, to ensure valve operability.



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### I-7430 Other Class 1 Pressure Relief Valves

*(a)* Valves and accessories that comply with their respective acceptance criteria for the tests specified may be returned to service without further testing.

*(b)* Valves and accessories that do not comply with their respective acceptance criteria shall be adjusted, refurbished, or replaced in accordance with written procedure. Valves shall be adjusted to meet the acceptance criteria of I-1310(e).

*(c)* Refurbished equipment shall be subjected to test(s) specified in I-7330, as applicable. If disassembly includes valve disk (main) components, then valve disk stroke capability shall be verified by mechanical examination or tests.

*(d)* Valves and accessories that do not comply with their respective acceptance criteria, whether the problem is associated with the component, the system, or associated equipment, shall be evaluated to determine the ability of the valve to perform its intended function until the next testing interval or maintenance opportunity. Corrective actions shall be taken, as appropriate, to ensure valve operability.

**I-7440 Class 1 Nonreclosing Pressure Relief Devices.** The device shall be periodically replaced in accordance with I-1330. The replacement device shall be visually examined at the time of installation and shall meet the acceptance criteria established by the Owner's examination procedure.

### I-7450 Classes 2 and 3 Main Steam Safety Valves

*(a)* Valves that comply with their respective acceptance criteria for the tests specified may be returned to service without further testing.

*(b)* Valves that do not comply with their respective acceptance criteria shall be adjusted, refurbished, or replaced in accordance with written procedure. Valves shall be adjusted to meet the acceptance criteria of I-1310(e).

*(c)* Refurbished equipment shall be subjected to test(s) specified in I-7350, as applicable. If disassembly includes valve disk (main) components, then valve disk stroke capability shall be verified by mechanical examination or tests.

*(d)* Valves and accessories that do not comply with their respective acceptance criteria, whether the problem is associated with the component, the system, or associated equipment, shall be evaluated to determine the ability of the valve to perform its intended function until the next testing interval or maintenance opportunity. Corrective actions shall be taken, as appropriate, to ensure valve operability.

### I-7460 Other Classes 2 and 3 Pressure Relief Valves

*(a)* Valves that comply with their respective acceptance criteria for the tests specified may be returned to service without further testing.

*(b)* Valves that do not comply with their respective acceptance criteria shall be adjusted, refurbished, or replaced in accordance with written procedure. Valves shall be adjusted to meet the acceptance criteria of I-1310(e).

*(c)* Refurbished valves shall be subjected to test(s) specified in I-7360, as applicable. If disassembly includes valve disk (main) components, then valve disk stroke capability shall be verified by mechanical examination or tests.

*(d)* Valves and accessories that do not comply with their respective acceptance criteria, whether the problem is associated with the component, the system, or associated equipment, shall be evaluated to determine the ability of the valve to perform its intended function until the next testing interval or maintenance opportunity. Corrective actions shall be taken, as appropriate, to ensure valve operability.

**I-7470 Classes 2 and 3 Nonreclosing Pressure Relief Devices.** The device shall be periodically replaced in accordance with I-1360. The replacement device shall be visually examined at the time of installation and shall meet the acceptance criteria established by the Owner's examination procedure. (04)

### I-7480 Classes 2 and 3 Vacuum Relief Valves

*(a)* Valves that comply with their respective acceptance criteria as specified may be returned to service without further testing.

*(b)* Valves that do not comply with their respective acceptance criteria shall be adjusted, refurbished, or replaced in accordance with written procedure. Valves shall be adjusted to meet the acceptance criteria of I-1310(e).

*(c)* Valves that have been refurbished shall be subjected to test(s) specified in I-7380.

## I-8000 PWR TEST METHODS

### I-8100 Set-Pressure Testing

#### I-8110 Steam Service

*(a) Test Media.* Valves designed to operate on steam, including safety valves designed for saturated steam service that are installed on a water-filled loop seal, shall be set-pressure tested with saturated steam. Alternative compressible fluids may be used as the test media if correlation data between the alternative fluid and steam has been established. The requirements of I-8300 shall apply for testing with alternative test media.

*(b) Accumulator Volume.* The volume of the accumulator drum and the pressure source flow rate shall be sufficient to determine the valve set-pressure. Valves may have their lifts restricted during set-pressure testing.



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*(c) Assist Devices.* Assist devices may be used for set-pressure testing, provided the accuracy complies with the requirements of I-1400.

*(d) Thermal Equilibrium.* Ambient temperature and test media temperature shall be established and valve thermal equilibrium confirmed before starting set-pressure testing. The valve shall be considered at thermal equilibrium only when the valve body temperature has stabilized and does not change more than 10°F (5.5°C) in 30 min as measured directly or determined by correlation from other valve temperature measurements. Valves insulated in service shall be insulated in a like manner during testing. Verification of thermal equilibrium is not required for valves that are tested at ambient temperature using a test medium at ambient temperature.

*(e) Ambient Temperature.* The ambient temperature of the operating environment shall be simulated during the set-pressure test. If the effect of ambient temperature on set-pressure can be established for a particular valve type, then the valve may be set-pressure tested using an ambient temperature different from the operating ambient temperature. Correlations between the operating and testing ambient temperatures shall comply with the requirements of I-8320 and I-8330.

*(f) Superimposed Back Pressure*

*(1)* Consideration of variable or constant back pressure in set-pressure setting is not required for balanced pressure relief valves, if the back pressure does not exceed 50% of the valve set-pressure. However, the set-pressure shall consider the effects of bonnet pressure when the bonnet vent is piped to a pressure or vacuum discharge other than atmospheric.

*(2)* Constant superimposed back pressure in set-pressure setting shall be considered for nonbalanced pressure relief valves when the back pressure exceeds 1% of the set-pressure. For conventional nonbalanced valves with constant superimposed back pressure, the required set-pressure shall be calculated by subtracting the superimposed back pressure from the stamped set-pressure.

*(g) Control Rings.* Adjustment of control rings to ensure valve action is permitted. For set-pressure acceptance testing, control ring positions shall not be altered between successive openings. Adjusted control rings shall be returned to their proper operating position prior to return to service, as documented by the Owner.

*(h) Time Between Valve Openings.* A minimum of 5 min shall elapse between successive openings.

*(i) Number of Tests.* The number of openings at set-pressure shall be sufficient to demonstrate satisfactory repeatability with a minimum of two consecutive openings within acceptance criteria. Any subsequent opening at the same set point adjustment shall be within acceptance criteria.

### I-8120 Compressible Fluid Services Other Than Steam

*(a) Test Media.* Valves shall be tested with the normal system operating fluid and temperature for which they are designed. Alternative compressible fluids and different temperatures may be used, provided the requirements of I-8300 are met. Air or nitrogen may be substituted at the same temperature without alternative media testing per I-8300.

*(b) Accumulator Volume.* The volume of the accumulator drum and pressure source flow rate shall be sufficient to determine the valve set-pressure. Valves may have their lifts restricted during set-pressure testing.

*(c) Assist Devices.* Assist devices may be used for set-pressure testing, provided the accuracy complies with the requirements of I-1400.

*(d) Thermal Equilibrium.* Ambient temperature and test media temperature shall be established and valve thermal equilibrium confirmed before starting set-pressure testing. The valve shall be considered at thermal equilibrium only when the valve body temperature has stabilized and does not change more than 10°F (5.5°C) in 30 min as measured directly or determined by correlation from other valve temperature measurements. Valves insulated in service shall be insulated in a like manner during testing. Verification of thermal equilibrium is not required for valves that are tested at ambient temperature using a test medium at ambient temperature.

*(e) Ambient Temperature.* The ambient temperature of the operating environment shall be simulated during the set-pressure test. If the effect of ambient temperature on set-pressure can be established for a particular valve type, then the valve may be set-pressure tested using an ambient temperature different from the operating ambient temperature. Correlations between the operating and testing ambient temperatures shall comply with the requirements of I-8320 and I-8330.

*(f) Superimposed Back Pressure*

*(1)* Consideration of variable or constant back pressure in set-pressure setting is not required for balanced pressure relief valves, if the back pressure does not exceed 50% of the valve set-pressure. However, the set-pressure shall consider the effects of bonnet pressure when the bonnet vent is piped to a pressure or vacuum discharge other than atmospheric.

*(2)* Constant superimposed back pressure in set-pressure setting shall be considered for nonbalanced pressure relief valves when the back pressure exceeds 1% of the set-pressure. For conventional nonbalanced valves with constant superimposed back pressure, the required set-pressure shall be calculated by subtracting the superimposed back pressure from the stamped set-pressure.

*(g) Control Rings.* Adjustment of control rings to ensure valve action is permitted. For set-pressure acceptance testing, control ring positions shall not be altered between successive openings. Adjusted control rings



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shall be returned to their proper operating position prior to return to service, as documented by the Owner.

*(h) Time Between Valve Openings.* A minimum of 5 min shall elapse between successive openings.

*(i) Number of Tests.* The number of openings at set-pressure shall be sufficient to demonstrate satisfactory repeatability with a minimum of two consecutive openings within acceptance criteria. Any subsequent openings at the same set point adjustment shall be within acceptance criteria.

### I-8130 Liquid Service

*(a) Test Media.* Valves shall be tested with the normal system operating fluid and temperature for which they are designed. Alternative liquids and different temperatures may be used, provided the requirements of I-8300 are met.

*(b) Accumulator Volume.* There is no requirement for minimum accumulator volume; however, the pressure tap for determining set-pressure shall be located at the valve inlet.

*(c) Assist Devices.* Assist devices to determine set-pressure are not recommended for liquid service pressure relief valves.

*(d) Thermal Equilibrium.* Ambient temperature and test media temperature shall be established and valve thermal equilibrium confirmed before starting set-pressure testing. The valve shall be considered at thermal equilibrium only when the valve body temperature has stabilized and does not change more than 10°F (5.5°C) in 30 min as measured directly or determined by correlation from other valve temperature measurements. Valves insulated in service shall be insulated in a like manner during testing. Verification of thermal equilibrium is not required for valves that are tested at ambient temperature using a test medium at ambient temperature.

*(e) Ambient Temperature.* The ambient temperature of the operating environment shall be simulated during the set-pressure test. If the effect of ambient temperature on set-pressure can be established for a particular valve type, then the valve may be set-pressure tested using an ambient temperature different from the operating ambient temperature. Correlations between the operating and testing ambient temperatures shall comply with the requirements of I-8320 and I-8330.

*(f) Superimposed Back Pressure*

*(1)* Consideration of variable or constant back pressure in set-pressure setting is not required for balanced pressure relief valves, if the back pressure does not exceed 50% of the valve set-pressure. However, the set-pressure shall consider the effects of bonnet pressure when the bonnet vent is piped to a pressure or vacuum discharge other than atmospheric.

*(2)* Constant superimposed back pressure in set-pressure setting shall be considered for nonbalanced pressure relief valves when the back pressure exceeds 1% of the set-pressure. For conventional nonbalanced valves with constant superimposed back pressure, the required set-pressure shall be calculated by subtracting the superimposed back pressure from the stamped set-pressure.

*(g) Time Between Valve Openings.* A minimum of 5 min shall elapse between successive openings.

*(h) Number of Tests.* The number of openings at set-pressure shall be sufficient to demonstrate satisfactory repeatability with a minimum of two consecutive openings within acceptance criteria. Unless otherwise stated in the test procedure, valve opening pressure shall be that inlet pressure when a continuous, unbroken stream of liquid is emanating from the valve outlet.

### I-8200 Seat Tightness Testing

Seat tightness testing shall be performed in accordance with the Owner's valve test procedure. Consideration shall be given to test media, temperature stability, and ambient temperature, as required in I-8100.

Seat tightness testing shall be performed using the same fluid used for set-pressure testing, except as provided by I-8300.

**I-8210 Inlet Pressure.** The inlet pressure for seat leak testing shall be in accordance with one of the following:

*(a)* maximum system operating pressure

*(b)* 90% of spring setting or 5 psig (34 kPa) below spring setting for valves having a spring set-pressure less than 50 psig (344 kPa)

*(c)* pressure established in Owner's valve test procedure

**I-8220 Acceptable Seat-Tightness Testing Methods.** Table I-8220-1 provides acceptable methods. Other methods may be determined by the Owner.

**I-8230 Acceptance Criteria for Seat Leakage Testing.** Either the original valve equipment design specification acceptance criteria or acceptance criteria established by the Owner in the valve test procedure shall be used for valve seat leakage acceptance criteria.

### I-8300 Alternative Test Media

Pressure relief devices may be subjected to set-pressure tests and seat tightness tests using a test medium (fluid and temperature) other than that for which they are designed, provided the testing complies with I-8310, I-8320, and I-8330.

**I-8310 Correlation.** Correlation of pressure relief device operation, with respect to the parameter under test, shall be established for the specified alternative media, as compared with the operating media.

**I-8320 Certification of Correlation Procedure.** The Owner shall ensure that the correlation established in accordance with the procedure will be of sufficient accuracy such that the pressure relief devices tested or adjusted, or both, using the alternate media, will comply (04)



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**Table I-8220-1 Seat Tightness Testing Methods for Pressure Relief Devices Used in Pressurized Water Reactors**

| Test Method | Service Fluid | | | Remarks |
|---|---|---|---|---|
| | Steam | Air/Gas | Liquids | |
| Audible/visible | X | X | X | ... |
| API RP-527 | X [Note (1)] | X [Note (1)] | ... | ... |
| Air/gas under water | X | X | ... | ... |
| Downstream temperature measurement | X | X | X | Installed valves only |
| Weighed condensate | X [Note (1)] | ... | ... | Min. 10 min test |
| Volumetric or weight measurement | ... | ... | X | Min. 10 min test |
| Cold bar | X [Note (2)] | ... | ... | ... |
| Acoustic emission | X | X | X | ... |

NOTES:
(1) On exposed spring valves, care must be exercised to ensure against leakage past the valve stem and adjacent valve pieces.
(2) Defined as 1 in. diameter polished stainless steel bar at a temperature less than 100°F passed in the plane parallel to the outlet flange face.

with the acceptance criteria of the following:

*(a)* I-1320(c) or I-1350(c) for determining the need to test additional valves

*(b)* I-8110(i), I-8120(i), or I-8130(h) for testing or adjusting valves, or both, for reuse

*(c)* I-8230 for determining seat tightness

Results of the tests performed to verify the adequacy of the alternate test media correlation shall be documented.

**I-8330 Procedure.** A written procedure shall be prepared by the Owner or the Owner's designee and certified in accordance with the requirements of I-8320. The procedure shall specify all test parameters that affect correlation and shall include, but not be limited to, the following:

*(a)* specific description of test setup

*(b)* specific requirements for instrumentation

*(c)* specific requirements for assist equipment (if any)

*(d)* specific requirements for test operating conditions, i.e., device temperature, ambient temperature, ambient pressure, etc.

*(e)* a list of test parameters, i.e., time between openings, number of tests, etc.

## I-9000 PWR RECORDS AND RECORD KEEPING

### I-9100 Requirements

The Owner shall maintain a record that shall include the following for each valve covered by this Appendix:

*(a)* the manufacturer and manufacturer's model and serial number, or other identifiers

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

*(c)* preservice test results

### I-9200 Record of Tests

In addition to the requirements of ISTA-9230, if testing is performed in accordance with I-8300, a copy of the alternate test media correlation, test procedure, and documentation of results of test performed to verify the adequacy of the alternate test media shall be maintained.

### I-9300 Record of Modification and Corrective Action

In addition to the requirements of ISTA-9240, the following requirements shall be met:

*(a)* The Owner shall document all modifications made to or corrective actions taken that affect the set-pressure of pressure relief devices or valves. The documentation shall also include any recommendations or modifications suggested by the manufacturer. Modification or corrective action, as outlined, shall be recorded and maintained for the period of time as outlined in the Owner's technical specifications.

*(b)* Any device modification or adjustment that affects nameplate data shall be recorded on a data sheet. The modification or adjustment shall be made in accordance with the manufacturer's published information or shall have the concurrence of the manufacturer.

An additional nameplate, not bearing a Code symbol stamp, shall be installed to reflect the new data and reference to records maintained by the Owner outlining the modification.



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# MANDATORY APPENDIX II[1]
# Check Valve Condition Monitoring Program

## II-1000 PURPOSE

This Appendix establishes the requirements for implementing and maintaining a check valve condition monitoring program as discussed in ISTC-5222.

## II-2000 GROUPINGS

Groupings shall be determined by the Owner. Groupings shall be technically justified and shall be based on

*(a)* the intended purpose of the condition monitoring program (e.g., improve performance, or optimize testing, examination, and preventive maintenance activities)

*(b)* analysis of test results and maintenance history

*(c)* design characteristics, application, and service conditions

The Owner shall assess the significance to plant safety if an extended test or examination interval is planned.

The Owner should also consider the sample disassembly examination program grouping details of ISTC-5221(c).

## II-3000 ANALYSIS

The Owner shall perform an analysis of the test and maintenance history of a valve or group of valves in order to establish the basis for specifying inservice testing, examination, and preventive maintenance activities. The analysis shall include the following:

*(a)* Identify any common failure or maintenance patterns.

*(b)* Analyze these patterns to determine their significance and to identify potential failure mechanisms:

*(1)* determine if certain preventive maintenance activities would mitigate the failure or maintenance patterns

*(2)* determine if certain condition monitoring tests such as nonintrusive testing are feasible and effective in monitoring for these failure mechanisms

*(3)* determine if periodic disassembly and examination activities would be effective in monitoring for these failure mechanisms

*(4)* determine if changes in the valve groupings are required

## II-4000 CONDITION-MONITORING ACTIVITIES

Valve obturator movement during applicable test or examination activities shall be sufficient to determine the bidirectional functionality of the moving parts. A full open exercise test, or an open test to the position required to perform its intended function (see ISTA-1100) is not required for this assessment.

*(a) Performance Improvement Activities*

*(1)* If sufficient information is not currently available to complete the analysis required in II-3000, or if this analysis is inconclusive, then the following activities shall be performed at sufficient intervals over an interim period of the next 5 years or two refueling outages, whichever is less, to determine the cause of the failure or the maintenance patterns.

*(a)* Identify interim tests (e.g., nonintrusive tests) to assess the performance of the valve or the group of valves.

*(b)* Identify interim examinations to evaluate potential degradation mechanisms.

*(c)* Identify other types of analysis that will be performed to assess check valve condition.

*(d)* Identify which of these activities will be performed on each valve in the group.

*(e)* Identify the interval of each activity.

*(2)* Identify attributes that will be trended. Trending and evaluation of existing data must be used as the bases to reduce or extend the time interval between tests or examinations.

*(3)* Complete or revise the condition-monitoring program test plans (see II-6000) to document the check valve program performance improvement activities and their associated frequencies.

*(4)* Perform these activities at their associated intervals until:

*(a)* sufficient information is obtained to permit an adequate evaluation of the specific application; or

*(b)* until the end of the interim period.

*(5)* After performance, review those attributes that were selected for trending, along with the results of each activity to determine if any changes to the program are required. If significant changes to the program are

[1] This Appendix contains requirements to augment the rules of Subsection ISTC, Inservice Testing of Valves in Light-Water Reactor Nuclear Power Plants.



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**Table II-4000-1 Maximum Intervals for Use When Applying Interval Extensions**

| Group Size | Maximum Interval [Note (1)], years |
|---|---|
| ≥ 4 | 16 |
| 3 | 12 |
| 2 | 12 |
| 1 | 10 |

NOTE:
(1) The maximum interval was determined by how many interval extensions could be obtained based on an 18-month or 24-month fuel cycle. All of the valves had to be tested or examined within the maximum interval to be considered a valid extension.

required, the program shall be revised prior to the performance of the next activity, and the applicable requirements of II-2000, II-3000, and II-4000 shall be repeated.

*(b) Optimization of Condition-Monitoring Activities*

*(1)* If sufficient information is available to assess the performance adequacy of the check valve or the group of check valves, then the following activities shall be performed.

*(a)* Identify the applicable preventive maintenance activities including their associated intervals that are required to maintain the continued acceptable performance of the check valve or group of check valves.

*(b)* Identify the applicable examination activities including their associated intervals that will be used to periodically assess the condition of each check valve or group of check valves.

*(c)* Identify the applicable test activities including their associated intervals that will be used to periodically verify the acceptable performance of each check valve or group of check valves.

*(d)* Identify which of these activities will be performed on each valve in the group.

*(e)* Identify the interval of each activity. Interval extensions shall be limited to one fuel cycle per extension. Intervals shall not exceed the maximum intervals shown in Table II-4000-1. All valves in a group sampling plan must be tested or examined again, before the interval can be extended again, or until the maximum interval would be exceeded. The requirements of ISTA-3120, Inservice Test Interval, do not apply.

*(2)* Identify attributes that will be trended. Trending and evaluation of existing data must be used to reduce or extend the time interval between tests or examinations.

*(3)* Revise the test plans (see II-6000) to document the optimized condition-monitoring program activities, and the associated intervals of each activity.

*(4)* Perform these activities at their associated intervals.

*(5)* After performance, review the results of each activity to determine if any changes to the optimized condition-monitoring program are required. If significant changes are required, the program shall be revised prior to the performance of the next activity, and the applicable requirements of II-2000, II-3000, and II-4000 shall be repeated.

Changes to IST intervals must consider plant safety and be supported by trending and evaluating both generic and plant-specific performance data to ensure the component is capable of performing its intended function(s) over the entire interval.

## II-5000 CORRECTIVE MAINTENANCE

If corrective maintenance is performed on a check valve, the analysis used to formulate the basis of the condition-monitoring activities for that valve and its associated valve group shall be reviewed to determine if any changes are required. If significant changes are required, the program shall be revised and the applicable requirements of II-2000, II-3000, and II-4000 shall be repeated.

## II-6000 DOCUMENTATION

The condition-monitoring program shall be documented and shall include the following information:

*(a)* list of valves in the program

*(b)* list of valves in each valve group

*(c)* dates valves were added/deleted to the program and the reason for their inclusion/deletion

*(d)* analysis forming the basis for the program

*(e)* identified failure or maintenance history patterns for each valve

*(f)* condition-monitoring program activities, including the trended attributes and the bases for the associated intervals for each valve or valve group



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# NONMANDATORY APPENDIX A[1]
# Preparation of Test Plans

## A-1000 PURPOSE

The purpose of this Appendix is to provide guidance for the preparation of test plans to ensure adequate information for submittal to reviewing agencies. This Appendix is not part of Subsection ISTA, General Requirements, but is included for informational purposes.

## A-2000 TEST PLAN CONTENTS

### A-2100 Background and Introduction

Test plans, which may consist of one or more parts (e.g., a part for general information and parts with details), should include the following:

*(a)* dates of test interval

*(b)* the edition and addenda of this Subsection used

*(c)* Code classification of components and boundaries of system classification including:

*(1)* specific rules for classification

*(2)* lists of systems and identification of acronyms used

*(d)* summary tables for each system showing Code classification, type of components, and tests or examinations to be performed

*(e)* the Code requirements for each component that are not being satisfied by the tests or examinations, and justification for the substitute tests or examinations as discussed in A-3000

*(f)* Code Cases proposed for use and the extent of their application

*(g)* a reference list of applicable documents, as required by A-2300

*(h)* names, signatures, and company affiliation of the preparers and approvers of the test plan

### A-2200 Summary of Changes in Updated Test Plans

The following summary information should be included to describe changes in updated test plans:

*(a)* listing of new or revised procedures

*(b)* changes in exemptions, tests, or examinations

*(c)* changes in substitute tests or examinations of A-3000

### A-2300 Applicable Documents

Test plans should include a reference list of applicable documents. The following documents should be considered:

*(a)* 10 CFR 50

*(b)* edition and addenda of this Subsection that apply (if portions of different editions or addenda are selected, identify the related requirements and components selected for testing or examination for each edition and addenda)

*(c)* Code Cases

*(d)* other regulatory documents

*(e)* piping and instrument diagrams (P&IDs)

### A-2400 Code Subsections

*(a)* Test plans should address the following Sub-sections:

*(1)* ISTB, pumps

*(2)* ISTC, valves

*(3)* ISTD, dynamic restraints (snubbers)

*(b)* Plans for Subsections may be combined in whole or part and published as one plan or as separate plans.

### A-2500 Detailed Contents

Test plans should include the following:

*(a)* specific exemptions applied to each system covered by this Subsection

*(b)* list of components, including system identification, Code classification, and nominal size

*(c)* tables that provide details of tests or examinations (typical information to be included in these tables is shown in Supplements 1, 2, and 3)

*(d)* a list of test and examination procedures including identification, titles, and general description of the components to which each procedure is applicable

## A-3000 SUBSTITUTE TESTS AND EXAMINATIONS

### A-3100 General

The following should be used when any Code requirement is not being satisfied by planned tests or examinations and when substitute tests or examinations[2] are included in the test plan.

[1] This Appendix is included for informational puposes only. While it is related to Subsection ISTA, General Requirements, it is not part of that Subsection.

[2] Substitute tests or examinations are tests or examinations that replace Code-required tests or examinations when the Code requirements are considered to be impractical.



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## A-3200 Justification of Substitute Tests and Examinations

Justification of substitute tests and examinations should include the following:

*(a)* Code Class

*(b)* Code test or examination requirements and identification of individual components for which substitute test or examinations are planned

*(c)* identification of the substitute tests or examinations that are planned

*(d)* frequency or schedule, as applicable, for the planned substitute tests or examinations including any plans for deferring the required tests or examinations

*(e)* documentation (drawings, sketches, or photographs may be used) of reasons the required tests or examinations are impractical, such as:

*(1)* system or plant operating limitations

*(2)* inaccessibility

*(3)* equipment design

*(4)* radiation levels at the test or examination area

*(5)* total estimated man-REM exposure involved in the test or examination

*(6)* flushing or shielding capabilities that might reduce radiation levels

*(7)* considerations involving remote examination

*(f)* technical justification and data to support the substitute tests or examinations, including:

*(1)* description and justification of any changes expected in the overall level of plant quality and safety by performing the proposed substitute tests or examinations in lieu of the Code requirements

*(2)* identification and discussion of similar components (in redundant systems or in the same system) to be tested or examined as substitutes

*(3)* percentage of the required tests or examinations that have been or will be completed on each component for which substitute tests or examinations are planned

*(4)* discussion of the consequences of failure of the component for which the substitute tests or examinations are planned



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# NONMANDATORY APPENDIX A
# Supplements

## SUPPLEMENT 1 INFORMATION FOR ISTB PUMP TEST TABLES

*(a)* Identification of system, in system-by-system order

*(b)* Code classification

*(c)* identification of specific pumps to be tested

*(d)* reference to drawings locating the pumps

*(e)* identification of specific tests to be performed, such as speed, flow rate, pressure, and vibration

*(f)* test frequency or schedule, as applicable

*(g)* reference to Code requirements that are not being satisfied, and identification of substitute tests

## SUPPLEMENT 2 INFORMATION FOR ISTC VALVE TEST TABLES

*(a)* Identification of systems, in system-by-system order

*(b)* Code classification

*(c)* identification of specific valves to be tested

*(d)* reference to drawings locating the valves

*(e)* valve category and size

*(f)* specific information on the valves to be tested, including valve type, actuator type, normal position, stroke direction, test to be performed, plant operational mode at the time of test, and maximum stroke time

*(g)* test frequency or schedule, as applicable

*(h)* reference to Code requirements that are not being satisfied, and identification of substitute tests

## SUPPLEMENT 3 INFORMATION FOR ISTD DYNAMIC RESTRAINT (SNUBBER) TABLES

*(a)* Identification of systems, in system-by-system order

*(b)* Code classification

*(c)* individual dynamic restraints (snubbers) selected for test and examination

*(d)* reference to drawings locating dynamic restraints (snubbers)

*(e)* acceptance criteria for the tests and examinations

*(f)* test or examination methods

*(g)* test or examination frequency or schedule, as applicable

*(h)* reference to Code requirements that are not being satisfied, and identification of substitute tests or examinations



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# NONMANDATORY APPENDIX B[1]
# Dynamic Restraint Examination Checklist Items

## B-1000 PURPOSE

The purpose of this Appendix is to provide examples of items normally included in a checklist used to verify preservice and inservice examination requirements. This Appendix is not part of Subsection ISTD, Inservice Testing of Dynamic Restraints in Light-Water Reactor Nuclear Power Plants, but is included for informational purposes.

## B-2000 EXAMPLES FOR PRESERVICE AND INSERVICE

Some examples of unacceptable attributes normally included in a checklist to verify preservice and inservice examination requirements are as follows:

*(a)* inadequate reservoir fluid level

*(b)* loose, missing, or incorrectly installed structural connections or fasteners

*(c)* vented reservoir oriented such that hydraulic fluid cannot gravitate to snubber

*(d)* corrosion or solid deposits that could result in unacceptable snubber performance

*(e)* deformed structural attachment or piston rod

*(f)* weld arc strikes, paint, weld slag, adhesive, or other deposits on piston rod or support cylinder that could result in unacceptable snubber performance

*(g)* spherical bearing not fully engaged in attachment lug

*(h)* inadequate position setting

## B-3000 EXAMPLES FOR PRESERVICE ONLY

Some examples of additional unacceptable attributes normally included in a checklist to verify preservice examination requirements only are as follows:

*(a)* incorrect snubber load rating

*(b)* incorrect installed location

*(c)* incorrect installed orientation

*(d)* incorrect position setting

*(e)* incorrect snubber configuration

*(f)* inadequate swing clearance

*(g)* snubber installed with preset locking screws used for shipment only

*(h)* protective coverings or shipping plugs not removed

[1] This Appendix is included for informational purposes only. While it is related to Subsection ISTD, Preservice and Inservice Examination and Testing of Dynamic Restraints (Snubbers) in Light-Water Reactor Nuclear Power Plants, it is not part of that Subsection.



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# NONMANDATORY APPENDIX C[1]
# Dynamic Restraint Design and Operating Information

## C-1000 PURPOSE

The purpose of this Appendix is to provide guidance in the form of design and operating information, which may be useful in the development of inservice examination and testing programs for snubbers. This Appendix is not part of Subsection ISTD, Inservice Testing of Dynamic Restraints in Light-Water Reactor Nuclear Power Plants, but is included for informational purposes.

## C-2000 DESIGN AND OPERATING ITEMS

Some items of snubber design and operating information that may be useful in the development of an inservice examination and testing program are as follows:

*(a)* snubber operation and maintenance instructions including parts list

*(b)* design drawings showing snubber rating, location, orientation, pin-to-pin dimensions, and hot and cold settings

*(c)* procurement specifications

*(d)* snubber qualification and acceptance test results

*(e)* snubber application reports

*(f)* the desired reservoir fluid level as a function of piston location and spatial orientation

*(g)* the correlation of activation velocity, acceleration, and release rate at normal test temperatures to the range of operating temperatures expected so that the snubber may be normalized at test temperature to perform within a specified range when at its operating temperature

*(h)* method for measuring the position setting

*(i)* required fluid and seal material specification

*(j)* limiting environmental conditions affecting service

*(k)* drag force for each size and type snubber furnished

*(l)* the correlation of hydraulic snubber release rate at various loads and the acceleration limiting value of mechanical snubbers at various loads to justify testing at less than rated loads

[1] This Appendix is included for informational purposes only. While it is related to Subsection ISTD, Preservice and Inservice Examination and Testing of Dynamic Restraints (Snubbers) in Light-Water Reactor Nuclear Power Plants, it is not part of that Subsection.



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# NONMANDATORY APPENDIX D[1]
# Comparison of Sampling Plans for Inservice Testing of Dynamic Restraints

## D-1000 PURPOSE

The purpose of this Appendix is to provide information to enable the user to make comparisons of the sampling plans included in Subsection ISTD. This Appendix is not part of Subsection ISTD, Inservice Testing of Dynamic Restraints in Light-Water Reactor Nuclear Power Plants, but is included for informational purposes.

## D-2000 DESCRIPTION OF THE SAMPLING PLANS

For simplicity, sampling plans are referred to as the 10% plan and the 37 plan.

### D-2100 The 37 Plan

The 37 plan has an "accept" line. The accept line is represented by the equation

$$N = 36.49 + 18.18C$$

where

$N$ = number of snubbers tested
$C$ = number of unacceptable snubbers

If the point plotted falls on or below the accept line, as shown in Subsection ISTD, Fig. ISTD-5431-1, testing of that group may be discontinued. If the accept region still has not been reached after testing between 100 and 200 snubbers, then the actual percent of population quality ($C/N$) should be used to indicate the probability of extended or 100% testing. A population quality of ≥ 5% failed snubbers will probably result in extended testing.

### D-2200 The 10% Plan

The 10% plan is really a family of "accept" lines that follow the equation

$$N = 0.1n\,(1 + C/2)$$

where

$n$ = the number of snubbers in the test population

The treatment of each accept line is the same as in the 37 plan.

## D-3000 COMPARISON OF SAMPLING PLANS

To cover the wide range of numbers of snubbers and acceptable population quality expected in different plants, two sampling plans are permitted. Both sampling plans provide the required protection. Therefore, the selection of a plan may be based on the number of tests required without compromising safety. The group size effect for the two plans is specified in D-3100 and D-3200.

### D-3100 Up to 370 Snubbers

The 10% plan requires the least testing for smaller groups. For groups up to 370 snubbers, the 10% plan is preferred because less testing is required. Note that for a group of 370 snubbers, the 10% plan and the 37 plan both require the same number of tests.

### D-3200 Above 370 Snubbers

For groups that have more than 370 snubbers, the 37 plan is preferred to the 10% plan. In this range, the 37 plan requires less testing than the 10% plan.

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# NONMANDATORY APPENDIX E[1]
# Flowchart for 10% and 37 Snubber Testing Plans

## E-1000 PURPOSE

This Appendix presents the testing plans in a flowchart form to enable the user to understand the options available for the corrective actions when unacceptable snubbers are found. (See Fig. E-1000-1.)

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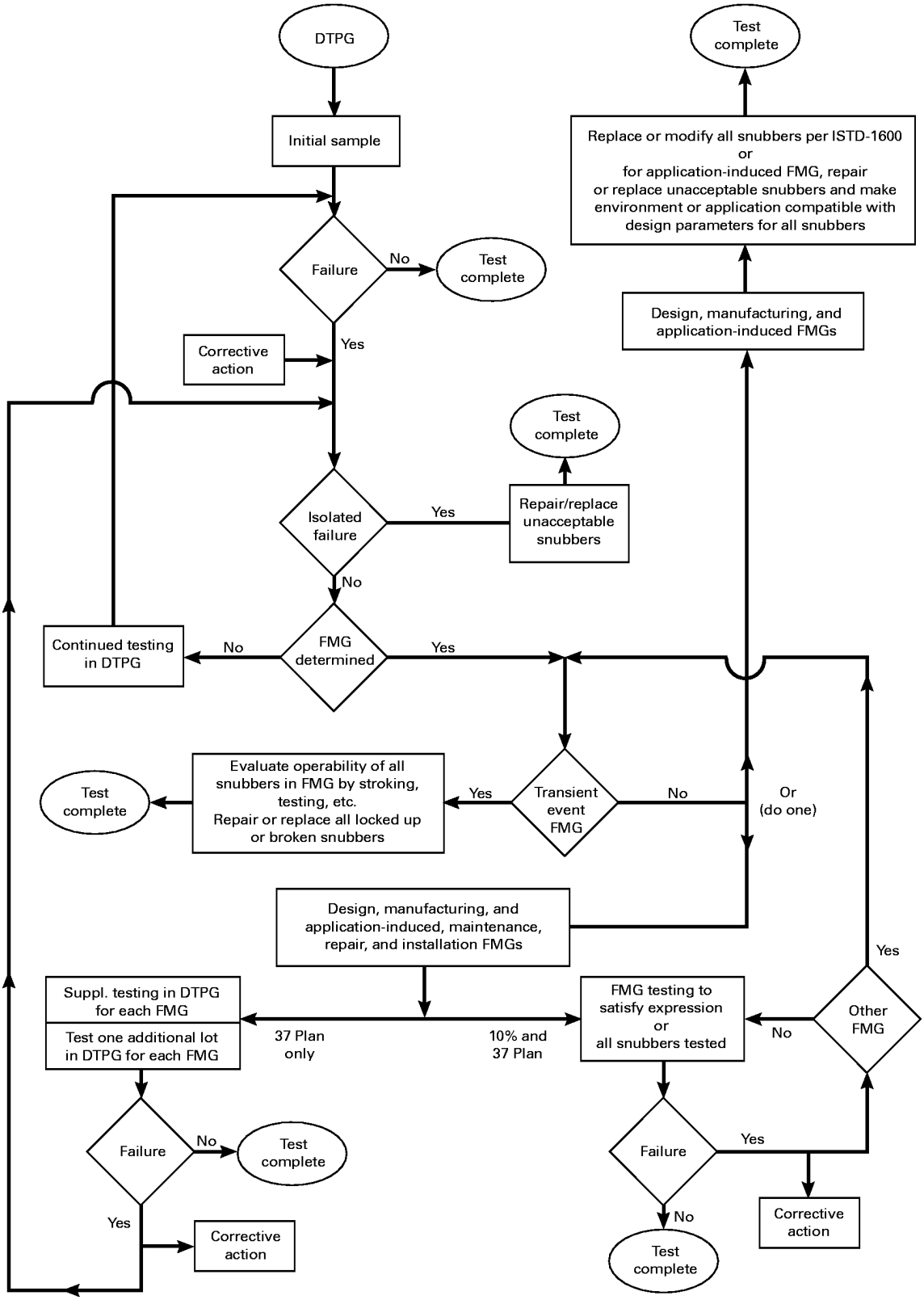


**Fig. E-1000-1 Flowchart for 10% and 37 Snubber Testing Plans**



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# NONMANDATORY APPENDIX F[1]
# Dynamic Restraints (Snubbers) Service Life Monitoring Methods

## F-1000 PURPOSE

Degradation due to service environment and maintenance errors can adversely affect snubber performance. This Appendix discusses methods and considerations that can be used to predict and reevaluate snubber service life to optimize snubber availability during plant operation. The service life monitoring program should be based on knowledge of the operating environment, snubber design limits, and service records.

## F-2000 PREDICTED SERVICE LIFE

Before start of service, snubber service life should be conservatively predicted, based on manufacturer recommendations or design review.

### F-2100 Manufacturer Recommendations

Manufacturer recommendations may include seal and fluid replacement intervals for hydraulic snubbers or critical parts, or snubber replacement intervals for mechanical snubbers. Such intervals may vary, depending upon the application.

### F-2200 Design Review

Snubber design review should consider materials, design features, and the plant operating environment. Evaluation of the effects of the environment on critical snubber parts such as seals, hydraulic fluids, lubricants, platings, etc., should be particularly emphasized.

## F-3000 SERVICE LIFE REEVALUATION

Service life reevaluation should include the considerations discussed in F-3100 through F-3320.

### F-3100 Knowledge of the Operating Environment

Actual plant operating environments can differ significantly from original plant design specifications. For example, some snubbers may be subjected to localized high temperatures that are not representative of the general snubber population. Such applications may require augmented inspections or more frequent snubber overhaul or replacement than originally predicted.

On the other hand, the operating environment for the majority of snubbers may be significantly less severe than described in plant design specifications. Unnecessary overhaul or replacement may increase the number of failed or degraded snubbers due to handling or maintenance errors.

It is important, therefore, that the operating environment be identified and appropriate maintenance intervals established for the various snubber applications in the plant and appropriate applicable service life established. Environmental parameters may include the following:

(*a*) temperature
(*b*) vibration
(*c*) transient loading
(*d*) radiation
(*e*) humidity
(*f*) airborne contaminants (e.g., sand and dusts)
(*g*) leakage of adjacent pipes or equipment

Severe environments may be identified by plant operating data, direct measurement of environmental parameters, evaluation of the installed location (e.g., proximity to high-temperature components) or by examination of snubbers (or snubber parts).

**F-3110 Direct Measurement of Environmental Parameters.** Various types of instrumentation and equipment are available for direct measurement of environmental parameters such as temperature, vibration, radiation, and humidity. Such equipment may be used for specific snubber locations where severe environments are expected or as an aid in determining the cause of snubber degradation.

**F-3120 As-Found Testing.** As-found testing of snubbers removed from service can identify degradation due to severe operating environments.

### F-3200 Knowledge of Operating Environment Effects

Reevaluation of a snubber service life should include a thorough knowledge of the effects of various operating environments on snubber performance. Such knowledge may not be readily available from the manufacturer and may require engineering evaluation, including monitoring of trendable degradation parameters for snubbers

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removed from service. This might include periodic measurement of potentially trendable test parameters (e.g., drag force) for selected snubbers. Periodic disassembly and evaluation of snubber internal parts (e.g., seals, springs fluid, etc.) may also be required.

**F-3210 Identification of Degraded Snubbers.** Degraded snubbers may often be identified by visual examination of snubbers or snubber parts, by sampling of hydraulic fluid, or by evaluation of characteristics including time traces (e.g., load and velocity), obtained during testing.

**F-3220 Trending.** The following should be considered for trending:

*(a)* establishment of trending parameters and associated baseline data

*(b)* trending parameters should relate directly to the anticipated failure mode

*(c)* reservoir fluid level is the most appropriate trending parameter for monitoring snubber leakage

*(d)* trends may be more effectively identified using average rather than peak drag force

## F-3300 Root-Cause Evaluation of Degraded or Failed Snubbers

Failures often result from influences not related to service time or service environment. Such influences include maintenance activities, construction activities, and manufacturing defects. It is important to ensure that service life, when based upon service history, is not unjustifiably influenced by such failures or degradation. Therefore, snubbers that failed inservice examinations or tests, or snubbers removed from service due to excessive degradation, should be evaluated to determine the root cause of the degradation or failure.

**F-3310 Failure Evaluation Data Sheet.** Failure evaluation data sheets should include information pertaining to failure mode, failure mechanism, environment, service time, abnormal conditions, visual observations, test results, and test observations. Data sheets should not utilize a format that might lead the examiner to a potentially incorrect failure cause (e.g., a checklist of failure causes).

**F-3320 Diagnostic Testing.** Diagnostic testing may be useful to identify the failure or degradation mechanism.

## F-4000 SHORTENED SERVICE LIFE

It may be necessary to shorten the service life of snubbers subjected to severe environments, such as excessively high temperatures and vibration. Snubbers in severe environments may require augmented surveillance, including "hands-on" evaluations (e.g., stroking) or in-situ monitoring.

## F-5000 SERVICE LIFE EXTENSION

In many cases, where there has been minimal degradation due to the service environment, it may be appropriate to extend the previously established service life. Service life extension should be based on a technical evaluation of snubber performance that includes knowledge pertaining to the current level of service-related degradation as well as to the degradation rate. Service life extension evaluations might include monitoring degradation parameters such as seal compression set in hydraulic snubbers, drag force in mechanical snubbers, or operating experience in a similar environment.

## F-6000 SEPARATE SERVICE LIFE POPULATIONS

Depending on the significance of environmental extremes from one area in the plant to another, separate and distinct service life populations may be appropriate.



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# NONMANDATORY APPENDIX G[1]
# Application of Table ISTD-4252-1, Snubber Visual Examination

## G-1000 PURPOSE

This Appendix provides guidance for use of Table ISTD-4252-1 to determine subsequent snubber examination interval.

## G-2000 ASSUMPTIONS

The assumptions used are as follows:

*(a)* snubber population = 750 snubbers installed in the unit

*(b)* accessible portion of the population = 300

*(c)* inaccessible portion of the population = 450

*(d)* normal fuel cycle = 12 months

NOTE: Examination intervals may vary by ±25%, i.e., examination can be performed between 9 and 15 months.

## G-3000 CASE 1: EXAMINE ACCESSIBLE AND INACCESSIBLE SNUBBERS JOINTLY

If the documented decision made before the examination begins is to examine the snubber population without categorizing snubbers as accessible or inaccessible in accordance with ISTD-4220, then the total number of snubbers unacceptable to the visual examination requirement is used in Table ISTD-4252-1 to determine the next examination interval.

### G-3100 Application of Column A

If the total number of unacceptable snubbers found during current examination is twenty or less, referring to population line for 750 snubbers and Column A, then, in accordance with Note (3) of Table ISTD-4252-1, the next examination interval is twice the previous interval but not greater than 48 months. If the previous examination interval was the normal fuel cycle, the examination during the next fueling outage may be skipped. Thus, the next examination is due at 24 months ±6 months (±25% of 24 months) to coincide with the second subsequent refueling outage. If the number of unacceptable snubbers found at the next examination is equal to or less than the number in Column A, the interval may be doubled again, but not to exceed 48 months.

### G-3200 Application of Column B

On the 750 population line, if the number of unacceptable snubbers is greater than 20 but less than or equal to 40, referring to Column B and Note (4), the next examination interval is the same as the previous interval. The next interval is exactly the same as the previous interval, ±25% of that previous interval, to coincide with the refueling outage.

### G-3300 Application of Less Than or Equal to Column C and Recovery

If the number of unacceptable snubbers is greater than 40, but less than or equal to 78 (say 60), referring to Columns B and C and Note (5), then interpolation may be used or the interval is reduced to two-thirds of the previous interval. If the previous interval was the 12-month normal fuel cycle, then the next examination interval is $\frac{2}{3} \times 12 = 8$ months. Alternatively, for 60 unacceptable snubbers, interpolate between Columns B and C, i.e., examination interval

$$= \frac{2}{3} \times 12 + \left[ \frac{(12 - 8)}{(78 - 40)} \times (78 - 60) \right]$$
$$= 8 + 1.89 = 9.89 \text{ months}$$

The reduced interval may vary by ±25% to coincide with an actual shutdown. However, for determining the subsequent examination interval, use the previous interval as 8 months without interpolation, or 9.89 months when interpolation is used.

The number of unacceptable snubbers found during the subsequent examination done at an 8 or 9.89 month interval will determine the next examination interval as follows.

If the number of unacceptable snubbers is

*(a)* less than or equal to Column A, the next examination interval is 2 × 8 or 2 × 9.89 months

*(b)* greater than Column A but less than or equal to Column B, the next examination interval is 8 or 9.89 months

*(c)* greater than Column B but less than or equal to Column C, the next examination interval is two-thirds of 8 or two-thirds of 9.89 months, or interpolate between Columns B and C

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### G-3400 Application of Table When Number Exceeds Column C

For a population of 750 snubbers, if the number of unacceptable snubbers is greater than 78 (i.e., the number shown in Column C), then the next examination interval is two-thirds of the previous interval. If the previous interval was the normal fuel cycle of 12 months, the calculation is $\frac{2}{3} \times 12 = 8$ months.

## G-4000 CASE 2: EXAMINE ACCESSIBLE AND INACCESSIBLE SNUBBERS SEPARATELY

If the decision was made to examine the accessible and inaccessible snubbers as separate categories, results are used separately in Table ISTD-4252-1.

### G-4100 Determine the Values From Columns A, B, and C

The values for 300 snubbers are given in Table ISTD-4252-1. However, for the 450 inaccessible snubbers, interpolate to determine the number of unacceptable snubbers for each column. The interpolation may be applied whenever the exact population or category quantity is not given in Table ISTD-4252-1.

| | Column A | Column B | Column C |
|---|---|---|---|
| 300 Accessible | 5 | 12 | 25 |
| 450 Inaccessible | 10 | 21 | 42 |

### G-4200 Determine Subsequent Interval Separately

The number of unacceptable snubbers found in the accessible or inaccessible category shall determine the next examination interval for each category separately. The process for each is the same as discussed in G-3000. Results of two categories cannot be combined to determine an extended examination interval. For example:

*(a)* if the number of unacceptable snubbers in the accessible category is 10 (greater than Column A but less than or equal to Column B), then the next examination interval for the accessible category is the previous interval

*(b)* if the number of unacceptable snubbers in the inaccessible category is 6 (less than or equal to Column A, which is 10 for 450 snubbers), then the next interval for the inaccessible category is twice the previous interval

### G-4300 Comparison of Example Results Using Total Population

If both accessible and inaccessible categories were examined jointly, then with sixteen unacceptable snubbers (less than or equal to Column A for 750 snubbers), the next examination interval can be increased to twice the previous examination interval for the entire snubber population. The decision to examine the categories separately or jointly shall be made and documented before a given examination begins, and cannot be changed during the examination.

### G-4400 Recombining Categories Into One Population

If the accessible and inaccessible categories have different intervals for the subsequent examination, they may be examined jointly at the shorter examination interval required by either category (or when the examination dates coincide, provided the separate schedules are met), provided the shorter interval is used as the previous interval in determining the subsequent examination interval for the entire population.



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# NONMANDATORY APPENDIX H[1]
# Test Parameters and Methods

## H-1000 PURPOSE

This Appendix provides guidelines for establishing snubber functional test methods that will produce information compatible with Subsection ISTD requirements. These guidelines do not preclude any particular test equipment or method. Manufacturer recommendations should be considered. EPRI Report No. TR-102363, Evaluation of Snubber Functional Test Methods, July 1993, provides additional guidance.

## H-2000 TEST VARIABLES

Snubber functional testing involves three test variables. These variables are force, displacement, and time. All snubber test parameters are measured in terms of one or more of these variables. For example, velocity is measured as change in displacement per unit time, acceleration is measured as change in velocity per unit time.

Snubber functional tests involve measuring at least one of these variables as a dependent variable, while controlling at least one of the other variables.

## H-3000 TEST PARAMETER MEASUREMENT

Subsection ISTD requires measurement of one or more of the following parameters:

*(a)* drag force
*(b)* activation
*(c)* release rate

### H-3100 Drag Force Measurement

Drag force is measured by controlling the snubber stroke displacement while measuring the resulting resistance force. Generally, the rate of change in displacement (velocity) is also controlled.

### H-3200 Activation Measurement

Activation applies to snubbers that have two distinct operating modes (i.e., activated and inactivated). Activation may involve control valve closure for a hydraulic snubber or engagement of a braking mechanism for a mechanical snubber. The three activation parameters are discussed below.

**H-3210 Locking Velocity.** Locking velocity is measured by stroking the snubber at a gradually increasing velocity. Generally, the rate of change in velocity (ramp rate) is also controlled. Locking velocity is determined by recording stroke velocity at the point of control valve closure. Control valve closure may be identified using a number of indicators including the point of sudden force increase.

**H-3220 Velocity Threshold.** Velocity threshold is measured by stroking the snubber at a velocity sufficient to activate the velocity limiting mechanism. After activation, a specified constant force is applied. Velocity threshold is determined by recording the average stroke velocity over a specified time period or stroke distance, after the force stabilizes at the specified value.

**H-3230 Acceleration Threshold.** Acceleration threshold is measured by stroking at an acceleration sufficient to activate the acceleration limiting mechanism. After activation, a specified force is applied. Acceleration threshold is determined by recording the average acceleration over a specified time period or stroke distance, after the force stabilizes at the specified value.

### H-3300 Release Rate Measurement.

Release rate is measured by applying a specified constant force to the snubber while measuring the resulting stroke velocity. Release rate is determined by recording the average stroke velocity over a specified time period or stroke distance, after the force stabilizes at the specified value.

## H-4000 GENERAL TESTING CONSIDERATIONS

Snubber functional testing may involve the use of more than one test machine. Test results are subject to some variation due to a number of influences, including differences in instrumentation, the magnitude of controlled variables, variations in test machine control methods, environmental influences, and variations in data interpretations.

### H-4100 Drag Test Velocity

For some snubber models, drag force is sensitive to test velocity. Test velocity should therefore be representative of the anticipated thermal movement rate of the

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components to which the snubbers are attached. Establishing standard drag test velocities will also facilitate identification of trends.

NOTE: For acceleration limiting snubbers, the ramp rate (acceleration) to the desired drag test velocity should be maintained at a level that is less than anticipated activation threshold.

## H-4200 Test Force

**H-4210 Effect on Release Rate.** The relationship between release rate and test force is generally consistent and predictable. Release rates measured at any test force can generally be reliably converted to the associated release rate value at the specified test force using empirically derived correlation curves or equations. For example, the release rate of a snubber tested at 60% of rated load may be converted to the corresponding release rate at 100% of rated load.

**H-4220 Effect on Activation.** Locking velocity is unaffected by test force because the test force is not applied until after activation. Velocity threshold and acceleration threshold, on the other hand, are measured while applying a force to the snubber. For these parameters, the effect of variations in test force should be established for each snubber model, for either correlation purposes or for verification that the parameter is unaffected by such variations.

## H-4300 Velocity Ramp Rate

Locking velocity test results may be affected by velocity ramp rate (the rate of increase of stroke velocity). Results of locking velocity tests conducted at a ramp rate less than 2 in. per min per sec will generally be unaffected in this regard.

## H-4400 Data Recording

A continuous recording of test variables should be performed. This data will assist in verification of the test results and resolution of any snubber performance anomalies.

## H-4500 Verification of Test Results

Some test machines calculate and print test results automatically. Manual verification of automatically generated results will help validate the printouts. See also H-4400.



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# NONMANDATORY APPENDIX J[1]
# Check Valve Testing Following Valve Reassembly

## J-1000 PURPOSE

The purpose of this Appendix is to provide guidance for determining the appropriate post-maintenance testing for check valves discussed in ISTC-5221(c).

## J-2000 POSTDISASSEMBLY TEST RECOMMENDATIONS

When a check valve is disassembled and examined because it is impractical to verify it open or close, verifying the proper reassembly of the valve should not require performance of the impractical test. Since an examination is not a test, the test matrix, shown in Table J-1000-1, was developed to help the Owner establish post-maintenance testing requirements. Some of the examples recommend a demonstration of the nonsafety function (e.g., if a valve is disassembled because closure cannot be demonstrated, then an open test to at least partially open the obturator is recommended). Disassembly and examination activities cannot be used to satisfy a leakage test requirement. If postmaintenance testing is not practicable, the Owner should take other appropriate actions to ensure proper reassembly.

## J-3000 TEST MATRIX

The test matrix, shown in Table J-1000-1, provides recommendations for the Owner's use in establishing postmaintenance test requirements. Where multiple recommendations are provided, the recommendations are listed in order of preference.

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**Table J-1000-1 Check Valve Test Matrix**

| Valve Exercise Requirement | Reason for Disassembly | Postmaintenance Testing Recommendation |
|---|---|---|
| Safety Function: | | |
| Open | Cannot achieve flow to fulfill its intended function | 1. Perform an open test to partially open the obturator, if practicable<br>2. If a seat leakage requirement exists, do the leakage test<br>3. Perform a closure test |
| Close | Cannot verify closure | Perform an open test to at least partially open the obturator, if practicable |
| Open and Close | Cannot achieve flow to fulfill its intended function | 1. Perform an open test to partially open the obturator, if practicable<br>2. If a seat leakage requirement exists, do the leakage test<br>3. Perform a closure test |
| Open and Close | Cannot verify closure | Perform an open test to at least partially open the obturator, if practicable |
| Open and Close | Cannot achieve flow to fulfill its intended function, and cannot verify closure | Perform an open test to partially open the obturator, if practicable |



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# ASME OM CODE-2004 INTERPRETATIONS

## Replies to Technical Inquiries
## June 1, 2003 through January 8, 2004

### FOREWORD

This publication includes all of the written replies issued between the indicated dates by the Secretary, speaking for the ASME Committee on Operation and Maintenance, to inquiries concerning interpretations of technical aspects of ASME OM Code.

These replies are taken verbatim from the original letters, except for a few typographical corrections and some minor editorial corrections made for the purpose of improved clarity.

These interpretations were prepared in accordance with the accredited ASME procedures. ASME procedures provide for reconsideration of these interpretations when or if additional information is available which the inquirer believes might affect the interpretation. Further, persons aggrieved by this interpretation may appeal to the cognizant ASME Committee or Subcommittee. ASME does not "approve," "certify," "rate," or "endorse" any item, construction, proprietary device, or activity.

An interpretation applies to the edition or addenda stated in the interpretation itself, or, if none is stated, to the latest published edition and addenda at the time it is issued. Subsequent revisions to the rules may have superseded the reply.

For detailed instructions on the preparation of technical inquiries, refer to Preparation of Technical Inquiries to the Committee on Operation and Maintenance of Nuclear Power Plants (p. viii of ASME OM Code-2004).



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**Interpretation: 01-18**

Subject: ASME OM Code-1995 With ASME OMa Code-1996 Addenda, Appendix I

Date Issued: June 26, 2003

File: OMI-03-01

Question (1): Are replacement valves for an operating nuclear power plant required by para. I6 to be tested in accordance with para. I7.2, required to be tested 6 months prior to fuel cycle initial criticality?

Reply (1): No. Paragraph I7.2 does not apply after initial electric power generation. However, the valve must have been tested within 5 years or 10 years as required by I1.3.

Question (2): In ASME OM Code-1995 with ASME OMa Code-1996 Addenda, para. I1.3.3(a), the statement is made that, "the test interval for any individual valve shall not exceed 5 years." Is this Code referring to "installed life" rather than "test interval"?

Reply (2): No.

Question (3): In ASME OM Code-1995 with ASME OMa Code-1996 Addenda, para. I1.3.5(a), the statement is made that "the test interval for any individual valve shall not exceed 10 years." Is the Code referring to "installed life" rather than "test interval"?

Reply (3): No.

**Interpretation: 01-19**

Subject: Table ISTC-3500-1, Inservice Test Requirements, Special Test Procedure

Date Issued: January 8, 2004

File: OMI-03-03

Question: Is it a requirement of Table ISTC-3500-1, Note (1), that passive valves with fail-safe actuators be fail-safe tested in accordance with ISTC-3560?

Reply: No.



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# OM CODE CASES

A Code Case is the official method of handling a reply to an inquiry when study indicates that the Code wording needs clarification, or when the reply modifies the existing requirements of the Code, or grants permission to use alternative methods.

ASME has agreed to publish Cases issued by the Operation and Maintenance Committee concerning the OM Code as part of the update service to the OM Code. A notice appears in *Mechanical Engineering* when new and revised Cases are approved, as well as announcements of approval of reaffirmed Cases and annulments. All Code Case actions then appear in the next update. Cases currently in effect at the time of publication of a new edition of the Code are included with it as a supplement.

The Cases affected by this supplement (OM Code-2004) are as follows:

| *Page* | *Location* | *Change* |
|---|---|---|
| C-3 | OMN-1 | New expiration date: March 30, 2007 |
| C-11 | OMN-2 | New expiration date: March 30, 2007 |
| C-12 | OMN-3 | New expiration date: March 30, 2007 |
| C-22 | OMN-4 | New expiration date: March 30, 2007 |
| C-23 | OMN-5 | New expiration date: March 30, 2007 |
| C-24 | OMN-6 | New expiration date: March 30, 2007 |
| C-37 | OMN-12 | New expiration date: February 15, 2007 |
| C-42 | OMN-13 | New expiration date: February 12, 2007 |
| C-45–C-47 | OMN-15 | Added |

Changes given above are identified on the pages by a margin note, **(04)**, placed next to the affected area. The pages not listed are the reverse sides of the listed pages and contain no changes.



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# CODE CASE OMN-1
# Alternative Rules for Preservice and Inservice Testing of Certain Electric Motor-Operated Valve Assemblies in Light-Water Reactor Power Plants OM Code-1995, Subsection ISTC

(04)

This Case shall expire on March 30, 2007 unless previously annulled or reaffirmed.

*Inquiry:* What alternative rules, to those of OM Code, Subsection ISTC, may be used for preservice and inservice testing to assess the operational readiness of certain electric motor-operated valve assemblies in light-water reactor power plants?

*Reply:* It is the opinion of the Committee that, in lieu of the rules for preservice and inservice testing to assess the operational readiness of certain electric motor-operated valve assemblies in light-water reactor power plants in OM Code, Subsection ISTC, except for ISTC 4.3 (1995 Edition with the 1996 and 1997 Addenda) or ISTC-3600 (1998 Edition with the 1999 and 2000 Addenda) as applicable, the following alternative requirements may be applied. Electric motor-operated valves for which seat leakage is limited to a specific maximum amount in the closed position for fulfillment of their required function (Category A) must also be seat leakage rate tested in accordance with the requirements of ISTC 4.3 (1995 Edition with the 1996 and 1997 Addenda) or ISTC-3600 (1998 Edition with the 1999 and 2000 Addenda) as applicable.

NOTE: The terms "shall consider" and "shall be considered" are used in paras. 3.5, 3.6.2, and 3.7.1 of this Code Case. The Code Case does not dictate how the considerations in the paragraphs are implemented or documented. Users of the Code Case will determine the best methods based on their programs, which may include procedures, checklists, training, or other methods.

## 1 INTRODUCTION

### 1.1 Scope

This Code Case establishes the requirements for preservice and inservice testing to assess the operational readiness of certain motor-operated valves (MOVs) in light-water reactor (LWR) power plants.

The MOVs covered are those required to perform a specific function in shutting down a reactor to the safe shutdown condition, in maintaining the safe shut-down condition, or in mitigating the consequences of an accident.

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

### 1.2 Exclusions

MOVs in the following categories are excluded from this Code Case, if they are not specifically required to perform a function described in para. 1.1:

*(a)* MOVs used only for operating convenience, such as vent, drain, instrument, and test valves

*(b)* MOVs used only for system control, such as pressure regulating valves

*(c)* MOVs used only for system or component maintenance

*(d)* MOVs not required to change position

External control and protection systems that sense plant conditions and provide signals for MOV operation are also excluded from the requirements of this Code Case.

## 2 SUPPLEMENTAL DEFINITIONS

*motor-operated valve (MOV):* a valve and its associated electric motor-driven mechanism for positioning the valve, including components that control valve action and provide position output signals.

*MOV functional margin:* the increment by which an MOV's available capability exceeds the capability required to operate the MOV under design basis conditions.

*stem factor:* the ratio of stem torque to stem thrust in rising-stem valves.

*design basis stem factor:* the greatest value for stem factor expected during design basis operation of an MOV.

## 3 GENERAL REQUIREMENTS

### 3.1 Design Basis Verification Test

A one-time test shall be conducted to verify the capability of each MOV to meet its safety-related design basis requirements. This test shall be conducted at conditions as close to design basis conditions as practicable. Requirements for a design basis verification test are specified in applicable regulatory documents. Testing that meets the requirements of this Code Case but conducted before implementation of this Code Case may be used.



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*(a)* Design basis verification test data shall be used in conjunction with preservice test data as the basis for inservice test criteria.

*(b)* Design basis verification testing shall be conducted in situ or in a prototype test facility that duplicates applicable design basis conditions. If a test facility is used, an engineering analysis shall be documented that supports applicability to the in situ conditions.

*(c)* Justification for testing at conditions other than design basis conditions and for grouping like MOVs shall be documented by an engineering evaluation, alternate testing techniques, or both.

*(d)* The design basis verification test shall be repeated if an MOV application is changed, the MOV is physically modified, or the system is modified in a manner that invalidates its current design basis verification test results or data. A determination that a design basis verification test is still valid shall be justified by an engineering evaluation, alternative testing techniques, or both.

### 3.2 Preservice Test

Each MOV shall be tested during the preservice test period or before implementing inservice testing. These tests shall be conducted under conditions as near as practicable to those expected during subsequent inservice testing. Testing that meets the requirements of this Code Case but conducted before implementation of this Code Case may be used. Only one preservice test of each MOV is required unless, as described in para. 3.4, the MOV has undergone maintenance that could affect its performance.

### 3.3 Inservice Test

Inservice testing shall commence when the MOV is required to be operable to fulfill its required function(s), as described in para. 1.1, and shall be sufficient to assess changes in MOV functional margin consistent with section 6.

*(a)* MOVs may be grouped for inservice testing as described in para. 3.5.

*(b)* Inservice tests shall be conducted in the as-found condition. Maintenance activities, such as stem lubrication, shall not be conducted if they might invalidate the as-found condition for inservice testing.

*(c)* The inservice testing program will include a mix of static and dynamic MOV performance testing. The mix of MOV performance testing may be altered when justified by an engineering evaluation of test data.

#### 3.3.1 Inservice Test Frequency

*(a)* The inservice test frequency shall be determined in accordance with para. 6.4.4.

*(b)* If insufficient data exist to determine the inservice test frequency in accordance with para. 6.4.4, then MOV inservice testing shall be conducted every 2 refueling cycles or 3 years (whichever is longer) until sufficient data exist to determine a more appropriate test frequency.

*(c)* The maximum inservice test frequency shall not exceed 10 years. MOV inservice tests conducted per para. 3.4 may qualify for this requirement.

### 3.4 Effect of MOV Replacement, Repair, or Maintenance

When an MOV or its control system is replaced, repaired, or undergoes maintenance that could affect the valve's performance, new inservice test values shall be determined or the previously established inservice test values shall be confirmed before the MOV is returned to service. If the MOV was not removed from service, inservice test values shall be immediately determined or confirmed. This testing is intended to demonstrate that performance parameters, which could be affected by the replacement, repair, or maintenance, are within acceptable limits. The Owner's program shall define the level of testing required after replacement, repair, or maintenance. Deviations between the previous and new inservice test values shall be identified and analyzed. Verification that the new values represent acceptable operation shall be documented as described in section 9, Records and Reports.

### 3.5 Grouping of MOVs for Inservice Testing

Grouping MOVs for inservice testing is permissible. Grouping MOVs shall be justified by an engineering evaluation, alternative testing techniques, or both. The following shall be considered when grouping MOVs:

*(a)* MOVs with identical or similar motor operators and valves and with similar plant service conditions may be grouped together based on the results of design basis verification and preservice tests. Functionality of all groups of MOVs shall be validated by appropriate inservice testing of one or more representative valves.

*(b)* test results shall be evaluated and justified for all MOVs in the group.

*(c)* a single representative MOV shall not be selected consecutively. All testable MOVs in a group shall be inservice tested before a previously tested representative MOV can be reselected. In addition to this requirement, the Owner may elect to consecutively test a certain MOV to monitor changes in its functional margin over time.

*(d)* the number of MOVs tested from each group shall be determined using appropriate statistical methodology. For groups with ten or more MOVs, at least two representative MOVs shall be tested.

*(e)* test results for a representative MOV shall be analyzed and evaluated per Section 6 for each MOV in the group.

### 3.6 MOV Exercising Requirements

**3.6.1** All MOVs, within the scope of this Code Case shall be exercised on an interval not to exceed one year



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or one refueling cycle (whichever is longer). Full-stroke operation of an MOV, as a result of normal plant operations or Code requirements, may be considered an exercise of the MOV, if documented. Alternatively, longer exercise intervals may be used if justified by successful operating experience.

**3.6.2** The Owner shall consider more frequent exercising requirements for MOVs in any of the following categories:

*(a)* MOVs with high risk significance

*(b)* infrequently operated MOVs with risk significance

*(c)* MOVs with adverse or harsh environmental conditions

*(d)* MOVs with any abnormal characteristics (operational, design, or maintenance conditions)

**3.6.3** MOVs shall be exercised as follows:

*(a)* full-stroke exercising during plant operation to the position(s) required to fulfill its function(s);

*(b)* if full-stroke exercising of an MOV is not practicable during plant operation, then full-stroke exercising shall be done during cold shutdowns; or

*(c)* if full-stroke exercising of an MOV is not practicable during plant operation or cold shutdown, then full-stroke exercising shall be done during the plant's refueling outages.

### 3.7 Risk-Based Criteria for MOV Testing

**3.7.1** Risk-based criteria for MOV testing are permissible. If establishing risk based criteria for performance testing, the Owner shall consider the following:

*(a)* develop an acceptable basis for MOV risk determination

*(b)* develop MOV screening criteria to determine each MOV's contribution to risk

*(c)* establish applicability by a documented evaluation from a plant expert panel

**3.7.2** Risk-based criteria, when applied to MOV performance testing, shall be used in conjunction with the MOV's margin to establish MOV grouping, acceptance criteria, exercising requirements, and testing frequency.

## 4 RESERVED

## 5 TEST METHODS

### 5.1 Test Prerequisites

All testing shall be conducted in accordance with plant-specific technical specifications, installation details, acceptance criteria, and maintenance, surveillance, operation, or other applicable procedures.

### 5.2 Test Conditions

Inservice test conditions shall be sufficient to determine the MOV's functional margin per para. 6.4. Test conditions shall be recorded for each test per section 9.

### 5.3 Limits and Precautions

*(a)* MOV exposure to dust, moisture, or other adverse conditions shall be minimized while performing tests.

*(b)* Manufacturer or vendor limits and precautions associated with the MOV and with the test equipment shall be considered, including the structural thrust and torque limits of the MOV.

*(c)* Plant-specific operational and design precautions and limits shall be followed. Items to be considered shall include, but are not limited to, water hammer and intersystem relationships.

### 5.4 Test Procedures

Procedures shall be established for all tests specified in this Code Case and shall provide for

*(a)* methodical, repeatable, and consistent performance testing

*(b)* collection of data required to analyze and evaluate the MOV functional margin in accordance with section 6

### 5.5 Test Parameters

Sufficient test parameters shall be selected for measurement to meet the requirements of section 6 in determining the MOV functional margin.

## 6 ANALYSIS AND EVALUATION OF DATA

### 6.1 Acceptance Criteria

The Owner shall establish methods to determine acceptance criteria for each MOV within the scope of this Code Case. Acceptance criteria shall be based upon the minimum amount by which available stem torque must exceed the required design basis stem torque. When determining the acceptance criteria, consider the following sources of uncertainty:

*(a)* test measurement uncertainty and equipment uncertainty (e.g., torque switch repeatability)

*(b)* analysis, evaluation, and extrapolation method uncertainty

*(c)* grouping method uncertainty

**6.1.1** MOV margins may be expressed in terms of other parameters, such as stem force, if those parameters are consistent with paras. 6.1 through 6.5.

### 6.2 Analysis of Data

Data obtained from a test required by this Code Case shall be analyzed to determine if the MOV performance is acceptable. The Owner shall determine which methods are suitable for analyzing necessary parameters for each MOV and application.



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Whenever data are analyzed, all relevant operating and test conditions shall be considered.

The Owner shall compare performance test data to the acceptance criteria. If the functional margin, determined per para. 6.4.3, does not meet the accept-ance criteria, the MOV shall be declared inoperable, in accordance with the Owner's requirements.

Data analysis shall include a qualitative review to identify anomalous behavior. If indications of anomalous behavior are identified, the cause of the behavior shall be analyzed and corrective actions completed, if required.

## 6.3 Evaluation of Data

The Owner shall determine which methods are suitable for evaluating test data for each MOV and application.

The Owner shall have procedural guidelines to establish the methods and timing for evaluating MOV test data. Evaluations shall determine the amount of degradation in functional margin that occurred over time. Evaluations shall consider the influence of past maintenance and test activities to establish appropriate time intervals for future test activities.

If grouping is used, the evaluations shall apply changes in functional margin to all members of the group to establish appropriate time intervals for future test activities.

## 6.4 Determination of MOV Functional Margin

The Owner shall demonstrate that adequate margin exists between the required torque and the available torque. Also, adequate margin shall exist to ensure that changes in MOV operating characteristics over time do not result in reaching a point of insufficient margin before the next scheduled test activity.

Figure 6.4-1 is a flow diagram that outlines the important steps for determining MOV functional margin. This figure is provided for information only. The figure shows separate paths for quarter-turn and rising-stem MOVs. For rotating-rising-stem MOVs, follow the path for rising-stem MOVs.

### 6.4.1 Determination of Required Torque

**6.4.1.1 Rising-Stem MOVs.** Design basis required torque shall be determined from measurements taken during testing at design basis conditions.

If not measured directly during testing at design basis conditions, design basis required torque for rising-stem MOVs shall be determined from the evaluation of the design basis required stem thrust and the design basis stem factor (torque equals thrust multiplied by stem factor).

*(a) Design Basis Stem Thrust.* Design basis stem thrust shall be determined from measurements taken during testing at design basis conditions. Alternatively, design basis stem thrust can, with justification, be estimated by analytical methods using valve parameters determined from testing at conditions other than design basis conditions.

*(b) Design Basis Stem Factor.* Design basis stem factor shall be calculated from measurements taken during testing at design basis conditions. Alternatively, the stem factor can, with justification, be estimated by analytical methods using valve parameters determined from testing at conditions other than design basis conditions.

**6.4.1.2 Quarter-Turn MOVs.** The design basis stem torque shall be determined from measurements taken during testing at design basis conditions. Alternatively, the design basis stem torque can, with justification, be estimated by analytical methods, using valve parameters determined from testing at conditions other than design basis conditions.

### 6.4.2 Determination of Available Stem Torque

**6.4.2.1 Available Stem Torque Based on Motor Capabilities.** Available stem torque shall be determined based on motor capabilities at the motor's design basis conditions. Considerations shall include

*(a)* rated motor start torque
*(b)* minimun voltage conditions
*(c)* elevated ambient temperature conditions
*(d)* operator efficiency
*(e)* other appropriate factors

**6.4.2.2 Available Torque Based on Torque Switch Setting.** Where used, the available stem torque, based on the current torque switch setting, shall be determined from the stem torque measurement taken at torque switch trip.

For MOVs where inservice testing does not sufficiently load the MOV to cause torque switch trip (e.g., butterfly and ball valves), available stem torque based on the current torque switch setting shall be determined analytically from test data. Considerations shall include

*(a)* calibration of the torque switch spring pack
*(b)* the current torque switch setting
*(c)* repeatability of torque switch operation

**6.4.3 Calculation of MOV Functional Margin.** MOV functional margin shall be calculated as the difference between the available stem torque and the required stem torque (available torque minus required torque equals margin).

Figure 6.4-2 illustrates this calculation for a rising-stem MOV where torque is expressed as a function of stem factor. The figure shows available stem torque based on two values:

*(a)* the stem torque based on the motor operating at its design basis conditions

*(b)* the stem torque based on the current torque switch setting

When calculating MOV functional margin, the available stem torque is the lesser of the two.



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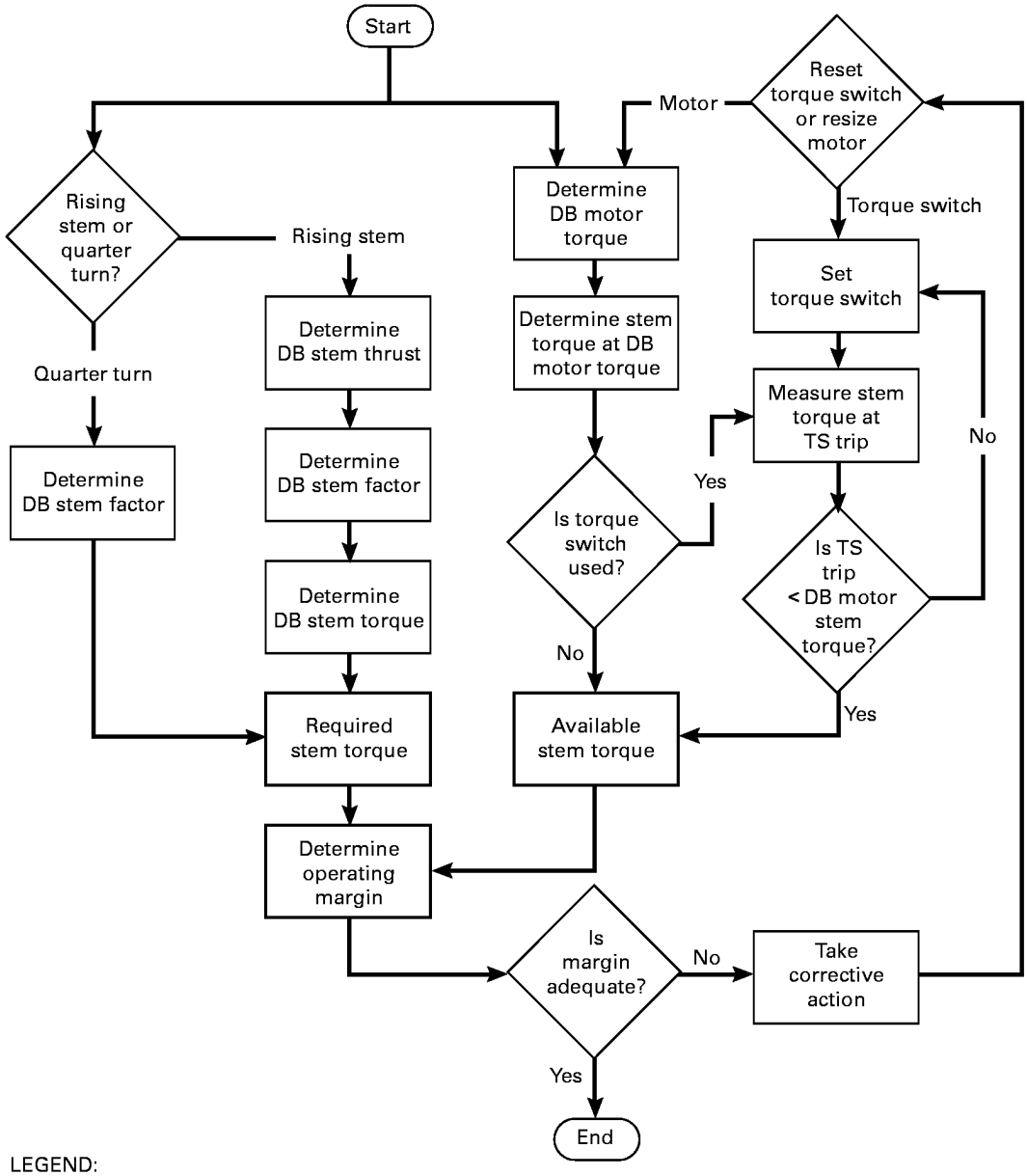


LEGEND:
DB = design basis
TS = torque switch

NOTE:
(1) Or alternate corrective action

**Fig. 6.4-1 MOV Functional Margin Determination Flowchart**



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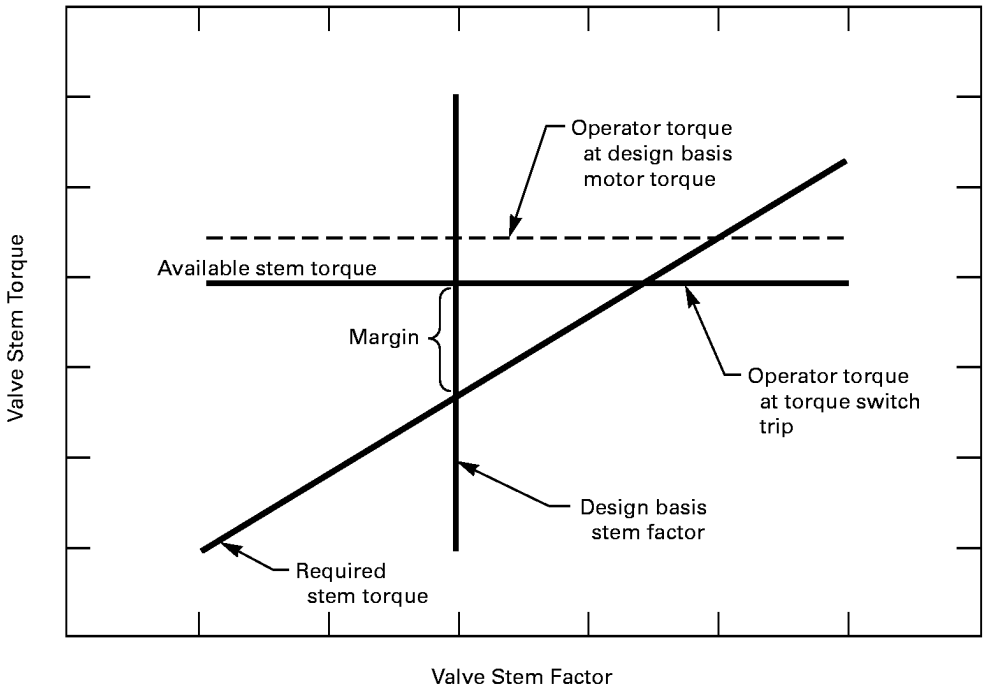


**Fig. 6.4-2 Determining Functional Margin for Rising-Stem MOVs**

For rising-stem valves, required stem torque appears as a diagonal line representing the torque needed to provide a given amount of stem thrust (required stem thrust) at various values for the stem factor. MOV functional margin is the difference between available stem torque and required stem torque at the design basis stem factor.

**6.4.4 Determination of MOV Test Interval.** Calculations for determining MOV functional margin shall also be evaluated to account for anticipated time-related changes in performance. Figure 6.4-3 provides an example of how the measured functional margin might change over time. Figure 6.4-4 provides an example of how changes in the functional margin over time can be evaluated to determine test intervals. Maintenance activities and intervals can affect test intervals and shall be considered.

The interval between tests shall be less than the anticipated time for the functional margin to decrease to the acceptance criteria.

### 6.5 Corrective Action

If the MOV performance is unacceptable, as established in para. 6.4, corrective action shall be taken in accordance with Owner's corrective action requirements.

**6.5.1 Record of Corrective Action.** The Owner shall maintain records of corrective action that shall include a summary of the corrections made, the subsequent inservice tests, confirmation of operational adequacy, and the signature of the individual responsible for corrective action and verification of results.

## 7 RESERVED

## 8 RESERVED

## 9 RECORDS AND REPORTS

### 9.1 Test Information

Pertinent test information shall be recorded or verified for MOV testing, described in section 3. The following information shall be considered:

*(a)* MOV plant-specific unique identification number.

*(b)* motor, valve, actuator nameplate data.

*(c)* test equipment unique identification numbers and equipment calibration dates.

*(d)* test method and conditions, described in section 5, including description of valve lineups, process equipment, and type of test. Descriptions shall include valve body, valve stem, electric motor-operator orientation, and piping configuration near the MOV.

*(e)* breaker setting/fuse size and motor starter thermal overload size, if used.



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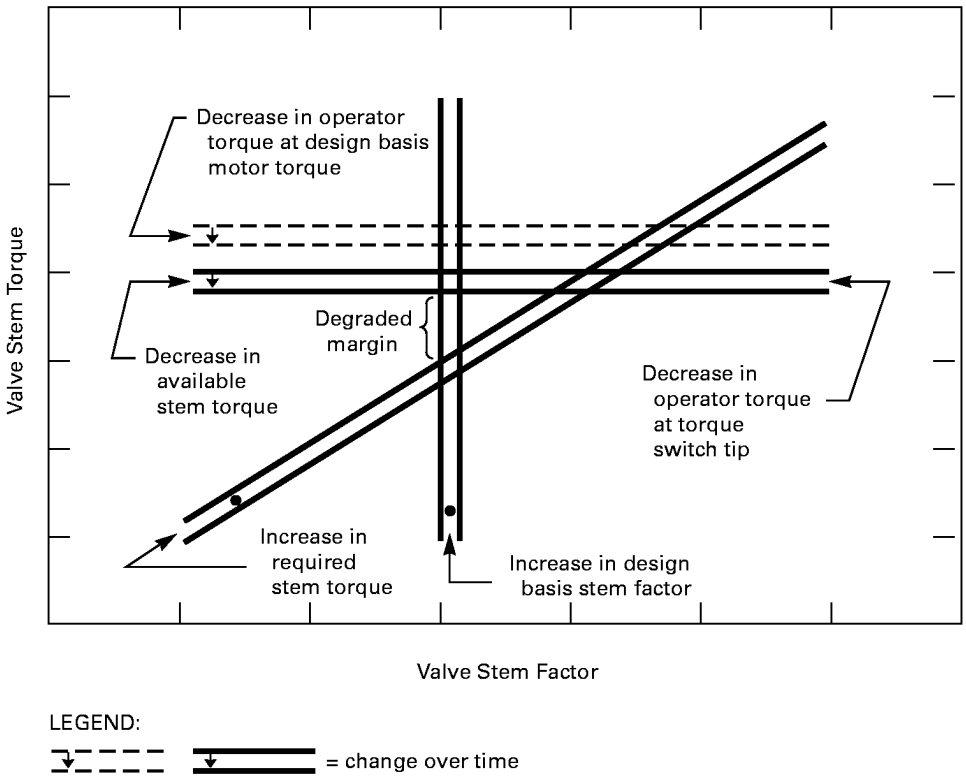
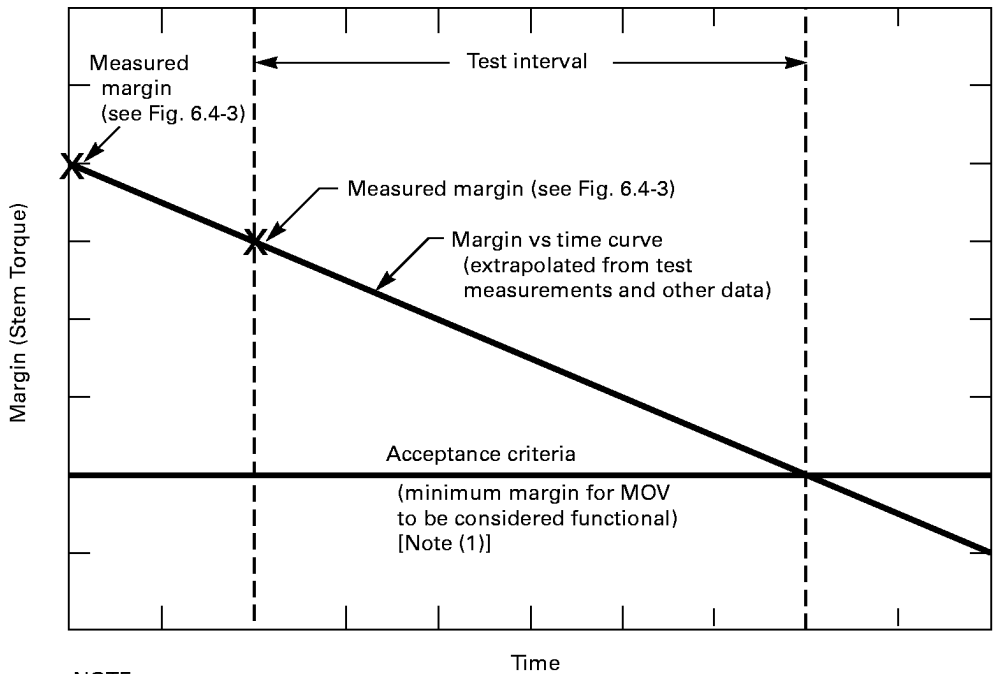



**Fig. 6.4-3 Decrease in Functional Margin Over Time for Rising-Stem MOVs**




NOTE:
(1) Calculated value plus uncertainty.

**Fig. 6.4-4 Determining the Test Intervals for Maintaining MOV Functional Margin**



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*(f)* MOV torque and limit switch configuration and settings.

*(g)* MOV performance test procedure and other approved plant documents containing acceptance criteria.

*(h)* name of test performer and date of test.

*(i)* system flow, system pressure, differential pressure, system fluid temperature, system fluid phase, and ambient temperature.

*(j)* significant observations — any comments pertinent to the test results which otherwise may not be readily identified by other recorded test data shall be recorded. Observations shall include any remarks regarding abnormal or erratic MOV action noted either during or preceding performance testing and any other pertinent design information which can be verified at the MOV.

## 9.2 Documentation of Analysis and Evaluation of Data

The documentation of acceptable MOV performance, which has been analyzed and evaluated in accordance with section 6, shall include, as a minimum

*(a)* values of test data, test parameters, and test information established by paras. 5.5 and 9.1.

*(b)* summary of analysis and evaluation required per paras. 6.2 and 6.3.

*(c)* statement(s), by an individual qualified to make such a statement through the Owner's qualification requirements, confirming that the MOV is capable of performing its intended safety function.

*(d)* signature and date of verification of the results of the analysis and evaluation by qualified individuals. Independent verification shall be by individuals qualified to verify those specific analyses and evaluations through the Owner's qualification requirements.



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## CODE CASE OMN-2
## Thermal Relief Valve Code Case, OM Code-1995, Appendix I

(04)

This Case shall expire on March 30, 2007 unless previously annulled or reaffirmed.

*Inquiry:* What alternative to ASME OM Code-1995, Appendix I, paras. I1.3.5(a), (b), and (c) may be used for Class 2 and Class 3 pressure relief valves, which are required to be tested per ASME OM Code-1995, Appendix I, para. I1.1, whose only overpressure protection function is to protect isolated components from fluid expansion caused by changes in fluid temperature?

*Reply:* It is the opinion of the Committee that in lieu of the requirements specified in ASME OM Code-1995, paras. I1.3.5(a), (b), and (c) testing for Class 2 and Class 3 pressure relief devices whose only overpressure protection function is to protect isolated components from fluid expansion caused by changes in fluid temperature shall be performed once every ten years on each device unless performance data indicates that more frequent testing is needed to assure device function. In lieu of test, the Owner may replace these devices every ten years unless performance data indicates more frequent replacement is needed to assure device function.



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# CODE CASE OMN-3

(04) **Requirements for Safety Significance Categorization of Components Using Risk Insights for Inservice Testing of LWR Power Plants**

This Case shall expire on March 30, 2007 unless previously annulled or reaffirmed.

*Inquiry:* Is it acceptable to categorize those components under the scope of the ASME OM Code Section IST into two categories based on their safety significance?

*Reply:* Yes, provided the following requirements are met.

## 1 APPLICABILITY

This Code Case establishes the component safety categorization methodology and process for dividing the population of pumps and valves, as identified in the IST Program Plan, into "high safety significant component" (HSSC) and "low safety significant component" (LSSC) categories.

## 2 SUPPLEMENTAL DEFINITIONS

*aggregate risk:* the risk due to programmatic changes in the IST program (test method effectiveness and/or testing interval) as measured by CDF or LERF.

*basic event:* basic fault event in a fault-free model that requires no further development, because appropriate limit of resolution has been reached.

*common cause failure (CCF):* a single event that adversely affects two or more components at the same time.

*core damage frequency (CDF):* the calculated frequency (per year) that core damage will occur due to failure of a critical safety function (i.e., reactivity control, core cooling, or containment heat removal). (A Level 1 PRA identifies accident sequences that can lead to core damage, calculates the frequency of each sequence, and sums those frequencies to obtain CDF.)

*decision criteria:* the quantitative and qualitative factors that influence a decision. These include both quantitative screening criteria (for PRA model) and the evaluation of other qualitative (or deterministic) factors that influence the results of an application.

*figures-of-merit:* the quantitative value, obtained from a PRA analysis, used to evaluate the results of an application (e.g., CDF, LERF).

*Fussell-Vesely (F-V) importance measure:* for a specified basic event, Fussell-Vesely importance is the fractional contribution to the total of a selected figure of merit for all accident sequences containing that basic event.

*high safety significant components (HSSCs):* components that have been designated as more important to plant safety by a blended process of PRA risk ranking and Plant Expert Panel evaluation.

*importance measure:* a mathematical expression that defines a quantity of interest. The most common importance measures are F-V and RAW.

*initiating event:* any event that perturbs the steady state operation of the plant, if operating, or the steady state operation of the decay heat removal system during shutdown operations, thereby initiating a transient within the plant. (Initiating events trigger sequences of events that challenge plant control and safety systems.)

*inservice test (IST):* a test to determine the operational readiness of a component/system.

*large early release frequency (LERF):* the calculated frequency (per year) that radioactivity release from the containment is both large and early. "Large" means involving the rapid, unscrubbed release of airborne fission products to the environment. "Early" means occurring before the effective implementation of offsite emergency and protective actions. (A Level 2 PRA identifies accident sequences that can lead to radioactivity release, calculates the frequency of each sequence, and sums these frequencies to obtain LERF.)

*living PRA:* a plant specific PRA that is maintained up to date, such that plant modifications, plant operation changes (including procedure changes), component performance, and other technical information significantly affecting the model are reflected in the model.

*low safety significant components (LSSCs):* components that have been designated as less important to plant safety by a blended process of PRA risk ranking and Plant Expert Panel evaluation.

*operational readiness:* the ability of a component to perform its intended system function when required.

*PRA failure rate:* the conditional probability of failure of a component on the next demand (for standby component) or in the next hour of operation (for operating component), given that it has not already failed.



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*probabilistic risk assessment (PRA):* a quantitative assessment of the risk associated with plant operation and maintenance. Risk is measured in terms of the frequency of occurrence of different events, including core damage. In general the scope of a PRA is divided into three categories: Level 1, Level 2, and Level 3. A Level 1 maps from initiating events to plant damage states, including their aggregate, core damage. Level 2 includes Level 1 mapping from initiating events to release categories (source term). A Level 3 includes Level 2 and uses the source term of Level 2 to quantify consequences, the most common of which are health effects and property damage in terms of cost.

*risk achievement worth (RAW) importance measure:* for a specified basic event, risk achievement worth importance reflects the increase in a selected figure of merit when an SSC is assumed to be unable to perform its function due to testing, maintenance, or failure. It is the ratio or interval of the figure of merit, evaluated with the SSC's basic event probability set to one, to the base case figure of merit.

*testing strategy:* the IST strategy to measure component degradation or to monitor a component for operational readiness at some interval by operating or inspecting the component (e.g., valve stroking, pump vibration test, motor circuit evaluation, motor current signature analysis, component bearing lube oil analysis).

*truncation limits:* the cutoff value of probability or frequency of individual accident sequences below which they are no longer retained in quantitative PRA model results.

## 3 GENERAL REQUIREMENTS

### 3.1 Implementation

The requirements of the risk-informed IST component code cases shall be implemented for all IST components of the same type. Component types are specified in the risk informed component code cases.

### 3.2 Plant Specific PRA

The plant specific PRA (Level 1 with internal initiating events, as a minimum) shall be available and used to perform component risk ranking.

### 3.3 Living PRA

The PRA shall be maintained up to date. (Reference 1 provides guidance.)

### 3.4 Integrated Effects

Components may be affected by more than one risk informed application. Integrated effects of multiple risk informed applications (including risk informed applications outside of the ASME scope) shall be evaluated.

### 3.5 Plant Expert Panel

A Plant Expert Panel shall be designated to perform the blended safety evaluation of probabilistic and deterministic engineering information for each component.

### 3.6 Determination of HSSC and LSSC

The Plant Expert Panel shall evaluate each component and categorize it as HSSC or LSSC, using PRA quantitative information (if component is modeled) and engineering qualitative information (for both modeled and not modeled components).

### 3.7 Inservice Testing Strategy for HSSCs and LSSCs

Testing strategies will be developed by other risk informed component code cases:

*(a)* Test strategies for the HSSCs shall have the objective of identifying and trending degradation that could lead to the occurrence of the failure mode(s) that resulted in the HSSC categorization.

*(b)* Test strategies for LSSCs shall have the objective of providing confidence for operational readiness.

### 3.8 Evaluation of Aggregate Risk

The aggregate risk impact of changes to the IST program shall be evaluated by the Owner (e.g., plant expert panel). Decision criteria, quantitative evaluations, and qualitative assessments are a part of this aggregate risk impact evaluation. Reference 1 provides guidance on evaluating aggregate risk.

### 3.9 Feedback and Corrective Actions

Feedback and corrective action processes are required elements of this Code Case.

## 4 SPECIFIC REQUIREMENTS

In addition to section 3 above, the following requirements apply to component classification into HSSC and LSSC categories, and to a risk-informed IST program based on those categories.

### 4.1 Component Risk Categorization

This paragraph establishes requirements for separating components into HSSC or LSSC categories, performing PRA sensitivity studies to ensure that quantitative ranking is correct, and determining how to treat components not modeled.

**4.1.1 Appropriate Failure Modes.** Component risk categorization shall be based on basic events that include failure modes representing functions addressed by inservice testing (e.g., pump failure to run, valve failure to open, common cause failure).

#### 4.1.2 Importance Measures

*(a)* As a minimum, two importance measures, F-V and RAW, shall be calculated for those components modeled in the PRA.



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*(b)* Importance measures should be evaluated for both CDF and LERF, if available.

**4.1.3 Screening Criteria.** For those components modeled in the PRA

*(a)* a threshold value of F-V > 0.005 or lower based on either CDF or LERF should be initially considered as HSSC

*(b)* a threshold value of RAW > 2 based on either CDF or LERF shall be initially considered as HSSC

**4.1.4 Sensitivity Studies**

*(a)* The following sensitivity studies shall be performed:

*(1) Data and Uncertainties.* Failure probabilities of components within the PRA models for those IST components that have initially very high or very low safety significance shall be selectively increased and/or decreased to determine if the results are sensitive to changes in the failure data. If sensitivities are indicated, steps shall be taken to determine if uncertainty ranges can be reduced and to validate the failure probabilities included in the models.

*(2) Human Recovery Actions.* The PRA shall be requantified, and the F-V and RAW importance measures recalculated, after human actions modeled in the PRA to recover from specific component failures are adjusted in the models (i.e., the probability of successful recovery due to human intervention is adjusted by factor of ten).

*(3) Test and Maintenance Unavailabilities.* The PRA models shall be requantified with test and maintenance unavailabilities adjusted, and the importance measures recalculated.

*(4) LSSC Failure Rates.* Failure rates for initially ranked LSSC components shall be increased by a factor representing the upper bound (95%) of the failure rate and the PRA models requantified. The importance measures shall then be recalculated.

*(5) Truncation Limits.* If the PRA has not been quantified with a truncation limit in accordance with Ref. 1, the PRA model shall be requantified with the truncation limit lowered to this value. The importance measures shall then be recalculated.

*(6) Common Cause.* Sensitivity analyses shall determine the impact of increased or decreased common cause failure rates. Importance measures shall then be recalculated.

*(b)* The results of these sensitivity studies and any others that are performed, shall be documented. In addition to the magnitude of the changes to the CDF or LERF, all insights obtained from the results shall be described.

*(c)* The results and insights of these sensitivity studies shall be provided to the Plant Expert Panel for their consideration in the final categorization of the components.

**4.1.5 Qualitative Assessments.** Qualitative assessments shall be performed for all IST components, modeled and not modeled in the PRA to determine whether there are other bases for categorizing IST components.

*(a)* The following qualitative assessments shall be performed:

*(1)* impact of initiating events (i.e., the impact of failure or degradation as it might result in an initiator, component contribution to initiating events represented by point estimates)

*(2)* potential consequences of shutdown (outage) conditions

*(3)* response to external initiating events (e.g., seismic, fire, high winds/tornadoes, flooding, etc.)

*(4)* impact of LERF, if not used in para. 4.1.2(b)

*(b)* Qualitative assessments shall be performed for plant-specific design bases conditions and events not modeled in a PRA.

*(c)* Qualitative assessments shall consider the impacts upon the plant to

*(1)* prevent or mitigate accident conditions

*(2)* reach and/or maintain safe shutdown conditions

*(3)* preserve the reactor primary coolant pressure boundary integrity

*(4)* maintain containment integrity

*(d)* Qualitative assessments shall also consider

*(1)* safety function being satisfied by the component's operation

*(2)* level of redundancy existing at the plant to fulfill the component's function

*(3)* ability to recover from a failure of the component

*(4)* performance history of the component

*(5)* plant technical specifications requirements applicable to the component

*(6)* emergency operating procedure instructions that use the component(s)

*(7)* design and current licensing basis information relevant to IST component function

*(e)* The cumulative impacts of combinations of component unavailability, which could impact an entire system (e.g., multitrain impacts) or critical safety function (e.g., multisystem impacts), shall also be considered.

*(f)* These qualitative assessments shall be available to the Plant Expert Panel for their decision of component safety categorization.

*(g)* These qualitative assessments and the Plant Expert Panel's disposition of them shall be documented.

**4.1.6 Components Not Modeled.** If IST components not modeled in the PRA are subsequently determined by the Plant Expert Panel to have an impact upon the ability of the facility to respond to analyzed events, consideration should be given to updating the PRA model to incorporate the effects of the component(s), then using



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the updated model to provide a quantified basis for categorization (either HSSC or LSSC).

## 4.2 Component Safety Categorization

This paragraph provides requirements for the Plant Expert Panel's review and evaluation process for categorizing IST components relative to their safety significance, using both deterministic and probabilistic insights.

**4.2.1 Plant Expert Panel Utilization.** The Plant Expert Panel shall blend deterministic and probabilistic information to classify IST components into HSSC or LSSC categories.

*(a) PRA Insights.* The results of PRA analyses shall be used by the Plant Expert Panel to determine the safety significance of components within the scope of IST and PRA programs. Information contained in PRAs relative to the role of components in mitigating or preventing core damaging events or radiological release events shall be considered. The scope of the PRA and depth of probabilistic analyses shall be assessed, evaluated, and documented. As a minimum, the following shall be documented:

*(1)* The level of plant specific PRA analysis available for assessing the applicability of PRA information relative to IST programs. For example, written documentation describing the level of plant specific PRA analysis such as Level 1 PRA (assessment of core damage frequency) and/or Level 2 PRA (assessment of core damage frequency plus containment performance).

*(2)* Scope of initiating events considered (internal events, external events, both).

*(3)* Typical failure modes considered (e.g., hardware failures, testing/maintenance failures, common cause failures, human errors).

*(4)* PRA scope for plant configurations (e.g., low power risk, shutdown risk, transition mode risk, at-power risk) reviewed relative to the applicability of PRA information and IST component function(s).

*(b) Deterministic Insights.* The Plant Expert Panel shall also consider deterministic factors when assessing the safety significance of components within the scope of IST programs (See Appendix A of this Code Case for a sample list of deterministic questions).

**4.2.2 Plant Expert Panel Requirements**

*(a) Plant Procedure.* A procedure approved by the Owner shall describe the process, including

*(1)* designated members and alternates

*(2)* designated chairman and alternate

*(3)* quorum

*(4)* attendance records

*(5)* agendas

*(6)* motions for approval

*(7)* process for decision making

*(8)* documentation and resolution of differing opinions

*(9)* minutes

*(10)* implementation of feedback/corrective actions

*(11)* feedback to the PRA

*(12)* required training

*(b) Training.* The Plant Expert Panel shall be trained and indoctrinated by the Owner in the specific requirements to be used for this Code Case. Training and indoctrination shall include the application of risk analysis methods and techniques used for this Code Case. At a minimum, the risk methods and techniques include

*(1)* PRA fundamentals (e.g., PRA technical approach, PRA assumptions and limitations, failure probability, truncation limits, uncertainty)

*(2)* use of risk importance measures

*(3)* assessment of failure modes

*(4)* reliability versus availability

*(5)* risk thresholds

*(6)* expert judgment elicitation

Each of the aforementioned topics shall be covered in the indoctrination to the extent necessary to provide the Plant Expert Panel with a level of knowledge needed to adequately evaluate and approve the scope of the IST selections, using both probabilistic and deterministic information.

*(c) Expertise.* Requirements for ensuring adequate expertise levels of Plant Expert Panel members. Member expertise levels shall be documented and maintained.

*(d) Membership*

*(1)* There shall be at least five experts designated as members of the Plant Expert Panel. Members may be experts in more than one field; however, excessive reliance on any one member's judgment shall be avoided.

*(2)* The chairperson shall be familiar with this Code Case and shall facilitate Plant Expert Panel activities, to ensure that the requirements of this Code Case are satisfied.

*(3)* Expertise in the following functions shall be represented on the Plant Expert Panel:

*(a)* operation

*(b)* safety analysis engineering

*(c)* probabilistic risk assessment

*(4)* Additional members of the Plant Expert Panel who have the following plant expertise may be selected:

*(a)* systems performance

*(b)* maintenance

*(c)* licensing

*(d)* component performance

*(e)* ASME inservice testing

*(f)* quality assurance

*(g)* design engineering

*(5)* Alternate members may be designated to the Plant Expert Panel on a temporary basis; however,



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vacancies in the Plant Expert Panel membership should be filled by qualified individuals within a reasonable period of time.

*(6)* Other plant or nuclear industry experts may be invited to attend some or all of the sessions of the Plant Expert Panel as visitors to provide observations, opinions, or recommendations.

**4.2.3 Plant Expert Panel Decision Criteria.** Plant Expert Panel decision criteria for categorizing components as HSSC and LSSC shall be documented.

**4.2.4 Reconciliation.** Decisions of the Plant Expert Panel shall be arrived at by consensus. Differing opinions shall be documented and resolved, if possible.

*(a)* If a resolution cannot be achieved concerning the safety significance classification of a component, then the component shall be classified HSSC.

*(b)* If components have a high initial ranking from the PRA (i.e., RAW > 2 or F-V > 0.005) but are ultimately ranked as LSSCs, the Plant Expert Panel decisions shall be documented.

## 4.3 Testing Strategy Formulation

*(a)* Testing strategies for HSSCs and LSSCs shall be developed following the requirements provided in the risk informed component code cases.

*(b)* After testing strategies are developed, the Owner shall provide the planned changes (e.g., test frequency, testing effectiveness, and test duration) for input to the evaluation of aggregate risk.

## 4.4 Evaluation of Aggregate Risk

### 4.4.1 Decision Criteria

*(a)* Appropriate decision criteria for aggregate risk effects shall be established and documented.

*(1)* Decision criteria shall be based on thresholds for aggregate risk limits using standard figures-of-merit (e.g., CDF, LERF). (Appendix B provides guidance.)

*(2)* Performance criteria used for other regulatory requirements may be taken into consideration when developing decision criteria for aggregate risk effects.

*(b)* Decision criteria may be determined both qualitatively and quantitatively.

### 4.4.2 Quantitative Assessment

*(a)* An aggregate risk evaluation shall be performed prior to implementation, as applicable, using the PRA.

*(1)* Quantitative attributes associated with this Code Case shall be considered and included in the quantitative evaluation, as appropriate, and within the scope of the PRA.

*(2)* Each applicable quantitative IST attribute shall be incorporated into the quantitative evaluation, as appropriate, until all proposed changes have been dispositioned (i.e., incorporated or not incorporated).

*(3)* Once all appropriate inputs have been incorporated, the PRA shall be rerun to assess the overall risk impact.

*(4)* Proposed IST program change shall be assessed to determine compliance with approved decision criteria and to quantitatively determine if any adjustments or compensatory measures are warranted.

*(b)* Types of quantitative attributes that should be considered in the quantitative evaluation include changes in

*(1)* testing frequency

*(2)* out of service duration

*(3)* failure rates

*(4)* failure modes

*(5)* common cause failure susceptibility

*(6)* compensatory measures

*(7)* testing scheme (staggered or simultaneous testing)

Compensatory measures include both those specifically incorporated into plant programs and those developed by the Owner for specific situations. Management directed compensatory measures should also be included in the quantitative assessment, as appropriate. Verifiable values of failure rates shall be used in the quantification process for IST component.

*(c)* Testing effectiveness shall be evaluated by periodic assessments or when new failure modes are identified that impact risk quantification.

*(1)* New failure modes shall be incorporated in accordance with the Owner's risk management and corrective action programs into the quantitative evaluation, as appropriate.

*(2)* Changes resulting from programs that significantly affect the reliability or availability of components that perform important safety functions shall be assessed, and, if appropriate, incorporated into the PRA for requantification.

Such assessments may be performed in conjunction with the plant specific Maintenance Rule (10 CFR 50.65) requirements.

### 4.4.3 Qualitative Evaluation

*(a)* Aggregate risk effects shall be qualitatively evaluated (i.e., risk decreases as well as risk increases) for IST program changes (e.g., testing effectiveness).

*(b)* Pertinent performance indicators, industry programs, or other scrutable methods for establishing aggregate risk effects shall be identified and monitored.

*(c)* Feedback processes and corrective action programs shall be considered in the evaluation of aggregate risk.

**4.4.4 Defense in Depth.** The IST aspects of Defense in Depth shall be maintained.

**4.4.5 Safety Margins.** The IST aspects of Safety Margin shall be maintained.



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### 4.5 Inservice Testing Program

**4.5.1 Maximum Testing Interval.** The maximum testing interval shall be based on the more limiting of the following:

*(a)* the results of the aggregate risk

*(b)* performance history of the component

**4.5.2 Implementation Schedule.** A schedule shall be developed for implementing the testing strategies as specified in the risk informed component code cases.

**4.5.3 Assessment of Aggregate Risk.** Once the test schedule has been developed, the schedule shall be assessed against the assumptions of the aggregate risk evaluation.

**4.5.4 Transition Plan.** A transition plan shall be developed for each component type to ensure adequate information is collected to support justification of stepwise test interval extension up to and including the maximum allowable interval. Staggered test intervals are acceptable for implementing a stepwise test interval extension.

### 4.6 Performance Monitoring

**4.6.1 HSSC Attribute Trending.** For HSSCs, a set of attributes to be tested, shall be established in accordance with the requirements of risk-informed component code cases and a trending program shall be implemented for those attributes selected for monitoring.

**4.6.2 LSSC Performance Trending.** For LSSCs, testing strategies shall be identified in accordance with the requirements of risk-informed component code cases and shall trend component performance.

### 4.7 Feedback and Corrective Actions

#### 4.7.1 Feedback

*(a)* A feedback process incorporating elements of both conditional and periodic feedback shall be established such that component performance information is directed to both the IST and PRA programs. Conditional feedback shall occur in a timely fashion following component failure. Periodic feedback shall be considered for maintenance of the PRA.

*(b)* Each program shall assimilate performance information to ensure the appropriate unavailability information is reflected in decision making.

*(c)* A feedback process shall be established so IST programmatic changes are directed to the PRA program.

**4.7.2 Corrective Action.** In addition to the requirements in the IST Code of Record with respect to Corrective Actions, a Corrective Action Program shall be established that identifies and tracks to resolution all failures of similar types of components within an IST Program incorporating risk insights, including evaluation of generic implications.

**4.7.3 Component Safety Recategorization.** The component's operational readiness is not changed by recategorization.

## 5 RESERVED

## 6 RESERVED

## 7 RESERVED

## 8 RECORDS AND REPORTS

In addition to the requirements in the Code of Record with respect to Records, the following records of the Plant Expert Panel and the component shall be maintained.

### 8.1 Plant Expert Panel Records

*(a)* Membership and attendance

*(b)* Member expertise representation and training records per para. 4.2.2(b)

*(c)* Member experience (years of experience in each of the expertise categories)

*(d)* Meeting agendas

*(e)* Meeting minutes

*(f)* Plant procedure

### 8.2 Component Records

*(a)* Risk significance based on PRA importance measures

*(b)* Additional PRA quantitative information

*(c)* Deterministic information

*(d)* Plant Expert Panel categorization decisions of HSSC or LSSC

*(e)* Basis for the HSSC/LSSC decision

## 9 REFERENCES

EPRI TR. 105396, PSA Applications Guide, August 1995



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# APPENDIX A
## Sample List of Component Deterministic Questions

This nonmandatory Appendix provides guidance to the Plant Expert Panel for categorizing components as HSSC or LSSC.

### A-1 DESIGN BASIS ANALYSIS

*(a)* Is component considered in design basis analysis?

*(b)* Is component function considered important in the Safety Analysis Report?

*(c)* Are there any Tech Spec considerations for this component?

### A-2 RADIOACTIVE MATERIAL RELEASE LIMIT

*(a)* Could the failure of this component be considered a breach in an engineered safety barrier?

*(b)* Could the failure of this component result in an uncontained release of radioactive material in excess of that allowed?

### A-3 MAINTENANCE RELIABILITY

*(a)* Is component important to maintaining system reliability?

*(b)* What type of component failures have been experienced for this and similar style components?

*(c)* What does the maintenance history indicate about the reliability of this component?

*(d)* Does the component receive preventive maintenance and is it effective for preventing identified failures?

*(e)* How are component failures detected?

### A-4 EFFECT OF COMPONENT FAILURE ON SYSTEM OPERATIONAL READINESS

*(a)* Is component important to maintaining system availability?

*(b)* How does component failure affect system performance?

*(c)* Does component failure cause other system component failures?

*(d)* What is the system component level of defense in depth?

*(e)* Does the system or component perform other functions outside the scope of the PRA?

*(f)* Can system or component failure modes affect redundant trains or other similar component?

### A-5 OTHER DETERMINISTIC CONSIDERATIONS

*(a)* Should other component failure modes be considered in the PRA model?

*(b)* Is this component used to mitigate the consequences of an accident caused by external events?

*(c)* Is this component important for safe shutdown?

*(d)* Is this component required to maintain the safe shutdown condition?

*(e)* Should other component failure modes which may not be included in the PRA be considered (e.g., aging effects, structural supports, human performance failures)?



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## APPENDIX B
## Acceptance Guidelines

This nonmandatory Appendix provides guidance on the decision criteria for aggregate risk limits using CDF and LERF.

The risk acceptance guidelines presented in this Appendix are structured as follows. Regions are established in the two planes generated by a measure of the baseline risk metric (CDF or LERF) along the $x$-axis, and the change in those metrics (CDF or LERF) along the $y$-axis (Figs. B-1 and B-2), and acceptance guidelines are established for each region as discussed below. These guidelines are intended for comparison with a full PRA scope (including internal events, external events, full power, low power, and shutdown) assessment of the change in risk metric, and, when necessary, as discussed below, the baseline value of the risk metric (CDF or LERF). However, it is recognized that many PRAs are not full scope and the use of less than full-scope PRA information is acceptable as discussed in this Code Case.

There are two acceptance guidelines, one for CDF and one for LERF, both of which should be used.

*(a)* The acceptance guidelines for CDF are as follows:

*(1)* If the change can be clearly shown to result in a decrease in CDF, then the change is satisfactory.

*(2)* When the calculated increase in CDF is very small, which is taken as being less than 1E-06 per reactor year, the change should be considered, regardless of whether there is a calculation of the total CDF (Region III). While there is no requirement to calculate the total CDF, should there be an indication that the CDF may be considerably higher than 1E-04 per reactor year, then the focus should be on finding ways to decrease CDF. Such an indication would result, for example, if:

*(a)* the contribution to CDF calculated from a limited scope analysis, such as the PRA, and, if appropriate the PRA with external initiating events, significantly exceeds 1E-04;

*(b)* there has been an identification of a potential vulnerability from a margin-type analysis; or

*(c)* historical experience at the plant in question has indicated a potential safety concern.

*(3)* When the calculated increase in CDF is in the range of 1E-06 per reactor year to 1E-05 per reactor year, changes should only be considered if it can be reasonably shown that the total CDF is less than 1E-04 per reactor year (Region II).

*(4)* Applications that result in increases to CDF above 1E-05 per reactor year (Region I) should not normally be considered.

*(b)* The acceptance guidelines for LERF are as follows:

*(1)* If the change can be clearly shown to result in a decrease in LERF, then the change is satisfactory.

*(2)* When the calculated increase in LERF is very small, which is taken as being less than 1E-07 per reactor year, the change should be considered, regardless of whether there is a calculation of the total LERF (Region III). While there is no requirement to calculate the total LERF, should there be an indication that the LERF may be considerably higher than 1E-05 per reactor year, then the focus should be on finding ways to decrease rather than increase it. Such an indication would result, for example, if:

*(a)* the contribution to LERF calculated from a limited scope analysis, such as that the IPE, and, if appropriate the IPEEE, significantly exceeds 1E-05;

*(b)* there has been an identification of a potential vulnerability from a margin-type analysis; or

*(c)* historical experience at the plant in question has indicated a potential safety concern.

*(3)* When the calculated increase in LERF is in the range of 1E-07 per reactor year to 1E-06 per reactor year, changes should only be considered if it can be reasonably shown that the total LERF is less than 1E-05 per reactor year (Region II).

*(4)* Changes that result in increases to LERF above 1E-06 per reactor year (Region I) should not normally be considered.

These acceptance criteria are intended to provide assurance that proposed increases in CDF and LERF are small.

The analysis may be subject to a more detailed technical and management review depending upon the degree to which a change resides in a given region. In the context of the integrated decision making by the Plant Expert Panel, the boundaries between regions should not be interpreted as being definitive; the numerical values associated with defining the regions in the figure are to be interpreted as being absolute.



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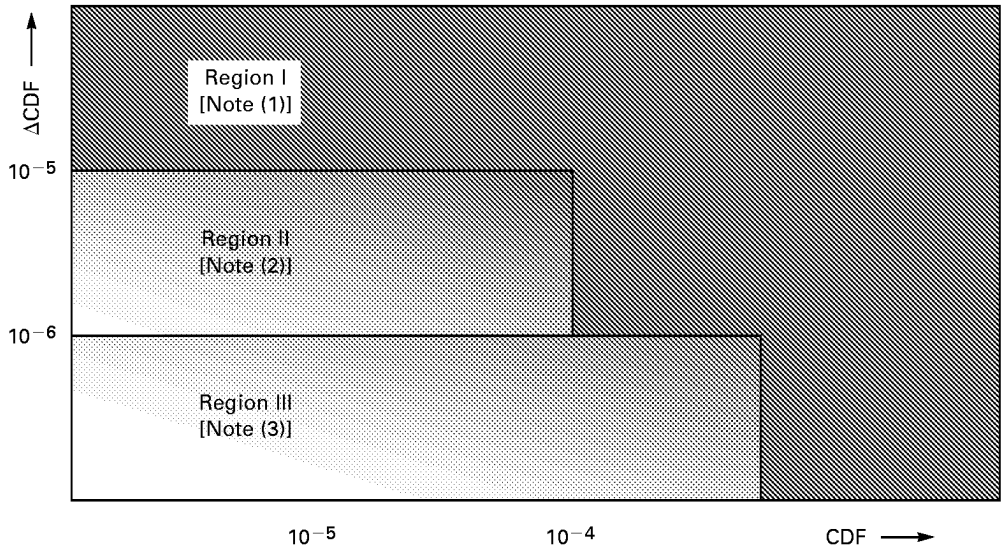


NOTES:
(1) Region I: No changes allowed.
(2) Region II:
    (a) Small changes
    (b) Track cumulative impacts
(3) Region III:
    (a) Very small changes
    (b) More flexibility with respect to baseline CDF
    (c) Track cumulative impacts

**Fig. B-1 Acceptance Guidelines for CDF (From RG 1.174)**



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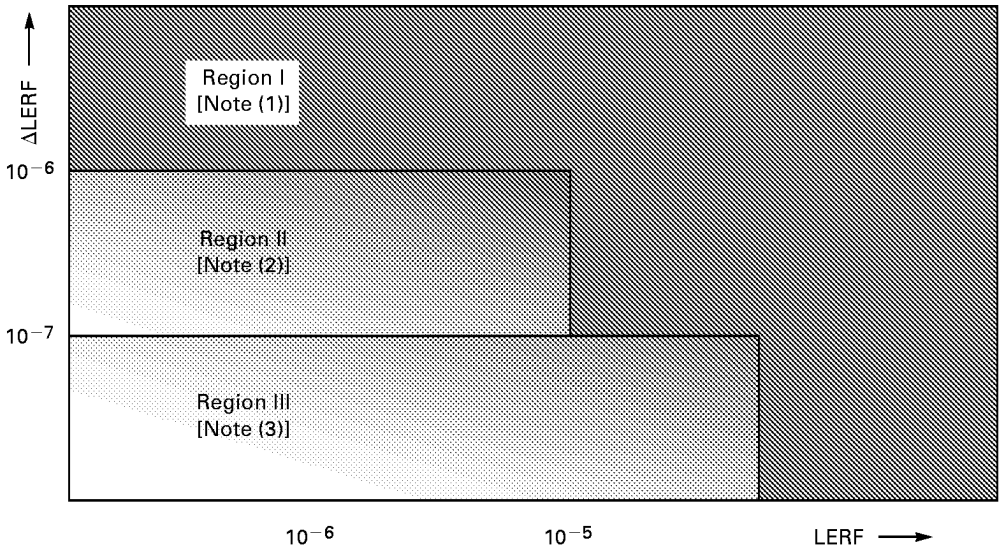


NOTES:
(1) Region I: No changes allowed.
(2) Region II:
    (a) Small changes
    (b) Track cumulative impacts
(3) Region III:
    (a) Very small changes
    (b) More flexibility with respect to baseline LERF
    (c) Track cumulative impacts

**Fig. B-2 Acceptance Guidelines for LERF (From RG 1.174)**



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# CODE CASE OMN-4

(04) **Requirements for Risk Insights for Inservice Testing of Check Valves at LWR Power Plants**

This Case shall expire on March 30, 2007 unless previously annulled or reaffirmed.

*Inquiry:* What alternative requirements may be used in lieu of the requirements of the ASME OM Code for inservice exercising tests for Category C check valves?

*Reply:* It is the opinion of the Committee that the following requirements may be applied.

## 1 SAFETY SIGNIFICANCE CATEGORIZATION

Check valves shall be evaluated and categorized as High Safety Significant Components (HSSCs) or Low Safety Significant Components (LSSCs) in accord- ance with the Code Case on Requirements for safety significance categorization of components using Risk Insights for Inservice Testing of LWR Power Plants.

## 2 HSSC TESTING

HSSC check valves shall be placed in a Condition Monitoring Program and tested in accordance with ASME OMa Code-1996, Appendix II. The Condition Monitoring program shall include identification and trending of attributes indicative of degradation that could lead to the occurrence of the failure mode(s) that resulted in HSSC categorization.

## 3 LSSC TESTING

LSSC check valves shall be tested in accordance with OMa Code-1996, Subsection ISTC, or placed in a Condition Monitoring Program and tested in accordance with the ASME OMa Code-1996, Appendix II.



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## CODE CASE OMN-5
## Testing of Liquid Service Relief Valves Without Insulation (04)

This Case shall expire on March 30, 2007 unless previously annulled or reaffirmed.

*Inquiry:* What alternative requirements to those of ANSI/ASME OM Code, Appendix I, paras. I4.1.1(d), I4.1.2(d), I4.1.3(d), I8.1.1(d), I8.1.2(d), and I8.1.3(d) may be used for valves which are insulated in service and removed for testing?

*Reply:* It is the opinion of the Committee that valves which are insulated in service and removed for testing at ambient temperature using a test media at ambient temperature need not be insulated during testing, provided the requirements of ANSI/ASME OM Code, Appendix I, paras. I4.3 and I8.3 are met.

*Applicability:* ASME OM Code-1990 Edition and later editions and addenda through 1995.



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(04)

# CODE CASE OMN-6
# Alternate Rules for Digital Instruments

This Case shall expire on March 30, 2007 unless previously annulled or reaffirmed.

*Inquiry:* What alternative requirements to those specified in OM Code, ISTB 4.6.1(b)(2) [ISTB 4.7.1(b)(2) in 1994 addenda and later] may be used for digital instruments used in the performance of inservice testing?

*Reply:* It is the opinion of the Committee that digital instruments may be selected such that the reference value does not exceed 90% of the calibrated range of the instrument.

*Applicability:* ASME OM Code-1990 Edition through ASME OMb Code-1997 Addenda.



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# CODE CASE OMN-7
# Alternative Requirements for Pump Testing

This Case shall expire on January 30, 2005 unless previously annulled or reaffirmed.

*Inquiry:* What alternative to the requirements of ASME OM Code, Subarticle ISTB-5.1 may be used in conjunction with Code Case OMN-3, Requirements for Safety Significance Categorization of Components Using Risk Insights for Inservice Testing of LWR Power Plants, for inservice testing to assess the operational readiness of pumps in light water reactor power plants?

*Reply:* It is the opinion of the Committee that, in lieu of the rules of ASME OM Code, Subsection ISTB, Subarticle ISTB-5.1, the following alternative requirements may be applied.

## 1 APPLICABILITY

The pumps covered by this Code Case are all those pumps determined to be within the scope of the risk-informed IST Program in accordance with Code Case OMN-3, Requirements for Safety Significance Categorization of Components Using Risk Insights for Inservice Testing of LWR Power Plants.

## 2 REQUIREMENTS

### 2.1 Related Requirements

Use of this Code Case also requires compliance with the requirements of ASME Code Case OMN-3 (risk ranking). Code Case OMN-3 groups components into one of two categories:

*(a)* high safety significant component (HSSC).

*(b)* low safety significant component (LSSC). Trending of parameters according to OM Code-1995 with OMa Code-1996 meets the performance monitoring requirements of Code Case OMN-3, para. 4.6.

### 2.2 HSSC Testing Requirements

Group A and Group B pumps categorized as HSSCs shall meet all the requirements of OM Code-1995 with OMa Code-1996.

### 2.3 LSSC Testing Requirements

Group A and Group B pumps categorized as LSSCs shall meet all the requirements of OM Code-1995 with OMa Code-1996, except that the testing requirements identified in this paragraph and in the table below may be substituted for those in ISTB 5.1 (Table ISTB 5.1-1). All Group A and Group B LSSC pumps shall receive an initial Group A test conducted within ±20% of pump design flow rate as soon as practical and no later than the first refueling outage following implementation of this Code Case. Thereafter, all Group A and Group B LSSC pumps shall be Group A tested within ±20% of pump design flow rate at least once every 5 years or three refueling outages, whichever is longer.

| Pump Group | Group A Test | Group B Test | Comprehensive Test |
|---|---|---|---|
| Group A (routinely or continuously operated pumps) | 6 months [Note (1)] | Not required | Not required |
| Group B (standby pumps) | 2 years | 6 months [Note (1)] | Not required |

NOTE:
(1) To meet vendor recommendations, pump operation may be required more frequently than the specified test frequency.

## 3 ADDITIONAL REQUIREMENTS

*(a)* The Owner shall develop a transition plan and implementation schedule for this Code Case.

*(b)* Feedback and corrective actions shall be taken in accordance with Code Case OMN-3, para 4.7.

*(c)* If the maximum test interval as determined from the aggregate risk assessment of Code Case OMN-3, para. 4.5.2, for a specific component is more limiting than the test frequency of para. 2.2 or 2.3 above (as applicable), the most limiting test interval shall be used for that component. A Group A or Group B test, as applicable, shall be performed to satisfy the increased test frequency requirements.



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## CODE CASE OMN-8
## Alternative Rules for Preservice and Inservice Testing of Power-Operated Valves That Are Used for System Control and Have a Safety Function Per OM-10

This Case shall expire on November 20, 2006 unless previously annulled or reaffirmed.

*Inquiry:* What alternative requirements to those of ASME/ANSI OMa-1988, Part 10, para. 4.2 through OM Code-1995, ISTC 4.2 may be used for power-operated control valves that have only a fail safe safety function?

*Reply:* It is the opinion of the Committee that the requirements of ASME/ANSI OMa-1988, Part 10, para. 4.2.1.4, Power-Operated Valve Stroke Testing; para. 4.2.1.8, Stroke Time Acceptance Criteria; and para. 4.2.1.9(b) need not be met. All other applicable requirements of para. 4.2 shall be met for ASME/ANSI OMa-1988, Part 10.

Further, the requirements of OM Code-1995, ISTC 4.2.4, Power-Operated Valve Stroke Testing; ISTC 4.2.8, Stroke Time Acceptance Criteria; and ISTC 4.2.9(b) need not be met. All other applicable requirements of the paragraph shall be met.

Any abnormality or erratic action experienced during valve exercising shall be recorded in the record of tests, and an evaluation shall be made regarding need for corrective action.



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# CODE CASE OMN-9
# Use of a Pump Curve for Testing

This Case shall expire on November 25, 2006 unless previously annulled or reaffirmed.

*Inquiry:* What alternative rules to those of ISTB 4.3, 4.4, 4.5, 5.2, and 6.1 may be used when it is impractical to adjust a centrifugal or vertical line shaft pump to a specific reference value as required by ISTB 5.2(b)?

*Reply:* It is the opinion of the Committee that the following rules may be used for testing of centrifugal or vertical line shaft pumps where adjustment to a specific reference value is impractical, in lieu of the requirements of ISTB 4.3, 4.4, 4.5, 5.2, and 6.1.

*Applicability:* ASME OM Code-1990 through ASME OMb Code-1992.

## 1 ADDITIONAL DEFINITIONS

*maximum pump curve range:* the maximum potential flow or differential pressure range for the pump curve, from shutoff conditions to maximum required flow rate.

*reference curve:* a range of values of a test parameter versus flow or differential pressure, for a centrifugal or vertical line shaft pump, measured or determined when the pump is known to be operating acceptably.

## 2 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 sections 4 and 5 below. 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 of pumps may be foundation, driver, and piping dependent. Therefore, if initial vibration readings are high and have no obvious relationship to the pump, the 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.

## 3 REFERENCE CURVES

If the establishment of specific reference values is impractical for a centrifugal or vertical line shaft pump, the Owner may establish reference curves. Reference curves shall be determined from data measured during preservice testing or from the first inservice test. A reference curve shall be established from a minimum of three data points and shall have at least one data point for each 20% of the maximum pump curve range. The range of the reference curve shall be sufficient to bound the points of operation expected during subsequent tests. All subsequent test results shall be compared to the initial reference curves or to new reference curves established in accordance with section 4 or 5 below. Reference curves shall only be established when the pump is known to be operating acceptably. If vibration is relatively unaffected by changing differential pressure or flow over the reference curve range, a single reference value may be used for that test quantity, provided it is at the minimum of the measured data. If reference curves are used, the reasons for doing so and the suitability of the methods used to develop the reference curves and acceptance criteria shall be justified and documented in the record of tests (see ISTB 7).

## 4 EFFECT OF PUMP REPLACEMENT, REPAIR, AND MAINTENANCE ON REFERENCE VALUES OR REFERENCE CURVES

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

## 5 ESTABLISHMENT OF ADDITIONAL SET OF REFERENCE VALUES OR REFERENCE CURVES

If it is necessary or desirable, for some reason other than stated in section 4 above, to establish an additional set of reference values or reference curves, an inservice



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test shall be run at the conditions of an existing set of reference values, or within the range of existing reference curves, and the results analyzed. If operation is acceptable per section 7 below, 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 or reference curves. Whenever an additional set of reference values or reference curves is established, the reasons for so doing shall be justified and documented in the record of tests (see ISTB 7). The requirements of section 2 or 3 above apply.

## 6 TEST PROCEDURE

An inservice test shall be conducted with the pump operating at the specified test conditions. The test parameters shown in Table ISTB 5.2-1 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 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 or if reference curves are used, flow rate and pressure shall be determined and compared to their respective reference values or the associated reference values from the reference curves.

*(d)* Pressure, flow rate, and vibration (displacement or velocity) shall be determined and compared with corresponding reference values or associated reference values from the reference curves. All deviations from the reference values shall be compared with the limits given in Table ISTB 5.2-2 and Fig. ISTB 5.2-1, and corrective action taken as specified in section 7 below. If the reference curve test method is used, the comparison may be done graphically as shown in Examples 1 and 2 of Fig. 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.

## 7 ACCEPTANCE CRITERIA

If deviations fall within the alert range of Fig. ISTB 5.2-1 and Table ISTB 5.2-2, the frequency of testing specified in ISTB 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 ISTB 5.2-2, the pump shall be declared inoperable until the cause of the deviation has been determined and the condition corrected. If using reference curves, evaluations for deviations in the alert or required action range may be done graphically as demonstrated in Examples 1 and 2 of Fig. 1. When a test shows deviations outside of the acceptable range of Table ISTB 5.2-2, the instruments involved may be recalibrated and the test rerun.

## 8 RECORDS AND REPORTS

Use of this Code Case shall be documented in the inservice test plans per ISTB 7.2.



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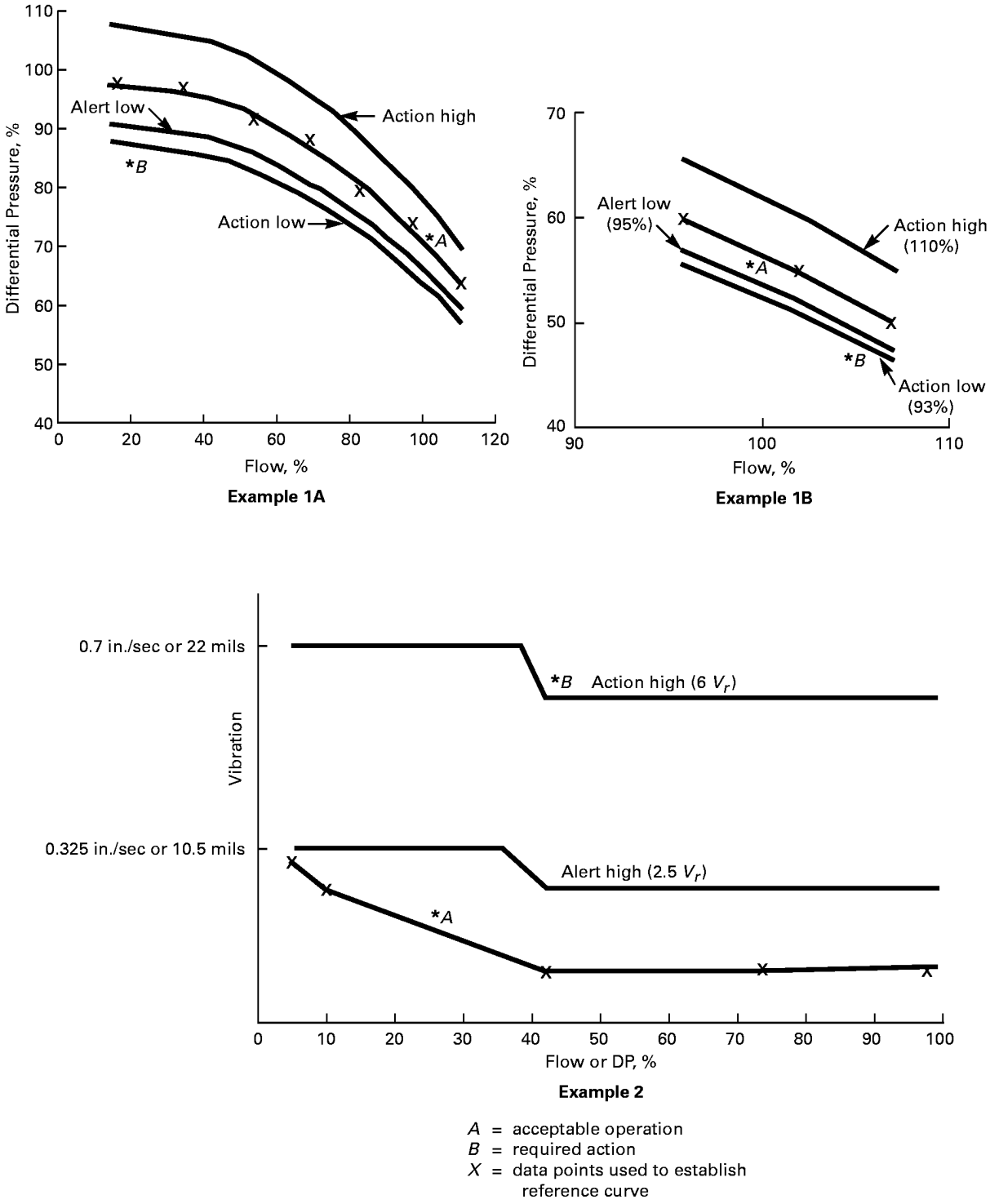


**Fig. 1 Examples of Graphical Evaluation of Tests Using Reference Curves**



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# CODE CASE OMN-10
# Requirements for Safety Significance Categorization of Snubbers Using Risk Insights and Testing Strategies for Inservice Testing of LWR Power Plants

This Case shall expire on January 26, 2006 unless previously annulled or reaffirmed.

*Inquiry:* Is it acceptable to categorize those snubbers under the scope of the ASME OM Code into two categories based on their significance for the purpose of applying different examination and testing strategies to those described in ISTD 6 and ISTD 7?

*Reply:* Yes, provided the following requirements are met.

## 1 APPLICABILITY

This Code Case establishes the safety categorization methodology and process for dividing the population of snubbers, as identified in the Owner's Snubber Program Plan, into high safety significant component (HSSC) and low safety significant component (LSSC) categories, and provides acceptable testing strategies for each category.

## 2 SUPPLEMENTAL DEFINITIONS

### 2.1 PRA Definitions

*common cause failure (CCF):* a single event that adversely affects two or more components at the same time.

*core damage frequency (CDF):* the calculated frequency (per year) that core damage will occur due to failure of a critical safety function (i.e., reactivity control, core cooling, or containment heat removal).

*Fussell-Vesely (F-V) importance:* the fractional decrease in total risk level (usually CDF) when the plant feature is assumed to be perfectly reliable (failure rate = 0.0).

*importance measure:* a mathematical expression that defines a quantity of interest. The most common importance measures are F-V and RAW.

*large early release frequency (LERF):* the calculated frequency (per year) that radioactivity release from containment is both large and early. Large means involving the rapid, unscrubbed release of airborne fission products to the environment. Early means occurring before the effective implementation of off-site emergency and protective actions.

*Level 1 PRA:* a PRA that identifies accident sequences that can lead to core damage, calculates the frequency of each sequence, and sums those frequencies to obtain CDF.

*Level 2 PRA:* a PRA that identifies accident sequences that can lead to radioactivity release, calculates the frequency of each sequence, and sums up those frequencies to obtain LERF.

*living PRA:* a plant specific PRA that is maintained up to date, such that plant modifications, plant operation changes (including procedure changes), component performance, and other technical information significantly affecting the model are reflected in the model.

*probabilistic risk assessment (PRA):* a quantitative assessment of the risk associated with plant operation and maintenance. Risk is measured in terms of the frequency of occurrence of different events, including core damage. In general, the scope of a PRA is divided into three categories: Level 1, Level 2, and Level 3. A Level 1 maps from initiating events to plant damage states, including their aggregate, core damage. Level 2 includes Level 1 mapping from initiating events to release categories (source term). Level 3 includes Level 2 and uses the source term of Level 2 to quantify consequences, the most common of which are health effects and property damage in terms of cost.

*risk achievement worth (RAW):* the increase in risk of a modeled plant feature (usually a component, train, or system) when the feature is assumed to be out of service (failed). RAW is expressed in terms of the ratio of the risk with the event failed to the baseline risk level.

### 2.2 Safety Definitions

*decision criteria:* the quantitative and qualitative factors that affect a decision. These include both quantitative screening criteria (for PRA model) and the evaluation of other qualitative (or deterministic) factors that influence the results of an application.

*Expert Panel:* a multidisciplined group of experienced plant experts who evaluate specific information, discuss this information amongst themselves (and others as appropriate), and make HSSC and LSSC determinations.

*high safety significant components (HSSCs):* components that have been designated as more important to plant safety by a blended process of PRA risk ranking and Expert Panel evaluation.

*low safety significant components (LSSCs):* components that have been designated as less important to plant



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safety by a blended process of PRA risk ranking and Expert Panel evaluation.

*technical specification:* the plant technical specifications that are a condition of the plant operating license granted to the Owner by the regulator.

### 2.3 IST Definitions

*active valve:* valve that is required to change obturator position to accomplish the required design functions.

*inservice test (IST):* a test to determine the operational readiness of a component/system (snubber).

*operational readiness:* ability of a component (snubber) to perform its intended system function when required.

*testing strategy:* the IST strategy to measure component (snubber) degradation or to monitor a component (snubber) for operational readiness at some interval by operating, examining, or testing the component (snubber).

### 2.4 Snubber Definitions

*component's snubber:* snubbers required to protect a component (e.g., pump, valve) during a dynamic event.

*equipment dynamic restraint (snubber):* a device that provides restraint to a component or system during the sudden application of forces, but allows essentially free motion during thermal movement.

*hydraulic snubbers:* devices in which the load is transmitted through a hydraulic fluid.

*mechanical snubbers:* devices in which the load is transmitted entirely through mechanical components.

*replacement snubber:* any snubber other than the snubber immediately previously installed at a given location.

*service conditions:* the operating environment for the snubber (e.g., temperature, vibration, weather) at its installed plant location, categorized as harsh or benign.

*service life:* period of time an item is expected to meet the operational readiness requirements without maintenance.

## 3 GENERAL REQUIREMENTS

### 3.1 Implementation

The requirements of this Code Case shall be implemented for all snubbers identified in the Snubber Program Plan, after the Owner has transferred the plant snubber examination and testing requirements from the plant technical specification to an Owner-controlled document and adopted the OM Code.

### 3.2 Plant Specific PRA

The plant specific PRA (Level 1 with internal initiating events, as a minimum) shall be available and used to perform system risk ranking.

### 3.3 Living PRA

The PRA shall be maintained up to date [reference (b) in section 9 below provides guidance].

### 3.4 Expert Panel

An Expert Panel shall be designated to perform the blended safety evaluation of probabilistic and deterministic engineering information for snubbers.

### 3.5 Determination of HSSC and LSSC

The Expert Panel shall evaluate each snubber and categorize it as HSSC or LSSC.

### 3.6 Inservice Testing Strategies for HSSCs and LSSCs

Testing strategies shall be implemented for HSSC snubbers and for LSSC snubbers.

### 3.7 Other Requirements

Subsection ISTD of reference (a) in section 9 below provides examination and testing requirements for snubbers. Any requirements not specifically addressed by alternative requirements in this Code Case shall stand.

## 4 SPECIFIC REQUIREMENTS FOR SAFETY CATEGORIZATION

In addition to section 3 above, the following requirements apply to snubber classification into HSSC and LSSC categories.

### 4.1 System Risk Categorization

This paragraph establishes requirements for separating systems with snubbers into high and low risk categories.

#### 4.1.1 Importance Measures

*(a)* As a minimum, two importance measures, F-V and RAW, shall be calculated for those systems modeled in the PRA.

*(b)* The impact upon CDF, and upon LERF if available, shall be determined.

**4.1.2 Screening Criteria.** For those systems modeled in the PRA, a threshold value of F-V > 0.05 (system level) or F-V > 0.005 (component or train level) based on CDF (and LERF if available) or RAW > 2 (component or train level) shall be initially considered as high risk components, trains, or systems.

#### 4.1.3 Sensitivity Studies

*(a)* The following sensitivity studies shall be performed for each system containing snubbers.

*(1)* For Level 1 PRA (CDF end state), determine system and component importance rankings (F-V and RAW) from internal and external initiating events. If



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external/seismic initiating event PRA is not available, then use alternative deterministic evaluation (i.e., seismic margins).

*(2)* If available for Level 2 PRA (LERF end state), determine system and component importance rankings as appropriate from internal and external initiating events. If Level 2 PRA is not available, then use alternative deterministic evaluation (i.e., containment bypass).

*(3)* Identify the major components and their contribution to system risk (F-V and RAW), using internal (and external if available) initiating events.

*(4)* If available for shutdown PRA (CDF end state), determine system and component importance rankings as appropriate from internal and external initiating events. If shutdown PRA is not available, then use alternative deterministic evaluation (i.e., shutdown cooling paths).

*(b)* The results of these sensitivity studies, and any others that are performed, shall be documented.

*(c)* The results and insights of these sensitivity studies shall be provided to the Expert Panel for their consideration in the final categorization of the snubbers.

**4.1.4 Qualitative Assessments.** Qualitative assessments shall be performed for all active IST components (e.g., pumps and valves) protected by snubbers, unless those snubbers are categorized as HSSC.

*(a)* The following qualitative assessments shall be performed:

*(1)* impact of initiating events (i.e., the impact of failure or degradation as it might result in an initiator)

*(2)* potential consequences of shutdown (outage) conditions

*(3)* response to external initiating events (e.g., seismic, fire, high winds/tornadoes, flooding, etc.)

*(b)* Qualitative assessments shall be performed for plant-specific design basis conditions and events not modeled in a PRA.

*(c)* Qualitative assessments shall consider the impacts upon the plant to

*(1)* prevent or mitigate accident conditions

*(2)* reach and/or maintain safe shutdown conditions

*(3)* preserve the reactor primary coolant pressure boundary integrity

*(4)* maintain containment integrity

*(d)* Qualitative assessments shall also consider

*(1)* safety function being satisfied by the component's operation

*(2)* level of redundancy existing at the plant to fulfill the component's function

*(3)* ability to recover from a failure of the component

*(4)* performance history of the component

*(5)* plant technical specifications requirements applicable to the component

*(6)* emergency operating procedure instructions that use the component(s)

*(7)* design and licensing basis information relevant to IST component function

*(e)* The cumulative impacts of combinations of component unavailability, which could impact an entire system (e.g., multitrain impacts) or critical safety function (e.g., multisystem impacts), shall also be considered.

*(f)* These qualitative assessments and the Expert Panel's disposition of them shall be documented so independent parties can review and cognizant analysts who did not take part in the original assessment can confirm the result.

*(g)* These qualitative assessments shall be available to the Expert Panel for their decision of component safety categorization.

## 4.2 Snubber Safety Categorization

This paragraph provides requirements for the Expert Panel's review and evaluation process for categorizing snubbers relative to their safety significance, using both deterministic and probabilistic insights.

**4.2.1 Expert Panel Utilization.** The Expert Panel shall blend deterministic and probabilistic information to classify snubbers into HSSC or LSSC categories using both PRA insights and deterministic insights.

*(a) PRA Insights.* The results of PRA analyses shall be used by the Expert Panel to determine the safety significance of components (e.g., pumps and valves) within HSSC systems. Information contained in PRAs relative to the role of components in mitigating or preventing core damaging events or large early radiological release events shall be considered.

*(b) Quality of PRA.* The scope of the PRA and depth of probabilistic analyses shall be assessed, evaluated, and documented. As a minimum, the following shall be documented:

*(1)* the level of plant specific PRA analysis available for assessing the applicability of PRA information relative to IST programs. For example, written documentation describing the level of plant specific PRA analysis such as Level 1 PRA (assessment of core damage frequency) and/or Level 2 PRA (assessment of core damage frequency plus containment performance).

*(2)* scope of initiating events considered (internal events, external events, both).

*(3)* typical failure modes considered (e.g., hardware failures, testing/maintenance failures, common cause failures, human errors).

*(4)* PRA scope for plant configurations (e.g., low power risk, shutdown risk, transition mode risk, at-power risk) reviewed relative to the applicability of PRA information and IST component function(s).

*(c) Deterministic Insights.* The Expert Panel shall also consider deterministic factors when assessing the safety



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significance of components within the scope of IST programs (see Appendix A for a sample list of deterministic considerations).

### 4.2.2 Expert Panel Requirements

*(a) Plant Procedure.* An approved plant procedure shall describe the process, including

*(1)* designated members and alternates

*(2)* designated chair and alternate

*(3)* quorum

*(4)* attendance records

*(5)* agendas

*(6)* motions for approval

*(7)* process for decision making

*(8)* documentation and resolution of differing opinions

*(9)* minutes

*(10)* required training

*(b) Training.* The Expert Panel shall be trained and indoctrinated in the specific requirements to be used for this Code Case. Training and indoctrination shall include the application of risk analysis methods and techniques used for this Code Case. At a minimum, the risk methods and techniques include

*(1)* PRA fundamentals (e.g., PRA technical approach, PRA assumptions and limitations, failure probability, truncation limits, uncertainty)

*(2)* use of risk importance measures

*(3)* assessment of failure modes for snubbers and components being supported by snubbers

*(4)* reliability versus availability

*(5)* risk thresholds

*(6)* expert judgment elicitation

Each of the aforementioned topics shall be covered in the indoctrination to the extent necessary to provide the Expert Panel with a level of knowledge needed to adequately evaluate and approve the scope of the snubber selections, using both probabilistic and deterministic information.

*(c) Experience.* Requirements shall be established for ensuring adequate experience levels of Expert Panel members. Member experience levels shall be documented and maintained.

*(d) Membership*

*(1)* There shall be at least five experts designated as members of the Expert Panel. Members may be experts in more than one field; however, excessive reliance on any one member's judgment shall be avoided.

*(2)* The chairperson shall be familiar with this Code Case and shall facilitate Expert Panel activities, to ensure that the requirements of this Code Case are satisfied.

*(3)* Expertise in the following functions shall be represented on the Expert Panel:

*(a)* operation

*(b)* safety analysis engineering

*(c)* probabilistic risk assessment

*(4)* Additional members of the Expert Panel should be selected who have the following plant expertise:

*(a)* systems performance

*(b)* maintenance

*(c)* licensing

*(d)* component performance

*(e)* ASME inservice examination and testing for snubbers

*(f)* ASME inservice testing for pumps and valves

*(g)* quality assurance

*(5)* Alternate members to the Expert Panel may be designated on a temporary basis; however, vacancies in the Expert Panel membership should be filled by qualified individuals within a reasonable period of time.

*(6)* Other plant or nuclear industry experts may be invited to attend some or all of the sessions of the Expert Panel as visitors to provide observations, opinions, or recommendations.

### 4.2.3 Expert Panel Decision Criteria

*(a) Level A Inclusion Criteria.* Any of the following contributors to snubber importance above stated threshold will potentially make the snubber HSSC:

*(1) Level A-1.* All snubbers protecting the following components:

*(a)* PWRs: steam generators, reactor coolant pumps

*(b)* BWRs: recirculation pumps

*(2) Level A-2.* All snubbers protecting components in systems with PRA importance ranking F-V > 0.05 or, if evaluated on a component/train level, all snubbers supporting the components in trains with PRA importance ranking F-V > 0.005 or RAW > 2.

*(b) Level B Exclusion Criteria.* The following conditions allow a snubber to potentially be classified as LSSC:

*(1) Level B-1.* All snubbers that support the component with an importance ranking F-V ≤ 0.005 and a RAW ≤ 2.

*(2) Level B-2.* All snubbers associated with unmodeled components and associated with components that would likely be unmodeled in Level 1, 2, 3, and shutdown PRAs, including both internal and external events.

**4.2.4 Reconciliation.** Decisions of the Expert Panel shall be arrived at by consensus. Differing opinions shall be documented and resolved, if possible. If a resolution cannot be achieved concerning the safety significance classification of a snubber, then the snubber shall be classified HSSC.

## 5 SPECIFIC REQUIREMENTS FOR SNUBBER SERVICE CONDITION DETERMINATION

All snubbers shall be placed in one of two service conditions, *harsh* or *benign*.



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### 5.1 Harsh

The *harsh* service condition shall be considered for those operating environments where the snubber is exposed to higher temperatures, vibration, or other service condition variables (see ISTD 8, Appendix F) that would result in a predicted service life of ≤ 10 years.

### 5.2 Benign

The *benign* service condition shall be considered for those operating environments where the snubber is exposed to lower temperatures, minimal vibration, or other service condition variables (see ISTD 8, Appendix F) that would result in a predicted service life of > 10 years.

## 6 SPECIFIC REQUIREMENTS FOR HSSC TESTING STRATEGIES

NOTE: These are alternate examination and testing strategies in lieu of ISTD 6 and ISTD 7 requirements in reference (a) in section 9 below.

### 6.1 Examination and Testing Strategies for HSSC Snubbers in Harsh Environment

*(a)* All snubbers (size, manufacturer, type) in this category shall be considered as one population for examination and testing.

*(b)* Perform visual examination per ISTD 6.

*(c)* Test per 37% or 10% plan each refueling cycle or 24 months. If a failure occurs, follow the applicable requirements of the selected plan.

*(d)* Test and/or replace all snubbers within this DTPG once every 6 years.

*(e)* The snubbers may be selected for testing on a rotational basis.

### 6.2 Examination and Testing Strategies for HSSC Snubbers in Benign Environment

*(a)* All snubbers (size, manufacturer, type) in this category shall be considered as one population for examination and testing.

*(b)* Perform visual examination per ISTD 6.

*(c)* Test per 37% or 10% plan each refueling cycle or 24 months. If a failure occurs, follow the applicable requirements of the selected plan.

*(d)* Test and/or replace all snubbers within this DTPG once every 10 years.

*(e)* The snubbers may be selected for testing on a rotational basis.

## 7 SPECIFIC REQUIREMENTS FOR LSSC TESTING STRATEGIES

NOTE: These are alternate examination and testing strategies in lieu of ISTD 6 and ISTD 7 requirements in reference (a) in section 9 below.

### 7.1 Examination and Testing Strategies for LSSC Snubbers in Harsh Environment

*(a)* All snubbers (size, manufacturer, type) in this category shall be considered as one population for examination and testing.

*(b)* Perform visual examination per ISTD 6.

*(c)* Test per 37% or 10% plan each refueling cycle or 24 months. If a failure occurs, follow the applicable requirements of the selected plan.

*(d)* Test and/or replace all snubbers within this DTPG once every 10 years.

*(e)* The snubbers may be selected for testing on a rotational basis.

### 7.2 Examination and Testing Strategies for LSSC Snubbers in Benign Environment

*(a)* Determine and monitor service life of each snubber per ISTD 8.

*(b)* Perform visual examination of all hydraulic snubbers in this category per ISTD 6.

*(c)* Perform visual examination of all mechanical snubbers in this category to satisfy visual examination requirements of ISTD 6.3 and verify freedom of motion by manual stroking, measuring incremental thermal movement, or functional testing. Perform visual examination of all mechanical snubbers once every 10 years, staggered on minimum 10% to 20% every refuel cycle or 24 months. If degradation is found, test the snubber. If the snubber fails, then verify freedom of motion or test all snubbers susceptible to the same failure mode.

## 8 RECORDS AND REPORTS

In addition to the requirements of reference (a) in section 9 below with respect to records, the following records of the Expert Panel and the component shall be maintained.

### 8.1 Expert Panel Records

*(a)* Membership and attendance

*(b)* Member expertise representation and training records

*(c)* Member experience (years of experience in each of the expertise categories)

*(d)* Meeting agendas

*(e)* Meeting minutes

*(f)* Plant procedure

### 8.2 Component Records

*(a)* Risk significance based on PRA importance measures

*(b)* Additional PRA quantitative information

*(c)* Deterministic information

*(d)* Expert Panel categorization decisions of HSSC or LSSC

*(e)* Basis for the HSSC/LSSC decision



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## 9 REFERENCES

*(a)* ASME OM Code, Subsection ISTD, Preservice and Inservice Examination and Testing of Dynamic Restraints (Snubbers) in Light-Water Reactor Power Plants, 1995 edition and later addenda

*(b)* EPRI PSA Applications Guide, TR-105396, August 1995



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# CODE CASE OMN-11
# Risk-Informed Testing for Motor-Operated Valves

This Code Case shall expire on March 3, 2006 unless previously annulled or reaffirmed.

*Inquiry:* What alternatives may be used for a risk-informed program in lieu of the testing frequency requirements of Code Case OMN-1, para. 3.3 for Inservice Testing of Motor-Operated Valves?

*Reply:* It is the opinion of the Committee that the following test frequency alternative requirements are an acceptable method of meeting the requirements of OMN-1, paras. 3.3 and 3.7 and may be applied.

## 1 SAFETY SIGNIFICANCE CATEGORIZATION

Motor-operated valves (MOVs) shall be evaluated and categorized as High Safety Significant Components (HSSCs) or Low Safety Significant Components (LSSCs), in accordance with the safety significance categorization methodology prescribed in Code Case OMN-3. The risk evaluation process may identify MOVs that were not previously included within the scope of OMN-1 but are applicable under a risk-informed program.

## 2 HSSC INSERVICE TESTING

HSSC MOVs shall be tested in accordance with OMN-1, para. 3.3, using established test frequencies and utilizing a mix of static and dynamic MOV performance testing.

## 3 LSSC INSERVICE TESTING

*(a)* LSSC grouping shall be technically justified, but need not comply with all the requirements of OMN-1, para. 3.5.

*(b)* LSSC MOVs shall be associated with an established group of other MOVs wherever possible. When a member of that group is tested, the test results shall be analyzed and evaluated in accordance with OMN-1, section 6, and applied to all LSSCs associated with that group.

*(c)* LSSC MOVs that are not able to be associated with an established group, shall be inservice tested in accordance with OMN-1, para. 3.3, using an initial test frequency of three refueling cycles or 5 years (whichever is longer) until sufficient data exist to determine a more appropriate test frequency.

*(d)* LSSC MOVs shall be inservice tested at least every 10 years in accordance with OMN-1, para. 3.3.1(c).



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# CODE CASE OMN-12
## Alternate Requirements for Inservice Testing Using Risk Insights for Pneumatically and Hydraulically Operated Valve Assemblies in Light-Water Reactor Power Plants (OM-Code 1998, Subsection ISTC) (04)

This Code Case shall expire on February 15, 2007 unless previously annulled or reaffirmed.

*Inquiry:* What alternative to the requirements of ISTC-5130 and ISTC-5140 may be used for risk-informed inservice testing of pneumatically and hydraulically operated valve assemblies?

*Reply:* It is the opinion of the Committee that the following alternative requirements may be used in lieu of ISTC-5130 and ISTC-5140 for risk-informed inservice testing of pneumatically and hydraulically operated valve assemblies.

## 1 INTRODUCTION

This Code Case establishes alternative requirements for implementing and maintaining a risk-informed inservice testing program for active pneumatically and hydraulically operated valve assemblies in light-water reactor power plants.

## 2 TERMS AND DEFINITIONS

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

*baseline data:* one or more values of test parameters measured or determined when the equipment is known to be operating acceptably at conditions including design basis conditions.

*baseline test:* a performance test to establish baseline data.

*bench set:* calibration of the actuator spring range to account for the in-service process forces.

*critical parameters:* one or more specific parameters that must be met for a valve assembly to meet its design function.

*design basis conditions:* conditions associated with design basis events, as specified in the final safety analysis report or design basis document(s).

*dynamic test:* a test conducted with system pressure and/or flow.

*hydraulic actuator:* a device that provides energy to open, close, or position a valve via hydraulic pressure.

*hydraulically operated valve assembly (or valve assembly):* a valve and its associated hydraulic actuator, including all subcomponents required for the valve assembly to perform its intended safety function.

*maximum available pneumatic pressure:* the maximum pressure available to the actuator.

*performance test:* a test to determine whether a system, structure, or component meets specified acceptance criteria.

*periodic valve assembly exercising:* periodic stroking of the valve assembly to ensure that the valve assembly is not binding and the valve actuator is functional.

*pneumatic actuator:* a device that provides energy to open, close, or position a valve via pneumatic pressure.

*pneumatically operated valve assembly (or valve assembly):* a valve and its associated pneumatic actuator, including all subcomponents required for the valve assembly to perform its intended safety function(s).

*seat load:* the total net contact force between the obturator and the seat under static conditions.

*set points:* a point or set of points that are set so that a valve assembly would meet its design function. Examples of set point would be bench set values, or pressure regulator values.

*setup:* the establishment and adjustment (i.e., bench set, seat load, regulator set point) of valve subcomponents so that a valve will perform its function(s).

*spring rate:* the force change per unit change in length, usually expressed as pounds per inch (lb/in.) or Newtons per millimeter (N/mm).

*total friction:* the sum of packing friction, valve internal friction and actuator friction.

*valve assembly group:* a collection of valve assemblies having similar design characteristics, applications, and service conditions so that test results, design evaluations, and operating experiences from one member may be applied to other members of the group.

## 3 PREREQUISITES

### 3.1 Classification

Valve assemblies shall be classified as either high safety significant or low safety significant in accordance with Code Case OMN-3.



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### 3.2 Grouping of Valve Assemblies

Grouping of valve assemblies is permissible. Valve assemblies with identical or similar designs and with similar plant service conditions may be grouped together. The following shall be performed if grouping of valve assemblies is used:

*(a)* grouping valve assemblies shall be justified by a documented engineering evaluation.

*(b)* the functionality of all valve assembly groups shall be validated by the appropriate inservice testing of one or more representative valve assemblies.

*(c)* test results shall be evaluated and justified for all valve assemblies in a group.

*(d)* a single representative valve assembly shall not be selected for inservice testing consecutively. All testable valve assemblies in a group shall be inservice tested before a previously tested representative valve assembly can be selected. In addition to this requirement, the owner may elect to consecutively test a certain valve assembly to monitor changes in its functional margin over time.

*(e)* the number of valve assemblies tested from each group shall be determined using appropriate statistical methodology.

*(f)* test results for the representative valve assembly shall be analyzed and evaluated for each valve assembly in the group.

### 3.3 Testing Basis

An analysis of the test, maintenance, and operating history of a valve assembly, or valve assembly group, shall be performed and documented in order to establish the basis for specifying testing requirements and frequency.

## 4 HIGH SAFETY SIGNIFICANT VALVE ASSEMBLIES

The purpose of the combination of testing and/or analysis is to ensure the capability of the valve assembly to perform its intended safety function. Testing of valve assemblies classified as high safety significant shall meet the requirements of paras. 4.1 through 4.5.

### 4.1 Design Verification

**4.1.1** The design basis capability for existing valve assemblies shall be verified prior to implementing this Code Case for those valve assemblies.

**4.1.2** The design basis capability for new valve assemblies shall be verified prior to initially being placed in service.

**4.1.3** A baseline test in combination with at least one of the following shall be performed to demonstrate design basis capability of the valve assembly:

*(a)* dynamic test at design basis conditions

*(b)* correlation with a similar valve assembly that has been dynamically tested at similar or bounding conditions

*(c)* extrapolation of results of dynamic tests at highest practicable test conditions

*(d)* calculation methods

### 4.2 Inservice Test Requirements

#### 4.2.1 Baseline Test Requirements

**4.2.1.1** Valve assemblies shall have a baseline test to establish reference values for comparison to subsequent periodic performance test data.

**4.2.1.2** The preservice test results may be used as the baseline test, provided the test conditions in para. 4.3.1 are satisfied. Testing in accordance with ISTC-3100 may be used as the baseline test.

#### 4.2.2 Periodic Test Requirements

**4.2.2.1** Periodic test frequency shall be determined based on analysis of data. Data analysis shall be in accordance with para. 4.4.

**4.2.2.2** If insufficient data exist to determine the inservice test frequency in accordance with para. 4.4, the valve assembly inservice testing shall be conducted every two refueling cycles or 3 years (whichever is longer) until sufficient data exist to determine a more appropriate test frequency.

**4.2.2.3** The maximum interval between inservice tests shall not exceed 10 years.

**4.2.2.4** Periodic test methods shall be in accordance with para. 4.3.

#### 4.2.3 Periodic Valve Assembly Exercising

**4.2.3.1** Once during each fuel cycle of operation, each valve assembly subject to this Code Case shall be operated to move the obturator through one full stroke (open and close). If a valve assembly experiences a full stroke during the fuel cycle of operation, and the Owner elects to document such operation, no additional valve operation is required to satisfy this requirement.

**4.2.3.2** More frequent exercise requirements for valve assemblies with higher risk significance, adverse or harsh environmental conditions, or with abnormal performance history shall be considered. Alternatively, longer exercise intervals may be used if justified by successful operating experience.

**4.2.3.3** Paragraph 4.2.3 does not limit the plant operating mode under which periodic valve assembly exercising may be performed.

### 4.3 Test Methods

The following test methods shall be applied to valve assemblies determined to be subject to this Code Case.



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The Owner is responsible for establishing conformance with the test methods, including off-site testing.

**4.3.1 Test Conditions.** Tests shall be performed without any changes, modifications, or adjustments to the valve assembly during testing. Test conditions that apply to valve assemblies based on the selection of the test parameters in accordance with para. 4.3.3 shall be determined. The baseline test shall be performed at specific repeatable conditions. The periodic performance tests shall be performed at the conditions used to establish baseline values.

**4.3.2 Test Procedures.** Procedures shall be established, as appropriate, to provide for the following:

*(a)* methodical, repeatable, and consistent performance testing

*(b)* valid test data that are not influenced by any preconditioning associated with performance testing procedural steps

*(c)* data that reflects, or can be correlated with, the design basis conditions

*(d)* adequate data for analysis and evaluation per para. 4.4

### 4.3.3 Test Parameters

**4.3.3.1** Test parameters shall be monitored to ensure that the valve assembly performs its intended safety function(s). The safety function(s) may include one or more of the following:

*(a)* open within a specified minimum or maximum time period, or both

*(b)* close within a specified minimum or maximum time period, or both

*(c)* stroke open to obtain specified flow or pressure

*(d)* stroke open or closed against flow or pressure, including maximum differential pressure for the valve assembly to fulfill its safety function, across the valve

*(e)* travel to a predetermined intermediate position

*(f)* remain in operating position for specified period of time

*(g)* operate a specified number of cycles

**4.3.3.2** Determine which of the following parameters, or combination of parameters, which may be determined from data obtained during testing, are important to monitor to ensure the safety function(s) capability of the valve assembly:

*(a)* bench set

*(b)* seat load

*(c)* spring rate

*(d)* full-stroke time

*(e)* actual travel

*(f)* total friction

*(g)* maximum available pneumatic pressure

*(h)* minimum pneumatic pressure required to accomplish the safety function(s) of the valve assembly

*(i)* hydraulic pressure at an appropriate point in operation

*(j)* pneumatic and hydraulic fluid condition and cleanliness

*(k)* set point of pressure switch, relief valve, regulator, etc.

*(l)* torque

*(m)* others as applicable

**4.3.4 Test Information.** Test information shall be recorded in accordance with ISTC-9000. In addition, the following information shall be recorded:

*(a)* test conditions per para. 4.3.1, including system fluid and ambient conditions

*(b)* remarks concerning abnormal or erratic action, either during or preceding performance testing

*(c)* date of test

*(d)* valve assembly identification

*(e)* nameplate data

*(f)* test equipment identification and date of calibration

*(g)* parameters measured in accordance with para. 4.3.3.2

*(h)* name of tester

## 4.4 Analysis and Evaluation of Data

The following analysis and evaluation of data shall be applied to valve assemblies determined to be subject to this Code Case.

**4.4.1 Acceptance Criteria.** Acceptance criteria shall be established by which test data shall be analyzed. The criteria shall specify the acceptable limits or range of test parameters based on design criteria necessary for the valve assembly to perform its intended safety function(s) until the next test.

**4.4.2 Analysis of Data.** Data obtained from a test performed under this Code Case shall be analyzed to determine acceptable valve assembly performance.

Performance test data shall be compared to parameter limits or ranges established in accordance with para. 4.4.1. Test history (such as degradation) shall be considered on a particular valve assembly. Performance test data trends (including allowance for uncertainties) shall be established to predict when data points may approach the parameter limits. If a datum being compared falls within the acceptable range of established parameters, the valve assembly may be considered acceptable. If the test data is unacceptable, corrective actions shall be taken in accordance with para. 4.5.

### 4.4.3 Evaluation of Data

**4.4.3.1** Criteria for data evaluation shall be established that ensures

*(a)* the valve assembly meets its established acceptance criteria



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(b) corrective action is taken as described in para. 4.5 if a valve assembly does not meet its established acceptance criteria

(c) validation of the test frequency

**4.4.3.2** Where grouping is used, the results of data evaluation shall be applied to all valve assemblies in the group.

**4.4.4 Documentation of Analysis and Evaluation of Data.** Results of test data evaluation and analysis shall be documented. Documentation shall include:

(a) assumptions made

(b) values of test parameters and test information established in accordance with paras. 4.3.4 and 4.4.1

(c) a statement that test data are within acceptable limits or that corrective actions have been initiated and that independent verification of the test data evaluation and analysis has been completed

(d) a summary of data analysis and evaluation in accordance with paras. 4.4.2 and 4.4.3

### 4.5 Corrective Action

If the monitored parameters are outside acceptable limits, then corrective action shall be initiated. If acceptance criteria (established in para. 4.4.1) limiting values are exceeded, the valve shall immediately be declared inoperable. Valve assemblies declared inoperable may be repaired or replaced, or the data may be analyzed to determine the cause of the deviation and to show the valve assembly to be operating acceptably.

The corrective action shall bring the valve assembly back into compliance with the acceptance criteria. When the corrective action consists of evaluating the acceptability of the valve assembly at the degraded conditions, new baseline data and acceptance criteria shall be established. The valve assembly shall be retested in accordance with para. 4.3 following the corrective action and prior to return to service. The cause of the failure or degradation shall be evaluated for identification of corrective actions to prevent recurrence in similar components or grouped valve assemblies. Documentation of corrective actions shall include

(a) valve assembly identification

(b) summary of corrective action and results

(c) subsequent test data or analysis, including analysis for valve assembly operability

(d) identification of the cause of the anomaly and technical justification for corrective action taken

(e) description of actions taken to restore operational readiness of the valve assembly

## 5 LOW SAFETY SIGNIFICANT VALVE ASSEMBLIES

The purpose of this section is to provide a high degree of confidence that the LSSC valve assemblies will perform their intended safety function if called upon. Valve assemblies classified as LSSC shall meet the requirements of paras. 5.1 through 5.6.

### 5.1 Set Points and/or Critical Parameters

**5.1.1** Set points and/or critical parameters for existing valve assemblies shall be established prior to implementing this Code Case for those valve assemblies.

**5.1.2** Set points and/or critical parameters for new valve assemblies shall be established prior to initially being placed in service.

**5.1.3** Establishment of set points and/or critical parameters should consider the following:

(a) walk down of the valve assembly to establish that the installed assembly agrees with the plant's information or database

(b) original manufacturer's set points

(c) changes to the original plant system design parameters or the operation of the valve assembly

(d) industry experience

(e) maximum expected packing and other valve assembly friction

(f) manufacturer's or industry calculations may be used to establish set points and/or critical parameters

**5.1.4** All information and methods used to establish the set points and/or critical parameters shall be documented.

### 5.2 Evaluation Requirements

Procedures shall be established, as appropriate, and should consider the following:

(a) consistent and verifiable evaluation of the valve assembly

(b) application of diagnostic test equipment

(c) documentation of parameters necessary to evaluate the valve assembly's ability to perform its intended safety function(s)

(d) system or plant conditions, at which the valve assembly is tested, shall be evaluated

(e) which of the parameters, or combination of parameters, listed in para. 4.3.3.2 are important to monitor to provide a high degree of confidence in the capability of the valve assembly to perform its safety function

### 5.3 Periodic Evaluation

**5.3.1 Periodic Evaluation Frequency.** Periodic evaluation frequency shall be established based on the requirements of paras. 5.3.1.1 through 5.3.1.3.

**5.3.1.1** No valve assembly shall exceed 10 years between evaluations.

**5.3.1.2** The initial evaluation period shall be established based on one or more of the following:

(a) plant-specific maintenance and operating history

(b) evaluation of nonmetallic materials required for safety function(s) of the valve assembly



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(c) manufacturer's recommendations

(d) if a subcomponent has no effect on the setup of the valve's safety function, it need not be considered in the evaluation period of the overall valve assembly

**5.3.1.3** All information and methods used to establish the evaluation period shall be documented.

### 5.3.2 Extending or Decreasing Periodic Evaluation Periods

**5.3.2.1** The initial evaluation period and subsequent periods may be extended 1 year or one refueling cycle at a time if the evaluation of valve assembly test data has determined that there is no unacceptable degradation of components in the valve assembly.

**5.3.2.2** The periodic evaluation period shall be decreased if it is determined that a component failure was due to degradation during the existing evaluation period.

**5.3.3 Group Evaluation Period.** Where grouping of valve assemblies is used, all valves in a group shall be assigned the same periodic evaluation period.

## 5.4 Evaluations

### 5.4.1 Initial or As-Left Evaluation

**5.4.1.1** The initial or as-left evaluation shall be performed after the valve assembly is initially put in service, postmaintenance, or refurbished and has been set up per the established criteria. The purpose of this evaluation is to:

(a) validate the assumptions used to establish the valve assembly's set-up criteria used in para. 5.1

(b) confirm the integrity and operation of all the valve assembly's subcomponents

**5.4.1.2** If a valve assembly's evaluation does not meet the parameters established in para. 5.1, corrective action shall be initiated.

**5.4.2 As-Found Evaluation.** Maintenance and operational activities shall be conducted in order to prevent or minimize preconditioning of the valve assembly prior to as-found evaluation.

**5.4.2.1** An as-found evaluation shall be performed to

(a) validate any assumptions used in para. 5.1

(b) confirm the integrity of the valve assembly's subcomponents

**5.4.2.2** As-found evaluations shall be performed on a valve assembly prior to any refurbishment at the end of a periodic evaluation period.

**5.4.2.3** If a valve assembly's evaluation does not meet the parameters established in para. 5.1, corrective action shall be initiated.

## 5.5 Periodic Valve Assembly Exercising

**5.5.1** Once during each fuel cycle of operation, each valve assembly subject to this Code Case shall be operated to move the obturator through one full stroke (open and close).

**5.5.2** If a valve assembly experiences a full stroke during the plant's cycle of operation and the Owner elects to document such operation, no additional operation is required for the cycle.

**5.5.3** Paragraph 5.3 does not limit the plant's operating mode under which periodic valve assembly exercising may be performed.

## 5.6 Corrective Action

**5.6.1** If the parameters monitored and evaluated do not meet the established criteria, then corrective action shall be initiated.

**5.6.2** If a valve assembly being evaluated for corrective action is part of a group of valve assemblies, the group must also be evaluated for corrective action.



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# CODE CASE OMN-13

(04) **Requirements for Extending Snubber Inservice Visual Examination Interval at LWR Power Plants**

This Code Case shall expire on February 12, 2007 unless previously annulled or reaffirmed.

*Inquiry:* With the low rate of problem identification through the visual examination process, can the visual examination interval allowed in Table ISTD 6.5.2-1 of the OM Code, Subsection ISTD, 1995 Edition 1996 Addenda be extended?

*Reply:* Yes, provided that the following additional service life monitoring requirements are met.

*Applicability:* ASME OM Code 1995 Edition with 1996 Addenda and later editions and addenda.

## 1 APPLICABILITY

This Code Case establishes specific requirements that must be met in order to allow extension of the visual examination interval beyond the maximum interval allowed in Table ISTD 6.5.2-1 for mechanical and hydraulic snubbers. Paragraphs referenced in this Code Case denote the 1995 Edition and 1996 Addenda. A correlation Table 1 is provided for 1998 Edition.

## 2 GENERAL REQUIREMENTS

The following requirements shall be implemented in order to extend the visual examination interval beyond the maximum interval allowed in Table ISTD 6.5.2-1.

*(a)* These requirements are in addition to the service life monitoring requirements in ISTD 8.

*(b)* The requirements of this Code Case shall be implemented after the requirements of ISTD 6.5.1, ISTD 6.5.2(a), ISTD 6.5.2(b), and ISTD 6.5.2(c) have been satisfied and the previous examination per Table ISTD 6.5.2-1 was performed at a maximum interval of two fuel cycles.

*(c)* Demonstrate that the requirements of paras. 3.1, 3.2, 3.3, 3.4, 3.5, and 3.6 of this Code Case have been met for one interval prior to extending the examination interval.

### 2.1 Service Life Evaluations

The data and information gathered under this Code Case shall be utilized to reevaluate service life as described in ISTD 8.

### 2.2 Testing for This Code Case

Snubbers tested specifically for this Code Case shall be dispositioned per ISTD 8.5.

**Correlation Table**

| 1995 Edition and 1996 Addenda | 1998 Edition |
|---|---|
| ISTD 1.13 | ISTD-1750 |
| ISTD 6 | ISTD-4200 |
| ISTD 6.1, 6.2, 6.3, 6.4 | ISTD-4210, 4220, 4230, 4240 |
| IST 6.5.1 | ISTD-4251 |
| ISTD 6.5.2(a) | ISTD-4252(a) |
| ISTD 6.5.2(b) | ISTD-4252(b) |
| ISTD 6.5.2(c) | ISTD-4252(c) |
| ISTD 8 | ISTD-6000 |
| ISTD 8.5 | ISTD-6500 |
| Table ISTD 6.5.2-1 | Table ISTD-4252-1 |

## 3 SPECIFIC REQUIREMENTS

### 3.1 Examination for Indications of Degradation or Severe Operating Environments

Examinations per ISTD 6.1, ISTD 6.2, ISTD 6.3, and ISTD 6.4 shall include examination for indications of degradation and severe operating environments.

### 3.2 Examination Prior to Maintenance or Testing

All snubbers shall be examined in accordance with the requirements of ISTD 6.1, ISTD 6.2, ISTD 6.3, and ISTD 6.4 and para. 3.1 of this Code Case prior to conducting any maintenance, stroking, or testing, and prior to removal, for any reason, from their installed location.

### 3.3 Monitoring of Reservoir Fluid Level

Fluid level in hydraulic snubber reservoirs shall be sufficient to ensure that the snubber is acceptable for continued service to the next examination interval.

### 3.4 Review of Operational Readiness Test Data

All inservice test data acquired since implementation of the requirements of this Code Case shall be evaluated for indications of snubber degradation or other anomalies. This includes a review of test traces, where available. The results of this evaluation shall be used

*(a)* to identify snubbers that are subject to progressive degradation

*(b)* to identify severe operating environments not previously identified



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Where applicable, data gathered prior to implementation of this Code Case shall also be evaluated.

### 3.5 Examination During Disassembly

Snubbers and snubber parts shall be examined for indications of degradation and severe operating environments during disassembly (e.g., during failure evaluation, refurbishment).

### 3.6 Transient Dynamic Event

The service life evaluation required by para. 2.1 of this Code Case shall include any transient dynamic event and actions taken under ISTD 1.13.

### 3.7 Frequency of Examinations

All snubbers within the scope of ISTD shall be examined and evaluated per ISTD 6.1, ISTD 6.3, and ISTD 6.4 at least once every 10 years.



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## CODE CASE OMN-14
## Alternative Rules for Valve Testing Operations and Maintenance, Appendix I: BWR CRD Rupture Disk Exclusion

This Case shall expire on February 10, 2006 unless previously annulled or reaffirmed.

*Inquiry:* What alternative to the requirements of the OM Code Appendix I, I-1.3.4 and I-1.3.6 may be used for rupture disks located in the Scram Accumulators of BWRs?

*Reply:* It is the opinion of the Committee that in lieu of the requirements of the OM Code Appendix I, I-1.3.4 and I-1.3.6 for rupture disks in the Scram Accumulators of BWRs, testing and replacement may be performed in accordance with the Owner's inspection procedures.

*Applicability:* ASME OMc Code-1994 through ASME OMb Code-1997.



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# CODE CASE OMN-15
# Requirements for Extending the Snubber Operational Readiness Testing Interval at LWR Power Plants

(04)

This Case shall expire on February 9, 2007 unless previously annulled or reaffirmed.

*Inquiry:* What alternative rules may be used in place of those specified in ISTD 7 and ISTD 7.4 of the 1995 edition and ISTD-5200 and ISTD-5240 of the 1998 and later editions of the ASME OM Code, which require operational readiness testing during each fuel cycle?

*Reply:* It is the opinion of the Committee that the test interval requiring operational testing during each fuel cycle specified in ISTD 7 and ISTD 7.4 of the 1995 edition and ISTD-5200 and ISTD-5240 of the 1998 and later editions of the ASME OM Code may be extended to two or more fuel cycles based on previous satisfactory operational readiness testing, provided that the following requirements are met.

## 1 APPLICABILITY

This Code Case establishes requirements for extending the test interval specified in ISTD 7 and ISTD 7.4 of the 1995 edition of the ASME OM Code and ISTD-5200 and ISTD-5240 of the 1998 and later editions and addenda of the ASME OM Code.

## 2 DEFINITIONS

*extended test interval:* interval greater than one fuel cycle.

*successful campaign:* campaign completed without having to test the entire population.

*test campaign:* the series of actions required to complete the test plan requirements defined in ISTD 7 or ISTD-5200, as applicable.

## 3 GENERAL REQUIREMENTS AND LIMITATIONS

This Code Case may be used for one or more DTPG (Defined Test Plan Group) during a given test campaign.

This Code Case may not be used for DTPGs defined in ISTD 7.5.3, 1995 edition of the ASME OM Code and ISTD-5253 of the 1998 and later editions.

The test interval may be extended by a maximum of one fuel cycle beyond the previous interval.

The maximum allowable test interval shall be three fuel cycles plus 60 days.

## 4 SPECIFIC REQUIREMENTS

For the test campaign immediately preceding an extended test interval, the initial sample size shall be as indicated in Table 1, Column A (rounded up to the next integer) in lieu of the initial sample size listed in ISTD 7.9.1, ISTD 7.12.1, ISTD-5311, or ISTD-5411, as applicable. Testing shall satisfy the applicable mathematical expression listed in Table 1, Column B in lieu of equations listed in ISTD 7.11.1, ISTD 7.14.1, ISTD-5331, or ISTD-5431, as applicable.

### 4.1 Additional Specific Requirements for Implementing a Two Fuel Cycle Test Interval

Prior to implementing a two fuel cycle test interval, three successive test campaigns shall be successfully completed for the applicable DTPG. These shall include the campaign conducted at the end of the fuel cycle immediately preceding the two cycle test interval.

### 4.2 Additional Specific Requirements for Implementing a Three Fuel Cycle Interval

Prior to implementing a three fuel cycle test interval, the following requirements shall be met:

*(a)* The test interval immediately preceding the three fuel cycle test interval shall be a two fuel cycle test interval.

*(b)* The four test campaigns immediately preceding the three fuel cycle test interval shall have been completed successfully.



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**Table 1 Test Plan Required for Test Campaign Immediately Preceding Extended Interval**

| Test Plan [Note (1)] | DTPG Size, $n$ | Column A Initial Sample Size [Note (2)] | Column B Mathematical Expression to Be Satisfied |
|---|---|---|---|
| 1 | $n \geq 370$ | 52 | $N \geq 51.09 + 18.18C$ |
| 2 | $369 \geq n \geq 300$ | $0.13n$ | $N \geq 0.13n + C(0.1n)$ |
| 3 | $299 \geq n \geq 250$ | $0.14n$ | $N \geq 0.14n + C(0.1n)$ |
| 4 | $249 \geq n \geq 200$ | $0.15n$ | $N \geq 0.15n + C(0.1n)$ |
| 5 | $199 \geq n \geq 150$ | $0.18n$ | $N \geq 0.18n + C(0.1n)$ |
| 6 | $149 \geq n \geq 100$ | $0.125n$ | $N \geq 0.125n + C(0.125n)$ |
| 7 | $n < 100$ | 13 | $N \geq 12.5 + 12.5C$ |

GENERAL NOTES:

(a) Definition of Terms:
$N$ = total number of snubbers tested that were selected from the DTPG
$n$ = number of snubbers in the DTPG
$C$ = total number of unacceptable snubbers found in the DTPG

(b) The requirements specified in Table 1 need only apply to the test campaign immediately preceding an extended test interval. For other campaigns, the requirements of Table 1 or the requirements of ISTD-5331(a) or ISTD-5341(a) shall be met.

NOTES:

(1) Alternatively, Test Plan 1 may be used for DTPG sizes less than 370 snubbers.

(2) Fractional sample values shall be rounded up to the next integer.



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# APPENDIX A
# Example Scenarios

This nonmandatory Appendix provides examples of various scenarios where the snubber inservice test (IST) interval specified in the ASME OM Code may or may not be extended. While it is related to Code Case OMN-15, it is not part of that Code Case. Definitions of terms not defined in this Appendix are included in Code Case OMN-15 or in the editions/addenda of the ASME OM Code to which it applies.

NOTE: Test plan numbers referred to in this Appendix are defined in Table 1 of OMN-15.

## A-1 SCENARIO 1

DTPG 3 at Plant X has a total of 298 snubbers. A successful test campaign was completed during RFO 5 using the 10% Plan. A successful test campaign was completed during RFO 6 using the 37 Snubber Plan. What is required in order to bypass a test campaign at RFO 8?

*Response:* Completion of a successful test campaign at RFO 7 using either Test Plan 1 or Test Plan 3.

## A-2 SCENARIO 2

Following Scenario 1 for DTPG 3 at Plant X, a test campaign was bypassed at RFO 8. What is required in order to bypass a test campaign at RFO 10 and RFO 11?

*Response:* Completion of a successful test campaign at RFO 9 using either Test Plan 1 or Test Plan 3.

## A-3 SCENARIO 3

DTPG 3 at Plant X has a total of 298 snubbers. Successful test campaigns were completed during RFO 5, 6, 7, and 8. A successful test campaign was completed during RFO 9 using Test Plan 1. Is a test campaign required at RFO 10?

*Response:* No.

Is a test campaign required at RFO 11?

*Response:* Yes. The test interval may be extended by a maximum of one fuel cycle beyond the previous interval.



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