**Code Case OMN-12**


*Inquiry:* What alternative to the requirements of paras. ISTC-5130 and ISTC-5140 may be used for risk-informed in-service 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 paras. ISTC-5130 and ISTC-5140 for risk-informed in-service testing of pneumatically and hydraulically operated valve assemblies.

*Applicability:* See Applicability Index

1 **INTRODUCTION**

This Code Case establishes alternative requirements for implementing and maintaining a risk-informed in-service 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.

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 sub-
sequent 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 deter-
mined 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 yr (whichever is longer)
until sufficient data exist to determine a more appro-
priate test frequency.

4.2.2.3 The maximum interval between inservice
tests shall not exceed 10 yr.

4.2.2.4 Periodic test methods shall be in accor-
dance 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 suc-
cessful 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.
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 section 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
(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 4.1
   (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. 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 yr 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
   (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 yr 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.