7.2 ASME 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

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 the OM Code-1995 Subsection ISTC, except for ISTC 4.3, 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.

Note: the terms "shall consider" and "shall be condisedered" 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 bewst 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 shutdown 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.

(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 (which ever 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 10 or more MOVs, at least 2 representative MOVs shall be tested; and

(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 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; or
(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; and
(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; and
(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; and
(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.

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 acceptance 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 7-3 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.

1**Figure 7-3 MOV Functional Margin Determination Flow Chart**

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) minimum voltage conditions;
c) elevated ambient temperature conditions;
d) operator efficiency; and
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 data. Considerations shall include:

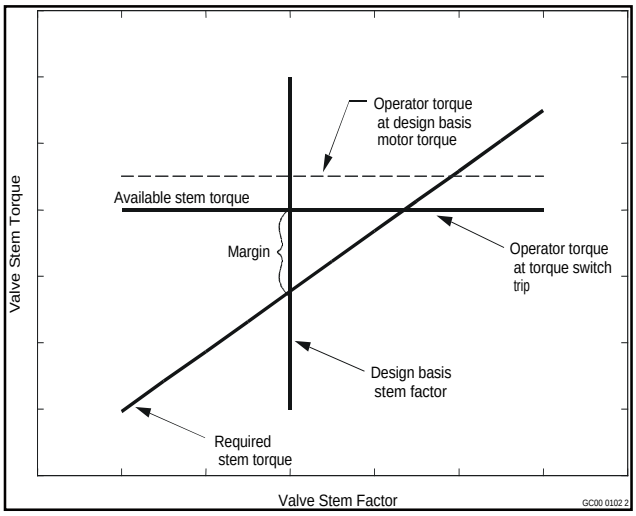
a) calibration of the torque switch spring pack;
b) the current torque switch setting; and
c) repeatability of torque switch operation.

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 7-4 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; and



1**Figure 7-4 Determining Functional Margin for Rising Stem MOV's**

(b) the stem torque based on the current torque switch setting.

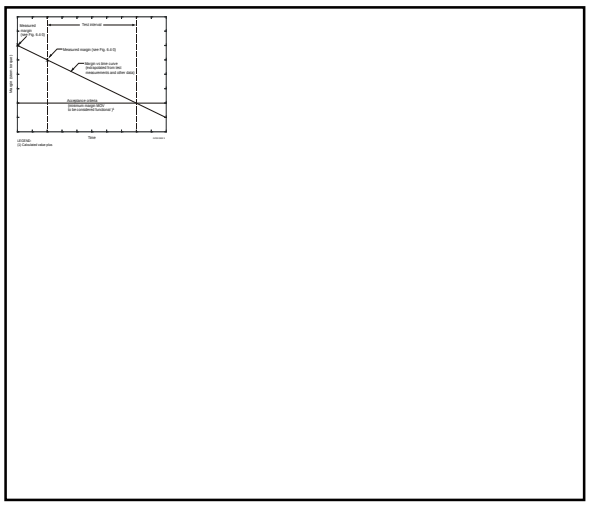
When calculating MOV functional margin, the available stem torque is the lesser of the two.

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

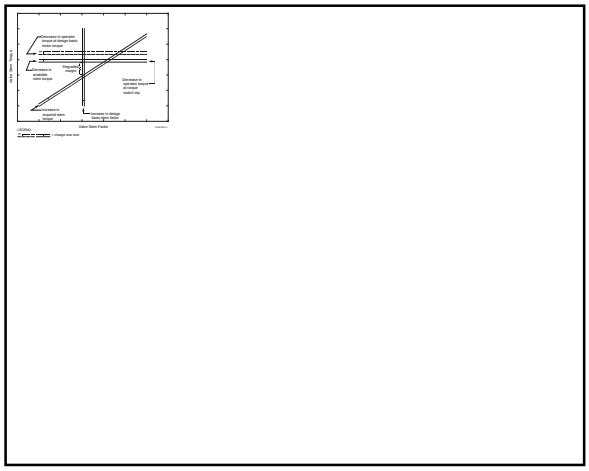
Calculations for determining MOV functional margin shall also be evaluated to account for anticipated time-related changes



3**Figure 7-5 Decrease in Functional Margin over Time**

in performance. Figure 7-5 provides an example of how the measured functional margin might change over time. Figure 7-6 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.



4**Figure 7-6 Functional Margin Test Interval Determination**

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;

(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; and

(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; and

(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.

7.2.1 OMNI-11CODE CASE

OMN-11 Code Case - - Risk Informed MOV Testing Alternatives

Inquiry: What alternatives may be used for a risk-informed program in lieu of the testing frequency requirements of Code Case OMN-1, Paragraph 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, Section 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

   a. HSSC MOVs shall be tested in accordance with OMN-1, Paragraph 3.3, using established test frequencies and utilizing a mix of static and dynamic MOV performance testing.

3. LSSC In-service Testing

   a. LSSC grouping shall be technically justified, but need not comply with all the requirements of OMN-1, Section 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, Paragraph 6, and applied to all LSSCs associated with that group.
   c. LSSC MOVs that are not associated with a group, shall be inservice tested in accordance with OMN-1, Paragraph 3.3, using an initial test frequency of 3 refueling cycles or 5 years (whichever is longer) until sufficient data exist to determine a more appropriate test frequency.
   d. LSSC MOV shall in service tested at least every 10 years in accordance with OMN-1, Paragraph 3.3.1(c)