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United States Nuclear Regulatory Commission
Protecting People and the Environment

NUREG-1482
Revision 4

Guidelines for Inservice Testing at Nuclear Power Plants

Inservice Testing of Pumps and Valves and Inservice Examination and Testing of Dynamic Restraints (Snubbers) at Nuclear Power Plants

Final Report

Office of Nuclear Reactor Regulation

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Inservice Testing of Pumps and Valves and Inservice Examination and Testing of Dynamic Restraints (Snubbers) at Nuclear Power Plants

Final Report

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ABSTRACT

The staff of the U.S. Nuclear Regulatory Commission (NRC, the Commission) is issuing Revision 4 to NUREG-1482, "Guidelines for Inservice Testing at Nuclear Power Plants," to assist the nuclear industry in establishing a basic understanding of the regulatory basis for pump and valve inservice testing (IST) programs and dynamic restraint (snubbers) examination and testing programs at nuclear power plants. This NUREG also provides information about the NRC's involvement in the development of the American Society of Mechanical Engineers (ASME) "Operation and Maintenance of Nuclear Power Plants," Division 1, "OM Code: Section IST" (OM Code). This NUREG discusses OM Code inquiries; the inservice examination and testing of snubbers, pump and valve IST; the use of ASME Code Cases; conditions on the use of the OM Code; guidance for OM Code noncompliance; requests for alternatives to and relief from the OM Code at operating commercial nuclear power plants; and the development of IST programs for new reactors.[1]

This NUREG replaces Revision 0, Revision 1, Revision 2, and Revision 3 to NUREG-1482 and is applicable, unless stated otherwise, to editions and addenda (up to and including the 2022 Edition) to the OM Code that are incorporated by reference in Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a, "Codes and standards." In addition, the NRC staff discusses other IST program topics such as the NRC process for the review of the OM Code, conditions on the use of the OM Code, interpretations of the OM Code, and development of IST programs for new reactors. This NUREG provides guidance included in Revision 3 to NUREG-1482 that has been updated to reflect IST lessons learned and operating experience since the NUREG was previously issued.

All subsections and paragraphs referred to in this revision of NUREG-1482 are from the 2022 Edition of the OM Code as incorporated by reference in 10 CFR 50.55a, unless otherwise noted. Appendix A contains guidance related to inservice examination and testing of snubbers. Appendix B responds to public comments related to the Commission direction in the NRC *Federal Register* notice for the treatment of pumps, valves, and dynamic restraints during implementation of 10 CFR 50.69, "Risk-informed categorization and treatment of structures, systems and components for nuclear power reactors." Appendix C contains guidance related to the "code of record" interval.

This revision to NUREG-1482 focuses on the 2022 Edition of the OM Code and does not attempt to address every provision in the editions and addenda of the OM Code before the 2022 Edition. In some cases where an IST provision does not appear in the 2022 Edition of the OM Code, this revision to NUREG-1482 might not discuss that provision. Prior revisions to NUREG-1482 might discuss IST provisions that have been removed from the OM Code as new editions and addenda have been prepared by ASME. For example, Revision 3 of NUREG-1482 is based on the 2017 Edition of the OM Code and may be referenced for specific code language from that edition.

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[1] "New reactor" (referred to as a post-2000 plant in the OM Code) is defined in NUREG-1482 as a nuclear power reactor that was issued (or will be issued) its construction permit or combined license for construction and operation by the applicable regulatory authority on or following January 1, 2000.

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EXECUTIVE SUMMARY

The information in NUREG-1482, Revision 0, issued April 1995; Revision 1, issued January 2005; Revision 2, issued October 2013; and Revision 3, issued July 2020, described inservice testing (IST) programs in the past. Revision 4 to NUREG-1482 replaces those earlier revisions and is applicable, unless stated otherwise, to editions and addenda (up to and including the 2022 Edition) to the American Society of Mechanical Engineers (ASME) "Operation and Maintenance of Nuclear Power Plants," Division 1, "OM Code: Section IST" (OM Code), that are incorporated by reference in Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a, "Codes and standards" (Volume 89 of the *Federal Register* (FR), pages 70449–70469 (89 FR 70449), dated August 30, 2024).

The U.S. Nuclear Regulatory Commission (NRC, The Commission) regulations quoted in Revision 4 to NUREG-1482 are current as of August 30, 2024 (89 FR 70449). Licensees should be aware that specific NRC regulations may have been further modified since Revision 4 to NUREG-1482 was drafted. The latest NRC regulations are available at www.ecfr.gov.

Effective August 16, 2024, the NRC amended 10 CFR 50.55a in a final rule (89 FR 58039) to provide more flexibility for nuclear power plant licensees by expanding the code of record interval from 10 years (120 months) to two consecutive IST and inservice inspection (ISI) program intervals. This rulemaking also incorporated by reference revisions to three NRC regulatory guides to approve new, revised, and reaffirmed ASME Code Cases. Revision 4 to NUREG-1482 includes the new terminology for the code of record interval rather than the previous 120-month interval when discussing IST/ISI programs. However, some licensees might not meet the conditions in 10 CFR 50.55a for expanding the code of record intervals for their IST/ISI programs at this time. Therefore, Revision 4 to NUREG-1482 summarizes the new rule and its conditions in Appendix C rather than incorporating the new rule directly into each section of this NUREG. Such a major reformatting will be considered in the next revision to NUREG-1482.

This NUREG provides guidance for the IST of pumps and valves and the inservice examination and testing of dynamic restraints (snubbers) at nuclear power plants based on lessons learned since the issuance of previous revisions to NUREG-1482. Appendix A contains guidance on inservice examination and testing of dynamic restraints (snubbers). Appendix B responds to public comments related to the Commission direction in the NRC FR notice for the treatment of pumps, valves, and dynamic restraints during implementation of 10 CFR 50.69, "Risk-informed categorization and treatment of structures, systems and components for nuclear power reactors." Appendix C contains additional information on the code of record designation and its association with the IST program and IST interval.

The guidelines and recommendations in this NUREG and its appendices do not supersede the regulatory requirements in 10 CFR 50.55a. Further, this NUREG and its appendices do not authorize the use of alternatives to, or grant relief from, the OM Code requirements for IST of pumps and valves or inservice examination and testing of dynamic restraints (snubbers) incorporated by reference in 10 CFR 50.55a.

ABBREVIATIONS AND ACRONYMS

ABWR	Advanced Boiling Water Reactor
ADAMS	Agencywide Documents Access and Management System
AFW	auxiliary feedwater
ALARA	as low as is reasonably achievable
ALWR	Advanced Light-Water Reactor
ANSI	American National Standards Institute
AOV	pneumatically operated valve (air-operated valve)
ASME	American Society of Mechanical Engineers
BEP	best efficiency point
BPV Code	Boiler and Pressure Vessel Code
BWR	boiling-water reactor
CFR	*Code of Federal Regulations*
CIV	containment isolation valve
COL	combined license
CPT	comprehensive pump test
ECCS	emergency core cooling system
EFCV	excess flow check valve
EPRI	Electric Power Research Institute
ESBWR	Economic Simplified Boiling-Water Reactor
FR	*Federal Register*
FSAR	final safety analysis report
FSER	final safety evaluation report
GDC	general design criterion/criteria
GE	General Electric Company
GL	generic letter
gpm	gallons per minute
GSI	generic safety issue
HOV	hydraulic-operated valve
HPCI	high-pressure coolant injection
HSSC	high safety significant component
IEEE	Institute of Electrical and Electronics Engineers

IN	information notice
IP	inspection procedure
ips	inch per second
ISI	inservice inspection
IST	inservice testing
ITAAC	inspections, tests, analyses, and acceptance criteria
JOG	Joint Owners Group
LCO	limiting condition for operation
LOCA	loss-of-coolant accident
LSSC	low safety significant component
LTOP	low-temperature overpressure protection
LWR	light-water reactor
MCCR	motor current cutoff relay
MOV	motor-operated valve
MSIV	main steam isolation valve
NEI	Nuclear Energy Institute (formerly NUMARC)
NIC	Nuclear Industry Check Valve Group
NQA	nuclear quality assurance
NRC	U.S. Nuclear Regulatory Commission
NUMARC	Nuclear Management and Resources Council (now NEI)
OD	operability determination
OM Code	ASME “Operation and Maintenance of Nuclear Power Plants,” Division 1, “OM Code: Section IST”
P&ID	piping and instrumentation diagram
PASS	postaccident sampling system
PdM	predictive maintenance
PIV	pressure isolation valve
PORV	power-operated relief valve
POV	power-operated valve
PPM	performance prediction methodology
PPVT	pump periodic verification test
psid	pounds per square inch differential
PST	preservice testing
PWR	pressurized-water reactor
QA	quality assurance

RCIC	reactor core isolation cooling
RCS	reactor coolant system
RFO	refueling outage
RG	regulatory guide
RHR	residual heat removal
RIS	regulatory issue summary
RISC	risk-informed safety class
rms	root mean square
RTNSS	regulatory treatment of nonsafety systems
SOV	solenoid-operated valve
SRM	staff requirements memorandum(a)
S/RV	safety/relief valve
SSC	system, structure, and/or component
STS	Standard Technical Specification(s)
TDI	Transamerica Delaval Inc.
TR	technical report
TS	technical specification(s)
VEGP	Vogle Electric Generating Plant
WGCV	Working Group on Check Valves (ASME)

10 CFR 50.55a(y) DEFINITIONS (89 FR 58039)

Code of record interval means the period of time between the code of record updates required by paragraphs (f)(4) and (g)(4) of this section for the inservice examination and test programs and inservice inspection programs, respectively.

(1) For licensees with codes of record prior to ASME BPV Code, Section XI, 2017 Edition, and OM Code, 2017 Edition, as incorporated by reference in paragraph (a) of this section, the code of record interval is the same as the inservice inspection interval or inservice examination and test interval.

(2) For licensees with codes of record of ASME BPV Code, Section XI, 2017 Edition and OM Code, 2017 Edition, or later, as incorporated by reference in paragraph (a) of this section, the code of record interval is two consecutive inservice inspection or inservice examination and test intervals.

Inservice examination and test (IST) code of record means the specific edition(s) and addenda of the ASME OM Code required by (f)(4)(i) or (ii) of this section, subject to the conditions listed in paragraph (b) of this section, and applicable NRC endorsed code cases, for inservice test to verify operational readiness of pumps, valves, and dynamic restraints, whose function is required for safety.

Inservice examination and test (IST) interval means the inservice examination and test interval described by the licensee's code of record (paragraph ISTA–3120 of the ASME OM Code, 2001 Edition through 2009 Edition, or paragraph ISTA–3120 of the ASME OM Code, 2012 Edition and later).

Inservice examination and testing (IST) program means the requirements for preservice and inservice examination and testing of pumps, valves, and dynamic restraints within the scope of this section to assess their operational readiness in nuclear power plants, including but not limited to:

(1) The requirements specified in the ASME OM Code, as incorporated by reference in this section, such as for test or examination, responsibilities, methods, intervals, parameters to be measured and evaluated, criteria for evaluating the results, corrective action, personnel qualification, and recordkeeping.

(2) Relief requested under paragraph (f)(5)(iii) of this section and granted under paragraph (f)(6)(i) of this section.

(3) Augmented IST requirements as applied by the Commission under paragraph (f)(6)(ii) of this section.

(4) Alternatives authorized under paragraph (z) of this section.

1 INTRODUCTION

1.1 Regulatory Basis

Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a, "Codes and standards," defines the requirements for applying industry codes and standards to boiling- or pressurized-water-cooled nuclear power facilities. Each of these facilities is subject to the conditions in 10 CFR 50.55a(a), (b), (f), and (g), as they relate to inservice inspection (ISI) and inservice testing (IST). By rulemaking effective September 8, 1992 (see Volume 57 of the *Federal Register* (FR), page 34666 (57 FR 34666); August 6, 1992), the U.S. Nuclear Regulatory Commission (NRC) established 10 CFR 50.55a(f) to separate the IST requirements from the ISI requirements in 10 CFR 50.55a(g).

The National Technology Transfer and Advancement Act of 1995 (Public Law 104-113) requires that if agencies establish technical standards, they must use the standards developed or adopted by voluntary consensus standards bodies unless the use of such standards is inconsistent with applicable law or is otherwise impractical. The act requires Federal agencies to use industry consensus standards to the extent practical; however, it does not require Federal agencies to endorse a standard in its entirety. The law does not prohibit an agency from generally adopting a voluntary consensus standard while taking exception to specific portions of the standard if those provisions are deemed to be "inconsistent with applicable law or otherwise impractical." Furthermore, taking specific exceptions furthers the congressional intent of Federal reliance on voluntary consensus standards because it allows the adoption of substantial portions of consensus standards without the need to reject the standards in their entirety because of limited provisions that are not acceptable to the agency.

The American Society of Mechanical Engineers (ASME) "Operation and Maintenance of Nuclear Power Plants," Division 1, "OM Code: Section IST" (OM Code), is a national, voluntary consensus standard. The NRC approves or mandates the use of editions and addenda to the OM Code in 10 CFR 50.55a through the rulemaking process of "incorporation by reference." Once the OM Code edition or addendum is incorporated by reference into the NRC's regulations, each provision of the OM Code that 10 CFR 50.55a incorporates by reference and mandates then constitutes a legally binding NRC requirement imposed by rule. The NRC staff notes that ASME no longer prepares addenda to the OM Code and publishes only new editions of the OM Code. Therefore, the staff has removed some references to addenda to the OM Code from this NUREG where the discussion involves future updating of IST programs.

As of August 30, 2024 (89 FR 70449), the NRC regulations in 10 CFR 50.55a(a)(1)(iv) incorporate by reference the 2022 Edition of the OM Code promulgated by ASME, in which Subsection ISTA provides general IST requirements, and Subsections ISTB, ISTC, and ISTD contain the IST requirements for pumps (pre-2000 plants), valves, and dynamic restraints, respectively. Subsection ISTE contains requirements for risk-informing IST programs. Subsection ISTF contains IST requirements for pumps in new reactors (post-2000 plants). Based on those requirements, each nuclear power plant licensee must establish an IST program, specify the components included in the program as well as the test methods and frequencies for those components, and implement the program in accordance with the OM Code as incorporated by reference in 10 CFR 50.55a.

Where a test requirement of the OM Code is determined to be impractical for a facility, the NRC's regulations in 10 CFR 50.55a(f)(5)(iii) allow the licensee to submit a request for relief

from that requirement, along with information to support the determination of impracticality. The Commission evaluates that request under 10 CFR 50.55a(f)(6)(i). Relief requests generally detail the reasons for deviating from the OM Code requirements and propose alternative testing methods or frequencies. The Commission is authorized to evaluate licensees' relief requests and may grant the requested relief, impose alternative requirements, or both, considering the burden that the licensee might incur if the OM Code requirements were enforced for the facility.

Pursuant to 10 CFR 50.55a(z)(1) and (2), the Commission may authorize the licensee to implement an alternative to the OM Code requirements, provided that the alternative ensures an acceptable level of quality and safety or the OM Code requirement presents a hardship without a compensating increase in the level of quality and safety.

The regulation in 10 CFR 50.55a(f)(4)(i) requires that inservice tests to verify operational readiness of pumps and valves, whose function is required for safety, conducted during the initial code of record interval must comply with the requirements in the latest edition and addenda of the ASME OM Code incorporated by reference in 10 CFR 50.55a(a) on the date no more than 18 months before the date of issuance of the operating license under 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities," or no more than 18 months before the date scheduled for initial loading of fuel under a combined license (COL) under 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants" (or the optional ASME OM Code Cases listed in NRC Regulatory Guide (RG) 1.192, "Operation and Maintenance Code Case Acceptability, ASME OM Code," as incorporated by reference in 10 CFR 50.55a), subject to the conditions listed in 10 CFR 50.55a(b). During the initial IST interval, this code edition is called the "code of record."

The NRC staff notes that the NRC revised 10 CFR 50.55a to specify "no more than 18 months" when discussing the requirement for applying a recent ASME OM Code edition to the IST and ISI programs in response to a comment that the previous language required licensees to use a Code edition that was incorporated by reference in 10 CFR 50.55a exactly 18 months prior to the start of the next Code of record interval for the applicable nuclear power plant. The NRC made the change to 10 CFR 50.55a to allow licensees the flexibility to choose their best option of Code editions incorporated by reference in 10 CFR 50.55a within the 18-month window. The NRC explains the intent of the change to 10 CFR 50.55a in the *Federal Register* Notice for the rule.

The regulation in 10 CFR 50.55a(f)(4)(ii) requires that an IST activity conducted during each code of record interval following the initial interval must comply with the requirements of the latest edition and addenda of the OM Code incorporated by reference in the version of 10 CFR 50.55a(a) that is in effect no more than 18 months before the start of the interval and subject to the conditions listed in 10 CFR 50.55a(b). Appendix C of this document provides additional information on the "code of record" designation.

The regulations in 10 CFR 50.55a(f)(4)(iv) specify that IST of pumps and valves may meet the requirements in editions and addenda of the OM Code that were published more recently than those incorporated by reference in 10 CFR 50.55a(a), subject to NRC approval and the conditions listed in 10 CFR 50.55a(b). Through a letter to the NRC, licensees may request approval to use later editions and addenda previously incorporated by reference in 10 CFR 50.55a. The NRC will evaluate the request and respond by letter. NRC Regulatory Issue Summary (RIS) 2004-12, "Clarification on Use of Later Editions and Addenda to the ASME OM Code and Section XI," dated July 28, 2004, contains additional clarification of this process.

The 10 CFR 50.55a regulations discussed throughout this NUREG apply to pump and valve IST programs at operating reactors. As a result of the unique wording in various paragraphs, note that the NRC **authorizes** licensee-proposed alternatives in accordance with 10 CFR 50.55a(z), **grants** relief and **imposes** alternative requirements in accordance with 10 CFR 50.55a(f)(6)(i) and 10 CFR 50.55a(g)(6)(i), or **approves** the use of later code editions and addenda in accordance with 10 CFR 50.55a(f)(4)(iv) and 10 CFR 50.55a(g)(4)(iv).

The NRC regulations quoted in this revision to NUREG-1482 are current as of August 30, 2024 (89 FR 70449). Licensees should be aware that specific NRC regulations may have been modified since then. The latest NRC regulations are available at www.ecfr.gov.

1.2 Regulatory History of NRC Staff Inservice Testing Guidance

Over the years, the NRC has issued guidance for implementing IST requirements. After publishing the rule that established the IST requirements in 10 CFR 50.55a (see 41 FR 6256; February 12, 1976), the NRC sent letters to notify operating licensees of the new rule. In November 1976, after receiving inquiries from licensees about acceptable methods for complying with the regulation, the NRC issued letters to licensees to transmit NRC staff guidance for complying with 10 CFR 50.55a(g).[2] An example of one of these transmittal letters is available in the NRC's Agencywide Documents Access and Management System (ADAMS) at Accession No. ML17215B409.

To eliminate the backlog of IST program reviews for operating nuclear power plants, the NRC issued Generic Letter (GL) 89-04, "Guidance on Developing Acceptable Inservice Testing Programs," dated April 3, 1989 (ML031150259). That GL included 11 technical positions that the NRC staff used in reviewing licensees' IST program relief requests and described alternatives to the OM Code requirements that the NRC staff considered acceptable. As a unique resolution of the backlogged IST program reviews, in GL 89-04, the NRC staff also approved 6 of the 11 technical positions (1, 2, 6, 7, 9, and 10), pursuant to 10 CFR 50.55a(g)(6)(i), with the provision that the licensee must perform the alternative testing delineated in the applicable position. The NRC staff approved these alternatives because it recognized that it might be impractical to perform the required testing, and enforcing the requirements might pose an unnecessary burden on licensees.

GL 89-04 stated that licensees must document their use of Positions 1, 2, 6, 7, 9, and 10 in the IST program, but it did not require the documentation to take the form of a relief request. The GL granted approval to follow the alternative testing delineated in Positions 1, 2, 6, 7, 9, and 10, pursuant to 10 CFR 50.55a(g) (now (f)), provided that the licensee followed the provisions of GL 89-04. For convenience, most licensees documented their use of these positions in relief requests; however, the NRC found other forms of program documentation to be acceptable as long as the provisions of the referenced positions were clearly documented and were discussed in adequate detail to ensure that they conformed with those provisions. Certain licensees may have submitted relief requests to ensure that they had adequately documented their conformance in their IST program, even though documentation in the IST program plan also would have been acceptable, as stated in GL 89-04.

[2] While most regulatory requirements associated with IST are now located in 10 CFR 50.55a(f), connections to 10 CFR 50.55a(g) continue for IST of snubbers because of the progression of the regulations over time. As snubber programs require periodic updates, the periodicity of intervals originally established under 10 CFR 50.55a(g) was maintained.

The NRC staff held four public meetings to discuss GL 89-04 and stated that the GL was a first step toward resolving various problems associated with developing and implementing IST programs at nuclear power plants. The NRC staff had previously identified these problems through its reviews of licensees' IST programs and by inspecting and auditing IST programs at plant sites, participating on the various ASME code committees, and meeting with licensees and industry groups. The NRC staff then summarized the questions and answers from the four public meetings in a letter entitled "Minutes of the Public Meetings on Generic Letter 89-04," dated October 25, 1989 (ML19262F381). That letter contained useful information about how to apply the guidance in GL 89-04 and discussed issues of interest to licensees that attended the public meetings. In a subsequent letter, dated January 22, 1991 (ML20139A075), the NRC staff issued "Supplement to Minutes of the Public Meetings on Generic Letter 89-04" to address a question on stop check valve testing.

Since the NRC issued GL 89-04, the staff has improved its guidance on IST programs by revising 10 CFR 50.55a and separating the IST and ISI programs in paragraphs (f) and (g), respectively, issuing additional guidance, and coordinating with ASME for periodic symposia on testing pumps and valves. The NRC intends to continue to improve its IST-related guidance through participation on OM Code committees and at meetings of technical organizations, as well as regularly updating the agency's published guidance as future needs arise.

Over many years, the NRC has determined that some OM Code provisions were inadequate to assess the operational readiness of specific components to perform their safety functions. For example, the NRC supplemented the previous IST requirements in the OM Code for quarterly stroke-time testing of motor-operated valves (MOVs) in light of the inadequacy of such testing to assess the operational readiness of those power-operated valves (POVs). By its incorporation by reference in 10 CFR 50.55a, the OM Code is intended to assess the operational readiness of pumps, valves, and dynamic restraints (snubbers) in the IST program to perform their safety functions. Monitoring degradation might be one method of assessing operational readiness of those components if their initial design-basis capability has been demonstrated. In response to POV testing and operational experience, ASME developed appendices to the OM Code to provide IST provisions for diagnostic testing to assess the operational readiness of certain MOVs and air- or pneumatically-operated valves (AOVs).

1.3 NRC Recommendations and Guidance

The NRC staff guidance and recommendations in NUREG-1482, Revision 4, are based on the OM Code, 2022 Edition.

The recommendations in this NUREG replace the guidance and technical positions in GL 89-04. Note that specific relief is required to implement the guidance derived from GL 89-04. However, relief justification may refer to the positions in GL 89-04 with clarifying information to clearly show how they would apply to a licensee's situation. To the extent practical, this document reflects the applicable section, subsection, or paragraph of the appropriate documents (subsections of 10 CFR Part 50, the OM Code, RGs, etc.).

The guidance presented here is voluntary and may be used for requesting relief under 10 CFR 50.55a(f), or for authorization of an alternative under 10 CFR 50.55a(z). Licensees may also request relief or the use of an alternative that is not in conformance with this guidance. The NRC may grant relief or authorize the alternative if the licensee has acceptably addressed all aspects of the proposed relief or alternative.

1.3.1 NRC Review of the ASME OM Code

The first edition and addendum to the OM Code that 10 CFR 50.55a incorporated by reference were the 1995 Edition and the 1996 Addendum. The NRC determines acceptability of new provisions in subsequent editions and addenda to the OM Code and the need for conditions on the use of the OM Code. Generally, the NRC staff participates with other ASME committee members in discussions and technical debates in the development of OM Code revisions. NRC committee representatives discuss the OM Code and technical justifications with other cognizant NRC staff to ensure an adequate technical review. Finally, NRC management reviews and approves the proposed agency position on the OM Code as part of the rulemaking to amend 10 CFR 50.55a to incorporate by reference new editions and addenda to the OM Code with any appropriate conditions. In addition, ASME has a process for developing and publishing the OM Code. Therefore, there is confidence that OM Code editions and addenda incorporated by reference in 10 CFR 50.55a (including necessary conditions) provide reasonable assurance of adequate protection of public health and safety with respect to IST of pumps, valves, and dynamic restraints (snubbers) in nuclear power plants.

1.3.2 Exemptions

Under 10 CFR 50.12(a) and 10 CFR 52.7, “Specific exemptions,” the NRC may, either on its own initiative or upon application by any licensee, grant an exemption from the requirements of 10 CFR Part 50 or 10 CFR Part 52, respectively, that is authorized by law, does not present an undue risk to public health and safety, is consistent with the common defense and security, and is appropriate because of special circumstances. If the NRC approves the application, the exemption relieves the licensee from compliance with the regulation(s) involved. Exemptions are normally not used for 10 CFR 50.55a(z) authorization of alternatives or 10 CFR 50.55a(f) granting of relief.

1.4 Synopsis of Report

This discussion follows the format of a typical IST program plan, including sections on development and implementation, general guidance, valves, pumps, technical specifications (TS), code noncompliance, and risk-informed IST.

Section 2 describes existing IST requirements, discusses the scope of the IST program, and offers guidance for presenting information in IST programs, including cold-shutdown justifications, refueling outage (RFO) justifications, and relief requests. Section 2 also includes a sample list of plant systems for boiling-water reactors (BWRs) and pressurized-water reactors (PWRs) that typically (but not necessarily) contain pumps or valves that perform a safety function and are subject to the requirements of the OM Code.

Section 3 describes the NRC’s recommendations and its bases for several general aspects of IST programs. Sections 4 and 5 then become more specific, describing recommendations for valve-related and pump-related issues, respectively. Throughout Sections 3 through 5, this document discusses the IST requirements for which licensees have requested relief or proposed alternatives. This document also provides guidance on the types of information that licensees typically should (or in some cases must) include in their relief requests. Sections 3 through 5 also discuss related OM Code and regulatory issues and provide recommendations and guidance as needed. These discussions do not impose additional requirements beyond those imposed by the OM Code or the regulations and, thus, do not represent backfits.

These discussions are intended to clarify the existing requirements of the OM Code or the regulations and, as such, they may make recommendations to ensure that licensees continue to meet the OM Code and other regulatory requirements.

Sections 6, 7, and 8 discuss the Standard Technical Specifications (STS), the process licensees should follow when they identify an OM Code nonconformance, and the development of a risk-informed IST program, respectively. Section 9 presents a list of supplemental reading.

This guidance is not equivalent to NRC staff positions in an RG, because licensees must request approval through the relief or alternative process described in 10 CFR 50.55a where the OM Code provisions as incorporated by reference in 10 CFR 50.55a will not be met.

2 DEVELOPING AND IMPLEMENTING AN INSERVICE TESTING PROGRAM

Licensees may use the following guidance for developing and implementing IST programs. This guidance supplements existing requirements and previously approved guidance on IST programs.

2.1 Compliance Considerations

The NRC regulations in 10 CFR 50.55a(f)(4) specify that pumps and valves that are within the scope of the OM Code must meet the IST requirements stated in the applicable editions and addenda of the OM Code that are incorporated by reference in 10 CFR 50.55a to the extent practical within the limitations of design, geometry, and materials of construction of the components. The IST program is intended to assess the operational readiness of the stated components. The regulations specify IST program requirements for the initial and successive IST program intervals following plant startup.

In 10 CFR 50.55a (f)(4)(i), the NRC requires that inservice tests to verify operational readiness of pumps and valves, whose function is required for safety, conducted during the initial IST program interval must comply with the requirements in the latest edition and addenda of the OM Code incorporated by reference in 10 CFR 50.55a(a) on the date no more than 18 months before the date of issuance of the operating license under 10 CFR Part 50, or no more than 18 months before the date scheduled for initial loading of fuel under a COL under 10 CFR Part 52 (or the optional OM Code Cases listed in RG 1.192, as incorporated by reference in 10 CFR 50.55a), subject to the conditions listed in 10 CFR 50.55a(b).

The regulation in 10 CFR 50.55a(f)(4)(ii) requires that IST activities conducted during each IST program interval following the initial interval must comply with the requirements of the latest edition and addenda of the OM Code incorporated by reference in the version of 10 CFR 50.55a(a) that is in effect no more than 18 months before the start of the interval. As of August 30, 2024, the NRC regulations in 10 CFR 50.55a(a)(iv) incorporate by reference the 2022 Edition of the OM Code subject to conditions.

The regulations incorporate by reference the OM Code with conditions to specify the IST requirements and, therefore, the OM Code IST provisions are legally binding requirements. A plant's TS, which might include general and specific requirements for IST and other surveillance testing of pumps and valves, are part of the facility operating license and, therefore, are also legally binding requirements. The plant's safety analysis includes information on the design limitations and functional requirements for the performance of pumps and valves for the given facility. The plant's IST program, including any relief requests and data analysis methods, describes the licensee's means for implementing the various requirements for the specific plant.

Because the OM Code with conditions is incorporated by reference into the regulations, the verbatim wording of the OM Code, as conditioned, is the precise legal requirement. Any errata or corrections made to the OM Code wording are not automatically incorporated into the regulations. Even potentially obvious errors in the OM Code provisions, if not addressed by a condition, must be resolved through the proposed alternative request process under 10 CFR 50.55a(z). The NRC must incorporate by reference any corrections into the regulations and perform a backfit analysis if erroneous wording was already incorporated by reference.

The implementing procedures include the lowest tier of IST elements. In addition, IST engineers often use other information (such as bases documents, vendor manuals, trend data, and graphs) in developing, maintaining, and implementing the plant's IST program.

Some licensees are not performing IST tests required by the OM Code as incorporated by reference in 10 CFR 50.55a for various reasons, such as the need to enter a limiting condition for operation (LCO) or the status of current system alignments. These licensees might not be performing the IST tests because the TS are not directly affected, or the absence of the test is not considered an operability concern under the TS. Some licensees might document these omissions of IST tests but have not submitted alternative requests under 10 CFR 50.55a(z) to obtain NRC authorization for not performing the IST tests required by the OM Code as incorporated by reference in 10 CFR 50.55a. Licensees need to be aware that the plant TS under 10 CFR 50.36, "Technical specifications," and the IST requirements in the OM Code as incorporated by reference in 10 CFR 50.55a are two different sets of regulatory requirements. Licensees must meet the NRC regulatory requirements in both 10 CFR 50.36 and 10 CFR 50.55a to remain in compliance with the NRC regulations and maintain public health and safety at their nuclear power plants.

Licensees must meet the regulations and TS if they identify a conflict between the regulations and their IST program or procedures. The regulations in 10 CFR 50.55a(f)(5)(ii) require that if a facility's IST program conflicts with the TS, the licensee shall apply to the NRC for amendment of the TS to conform the TS to the revised program. The NRC staff provides guidance on cases in which a licensee modifies its plant in a way that affects the basis for relief that the NRC has previously granted. Similarly, if a licensee has obtained the NRC's authorization of an alternative pursuant to 10 CFR 50.55a(z)(1) or (2), the licensee need not use that alternative if it subsequently determines that continued compliance with the OM Code requirements is warranted or necessary for particular circumstances that may preclude implementation of the authorized alternative. When a licensee revises an implementing procedure, the licensee typically ensures that the IST program continues to reflect the required testing. Similarly, when a system, subsystem, or component is modified, or an operating or test procedure or valve alignment is changed in accordance with 10 CFR 50.59, "Changes, tests and experiments," the licensee typically reviews the IST requirements to determine whether it must change the program for the affected components.

The NRC may grant relief from or authorize alternatives to IST requirements submitted as requests that include a discussion of the requirements, a description of the proposed alternative, and the justification for approval or use of the alternative. The following provisions in 10 CFR 50.55a address the process for authorizing alternatives or granting relief:

- Regulations in 10 CFR 50.55a(z)(1) allow the NRC to authorize an alternative to an OM Code provision as incorporated by reference in 10 CFR 50.55a if the proposed alternative would provide an acceptable level of quality and safety. The NRC will normally authorize an alternative pursuant to this provision only if the licensee proposes a method of testing that is equivalent to, or an improvement of, the method specified by the OM Code as incorporated by reference in 10 CFR 50.55a, or if the alternative testing will comply or is consistent with later OM Code editions incorporated by reference in 10 CFR 50.55a.

- Regulations in 10 CFR 50.55a(z)(2) allow the NRC to authorize an alternative if compliance with the OM Code provision as incorporated by reference in 10 CFR 50.55a would result in hardship or unusual difficulty without a compensating increase in the level

of quality and safety. The NRC may authorize an alternative pursuant to this provision if, although the proposed alternative testing does not comply with the OM Code, the increase in overall plant safety and quality attained by complying with the OM Code requirement is not justified in light of the difficulty associated with compliance.

- Regulations in 10 CFR 50.55a(f)(6)(i) include the following provision:

  > The Commission will evaluate determinations under paragraph (f)(5) of this section that code requirements are impractical. The Commission may grant relief and may impose such alternative requirements as it determines are authorized by law, will not endanger life or property or the common defense and security, and are otherwise in the public interest, giving due consideration to the burden upon the licensee that could result if the requirements were imposed on the facility.

  Therefore, the NRC may grant relief pursuant to 10 CFR 50.55a(f)(6)(i) or may authorize alternatives if the licensee demonstrates that the design or access limitations make the OM Code requirement impractical. The NRC staff's evaluation considers the burden created by imposing the OM Code requirements on the licensee.

2.1.1 ASME OM Code Case Applicability

Code Cases prepared by ASME represent alternatives or additions to the OM Code. A Code Case is the official ASME method for handling a reply to an inquiry or proposed alternative when study indicates that the OM Code wording needs clarification, or when the reply allows an alternative to the existing requirements of the OM Code, if ASME endorses the use of the alternative methods. ASME develops Code Cases through the OM Code committee consensus process to clarify the intent of existing OM Code requirements or to provide an alternative to a specific OM Code requirement. A Code Case may be issued to provide alternative rules when justified, to permit early implementation of an approved revision when the need is urgent, or to specify IST methods for situations not covered by existing provisions of the OM Code.

The NRC reviews new or revised Code Cases to determine their acceptability for incorporation by reference in 10 CFR 50.55a through NRC RGs. Accordingly, the NRC staff developed RG 1.192 and RG 1.193, "ASME Code Cases Not Approved for Use."

The regulations in 10 CFR 50.55a(a)(3)(iii) incorporate by reference RG 1.192. Licensees may implement the OM Code Cases listed in RG 1.192 without obtaining further NRC review or approval if the OM Code Cases are used in their entirety with any supplemental conditions specified in RG 1.192 and the licensee's IST code of record is applicable to the OM Code Case. RG 1.193 lists Code Cases not approved for general use. Licensees requesting the NRC's approval as part of a relief or alternative request to implement an OM Code Case listed in RG 1.193 must show, at a minimum, that adequate protection to public health and safety is provided if the OM Code Case is applied.

If a licensee would like to use an OM Code Case with an edition or addendum of the OM Code to which it is not applicable, the licensee has the following options:

- Request to use the OM Code Case as an alternative, beyond its stated applicability, and receive authorization by the NRC pursuant to 10 CFR 50.55a(z).

- If the OM Code Case is applicable to an edition or addendum of the OM Code later than the version of the OM Code being used by the licensee, update the IST program to the later version of the OM Code pursuant to 10 CFR 50.55a(f)(4)(iv) or (g)(4)(iv) and then use the OM Code Case, provided that the OM Code Case has been approved for use in the appropriate RG 1.192 and incorporated by reference into 10 CFR 50.55a. Note that (1) the later version of the OM Code must also have been incorporated by reference into 10 CFR 50.55a, (2) the licensee must update all related requirements of the respective edition or addenda, and (3) the update must be specifically approved by the Commission.

The NRC may authorize the use of an OM Code Case that has not yet been approved for use in RG 1.192 if a licensee requests the use of the OM Code Case under 10 CFR 50.55a(z). The authorization for a specific licensee to use a Code Case that is not listed in RG 1.192 does not authorize any other licensee to use the Code Case. Broad generic authorizations of Code Cases that are in the process of being incorporated into RG 1.192 through the use of the 10 CFR 50.55a(z) alternative process may amount to a de facto rulemaking and circumvent the public's involvement in the rulemaking process. Therefore, each authorization must be necessarily limited to the licensee requesting the authorization.

Regarding risk-informed IST, the following OM Code Cases, as accepted in RG 1.192, include risk-informed provisions that licensees may apply in their IST programs:

- OMN-1, "Alternative Rules for Preservice and Inservice Testing of Active Electric Motor-Operated Valve Assemblies in Light-Water Reactor Power Plants"

- OMN-3, "Requirements for Safety Significance Categorization of Components Using Risk Insights for Inservice Testing of LWR Power Plants"

- OMN-4, "Requirements for Risk Insights for Inservice Testing of Check Valves at LWR Power Plants"

- OMN-11, "Risk-Informed Testing for Motor-Operated Valves"

- 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)"

- OMN-26, "Alternate Risk-Informed and Margin Based Rules for Inservice Testing of Motor Operated Valves"

RG 1.175, "Plant-Specific, Risk-Informed Decisionmaking: Inservice Testing," describes an acceptable alternative approach for applying risk insights from a probabilistic risk assessment, in conjunction with established traditional engineering information, to make changes to a nuclear power plant's IST program. The approach described in RG 1.175 addresses the high-level safety principles specified in RG 1.174, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis," and attempts to strike a balance between defining an acceptable process for developing risk-informed IST programs without being overly prescriptive. The NRC must authorize the alternative approach described in RG 1.175 pursuant to 10 CFR 50.55a(z)(1) on a plant-specific basis before the licensee can implement the approach. However, because 10 CFR 50.55a(z)(1) places no restrictions on the scope of alternatives that the NRC may authorize, licensees may propose

risk-informed alternatives to their entire IST program or may propose alternatives that are more limited in scope (e.g., for a particular system or group of systems, or for a particular group of components). However, with the issuance of RG 1.192, licensees may use specific risk-informed IST methods without first obtaining NRC staff review and approval. Section 8 discusses risk-informed IST in greater detail. Subsection ISTE, "Risk-Informed Inservice Testing of Components in Water-Cooled Reactor Nuclear Power Plants," of the 2020 and 2022 Editions of the OM Code are endorsed without conditions.

2.1.2 Conditions to the ASME OM Code

The NRC regulations incorporate by reference specific editions and addenda (1995 through the 2022 Edition) to the OM Code in 10 CFR 50.55a(a)(1)(iv), subject to conditions, as appropriate, such as those outlined below.

2.1.2.1 10 CFR 50.55a(b)(3)(i)—Quality Assurance

The OM Code references the use of either the 1994 Edition, 2008 Edition, and 2009-1a Addenda of ASME Nuclear Quality Assurance (NQA)-1, "Quality Assurance Requirements for Nuclear Facility Applications," or the Owner's 10 CFR Part 50, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," program as part of its individual provisions for a quality assurance (QA) program. However, ASME NQA-1 does not contain some of the QA provisions and administrative controls governing operational phase activities that would be required to use ASME NQA-1 in lieu of an Owner's 10 CFR Part 50, Appendix B, QA program description. The NRC originally endorsed ASME NQA-1 with the knowledge that it was not entirely adequate and that other commitments such as the ASME standards must supplement it. Hence, ASME NQA-1 is not acceptable for use without the other QA program provisions identified in TS and licensee QA programs.

2.1.2.2 10 CFR 50.55a(b)(3)(ii)(A), (B), (C), and (D)—Motor-Operated Valve (MOV) Testing

This condition requires that licensees establish a program to ensure that MOVs continue to be capable of performing their design-basis safety functions. The condition in 10 CFR 50.55a(b)(3)(ii) supplements the quarterly MOV stroke-time testing requirement in Subsection ISTC of the OM Code prior to its 2009 Edition. In 1989, the NRC recognized that quarterly stroke-time testing is not sufficient to provide assurance of MOV capability under design-basis conditions. For example, in GL 89-10, "Safety-Related Motor-Operated Valve Testing and Surveillance," dated June 28, 1989, the NRC stated that stroke-time testing alone is not sufficient to provide assurance of MOV operability under design-basis conditions. Therefore, in GL 89-10, the NRC staff requested licensees to verify the design-basis capability of their safety-related MOVs and to establish long-term MOV programs. The NRC subsequently issued GL 96-05, "Periodic Verification of Design-Basis Capability of Safety-Related Motor-Operated Valves," dated September 18, 1996, to provide updated guidance for establishing long-term MOV programs. The condition in 10 CFR 50.55a(b)(3)(ii) establishes a regulatory requirement for nuclear power plant licensees implementing the applicable editions and addenda to the OM Code to establish programs to periodically assess the design-basis capability of MOVs within the scope of the IST program at nuclear power plants.

In response to the MOV issues, ASME published Code Case OMN-1 for the OM Code to allow users to replace quarterly MOV stroke-time testing with a combination of MOV exercising at least every RFO and MOV diagnostic testing on a longer interval. In RG 1.192, the NRC

addresses the acceptability of Code Case OMN-1 in lieu of the quarterly MOV stroke-time testing requirements in Subsection ISTC of the editions and addenda of the OM Code prior to the 2009 Edition. The implementation of OM Code Case OMN-1, as accepted in RG 1.192, may be used in satisfying the requirement in 10 CFR 50.55a(b)(3)(ii). ASME has incorporated Code Cases OMN-1 and OMN-11 into Mandatory Appendix III in the 2009 Edition through the 2022 Edition to the OM Code to replace quarterly MOV stroke-time testing with periodic exercising and diagnostic testing. Based on its review, the NRC specifies the following conditions for implementation of Mandatory Appendix III to the OM Code in 10 CFR 50.55a(b)(3)(ii):

(A) *MOV diagnostic test interval.* Licensees shall evaluate the adequacy of the diagnostic test intervals established for MOVs within the scope of ASME OM Code, Appendix III, not later than 5 years or three refueling outages (whichever is longer) from initial implementation of ASME OM Code, Appendix III.

(B) *MOV testing impact on risk.* Licensees shall ensure that the potential increase in core damage frequency and large early release frequency associated with the extension is acceptably small when extending exercise test intervals for high risk MOVs beyond a quarterly frequency.

(C) *MOV risk categorization.* When applying Appendix III to the ASME OM Code, licensees shall categorize MOVs according to their safety significance using the methodology described in ASME OM Code Case OMN-3, "Requirements for Safety Significance Categorization of Components Using Risk Insights for Inservice Testing of LWR Power Plants," subject to the conditions applicable to OMN-3 which are set forth in RG 1.192, or using an MOV risk ranking methodology accepted by the NRC on a plant-specific or industry-wide basis in accordance with the conditions in the applicable safety evaluation.

(D) *MOV stroke time.* When applying Paragraph III-3600, "MOV Exercising Requirements," of Appendix III to the ASME OM Code, licensees shall verify that the stroke time of MOVs specified in plant technical specifications satisfies the assumptions in the plant's safety analyses.

The NRC has removed conditions 10 CFR 50.55a(b)(3)(ii)(A) through (C) for licensees implementing the 2022 Edition of the OM Code as incorporated by reference in 10 CFR 50.55a as the IST code of record based on the associated requirements in that edition of the OM Code. Licensees using a code of record earlier than the 2022 Edition should review the 2022 Edition for guidance on addressing these conditions.

2.1.2.2.a. 10 CFR 50.55a(b)(3)(iii)(A), (B), (C), and (D)—New Reactors

In addition to complying with the provisions in the OM Code with conditions specified in 10 CFR 50.55a(b)(3), the holders of operating licenses for nuclear power reactors that received construction permits under this part on or after August 17, 2018, and holders of COLs issued under 10 CFR Part 52, whose initial loading occurs on or after August 17, 2018, must also comply with the following conditions, as applicable:

(A) *Power-operated valves.* Licensees must periodically verify the capability of power-operated valves to perform their design-basis safety functions.

(B) [Reserved]

(C) [Reserved]

(D) *High risk non-safety systems.* Licensees must assess the operational readiness of pumps, valves, and dynamic restraints within the scope of the Regulatory Treatment of Non-Safety Systems for applicable reactor designs.

2.1.2.3 10 CFR 50.55a(b)(3)(iv)—Check Valves (Appendix II)

This condition supplements the provisions in Mandatory Appendix II, "Check Valve Condition Monitoring Program," to the OM Code. Subsection ISTC of the OM Code permits the use of Mandatory Appendix II as an alternative to other testing or examination provisions of Subsection ISTC. If a licensee elects to use Mandatory Appendix II, the provisions of Mandatory Appendix II become mandatory in accordance with the OM Code requirements. Based on its review, the NRC specifies that Mandatory Appendix II of the OM Code, 2003 Addenda through the 2012 Edition, is acceptable for use with the following requirements. Trending and evaluation must support the determination that the valve or group of valves is capable of performing its intended function(s) over the entire interval. At least one of the Mandatory Appendix II conditions monitoring activities for a valve group shall be performed on each valve of the group at approximate equal intervals not to exceed the maximum interval as shown in Table 3, "Maximum Intervals for Use When Applying Internal Extensions," of 10 CFR 50.55a(b)(3)(iv). The NRC regulations in 10 CFR 50.55a(b)(3)(iv) do not specify any conditions for the use of Mandatory Appendix II in the 2015 or later Editions of the OM Code incorporated in 10 CFR 50.55a.

2.1.2.4 10 CFR 50.55a(b)(3)(v)—Snubbers ISTD

Article IWF 5000 of ASME Boiler and Pressure Vessel Code (BPV Code), Section XI, must be used when performing inservice examinations and tests of snubbers at nuclear power plants, except as conditioned in 10 CFR 50.55a(b)(3)(v)(A)–(B) as follows:

(A) Snubbers: First provision. Licensees may use Subsection ISTD, "Preservice and Inservice Examination and Testing of Dynamic Restraints (Snubbers) in Light-Water Reactor Power Plants," of the ASME OM Code, 1995 Edition through the latest edition and addenda incorporated by reference in [10 CFR 50.55a(a)(1)(iv)], in place of requirements for snubbers in the editions and addenda up to the 2005 Addenda of the ASME BPV Code, Section XI, [Articles] IWF-5200(a) and (b) and IWF-5300(a) and (b), by making appropriate changes to their technical specifications or licensee-controlled documents. [When using Subsection ISTD as an alternative,] Preservice and inservice examinations must be performed using the VT-3 visual examination method described in IWA 2213.

(B) Snubbers: Second provision. Licensees must comply with the provisions for examining and testing snubbers in Subsection ISTD of the ASME OM

Code and make appropriate changes to their technical specifications or licensee controlled documents when using the 2006 Addenda and later editions and addenda of Section XI of the ASME BPV Code.

This condition in 10 CFR 50.55a(b)(3)(v) allows licensees using the 1995 Edition through the latest edition and addenda up to the 2005 Addendum of ASME BPV Code, Section XI, to optionally use Subsection ISTD of the OM Code in place of the requirements for snubbers in Section XI. This condition also states that snubber preservice and inservice examinations must be performed using the VT-3 visual examination method (as described in IWA 2213) when using Subsection ISTD of the OM Code. The NRC imposed the VT-3 visual examination requirement to ensure that licensees use an appropriate visual examination method or scope for the examination of integral and nonintegral snubber attachments, such as lugs, bolting, and clamps, when using Subsection ISTD as an alternative to ASME BPV Code, Section XI.

Licensees that use the 2006 Addenda and later editions and addenda to Section XI of the ASME BPV Code must follow the requirements of Subsection ISTD of the OM Code for snubbers because snubber inservice examination and testing requirements have been deleted from the scope of ASME BPV Code, Section XI, in the 2006 Addenda. The condition in 10 CFR 50.55a(b)(3)(v) does not invoke the VT-3 visual examination requirement when licensees use the 2006 Addendum and later editions and addenda to ASME BPV Code, Section XI, because ASME revised Figure IWF-1300-1, “Illustrations of Typical Support Examination Boundaries,” in the 2006 Addenda to Section XI to clarify that integral and nonintegral snubber attachments are within the scope of Section XI and not within the OM Code scope. Therefore, the visual examination method specified in the 2006 Addenda and in later editions and addenda to ASME BPV Code, Section XI, applies to the examination of integral and nonintegral snubber attachments

2.1.2.5 10 CFR 50.55a(b)(3)(vi)—Exercise Interval for Manual Valves

This condition requires that manual valves must be exercised on a 2-year interval rather than the 5-year interval specified in paragraph ISTC-3540 of the 1999 through the 2005 Addenda to the OM Code, provided that adverse conditions do not require more frequent testing. The 1998 Edition and earlier versions of the OM Code specified an exercise interval of 3 months for manual valves. The 1999 Addendum to the OM Code revised paragraph ISTC-3540 to extend the exercise frequency for manual valves to 5 years; however, the NRC staff did not agree that justification was sufficient to extend the exercise interval for manual valves to 5 years (see 67 FR 60520, 60531-32; September 26, 2002). The condition in 10 CFR 50.55a(b)(3)(vi) does not apply to the 2006 Addendum through the 2022 Edition to the OM Code because ASME revised the exercise interval in paragraph ISTC-3540 of the 2006 Addendum to the OM Code to 2 years for manually operated valves.

2.1.2.6 10 CFR 50.55a(b)(3)(vii)—Snubber Visual Examination Interval Extension

This condition restricts the extension of operational readiness testing intervals of snubbers through the use of OM Code Case OMN-15, Revision 2, when implementing Subsection ISTD, paragraph ISTD-4253, and Note 7 of Table ISTD-4252-1, in the 2022 Edition of the ASME OM Code, incorporated by reference in 10 CFR 50.55a(a)(1)(iv).

2.1.2.7 10 CFR 50.55a(b)(3)(viii)—Subsection ISTE

This condition requires that licensees wishing to implement Subsection ISTE of the OM Code, 2009 through 2017 Editions, request and obtain NRC authorization in accordance with 10 CFR 50.55a(z) to apply Subsection ISTE on a plant-specific basis as a risk-informed alternative to the applicable IST requirements in the OM Code.

Nuclear power plant applicants for construction permits under 10 CFR Part 50, or COLs for construction and operation under 10 CFR Part 52, may describe in their application their proposed implementation of the risk-informed IST approach specified in Subsection ISTE of the OM Code for NRC review.

The NRC has accepted the 2020 and 2022 Editions of Subsection ISTE of the OM Code for use without condition.

2.1.2.8 10 CFR 50.55a(b)(3)(ix)—Subsection ISTF

This condition is for applying Subsection ISTF of the 2012 Edition of the OM Code. While using Subsection ISTF of the OM Code, 2012 Edition, licensees must satisfy the requirements of Mandatory Appendix V, “Pump Periodic Verification Test Program,” of the OM Code, 2012 Edition. However, the 2011 Addenda to the OM Code did not include a pump periodic verification test program (PPVT). Since then, the 2012 Edition of the OM Code has incorporated Mandatory Appendix V, which supports the changes to the comprehensive pump test (CPT) in Subsection ISTF. Therefore, 10 CFR 50.55a(b)(3)(ix) prohibits the use of Subsection ISTF of the 2011 Addenda to the OM Code. Licensees will be allowed to apply Subsection ISTF with revised acceptable and required action ranges in the 2012 through 2015 Editions of the OM Code as incorporated by reference in 10 CFR 50.55a. The 2017 through 2022 Editions of the OM Code incorporate Mandatory Appendix V into Subsection ISTF such that this condition is not necessary when implementing the 2017 through 2022 Editions of the OM Code.

2.1.2.8 10 CFR 50.55a(b)(3)(x)—Class 1 Pressure Relief Valve Sample Expansion

This condition is for applying the Class 1 Pressure Relief Valve Sample Expansion of Mandatory Appendix I. When implementing paragraph I-1320(c)(1) in Appendix I, “Inservice Testing of Pressure Relief Devices in Water-Cooled Reactor Nuclear Power Plants,” of the editions and addenda of the ASME OM Code, incorporated by reference in 10 CFR 50.55a(a)(1)(iv), the requirement for sample expansion of Class 1 Pressure Relief Valves shall be implemented such that for each valve tested for which the as-found set-pressure (first test actuation) exceeds the plus/minus tolerance limit of the Owner-established design set-pressure acceptance criteria of paragraph I-1310(e), two additional valves shall be tested from the same group. If the Owner has not established design set-pressure acceptance criteria, then for each valve tested for which the as-found set-pressure (first actuation) exceeds ±3 percent of valve nameplate set-pressure, two additional valves shall be tested from the same valve group.

2.1.2.9 10 CFR 50.55a(b)(3)(xi)—Valve Position Indication

This condition requires that licensees implementing Paragraph ISTC-3700, “Position Verification Testing,” in the OM Code, 2012 Edition through the latest edition and addenda of the OM Code incorporated by reference in 10 CFR 50.55a(a)(1)(iv), must verify that valve operation is accurately indicated by supplementing valve position indicating lights with other indications, such as flow meters or other suitable instrumentation, to provide assurance of proper obturator position for valves with remote position indication within the scope of Subsection ISTC, including its mandatory appendices and their verification methods and frequencies. For valves not susceptible to stem-disk separation, licensees may implement OM Code Case OMN-28, ‘‘Alternative Valve Position Verification Approach to Satisfy ISTC-3700 for Valves Not Susceptible to Stem-Disk Separation,’’ which is incorporated by reference in 10 CFR 50.55a(a)(1)(iii)(H). Where plant conditions make it impractical to perform the initial ISTC-3700 test as supplemented by 10 CFR 50.55a(b)(3)(xi) by the date 2 years following the previously performed ISTC-3700 test, a licensee may justify an extension of this initial supplemental valve position verification provided the ISTC-3700 test as supplemented by 10 CFR 50.55a(b)(3)(xi) is performed at the next available opportunity and no later than the next plant shutdown. This one-time extension of the ISTC-3700 test schedule as supplemented by 10 CFR 50.55a(b)(3)(xi) is acceptable provided the licensee has available for NRC review documented justification based on information obtained over the previous 5 years of the structural integrity of the stem-disk connection for the applicable valves. The licensee’s justification could be based on, for example, verification of the valve stem-disk connection through an appropriate weak link analysis, appropriate disk motion confirmed during diagnostic testing, or allowance and cessation of flow through the valves. The licensee’s justification must provide reasonable assurance that the remote indicating lights accurately reveal the position of the valve obturator until the next ISTC-3700 test as supplemented by 10 CFR 50.55a(b)(3)(xi) is performed.

2.1.3 Voluntary Use of Later Editions and Addenda to the ASME OM Code

The NRC regulations in 10 CFR 50.55a(f)(4) and (g)(4) establish the effective edition and addenda of the OM Code or ASME Boiler and Pressure Vessel (BPV) Code, as applicable, to be used by licensees in performing IST of pumps and valves and ISI of components (including supports). The regulations in 10 CFR 50.55a(f)(4)(ii) and (g)(4)(ii) require the use of the latest edition and addenda of the applicable ASME code that have been incorporated by reference into 10 CFR 50.55a. The ASME code edition or addendum identified as applicable to the IST and ISI interval is called the code of record for the IST and ISI interval.

In a rulemaking effective in August 2024 (89 FR 58039), the NRC modified 10 CFR 50.55a(f)(4)(iv) and (g)(4)(iv) with respect to the voluntary use of later editions and addenda of the OM Code. For IST programs, 10 CFR 50.55a(f)(4)(iv) now states the following:

> Inservice tests of pumps and valves may meet the requirements set forth in subsequent editions and addenda that are incorporated by reference in paragraph (a)(1)(iv) of this section, subject to the conditions listed in paragraph (b) of this section, and subject to NRC approval. Portions of editions or addenda may be used, provided that all related requirements of the respective editions or addenda are met. NRC approval is not required when updating the IST code of record before the start of an IST interval in which the updated IST code of record will be used and when using the latest edition incorporated by reference in (a)(1)(iv) of this section in its entirety, subject to the conditions listed in paragraph (b) of this section (or the optional ASME Code Cases listed in NRC

Regulatory Guide 1.147 or NRC Regulatory Guide 1.192 as incorporated by reference in paragraphs (a)(3)(ii) and (iii) of this section, respectively).

Appendix C to this document provides information on the code of record designation and its association with the IST Interval.

The regulations in 10 CFR 50.55a(f)(4)(iv) and (g)(4)(iv) allow IST of pumps and valves and ISI of components (including supports) to meet the requirements set forth in subsequent editions and addenda to the code of record that are incorporated by reference in 10 CFR 50.55a(a), subject to conditions listed in 10 CFR 50.55a(b) and subject to NRC approval. The regulations in 10 CFR 50.55a(f)(4)(iv) and (g)(4)(iv) do not require NRC approval when updating the IST code of record before the start of an IST/ISI interval in which the updated IST/ISI code of record will be used and when using the latest edition incorporated by reference in 10 CFR 50.55a(a)(1)(iv) in its entirety, subject to the conditions listed in 10 CFR 50.55a(b) (or the optional ASME Code Cases listed in RG 1.147, "Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1," or RG 1.192 as incorporated by reference in 10 CFR 50.55a(a)(3)(ii) and (iii), respectively).

If planning to voluntarily update to a more recent edition or addenda of the OM Code other than at the start of an IST/ISI interval, a licensee should recognize that the fact that these code editions and addenda have been incorporated by reference into the NRC regulations does not imply that NRC approval has already been granted for their use in lieu of the code of record for the specific licensee. If a licensee plans to apply a later edition or addenda of the OM Code during its IST or ISI interval, the licensee must request NRC approval to use the later code editions and addenda via a letter to the NRC. In such case, the licensee may not update the IST and ISI programs without NRC approval to use the later code editions and addenda. When proposing to use any or all of a later code edition or addendum, the licensee must meet all related requirements of the respective editions or addenda, and any deviations are subject to NRC approval in accordance with 10 CFR 50.55a(f)(4)(iv) and (g)(4)(iv). The regulations do not specify when the licensee should submit the request to apply a later edition or addendum of the OM Code. The regulations only specify that the licensee must receive NRC approval before use of a later code edition or addendum if not updated at the start of an IST/ISI interval.

If a licensee plans to update its IST/ISI program during the IST/ISI interval, the amount of written documentation needed to support a request to use a later code edition and addendum that 10 CFR 50.55a(a) incorporates by reference is significantly less than that necessary for other types of requests for relief from or alternatives to the codes. For example, licensees are not required to provide specific justification for requests to use later code editions and addenda that 10 CFR 50.55a(a) incorporates by reference. This is because the NRC has reviewed and accepted the provisions of those code editions or addenda, with any appropriate conditions, as part of the process for incorporation of the editions and addenda by reference in the regulations. The purpose of the NRC review and approval of the use of later code editions and addenda is to provide and monitor consistency in the use of the appropriate code editions and addenda in IST and ISI activities for nuclear plant components.

When requesting to use editions and addenda of the OM Code that have not been incorporated by reference into 10 CFR 50.55a, licensees must first request authorization to use these later editions and addenda as an alternative to the regulations pursuant to 10 CFR 50.55a(z). The NRC staff issued RIS 2004-12 and RIS 2004-16, "Use of Later Editions and Addenda to ASME Code Section XI for Repair/Replacement Activities," dated October 19, 2004, to clarify this matter.

2.1.4 Identification of Code Noncompliance

NRC Inspection Manual Chapter 0326, “Operability Determinations,” dated September 30, 2019, provides the following guidance for TS operability determinations (ODs) versus OM Code criteria:

> The TS normally applies to the overall performance of plant systems, but sometimes contains limiting values for the performance of certain components. The limiting values are specified to ensure that the operational limits established by the design basis and safety analysis are satisfied. The values (e.g., pump flow rate, valve closure time, valve leakage rate, safety/relief valve set point pressure) are criteria that can be used to verify operability. If at any time these values are not met, the system must be declared inoperable, the LCO must be declared not met, and the applicable conditions must be entered.
>
> The ASME OM Code establishes the requirements for preservice and inservice testing and the examination of certain components to assess their operational readiness. ASME OM Code acceptance criteria for inservice testing (IST) include “required action ranges” or limiting values for certain component performance parameters. These required action ranges or limiting values, defined by the ASME OM Code as component performance parameters, may be more limiting than the TS values (which are accident analysis limits). Where IST requirements are incorporated into a facility’s surveillance requirements [and] when performance data falls outside the required action range, regardless of whether the limit is equal to the TS limit or more restrictive, the surveillance requirement is not met (the word “inoperative” is used in the text of the ASME Code, i.e., the pump or valve is “inoperative”) and the LCO must be declared not met and the applicable conditions must be entered.
>
> When the required action range is more limiting than its corresponding TS, the corrective action need not be limited to replacement or repair; an analysis demonstrating the specific performance degradation does not impair operability would be acceptable. A new required action range may be established after such analysis, allowing a new OD.
>
> The NRC does not accept durations specified by the ASME OM Code for analyzing test results as a reason for postponing entry into a TS action statement. As soon as data are recognized as being within the required action range for pumps or as exceeding the limiting-value full-stroke time for valves, the associated component must be declared inoperable, and if subject to TS, the completion time specified in the action statement must be started at the time the component was declared inoperable. For inoperable pumps and valves that are part of an ASME IST program but not subject to TS, only the actions required by the applicable sections of the ASME code are applicable.
>
> Recalibrating test instruments and then repeating pump or valve tests are acceptable as an alternative to repair or replacement but cannot be done before declaring the pump or valve inoperable. However, if during a test it is obvious that a test instrument is malfunctioning, the test may be halted and the instruments promptly recalibrated or replaced. During a test, anomalous data with no clear indication of the cause must be attributed to the pump or valve

under test. In that case, the licensee should evaluate to determine if this condition results in the loss of the presumption of operability and if so enter the OD process.

Licensees need to be aware that both 10 CFR 50.36 and 10 CFR 50.55a specify requirements that must be met at nuclear power plants. A licensee might declare a component operable per TS. However, a licensee must meet the acceptance criteria in the OM Code and implement any specified corrective actions required by the OM Code as incorporated by reference in 10 CFR 50.55a. A licensee is out of compliance with the OM Code should the actions required by the OM Code not be met. The OM Code requirements for corrective action might allow the analysis of data to determine the cause of the deviation and to show the component to be operating acceptably. This analysis might allow a licensee to justify a return of the component to service without repair or replacement, but this process must be followed in its entirety. Should a replacement not be available within a reasonable amount of time (e.g., a week), it would be contrary to the intent of the OM Code to defer an operability call on account of an ongoing analysis in order to allow for receipt of the replacement component.

The NRC regulations in 10 CFR 50.55a require licensees to conduct IST tests to verify operational readiness of pumps and valves. Components that do not meet the OM Code requirements are not considered operationally ready in accordance with the OM Code as incorporated by reference in 10 CFR 50.55a. They need not be physically removed from service, but they cannot be relied on to perform their credited functions. The TS may have additional requirements for these components. If an OM Code test is missed, but it is not required per TS, the component is not necessarily required to be immediately declared inoperable. The licensee is out of compliance with 10 CFR 50.55a for missing an OM Code requirement, but the operability impact would need to be evaluated as part of the licensee's corrective action program. A licensee can submit a relief request under 10 CFR 50.55a(f) should an OM Code test be considered impractical, or a proposed alternative submitted under 10 CFR 50.55a(z), but the proposed alternative must be authorized prior to implementation.

OM Code, Subsection ISTC, Paragraph ISTC-5100, "Power-Operated Valves (POVs)," Paragraph ISTC-5115, "Corrective Action," subparagraph (a), states that if a valve fails the applicable leak test acceptance criteria, fails to exhibit the required change of obturator position, or exceeds the limiting values of full-stroke time, the valve shall be immediately declared inoperable. Paragraph ISTC-5115(b) specifies that valves with measured stroke times that do not meet the acceptance criteria of ISTC-5114 shall be immediately retested or declared inoperable. Paragraph ISTC-5115(b) allows the new test data to be analyzed within 96 hours to verify that the new stroke time represents acceptable valve operation, or the valve shall be declared inoperable. Under paragraph ISTC-5115(c), the valve may be repaired, replaced, or the data analyzed to determine the cause of the deviation and the valve shown to be operating acceptably. If repair or replacement will take longer than the 96-hour period discussed in the OM Code for analyzing stroke-time data, the licensee should analyze the data and, if possible, determine the cause and show that the valve is operating acceptably. The licensee might justify not disassembling the valve if the data can determine the cause (such as slow wear degradation for fast-acting valves). If the cause cannot be determined from the data and repair or replacement will take longer than 96 hours (such as when a replacement valve or parts must be ordered), the licensee should contact the NRC project manager to discuss submittal of a request for an alternative under 10 CFR 50.55a(z) to allow the valve repair or replacement to be completed over a longer time period.

2.1.5 ASME OM Code Interpretations

ASME issues “Interpretations” to clarify provisions of the OM Code. Users submit requests for interpretation and, after appropriate committee deliberations and balloting, ASME issues responses. Interpretations do not follow the same approval process as OM Code and Code Cases. The code interpretations provide the meaning or the intent of the existing requirements in the OM Code. Licensees should exercise caution when applying interpretations as they are not specifically part of the OM Code’s incorporation by reference into 10 CFR 50.55a and have not received NRC approval. The NRC recognizes that ASME is the official interpreter of the OM Code, but the NRC will not accept ASME interpretations that, in the NRC’s opinion, are contrary to NRC requirements or may adversely impact facility operations.

2.1.6 Impractical Versus Impracticable

The terms “impractical” and “impracticable” are frequently used interchangeably in discussing IST program activities. Some of the definitions of these two terms are similar. Merriam-Webster defines “impractical” as not wise to put into practice, and “impracticable” as incapable of being performed. With respect to IST program activities, the NRC staff uses a reasonableness standard in applying these terms. Licensees should justify an activity as impractical or impracticable with respect to whether it is reasonable to expect the activity to be performed. For example, the construction of a structure requiring significant resources to enable an IST activity to be performed on the specific OM Code test interval might be considered impractical or impracticable if the activity could be performed readily on a slightly extended interval without significant degradation in the operational readiness of the pump, valve, or snubber to perform its safety function. The NRC regulations in 10 CFR 50.55a(f)(5) and (6) address relief requests in which a licensee considers an OM Code requirement to be impractical for its facility. The ASME OM Code frequently uses the term “practicable” when requiring appropriate conditions for testing (e.g., see ISTB-3100, “Preservice Testing,” for pumps).

2.2 Scope of Inservice Testing Programs

General Design Criterion (GDC) 1, “Quality standards and records,” in Appendix A, “General Design Criteria for Nuclear Power Plants,” to 10 CFR Part 50, and Criterion XI, “Test Control,” in Appendix B to 10 CFR Part 50, require that all components (such as pumps and valves) that are important to safety be tested to demonstrate that they will perform satisfactorily in service. Among other things, GDC 1 requires that components important to safety must be tested to quality standards that are commensurate with the importance of the safety functions to be performed. Criterion XI requires, in part, that a test program shall be established to provide assurance that all testing required to demonstrate that systems, structures, and components (SSCs) will perform satisfactorily in service is identified and performed in accordance with written test procedures. For pre-GDC plants, the licensee should verify that the scope of the IST program is consistent with the applicable licensing requirements.

Each licensee has the responsibility to demonstrate the continued operability or functionality of all components within the scope of its IST program. The NRC staff considers the OM Code to apply to pumps, valves, and dynamic restraints installed in piping systems. For example, the NRC staff does not consider the OM Code to apply to rupture panels in building structures or dampers in ventilation systems. The requirements in Appendices A and B to 10 CFR Part 50 that apply to these other components may be satisfied by a performance monitoring program separate from an OM Code IST program. Boundary valves separating piping systems and duct systems will need to be evaluated for their inclusion within the scope of the IST program (see

the discussion in Supplement 1 to GL 89-10, Question 3, dated June 13, 1990 (ML031140169)). An IST program, including implementing procedures, is subject to the requirements of 10 CFR Part 50, Appendix B, and OM Code, Subsection ISTA. Changes to the scope, test methods, or acceptance criteria should be reviewed for compliance with the requirements of 10 CFR 50.59, 10 CFR 50.55a, and 10 CFR 50.65, "Requirements for monitoring the effectiveness of maintenance at nuclear power plants" (Maintenance Rule), as appropriate.

The TS for some plants may include IST requirements that are more restrictive than the NRC regulations.

2.2.1 Basis for Scope Requirements

The requirements for the scope of components to be included in an IST program are addressed in 10 CFR 50.55a(f)(4) and Paragraph ISTA-1100, "Scope," of the OM Code.

The NRC regulations in 10 CFR 50.55a(f)(4) state the following:

> Throughout the service life of a boiling or pressurized water-cooled nuclear power facility, pumps and valves that are within the scope of the ASME OM Code must meet the inservice test requirements (except design and access provisions) set forth in the ASME OM Code and addenda that become effective subsequent to editions and addenda specified in paragraphs (f)(2) and (3) of this section and that are incorporated by reference in paragraph (a)(1)(iv) of this section, to the extent practical within the limitations of design, geometry, and materials of construction of the components. The inservice test requirements for pumps and valves that are within the scope of the ASME OM Code but are not classified as ASME BPV Code Class 1, Class 2, or Class 3 may be satisfied as an augmented IST program. This use of an augmented IST program is acceptable without prior NRC approval provided the basis for deviations from the ASME OM Code, as incorporated by reference in this section, demonstrates an acceptable level of quality and safety, or that implementing the Code provisions would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety, where documented and available for NRC review.

The OM Code defines its scope by stating that IST programs shall include pumps and valves that are credited to perform a specific function in (1) shutting down the reactor to a safe-shutdown condition, (2) maintaining the safe-shutdown condition, or (3) mitigating the consequences of an accident. The scope of the OM Code also covers pressure-relief devices that are used to protect systems (or portions of systems) that perform a required safety-related function. Therefore, the scope of components to be included in an IST program must encompass the components covered in Subsection ISTA of the OM Code. Appendix A to this NUREG discusses the IST scope for dynamic restraints.

With respect to non-code class safety-related pumps and valves, the regulations in 10 CFR 50.55a(f)(4) specify that the IST requirements for pumps and valves that are within the scope of the OM Code but are not classified as ASME BPV Code Class 1, 2, or 3 may be satisfied in an augmented IST program in accordance with 10 CFR 50.55a(f)(6)(ii) without requesting relief under 10 CFR 50.55a(f)(5) or alternatives under 10 CFR 50.55a(z). As an example, a licensee or applicant could specify the augmented IST program activities in the IST program plan with the basis for those activities indicated in the IST program tables similar to the justification for cold shutdown and RFO test frequencies.

Paragraph ISTA-1100 of the OM Code refers to components that are credited to perform a specific function in "mitigating the consequences of an accident." The NRC regulations in 10 CFR 50.2, "Definitions," define safety-related SSCs as follows:

> Safety-related structures, systems and components means those structures, systems and components that are relied upon to remain functional during and following design basis events to assure:
>
> (1) The integrity of the reactor coolant pressure boundary
>
> (2) The capability to shut down the reactor and maintain it in a safe shutdown condition; or
>
> (3) The capability to prevent or mitigate the consequences of accidents which could result in potential offsite exposures comparable to the applicable guideline exposures set forth in § 50.34(a)(1) or § 100.11 of this chapter, as applicable.

The language of paragraph ISTA-1100 and 10 CFR 50.2 is consistent with respect to mitigating the consequences of accidents with the exception that paragraph ISTA-1100 does not include specific references to exposure guidelines provided in the NRC regulations. Therefore, the NRC staff interprets paragraph ISTA-1100, in specifying pumps and valves that are credited to perform a specific function in (1) shutting down the reactor to a safe-shutdown condition, (2) maintaining the safe-shutdown condition, or (3) mitigating the consequences of an accident, to be consistent with the definition of safety-related specified in the NRC regulations. Licensees and applicants could use their identification of the safety-related pumps and valves with respect to design-basis events in the final safety analysis report (FSAR) for their nuclear power plants to identify the pumps and valves within the scope of paragraph ISTA-1100. Similarly, the NRC regulations (e.g., 10 CFR 50.62, "Requirements for reduction of risk from anticipated transients without scram (ATWS) events for light-water-cooled nuclear power plants," and 10 CFR 50.63, "Loss of all alternating current power") for some events such as anticipated transients without scram, station blackout, and low-temperature overpressure protection (LTOP) might allow licensees to use either safety-related or non-safety-related pumps and valves to satisfy those regulations. However, the scope of the OM Code is provided in paragraph ISTA-1100 as incorporated by reference in 10 CFR 50.55a.

In the 2022 Edition of the OM Code, ASME has included a detailed definition of "accident" to resolve uncertainties regarding the scope of the IST Program specified in paragraph ISTA-1100. In particular, paragraph ISTA-2000, "Definitions," defines "accident(s)" as follows:

> *accident(s):* refer to postulated accident(s) or event(s) that are used to set plant design criteria and limits (including potential offsite exposures) which are evaluated in the plant's design basis accident analysis documents to demonstrate acceptability of the plant design in accordance with the licensing guidelines specified by the applicable regulatory authority, and to postulated accident(s) and event(s) required to be included in the IST program by regulatory commitments for the plant. Other accidents or events are addressed by separate requirements (such as fire protection requirements) that are imposed by regulatory authorities having jurisdiction at the plant site.

The NRC staff notes that this definition of accident in the 2022 Edition of the OM Code clarifies the scope of the IST Program required by paragraph ISTA-1100.

The NRC staff notes that the regulations include requirements for a wide range of potential adverse events at nuclear power plants. For example, Appendix R, "Fire Protection Program for Nuclear Power Facilities Operating Prior to January 1, 1979," to 10 CFR Part 50 provides specific requirements for mitigating fire events at nuclear power plants. Appendix R specifies requirements for plant SSCs that might be relied upon to mitigate fire events, including SSCs that are not classified as safety-related at a nuclear power plant. The NRC staff does not consider that a pump or valve relied on only to satisfy the Appendix R requirements must also be included in the IST program required by the OM Code as incorporated by reference in 10 CFR 50.55a. The scope of the OM Code is provided in paragraph ISTA-1100 as incorporated by reference in 10 CFR 50.55a.

Components within the scope of 10 CFR 50.55a are included in the scope of 10 CFR 50.65. Licensees may elect to consolidate testing for pumps and valves, designating any non-code components as such in the IST program.

Table 2.1, "Typical Systems and Components in an Inservice Testing Program for a PWR," and Table 2.2, "Typical Systems and Components in an Inservice Testing Program for a BWR" (which appear at the end of this chapter), present examples of systems and components that licensees typically include in their IST programs. These tables are not intended to be all-inclusive, but they may form the basis for the initial review of a licensee's IST program scope.

2.2.2 Examples of Omitted Components

During IST program reviews and inspections, the NRC staff has noted that licensees do not always include the necessary equipment in the scope of their IST programs. Licensees should review their IST programs to ensure adequate scope. Components that are frequently erroneously omitted from IST programs include the following examples:

(a) BWR scram system valves

(b) control room chilled-water system pumps and valves

(c) accumulator vent valves or motor-operated isolation valves

(d) auxiliary pressurizer spray system valves

(e) boric acid transfer pumps

(f) valves in the emergency boration flow path

(g) control valves that have a required fail-safe position

(h) valves in mini-flow lines

(i) control rod drive system check valves

(j) keep fill systems

(k) excess flow check valves (EFCVs)

Licensees should review whether these components meet the scoping requirements, and the safety significance of these components, to ensure that the IST activities are adequate to demonstrate their continued operational readiness. Licensees should also recognize that the

pumps and valves listed above do not apply to every plant and do not satisfy the scope required by Subsection ISTA for all plants. For example, items c, d, e, and f above do not apply to BWRs. Each licensee should review the list and determine which items apply to its facility.

When a licensee omits a component from its IST program and has missed IST tests, the licensee is in noncompliance with the requirements of the OM Code as incorporated by reference in 10 CFR 50.55a. The licensee should assess the operability or functionality of the affected component. The components should be tested in accordance with the IST requirements as soon as possible to return to compliance with the OM Code. Consistent with 10 CFR 50.55a(z), the NRC staff does not authorize alternatives that have already been implemented by a licensee (such as omitting IST tests past their due date). Those situations are addressed by appropriate regulatory enforcement action. Once the components have been appropriately tested, OM Code compliance is restored. After that, the components must be tested in accordance with the OM Code at their required intervals. If a licensee proposes to not conduct a future required IST test of a component that had been omitted from the IST program, the licensee must submit an alternative request for such a proposal under 10 CFR 50.55a(z) for NRC prior review and authorization, if appropriate.

2.2.3 Testing of Additional Components

As discussed above, OM Code, Subsection ISTA, paragraph ISTA-1100, specifies that pumps and valves, as well as snubbers, that are required to perform a specific function in (1) shutting down the reactor to a safe-shutdown condition, (2) maintaining the safe-shutdown condition, or (3) mitigating the consequences of an accident are within the scope of the IST program, consistent with the definition of safety-related SSCs as specified in 10 CFR 50.2. Therefore, a licensee is required to implement the OM Code requirements as incorporated by reference in 10 CFR 50.55a for those pumps, valves, and snubbers. The NRC regulations in 10 CFR 50.55a(f) allow that IST requirements for pumps and valves that are within the scope of the OM Code but are not classified as ASME BPV Code Class 1, 2, or 3 may be satisfied as an augmented IST program. The regulations in 10 CFR 50.55a(f)(4) specify that this use of an augmented IST program is acceptable without prior NRC approval provided the basis for deviations from the OM Code, as incorporated by reference in this section, demonstrates an acceptable level of quality and safety, or that implementing the code provisions would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety, where documented and available for NRC review.

For components not within the scope of the OM Code, licensees are required to test safety-related components to demonstrate that they will perform satisfactorily in service in accordance with 10 CFR Part 50, Appendices A and B. An IST program is a reasonable vehicle to periodically demonstrate the operational readiness of pumps and valves that are not covered by the OM Code. Thus, if a licensee voluntarily chooses to include components in its OM Code IST program (or some other licensee-developed testing program) and, as a result, is unable to meet certain OM Code provisions for these components, the NRC regulations in 10 CFR 50.55a do not require the licensee to submit a relief or alternative request to the NRC. However, licensees should ensure that these voluntarily included components are appropriately handled within the testing program. Unless otherwise stated in the implementing procedures for the program, components included in a licensee testing program must follow the provisions of that program and any applicable regulatory requirements. Licensees are expected to follow all provisions of their self-imposed programs. Nonetheless, the licensee should maintain documentation that provides assurance of the continued operational readiness, or as required, the continued functional capability of these components through the performed tests.

2.2.4 Components in Inservice Testing Programs

The licensee is responsible for determining whether a component is required to be included in its IST program in compliance with 10 CFR 50.55a(f) and paragraph ISTA-1100 of the OM Code, or whether that classification is optional under paragraph ISTA-1320. Specifically, paragraph ISTA-1320 states that optional construction of a component within a system boundary to a classification higher than the minimum class established in the component design specification shall not affect the overall system classification by which applicable requirements of IST are determined. Thus, if a licensee changes the code classification pursuant to 10 CFR 50.59, the pumps and valves may remain as "augmented components" (denoted as non-code) in the IST program. (Note that NRC approval of a licensee amendment may be necessary, as determined by the evaluation conducted in accordance with 10 CFR 50.59.) RG 1.187, "Guidance for Implementation of 10 CFR 50.59, 'Changes, Tests, and Experiments,'" provides guidance for 10 CFR 50.59 implementation.

2.2.5 Components Added to Inservice Testing Programs

The OM Code establishes the requirements for preservice and inservice testing and examination of certain components to assess their operational readiness in nuclear power plants. Licensees have the responsibility to identify all components subject to test or examination within the scope of their IST program as required by ISTA-1500(a). During the life of an operating nuclear power plant, components may be added or deleted from the scope of the IST program due to plant modifications, changes in procedures, or changes in engineering safety analyses.

Each component that has been identified to be within the IST program scope is required by NRC regulations to have a test plan prepared for the preservice testing (PST) period, initial IST interval, and subsequent IST intervals. During the PST period, the applicable preservice requirements must be met for the component. Examples include an initial set of reference values determined under conditions as near as practical to those expected during subsequent IST, the PST required in Mandatory Appendix III, paragraph III-3200 for MOVs, or the PST required in Mandatory Appendix IV, paragraph IV-3300 for AOVs. Section ISTA-2000, "Definitions," in the OM Code defines the PST period as follows:

> [T]he 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.

For components added to the scope of the IST program, it is expected that a preservice test will be performed when the component is added to the IST program. In addition, the component added to the IST program should undergo an engineering analysis review to determine if the component would require a verification test at its expected design parameters for performance of its safety function in accordance with 10 CFR 50.55a.

2.3 Systems Containing Safety-Related Pumps and Valves

The plant FSAR, TS, and other documents list the systems and components that are necessary to function to support the safe operation and shutdown of the plant. Tables 2.1 and 2.2 at the end of this chapter list systems and components typically included in the IST programs for PWRs and BWRs, respectively. These tables do not necessarily apply to all plants. The listed

systems and components are not considered safety-related at every plant and are not necessarily classified as ASME BPV Code Class 1, 2, or 3. The NRC provides information on quality group and code classifications in RG 1.26, “Quality Group Classifications and Standards for Water-, Steam-, and Radioactive-Waste-Containing Components of Nuclear Power Plants,” and Section 3.9.6, “Functional Design, Qualification, and Inservice Testing Programs for Pumps, Valves, and Dynamic Restraints,” of NUREG-0800, “Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition.” The licensee’s FSAR generally contains a section describing the code classification of components. The IST program scope should be developed to be consistent with the FSAR.

2.4 Inservice Testing Program Document

In this discussion of the IST program document, section 2.4.1 applies to pumps, and section 2.4.2 applies to valves. These sections describe the information that licensees generally need in order to prepare the related sections of the IST program document.

The OM Code includes the following:

- Subsection ISTA includes general requirements for testing components.
- Subparagraph ISTA-3200(a) (in editions prior to 2020) states that the Owner shall file IST plans with the regulatory authorities having jurisdiction at the plant site. See below for additional discussion.
- Section ISTA-9000 addresses the records and reports that are required for these inspection and testing programs, and retention of these records.
- Paragraph ISTA-9210 states that the Owner shall prepare plans for preservice and inservice examinations and tests to meet the requirements of the OM Code.
- Paragraph ISTA-9220 states that licensees shall prepare test and examination records in accordance with the requirements of the respective articles of the OM Code.
- Sections ISTB-9000 and ISTC-9000 include additional guidance on the information that the IST program document must include for pumps and valves that perform safety functions.
- Sections III-9000 and IV-9000 include additional guidance for the information that the IST program document must include for MOVs and AOVs, including risk ranking information.
- Nonmandatory Appendix A, “Preparation of Test Plans,” and Supplement to Appendix A, “Preparation of Test Plans,” to the OM Code give voluntary guidance for licensees to use in preparing their inspection and test plans.

Licensees have found that pump and valve tables are a convenient format for the information. These tables typically include sufficient information to allow NRC inspectors to determine whether the testing complies with the OM Code requirements for test method and frequency. The tables also could note applicable NRC positions or recommendations for each pump or valve.

Licensees should ensure that the IST program plan identifies all components within the scope of the IST program. For example, some skid-mounted pumps or valves might be tested as part of testing the major component such as discussed in Paragraph ISTB-1200, “Exclusions,” or Paragraph ISTC-1200, “Exclusions.” The IST program plan should identify those pumps and valves to ensure that the scope of the IST program is accurately indicated to licensee personnel and the NRC staff.

The NRC intends that the IST program reflect design modifications and other activities performed under 10 CFR 50.59 that relate to pumps and valves within the scope of the program. Thus, the NRC staff recommends that the program plan submitted to the NRC include documentation of the use of positions contained herein, and Code Cases.

In the 2020 Edition of the OM Code, ASME deleted the previous requirement of ISTA-3200(a) for the submittal of the IST program plan to regulatory authorities as more appropriate as a regulatory requirement rather than an ASME requirement. 10 CFR 50.55a(f)(7), the NRC added a regulatory requirement for the submittal of IST program plans by nuclear power plant licensees within 90 days of implementation. The NRC staff considers submission within 90 days before or after implementation to be a reasonable interpretation of this requirement.

2.4.1 Pumps

In preparing pump tables, licensees should consider the following information, which includes headings and a description of the text that could be included under each heading:

- Title: List the applicable plant and unit.
- Page number: Include the page number and total number of pages in the program document or the relevant section, such as “Page 15 of 135.”
- Program revision or revision date: List the program or page revision number and date (on each page). List the revision number for each program change submitted.
- System, code class, and group: List the plant system, code class, and pump group, and briefly describe the service of the pump.
- Pump identification: List a unique identifier for each pump. This identifier should be used consistently in all IST program documentation and design information such as system piping and instrumentation diagrams (P&IDs), test procedures, and relief requests or proposed alternatives.
- P&ID number: List the applicable P&ID or figure that depicts the pump in the system.
- Drawing coordinates: List the coordinates of the pump on the P&ID.
- Test parameters: List each of the five parameters in Tables ISTB-5121-1, ISTB-5221-1, ISTB-5321-1, and ISTB-5321-2 (or similar ISTF tables) for each pump. Include the test parameters for the pump periodic verification test (PPVT), if applicable. A column or a footnote is typically used to list factors that affect testing. List a relief request, proposed alternative, or OM Code Case number where the testing will not be performed in accordance with the OM Code. Notes can be used where OM Code testing would

otherwise be required. A relief request or proposed alternative is not required if the test requirement is exempted by the OM Code.

- Relief request or proposed alternative(s): List any applicable relief requests or proposed alternatives in the pump table. Table 2.3, "Example Data Table for Pumps," provides an example of a data table for pumps.

- Notes: Notes at the end of the pump table can be used to clarify IST activities for specific pumps. Notes may also be used to describe augmented testing activities for non-code pumps consistent with 10 CFR 50.55a(f)(4).

2.4.2 Valves

In preparing valve tables, licensees should consider the following information, which includes headings and a description of the text that could be included under each heading:

- Title: List the applicable plant and unit.

- Page number: Include the page number and total number of pages in the program document or the relevant section, such as "Page 15 of 135."

- Program revision or revision date: List the program or page revision number and date (on each page). List the revision number for each program change submitted.

- System, code class, and group: List the plant system, code class, and valve group, and briefly describe the service of the valve.

- Valve identification: List a unique identifier for each valve. This identifier should be used consistently in all IST program documentation and design information such as P&IDs, test procedures, and relief requests or proposed alternatives. If valves such as excess flow check valves (EFCVs) are grouped together in the table, the number of valves and the valve number must be clearly indicated.

- P&ID number: List the applicable P&ID or figure that depicts the valve in the system.

- Drawing coordinates: List the coordinates of the valve on the P&ID.

- Valve type: List the valve type (e.g., gate, globe, check, or relief).

- Valve size: Specify the valve size in inches, fractions of an inch, or metric units.

- Actuator type: List the type of valve actuator (e.g., motor, solenoid, pneumatic, hydraulic, or self) with the type and function of each valve.

- Code category: Specify the code category (or categories), as defined in paragraph ISTC-1300. Section 4.5.1 contains further discussion.

- Risk Ranking: Provide appropriate risk ranking information based on the requirements of Mandatory Appendix III or Mandatory Appendix IV, as applicable. Section 4.5.2 contains further discussion.

- Active/Passive: State whether a valve is active or passive, as defined in Section ISTA-2000 in the OM Code. Section 4.5.3 contains further discussion.

- Safety position: List the safety function position(s), and specify both positions for valves that perform a safety function in both the open and closed positions. Valves must be exercised to the position(s) required to fulfill their safety function(s). Check valve tests must include both open and close tests.

- Tests performed: Specify which tests are to be performed on each valve.

- Stroke-Time Testing: With the advent of highly precise digital stroke-time measurements, licensees have requested guidance on the rounding of partial second stroke times. The NRC staff considers that licensees may use a consistent approach to measuring and rounding stroke time (such as moving to the next higher second when reaching a half second or greater).

- Fail-Safe Testing: OM Code, Subsection ISTC, Paragraph ISTC-3560, "Fail-Safe Valves," requires that 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. Paragraph ISTC-3560 also requires that AOV fail-safe test frequency shall meet the requirements of Division 1, Mandatory Appendix IV. Licensees are cautioned that testing of fail-safe actuators cannot rely on external motive force, such as supply air, to assist the valve in reaching its safety position.

- Test frequency: List the actual frequency for each test to be performed. If it would be impractical (rather than a convenience consideration) or burdensome to perform the test at the frequency specified in the OM Code, reference cold shutdown or RFO justifications or relief requests or proposed alternatives for the alternative test frequency.

- Relief requests and cold shutdown/RFO justifications: List any applicable relief request(s) or proposed alternative(s). In addition, when the testing is deferred to cold shutdowns or RFOs, reference the technical justification for the test frequency. Notes at the end of the valve table may provide the technical justification.

- Remarks: Include any pertinent information not stated elsewhere in the table such as a brief functional description of the valve.

- Notes: Notes at the end of the valve table can clarify IST activities for specific valves. Notes may also describe augmented testing activities for non-code valves consistent with 10 CFR 50.55a(f)(4).

Table 2.4, "Useful Abbreviations for Valve Data," lists abbreviations commonly used in valve data tables.

2.4.3 Piping and Instrumentation Diagrams and Drawings

The NRC staff recommends that licensees' program submittals include P&IDs or system drawings to assist in locating the pumps and valves included in the program; such drawings should be the latest revision at the time the program is submitted to the NRC. This information will assist the NRC staff in reviewing relief requests or proposed alternatives. ISI boundary

system drawings and isometrics, or reduced-size drawings, are suitable for inclusion in the program document. If the reduced-size drawings are not complete P&IDs, the NRC staff may request a set of full-size drawings for use in completing its evaluation. A partial submittal of the program containing relief requests and proposed alternatives could include applicable drawings to support the relief requests or to supersede previous IST program drawings.

Licensees need not update their program drawings regularly, but if drawings change because of modifications, or if the changes affect relief requests and proposed alternatives, the NRC staff recommends that licensees revise and resubmit the drawings in the next periodic submittal of revisions to the IST program document. The NRC staff also recommends that licensees include detailed drawings with relief requests or proposed alternative submittals and submittals to supplement the IST program. Such drawings are helpful because the NRC technical staff that reviews relief requests does not maintain a set of FSARs for each plant. Drawings are helpful in reviewing relief requests and proposed alternatives, regardless of whether they are submitted as part of the program document or as an attachment to a relief request or proposed alternative.

2.4.4 Bases Document

The NRC staff recommends that each licensee create a bases document for the IST program. A paper discussing the creation and management of a bases document is included in Supplement 1 to NUREG/CP-0123, “Proceedings of the Second NRC/ASME Symposium on Pump and Valve Testing Errata,” issued November 1992. Bases documents have typically included a description of the methods used in preparing the IST program, with a list of each pump and valve in a system within the scope of the OM Code, the basis for including (or excluding) the pump or valve, and the basis for the testing applied to each component. Although not required by the NRC, the bases document may help licensees ensure the continuity of their IST programs when the responsibilities of personnel or groups change. A bases document will also enable the plant staff to clearly understand the reasons that the components are either in the program or not, as well as the basis for testing (or not testing) certain functions. Although not a “licensing-basis document” (unless the licensee makes the document part of the licensing basis for a plant), the bases document is a useful reference for licensee reviews performed under 10 CFR 50.59 when changes are being considered for a facility.

2.4.5 Deferring Valve Testing to Cold Shutdown or Refueling Outages

Exercising valves on a cold shutdown or RFO frequency does not constitute a deviation from the OM Code. Paragraph ISTC-3520, “Exercising Requirements,” provides guidance for testing valves during cold shutdown or RFOs if it is impractical to test during operation. Paragraph III-3610 provides similar guidance for MOVs, and paragraph IV-3420 offers similar guidance for AOVs. The licensee should list the affected valves in the program document (or include in the table) and include cold shutdown or RFO justifications for each affected valve or group of valves. The NRC staff recommends that licensees should include these cold shutdown and RFO justifications in their IST program submittals to the NRC.

Check valves that can be stroked quarterly but must be monitored by a nonintrusive technique to verify full stroke, may be full-stroke tested during cold shutdown or RFOs if another method of verifying full stroke exists during such plant conditions. The NRC would not require a licensee to invest in nonintrusive equipment for the purpose of testing check valves quarterly (instead of testing them during cold shutdown or RFOs), even though the use of nonintrusive techniques is recommended where practical.

A licensee may request relief or authorization of a proposed alternative from quarterly testing where such testing would impose a hardship (e.g., entering an LCO of 3 to 4 hours in duration, repositioning a breaker from "off" to "on" and necessitating manual operator actions to restore the system if an accident were to occur while the test was in progress). For such situations, the risk associated with quarterly testing may outweigh the benefits that might otherwise be achieved. (Section 3.1.2 provides guidance on these types of situations.) Thus, it is appropriate for licensees to weigh the safety impact against the benefits of testing as a basis for deferring testing from a quarterly frequency to cold shutdown or RFOs. NUREG/CR-5775, "Quantitative Evaluation of Surveillance Test Intervals Including Test-Caused Risks," issued February 1992 (ML19172A254), describes a method for making this comparison.

In the event of a planned or unplanned maintenance outage, a licensee may decide to test some or all valves in a cold shutdown mode, rather than waiting for the RFO. In making this decision, the licensee should consider the duration of the shutdown and the extent of other outage activities. The requirements of Subsection ISTC for testing valves in systems that are out of service may apply for extended outages that last for several months. Guidance on minimizing shutdown risk also may apply for extended outages.

Impractical conditions justifying test deferrals may include the following situations that could result in an unnecessary plant shutdown, cause unnecessary challenges to safety systems, place undue stress on components, cause unnecessary cycling of equipment, or unnecessarily reduce the life expectancy of the plant systems and components:

- inaccessibility
- testing that would require major plant or hardware modifications
- testing that has a high potential to cause a reactor trip
- testing that could cause system or component damage
- testing that could create excessive plant personnel hazards
- existing technology that will not give meaningful results

In the licensing process, the NRC staff weighs the possible safety consequences and benefits of performing a required test as part of TS surveillance, including circumstances in which one train is out of service. Nonetheless, any related guidance provided by the NRC staff does not supersede the TS requirements. For example, if testing is specified as part of the TS surveillance, the cycling of nonredundant valves in a remaining operable train may not be deferred to the next cold shutdown when one train is out of service, even though their failure would cause a loss of total system function. In this case, a TS change or enforcement discretion would be necessary to defer testing.

The NRC expects licensees to comply with required IST test frequencies. The OM Code does not require documentation for valves that are not tested during a cold shutdown outage other than as required for maintaining the IST schedule. The NRC does not have a position on the efforts a licensee expends in performing cold shutdown valve testing during a short outage. The NRC staff, however, expects licensees to expend a reasonable "good faith" effort.

Sections 3 and 4, which provide guidance on deferring testing, discuss this issue further.

2.5 Relief Requests and Proposed Alternatives

Relief Requests

Licensees can request that the NRC grant relief from an OM Code or ASME BPV Code, Section XI, requirement in accordance with 10 CFR 50.55a(f)(5)(iii) and (iv), and (g)(5)(iii) and (iv). Requests made under these paragraphs are called "relief."

The NRC regulations in 10 CFR 50.55a(f)(4) require licensees to test pumps and valves in the IST program to the "extent practical" within the limitations of the design, geometry, and materials of construction. The regulations in 10 CFR 50.55a(f)(5) and (g)(5) allow licensees to request relief from OM Code requirements that are "impractical" for the facility. For example, OM Code, Subsection ISTC, requires that the limiting stroke time for POVs be specified by the licensee and measured within limits based on the full-stroke time of the valves. At some plants, the scram discharge volume vent and drain valves are not designed to be individually actuated. These valves are required by TS to close within a specified time (45 seconds for some plants) upon receipt of a scram signal. The valves are tested quarterly by cycling the valves to assess their operational readiness and performing a valve sequence response time test during each RFO. This testing is essentially a design-basis test of the valve combination. Requiring these valves to be stroke timed individually is impractical and places a burden on the licensee because of the extensive modification to the system necessary to individually stroke the valve. In addition, jumpering the control circuit during plant operation to test these valves individually would be impractical because of the potential for a reactor scram. Some licensees may have difficulty fully implementing these required tests, and, in certain cases, because of the impracticality of implementation, a request for relief under 10 CFR 50.55a(f)(5) would be appropriate.

In addition to design, geometry, and materials issues, licensees might also identify testing requirements specified in the OM Code that are impractical because their performance might be unwise or unreasonable for certain pumps or valves and their applications at a specific facility. Licensees may request relief from such requirements in accordance with 10 CFR 50.55a(f)(5) or (g)(5). Consistent with its regulations, the NRC staff does not evaluate a request as relief if submitted as an alternative, and vice versa.

Additionally, as noted in NRC Office Instruction LIC-102, Revision 3, "Review of Relief Requests, Proposed Alternatives, and Requests to Use Later Code Editions and Addenda," dated April 6, 2020 (ML18351A218), other examples of impracticality are as follows:

- being inaccessible for IST or ISI due to design features
- requiring major plant or hardware modification
- having high potential to cause a reactor trip
- causing system or component damage
- replacing equipment or in-line components
- existing technology will not give meaningful results

In accordance with the regulations, when updating a program to a later edition of the OM Code, licensees must implement the updated program at the beginning of an IST interval. The regulations state that in cases in which a licensee determines that an OM Code-specified pump or valve test is impractical and is not included in the revised IST program, the licensee must submit a relief request demonstrating the basis for its determination to the NRC no later than 12 months after the previous IST interval ends, or 12 months after the current IST interval starts.

However, experience has shown that licensees also find impractical test provisions throughout the interval. In such cases, licensees may request relief as soon as they identify the condition. Where the OM Code requirements are impractical, the licensee would test the applicable components using the method proposed in the relief request in the period of time from the beginning of the new interval or time of discovery (or from the time of identification) and using a method granted by the NRC for the applicable IST interval.

Alternative Requests

Licensees can request that the NRC authorize an alternative to an OM Code requirement in accordance with 10 CFR 50.55a(z). Requests made under 10 CFR 50.55a(z) are called "alternatives."

The OM Code establishes the requirements for PST and IST and the examination of certain components to assess their operational readiness in water-cooled reactor nuclear power plants. These requirements apply to pumps, valves, pressure-relief devices, and snubbers within the scope of the OM Code. The requirements are constantly being reviewed and improved in order to meet the basic function of maintaining the safe and reliable operation and maintenance of nuclear power plants.

It is understood that not all plants are designed the same. It is also understood that the general requirements developed in the OM Code may not be applicable or that complying with these requirements may be difficult. Licensees may propose alternatives to the OM Code provided that (1) the alternative would provide an acceptable level of quality and safety under 10 CFR 50.55a(z)(1), or (2) compliance with the specified requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety under 10 CFR 50.55a(z)(2). Hardships generally involve reductions in radiation exposure to as low as is reasonably achievable (ALARA), challenges to operators or plant equipment, components that are somewhat unique in design such as jockey (waterleg) pumps, having to enter multiple TS LCOs, creating significant hazards to plant personnel, or systems in which pump flow is fixed and cannot be adjusted.

Licensees shall not implement proposed alternatives to the OM Code requirements under 10 CFR 50.55a(z) until the NRC staff completes its evaluation and authorizes the alternative. For example, if a licensee proposes to implement a pump vibration program based on the use of spectral analysis rather than the OM Code-specified method, the licensee must continue to meet the OM Code requirements until the NRC staff completes its evaluation and authorizes the alternative.

2.5.1 Justifications for Relief or Alternatives

In determining whether to grant relief from the OM Code requirements or to authorize alternatives, the NRC staff considers the merits of the submitted technical information. In requesting relief or use of an alternative, the licensee would typically identify the specific OM Code requirement and associated paragraph for which relief or use of an alternative is requested, describe the proposed alternative(s), describe the basis for relief or authorization of the proposed alternative(s), and clarify the burden that would result if the NRC enforced the specified requirements. Situations that warrant granting relief or authorizing alternatives (as

determined by the NRC staff in previous safety evaluations for plant-specific requests) may include the following examples:

- In complying with the OM Code requirements, the licensee would not obtain information that is more useful than the information currently available. For example, installing an analog gauge with a range of three times the reference value (or less) to comply with OM Code requirements may not yield more accurate readings than those provided by the gauge that is presently installed (see section 5.5.1).

- Compliance with the OM Code is impractical because of design limitations. Imposition of the OM Code requirements would require significant system redesign and modifications. For example, a flow meter does not meet the accuracy requirements of ISTB-3510 and Table ISTB-3510-1 because the present system configuration does not have a straight section of pipe of sufficient length in which to measure flow accurately (see section 5.5).

- The required measurements or appropriate observations cannot be made because of physical constraints. Examples include a component located in an area that is inaccessible during power operation or a pump that is totally immersed in system fluid.

- The need to keep personnel radiation exposure ALARA may present an adequate justification. The licensee should include information about the general area radiation field, local hot spots, plant radiation limits and stay times, the amount of exposure personnel would receive in performing the testing, and the safety significance of deferring testing or performing an alternative method. ALARA relates to controlling exposure during an activity, not specifically to eliminating activities; however, it may be a basis for relief or for deferring a test on the basis of hardship when exposure limits are prohibitive for performing testing (or possibly for accessing a valve for repair in the event that it could fail during a test). If the exposure limits are prohibitive, the licensee should defer testing to cold shutdown or RFOs during which the exposure limits would no longer be prohibitive. ALARA is part of an overall program, including activities such as IST, as required by 10 CFR 20.1101, “Radiation protection programs.” The NRC has not established predetermined acceptable limits for deferring an IST activity, based on maintaining occupational exposure ALARA.

- Testing as required by the OM Code could cause significant equipment damage. For example, shutting off cooling flow to an operating pump by exercising a valve in the cooling flow path could damage the pump.

- Failure of a component during testing could disable multiple trains of a reactor safety system and cause a loss of system function. For example, a motor-operated suction valve common to both trains of high-pressure safety injection could not be tested during power operation because a failure of the valve would result in both trains being out of service. As another example, a valve is undergoing maintenance in one train, and testing of the valve in the other train would result in a loss of system function.

Inconvenience and administrative burden are not, in and of themselves, adequate justification for deviating from the OM Code requirements. Similarly, entering a TS LCO is not, in and of itself, adequate justification for deviating from the OM Code-specified frequency, except when entering the LCO would be prohibited because the total system function would be out of service.

The justification for an alternative request under 10 CFR 50.55a(z)(1) differs from that of a request under 10 CFR 50.55a(z)(2). A licensee may request an alternative under one 10 CFR 50.55a(z) subparagraph, but the NRC might also evaluate the request under the other 10 CFR 50.55a(z) subparagraph. The standard for justification under 10 CFR 50.55a(z)(1) (an acceptable level of quality and safety) is different from the justification under 10 CFR 50.55a(z)(2) (a hardship or unusual difficulty would result without a compensating increase in the level of quality and safety). The NRC staff typically evaluates a request under 10 CFR 50.55a(z)(1) as to whether the alternative provides information comparable to the information provided by the testing required in the OM Code. For a request under 10 CFR 50.55a(z)(2), the staff considers the challenges (such as plant shutdown, major modifications, or significant radiation exposure) related to performing the test as specified in the OM Code. Consistent with its regulations, the NRC staff does not evaluate a request as an alternative if submitted as relief, and vice versa. When uncertain as to the most appropriate request provision, a licensee should discuss its plans for the request during a presubmittal meeting with the NRC.

2.5.2 Categories of Relief or Alternative Requests

Licensees may submit relief or alternative requests on a plant-specific basis for a single nuclear power plant, or on a basis for multiple nuclear power plants. The NRC staff will evaluate these requests for the applicable components for each nuclear power plant included in the request with respect to the IST code of record for that plant. The staff notes that requests that include multiple nuclear power plants with different OM Code editions and addenda for their IST code of record will require more review time and resources. Licensees should address any previous relief that was granted or alternatives that were authorized that might overlap with current relief or alternative requests.

Licensees must identify the components within the scope of a relief and alternative request for each nuclear power plant for the staff to be able to reach a finding under 10 CFR 50.55a(f)(6)(i) or 10 CFR 50.55a(z) for that request. The NRC staff receives a copy of the IST program plan at the beginning of the code of record interval but not periodic updates. Therefore, a licensee will need to ensure that a relief or alternative request identifies the specific components within the scope of the request. If a request is intended to encompass all pumps, valves, or snubbers (or a subgroup) in the IST program for a specific plant, the licensee will need to provide an updated list of the applicable components in the IST program to allow the NRC staff to specify the scope of its safety evaluation for the request. This might be challenging for requests involving multiple nuclear power plants.

2.5.3 Content and Format of Relief or Alternative Requests

Relief or alternative requests may be submitted to the NRC either in paper form or electronically. As a minimum, the NRC staff recommends that each relief or alternative request include the following information:

- Title and relief or alternative request number: Licensees should title each relief or alternative request and specify a unique identifier. The identifier should remain unique to avoid confusion with later revisions. The staff recommends that the licensee determine whether the request involves relief under 10 CFR 50.55a(f)(5) or (g)(5), or an alternative under 10 CFR 50.55a(z), and label the request as relief or an alternative as appropriate.

- Page number: List the page number and total number of pages in the program document or the relevant section, such as “Page 15 of 135.”

- Program revision or page revision date: List the program or page revision number and date (on each page). List the revision number for each program change submitted.

- Code of record: List the applicable code edition for the plant’s IST interval, including the start and end dates of the IST interval for which relief or alternative is requested.

- System and code class: List the plant system and code class of the system in which the component is located.

- Pump or valve category or group: List the ASME category or group for each pump or valve (i.e., A, A/B, A/C, B, C, or D).

- Component identification: List the identification number for each component in a specific relief or alternative request. Each individual component need not be listed in a general relief or alternative request, such as one for all pumps in the IST program. However, the NRC staff recommends that the list of program components (pump or valve table) should include the relief or alternative request number.

- Component function: Briefly describe the functions of the affected components and specify the function that is the subject of the relief or alternative request.

- OM Code test requirement(s): List and describe the OM Code requirement(s) from which relief or an alternative is being requested.

- Basis for relief or alternative: Clearly state the regulatory basis under which relief or an alternative is requested, and then explain the reasons why complying with the OM Code requirements is impractical, poses a hardship, or otherwise should not be enforced. Include all information that the NRC staff might need to complete its review. For example, most relief requests for check valves list the test direction(s) for which relief is requested.

- Proposed alternative testing: Clearly and thoroughly discuss the proposed alternative in sufficient detail to clearly demonstrate why it is a reasonable alternative to the OM Code requirement and provide a technical basis for its acceptability.

- Duration of proposed alternative or relief: Provide the requested duration for which the relief or alternative is requested (e.g., typical alternative requests are for the remainder of the current IST interval or until the next testing opportunity).

- Drawings and/or diagrams: If the relief request or alternative testing is complex, or if drawings or diagrams are available for further clarification, include them in the relief or alternative request, or include them in the IST program document and reference them in the relief or alternative request.

- References: List references to FSAR sections, TS, and other pertinent documents. Any document referenced in the relief or alternative request should be submitted to the NRC on the plant docket. If a document is not docketed but contains pertinent information, the relief request should explicitly include the information (if it is not readily available to the NRC staff and the public), rather than merely referencing the document.

2.5.4 Revising NRC-Granted Relief or NRC-Authorized Alternative

A licensee might determine that a relief request that has been granted by the NRC or an alternative request that has been authorized by the NRC does not accomplish the intent of the original request. In this case, the licensee might decide not to implement the relief or alternative. Otherwise, the licensee might submit a new request, or a revision to the original request, for relief from or an alternative to the OM Code requirements for NRC review. As specified in 10 CFR 50.55a(z), a proposed alternative to the OM Code requirements must be authorized by the NRC prior to being implemented by a licensee.

RG 1.187 provides guidance on the use of the 10 CFR 50.59 process. The 10 CFR 50.59 process does not allow the licensee to change an NRC granted or authorized relief request or alternative. Nuclear Energy Institute (NEI) document NEI 96-07, Revision 1, "Guidelines for 10 CFR 50.59 Implementation," issued November 2000 (ML003771157), states that licensees' activities that are controlled by the regulations in 10 CFR 50.55a may take precedence over 10 CFR 50.59. RG 1.187 endorses NEI 96-07, Revision 1.

2.5.5 NRC Verbal Authorization of an Alternative Request

On rare occasions, the NRC may grant verbal authorizations as an alternative under 10 CFR 50.55a(z) when, because of unforeseen circumstances, licensees need NRC authorization before the agency is able to issue its written safety evaluation as described in NRC Office Instruction LIC-102, Revision 3.

Verbal authorization for an alternative under 10 CFR 50.55a(z) is subject to the following:

- The proposed alternative is in writing, and all the information that the NRC requires to complete the safety evaluation has been docketed.

- An identified need for the verbal authorization is recognized given the circumstances of the licensee's request.

- The NRC has completed its review and determined that the proposed alternative is technically justified, but the agency has not yet formally documented it in a safety evaluation. As noted in verbal authorizations issued in the past, a verbal authorization does not preclude the NRC staff from asking for additional clarification of the proposed alternative while subsequently preparing the written safety evaluation.

- The technical branch and reactor licensing branch chiefs have agreed to the verbal authorization.

Verbal authorization is most likely conveyed in a teleconference with a summary of the NRC staff evaluation. As such, appropriate NRC personnel who are normally involved in authorizing the alternative must be present in the teleconference. The NRC project manager should promptly (i.e., in 1 or 2 days) generate a record of the teleconference; this record will meet the definition of an Official Agency Record and must be entered into ADAMS and made publicly available. The NRC should issue the final written authorization within 150 days after giving verbal authorization. Because NRC safety evaluations are commonly used as precedents for other licensee actions, the NRC staff may ask for additional information to be docketed after verbally approving the alternative request, with the intent that the final NRC safety evaluation provides an appropriate precedent for general reference.

2.5.6 NRC Authorization of Proposed Alternative Similar to Prior NRC-Authorized Alternative and Reliefs

When updating their IST program in accordance with 10 CFR 50.55a(f)(4)(ii), licensees occasionally submit alternative and relief requests that are very similar to NRC-authorized alternative and relief requests for the previous IST intervals. This practice is acceptable provided that the licensee compares the requirements between the old and new OM Codes and evaluates whether changes to the alternative or relief request are necessary. For example, the OM Code has added provisions for exercising check valves such as disassembly and condition monitoring programs. Addressing the check valve disassembly and condition monitoring programs in the alternative request may be appropriate if these provisions were not included in the OM Code on which the original alternative request was based. Furthermore, the addition of disassembly and condition monitoring programs to the OM Code may eliminate the need for the alternative request. In addition, licensees should review new OM Code Cases before submitting an alternative or relief request for updated IST programs.

In many instances, licensees submit an alternative or relief request with a reference to a prior NRC-authorized alternative or relief request for a different nuclear power plant as a precedent for their request. When a previous NRC-authorized request is referenced as a precedent, the NRC staff must review the previous request to determine its applicability to the new request. Alternative or relief requests are considered on a case-by-case basis. The NRC staff will review the request in relation to the alternative or relief requirements, not merely by the fact that a prior alternative was approved. The licensee can save considerable time and resources for the NRC staff review by identifying the similarities and differences between its request and the referenced precedent from a different nuclear power plant.

2.6 Inservice Testing Program Documents

The applicable OM Code, Subsection ISTA, contains documentation requirements such as the following:

- In older editions and addenda of the OM Code, ISTA-3200(a) requires that IST plans shall be filed with the regulatory authority having jurisdiction at the plant site. As it was considered to be more like a regulatory requirement than an IST requirement, ASME removed this requirement beginning with the 2020 Edition of the OM Code. To maintain the submittal of IST program plans, the NRC regulations were amended so that 10 CFR 50.55a(f)(7) requires the submittal of the IST plan for pumps, valves, and snubbers within 90 days of the implementation of the applicable IST interval at each nuclear power plant.

- Section ISTA-9000, “Records and Reports,” provides the requirements for preparation, submittal, and retention of records and reports.

- Nonmandatory Appendix A and the Supplement to Nonmandatory Appendix A in the OM Code describe voluntary guidance for licensees for development of IST plans for pumps and valves.

As long as the IST program is consistent with the regulations, OM Code relief is not required. That is, deletions from or additions to the IST program do not necessarily require NRC approval. The burden is on each licensee to verify that its IST program is complete and includes all components that require IST activities, and that all such components are tested to the extent

required by the applicable edition and addenda of the OM Code, as endorsed in 10 CFR 50.55a. If a licensee deletes a particular component from its IST program, the NRC staff recommends that the licensee document the reason in an appropriate place.

The NRC staff expects each licensee to maintain its IST program up to date and ensure that it remains consistent with changes in plant configuration. If a particular relief request or proposed alternative is no longer required because of changes in hardware, system design, or new technology, the licensee is expected to revise its program to withdraw the relief request or proposed alternative. Conversely, if a system modification results in the addition of a component to the IST program, the licensee should ensure that it meets the OM Code requirements, or that a relief request or proposed alternative is submitted for NRC review and approval, as appropriate.

IST program documents submitted to the NRC are used to prepare for IST inspections and to address other licensing actions that may arise. Between a licensee's IST interval submittals, the NRC staff expects to receive up-to-date program documents when the licensee makes significant changes to the IST program to facilitate these regulatory activities. These updates should be provided on a schedule commensurate with the UFSAR updates.

2.7 Developing Inservice Testing Programs for New Nuclear Power Plants

The nuclear industry has submitted applications for licenses to construct and operate new nuclear power plants. The NRC discusses policy and technical issues associated with new reactors, including the development of IST programs, in several Commission papers, such as the following:

- SECY-90-016, "Evolutionary Light Water Reactor (LWR) Certification Issues and Their Relationship to Current Regulatory Requirements," dated January 12, 1990 (ML003707849)

- SECY-93-087, "Policy, Technical, and Licensing Issues Pertaining to Evolutionary and Advanced Light-Water Reactor (ALWR) Designs," dated April 2, 1993 (ML003708021)

- SECY-94-084, "Policy and Technical Issues Associated with the Regulatory Treatment of Non-Safety Systems in Passive Plant Designs," dated March 28, 1994 (ML003708068)

- SECY-95-132, "Policy and Technical Issues Associated with the Regulatory Treatment of Non-Safety Systems (RTNSS) in Passive Plant Designs (SECY-94-084)," dated May 22, 1995 (ML003708005)

- applicable staff requirements memoranda (SRMs)

In the staff memorandum, "Consolidation of SECY-94-084 and SECY-95-132," dated July 24, 1995 (ML003708048), the NRC staff consolidated the discussion of the policy and technical issues associated with RTNSS in new passive plant designs provided in SECY-94-084 and SECY-95-132, and their associated SRMs.

The NRC regulations in 10 CFR Part 52 include design certifications for specific new reactor designs, such as the Advanced Boiling Water Reactor (ABWR); AP600, AP1000, and APR1400 PWRs; Economic Simplified Boiling-Water Reactor (ESBWR); NuScale; and System 80+

reactor. In addition, suppliers of design certifications have submitted applications for, or updates to, certification of designs for several new reactors. The NRC regulations require new reactor suppliers to address the design of plant systems related to the performance of the IST program in their design certification application. While the design phase contains significant flexibility, new reactor vendors should design their plants to minimize the need for requests for relief from the IST provisions in the OM Code. Under 10 CFR Part 52, the COL applicant is responsible for the development of a plant-specific IST program for a COL to construct and operate a nuclear power plant.

The Commission's SRM, dated September 11, 2002 (ML022540755), for SECY-02-0067, "Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC) for Operational Programs (Programmatic ITAAC)," dated April 15, 2002 (ML020700641), stated that ITAAC for an operational program are unnecessary if the COL application fully describes the program and its implementation and the NRC finds them acceptable. The Commission also stated that the burden is on the COL applicant to provide the necessary and sufficient programmatic information for approval of the COL without ITAAC.

In its May 14, 2004, SRM (ML041350440) for SECY-04-0032, "Programmatic Information Needed for Approval of a Combined License without Inspections, Tests, Analyses and Acceptance Criteria," dated February 26, 2004 (ML040230079), the Commission defined "fully described" as meaning that the program is clearly and sufficiently described in terms of the scope and level of detail to allow a reasonable assurance finding of acceptability. The Commission also noted that required programs should always be described at a functional level and at an increasing level of detail when implementation choices could materially and negatively affect program effectiveness and acceptability. SECY-05-0197, "Review of Operational Programs in a Combined License Application and Generic Emergency Planning Inspections, Tests, Analyses, and Acceptance Criteria," dated October 28, 2005 (ML052770257), summarizes the NRC position on the full description of operational programs to be provided by COL applicants. The guidance in this NUREG may be used in developing and implementing the IST program for new nuclear power plants.

For a COL issued under 10 CFR Part 52, 10 CFR 50.55a(f)(4)(i) states that inservice tests conducted during the initial code of record interval to verify operational readiness of applicable plant components, whose function is required for safety, must comply with the requirements in the latest edition and addenda of the OM Code, incorporated by reference in 10 CFR 50.55a(a), on the date no more than 18 months before the date scheduled for initial fuel loading (or the optional Code Cases listed in RG 1.192) subject to the conditions listed in 10 CFR 50.55a. As discussed in RIS 2012-08, Revision 1, "Developing Inservice Testing and Inservice Inspection Programs under 10 CFR Part 52," dated July 17, 2013 (ML13122A365), licensees may submit a request under 10 CFR 50.55a(z) to apply the edition and addenda of the OM Code specified in the COL application for the initial code of record interval as an alternative to the latest edition and addenda of the OM Code, where the differences between the IST provisions in these code editions and addenda are addressed.

Several applications under 10 CFR Part 52 were submitted for COLs to construct and operate new nuclear power plants that reference certified reactor designs or designs under certification review. In addition to addressing design aspects related to the IST program, new reactor design certification applicants typically provide a description of generic aspects of the IST program to allow the COL applicants to incorporate by reference this design certification information in their COL application. The NRC staff reviews the description of the IST program in the COL application, with its incorporation by reference of IST provisions in the applicable design

certification documentation, as part of the safety evaluation for the COL application. The NRC staff will conduct inspections of the development and implementation of the IST program following COL issuance.

ASME has prepared "Component Testing Requirements at Nuclear Facilities," referred to as the OM-2 Code, which provides improved IST provisions for components that move fluid and stop fluid from moving, as well as snubbers, in new nuclear power plants that might rely on non-water-cooled systems. The NRC staff is preparing a new RG to address the acceptance of the ASME OM-2 Code. For licensees of water-cooled nuclear power plants, 10 CFR 50.55a would continue to require implementation of the OM Code for IST programs for pumps, valves, and snubbers.

Lessons learned from nuclear power plant operating experience and research that should be considered in the development of IST programs for new reactors include the following, for example:

- Design and qualification of pumps, valves, and snubbers to allow IST activities (including sufficient flow testing) to assess the operational readiness of those components, including ASME Standard QME-1-2017, "Qualification of Active Mechanical Equipment Used in Nuclear Power Plants," as found acceptable by the NRC staff in Revision 4 of RG 1.100, "Seismic Qualification of Electric and Active Mechanical Equipment and Functional Qualification of Active Mechanical Equipment for Nuclear Power Plants," issued May 2020, to incorporate lessons learned in the qualification of mechanical equipment for nuclear power plants. ASME has issued a 2023 Edition of the QME-1 Standard and is preparing a reformatted version of QME-1 that will be more applicable to non-water-cooled reactors. The NRC plans to revise RG 1.100 when ASME issues the reformatted version of the QME-1 Standard.

- Performance and testing of MOVs that indicate the need for improved MOV activities, such as the importance of adequate design and qualification, sufficient flow during testing to assess valve performance, consideration of MOV performance parameters (including valve disk and stem friction coefficients, reduced voltage, elevated temperature, and load sensitive behavior), use of adequate diagnostic instrumentation to allow proper evaluation and setup, improved maintenance and personnel training, monitoring of potential motor magnesium rotor degradation, and justification for motor control center testing.

- Application of MOV lessons learned to other POVs.

- Provisions for bi-directional testing of check valves.

- Implementation of PST and CPT provisions without the need for relief from the OM Code provisions.

- Consideration of potential adverse flow effects on plant components from flow-induced vibration resulting from hydrodynamic loads and acoustic resonance.

New reactor issues that should be considered in the development of IST programs for new nuclear power plants include the following examples:

- Description of IST programs by COL applicants in accordance with 10 CFR Part 52 with implementation of design certification provisions for design, qualification, and IST activities.

- Coordination of PST and ITAAC so that testing is performed once for both purposes. For example, implementation of PST requirements and the 10 CFR Part 52 ITAAC closure and maintenance process both need to be accomplished. Under the 10 CFR Part 52 process, an applicant is required to meet OM Code requirements after a 10 CFR 52.103(g) finding is made, although it would be preferable to complete the PST requirements earlier.

- Design, qualification, and IST and inspection activities for pyrotechnic-actuated (squib) valves that have high safety significance and that represent more significant engineering challenges for new reactors than for currently operating plants.

- Design of plant systems and development of IST programs to minimize the need for relief from the OM Code provisions.

- Design, qualification, PST, and IST activities for RTNSS components that perform safety significant functions.

- Development and implementation of risk-informed IST programs, including programs under 10 CFR 50.69, “Risk-informed categorization and treatment of structures, systems and components for nuclear power reactors,” for new reactors.

- Consideration of appropriate code and standard modifications for design, qualification, PST, and IST activities in response to the application of software-based digital technology in mechanical components (e.g., pumps and valves).

Applicants for new nuclear power plants should consider the information in this NUREG and other sources in developing their IST programs.

The NRC regulations in 10 CFR 50.55a(b)(3)(iii) apply specific conditions for IST programs applicable to licensees of new nuclear power plants in addition to the provisions of the OM Code as incorporated by reference with conditions in 10 CFR 50.55a. Licensees of “new reactors” are identified in 10 CFR 50.55a as holders of operating licenses for nuclear power reactors that received construction permits under 10 CFR Part 50 on or after August 17, 2018, and COL holders issued under 10 CFR Part 52, whose initial fuel loading occurs on or after August 17, 2018.

As described in the following paragraphs, 10 CFR 50.55a(b)(3)(iii) includes two specific conditions.

The NRC regulations in 10 CFR 50.55a(b)(3)(iii)(A) require licensees within the scope of 10 CFR 50.55a(b)(3)(iii) to periodically verify the capability of POVs to perform their design-basis safety functions. Mandatory Appendix III to the OM Code addresses this requirement for MOVs with the conditions specified in 10 CFR 50.55a. Mandatory Appendix IV to the OM Code addresses this requirement for AOVs. RIS 2000-03, “Resolution of Generic

Safety Issue 158: Performance of Safety-Related Power Operated Valves Under Design Basis Conditions," dated March 15, 2000, describes attributes of a successful long-term periodic verification program for POVs by incorporating lessons learned from MOV performance at operating nuclear power plants and research programs. Applicable licensees will need to satisfy 10 CFR 50.55a(b)(3)(iii)(A) for other POVs.

Paragraph (A) of 10 CFR 50.55a(b)(3)(iii) is consistent with the Commission policy for new reactors summarized in an NRC staff memorandum, "Consolidation of SECY-94-084 and SECY-95-132," dated July 24, 1995 (ML003708048). The policy states that (1) the design capability of safety-related POVs should be demonstrated by a qualification test prior to installation, (2) prior to initial startup, POV capability under design-basis differential pressure and flow should be verified by a preoperational test, and (3) during the operational phase, POV capability under design-basis differential pressure and flow should be verified periodically through a program similar to that developed for MOVs in GL 89-10. The condition in paragraph (A) specifies with the same level of detail as the condition in 10 CFR 50.55a(b)(3)(ii) that nuclear power plant licensees must establish a program to ensure the continued capability of MOVs in performing their design-basis safety functions. When establishing the MOV periodic verification condition, the NRC provided guidance in the final rule published on September 22, 1999 (64 FR 51370), for licensees to develop acceptable programs that would satisfy the MOV periodic verification condition. Similarly, the NRC staff provided guidance in an FR notice for the final rule dated July 18, 2017 (82 FR 32934), and summarized herein, for new reactor applicants and licensees to develop acceptable programs to periodically verify the capability of POVs to perform their design-basis safety functions.

In NUREG-2124, Volume 1, "Final Safety Evaluation Report [FSER] Related to the Combined Licenses for Vogtle Electric Generating Plant [VEGP], Units 3 and 4," issued September 2012 (ML12271A045), the NRC staff found the provisions established by the COL applicant for VEGP Units 3 and 4 in its FSAR, Revision 5, Section 3.9.6.2.2, "Valve Testing," to periodically verify the capability of POVs, such as AOVs, solenoid-operated valves (SOVs), and hydraulic-operated valves (HOVs), to perform their design-basis safety functions to be acceptable. In particular, the VEGP Units 3 and 4 FSAR in Section 3.9.6, "Inservice Testing of Pumps and Valves," specifies the following:

> Power-operated valves other than active MOVs are exercised quarterly in accordance with OM ISTC, unless justification is provided in the inservice testing program for testing these valves at other than Code mandated frequencies. Although the design basis capability of power-operated valves is verified as part of the design and qualification process, power-operated valves that perform an active safety function are tested again after installation in the plant, as required, to ensure valve setup is acceptable to perform their required functions, consistent with valve qualification. These tests, which are typically performed under static (no flow or pressure) conditions, also document the "baseline" performance of the valves to support maintenance and trending programs. During the testing, critical parameters needed to ensure proper valve setup are measured. Depending on the valve and actuator type, these parameters may include seat load, running torque or thrust, valve travel, actuator spring rate, bench set and regulator supply pressure. Uncertainties associated with performance of these tests and use of the test results (including those associated with measurement equipment and potential degradation mechanisms) are addressed appropriately. Uncertainties may be considered in the specification of acceptable valve setup parameters or in the interpretation of the test results (or a combination of both).

Uncertainties affecting both valve function and structural limits are addressed. Additional testing is performed as part of the air-operated valve (AOV) program, which includes the key elements for an AOV Program as identified in the JOG AOV program document, Joint Owners Group Air Operated Valve Program Document, Revision 1, December 13, 2000 (References 203 and 204 from JOG Program Document) [Joint Owners Group (JOG) AOV Program Document, Revision 1, December 13, 2000 (ML010950310), and NRC comment letter dated October 8, 1999, to the NEI (ML020360077)]. The AOV program incorporates the attributes for a successful power-operated valve long-term periodic verification program, as discussed in Regulatory Issue Summary 20-00-03, Resolution of Generic Safety Issue 158: Performance of Safety-Related Power-Operated Valves Under Design Basis Conditions, by incorporating lessons learned from previous nuclear power plant operations and research programs as they apply to the periodic testing of air- and other power-operated valves included in the IST program.

For example, key lessons learned addressed in the AOV program include:

- Valves are categorized according to their safety significance and risk ranking.

- Setpoints for AOVs are defined based on current vendor information or valve qualification diagnostic testing, such that the valve is capable of performing its design-basis function(s).

- Periodic static testing is performed, at a minimum on high risk (high safety significance) valves, to identify potential degradation, unless those valves are periodically cycled during normal plant operation, under conditions that meet or exceed the worst-case operating conditions within the licensing basis of the plant for the valve, which would provide adequate periodic demonstration of AOV capability. If required based on valve qualification or operating experience, periodic dynamic testing is performed to re-verify the capability of the valve to perform its required functions.

- Sufficient diagnostics are used to collect relevant data (e.g., valve stem thrust and torque, fluid pressure and temperature, stroke time, operating and/or control air pressure, etc.) to verify the valve meets the functional requirements of the qualification specification.

- Test frequency is specified and is evaluated each refueling outage based on data trends as a result of testing. Frequency for periodic testing is in accordance with References 203 and 204, with a minimum of 5 years (or 3 refueling cycles) of data collected and evaluated before extending test intervals.

- Post-maintenance procedures include appropriate instructions and criteria to ensure baseline testing is re-performed as necessary when maintenance on the valve, repair or replacement, have the potential to affect valve functional performance.

- Guidance is included to address lessons learned from other valve programs specific to the AOV program.

- Documentation from AOV testing, including maintenance records and records from the corrective action program are retained and periodically evaluated as a part of the AOV program.

The attributes of the AOV testing program described above, to the extent that they apply to and can be implemented on other safety-related power-operated valves, such as electro-hydraulic operated valves, are applied to those other power-operated valves.

Applicants and licensees may follow the method described in the VEGP Units 3 and 4 FSAR, as applicable, in satisfying 10 CFR 50.55a(b)(3)(iii)(A), or they may establish a different method, subject to evaluation by the NRC during the licensing process or inspections.

The NRC regulations in 10 CFR 50.55a(b)(3)(iii)(D) require that licensees within the scope of 10 CFR 50.55a(b)(3)(iii) establish a program to assess the operational readiness of pumps, valves, and dynamic restraints within the scope of RTNSS for applicable reactor designs. SECY-94-084 and SECY-95-132 discuss RTNSS policy and technical issues associated with passive plant designs. Some new nuclear power plants have ALWR designs that use passive safety systems that rely on natural forces, such as density differences, gravity, and stored energy to supply safety injection water and to provide reactor core and containment cooling. Active systems in passive ALWR designs are categorized as nonsafety systems with limited exceptions. Active systems in passive ALWR designs provide the first line of defense to reduce challenges to the passive systems in the event of a transient at the nuclear power plant. Active systems that provide a defense-in-depth function in passive ALWR designs need not meet all of the acceptance criteria for safety-related systems. However, there should be a high level of confidence that these active systems will be available and reliable when needed.

The combined activities to provide confidence in the capability of these active systems in passive ALWR designs to perform their functions important to safety are referred to as the RTNSS program. In the NRC staff memorandum, “Consolidation of SECY-94-084 and SECY-95-132,” dated July 24, 1995 (ML003708048), the NRC staff provided a consolidated list of the approved policy and technical positions associated with RTNSS equipment in passive plant designs discussed in SECY-94-084 and SECY-95-132. The NRC regulations in 10 CFR 50.55a(b)(3)(iii)(D) specify the need for licensees to assess the operational readiness of RTNSS pumps, valves, and dynamic restraints.

The July 24, 1995, NRC staff memorandum summarizes the Commission policy positions related to IST of RTNSS pumps and valves as follows:

> The NRC staff also concluded that additional inservice testing requirements may be necessary for certain pumps and valves in passive plant designs. The unique passive plant design relies significantly on passive safety systems, but also depends on non-safety systems (which are traditionally safety-related systems in current light-water reactors) to prevent challenges to passive systems. Therefore, the reliable performance of individual components is a very significant factor in enhancing the safety of passive plant design. The NRC staff recommends that the following provisions be applied to passive ALWR plants to ensure reliable component performance.

1. Important non-safety-related components are not required to meet criteria similar to safety-grade criteria. However, the non-safety-related piping systems with functions that have been identified as being important by the RTNSS process should be designed to accommodate testing of pumps and valves to assure that the components meet their intended functions. Specific positions on the inservice testing requirements for those components will be determined as a part of the NRC staff's review of plant-specific implementation of the regulatory treatment of non-safety systems for passive reactor designs.

2. …The vendors for advanced passive reactors, for which the final designs are not complete, have sufficient time to include provisions in their piping system designs to allow testing at power. Quarterly testing is the base testing frequency in the Code and the original intent of the Code. Furthermore, the COL holder may need to test more frequently than during cold shutdowns or at every refueling outage to ensure that the reliable performance of components is commensurate with the importance of the safety functions to be performed and with system reliability goals. Therefore, to the extent practicable, the passive ALWR piping systems should be designed to accommodate the applicable Code requirements for the quarterly testing of valves. However, design configuration changes to accommodate Code-required quarterly testing should be done only if the benefits of the test outweigh the potential risk.

3. The passive system designs should incorporate provisions (1) to permit all critical check valves to be tested for performance, to the extent practicable, in both forward- and reverse-flow directions, although the demonstration of a non-safety direction test need not be as rigorous as the corresponding safety direction test, and (2) to verify the movement of each check valve's obturator during inservice testing by observing a direct instrumentation indication of the valve position such as a position indicator or by using nonintrusive test methods.

4. …Similarly, to the extent practicable, the design of non-safety-related piping systems with functions under design-basis condition that have been identified as being important by the RTNSS process should incorporate provisions to periodically test power-operated valves in the system during operations to assure that the valves meet their intended functions under design-basis conditions.

5. …Mispositioning may occur through actions taken locally (manual or electrical), at a motor control center, or in the control room, and includes deliberate changes of valve position to perform surveillance testing. The NRC staff will determine if and the extent to which this concept should be applied to MOVs in important non-safety-related systems when the NRC staff reviews the implementation of the regulatory treatment of non-safety systems. [NRC staff memorandum, “Consolidation of SECY-94-084 and SECY-95-132,” July 24, 1995, pages 26–28]

Consistent with the Commission policy for RTNSS equipment, 10 CFR 50.55a(b)(3)(iii)(D) specifies that new reactor licensees shall assess the operational readiness of pumps, valves,

and dynamic restraints within the RTNSS scope. This regulatory requirement will allow licensees flexibility in developing programs to assess operational readiness of RTNSS components that satisfy the Commission policy. Guidance on the implementation of the Commission policy for RTNSS equipment is set forth in NRC Inspection Procedure (IP) 73758, "Part 52, Functional Design and Qualification, and Preservice and Inservice Testing Programs for Pumps, Valves and Dynamic Restraints," dated February 6, 2020 (ML19364A004).

Table 2.1 Typical Systems and Components in an Inservice Testing Program for a PWR

Typical safety-related, code-class system in PWRs	Typical components in an IST program
Reactor coolant system and flow paths for establishing natural circulation	- Power-operated relief valves (PORVs) and associated block valves - Reactor high point and head vents - Primary system safety and relief valves (pressurizer code safety valves) - Valves in any proposed flowpath used for long-term core cooling or safe shutdown - Pressure boundary isolation valves - Valves in lines to pressurizer relief/quench tank
Main steam system	- Main steam isolation valves (MSIVs) - Main steam non-return valves (if applicable) - Secondary system safety and relief valves - Atmospheric dump valves - Auxiliary feedwater (AFW) turbine steam supply valves - Steam generator blowdown isolation valves
High-pressure safety injection system	- High-pressure injection pumps and discharge check valves - Injection valves in injection flowpath - Isolation valves - Valves for the refueling water storage tank, borated water storage tank, and refueling water tank, including vacuum breakers
Chemical and volume control or makeup system	- Charging or makeup pumps and suction/discharge check valves - Valves in charging/makeup flowpath - Boric acid transfer pumps and suction/discharge check valves - Valves in emergency boration flowpaths - Relief valves

Table 2.1 Typical Systems and Components in an Inservice Testing Program for a PWR (cont.)

Typical safety-related, code-class system in PWRs	Typical components in an IST program
Low-pressure safety injection system	- Injection pumps and suction/discharge check valves - Valves associated with safety injection accumulators and core flood tanks - Recirculation flowpath valves, including containment sump isolation valves - Isolation valves (high-low pressure interface) - Relief valves
Shutdown cooling, residual heat removal (RHR), or decay heat removal systems	- Pumps and suction/discharge check valves - Valves in flowpath - Isolation valves (high-low pressure interface) - Relief valves
Containment spray system	- Containment spray pumps and suction/discharge check valves - Valves in flowpaths to spray header - Isolation valves - Valves in spray additive flowpath - Spray additive tank valves, including vacuum breakers
Main feedwater system	- Main feedwater isolation valves
AFW system	- AFW pumps and suction/discharge check valves - Valves in flowpath to steam generators - Valves in suction lines - Valves between normal and ultimate heat sink suction sources - Relief valves and isolation valves
Primary containment system	- Containment isolation valves (CIVs) (various systems) - Containment combustible gas venting valves - Containment atmosphere sampling valves (if within the scope of 10 CFR 50.55a)
Component cooling water system	- Component cooling water pumps and discharge check valves - Valves in letdown cooling water flowpath - Valves in reactor coolant pump seal injection and cooling water flowpath - Valves needed to isolate a rupture of the thermal barrier - Relief valves
Spent fuel pool/pit cooling system	- Spent fuel cooling pumps and suction/discharge check valves - Valves in flowpath from ultimate heat sink source supply

Table 2.1 Typical Systems and Components in an Inservice Testing Program for a PWR (cont.)

Typical safety-related, code-class system in PWRs	Typical components in an IST program
Service water system	- Service water pumps and suction/discharge check valves - Valves in flowpath to AFW system - Valves in flowpaths to emergency room coolers - Valves in flowpaths to containment emergency coolers - Valves in flowpaths to emergency diesel generator heat exchangers - Isolation and cross-tie valves - Valves in ultimate heat sink source flowpaths - Valves in standby or backup service water, if applicable
Emergency diesel generator system (within scope of 10 CFR 50.55a)	- Fuel oil storage and transfer pumps and valves - Diesel generator external cooling (service water) - Engine air start check valves - Air receiver relief valves
Ventilation systems	- Pumps and valves in control room emergency cooling water supply flowpath
Instrument air system (if within the scope of 10 CFR 50.55a)	- Air supply to containment purge valves - Air supply to PORVs - Air supply to MSIVs

Table 2.2 Typical Systems and Components in an Inservice Testing Program for a BWR

Typical safety-related, code-class system in BWRs	Typical components in an IST program
Nuclear boiler and reactor recirculation system	- Primary system isolation valves - Excess flow check valves - Safety Relief Valve/Automatic Depressurization System valves
Main steam system	- MSIVs and actuator valves (pilot valves, accumulator check valves) - Main steam safety and relief valves - Main steam safety valve discharge rupture diaphragm valve - MSIV leakage valves
High-pressure coolant injection (HPCI) system	- Pump and suction/discharge check valves - Valves in injection flowpath - Isolation valves, including valves in test lines - Excess flow check valves - HPCI pump turbine valves, including turbine exhaust vacuum breakers (unless considered skid-mounted)

Table 2.2 Typical Systems and Components in an Inservice Testing Program for a BWR (cont.)

Typical safety-related, code-class system in BWRs	Typical components in an IST program
High-pressure core spray system	- Pumps and suction/discharge check valves - Valves in injection flowpath - Isolation valves, including valves in test lines
Reactor core isolation cooling (RCIC) system	- Pump and suction/discharge check valves - RCIC pump turbine valves - Excess flow check valves - Isolation valves
Reactor water cleanup system	- CIVs
RHR system	- RHR pumps and suction/discharge check valves - Isolation and cross-tie valves - Pump suction relief valves - RHR heat exchanger thermal relief valves - Valves in injection flowpath - Flow control valves
Spent fuel pool cooling system	- Fuel pool pumps and suction/discharge check valves - Ultimate heat sink supply valve
Feedwater coolant injection and isolation condenser system (if applicable)	- Reactor feedwater pumps and suction/discharge check valves - Condensate pumps and suction/discharge check valves - Condensate booster pumps and suction/discharge check valves - Emergency condensate transfer pump and suction/discharge check and isolation valves - Isolation and bypass valves - Vent valves - Makeup to condenser shell check valves
Standby liquid control system	- Standby liquid control pumps and suction/discharge check valves - Relief valves - Injection line valves - Pyrotechnic-actuated (squib) valves
Main feedwater system	- Isolation valves
Primary containment system	- CIVs, including excess flow check valves (various systems) - Containment atmosphere monitoring system valves - Containment atmosphere dilution system valves - Containment pressure suppression and vents
Closed cooling or component cooling water system	- Pumps and suction/discharge check valves - Valves in flowpaths to safety-related coolers

Table 2.2 Typical Systems and Components in an Inservice Testing Program for a BWR (cont.)

Typical safety-related, code-class system in BWRs	Typical components in an IST program
Service water system	- Pumps and suction/discharge check valves - Isolation and cross-tie valves - Valves in flowpaths to safety-related coolers - Valves in flowpaths to diesel generator coolers - Valves in standby or backup service water - Valves in flowpath from ultimate heat sink source - Valves in RHR service water flow path
Control rod drive system (portions within the scope of 10 CFR 50.55a)	- Scram dump valves - Scram discharge volume vent valves - Scram discharge volume drain valves - Accumulator rupture disks - Hydraulic control unit control valves - Drive water backflow prevention valves
Emergency diesel generator systems (if within the scope of 10 CFR 50.55a)	- Fuel oil storage and transfer pumps and valves - Diesel generator external cooling (service water) - Engine air start check valves - Air receiver relief valves
Ventilation systems	- Pumps and valves in control room emergency cooling water supply flowpath
Instrument air system (if within the scope of 10 CFR 50.55a)	- MSIV accumulator check valves - MSIV pilot valves - Automatic depressurization system valve accumulator check valves - Automatic depressurization system pilot valves
Traversing incore probe system (if within the scope of 10 CFR 50.55a)	- CIVs

Table 2.3 Example Data Table for Pumps

PLANT NAME/UNIT

PUMP TESTING PLAN

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Pump List					Parameters				
SYSTEM	PUMP ID	P&ID NO.	COORD.	PUMP GROUP	S	P	dP	Flow	V (PR-1)
Residual Heat Removal	RHR-01 RHR-02 RHR-03	M-402, Sh. 1 M-402, Sh. 2 M-402, Sh. 2	D-4 G-4 F-5	A	(1) (1) (1)	(2) (2) (2)	Q/2Y Q/2Y Q/2Y	Q/2Y Q/2Y Q/2Y	Q/2Y Q/2Y Q/2Y
Auxiliary Feedwater	AFW-01 AFW-02 AFW-03	M-408, Sh 1 M-408, Sh. 1 M-408, Sh. 1	B-5 B-8 B-11	B	(1) (1) Q/2Y	(2) (2) (2)	Q/2Y Q/2Y Q/2Y	Q/2Y Q/2Y Q/2Y	2Y 2Y 2Y
Service Water	SWS-01 SWS-02 SWS-03 SWs-04	M-335, Sh 1 M-335, Sh 2 M-335, Sh. 3 M-335, Sh. 4	F-9 D-4 E-8 C-4	A	(1) (1) (1) (1)	(2) (2) (2) (20	Q/2Y Q/2Y Q/2Y Q/2Y	PR-3 PR-3 PR-3 PR-3	PR-2 PR-2 PR-2 PR-2
Standby Liquid Control	SLC-01 SLC-02	M-367, Sh. 1 M-367, Sh. 1	D-9 D-4	B	(1) (1)	2Y 2Y	(3) (3)	Q/2Y Q/2Y	2Y 2Y

Note (1): Pump is directly coupled to a **content** speed synchronous or induction type driver.
Note (2): Discharge pressure is a required parameter for positive displacement pumps only.
Note (3): dP is not a required parameter for positive displacement pumps.

Legend:

S	Speed
P_i	Pressure
dP	Differential Pressure
PR	Pump Relief Request
Q	Quarterly
V	Vibration

Table 2.4 Useful Abbreviations for Valve Data

Parameter	Abbreviation	Description
Valve Type	GT	Gate valve
	GB	Globe valve
	CK	Check valve
	RV	Relief valve
	SC	Stop check
	BF	Butterfly valve
	DI	Diaphragm valve
	EX	Pyrotechnic-actuated valve
	BA	Ball valve
Actuator Type	MO	Motor-operated
	SO	Solenoid-operated
	AO	Air-operated
	HO	Hydraulic-operated
	SA	Self-actuated
	MA	Manual
	PA	Pilot-actuated
Safety Position(s)	O	Open
	C	Closed
	O/C	Both open and closed
	T	Throttled
Tests(s) Performed	FS	Full-stroke exercise valve to safety position(s)
	PS	Part-stroke exercise valve
	LT	Leak-rate test valve to Section XI requirements
	LJ	Leak-rate test valve to Appendix J requirements
	ST	Measure the full-stroke times of the valve
	FT	Observe the fail-safe operation of the valve
	PI	Verify the valve position indication
	RV	Safety and relief valve test
	EX	Pyrotechnic-actuated valve test
Test Frequency	Q	Test performed once every 92 days
	CS	Test performed during cold shutdowns, but not more frequently than once every 92 days
	RF	Test performed each reactor RFO
	2Y	Test performed once every 2 years
	RV	Test relief valve at OM schedule
	SD	Disassemble, inspect, and manually exercise one valve from specified group each reactor RFO

3 GENERAL GUIDANCE ON INSERVICE TESTING

3.1 Inservice Test Frequencies and Extensions

In the past, the OM Code generally specified quarterly testing of valves. Now, the IST requirements and frequency are more dependent on the type of valve. For example, Mandatory Appendix II to the OM Code allows condition monitoring of check valves. Mandatory Appendix III requires periodic exercising and diagnostic testing of MOVs. Mandatory Appendix IV specifies various testing requirements (including diagnostic testing as applicable) for AOVs based on their safety significance.

Where quarterly valve exercising is required, Subsection ISTC of the OM Code allows licensees to defer valve exercising to cold shutdown or RFOs if it is not practical to exercise the valves during plant operation. Impractical conditions justifying test deferrals are those that could result in an unnecessary plant shutdown, cause unnecessary challenges to safety systems, place undue stress on components, cause unnecessary cycling of equipment, or unnecessarily reduce the life expectancy of the plant systems and components.

IST requirements and frequency for pumps depend on the pump group and the type of test. Table 3.1 lists the tests and associated test frequencies required by the OM Code.

Table 3.1 ASME OM Code Tests and Test Frequencies for Pumps and Valves

Test	Frequency
Measure pump parameters	Subsection ISTB Once every 3 months (Group A, B Tests) Biennially (Comprehensive Test, Pump Periodic Verification Test) Exceptions: - Pumps that are out of service - Group B Pumps lacking required fluid inventory Subsection ISTF Inservice Test quarterly Periodic Verification Test biennially
Exercise Category A and B valves	Once every 3 months Exceptions: - Extension because of impracticality - Valves in regular use - Valves out of service - MOVs covered by OM Code, Mandatory Appendix III

Table 3.1 ASME OM Code Tests and Test Frequencies for Pumps and Valves (cont.)

Test	Frequency
Measure stroke times of power-operated Category A and B valves	Once every 3 months Exceptions: - Extension because of impracticality - Valves in regular use - Valves out of service - MOVs covered by OM Code, Mandatory Appendix III
Verify remote position indication	Once every 2 years, except when verified in accordance with OM Code appendices
Observe operation of fail-safe actuators for applicable valves	Once every 3 months, except for extension because of impracticality
Leak-test Category A and A/C valves	Once every 2 years
Test safety and relief valves, primary containment vacuum relief valves, and non-reclosing pressure-relief devices	Test interval specified by ASME OM Code, Mandatory Appendix I
Exercise check valves	Once every 3 months Exceptions: - Extension because of impracticality - Valves in regular use - Valves out of service - Check valves covered by OM Code, Mandatory Appendix II
Test pyrotechnic-actuated valves	20 percent tested once every 2 years Charges shall not be older than 10 years Additional testing and inspection required for pyrotechnic-actuated valves in post-2000 plants

3.1.1 Deferring Valve Testing to Each Cold Shutdown or Refueling Outage

For valves required to be exercised quarterly, the OM Code allows licensees to test valves during cold shutdowns if it is impractical to test the valves quarterly during plant operation. Paragraph ISTC-3500 provides guidance and alternatives. Therefore, exercising valves during cold shutdown outages does not constitute a deviation from the OM Code and does not require a relief request or proposed alternative if the licensee determines that quarterly testing is impractical. Similarly, the OM Code allows licensees to test valves during each RFO if it is impractical to test the valves during cold shutdowns. In such instances, the licensee should identify the valves for which testing is deferred, and the IST program document should specify the basis for determining that quarterly and/or cold shutdown testing is impractical.

In the past, the NRC staff has provided examples of valves that may be excluded from exercising (cycling) tests during plant operations. The excluded valves include the following examples:

- All valves that would cause a loss of system function if they were to fail in a nonconservative position during the cycling test. Valves in this category would typically

include all nonredundant valves in lines such as a single discharge line from the refueling water storage tank or accumulator discharge lines in PWRs and the HPCI turbine steam supply and HPCI pump discharge in BWRs. Other valves may fall into this category under certain system configurations or plant operating modes. For example, when one train of a redundant system (such as an emergency core cooling system (ECCS)) is inoperable, nonredundant valves in the remaining train should not be cycled because their failure would cause a loss of total system function.

- All valves that would result in a loss of containment integrity if they failed to close during a cycling test. Valves in this category would typically include all valves in containment penetrations where the redundant valve is open and inoperable.

- All valves that, when cycled, could subject a system to pressures in excess of their design pressures. For the purpose of a cycling test, it is assumed that one or more of the upstream check valves have failed unless positive methods are available for determining the pressure or lack thereof on the high-pressure side of the valve to be cycled. Valves in this category would typically include the isolation valves of the RHR or shutdown cooling system and, in some cases, certain ECCS valves.

The guidance in this NUREG and in the NRC's letters issued in 1976 to licensees (see section 1.2 of this document) does not supersede the TS requirements.

For valves required to be tested quarterly and such testing is practical, a licensee may request an alternative in accordance with 10 CFR 50.55a(z) to quarterly testing where such testing would impose a hardship (e.g., entering an LCO of 3 to 4 hours in duration, repositioning a breaker from "off" to "on," and necessitating manual operator actions to restore the system if an accident were to occur while the test was in progress). For such situations, the risk associated with quarterly testing may outweigh the benefits that might otherwise be achieved. (Section 3.1.2 gives guidance on these types of situations.) Thus, it is appropriate for licensees to weigh the safety impact against the benefits of testing as a basis for deferring testing from a quarterly frequency to cold shutdown or RFOs. NUREG/CR-5775 describes a method for making this comparison.

The following sections discuss issues related to deferring valve testing. These sections do not apply to testing that is required following maintenance or repair activities.

3.1.1.1 Inservice Testing Cold Shutdown Testing

Although Subsection ISTC of the OM Code does not include schedules for cold shutdown testing, an acceptable method is to ensure that the valves tested in the preceding cold shutdown are the last valves tested during the next cold shutdown, with the exception of valves that must be tested during each cold shutdown. The following is a sample schedule for 15 cold shutdown tests:

- First cold shutdown: Complete Tests 1, 2, 3, 4, 5, and 6
- Second cold shutdown: Complete Tests 7, 8, 9, and 10
- Third cold shutdown: Complete Tests 11, 12, 13, 14, 15, 1, 2, and 3
- Fourth cold shutdown: Complete Tests 4, 5, 6, and 7

Paragraph ISTC-3520 discusses exercising valves during both plant operation and cold shutdown as circumstances and situations apply. While the discussion does not specifically

address testing in hot standby or hot shutdown, valves should be exercised in the appropriate mode of operation. For a valve that cannot be tested in operation, testing might be practical during hot standby, hot shutdown, cold shutdown, or an RFO.

Valves that must be operable during cold shutdown may be tested during plant operation in accordance with Paragraph ISTC-3520 or Paragraph ISTC-3550, “Valves in Regular Use.” Paragraph ISTC-3550 applies if the component’s “normal use” is during cold shutdown.

3.1.1.2 Testing at a Refueling Outage Frequency for Valves Tested During Power Ascension

Paragraph ISTC-3520 specifies that valves tested on an RFO frequency should be tested before returning the plant to operation at power. Several plants are designed such that systems (including the valves) cannot be tested until after power ascension begins. The NRC staff has included this section to provide guidance for such valves and to indicate that the operability TS would control the timing for testing such valves. The IST program document is expected to identify such valves as being tested on an RFO frequency, even though the plant may actually return to “operation” at power before the testing is completed. A similar intent applies to valves that are tested during power ascension from cold shutdowns (which are not RFOs); however, Subsection ISTC uses different language in discussing valves that are tested on a cold shutdown frequency.

Before beginning power ascension from an RFO, licensees normally complete the tests of those valves that are tested during each RFO. However, for valves that can be tested only during power ascension or at power, licensees may begin increasing the power level and changing modes in accordance with TS requirements and may test the applicable valves when plant conditions allow testing. This situation also could apply to valves that are tested during power ascension or at power following a cold shutdown outage.

NRC Recommendation

Paragraph ISTC-3520 of the OM Code requires that all valve testing scheduled for performance during an RFO shall be completed before returning the plant to operation. For valves that can be tested only during power ascension, TS requirements (for the valves or the associated system) determine when the valves are required to be operable. The testing for these valves may be scheduled for RFOs or during cold shutdown conditions but must be completed during power ascension from the RFO.

The NRC staff has determined that testing of such valves during the plant startup period but prior to reaching steady-state full power operation is acceptable without a relief request or proposed alternative, provided that the licensee meets all requirements of paragraph ISTC-3520.

Basis for Recommendation

The NRC staff has determined that the guidance in this section is consistent with OM Code, paragraph ISTC-3520, and the TS requirements and, therefore, is acceptable for meeting the OM Code provisions.

3.1.1.3 De-Inerting Containment of Boiling-Water Reactors to Allow Cold Shutdown Testing

According to 10 CFR 50.44, "Combustible gas control for nuclear power reactors," each BWR that is equipped with a Mark I or Mark II containment must have provisions for an inerted containment atmosphere during power operation to protect against a burn or explosion of hydrogen gas generated by the core metal-water reaction following a postulated loss-of-coolant accident (LOCA).

Licensees regularly monitor oxygen content in the containment atmosphere during normal power operation, and the plant's TS specify the maximum oxygen concentrations allowed. Since hydrogen generation is not a concern during cold shutdown or RFOs, the TS allow the containment atmosphere to be de-inerted. However, licensees do not routinely de-inert the containment during cold shutdown outages because of impracticality concerns associated with the time needed to de-inert and re-inert the containment, and because of the amount of nitrogen necessary for inerting.

For certain valves that are located in the inerted containment, paragraph ISTC-3500 allows licensees to perform testing during cold shutdown outages because it is not practical to test such valves during power operation. The NRC staff has determined that it is impractical to de-inert the containment during each cold shutdown outage solely to perform such routine testing or repair activities.

NRC Recommendation

The NRC staff considers it impractical to de-inert the containment merely to conduct regularly scheduled valve testing, and the OM Code allows licensees to defer such testing to an RFO when the containment is de-inerted for refueling or other reasons. The NRC staff also has determined that few outages require de-inerting, and it is unnecessary to maintain a separate schedule for valve testing. Consequently, testing is at the discretion of the licensee in the event of an extended cold shutdown that necessitates de-inerting the containment. Factors to be considered in the licensee's decision-making might include the length of the shutdown and the extent of other outage activities. In addition, for extended outages that last several months, the requirements of paragraph ISTC-3570 may apply for valves in systems that are out of service.

Basis for Recommendation

Subsection ISTC allows licensees to extend the test interval to defer valve testing to RFOs if such testing is impractical at quarterly intervals (during power operations) or during cold shutdown outages. Consequently, it is also acceptable for licensees to extend the test interval for those valves which cannot be tested unless the containment is de-inerted.

Unless the licensee has some other reason to enter the drywell during cold shutdown outages, the NRC staff regards it as impractical to de-inert the drywell during such outages merely to perform valve testing. The NRC staff's position is based on the time and effort needed to de-inert, re-inert, and replace lost nitrogen gas (which could delay the plant's return to power operation).

3.1.1.4 Stopping Pumps for Cold Shutdown Valve Testing

Licensees frequently defer the testing of certain valves in support systems that perform functions that are vital to the continued operability of important pumps (e.g., PWR reactor coolant pumps and BWR reactor recirculation pumps), such as component cooling and the supply and return of seal water during cold shutdown. Exercising these valves while such pumps are operating could result in pump damage, and stopping the pumps could extend the cold shutdown period.

NRC Recommendation

The NRC staff recommends that licensees test the affected valves on an RFO schedule and during plant outages when the PWR reactor coolant pumps or BWR reactor recirculation pumps are stopped for a sufficient period of time, but not more often than once every 92 days.

Basis for Recommendation

Subsection ISTC of the OM Code allows licensees to extend the test interval to defer testing to RFOs when it is not practical to perform the tests during power operation or cold shutdown outages. The NRC staff believes that licensees need not schedule valve testing that requires stopping and restarting PWR reactor coolant pumps or BWR reactor recirculation pumps during each cold shutdown solely to allow for the testing of valves. This repetitive cycling would increase pump wear and stress, as well as the number of cycles of related plant equipment, and could extend the length of cold shutdown outages. Consequently, licensees may consider establishing a schedule to account for extended cold shutdown outages that would allow for valve testing when the PWR reactor coolant pumps or BWR reactor recirculation pumps are stopped for a sufficient period of time. However, valves are to be tested at least during each RFO, as required by Subsection ISTC.

3.1.2 Entry into a Limiting Condition for Operation to Perform Testing

The OM Code allows deferred testing until a cold shutdown or RFO, if testing is not practicable at power. The NRC staff believes that it is better to defer testing as allowed by the OM Code, rather than entering into an LCO ACTION to perform IST or requesting approval of a relief or exemption to perform such IST without entering into LCO ACTION. Section 3.1.3 contains guidance on scheduling of IST.

3.1.3 Scheduling of Inservice Tests

The OM Code requires that testing be performed normally within a certain time period.

NRC Recommendation

To eliminate ambiguity concerning the IST intervals, the NRC staff recommends that licensees use the stated test frequency definitions in Paragraph ISTA-3170, “Inservice Examination and Testing Frequency Grace,” of the OM Code and also see Table ISTA-3170-1, “Test Frequency and Time Between Tests.” For example, paragraph ISTC-3510 requires licensees to test Category A and B valves “nominally every 3 months.” For quarterly testing, the NRC staff recommends that licensees schedule the pump and valve tests such that a particular test is performed at approximately the same time within each quarter. For example, if a test procedure applies to many valves and, thus, requires 2 to 3 weeks or more to complete, the licensee would

typically begin the procedure at approximately the same time in each quarter and include directions to perform tests in a specified order to ensure that specific valves are tested “at least once every 92 days.”

The OM Code specifies performing the tests throughout extended shutdown periods for equipment that must be returned to operable status. Most equipment must be tested before being returned to service after being out of service for an extended period in accordance with TS requirements (if applicable). Older editions of the OM Code in Paragraphs ISTB-3420, “Pumps in Systems Out of Service”; ISTC-3570, “Valves in Systems Out of Service”; and ISTF-3420, “Pumps in Systems Out of Service,” specify that licensees need not follow the test schedule if the system in which the component is installed was declared inoperable or was not required to be operable. The 2022 Edition of the OM Code has revised paragraphs ISTB-3420, ISTC-3570, and ISTF-3420 to specify that a pump or valve declared inoperable or not required to be operable need not follow the test schedule. The revised paragraphs in the 2022 Edition of the OM Code indicate that for licensees implementing the 2022 Edition, the entire system need not be declared out of service in order to be subject to these paragraphs. These revised paragraphs require that the pump or valve be tested or exercised, as applicable, with the test schedule followed within 3 months before the pump or valve is placed in an operable status. This change in the IST requirements is not applicable to earlier editions and addenda of the OM Code; licensees will need to determine whether an alternative request is needed for their specific situations.

Basis for Recommendation

The NRC staff considers that the test frequency definitions in paragraph ISTA-3170 and Table ISTA-3170-1 of the OM Code provide flexibility in the specific dates for the performance of IST activities with the grace period allowed by the OM Code. Since paragraph ISTC-3510 requires licensees to test Category A and B valves “nominally every 3 months,” the scheduling of valve tests such that a particular test is performed at approximately the same time within each quarter will provide assurance that the tests will remain within the test interval required by the OM Code with the grace period when needed if an unexpected delay occurs in the performance of the subsequent test. This recommendation also applies to pump testing.

To resolve the confusion about IST interval grace periods, ASME prepared OM Code Case OMN-20, “Inservice Test Frequencies,” with the 2012 Edition of the OM Code to address IST interval grace periods and the 25-percent margin. OM Code Case OMN-20 is approved for use in RG 1.192, Revision 5, issued March 2024, with conditions. ASME Code Case OMN-20 can be used with editions and addenda of the OM Code incorporated by reference in 10 CFR 50.55a. ASME Code Case OMN-20 has been incorporated in the 2017 and later Editions of the OM Code in paragraph ISTA-3170. Prior to its acceptance in RG 1.192, ASME Code Case OMN-20 was approved for use in 10 CFR 50.55a.

The nuclear industry has developed TSTF-545 to remove the reference to the IST program from the STS. To avoid confusion with plant-specific TS, licensees should follow the guidance in the OM Code or ASME Code Case OMN-20 as accepted in RG 1.192 when justifying grace periods for IST intervals.

The NRC staff considers that the grace periods for IST intervals allowed in the OM Code and ASME Code Case OMN-20 may be applied (except where prohibited as noted below) to IST intervals specified in requests for (1) relief from the OM Code granted by the NRC to a licensee in accordance with 10 CFR 50.55a(f)(6)(i), and (2) an alternative to the OM Code authorized by

the NRC for use by a licensee in accordance with 10 CFR 50.55a(z). The submittal of a separate request by the licensee to the NRC for an IST interval grace period is not necessary, unless the staff specifically prohibits a grace period in granting the relief from, or authorizing the alternative to, the OM Code.

Rather than the general test intervals described in paragraph ISTA-3170 and ASME Code Case OMN-20, the OM Code might specify a maximum limit on intervals for tests or other actions. For example, paragraph (c) in Section III-3310, "Inservice Test Interval," of Appendix III states that the "maximum inservice test interval" for MOVs shall not exceed 10 years and specifies that MOV inservice tests conducted in accordance with Section III-3400 may be used to satisfy that requirement. The grace period in paragraph ISTA-3170 and ASME Code Case OMN-20 does not apply in such instances of a specific maximum time limit placed on performance of a test or action in the OM Code. Licensees should submit a request for relief from or an alternative to such an OM Code requirement with appropriate justification if determined to be necessary when implementing the IST program.

3.2 Initial Code of Record Interval

The regulations in 10 CFR 50.55a(f)(4)(i) require that inservice tests to verify operational readiness of pumps and valves, whose function is required for safety, conducted during the initial code of record interval must comply with the requirements in the latest edition and addenda of the OM Code incorporated by reference in 10 CFR 50.55a on the date no more than 18 months before the date of issuance of the operating license under 10 CFR Part 50, or no more than 18 months before the date scheduled for initial loading of fuel under a COL under 10 CFR Part 52 (or the optional OM Code Cases listed in RG 1.192, as incorporated by reference in 10 CFR 50.55a(a)(3)(iii)), subject to the conditions listed in 10 CFR 50.55a(b). Appendix C to this document contains additional information on the "code of record" designation and its association with the IST program interval.

3.3 Code of Record Updates Required by 10 CFR 50.55a(f)(4)(ii)

The regulations in 10 CFR 50.55a(f)(4)(ii) require licensees to revise their IST programs periodically to reflect the latest edition and addenda to the OM Code incorporated by reference in 10 CFR 50.55a that is in effect no more than 18 months before the start of the new IST program interval.

After the initial code of record interval, in accordance with 10 CFR 50.55a(f)(4)(ii), licensees must update the code of record for successive code of record intervals. Licensees must comply with the provisions of the latest edition and addenda of the OM Code incorporated by reference in 10 CFR 50.55a that is in effect no more than 18 months before the start of the code of record interval, subject to the conditions listed in 10 CFR 50.55a(b). In addition, 10 CFR 50.55a(f)(5)(iv) specifies that when a pump or valve test requirement in the OM Code edition or addenda is determined to be impractical by the licensees and is not included in the new IST program interval, the basis for this determination must be submitted for NRC review and approval not later than 12 months after the expiration of the initial inservice examination and test interval of operation from the start of the facility commercial operation and each subsequent inservice examination and test interval during which the test is determined to be impractical.

Up to the 2017 Edition, the OM Code specified in ISTA-3200, "Administrative Requirements," that the code user comply with the latest edition and addenda of the OM Code adopted by the regulatory authority 12 months prior to the issuance of an operating license or 12 months before

initial fueling under a COL, and 12 months prior to the start of successive IST program intervals. As this NUREG cannot authorize alternatives to the ASME OM Code, licensees will need to submit an alternative request to follow the 18-month provisions in 10 CFR 50.55a(f)(4)(i) and (ii) rather than complying with the 12-month provisions in ISTA-3200, until the licensees update to the 2020 or later Editions of the OM Code, which has updated language in ISTA-3200 to simply state that the code edition and addenda shall be as required by the regulatory authority having jurisdiction at the plant site.

Appendix C to this document provides additional information on the "code of record" designation and its association with the IST program intervals required by 10 CFR 50.55a(f)(4)(ii).

3.3.1 Extension of Inservice Testing Interval

The IST interval may be extended in accordance with subparagraph ISTA-3120(c) in the OM Code:

> Each of the inservice examination and test intervals may be extended or decreased by as much as 1 yr. Adjustments shall not cause successive intervals to be altered by more than 1 yr. from the original pattern of intervals.

Subparagraph ISTA-3120(d) in the OM Code further states that, for units that are continuously out of service for 6 months or more, licensees may extend the IST interval during which the outage occurred for a period equivalent to the outage and may extend the original pattern of intervals accordingly for successive intervals. Subparagraph ISTA-3120(d) appears to be based on the assumption that the IST Program is maintained during the shutdown period. When planning to apply subparagraph ISTA-3120(d), licensees are encouraged to discuss their plans with their NRC Project Manager to avoid any conflicts with the code of record update requirements in 10 CFR 50.55a.

NRC Recommendation

Licensees must establish the next updated IST program to the latest edition of the OM Code incorporated in the regulation no more than 18 months before the interval start date. When extending its IST interval by as much as 1 year, as allowed by paragraph ISTA-3120, licensees may continue to apply the same OM Code edition and addenda from its current IST interval during this extended 1-year period. The NRC staff recommends that licensees document and inform the NRC of any change to extend before the start and end dates of the IST interval allowed by the OM Code. An extension beyond 1 year (other than for extended outages, as permitted by paragraph ISTA-3120) requires NRC authorization of an alternative to, or exemption, from the OM Code provisions of 10 CFR 50.55a, as applicable.

Basis for Recommendation

While it is not mandatory to maintain identical intervals for the ISI and IST programs, it is often desirable in order to maintain the same edition of ASME BPV Code, Section XI, and the OM Code for all plant activities related to the ISI and IST programs. Even though 10 CFR 50.55a does not discuss extending the intervals, the codes are incorporated by reference in the regulation and, therefore, have the same effect as the regulation. Although NRC approval is not required for 1-year extensions of the IST interval, licensees would avoid any discrepancies in the IST interval dates by informing the NRC of the extension and documenting it in the IST program document. Because the codes do not allow extension beyond 1 year (other than for

extended outages), such an extension would require NRC authorization of an alternative to or exemption from the code provisions to comply with the regulatory requirements. Related to extensions of intervals, Appendix C to this document contains additional information on the "code of record" designation and its association with the IST interval.

3.3.2 Concurrent Intervals

Several licensees have established concurrent intervals for all units at sites with multiple units, so that each unit is updated to a newer edition of the OM Code at the same starting date. Because the regulations do not specifically allow for adjustments to accommodate concurrent intervals among multiple units, when the interval start dates are aligned to be concurrent, licensees may request a one-time alternative to the OM Code or exemption from 10 CFR 50.55a, as applicable. If a licensee prefers not to request an alternative or exemption, the establishment of concurrent intervals might require that the licensee perform program updates (likely one-time) for a particular unit more often than required by the NRC regulations. The regulation in 10 CFR 50.55a(f)(4)(iv) permits IST of pumps and valves to meet the provisions in subsequent OM Code editions and addenda (or portions of them) that are incorporated by reference in 10 CFR 50.55a, subject to the conditions listed, prior to the required update of 10 CFR 50.55a(f)(4)(ii). An "early update" does not require NRC approval, but should be documented in a letter to the NRC. Note that any granted relief or authorized alternatives will need to be updated to the new code of record.

NRC Recommendation

If a licensee elects to use the same OM Code edition for multiple units and that results in extending an IST interval beyond the allowance in ISTA-3120, the licensee must request an alternative to the OM Code or exemption to 10 CFR 50.55a, to extend a unit's interval. To establish concurrent intervals without an alternative or exemption, the licensee must update the referenced edition of the OM Code more frequently for the selected unit(s) to remain in compliance with 10 CFR 50.55a, except in the case where the interval dates are within 12 months, whereby the OM Code allowance for an extension would result in concurrent intervals. The NRC will likely authorize an alternative allowing the licensee to update to later editions of the OM Code, if the licensee uses the following guidelines:

- Without obtaining an alternative or exemption, the licensee may perform the IST program for multiple units using the same edition of the OM Code at concurrent intervals if the initial interval for combining the programs is established such that no single unit's program interval exceeds that required by the NRC regulations.

- To exceed the interval requirement, other than as addressed in the OM Code for an extension, the licensee must first obtain authorization of an alternative to the OM Code or exemption from 10 CFR 50.55a.

The IST program document and the request for the alternative or exemption would typically describe the method for selecting the interval dates, specifying the dates at which the interval will begin and end, and comparing the effect of those dates with that of the dates that would otherwise be required.

Basis for Recommendation

The NRC staff believes that conducting IST programs for multiple unit sites using the same OM Code edition could improve program effectiveness. Adopting later edition and addenda of the OM Code incorporated by reference in 10 CFR 50.55a only requires notification to the NRC, while maintaining earlier edition and addenda beyond the requirements of 10 CFR 50.55a requires an approved exemption.

3.3.3 Implementation of Updated Programs

Updating the IST program to a later edition and addenda of the ASME OM Code is an extensive effort that involves changes to administrative and implementing procedures. Often, the revised requirements will necessitate establishing new reference values, such as by implementing a vibration program using velocity measurements rather than displacement measurements for pump testing. Implementing a new CPT may be necessary for parameters that are not currently measured. New reference values for currently monitored parameters may not be necessary if previous reference values were acceptable. However, the OM Code does not specifically require licensees to establish new reference values simply because a later edition is used.

NRC Recommendation

The NRC staff recommends that, before beginning the first tests during the new interval, licensees revise the implementing procedures according to the appropriate requirements. When the testing requires baseline values to be established for the first time or reestablished to meet OM Code changes, the new baseline (reference) values would typically be established during the first quarterly or cold shutdown outage test performed in the new interval, if not before. Before performing tests during the first RFO, licensees would typically revise implementing procedures for the tests to be performed during that outage to incorporate any new requirements or components.

Before or during startup from the RFO, licensees must complete all tests that are required to be performed during the RFO, as required by the OM Code (ISTC-3500 and Mandatory Appendix I, Section I-1300). If a licensee determines that timely implementation is not possible, the NRC staff recommends that the licensee submit a schedule to the NRC (1) before the beginning of the interval, or (2) before startup from the RFO if the interval begins while a plant is shut down for refueling.

For updated programs, the NRC staff recommends that licensees submit relief requests before the next inspection interval's start date to allow adequate time for NRC review and approval. This is generally within 12 months after the interval start date (i.e., submit the updated program at least 3 to 6 months before the start date).

In accordance with the regulations, when updating a program to a later edition of the OM Code, as required by 10 CFR 50.55a, licensees must implement the updated program at the beginning of a new IST interval. The regulations state that, where a pump or valve test specified by the OM Code is determined to be impractical and is not included in the revised IST interval, the basis for this determination must be submitted for NRC review and approval not later than 12 months after the expiration of the initial inservice examination and test interval from the start of the facility commercial operation and for each subsequent inservice examination and test interval during which the test is determined to be impractical. However, experience has shown that licensees also identify impractical test provisions throughout the inservice examination and

test interval. In such cases, the NRC staff recommends that licensees request relief as soon as they identify the condition. Because the requirements are impractical, the licensee would test the applicable components using the method proposed in the relief request from the time of identification until the NRC staff completes its evaluation. This would include, for example, a situation in which a licensee identifies a solenoid valve that is within the scope of the IST program and is stroke-time tested but has no position indication, or if the licensee cannot meet the OM Code requirements because of design limitations and an alternative method may not comply with the OM Code requirements. Proposed alternatives to the OM Code requirements (rather than relief from "impractical" requirements) shall not be implemented until the NRC staff completes its evaluation (e.g., if a licensee proposes to implement a pump vibration program based on using spectral analysis, rather than the OM Code-specified method, the licensee must continue to meet the OM Code requirements until the NRC staff completes its evaluation).

Basis for Recommendation

When licensees update their IST programs to a revised edition of the OM Code, the NRC staff recognizes that changes might be completed over a period of time to allow for adequate review and approval; however, the NRC staff recommends completing the procedural revisions in a timely manner. The regulations do not allow a licensee to continue with a previous program while waiting for NRC review to grant relief requests and to authorize proposed alternatives for the next interval. The NRC staff recommendation that the request be submitted 3 to 6 months before the end of the inspection interval is based on the expected time needed for the NRC staff to evaluate the request and inform the licensee.

3.3.4 General Comments on Inservice Testing Intervals

The NRC has received requests for IST programs and partial submittals that lack the dates of the intervals or the OM Code edition in use. Some licensees were not aware that the NRC may issue final rules amending 10 CFR 50.55a that are not reflected in the current printed version of the *Code of Federal Regulations*. Therefore, when those individuals revised their programs, they used the printed version of 10 CFR Part 50 to determine the OM Code edition cited in 10 CFR 50.55a at the specified time period before the interval start date. However, a more recent edition may have been incorporated by reference in 10 CFR 50.55a as noticed in the FR, which may have resulted in the program being developed to an incorrect edition of the OM Code.

Additionally, several licensees have asked about phasing in the updated IST program. Generally, this is an acceptable approach for testing if the program does not involve any requests for relief from OM Code requirements.

NRC Recommendation

The NRC staff recommends that licensees include the interval dates and OM Code edition in each IST program submittal, regardless of whether it is for an entire program or only a partial submittal containing new or revised relief or alternative requests. The NRC staff verifies the interval dates and the OM Code edition or addenda from which the licensee is requesting relief or an alternative. The NRC staff also recommends that licensees implement procedures to ensure that the individuals responsible for developing and maintaining the IST program are aware of the regulatory changes made in 10 CFR 50.55a throughout the year.

For phasing in a new edition of the OM Code before the start of a new interval (or during an ongoing interval), the NRC staff recommends that licensees submit a plan and schedule to the NRC. If there are no issues that require NRC review, the testing can be phased into the appropriate edition of the OM Code (1) during the 18 months prior to the interval start date, or (2) during any time period identified by the licensee up to an interval start date, if the phasing-in begins in the middle of an interval and a licensee wants to use an edition of the OM Code that is more recent than that incorporated by reference in 10 CFR 50.55a.

Basis for Recommendation

The NRC staff has noted incorrect interval dates and OM Code editions cited in IST program submittals. The OM Code stipulates that licensees shall calculate the IST interval according to the number of calendar years that have passed since the power unit was placed into commercial service. Licensees may verify the licensing and commercial operation dates for their plants by reviewing the annual "NRC Information Digest" (NUREG-1350). For convenience, the licensees for several plants have established the initial interval as beginning on the date of their operating licenses or some other unspecified milestone. However, the NRC staff cautions that if the NRC revised 10 CFR 50.55a after the interval start date cited by the licensee and before the date of the operating license, and if the revision of 10 CFR 50.55a incorporated a later edition of the OM Code, the regulations may require use of a more recent edition than the licensee believes is required. Therefore, it is important that the IST program document state the OM Code edition and addenda used to develop the program, so that the NRC may verify the licensee's correct use of the applicable OM Code edition and addenda.

3.4 Skid-Mounted Components and Component Subassemblies

The safety-related piping systems at a plant may include skid-mounted components or component subassemblies, such as valves in diesel air start subassemblies, diesel skid-mounted fuel oil pumps and valves, steam admission and trip throttle valves for HPCI or AFW pump turbine drivers, steam traps, and air supply system check valves and SOVs for MSIVs. If the licensee's FSAR identifies these components as safety-related, they are within the scope of the OM Code based on ISTA-1100 as incorporated by reference in 10 CFR 50.55a. If the components are non-code class, the regulations in 10 CFR 50.55a(f)(4) allow the licensee to include those components in an augmented IST program. Paragraph ISTC-1200, in subparagraph (b), states that skid-mounted valves that are tested as part of the major component and are justified by the Owner to be adequately tested are excluded from the testing requirements of Subsection ISTC. Subparagraphs ISTB-1200(c) and ISTF-1200(c) provide similar statements for skid-mounted pumps in pre-2000 and post-2000 reactors, respectively. In accordance with subparagraphs ISTB-1200(c), ISTC-1200(b), and ISTF-1200(c), licensees need to have justification for components excluded from the testing requirements of Subsections ISTB, ISTC, and ISTF. If subparagraph ISTB-1200(c), ISTC-1200(b), or ISTF-1200(c) applies to skid-mounted pumps and valves that are safety-related, these components continue to be within the scope of the IST program and should be identified in the IST program plan. In addition, these components continue to be subject to periodic testing in accordance with Appendix A and Appendix B to 10 CFR Part 50.

NRC Recommendation

The NRC staff considers that testing the major component is an acceptable means to verify the operational readiness of the skid-mounted components and component subassemblies if the licensee identifies these components as within the scope of the IST program in the IST program

plan and discusses the skid-mounted testing approach in the IST program plan. Licensees should consider and document the specific measurements and attributes of major component testing that relate to the assessment of the skid-mounted component condition. In addition, various continuous and periodic observations of the major components (such as system monitoring walkdowns or operator logs) may also support assurance of skid-mounted component readiness. This is acceptable for both code components and non-code components that are tested and tracked by an IST or augmented IST program. Documentation and justification are important for these components, as there have been several instances of valves in a skid-mounted component that were not adequately tested to provide reasonable assurance of their operational readiness. In these situations, periodic testing of the major component did not adequately test the specific valves, and operational readiness could not be easily ascertained. A licensee should ensure that existing testing demonstrates operational readiness of skid-mounted components and supplement as necessary with the appropriate justification. It is the licensee's responsibility to have justification that the requirements in subparagraphs ISTB-1200(c), ISTC-1200(b), and ISTF-1200(c) for excluding pumps and valves from the specific OM Code requirements are met as part of skid-mounted testing. The justification should demonstrate that the requirements in 10 CFR 50.55a to assess the operational readiness of the pumps and valves to perform their safety functions are satisfied by the skid-mounted testing in terms of the capability to perform their safety functions over the interval between tests.

Basis for Recommendation

Various pumps and valves that are procured as part of larger component subassemblies are often not designed to meet the requirements for components in ASME BPV Code Classes 1, 2, and 3. In RG 1.26, the NRC provides guidance on classifying components for Quality Groups A, B, C, and D. (For additional guidance, licensees should review NUREG-0800.) When many of the components were procured, the IST requirements did not apply and, thus, the components might not have included features for IST performance. Licensees may, therefore, elect to use the IST program for testing these components and state in the IST program document that the surveillance tests of these components adequately test the skid-mounted components.

The OM Code addresses both components that are physically mounted on the skid and those that are not mounted on the skid but function the same as skid-mounted components (e.g., check valves in the service water system that supply cooling water to a pump or a system of valves that work together to perform a safety function), provided that testing the major component is adequate to test the function of the system component. This adequacy should be sufficiently documented to provide justification that the major component testing demonstrates operational readiness of the other components over the interval between tests.

Section 4.1.10 specifically discusses testing of skid-mounted check valves.

3.5 Preconditioning of Pumps and Valves

3.5.1 Background

The NRC regulations in 10 CFR 50.55a require licensees to test pumps and valves at nuclear power plants to assess their operational readiness within the scope of the OM Code. Criterion XI in Appendix B to 10 CFR Part 50 specifies that licensees must establish a test program to ensure that all testing required to demonstrate that SSCs will perform satisfactorily in service is identified and performed in accordance with written test procedures that incorporate

the requirements and acceptance criteria contained in applicable design documents. Criterion XI further requires that test procedures must include provisions to ensure that (1) all prerequisites for the given test have been met, (2) adequate test instrumentation is available and used, and (3) the test is performed under suitable environmental conditions. Criterion XI then requires licensees to document and evaluate the test results to ensure that the test requirements have been satisfied. In order to effectively assess operational readiness, the performance of the tested pump or valve, and the conditions under which the pump or valve must be capable of performing its safety function, need to be fully understood. Any maintenance activities performed before actual IST are called "preconditioning" or "grooming," and this will adversely affect the validity of the test results.

3.5.2 NRC Guidance

Information Notice (IN) 97-16, "Preconditioning of Plant Structures, Systems, and Components before ASME Code Inservice Testing or Technical Specification Surveillance Testing," dated April 4, 1997, discusses the long-standing concern about unacceptable preconditioning of plant SSCs before testing. The NRC staff noted that experience has demonstrated that some testing cannot be performed without disturbing or altering the equipment. The NRC staff also stated that any such disturbance or alteration would be expected to be limited to the minimum necessary to perform the test and to prevent damage to the equipment. In addition, the NRC staff alerted licensees that, in certain cases, the safety benefit of some preconditioning activities might outweigh the benefits of testing in the as-found condition.

The NRC staff has provided guidance to the NRC's regional offices and inspectors with respect to preconditioning of plant equipment prior to OM Code and TS testing. For example, guidance is found in the following documents (see section 9 for the ADAMS Accession Numbers for these documents):

- NRC memorandum, dated July 2, 1996, from Frederick J. Hebdon, Director, Project Directorate II-3, Division of Reactor Projects I/II, Office of Nuclear Reactor Regulation, to Jon R. Johnson, Acting Director, Division of Reactor Projects, Region II, in response to Technical Assistance Request TIA 96-007, "Regulatory Acceptability of Lubricating Valves Prior to Surveillance Testing"
- NRC Inspection Manual Part 9900, "Technical Guidance: Maintenance—Preconditioning of Structures, Systems, and Components before Determining Operability"
- Attachment 22, "Surveillance Testing," to IP 71111, "Reactor Safety—Initiating Events, Mitigating Systems, Barrier Integrity"

The guidance in these documents is instructive for nuclear plant personnel in providing assurance that testing conducted as part of the IST program is capable of assessing the operational readiness of pumps and valves within the scope of the OM Code.

Preconditioning

NRC Inspection Manual Part 9900 (Technical Guidance: Maintenance) defines preconditioning as the "alteration, variation, manipulation, or adjustment of the physical condition of an SSC before Technical Specification surveillance or ASME Code testing." Any maintenance activities performed before actual IST are called "preconditioning" or "grooming," and might adversely affect the validity of the test results.

Acceptable Preconditioning:

The licensee may consider several factors in determining whether an activity constitutes acceptable preconditioning of a pump or valve to be tested. For example, an activity would constitute acceptable preconditioning of a pump or valve if it is performed to protect personnel or equipment or to meet the manufacturer's recommendations (or based on industry-wide operating experience). If a preventive maintenance activity (such as valve stem lubrication or pump venting) periodically occurs prior to testing, the licensee might justify the acceptability of this infrequent preconditioning of a pump or valve if the licensee evaluates the effect of the activity on the overall ability to assess the operational readiness of the pump or valve and to trend degradation in its performance. As noted in the inspection guidance, the licensee should have evaluated and documented the activity as acceptable preconditioning before performing the testing.

Unacceptable Preconditioning

Some activities would constitute unacceptable preconditioning of a pump or valve to be tested under the IST program. NRC Inspection Manual Part 9900 (Technical Guidance: Maintenance) defines unacceptable preconditioning of an SSC as an activity before or during surveillance or testing that alters one or more of the SSC's operational parameters which results in acceptable test results. For example, a preventive maintenance activity might constitute unacceptable preconditioning of a pump or valve if the licensee routinely conducts the activity prior to testing. NRC Inspection Manual, IP 71111, Attachment 22, instructs NRC inspectors to evaluate the acceptability of any preconditioning of equipment in preparation for surveillance tests. Similarly, NRC inspectors also verify that licensees do not routinely schedule preventive maintenance activities prior to testing in order to help ensure that the test is passed satisfactorily. In addition to activities related to an individual pump or valve, maintenance or surveillance activities involving several SSCs, including the scheduling or timing of such activities, can inadvertently result in unacceptable preconditioning of a pump or valve.

NRC Inspection Manual Part 9900 (Technical Guidance: Maintenance) provides a series of questions that NRC inspectors should consider when evaluating the acceptability of an activity that appears to involve preconditioning of a plant SSC. With respect to pumps and valves, those questions can be interpreted as follows:

- Does the practice performed ensure that the pump or valve will meet its testing acceptance criteria?
- Would the pump or valve have failed the test without the preconditioning?
- Does the practice bypass or mask the as-found condition of the pump or valve?
- Is preventive maintenance routinely performed on the pump or valve just before testing?
- Is preventive maintenance on the pump or valve performed only for scheduling convenience?

According to the NRC technical guidance, an activity constitutes unacceptable preconditioning if an affirmative answer is determined in response to any of these questions, and the activity meets the definition of unacceptable preconditioning provided in the inspection guidance. Licensees are encouraged to consider such questions as part of their determination of whether

an activity related to a pump or valve in their IST program constitutes unacceptable preconditioning.

The following are examples of acceptable preconditioning:

- The running of prelube booster pumps prior to diesel starts is allowed by NUREG-1431, "Standard Technical Specifications—Westinghouse Plants," when documented and approved in TS.

- To help prevent damage due to hydro-locking, NUREG-1216, "Safety Evaluation Report Related to the Operability and Reliability of Emergency Diesel Generators Manufactured by Transamerica DeLaval (TDI), Inc.," issued August 1986, recommends that TDI diesel generator engines be rolled or cranked with cylinder petcocks open, using the air start system to purge any water from the cylinders before performing preplanned startups and testing. This allowance is made for a limited number of starts per year. (Note: The licensee should evaluate the amount of water collected to determine if it is excessive and whether operability of the diesel is affected.) The NUREG still directs that a number of starts are conducted in the as-found condition. This has become an accepted industry practice for this particular diesel because experience has shown that TDI diesel cylinders were prone to collecting water in the cylinders when idle. However, rolling (or cranking) the diesel using the air start system may be considered unacceptable preconditioning for other types of diesels that are not prone to water accumulation.

- Gas accumulation in the suction piping of pumps or condensate accumulation in turbine steam supply lines can result in equipment performance degradation. Verifying that pump suction piping is gas free and turbine steam supply lines are condensate free prior to planned equipment operation, including surveillance testing, is a good operating practice and may improve equipment reliability. Performance of these evolutions may be acceptable provided that it does not remove a preexisting adverse condition without proper identification and evaluation. However, routine uncontrolled pump venting or draining turbine steam supply lines directly preceding surveillance testing without proper controls is unacceptable preconditioning.

The following are examples of pump venting or draining condensate from turbine supply lines that would be considered acceptable:

- Periodic venting of pumps that is not routinely scheduled to be performed directly prior to surveillance testing but may occasionally be performed before surveillance testing. For example, venting would be acceptable if the licensee routinely vents a pump weekly and then randomly conducts pump surveillance tests at various times during the week.

- Pump venting directly prior to surveillance testing is acceptable provided that the venting operation has proper controls. A technical evaluation is required to establish that the amount of gas vented would not adversely affect pump operation. If an unacceptable amount of gas is vented, an operability evaluation of the as-found (pre-vented) condition is required.

- Turbine steam supply lines can be drained prior to surveillance testing provided that the evolution has proper controls. A technical evaluation is required to support that the condensate drained would not have an adverse effect on the turbine operation. If an

unacceptable amount of condensate is drained, an operability evaluation of the as-found condition is required.

If the licensee chooses to precondition SSCs, an engineering evaluation should document the effects on equipment performance or condition. The engineering evaluation should be performed using procedures to ensure that design and licensing bases are satisfied.

The following examples of unacceptable preconditioning are taken from NRC inspection reports:

- Electrical
  - Inspectors noted that electrical loads were removed from a number of 480-volt circuit breakers before surveillance testing was performed. In addition, surveillance procedures instructed technicians to inspect, clean, and lubricate several breakers before performing as-found testing. Accordingly, a violation for failure to maintain appropriate test controls in accordance with 10 CFR Part 50, Appendix B, Criterion XI, was issued.
- Mechanical
  - Four air-operated containment spray flow control valves were unacceptably preconditioned before stroke time surveillance testing by having the valve stems lubricated. Accordingly, a violation was issued for failure to develop appropriate test controls in accordance with 10 CFR Part 50, Appendix B, Criterion XI. The licensee's administrative procedures failed to ensure that these stroke-time tests were performed under suitably controlled conditions.
  - During observation of surveillance testing, inspectors noted that certain heat exchangers had their air-operated inlet valve and outlet valves controlled by a single hand switch on the main control room panel. The safety function of these air-operated valves was to open or to remain open in response to an accident signal. A surveillance test was performed quarterly to ensure that the opening function was intact and was not degrading. During the test, with the valves closed, the hand switch was taken to the open position and the opening stroke time for the "A" valve was recorded. At the same time, the "B" valve cycled open. After both valves were closed, the hand switch was again taken to the open position, and the opening time for the "B" valve was recorded. The inspectors considered the manner in which this test was conducted to constitute inappropriate preconditioning of the "B" valves. Since the stroke-time test of the "A" valve was performed first during each test, the stroke time of the "B" valve was always checked a short time after the "B" valve had been cycled with the "A" valve. Therefore, an as-found stroke time anomaly for one of the "B" valves may not be detected if the pretest stroke eliminated the anomaly. Accordingly, a violation for failure to maintain appropriate test control in accordance with Criterion XI of Appendix B to 10 CFR Part 50 was issued.
  - Inspectors identified the practice of operating the turbine-driven AFW pumps immediately before performing surveillance tests and the practice of venting the RHR pumps immediately before performing surveillance tests as examples of unacceptable preconditioning. The failure to test safety-related equipment under suitably controlled conditions and in accordance with design and licensing bases

was cited as a violation of 10 CFR Part 50, Appendix B, Criterion V, “Instructions, Procedures, and Drawings.”

  - Inspection findings indicated that plant operators had recognized that performing a series of different HPCI system and RCIC surveillance tests in sequence, without allowing sufficient time for the system to cool down between tests, would constitute unacceptable preconditioning. However, the licensee personnel did not identify or document the full extent of the preconditioning conditions, nor did they initiate appropriate corrective actions to ensure that preconditioning would not be repeated. The failure of the licensee personnel to fully recognize and initiate action to correct preconditioning concerns was identified as a violation of 10 CFR Part 50, Appendix B, Criterion V.

- Instrumentation and Control

  - Inspectors noted that the surveillance procedure for the containment and drywell hydrogen analyzer calibrations required technicians to check and adjust reagent gas flow before obtaining the as-found calibration data. However, adjusting the reagent gas flow could affect the as-found condition of the analyzer and invalidate the test results. The inspectors determined that the test procedure was inadequate. Accordingly, a violation was issued on the basis of TS 5.4.1.a, which requires that specific written procedures be established for surveillance tests.

3.5.3 ASME OM Code Guidance

The ASME OM Code relies on the licensee to determine whether an activity would constitute acceptable or unacceptable preconditioning of a pump or valve prior to testing under its IST program, except in a few limited instances. For example, OM Code Case OMN-1 specifies that MOV inservice tests shall be conducted in the as-found condition and that maintenance activities shall not be conducted if they might invalidate the as-found condition for IST. If maintenance activities are scheduled concurrently with an inservice test, then the inservice test shall be conducted prior to the maintenance activity. The 2009 Edition of the OM Code incorporates Code Case OMN-1 (including the as-found testing provision) and Code Case OMN-11 as Mandatory Appendix III to the OM Code, to replace quarterly MOV stroke-time testing with periodic exercising and diagnostic testing. Mandatory Appendix IV contains similar wording in subparagraph IV-3410(d) for AOV maintenance activities and subparagraph IV-3420(c) additionally specifies that stroke testing should be performed prior to performance assessment testing. The licensee is responsible for determining whether an activity constitutes acceptable or unacceptable preconditioning of a pump or valve to be tested under its IST program.

3.5.4 NRC Recommendation

The NRC staff has provided examples of acceptable and unacceptable preconditioning of plant components prior to testing in such documents as IN 97-16 and NRC Inspection Manual Part 9900 (Technical Guidance: Maintenance). Where the OM Code does not provide specific provisions related to as-found testing of a pump or valve in the IST program, the NRC staff considers acceptable preconditioning to include such activities as (1) periodic venting of pumps, where not routinely scheduled directly prior to testing but occasionally performed before testing, (2) pump venting directly prior to testing, provided that the venting operation has proper controls with a technical evaluation to establish that the amount of gas vented would not adversely affect

pump operation, (3) occasional lubrication of a valve stem prior to testing of the valve, where stem lubrication is not typically performed prior to testing, (4) unavoidable movement attributable to the setup and connection of test equipment, and (5) test instrument venting directly prior to equipment testing. In each instance of acceptable preconditioning, the NRC staff will expect the licensee to have available a documented evaluation of the preconditioning activity and a justification for continued confidence in the capability of the IST program to assess the operational readiness of the pump or valve. Generic evaluations may be acceptable as long as the evaluation bounds the conditions of specific activity performed on the SSC.

By contrast, the NRC staff considers unacceptable preconditioning of pumps and valves in the IST program to include such activities as (1) routine lubrication of a valve stem prior to testing the valve, (2) operation of a pump or valve shortly before a test, if such operation could be avoided through plant procedures with personnel and plant safety maintained, and (3) venting a pump immediately prior to testing without proper controls and scheduling. Licensees may evaluate applicable NRC staff documents to determine whether specific activities prior to testing constitute acceptable or unacceptable preconditioning of a pump or valve in the IST program. The NRC staff encourages licensees to contact their NRC resident inspector or Office of Nuclear Reactor Regulation project manager if questions arise about potential preconditioning of a pump or valve to be tested under the IST program.

3.6 Testing in the As-Found Condition

The intent of the IST program is primarily to detect and monitor the degradation or rate of changes of a component after a period of operation or stand-by conditions. If “as-found” tests are not performed as part of IST activities, degradation mechanisms or rate of degradation resulting from a previous period of operation or stand-by condition cannot be identified and obtained. Therefore, discussion is provided to ensure that the intent of the IST program is retained.

NRC staff review of IST programs during 1985 through 1991 with older editions of ASME BPV Code, Section XI, and the OM Code, had been interpreted to require that IST activities be performed in the “as-found” condition. However, later editions and addenda of the OM Code, with the exception of Mandatory Appendix I for safety/relief valves (S/RVs) and Mandatory Appendix III for MOVs, do not specifically require licensees to test components in the “as-found” condition.

OM Code, Mandatory Appendix I, requires licensees to measure the initial lift of S/RVs to determine whether additional valves are to be tested.

OM Code, Mandatory Appendix III, subparagraph III-3300(b), states that inservice tests shall be conducted in the as-found condition.

With respect to as-found testing prior to maintenance, OM Code, Mandatory Appendix III, subparagraph III-3300(b) states:

> As-found testing is not required prior to maintenance activities as long as the MOV is not due for an inservice test. If maintenance activities are scheduled concurrently with an MOVs inservice test, then the inservice test shall be conducted in the as-found condition, prior to the maintenance activity.

The NRC staff was asked to provide an example of its interpretation of this Mandatory Appendix III requirement. One example would be if an MOV is on an 8-year inservice test schedule, then maintenance at year 3 would not require an as-found test based on paragraph III-3300(b).

The “as-found” condition is generally considered to be the condition of a valve without pre-stroking or maintenance. The OM Code does not require stroke-time testing or check valve stroking prior to maintenance; however, degradation mechanisms might not be identified if the licensee does not perform any as-found testing. Therefore, the NRC staff encourages licensees to perform as-found testing, where practical. The NRC staff also cautions licensees to consider the timing of maintenance with regard to the required test intervals and the potential for preconditioning. Postmaintenance testing is required when the maintenance could have affected the valve’s performance. As-found testing might also apply to pumps in a similar fashion. Most IST is performed in a manner that generally represents the condition of a standby component if it were actuated in the event of an accident (i.e., no preconditioning prior to actuation).

3.7 Testing at Power

In an effort to shorten RFOs, many licensees are trying to perform as much maintenance, testing, and surveillance as possible with the nuclear power plant online. For example, several licensees have submitted alternative requests to obtain NRC authorization to conduct IST once per refueling cycle, rather than during the RFO as prescribed by the OM Code. In preparing (and evaluating) such alternative requests, licensees (and the NRC staff) should consider several factors to ensure that the licensee’s proposed alternative provides an acceptable level of quality and safety. If a licensee is testing a particular valve during RFOs, the licensee may have determined that it is impractical to test the valve quarterly during operation. The licensee’s IST program document should, therefore, discuss the basis for deferring the testing from quarterly (and during cold shutdowns) to RFOs. Relief requests to perform testing once each refueling cycle with the nuclear power plant online should be prepared in lieu of the RFO justification for each affected valve or group of valves. If necessary, the licensee should revise the RFO justification to be consistent with the relief request.

Licensees (and the NRC staff) should also consider whether the testing can be accomplished within the allowed outage time permitted by any applicable TS. In general, the time necessary to complete the testing should be significantly less than the allowed outage time. This is to preclude TS violations or the need to issue exigent TS amendments or notices of enforcement discretion. In addition, licensees should not conduct noncorrective maintenance/testing activities at power if the associated postmaintenance testing cannot reasonably be accomplished until the next outage.

Sometimes, there is a tradeoff between testing components at power (e.g., when they could be needed to mitigate the consequences of an accident) and testing them during outages (e.g., when there may be greater reliance on shutdown cooling or when other equipment is necessarily out of service). Licensees should quantitatively or qualitatively address the risks associated with testing components online, rather than testing during the RFO. If the proposed testing could have a significant risk impact, or if its justification includes risk-related arguments, the relief request should be prepared and reviewed in accordance with RG 1.174, as applicable. Licensees should also identify any compensatory measures to be established as a means to reduce the impact (e.g., risk and operational worker safety) of testing with the nuclear power plant at power.

If relevant, licensees should also provide information on how testing at power (rather than testing during RFOs) will affect scheduled maintenance work windows for the applicable system (i.e., whether the testing can be completed within the work windows or whether it will extend either the shutdown or at-power work windows). In addition, licensees will need to develop a new estimate of the maintenance unavailabilities that reflects the increased maintenance activities at power and will need to document the basis for the new estimate (e.g., use plant logs or maintenance data to include in the current estimate of the maintenance unavailabilities those activities that were being performed during shutdown that will now be performed at power).[3]

At times, testing (or the disassembly and inspection of components) during RFOs can be more advantageous than at-power operations from a worker safety perspective (for example, systems may be cold and depressurized). When requesting NRC authorization to perform testing with the nuclear power plant online, licensees should consider worker safety and should discuss whether the applicable components can be adequately isolated and restored.

In Section 11.2.3 of Nuclear Management and Resources Council (NUMARC) 93-01, "Industry Guideline for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," issued April 1996, NUMARC, now NEI, provided additional guidance for conducting online maintenance and testing. Section 11.2.3 states, in part, the following:

> Online maintenance [and testing] should be carefully managed to achieve a balance between the benefits and potential impacts on safety, reliability or availability. For example, the margin of safety could be adversely impacted if maintenance is performed on multiple equipment or systems simultaneously without proper consideration of risk, or if operators are not fully cognizant of the limitations placed on the plant due to out of service equipment. Online maintenance should be carefully evaluated, planned and executed to avoid undesirable conditions or transients, and to thereby ensure a conservative margin of core safety.

[3] It should be noted that the assessment of risk resulting from performance activities as required by 10 CFR 50.65(a)(4) of the Maintenance Rule is not sufficient justification for testing components at power. This assessment is required for maintenance activities performed during power operations or during shutdowns. The configuration risk management does not address the relative merits of testing at power versus testing during an RFO.

4 SUPPLEMENTAL GUIDANCE ON INSERVICE TESTING OF VALVES

The NRC staff has developed the following recommendations for valves that may be a part of an IST program at nuclear power plants. The types of valves discussed herein are covered by the OM Code. Specifically, these include check valves (section 4.1), POVs (section 4.2), S/RVs (section 4.3), and other miscellaneous valves (section 4.4). Section 4.5 covers topics generally applicable to all types of valves covered by the OM Code.

4.1 Check Valves

The NRC staff considers check valves, and other automatic valves designed to close without operator action following an accident, to be "active" valves that would be classified as such in the IST program (reference, for example, section B 3.6.3 of NUREG-1431, Revision 5, issued September 2021). Similar criteria could be applied to the opening function of a check valve. The flow through a check valve would be blocked by any condition that precludes flow through the system. For example, installing a flange or closing another valve (other than a check valve) in the line would block flow. A valve that is "positively held in place" would be one that has an operator or other auxiliary device that maintains the disk in an open or closed position, such as a stop check valve.

SECY-77-439, "Single Failure Criterion," dated August 17, 1977, which is referenced in several plants' licensing bases, discusses the failure of a check valve to move to its correct position as a passive failure; however, this does not correspond to the issue of "active" versus "passive" for the purpose of the IST program. SECY-94-084 specifies that check valves in passive cooling systems in new reactors might need to be addressed by the single failure criterion unless justified with a high reliability.

The OM Code defines valves that are self-actuating in response to some system characteristic, such as flow direction, for fulfillment of the required function(s) as Category C valves. Those check valves (Category C valves) that must also be leak-tight (Category A valves) would be designated as Category A/C in the IST program. Those check valves (Category C valves) where leakage is inconsequential (Category B valves) would be designated as Category B/C (or simply Category C) in the IST program. Section 4.5.1 discusses Category A and Category B valves.

Whereas the OM Code only requires licensees to exercise Category C check valves on a periodic basis, Category A/C check valves must be leak tested in addition to being exercised. The NRC staff has found that, in many instances, licensees are not assigning check valves to Category A/C, despite the fact that the licensees take credit for the check valve providing an essentially leak-tight function such that leakage is not inconsequential.

When determining the proper categorization of a check valve, a licensee should consider all applicable aspects. For example, the licensee should determine (1) whether the flow requirements for connected systems can be achieved with the maximum possible leakage through the check valve, (2) the effect of any reduced system flows resulting from the leakage on the performance of other systems and components, (3) the consequences of the loss of water from the system, (4) the effect that backflow through the valve may have on piping and components, such as the effect of high temperature and thermal stresses, and (5) the radiological exposure to plant personnel and the public caused by the leak. If any of the above considerations indicate that Category C testing might not be adequate, licensees should assign

the check valve to Category A/C and should comply with the associated leak testing requirements.

Licensees may refer to IN 91-56, “Potential Radioactive Leakage to Tank Vented to Atmosphere,” dated September 19, 1991, for information on the categories assigned to valves that function to close. These valves may also function to prevent leakage above an assumed limit to prevent the plant from exceeding the limits in 10 CFR Part 100, “Reactor Site Criteria.” Section 4.1.1 of this report discusses backflow testing of check valves in series.

Paragraph ISTC-3550 of the OM Code discusses valves in regular use and states that valves that operate in the course of plant operation at a frequency that would satisfy the exercising requirements 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 paragraph ISTC-3510. Even if licensees “exercise” check valves in accordance with paragraph ISTC-3550, the valves need to be listed in the IST program document, and the record (e.g., plant log, test procedure) needs to indicate that the test requirements are met.

For grouping valves in multiple nuclear power plants of like design and construction, if the plants are “identical” and the grouped valves have similar operational experience and otherwise meet the grouping criteria, it is acceptable for licensees to group valves from multiple plants. If a potentially generic problem is identified through disassembly and inspection during an RFO, the licensee must inspect all valves in the group in that plant during the RFO. If the other plant is not also in an RFO, inspection of the valves in the group that are installed in that plant may be deferred to the next RFO unless the licensee’s evaluation of the problem indicates that it could impact the safety of continued operation. “Grouping” may also be applied to the use of nonintrusive techniques as discussed in section 4.1.2, although the focus is slightly different, in that all of the valves in the group are tested at a specified maximum test interval as detailed in Mandatory Appendix II of the OM Code. At least one of the nonintrusive techniques for a valve group needs to be performed on each valve of the group at approximately equal intervals not to exceed the maximum test interval; therefore, all valves in the group need to be in the same nuclear power plant.

The NRC issued the following INs and bulletin on IST for check valves:

- IN 82-08, “Check Valve Failures on Diesel Generator Engine Cooling System,” dated March 26, 1982
- IN 83-54, “Common Mode Failure of Main Steam Isolation Nonreturn Check Valves,” dated August 11, 1983
- IN 88-70, “Check Valve Inservice Testing Program Deficiencies,” dated August 29, 1988
- IN 2000-21, “Detached Check Valve Disk Not Detected by Use of Acoustic and Magnetic Nonintrusive Test Techniques,” dated December 15, 2000
- Bulletin 83-03, “Check Valve Failures in Raw Water Cooling Systems of Diesel Generators,” dated March 10, 1983

4.1.1 Closure Verification for Series Check Valves without Intermediate Test Connections

Some plants have piping configurations that include two check valves in series with no provision for verifying that each valve can close. These valves might perform a safety function in the closed position. For example, the valves might be required to prevent the gross diversion of flow rather than to be leak-tight. The OM Code requires that each valve performing safety functions must be stroked to the position(s) required for the valve to perform those functions. The requirements for testing two check valves in a series configuration are addressed in paragraph ISTC-5223, "Series Valve in Pairs," for pre-2000 plants as follows:

> 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.

NRC Recommendation

Both check valves in a series pair should be tested to demonstrate individual valve closure if the plant safety analysis credits or otherwise requires both valves. For example, 10 CFR Part 50, Appendix A, GDC 14, "Reactor coolant pressure boundary," requires licensees, in part, to test the valves in the reactor coolant pressure boundary to demonstrate extremely low probability of abnormal leakage. Pressure isolation valves (PIVs) are a special case of reactor coolant pressure boundary valves, which are generally required to be individually leakage tested at a frequency specified by the TS and the OM Code.

Systems containing series pair check valves might have provisions for verifying that at least one valve is capable of closing. These provisions enable the licensee to measure or observe operational parameters such as leakage, pressure, or flow during each quarter, each cold shutdown outage, or each RFO. However, testing the series pair as a unit provides no assurance that both valves close. The only indication of a problem would be the failure of both valves in the series. If the valve pair is operationally tested closed as a unit, as allowed by paragraph ISTC-5223, because the plant safety analysis assumes closure of either valve (but not both), and the tested unit closure capability cannot be demonstrated, both valves should be declared inoperable, and corrective actions must be taken for both valves.

If it is not practical to flow test the pair of check valves in accordance with the OM Code, the licensee may demonstrate the closure safety function of each valve by other positive means, such as nonintrusive testing or disassembly and inspection. However, licensees should not use these methods to verify leak tightness, which requires Category A valve testing.

Basis for Recommendation

The requirements of paragraph ISTC-5223 are in the OM Code, 2004 Edition with 2005 and 2006 Addenda through 2022 Edition, as incorporated by reference in 10 CFR 50.55a.

Subparagraphs ISTC-5221(a) and/or ISTC-5221(c) allow the use of nonintrusive examination, disassembly and inspection, or other positive means for check valves that have no provision for

testing individual valves or practical means to demonstrate the closure capability of each valve by flow, but not for verifying leak-tightness.

Keep-fill valves are a special case, in that they are redundant check valves in a system in which only one valve of a series is actually necessary to perform a system's intended function. Licensees have proposed to exclude the upstream valve from the IST program. However, recognizing that neither valve can individually demonstrate a closure function, and that the OM Code alternative allows the valve pair to be operationally tested closed as a unit, the NRC staff's position is that both valves need to be included in the IST program and should be operationally tested as a pair to prevent reverse flow. Upon observing leakage, the licensee should disassemble, inspect, and repair or replace both valves (as necessary) before returning them to service.

4.1.2 Exercising Check Valves with Flow and Nonintrusive Techniques

The OM Code requires both an open and close test for check valves and that check valves be exercised to the position(s) required to fulfill their safety function(s). To verify the disk position of check valves that do not have external disk position indication, the OM Code allows licensees to use indirect evidence (such as changes in system pressure, flow, temperature, or level) or other positive means. An acceptable test method must demonstrate by positive means that a check valve disk moves to the position necessary to fulfill its safety function. The demonstration might require that the valve be exercised "full-open" to the backstop. The full stroke to the open position may be verified either by passing design flow or by other positive means such as nonintrusive techniques. The "other positive means" must be repeatable to meet the intent of the OM Code.

NRC Recommendation

The licensee may use nonintrusive techniques for IST of check valves. Relief is not required except as necessary for the testing frequency if the test interval extends beyond each RFO as allowed by the OM Code. The licensee may use nonintrusive techniques to verify the valve's capability to open, close, and fully stroke (as necessary) if the technique is qualified for the application in accordance with the plant's QA program requirements. A qualified nonintrusive technique is one that has been successfully and reliably demonstrated for the examination method and specific valve application. The licensee may qualify the technique and application on its own equipment, subcontract it to a vendor, or rely on the results of the Nuclear Industry Check Valve Group (NIC) evaluation of nonintrusive diagnostic techniques for check valves. Personnel training and qualification performed by a vendor in accordance with the licensee's QA program may be acceptable; however, the technique must also be qualified as described above. Records of techniques and qualification documentation shall be maintained in accordance with the licensee's QA program, and the NRC inspector may examine the licensee's records.

Basis for Recommendation

The NRC staff previously determined that nonintrusive testing methods appropriate for certain valve applications are acceptable to verify the capability of the valve to open, close, and fully stroke, provided that the licensee properly qualifies the testing methods used for the valve application in accordance with the plant's QA program requirements. These techniques are considered "other positive means" in accordance with subparagraph ISTC-5221(a)(3). It is the licensee's responsibility to qualify and document the results in accordance with the plant's QA program requirements. Appendix B to 10 CFR Part 50 specifies criteria for the QA program,

which include, in part, requirements to ensure that nondestructive testing is controlled and accomplished by qualified personnel using qualified procedures in accordance with applicable codes, standards, specifications, criteria, and other special requirements. The NIC conducted an experimental research and testing program to evaluate available nonintrusive technologies to determine their acceptability and reliability for use in check valve testing applications. The summary of the NRC's public workshops on the revision of NRC IP 73756, "Inservice Testing of Pumps and Valves," provides information on qualification of nonintrusive testing. In response to a question about expectations for qualification of a nonintrusive test method, the NRC indicated that a qualified nonintrusive test method is a technique that has been successfully and reliably demonstrated for the examination method and for the specific valve application. Other expectations are discussed in NRC IN 2000-21.

Qualification includes establishing a performance baseline when the check valve is known to be in good operating condition. A check valve's performance can be assessed against this baseline trace. One means to determine whether a nonintrusive test method or technique will provide accurate, reliable, and repeatable results for a specific check valve is to qualify the method prior to its use. The qualification process may reveal that certain techniques or methods give inconclusive results for a particular application. Acoustic techniques and test methods are susceptible to other plant system noise being transmitted and masking or affecting the desired sound pattern and results. The NIC suggests the use of more than one technique to verify questionable results.

4.1.3 Full Flow Testing of Check Valves

The OM Code requires that licensees conduct both an open and close test for check valves and exercise check valves to the position(s) in which they perform their safety function(s). A check valve's full stroke to the open position may be verified by passing the necessary flow through the valve to perform its safety function. This is considered an acceptable full stroke. Any flow rate less than this is considered a partial-stroke exercise. A valid full-stroke exercise by flow requires that the flow through the valve must be known. Knowledge of only the total flow through multiple parallel lines does not provide verification of flow rates through an individual valve and may not be a valid full-stroke exercise without further analysis.

4.1.3.1 Alternative to Direct Flow Measurement

Flow through a check valve must be known for a valid full-stroke exercise test, but an alternative to direct flow rate instrumentation may be acceptable. Any quantitative measure that has acceptance criteria that demonstrate the required flow through the check valve may be used to satisfy the full-stroke requirement. An indirect measure of flow may be acceptable. For example, a change in tank level over a specified period could be used. In another case, the acceptance criterion could be based on a change in flow rate of an instrumented line when flow is admitted from a noninstrumented line containing the check valve being tested. In any event, some form of quantitative criteria should be established to demonstrate full-stroke capability.

4.1.3.2 Flow Through Parallel Lines

Knowledge of total flow through multiple parallel lines does not provide indication of flow through each individual path. The objective of IST is to evaluate and investigate the possibility of degradation of individual components and to take corrective action before a component fails. Verification of the total header flow rate might not identify a problem developing or occurring with an individual check valve in one of the parallel flow paths. With respect to the balancing of

flow, TS requirements are based on the flow from one loop being lost through a postulated break. Consequently, that flow path is restricted or throttled to minimize significant diversion of flow. TS surveillance requirements were not intended to verify individual check valve operability. The licensee is expected to justify the use of a test method that does not verify full stroke of individual check valves.

For example, in the Beaver Valley Power Station, Unit 1, "Safety Evaluation Related to the IST Program and Relief Requests," dated January 24, 1992 (ADAMS Legacy Accession No. 9201310094), the NRC informed the licensee of the results of an evaluation of flow through parallel lines and stated that a flow test through parallel lines without individual flow measurement may not be sufficient to indicate that the check valves in the lines are full-stroke exercised. Knowledge of only total flow through multiple parallel lines does not provide verification of flow rates through an individual valve and may not be a valid full-stroke exercise without further analysis.

4.1.3.3 Accident Condition Flow

The phrase "necessary flow through the valve for safety function" is the largest flow rate for which a licensee takes credit in a safety analysis for this check valve in any flow configuration. The safety analyses are those contained in the plant's FSAR, or equivalent, but are not limited to the accident and transient analyses.

4.1.3.4 Check Valves Not Required to Be Fully Opened

For check valves that are never required to open fully (i.e., thermal expansion or siphon breakers), design (safety) function is verified by testing to confirm the capability of forward flow through the system. In addition to verifying their safety function performance, licensees should develop quantifiable acceptance criteria for the testing of these components. Verifying that a system is full is an acceptable means for verifying that the keep-fill check valves are capable of opening to provide flow when necessary.

4.1.3.5 Alternative to Full-Flow Testing

Full-flow testing of a check valve might not be achievable for certain valves. It may be possible to qualify other techniques to confirm that a valve is exercised to the position required to perform its safety function. To substantiate the acceptability of any alternative technique for meeting the OM Code requirements, licensees need to address and document the following items, as a minimum, in the IST program:

- the difficulty of performing a full-flow test
- a description of the alternative technique used and a summary of the procedures being followed
- a description of the method and results of the program to qualify the alternative technique for meeting the OM Code
- a description of the instrumentation used and the maintenance and calibration of the instrumentation

- a description of the basis used to verify that the baseline data have been generated when the valve is known to be in good working order, such as recent inspection and maintenance of the valve internals

- a description of the basis for the acceptance criteria for the alternative testing and a description of corrective actions to be taken if the acceptance criteria are not met

Any alternative techniques for meeting OM Code requirements must be submitted to the NRC for authorization pursuant to 10 CFR 50.55a(z).

The NRC staff's position with respect to full-flow testing of check valves allows licensees flexibility in qualifying alternatives to full-flow testing. In general, licensees should demonstrate that the alternative test is quantifiable and repeatable. The alternative test must meet the intent of the OM Code. This qualification of the alternative test should be documented by the licensee and should be available for review by NRC inspectors. Any alternative techniques for meeting OM Code requirements must be submitted to the NRC for authorization pursuant to 10 CFR 50.55a(z).

The 1994 Edition of the OM Code and subsequent editions include the use of nonintrusive testing as other positive means for demonstrating check valve exercising. The criteria listed in the NRC staff's position for full-flow testing of check valves could be applied to the nonintrusive techniques.

4.1.4 Disassembly and Inspection Alternative to Flow Testing

Subparagraph ISTC-5221(c) includes guidance for disassembly and inspection of certain check valves for use if the test methods of subparagraphs ISTC-5221(a) and ISTC-5221(b) are impractical or sufficient flow cannot be achieved.

NRC Recommendation

Testing of check valves by disassembly should be accomplished as follows:

- The sample disassembly and inspection program should involve grouping similar valves and testing a different valve in each group during each RFO. The sampling technique should require that each valve in the group be of the same design (manufacturer, size, model number, and materials of construction) and have the same service conditions including valve orientation. The grouping process should consider maintenance and modification history.

- At each RFO sampling, the licensee should verify that the disassembled valve is capable of completing a full stroke and that the internals of the valve are structurally sound (no loose or corroded parts). Also, if the disassembly is to verify the full-stroke capability of the valve, the disk should be manually exercised. While the valve is in a partially disassembled condition, the valve internals should be inspected and the condition of the moving parts evaluated. This inspection and evaluation should include verification that the valve disk is free to move. Following reassembly, a partial flow test should be performed, if practical.

- A different valve of each group should be disassembled, inspected, and manually full-stroke exercised at each successive RFO, until the entire group has been tested. If

the disassembled valve is not capable of being full-stroke exercised or there is binding or failure of valve internals, then the remaining valves in that group should also be disassembled, inspected, and manually full-stroke exercised during the same outage. Once this is completed, the sequence of disassembly should be repeated unless the valve group is in the condition monitoring program alternative and an extension of the interval can be justified.

- At least one valve from each group should be disassembled and examined at each RFO. All valves in each group shall be disassembled and examined at least once every 8 years, in accordance with ISTC-5221(c)(3).

The disassembly and inspection must be qualified to evaluate the condition of the valve and to assess its continued operational readiness. The licensee is responsible for the development and implementation of a program to ensure that IST personnel are appropriately trained and qualified to perform the valve disassembly and inspections. Licensees should implement the provisions of ASME NQA-1. The NRC staff encourages licensees to review the ASME NQA-1 standard for guidance in developing a program for the qualification of IST personnel.

Basis for Recommendation

OM Code, subparagraph ISTC-5221(c), allows the use of sample disassembly and inspection of check valves. Specifically, subparagraph ISTC-5221(c) provides requirements for sample disassembly and inspection of certain check valves, if the test methods of subparagraphs ISTC-5221(a) and ISTC-5221(b) are impractical, or if sufficient flow cannot be achieved or verified. ISTC-5221(c)(3) requires that every valve in each group be examined at least once every 8 years. These OM Code requirements are incorporated by reference in 10 CFR 50.55a.

4.1.5 Reverse Flow Testing of Check Valves

The OM Code requires that Category C check valves (those that are self-actuated in response to a system characteristic such as pressure or flow direction) that perform a safety function in the closed position to prevent reverse flow must be tested in a manner that demonstrates that the disk travels to the seat on cessation or reversal of flow. In addition, for Category A/C check valves (those that have a specified leak rate limit and are self-actuated in response to a system characteristic), seat leakage must be limited to a specific maximum amount in the closed position for fulfillment of their function. Verification that a Category C valve is in the closed position can be achieved through visual observation, by an electrical signal initiated by a position-indicating device, by observation of appropriate pressure indication in the system, by leak testing, or by other OM Code-defined positive means (i.e., paragraph ISTC-5221).

4.1.5.1 Closure Testing of Stop Check Valves

If a stop check valve does not perform a safety-related function in the closed position, valve closure is only necessary to ensure a repeatable starting point for opening testing. Valves may be closed by using a handwheel or a hand switch. (Note: 1996 Addenda, and later editions and addenda, to the OM Code require bi-directional testing.)

If the use of a handwheel or hand switch to close a valve achieves the safety-related function of the system, exercising the valve by this method meets the OM Code requirements of paragraph ISTC-5221. By contrast, if closure of a stop check valve on cessation or reversal of

flow is required to accomplish a safety-related function, its closure must be verified by reverse flow testing or other positive means, such as acoustic monitoring or radiography, to satisfy the OM Code.

When no other means of verification are possible, licensees may disassemble valves to verify valve closure. However, disassembly provides limited information on valve capability to seat on cessation or reversal of flow. Furthermore, if the method involves extensive disassembly, a post-reassembly test would be necessary in accordance with Paragraph ISTC-3310, “Effects of Valve Repair, Replacement, or Maintenance on Reference Values,” because disassembly and inspection can increase the probability of human error when the valve is reassembled. Licensees may evaluate the use of nonintrusive testing techniques and may implement such techniques if they are demonstrated to be effective in assessing closure capability, degradation, and incipient failure. Infrequent disassembly and inspection of the valves are appropriate to assess overall check valve condition, while reverse flow testing and nonintrusive testing provide an assessment of continued operational readiness.

4.1.5.2 Other Positive Means of Verification

Subparagraph ISTC-5221(a)(1) requires that 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), and verify that on cessation or reversal of flow, the obturator has traveled to the seat. Subparagraph ISTC-5221(a) also requires observations to 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).

Paragraph ISTC-5221 allows for other positive means of verification of obturator position. Examples from IST programs include verifying that a parallel centrifugal pump does not spin in reverse to verify closure of a pump discharge check valve, monitoring an upstream pressure indicator, monitoring a tank level, measuring the flow rate of a redundant train, or opening an upstream vent and drain valve. However, licensees need to ensure that subparagraph ISTC-5221(a) is met by verifying that the disk traveled to the seat such that seat leakage does not cause problems with the system or its components. For example, the pump flow might mask a stuck-open check valve. Therefore, to meet the allowance in subparagraph ISTC-5221(a), a licensee will need to establish a positive means to verify that the check valve disk travels to the seat on cessation or reversal of flow to ensure that seat leakage does not cause adverse impacts on the system or its pumps.

4.1.6 Extension of Test Interval to Refueling Outage for Check Valves Verified Closed by Leak Testing

When it is impracticable for the licensee to verify check valve closure or opening during plant operation or cold shutdown, the OM Code allows the licensee to extend the check valve quarterly exercise test (both open and close) to the RFO. The closure verification may be performed in conjunction with the Type C leak rate test conducted in accordance with Option A or Option B of Appendix J, “Primary Reactor Containment Leakage Testing for Water-Cooled Power Reactors,” to 10 CFR Part 50. Licensees may also perform the open exercise test during the RFO or anytime during the fuel cycle interval.

NRC Recommendation

If no other practical means are available, it is acceptable for licensees to extend the quarterly closure or opening exercise test to a refueling frequency. In such instances, the licensee needs to develop an RFO justification describing the impracticality of performing the quarterly closure test during plant operation or cold shutdown. The NRC staff has determined that the need to set up test equipment constitutes adequate justification to defer reverse flow testing of a check valve to an RFO. By referencing the refueling justification in the IST program document, the licensee may perform the closure exercise test during each reactor shutdown for refueling. A seat leak test is one method to verify that the obturator has traveled to the seat. All requirements of each individual valve category are applicable, although repetition of a common testing requirement is not required. Therefore, when the required performance of the Appendix J leak rate test coincides with an RFO exercise seat leak test, only the Appendix J test is required.

The OM Code states that open and close tests need only be performed at an interval "when it is practicable to perform both tests." The OM Code also states that licensees are not required to perform open and close tests at the same time if they are both performed during the same interval. For example, since the closure test is extended to the RFO by the refueling justification, the quarterly exercising test may also be extended to the RFO or may be performed anytime during the fuel cycle interval.

Basis for Recommendation

Subparagraph ISTC-5221(a) of the OM Code states that valve obturator movement observations shall be made by a direct indicator (e.g., a position-indicating device) or other positive means including seat leak testing. Therefore, a seat leak test is one method to verify that the obturator has traveled to the seat.

Subparagraph ISTC-3522(c) states that if exercising is not practical during plant operation and cold shutdowns, it shall be performed during RFOs. An RFO justification shall document the extension of the exercise test to the RFO.

Subparagraph ISTC-3522(a) states that open and close exercise tests need only be performed at an interval when it is practical to perform both tests. This OM Code section also states that open and close tests are not required to be performed at the same time if they are both performed during the same interval.

4.1.7 Testing and Examination of Check Valves Using Manual Mechanical Exercisers

OM Code, subparagraph ISTC-5221(b), "Valve Obturator Movement," requires, in part, that if a manual mechanical exerciser is used to test the check valve, the force(s) or torque(s) required to move the obturator to fulfill its safety function(s) shall meet the acceptance criteria specified by the Owner. These include the following:

(1) Exercise test(s) shall detect a missing obturator, sticking (closed or open), binding (throughout obturator movement), and the loss or movement of any weights.

(2) Acceptance criteria shall consider the specific design, application, and historical performance.

(3) If it is impractical to detect a missing obturator or loss or movement of any weight(s), 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).

NRC Recommendation

In the past, the OM Code (through the 1996 Addenda), subparagraph ISTC 4.5.4(b), required that, if a manual mechanical exerciser is used for IST movement of the obturator, the force or torque to initiate disk movement shall not vary by more than 50 percent from an established reference value. Licensees continually experienced difficulty with this IST acceptance criterion. The manual mechanical exerciser assembly includes a packing gland to seal the hinge pin penetration of the valve body. The hinge pin seal packing introduces conditions that produce variations in friction forces over time. These variations make it difficult to establish a reference value that would continually be consistent and appropriate for use in the IST program.

The NRC received a number of requests for relief from the requirement that force or torque to initiate disk movement not vary by more than 50 percent of the reference value. Licensees also requested that the OM Code Working Group on Check Valves (WGCV) reexamine this requirement. The WGCV reexamination resulted in the change in OM Code, 2000 Edition, subparagraph ISTC-5221(b), which is discussed above. This change requires the Owner to specify the acceptance criteria within certain OM Code-defined expectations. In establishing an acceptance criterion for IST when using a manual mechanical exerciser, the Owner should consider the interactions, wear, and effects of the valve parts on friction forces, and the valve preventive maintenance activities.

Additionally, licensees should be aware that if a mechanical exerciser is used for only one direction, the requirements in subparagraph ISTC-5221(a) or ISTC-5221(c) still apply for the other direction.

Basis for Recommendation

Mechanical exercisers are attached to a hinge pin that is fixed to the disk and penetrates the valve body. Many of these valves involve swing check valves that manufacturers supplied with a lever arm and counterweight modification. The counterweight is used to affect the opening or closing response of the disk to flow conditions, depending on the lever arm's location relative to the disk. The counterweight modification involves the use of a packing gland to seal the hinge pin penetration of the valve body. Over time, the seal packing introduces variations in the required disk opening force and opening and closing responses of the disk, depending on the type of packing material used, its condition, friction changes, leakage control adjustments, and the packing gland tightening procedure. Any wear of the hinge pin and bearing interfaces may exacerbate these variations. Disk opening and closing friction forces may also change as a result of valve preventive maintenance activities. Subparagraph ISTC-5221(b) of the OM Code states that if a mechanical exerciser is used to exercise the check valve, the force(s) or torque(s) required to move the obturator to fulfill its safety function(s) shall meet the acceptance criteria specified by the Owner.

4.1.8 Check Valve Bi-Directional Testing and Condition Monitoring Program

Bi-directional testing ensures that a check valve is adequately tested, regardless of its safety function. Such testing also improves the IST capability to detect valve degradation prior to valve

failure. The 1996 Addenda to the OM Code introduced two significant OM Code changes, in Paragraph ISTC 4.5.4(a), “Valve Obturator Movement,” and Subsection ISTC 4.5.5, “Condition Monitoring Program,” respectively. Specifically, those changes included (1) a requirement for bi-directional exercise testing of the disk movement of check valves, and (2) a voluntary provision to use the condition monitoring program as an alternative to IST exercise testing for certain check valves. This integral two-part improvement to the OM Code provides interrelated requirements. The condition monitoring program allows licensees certain IST flexibility in establishing the types of test, examination, and preventive maintenance activities and their associated intervals, when justified based on the valve’s performance and operating condition. These OM Code changes were developed so that licensees electing not to implement condition monitoring in their IST program would be required to bi-directionally test check valves as a default set of testing and examination requirements.

Paragraph ISTC 4.5.4(a) of the 1996 Addenda to the OM Code requires, in part, that the necessary obturator movement during exercise testing shall be demonstrated by performing both an open and close test, and observations shall be made by a direct indicator (e.g., a position-indicating device) or by other positive means (e.g., changes in system pressure, flow, level, temperature, seat leakage, testing, or nonintrusive testing and examination).

Subsection ISTC 4.5.5 of the 1996 Addenda to the OM Code provides, in part, an option for the Owner to establish a check valve condition monitoring program alternative to the testing and examination requirements of Subsections ISTC 4.5.1–4.5.4. The purpose of the program is to improve valve performance and optimize testing, examination, and preventive maintenance activities in order to maintain acceptable check valve performance. The program must be implemented in accordance with Mandatory Appendix II to the OM Code. The requirements of Mandatory Appendix II do not require full-open exercise testing, as discussed in Section II-4000, which differs from paragraph ISTC-5221.

More recent editions of the OM Code continue to specify bi-directional testing of check valves and allow the implementation of check valve condition monitoring programs.

NRC Recommendation

The required testing or examination of the check valve obturator movements to both the open and closed positions, as required by paragraph ISTC-3522 in the OM Code, is necessary to assess the valve’s operational condition, confirm the acceptability of its performance, and detect degradation prior to failure. Single-direction flow testing of check valves will not always detect functional degradation of the valves. In addition to check valves with both open and close safety functions, a check valve that has a safety function in only one direction (such as either open or close) needs to be tested in both directions to demonstrate that the disk is in its proper operating condition to provide reasonable assurance that the check valve is operationally ready to perform its open or close safety function.

The NRC staff considers the condition monitoring program approach of OM Code, Mandatory Appendix II, for check valve IST with the regulatory modifications in 10 CFR 50.55a(b)(3)(iv) to be an improvement over the prior OM Code requirements and encourages licensees to implement the condition monitoring alternative.

Basis for Recommendation

The NRC incorporated the 1996 Addenda to the OM Code by reference in 10 CFR 50.55a on September 22, 1999 (64 FR 51370). Subsection ISTC 4.5.4(a) of the 1996 Addenda to the OM Code included the requirement that the necessary obturator movement during exercise testing must be demonstrated by performing both open and closed tests. More recent editions of the OM Code continue this exercising requirement for check valves. The NRC agrees with the need for a required demonstration of bi-directional exercise testing of the movement of the check valve disk. Single-direction flow testing will not always detect degradation of the valve. The classic example of the flawed single-direction testing strategy is that the loss of the disk would not be detected during forward flow tests. The detached disk could be lying at the bottom of the valve body or another part of the system and could move to block flow or disable another valve or component. IN 2000-21 discusses one example of an undetected detached check valve disk lying at the bottom of the valve body. The NRC considers testing or examination of the check valve obturator movement to both the open and closed positions necessary to assess its condition and confirm acceptable valve performance.

The use of OM Code, Mandatory Appendix II, as incorporated by reference in 10 CFR 50.55a, includes requirements that apply when extending check valve IST intervals, with regard to consideration of the plant safety significance, justification by trending of current and historical valve condition and performance data, maximum IST interval limits, stepwise IST interval limits, and bi-directional testing or examination. These requirements provide the licensee with knowledge of the valve's operating condition, monitor and verify valve performance over extended intervals, and provide a process to justify prudent IST interval extensions to reduce the burden of unnecessary IST.

The OM Code Committee WGCV proposed changes to Subsection ISTC of the OM Code to address several regulatory modification issues. ASME issued these changes as part of the 2003 Addenda to the OM Code. All changes discussed above are incorporated in the 2004 through 2022 Editions of the OM Code.

4.1.9 Instrumentation Requirements

Instruments used to verify that check valves fulfill their safety function(s) are not subject to the same range and accuracy requirements as instrumentation used for pump-related IST. However, the 1998 Edition of the OM Code added paragraph ISTC-3800, "Instrumentation," in Subsection ISTC to provide specific requirements for instrumentation used in the testing and examination of valves. In editions and addenda of the OM Code subsequent to the 1998 Edition, paragraph ISTC-3800 required that instrumentation accuracy shall be considered when establishing valve test acceptance criteria. Paragraph ISTC-3800 was moved to ISTC-4000 starting in the 2020 Edition.

Subsection ISTA, Section ISTA-4000, "Instrumentation and Test Equipment," of the OM Code provides requirements for range, accuracy, and calibration for testing all components within the IST program. In particular, paragraph ISTA-4100, "Range and Accuracy," states that instrumentation and test equipment used in the examination and testing program shall have the range and accuracy necessary to demonstrate conformance to specific examination or test requirements. Paragraph ISTA-4200, "Calibration," states that all instruments and test equipment used in the examination and testing program shall be calibrated and controlled in accordance with the Owner's administrative procedures or a QA program approved by the Owner.

NRC Recommendation

OM Code (up to the 2020 Edition), paragraph ISTC-3800, specifies requirements for instrumentation used in performing IST for check valve testing and examination activities. OM Code, Section ISTA-4000, provides requirements for range, accuracy, and calibration for testing all components within the IST program. For all pumps, valves, and snubbers in the IST program, the NRC staff expects that instrumentation that is used in IST must be controlled and calibrated, and must have the accuracy, range, and repeatability necessary to verify compliance with the requirements. Accuracy and repeatability of the instrumentation are important considerations in the IST testing. IST should be performed in a way that permits the results to be compared for indications of degradation trends. When instrumentation used in component testing and examination is not properly controlled and calibrated, any degradation indications may be masked, thereby diminishing the usefulness of the test results. The NRC staff recognizes that some instrumentation cannot be adjusted by calibration (such as some strain gages). Instrumentation that cannot be adjusted by calibration should be checked for proper performance prior to IST testing and replaced if necessary.

Basis for Recommendation

The instrumentation requirements and QA activities specified in Section ISTA-4000 and paragraph ISTC-3800 are needed to properly verify compliance with OM Code requirements and to detect and trend any operational degradation for assurance that the check valves will perform satisfactorily until the next IST. Appendix B to 10 CFR Part 50 provides for the QA program and includes requirements for IST of safety-related components, test control, and control of measuring and test equipment.

4.1.10 Skid-Mounted Valves and Component Subassemblies

The exercising or examination of each check valve contained in (or part of) a skid-mounted package or major component is not always practical, particularly if the valve is enveloped within the structure of the package or component. Although the valve's performance may support a safety function, the practicality of exercising or examining each valve separately, as required by the OM Code, was not addressed prior to the 1996 Addenda to the OM Code. Subparagraph ISTC-1200(c) of the 1996 Addenda to the OM Code through the 2017 Edition (ISTC-1200(b) in the 2022 Edition) exempts skid-mounted valves from the individual testing requirement and allows the valves to be tested as part of the overall package or major component. Specifically, paragraph ISTC-1200 states, in part, "Skid-mounted valves and component subassemblies 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."

NRC Recommendation

To satisfy the OM Code, testing major components that include check valves that are an integral portion of the major component and that support the major component's performance of its safety function requires that the licensee determine that the check valves are adequately tested. The NRC staff expects that, as part of the licensee's testing and determination responsibility, the check valves will be identified in the IST plan, along with an explanation of how the testing of the major component adequately tests the valves. The licensee should review the safety significance of the identified valves to ensure that the IST program is adequate to demonstrate their continued operability. The documentation providing assurance of the operational readiness of the valves through the performed tests should be available at the plant site.

Documentation and justification are important for these components, as there have been several instances of valves in a skid-mounted component that were not adequately tested to provide reasonable assurance of their operational readiness. In these situations, periodic testing of the major component did not adequately test the specific valves, and operational readiness could not be easily ascertained. A licensee should ensure that existing testing demonstrates operational readiness of skid-mounted components and supplement as necessary with the appropriate justification. It is the licensee's responsibility to have justification that the requirements in paragraph ISTC-1200 for excluding valves from the specific OM Code requirements are met as part of skid-mounted testing. The justification should demonstrate that the requirements in 10 CFR 50.55a to assess the operational readiness of the valves to perform their safety functions are satisfied by the skid-mounted testing in terms of the capability to perform their safety functions over the interval between tests.

Basis for Recommendation

GDC 1 in Appendix A to 10 CFR Part 50, in part, requires that components important to safety be tested to quality standards commensurate with the importance of the safety functions performed.

4.1.11 Check Valves in New Reactors

Nuclear power plant operating experience has revealed that testing check valves in only the flow direction can fail to identify significant degradation, such as a missing valve disk. Nonmandatory Appendix M to the OM Code, 2012 through 2022 Editions, includes guidance for the design of new reactors to enable bi-directional testing of check valves. New reactor designs will provide the capability for licensees of new nuclear power plants to perform bi-directional testing of check valves within the IST program. Bi-directional testing of check valves in new reactors could be accomplished by valve-specific testing or condition monitoring activities in accordance with Mandatory Appendix II to the OM Code as accepted in 10 CFR 50.55a.

Some new reactors include nozzle check valves in nuclear power plant systems to perform functions important to safety. Nozzle check valves are more complex than the swing check valves used in most safety-related check valve applications in nuclear power plants. The provisions in the OM Code focus on exercising check valves to demonstrate their operational readiness. The internal mechanism of the nozzle check valve might require more precise IST provisions to provide assurance of their operational readiness for their specific applications. Appendix A to 10 CFR Part 50 states that where generally recognized codes and standards are used, they shall be identified and evaluated to determine their applicability, adequacy, and sufficiency, and shall be supplemented or modified as necessary to assure a quality product in keeping with the required safety function. Licensees of new reactors are responsible for satisfying 10 CFR Part 50, Appendix A, when developing IST provisions for nozzle check valves that provide reasonable assurance that they are capable of performing their safety functions.

4.1.12 Maximum Interval for Excess Flow Check Valves

BWR containments use EFCVs to limit the release of fluid from the reactor coolant system (RCS) in the event of an instrument line break. EFCVs are not required to close in response to a containment isolation signal and are not postulated to operate under post-LOCA conditions.

The NRC has authorized alternatives to the OM Code for EFCV testing in response to requests from nuclear power plant licensees under 10 CFR 50.55a(z)(1). In these prior authorizations, a

staggered test interval approach was proposed with a maximum test interval of 10 years for each EFCV. Examples of these authorizations may be found in ADAMS at ML18163A054, ML19248C707, ML21049A024, and ML22061A040. On March 14, 2000, the NRC issued a safety evaluation (ML003691722) accepting with conditions the General Electric Company (GE) topical report NEDO-32977-A, "Excess Flow Check Valve Testing Relaxation," issued June 2000 (ML003729011), which specifies a 10-year maximum test interval for individual EFCVs. Licensees should be aware of these examples during the development of proposed alternatives to the OM Code requirements for EFCVs.

4.2 Power-Operated Valves

POVs are equipped with actuators that use motive force to change the position of the valve obturator. The types of POVs include, for example, MOVs, AOVs, HOVs, SOVs, and pyrotechnic-actuated (squib) valves.

Paragraph ISTC-2000, "Supplemental Definitions," defines a power-operated relief valve (PORV) as follows:

> *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 PORV is not capacity certified under ASME Boiler and Pressure Vessel Code (ASME BPVC), Section III overpressure protection requirements.

Certain valves, such as MSIVs and valves that have a fail-safe function, may actuate open (or closed) on spring force. Mandatory Appendix III provides diagnostic testing requirements for MOVs, and Mandatory Appendix IV provides diagnostic testing requirements for AOVs. The following sections provide guidance on the implementation of specific OM Code provisions and associated regulatory requirements.

4.2.1 Stroke-Time Testing Reference Values for Power-Operated Valves

Paragraph ISTC-5113 of the OM Code specifies that certain active POVs shall have their stroke times measured when exercised in accordance with the nominal 3-month schedule specified in paragraph ISTC-3500. Mandatory Appendix III to the OM Code (2009 Edition and later) and Mandatory Appendix IV to the OM Code (2017 Edition and later) specify separate diagnostic IST requirements for MOVs and AOVs, respectively.

The OM Code includes provisions for establishing reference values and limiting values for POV stroke times. For example, reference values shall be determined from the results of PST or IST. Limiting values for stroke time for various types of POVs shall be specified by the Owner. Corrective actions shall be taken if acceptance criteria are not satisfied. If the limiting value of stroke time is exceeded, the POV shall be immediately declared inoperable.

The OM Code does not specify provisions for establishing the limiting value for stroke times, and it does not identify the relationship that should exist between those limits and the reference values for stroke time or any limits identified in the plant TS or safety analysis.

NRC Recommendation

The limiting value of full-stroke time should be based on the reference stroke time of a POV when it is known to be in good condition and operating properly. The limiting value should be a

reasonable deviation from this reference stroke time, based on the size and type of the valve and power actuator. The deviation should not be so restrictive that it results in a POV being declared inoperable as a result of reasonable stroke time variations. However, the deviation used to establish the limiting value should be such that corrective action would be taken to provide assurance that the POV would remain capable of performing its safety function.

The limiting value for stroke time of a POV should be that point at which the licensee seriously questions continued operability. It is expected to be a value determined to be reasonable for the individual POV based on its characteristics and past performance but not to exceed any safety analysis requirements. The value should not be based solely on the system requirements or values specified in safety analyses for system performance. When the identified limiting value is exceeded, the licensee shall declare the component inoperable and shall enter any applicable TS LCO. After declaring the valve inoperable, the licensee should perform an analysis to identify the cause of the problem with the POV. If this analysis clearly demonstrates that the POV remains capable of performing its safety function, the analysis might constitute the corrective action required by the OM Code. The analysis must be documented.

Licensees should establish reference values that reflect the stroke time of the specific POV when in good condition and operating under applicable conditions. A licensee may establish additional sets of reference values as discussed in paragraph ISTC-3320, such as reference values that reflect test conditions of fluid pressure or flow in the system.

Licensees may use a quantitative multiplier on a reference time as a means of establishing a limiting value for stroke time. The licensee should document the justification for its selection of reference values for the stroke time of each POV and should have this justification available at the plant site for review by NRC personnel.

If the TS or safety analysis limit for a POV is less than the IST value established using the above guidelines, the TS or safety analysis limit should be used as the limiting value of full-stroke time. When the TS or safety analysis limit for a POV is greater than the IST value established using the above guidelines, the limiting value of full-stroke time should be based on the above guidelines instead of the TS or safety analysis limit. The TS and safety analysis limits are useful for analyzing data when a POV has indicated degraded performance and been declared inoperable. In accordance with the OM Code, the data may be analyzed to verify that the new stroke time represents acceptable POV operation. Section 4.2.4.1 includes further discussion of the scope of 10 CFR 50.55a(b)(3)(ii)(D) for MOVs.

Basis for Recommendation

The purpose of the limiting value of full-stroke time for a POV is to establish a value for taking corrective action on a degraded POV before it reaches the point where there is a high likelihood of failure to perform its safety function. While the TS provide assurance that important plant systems are capable of performing their safety functions in a timely manner during selected plant transients, accidents, and anticipated operational occurrences, the provisions of the OM Code are intended to ensure the continued operability of particular plant components. The distinct bases for these two documents (i.e., TS and OM Code) lead to criteria that may differ significantly. Nonetheless, the TS and OM Code are both needed to provide confidence that the nuclear power plant can be operated safely. Therefore, licensees must follow the more restrictive criteria of the two documents, even though this might result in a more conservative decision of a component or system being declared inoperable.

4.2.2 Stroke-Time Measurements for Rapid-Acting Valves

The OM Code allows licensees to establish the limiting stroke time of 2 seconds for POVs that stroke in less than 2 seconds. The OM Code also eliminates the acceptance criterion related to the reference value for stroke time for those POVs. However, new technologies and new applications of existing technologies enable licensees to time the strokes of rapid-acting valves with accuracy measured in milliseconds. Using new technology, licensees could establish an appropriate limiting stroke time based on a multiple of a reference value to ensure that corrective actions are taken if degrading conditions are identified.

NRC Recommendation

The NRC staff recommends that licensees determine whether continued reliance on the 2-second limiting stroke time criterion in the OM Code is appropriate when the actual stroke time can be measured in milliseconds. Considerations could be whether credit is taken in the licensing basis for fast action (less than 2 seconds) and the practicality of using more accurate equipment on the valve.

Basis for Recommendation

The 2-second limiting stroke time for rapid-acting valves was based on measurement of stroke times using a stopwatch. Updated technology may improve the monitoring of the condition of these POVs or verify that a valve operates within a safety analysis limit that is less than 2 seconds.

4.2.3 Stroke Time for Solenoid-Operated Valves

The NRC is often asked to approve relief from the OM Code provisions to allow licensees not to measure the stroke times of enclosed SOVs that do not have position indication. If the licensee cannot time the stroke of an SOV by the conventional method using position indication, the licensee needs to propose a method to time the stroke of the valve or otherwise monitor the POV for degrading conditions to provide assurance of its operational readiness. If the frequency provisions of the OM Code are met, the licensee does not need to request relief to use methods such as acoustics or diagnostic systems for stroke timing. If the licensee intends to apply a method to monitor for degradation other than by measuring stroke time, NRC authorization of the alternative is required pursuant to 10 CFR 50.55a(z). For example, an enhanced

maintenance program or periodic replacement may be acceptable when testing methods cannot be used effectively.

NRC Recommendation

The NRC staff recommends that licensees use advanced diagnostic techniques to obtain stroke-time measurements in accordance with the frequency provisions of the OM Code and should also use those advanced techniques or maintenance programs to monitor the degradation of SOV performance. In addition, the NRC staff recommends that the technique should evaluate actual disk movement and not only movement of the pilot valve or valve stem.

Basis for Recommendation

In NUREG-1275, Volume 6, "Operating Experience Feedback Report—Solenoid-Operated Valve Problems, Commercial Power Reactors," issued September 1991 (ML063550260), the NRC described common-mode SOV problems that could significantly reduce plant safety. Several methods are available to measure stroke time or monitor the condition of SOVs using parameters such as the acoustic effects of disk movement, electric resistance, and the temperature of the coil. These advanced diagnostic techniques provide more precise means of monitoring SOV performance.

4.2.4 Supplement to the Power-Operated Valve Test Provisions of the ASME OM Code

Operational experience and valve testing programs have revealed weaknesses in the ability of stroke-time testing to assess the operational readiness of some POVs to perform their safety functions. In response to those weaknesses, ASME, the NRC, and various industry groups have acted to improve confidence in the capability of POVs to perform their safety functions under design-basis conditions.

For MOVs, the NRC's regulations in 10 CFR 50.55a require that licensees implementing the OM Code (beginning with the 1995 Edition) must supplement the provisions for MOV stroke-time testing specified in the OM Code with a program to ensure that the MOVs continue to be capable of performing their design-basis safety functions. In an FR notice (64 FR 51370) dated September 22, 1999, the NRC discussed the implementation of MOV programs in satisfying the requirement to supplement MOV stroke-time testing.

The NRC established Generic Safety Issue 158, "Performance of Safety-Related Power-Operated Valves under Design-Basis Conditions," to evaluate whether additional regulatory actions were necessary to address performance issues for POVs. In RIS 2000-03, the NRC closed Generic Safety Issue 158 on the basis that current regulations provide adequate requirements to ensure verification of the design-basis capability of POVs, and no new regulatory requirements were needed. The NRC staff also stated that it would continue to monitor licensees' activities to ensure that POVs are capable of performing their specified safety-related functions under design-basis conditions. In RIS 2000-03, the NRC staff provided attributes for an effective POV testing program that incorporates lessons learned from MOV research and testing programs.

In response to these valve issues, ASME updated the OM Code to replace the previous IST requirements that relied only on quarterly stroke-time testing with improved IST requirements for MOVs and AOVs in Mandatory Appendix III and Mandatory Appendix IV, respectively. See

Mandatory Appendix III for MOVs and Mandatory Appendix IV for AOVs for the details of these IST requirements, which include diagnostic testing as specified in each appendix.

The NRC regulations in 10 CFR 50.55a incorporate by reference Mandatory Appendix III and Mandatory Appendix IV to the OM Code. The regulations specify conditions in 10 CFR 50.55a(b)(3)(ii)(A), (B), (C), and (D) for the implementation of Mandatory Appendix III.

NRC Recommendation

Licensees are required to apply the OM Code as incorporated by reference in 10 CFR 50.55a, including Mandatory Appendices III and IV, according to the applicable edition of their OM Code of record. The NRC staff recommends that licensees apply lessons learned from their MOV programs established and implemented in response to GL 89-10 and GL 96-05 in implementing the provisions in the OM Code in accordance with the requirements in 10 CFR 50.55a. The NRC staff also recommends that licensees consider information in RIS 2000-03 and apply the lessons learned from POV inspections summarized in IN 2021-01, "Lessons Learned from NRC Inspections of Design-Basis Capability of Power-Operated Valves at Nuclear Power Plants," dated May 6, 2021 (ML21061A265), and Supplement 1 to IN 2021-01, dated July 24, 2023 (ML23129A014), to provide reasonable assurance of the capability of POVs to perform their safety functions at nuclear power plants.

Basis for Recommendation

In the 1980s and 1990s, operating experience at nuclear power plants revealed that weaknesses in the ability of stroke-time testing to assess the operational readiness of POVs allowed performance deficiencies to remain undetected for an extended period of time. In 10 CFR 50.55a, the NRC requires that licensees whose code of record is the 1995 Edition (or a later edition or addenda) of the OM Code must supplement their stroke-time testing of MOVs with programs to ensure that the MOVs are capable of performing their design-basis safety functions. As discussed in RIS 2000-03, the NRC staff determined that current requirements and guidance indicate the need for licensees to have confidence in the capability of all safety-related POVs to perform their design-basis functions. In RIS 2000-03, the NRC staff discusses industry activities to improve POV performance. The NRC staff also stated that it would continue to monitor licensees' activities to ensure that POVs are capable of performing their specified safety-related functions under design-basis conditions.

In GL 89-10, the NRC asked licensees to ensure that MOVs in safety-related systems have the capability to perform their intended functions by reviewing MOV design bases, verifying MOV switch settings initially and periodically, testing MOVs under design-basis conditions where practical, improving evaluations of MOV failures and necessary corrective actions, and trending MOV problems. The NRC subsequently issued GL 96-05 to request that licensees establish a program, or ensure the effectiveness of their current program, to verify, on a periodic basis, that safety-related MOVs continue to have the capability to perform their safety functions within the current licensing basis of the facility. The NRC staff reviewed licensees' activities in response to GL 89-10 and GL 96-05 through plant-specific inspections and reviews of submitted information.

Licensees have completed their GL 89-10 programs for the operational nuclear power plants. In response to GL 96-05, the Owners' groups of nuclear power plant licensees established the JOG Program on MOV Periodic Verification as an industrywide effort to evaluate potential degradation of MOV operating requirements. Most licensees committed to implement the JOG MOV program as part of their response to GL 96-05. In a safety evaluation issued

September 2006 and its supplement issued September 2008, the NRC staff accepted the application of the JOG Program on MOV Periodic Verification as described in the safety evaluation and its supplement. As discussed in the safety evaluation, the JOG program addresses the operating requirements of valves, and therefore, licensees are responsible for justifying the output capability of MOVs within the scope of the JOG program. Further, licensees are responsible for justifying the long-term periodic verification programs for MOVs or their applications that are outside the scope of the JOG program.

The NRC staff notes that the NRC regulations and documents contain requirements and guidance intended to provide assurance that safety-related POVs are capable of performing their safety-related functions. For example, the regulations in Appendices A and B to 10 CFR Part 50 require that licensees provide confidence that safety-related equipment (including POVs) is capable of performing its safety functions under design-basis conditions. Further, the regulations in 10 CFR 50.65 require that licensees monitor the performance of SSCs in a manner sufficient to provide reasonable assurance that such SSCs are capable of fulfilling their intended functions. With respect to air systems, the NRC staff issued GL 88-14, "Instrument Air Supply System Problems Affecting Safety-Related Equipment," dated August 8, 1988, to ask licensees to verify (by test) that AOVs will perform as expected in accordance with all design-basis events. The NRC staff provided the results of studies of POV issues in NUREG-1275, "Operating Experience Feedback Report," Volumes 2, 6, and 13; NUREG/CR-6644, "Generic Issue 158: Performance of Safety-Related Power-Operated Valves under Operating Conditions," issued September, 1999; and NUREG/CR-6654, "A Study of Air-Operated Valves in U.S. Nuclear Power Plants," issued February 2000. In RIS 2000-03, the NRC staff listed attributes of a successful POV design capability and long-term periodic verification program based on lessons learned from NRC staff reviews of valve programs and plant visits. The NRC staff also prepared several INs to alert licensees to IST issues related to POV performance. Specifically, these included IN 86-50, "Inadequate Testing to Detect Failures of Safety-Related Pneumatic Components or Systems," dated June 18, 1986; IN 85-84, "Inadequate Inservice Testing of Main Steam Isolation Valves," dated October 30, 1985; and IN 96-48, "Motor-Operated Valve Performance Issues," dated August 21, 1996, which described lessons learned from MOV programs that are applicable to other POVs.

In response to POV operating and test experience, ASME began to improve the OM Code provisions for assessing the operational readiness of POVs in IST programs at nuclear power plants. For example, ASME developed OM Code Cases OMN-1 and OMN-11. ASME also developed OM Code Case OMN-12, which provides guidance for an alternative to quarterly stroke-time testing for AOVs and HOVs. OMN-12 includes risk-informed provisions to allow licensees to obtain more precise performance data for use in assessing the operational readiness of POVs that are determined to have higher safety significance, while allowing licensees to obtain less precise data for POVs of lower safety significance.

In addition to the NRC and ASME, the nuclear industry addressed POV performance issues. As discussed above, the industry developed the JOG Program on MOV Periodic Verification to share resources among licensees and to establish an improved response to the MOV issues to be addressed under GL 96-05. In addition, the Joint Owners' Group on Air-Operated Valves (JOG AOV) established a voluntary program to improve confidence in the capability of safety-related AOVs to perform their design-basis functions. In RIS 2000-03, the NRC staff noted that it provided comments on the JOG AOV program in a letter to the NEI dated October 8, 1999. The NRC staff also stated that it would continue to monitor licensees' activities to ensure that POVs are capable of performing their safety-related functions under design-basis conditions. If the

industry does not adequately address POV functionality under design-basis conditions, the NRC staff indicated in RIS 2000-03 that additional regulatory action may be necessary.

As a follow-up to RIS 2000-03, the NRC staff conducted an inspection program between 2020 and 2023 as described in Attachment 21N.02, "Design-Basis Capability of Power-Operated Valves under 10 CFR 50.55a Requirements," to NRC IP 71111, "Reactor Safety—Initiating Events, Mitigating Systems, Barrier Integrity." In particular, the NRC implemented IP 71111.21N.02 to assess the reliability, functional capability, and design-basis capability of risk-important POVs to determine whether licensees are maintaining the POV capability to perform as intended under design-basis conditions. During and following the POV inspection program, the NRC staff presented lessons learned from the POV inspections at several industry and public meetings. The NRC inspections using IP 71111.21N.02 identified numerous lessons learned related to the design-basis capability of POVs installed in nuclear power plants. The NRC issued IN 2021-01 and Supplement 1 to alert licensees to the lessons learned from those inspections.

The NRC regulations in 10 CFR 50.55a(b)(3)(ii), "*OM condition: Motor-Operated Valve (MOV) testing*," specify the following requirements:

> Licensees must comply with the provisions for testing MOVs in ASME OM Code, ISTC 4.2, 1995 Edition with the 1996 and 1997 Addenda, or ISTC-3500, 1998 Edition through the latest edition and addenda incorporated by reference in paragraph (a)(1)(iv) of this section, and must establish a program to ensure that MOVs continue to be capable of performing their design basis safety functions. Licensees implementing ASME OM Code, Mandatory Appendix III, "Preservice and Inservice Testing of Active Electric Motor-Operated Valve Assemblies in Water-Cooled Reactor Nuclear Power Plants," of the 2009 Edition, through the latest edition and addenda of the ASME OM Code incorporated by reference in paragraph (a)(1)(iv) of this section shall comply with the following conditions (with the exception of conditions in paragraphs (b)(3)(ii)(A) through (C) of this section when implementing the 2022 Edition of the ASME OM Code):
>
> (A) *MOV diagnostic test interval.* Licensees shall evaluate the adequacy of the diagnostic test intervals established for MOVs within the scope of ASME OM Code, Appendix III, not later than 5 years or three refueling outages (whichever is longer) from initial implementation of ASME OM Code, Appendix III.
>
> (B) *MOV testing impact on risk.* Licensees shall ensure that the potential increase in core damage frequency and large early release frequency associated with the extension is acceptably small when extending exercise test intervals for high risk MOVs beyond a quarterly frequency.
>
> (C) *MOV risk categorization.* When applying Appendix III to the ASME OM Code, licensees shall categorize MOVs according to their safety significance using the methodology described in ASME OM Code Case OMN-3, "Requirements for Safety Significance Categorization of Components Using Risk Insights for Inservice Testing of LWR Power Plants," subject to the conditions applicable to OMN-3 which are set forth in Regulatory Guide 1.192, or using an MOV risk ranking methodology accepted by the NRC on a plant specific or industry-wide basis in accordance with the conditions in the applicable safety evaluation.

(D) *MOV stroke time.* When applying Paragraph III-3600, "MOV Exercising Requirements," of Appendix III to the ASME OM Code, licensees shall verify that the stroke time of MOVs specified in plant technical specifications satisfies the assumptions in the plant's safety analyses.

Under 10 CFR 50.55a(b)(3)(ii), licensees must establish a program to ensure that MOVs continue to be capable of performing their design basis safety functions. Licensees that are implementing an OM Code edition or addenda as the Code of record for their IST Program prior to incorporation of Mandatory Appendix III will apply their regulatory commitments for MOV testing programs in response to GL 89-10 and GL 96-05 as part of meeting 10 CFR 50.55a(b)(3)(ii). Upon updating to a more recent ASME OM Code edition, implementation of Mandatory Appendix III to the OM Code, as incorporated by reference in 10 CFR 50.55a with specific conditions, is part of the licensee's actions to satisfy 10 CFR 50.55a(b)(3)(ii).

Licensees will need to update their MOV programs to implement the provisions in Mandatory Appendix III. For example, Mandatory Appendix III includes all active valves powered by motor actuators within the scope of the OM Code as incorporated by reference in 10 CFR 50.55a. The GL 89-10 and GL 96-05 programs focused on motor-operated gate, globe, and butterfly valves because of the adverse operating experience identified with those valve types leading to the issuance of those generic letters.

Licensees may apply the lessons they learned from the GL 89-10 and GL 96-05 programs in satisfying this condition. However, licensees might need to supplement the lessons learned for valve types (such as ball or plug valves) that might not have been dynamically tested as part of those programs. Licensees might obtain information from the valve vendor or operating and testing experience to satisfy this condition for specific valve types. Licensees may need to modify their regulatory commitments as part of establishing their programs under Mandatory Appendix III in lieu of the GL 89-10 and GL 96-05 programs.

When implementing Mandatory Appendix III to the OM Code, licensees will need to address the conditions specified in 10 CFR 50.55a(b)(3)(ii) as discussed in the following paragraphs.

In 10 CFR 50.55a(b)(3)(ii)(A), the regulations require licensees implementing OM Code editions prior to the 2022 Edition to evaluate the adequacy of their diagnostic test intervals established for MOVs within the scope of Mandatory Appendix III not later than 5 years or three RFOs (whichever is longer) from initial implementation of Mandatory Appendix III. The NRC staff considers that licensees that implemented GL 89-10 programs and are currently implementing their GL 96-05 programs could apply lessons learned from those programs to justify the adequacy of their diagnostic test intervals in satisfying this condition. The NRC has removed this condition for licensees implementing the 2022 Edition of the OM Code as their IST code of record.

In 10 CFR 50.55a(b)(3)(ii)(B), the regulations require licensees implementing OM Code editions prior to the 2022 Edition to ensure that the potential increase in core damage frequency and large early release frequency associated with the extension is acceptably small when extending exercise test intervals for high-risk MOVs beyond a quarterly frequency. This condition also applied to the acceptance of OM Code Case OMN-1 as an alternative to quarterly stroke-time testing. The NRC staff considers that licensees may apply their plant probabilistic risk assessment to justify the extension of the exercise interval for high-risk MOVs in satisfying this

condition. The NRC has removed this condition for licensees implementing the 2022 Edition of the OM Code as their IST code of record.

In 10 CFR 50.55a(b)(3)(ii)(C), the regulations indicate that when applying Mandatory Appendix III, licensees implementing OM Code editions prior to the 2022 Edition shall categorize MOVs according to their safety significance using the methodology described in OM Code Case OMN-3, subject to the conditions applicable to OMN-3 stated in RG 1.192, or using an MOV risk ranking methodology accepted by the NRC on a plant-specific or industrywide basis in accordance with the conditions in the applicable safety evaluation. This condition indicates acceptable alternatives to MOV risk ranking beyond the provision for the use of OM Code Case OMN-3 specified in Mandatory Appendix III. The allowance for alternatives to OM Code Case OMN-3 relaxes the provisions in Mandatory Appendix III. The NRC has removed this condition for licensees implementing the 2022 Edition of the OM Code as their IST code of record.

In 10 CFR 50.55a(b)(3)(ii)(D), the regulations require that when applying Paragraph III-3600, "MOV Exercising Requirements," of Mandatory Appendix III, licensees shall verify that the stroke time of MOVs specified in plant TS satisfies the assumptions in the plant's safety analyses. Early editions and addenda of the OM Code specified that the licensee must perform quarterly MOV stroke-time measurements that could be used to verify that the MOV stroke time satisfies the assumptions in the safety analyses consistent with plant TS. Current reliance on plant TS to provide confidence in MOV stroke times has led to this condition. The NRC staff notes that, in satisfying this condition, exercising of the MOVs specified in plant TS may verify that the stroke time does not exceed the safety analysis assumptions. This specific condition does not require trending of MOV stroke time.

When implementing Mandatory Appendix IV, licensees must satisfy the IST requirements for AOVs with different testing provisions based on their risk significance. Licensees will need to establish the high or low safety significance of the AOVs within the OM Code scope to implement Mandatory Appendix IV.

4.2.4.1 Scope of 10 CFR 50.55a(b)(3)(ii)(D)

When 10 CFR 50.55a was modified to incorporate by reference the 2009 Edition and later editions of the OM Code, the NRC included condition 10 CFR 50.55a(b)(3)(ii)(D) to ensure that MOV stroke time would be verified to satisfy certain TS surveillance requirements. Condition D was needed because, with the incorporation of Mandatory Appendix III, the OM Code no longer explicitly required stroke time testing of active MOVs. Mandatory Appendix III comprehensively provides assurance of operational readiness of active MOVs.

The NRC regulations in 10 CFR 50.55a(b)(3)(ii)(D) currently state the following:

> *MOV stroke time.* When applying Paragraph III-3600, "MOV Exercising Requirements," of Appendix III to the ASME OM Code, licensees shall verify that the stroke time of MOVs specified in plant technical specifications satisfies the assumptions in the plant's safety analyses.

Historically, TS surveillance requirements have often been satisfied by crediting stroke-time testing performed by the plant's IST program, which is developed in accordance with the OM Code. Often licensees will designate the surveillance frequency in the TS as "in accordance with the IST Program" or other plant documents such as the "Surveillance Frequency Control

Program" that may indirectly credit the IST program for satisfying the TS requirements. The OM Code no longer requires stroke-time testing of active MOVs. Therefore, certain surveillance activities may be left pointing to an IST program that does not satisfy the requirement to verify stroke time until the periodic inservice test (diagnostic test) is performed in accordance with OM Code, Mandatory Appendix III. This gap was addressed by incorporating 10 CFR 50.55a(b)(3)(ii)(D).

The NRC staff clarified the requirements in 10 CFR 50.55a(b)(3)(ii)(D) in the NRC response to public comments (ML16130A531) on the proposed rule in 80 FR 56820 to include this condition in 10 CFR 50.55a, and in 82 FR 32934 for the final rule modifying 10 CFR 50.55a to incorporate by reference the OM Code with Mandatory Appendix III. As indicated in these documents, the language of 10 CFR 50.55a(b)(3)(ii)(D) is such that its scope applies to MOVs that are referenced in the plant TS and rely on the IST program for stroke-time verification. For these active MOVs, the MOV exercising requirements in Paragraph III-3600 shall include verifying that the measured stroke time meets the assumptions in the plant's safety analyses. The stroke time is not required to be trended under Condition D. Trending activities shall be addressed as part of the inservice test evaluation.

When transitioning to Mandatory Appendix III, licensees should review their TS and identify instances where stroke-time testing performed by the IST program is used to satisfy TS requirements and include them in the scope of Condition D. Examples are provided below (this list is not all-inclusive):

- site surveillance requirement to verify that the isolation time of CIVs is within limits in accordance with the IST program

- site surveillance requirement to verify that the engineered safety features actuation system response times are within limits in accordance with the surveillance frequency control program (if the surveillance frequency control program credits the IST program)

- site surveillance requirement to verify that the closure time of each MFIV, MFCV, MFCV bypass valve, and MFW/AFW nozzle bypass valve is ≤ 10 seconds on an actual or simulated actuation signal in accordance with the IST program

- where IST stroke-time testing is used to satisfy a surveillance requirement to verify that a valve that is not locked, sealed, or otherwise secured in position, actuates to the correct position on an actual or simulated actuator signal

- where the TS references valves in systems that are required to actuate to satisfy their safety functions and credits stroke-time testing performed by the IST program

4.2.5 Alternatives to Power-Operated Valve Stroke-Time Testing

Prior to the development of Mandatory Appendices III and IV to the OM Code, ASME developed alternatives to the OM Code provisions for stroke-time testing of POVs. As an alternative to MOV stroke-time testing, ASME developed OM Code Case OMN-1, which provides periodic exercising and diagnostic testing for use in assessing the operational readiness of MOVs. In OM Code Case OMN-11, ASME provided additional guidance for use with OM Code Case OMN-1 to emphasize the testing provisions for MOVs in the IST program that are determined to have high safety significance, while allowing less precise testing for MOVs that are determined to

have lower safety significance. ASME has incorporated these Code Cases into Mandatory Appendix III to the 2009 Edition of the OM Code to replace quarterly MOV stroke-time testing with periodic exercising and diagnostic testing. ASME also developed Code Case OMN-26, which is further discussed in section 8.4.

With respect to AOVs and HOVs, ASME developed OM Code Case OMN-12 to provide an alternative to the OM Code stroke-time testing provisions that incorporates risk insights to focus on AOVs and HOVs in the IST program that are determined to have the highest safety significance, while allowing less emphasis on AOVs and HOVs that have lower safety significance. ASME has incorporated some provisions of this Code Case into Mandatory Appendix IV to the OM Code in the 2017 Edition and later editions.

NRC Recommendation

The NRC regulations in 10 CFR 50.55a(b)(3)(ii) require nuclear power plant licensees implementing the OM Code incorporated by reference in 10 CFR 50.55a to supplement the MOV testing provisions in the OM Code with a program to periodically demonstrate the design-basis capability of safety-related MOVs. The NRC staff considers that licensees may apply the lessons learned from their MOV programs developed in response to GL 89-10 and GL 96-05 in satisfying the regulatory requirement to supplement the MOV stroke-time provisions in the OM Code. The NRC staff also considers the provisions in OM Code Case OMN-1 as accepted in RG 1.192 to satisfy the regulatory requirement to supplement the quarterly MOV stroke-time provisions. ASME has replaced the quarterly MOV stroke-time testing provisions in Mandatory Appendix III to the 2009 Edition through the 2022 Edition of the OM Code that incorporates the provisions in OM Code Cases OMN-1 and OMN-11. The NRC staff also considers the alternative approach to quarterly stroke-time testing of AOVs and HOVs in OM Code Case OMN-12 as accepted in RG 1.192 to provide an acceptable alternative to the OM Code stroke-time testing provisions for those POVs as discussed in RG 1.192. Therefore, the NRC staff recommends that licensees update their IST programs to implement Mandatory Appendices III and IV to the OM Code as incorporated by reference in 10 CFR 50.55a. OM Code Cases OMN-1, OMN-11, and OMN-12, as accepted by the NRC (with certain conditions) in RG 1.192, are also acceptable as alternatives to the stroke-time testing provisions in the OM Code for applicable POVs. In the future, licensees will be responsible for modifying their MOV testing programs in accordance with the update requirements for IST programs.

Basis for Recommendation

ASME developed Mandatory Appendices III and IV, as well as OM Code Cases, to address weaknesses in the ability of stroke-time testing to assess the operational readiness of POVs in IST programs at nuclear power plants. Mandatory Appendices III and IV and the Code Cases, incorporate risk insights to emphasize IST provisions for POVs that are determined to have the highest safety significance. The NRC has incorporated by reference Mandatory Appendices III and IV of the OM Code in 10 CFR 50.55a with specific conditions. The NRC has accepted several Code Cases with certain conditions. For example, RG 1.192 allows licensees with an applicable code of record to implement OM Code Case OMN-1 (in accordance with the provisions in the RG) as an alternative to the OM Code provisions for MOV stroke-time testing, without submitting a request for relief from their code of record. In RG 1.192, the NRC staff also accepts (with certain conditions) the use of the risk-informed provisions in OM Code Case OMN-11 by applicable licensees, in conjunction with OM Code Case OMN-1. RG 1.192 also allows licensees with an applicable code of record to implement OM Code Case OMN-12 for AOVs and HOVs (with certain conditions) in lieu of the OM Code provisions for stroke-time

testing, without the need to submit a relief request. Licensees with a code of record that is not applicable to the acceptance of these OM Code Cases may submit a request to apply those OM Code Cases, consistent with the indicated conditions, as an alternative to the OM Code that provides an acceptable level of quality and safety. ASME has incorporated OM Code Cases OMN-1 and OMN-11 as Mandatory Appendix III and OM Code Case OMN-12 as Mandatory Appendix IV to the OM Code. Therefore, the NRC regulations will require licensees to modify their MOV and AOV testing programs to apply the provisions of Mandatory Appendices III and IV to the OM Code in accordance with the update requirements for IST programs.

4.2.6 Main Steam Isolation Valves

IN 85-84 describes an inadequacy in the IST of MSIVs. Specifically, the NRC staff stated that two licensees were testing their MSIVs using the non-safety-related instrument air to achieve closure. Fail-safe IST of MSIVs as required by paragraph ISTC-3560 necessitates the removal of the instrument air supply and electric power. IN 94-08, “Potential for Surveillance Testing to Fail to Detect an Inoperable Main Steam Isolation Valve,” dated February 1, 1994, and IN 94-44, “Main Steam Isolation Valve Failure to Close on Demand Because of Inadequate Maintenance and Testing,” dated June 16, 1994, describe operating experience related to MSIVs is described in.

NRC Recommendation

The NRC staff recommends that licensees review their inservice and fail-safe testing of MSIVs to ensure compliance with OM Code requirements. The OM Code states the following:

> **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. AOV fail-safe test frequency shall meet the requirements of Division 1, Mandatory Appendix IV.

Paragraph ISTC-3560 requires that the air supply be removed for fail-safe valves.

Basis for Recommendation

The practice of performing IST of components that are relied on to mitigate the consequences of plant events using sources of power that were not considered in the safety analyses is inconsistent with the objective of periodic IST for fail-safe testing. In IN 85-84, the NRC staff alerted licensees that, with low or no steam flow, the MSIV might not close unless instrument air is available to power the actuator.

In its Service Information Letter 477, GE described a related issue for BWRs in which excessive tightening of gland flanges in the MSIV can prevent the valve from closing in response to spring force alone. GE recommended a review of packing chamber maintenance practices, “springs-only” full-stroke closing tests, a force balance in which containment pressure is considered, a leak-tightness test of the MSIV actuator and accumulator, and a modification of the applicable licensing-basis documents. Licensees should review their licensing basis to ensure that they are complying with the appropriate requirements.

4.2.7 Verification of Remote Position Indication for Valves by Methods Other Than Direct Observation

OM Code, paragraph ISTC-3700, states the following:

> Valves with remote position indicators shall be observed locally at least once every 2 yr. to verify that valve operation is accurately indicated. Where practicable, this local observation should be supplemented by other indications such as the use of flow meters 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. Position verification for active MOVs shall be tested in accordance with Division 1, Mandatory Appendix III [of the OM Code].

The NRC regulations in 10 CFR 50.55a(b)(3)(xi) require that licensees implementing paragraph ISTC-3700 in the OM Code, 2012 Edition through the latest edition and addenda of the OM Code incorporated by reference in 10 CFR 50.55a, do the following:

> …verify that valve operation is accurately indicated by supplementing valve position indicating lights with other indications, such as flow meters or other suitable instrumentation to provide assurance of proper obturator position for valves with remote position indication within the scope of Subsection ISTC including its mandatory appendices and their verification methods and frequencies. For valves not susceptible to stem-disk separation, licensees may implement ASME OM Code Case OMN–28, ‘‘Alternative Valve Position Verification Approach to Satisfy ISTC–3700 for Valves Not Susceptible to Stem-Disk Separation,’’ which is incorporated by reference in paragraph (a)(1)(iii)(H) of this section. Where plant conditions make it impractical to perform the initial ISTC–3700 test as supplemented by paragraph (b)(3)(xi) of this section by the date 2 years following the previously performed ISTC–3700 test, a licensee may justify an extension of this initial supplemental valve position verification provided the ISTC–3700 test as supplemented by paragraph (b)(3)(xi) of this section is performed at the next available opportunity and no later than the next plant shutdown. This one-time extension of the ISTC–3700 test schedule as supplemented by paragraph (b)(3)(xi) of this section is acceptable provided the licensee has available for NRC review documented justification based on information obtained over the previous 5 years of the structural integrity of the stem-disk connection for the applicable valves. The licensee’s justification could be based on, for example, verification of the valve stem-disk connection through an appropriate weak link analysis, appropriate disk motion confirmed during diagnostic testing, or allowance and cessation of flow through the valves. The licensee’s justification must provide reasonable assurance that the remote indicating lights accurately reveal the position of the valve obturator until the next ISTC-3700 test as supplemented by paragraph (b)(3)(xi) of this section is performed.

For many years, the NRC staff has indicated that the provisions in paragraph ISTC-3700 to verify valve position indication were unclear. Since 1995, NUREG-1482 and its revisions have emphasized the importance of proper implementation of paragraph ISTC-3700 to provide reasonable assurance that the indicating lights for valves with remote position indication properly inform the plant operators whether the valve is open or closed. Recent operating

experience, including notices under 10 CFR Part 21, “Reporting of Defects and Noncompliance,” when valve disks have become separated from the valve stems at nuclear power plants, reinforced the need to supplement the paragraph ISTC-3700 provisions with a condition in 10 CFR 50.55a.

The requirement that valves with remote position indicators must be observed at least once every 2 years to verify that valve position is accurately indicated has been specified in the OM Code and the previous ASME OM Part 10 for many years. The additional guidance for supplementing the local observation was not present in older versions of OM Part 10, such as in the 1983 version.

Many valves have no provision for verifying the position by direct observation. To verify the position by observation, licensees can disassemble the valve, which could introduce additional valve failure mechanisms. Other methods (such as nonintrusive techniques, causing the flow to begin or cease, leak testing, and pressure testing) can yield a positive indication of disk position.

The OM Code does not require licensees to verify the indication at the remote panels. The other remote lights can be assumed to function properly because the stem and disk will be known to be connected. However, verification at remote panels is a good practice and provides confidence in the remote indication.

NRC Recommendation

Paragraph ISTC-3530, “Valve Obturator Movement,” allows obturator movement to be determined by indicating lights in the control room when exercising the valve to meet the quarterly stroke-time testing requirement of the OM Code. The valve position verification testing required by paragraph ISTC-3700 provides confirmation on a 2-year frequency that the indicating lights reflect actual valve operation. Paragraph ISTC-3700 allows flexibility to licensees in verifying that operation of valves with remote position indicators is accurately indicated. Operating experience has revealed that indicating lights might not be sufficient to verify valve position. The extent of verification necessary for valve operation to satisfy paragraph ISTC-3700 will depend on the type of valve, the sophistication of the diagnostic equipment used in testing the valve, possible failure modes of the valve, and the operating history of the valve and similar valve types. The licensee will be responsible for developing and implementing a method to verify that valve operation is accurately indicated, as required by paragraph ISTC-3700, and complies with 10 CFR 50.55a(b)(3)(xi) when the IST code of record is the 2012 Edition or later edition of the OM Code.

Basis for Recommendation

Appendix A to 10 CFR Part 50 states that where generally recognized codes and standards are used, they shall be identified and evaluated to determine their applicability, adequacy, and sufficiency, and shall be supplemented or modified as necessary to assure a quality product in keeping with the required safety function. Nuclear power plant licensees are responsible for satisfying 10 CFR Part 50, Appendix A, where codes and standards are insufficient to provide reasonable assurance that components are capable of performing their safety functions.

In Section 4.2.5, “Verification of Remote Position Indication for Valves by Methods Other Than Direct Observation,” of the original version of NUREG-1482 issued in April 1995, the NRC staff noted that the OM Code requires that valves with remote position indicators be observed at least once every 2 years to verify that valve position is accurately indicated. The NRC staff

stated that if remote valve position cannot be verified by local observation at the valve, an acceptable approach is for the licensee to observe operational parameters such as leakage, pressure, and flow that give positive indication of the valve's actual position. The NRC staff indicated its interpretation of the OM Code requirement by stating that for certain types of valves that can be observed locally, but for which valve stem travel does not provide assurance that the stem is attached to the disk, the local observation must be supplemented by observing an operating parameter as required in the OM Code. In the basis discussion, the NRC staff stated that accurate position indication for safety-related valves is important for reactor operation during all plant conditions. Therefore, the NRC staff noted that the OM Code requires verification of the accuracy of the remote position indication for all valves in the IST program with remote position indication. Many positive ways are available to verify the indication that a valve is open or closed. For example, the NRC staff referenced leak-rate testing, inline flow rate instrumentation, and system and differential pressures for indication of valve position.

Section 4.2.7 of Revision 1 to NUREG-1482, issued January 2005, discusses the NRC staff's interpretation of the OM Code for position indication verification. The NRC staff noted that paragraph ISTC-3700 requires verification of the accuracy of the remote position indication for all valves in the IST program with remote position indication. If licensees cannot verify remote valve position by local observation at the valve, an acceptable approach is for the licensee to observe operational parameters (such as leakage, pressure, and flow) that give a positive indication of the valve's actual position. In Revision 1, the NRC staff modified the discussion of supplementing local observation of valves for which stem travel does not provide assurance that the stem is attached to the disk with observation of operating parameters (i.e., changing "must" to "should") because Revision 1 to the NUREG removed the preapproval of this approach and required Commission approval pursuant to 10 CFR 50.55a.

The OM Code requires licensees to verify the accuracy of the remote position indication for all valves in the IST program that have remote position indication. Paragraph ISTC-3700 states that where local observation is not possible, licensees shall use other indications to verify operation. Nuclear power plant operating experience has revealed that reliance on indicating lights and stem travel is not sufficient to satisfy the requirement in paragraph ISTC-3700 to verify that valve operation is accurately indicated for those valves where the integrity of the internal mechanism of the valve (such as stem-to-disk connection) cannot be assured. Criterion V of Appendix B to 10 CFR Part 50 requires safety-related components that are subjected to test activities to have appropriate instructions, procedures, or drawings and qualitative or quantitative acceptance criteria for determining that activities have been successfully completed. Therefore, licensees are responsible for developing a method to verify that valve operation is accurately indicated to satisfy paragraph ISTC-3700 requirements such that IST can help to identify stem-to-disk separation as valves are tested.

IN 2012-14, "Motor-Operated Valve Inoperable due to Stem-Disc Separation," dated July 24, 2012, discusses the OM Code provisions for valve position verification.

The modification to 10 CFR 50.55a issued in 2020 clarifies that 10 CFR 50.55a(b)(3)(xi) requires that licensees implementing paragraph ISTC-3700 in the OM Code, 2012 Edition through the latest edition and addenda of the OM Code incorporated by reference in 10 CFR 50.55a, shall verify that valve operation is accurately indicated by supplementing valve position indicating lights with other indications, such as flow meters or other suitable instrumentation to provide assurance of proper obturator position for valves with remote position indication within the scope of Subsection ISTC, including its mandatory appendices and their verification methods and frequencies. Paragraph ISTC-3700 states that position verification for

active MOVs shall be tested in accordance with Division 1, Mandatory Appendix III. In 10 CFR 50.55a(b)(3)(xi), the NRC clarified this reference to Appendix III and also expanded the OM Code provision to apply to "mandatory appendices and their verification methods and frequencies." Therefore, licensees may demonstrate valve position indication according to the internal inspection interval for check valves in OM Code, Mandatory Appendix II; the diagnostic testing interval for MOVs in OM Code, Mandatory Appendix III; and the performance assessment testing interval for AOVs in OM Code, Mandatory Appendix IV, rather than the 2-year interval specified in paragraph ISTC-3700.

Although not specifically mentioned in 10 CFR 50.55a(b)(3)(xi), applicants and licensees may submit an alternative request in accordance with 10 CFR 50.55a(z) to propose that a combination of plant activities (such as periodic flow testing and Appendix J leakage testing) be used to demonstrate that the valve disk is in the open position during flow testing and is in the closed position during Appendix J leakage testing to satisfy the intent of 10 CFR 50.55a(b)(3)(xi) on a longer interval than the 2-year interval specified in paragraph ISTC-3700.

4.2.8 Requirements for Verifying Position Indication of Passive Valves

The OM Code does not restrict the verification of position indication to only active valves. Table ISTC-3500-1 of the OM Code indicates that the licensee must also locally verify the position indication for Category B passive valves. (Table ISTC-3500-1 was reformatted in the 2022 Edition of the ASME OM Code to increase readability compared to prior Editions.) As discussed in section 4.2.7 of this NUREG, the licensee is responsible for developing and implementing a method to verify that valve operation is accurately indicated as required by paragraph ISTC-3700 and 10 CFR 50.55a(b)(3)(xi). The extent of verification necessary for valve operation to satisfy paragraph ISTC-3700 and 10 CFR 50.55a(b)(3)(xi) will depend on the type of valve, the sophistication of the diagnostic equipment used in testing the valve, possible failure modes of the valve, and the operating history of the valve and similar valve types.

The OM Code does not require licensees to verify the indication at the remote panels. The other remote lights can be assumed to function properly because the stem and disk will be known to be connected. However, verification at remote panels is a good practice and provides confidence in the remote indication.

4.2.9 Control Valves with a Safety Function

In general, control valves used only for system control would be exempt from IST as discussed in paragraph ISTC-1200. However, some control valves also perform safety or fail-safe functions (e.g., fail open, fail closed, or fail as-is), and such valves must be tested in accordance with the OM Code IST requirements. The NRC staff has received many requests for relief from stroke-time measurement requirements, based on the impracticality of performing the measurement by the conventional method using position indication lights. Typically, the control valves do not have position indication, and testing can be performed only by bypassing control signals. To allow stroke timing by bypassing the control signals of those control valves that have position indication lights, the licensee may have to drain systems, which might make it impractical to test at the OM Code-defined frequency.

NRC Recommendation

Control valves that perform a safety or fail-safe function must be tested in accordance with the OM Code provisions for IST to monitor the valves for degrading conditions. The NRC staff

recommends that licensees apply OM 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, ISTC-1.1, or ISTA-1100,” as accepted in RG 1.192. OM Code Case OMN-8 states that stroke-time testing need not be performed for POVs when the only safety-related function of those valves is to fail safe. Any abnormality or erratic action experienced during valve exercising should be recorded in the test record and an evaluation should be performed. RG 1.192, Revision 5, endorses Code Case OMN-8 with no conditions. The OM Code (2022 Edition) stated that Code Case OMN-8 is applicable to the 1988 Edition through the 2004 Edition. Therefore, a licensee must submit a request in accordance with 10 CFR 50.55a to use Code Case OMN-8 if the licensee’s code of record is later than the 2004 Edition, until ASME updates Code Case OMN-8 to more recent editions and RG 1.192 accepts the updated versions of Code Case OMN-8.

4.2.10 Pressurizer Power-Operated Relief Valve Inservice Testing

Pressurizer PORVs were often not purchased as safety-related valves, and the function of these valves to provide pressure control for plant transients was not considered safety related. The valves were not designed to serve as overpressure protection devices during power operations, as required by ASME BPV Code, Section III, but many have been used as LTOP valves.

NRC Recommendation

Recognizing that the PORVs have shown a high likelihood of sticking open and are not needed for overpressure protection during power operation, the provisions in paragraphs ISTC-3500 and ISTC-5100 for exercising quarterly during power operation are not practical and, therefore, exercising may be performed during cold shutdown conditions. Paragraph ISTC-3310 requires licensees to perform testing after maintenance or repair. Test methods must confirm that the PORV has been reassembled correctly and is capable of performing its design function. There have been instances (see IN 96-02, “Inoperability of Power-Operated Relief Valves Masked by Downstream Indications During Testing,” dated January 5, 1996) where improper evaluation of testing failed to identify the incorrect reassembly of a PORV.

Previously approved NRC guidance appeared in GL 90-06, “Resolution of Generic Issue 70: ‘Power-Operated Relief Valve and Block Valve Reliability,’ and Generic Issue 94, ‘Additional Low-Temperature Over Pressure Protection for Light-Water Reactors,’ Pursuant to 10 CFR 50.54(f),” dated June 25, 1990. That guidance indicates that, because the PORVs function during reactor startup and shutdown to protect the reactor vessel and coolant system from LTOP conditions, they should be exercised before system conditions warrant vessel protection and should also be exercised after the operational readiness of the block valves is ensured, by exercising and stroke-timing (as applicable) according to the following test schedule:

- Perform full-stroke exercising during each cold shutdown or, as a minimum, once each refueling cycle.
- Perform stroke timing during each cold shutdown, or as a minimum, once each refueling cycle.
- Perform fail-safe testing during each cold shutdown, or as a minimum, once each refueling cycle.

- Include the PORV block valves in the IST program and test them quarterly to ensure protection against a small-break LOCA in the event that a PORV fails open.

If the plant frequently enters cold shutdown mode, testing of the PORVs is not required more often than once every 3 months.

Basis for Recommendation

GL 90-06 includes the NRC's guidance on the IST requirements for PORVs. IN 89-32, "Surveillance Testing of Low-Temperature Overpressure-Protection Systems," dated March 23, 1989, discusses the stroke-time assumptions made in plants' safety analyses for these PORVs, and the IST performed for these valves. Stroke times of the valves were unacceptable or were not measured in the direction required for LTOP systems to prevent exceeding the limits in Appendix G, "Fracture Toughness Requirements," to 10 CFR Part 50. The licensees and the NRC project managers for each plant have coordinated implementation of the guidance in GL 90-06 on a case-by-case basis.

4.2.11 Online Check Valve Sample Disassembly and Inspection

Licensees have proposed, as an alternative to subparagraph ISTC-5221(c) and paragraph ISTC-5224 of the OM Code, to perform sample disassembly and inspection of check valves in a group online. Paragraph ISTC-3510 requires that check valves be exercised every 3 months. Subparagraph ISTC-3522(c) states that if exercising is not practicable during operation at power and cold shutdown, it shall be performed during RFOs. Subparagraph ISTC-5221(c) allows disassembly of check valves every RFO as an alternative means to verify their operability. Instead of disassembling every RFO, subparagraph ISTC-5221(c) provides the option of using a sample disassembly and inspection program for groups of identical valves in similar applications. Further, subparagraph ISTC-5221(c)(3) states that at least one valve from each group shall be disassembled and examined at each RFO and all valves in each group shall be disassembled and examined at least once every 8 years. Paragraph ISTC-5224 requires that check valves in a sample disassembly program that are not capable of being full-stroke exercised, or have failed, or have unacceptably degraded valve internals, shall have the cause of failure analyzed and the condition corrected.

Paragraph ISTC-5224 also states that other check valves in the sample group that may also be affected by this failure mechanism be examined or tested during the same RFO to determine the condition of internal components and their ability to function. A licensee should fully describe how it plans to comply with the requirements in ISTC-5224 when submitting alternative requests for check valve group sample disassembly and inspection online. The plan description also should include information on management of examination and testing of all group valves should a scheduled valve inspection be declared inoperable. For example, licensees should explain how the disassembly and inspection of the other check valves in a group will be completed within the allowed system outage time.

4.2.12 Power-Operated Valves in New Reactors

The NRC regulations in 10 CFR 50.55a(b)(3)(iii) apply specific conditions for IST programs applicable to licensees of new nuclear power plants in addition to the provisions of the OM Code as incorporated by reference with conditions in 10 CFR 50.55a. Licensees of "new reactors" are, as identified in 10 CFR 50.55a, holders of operating licenses for nuclear power reactors that received construction permits under this part on or after the date 12 months after

August 17, 2017, and COL holders issued under 10 CFR Part 52, whose initial fuel loading occurs on or after the date 12 months after August 17, 2017.

Commission papers SECY-90-016, SECY-93-087, SECY-94-084, and SECY-95-132 discuss IST programs for new reactors licensed under 10 CFR Part 52.

In recognition of new reactor designs and lessons learned from nuclear power plant operating experience, ASME is updating the OM Code to incorporate improved IST provisions for components used in nuclear power plants that were issued (or will be issued) construction permits, or COLs, on or following January 1, 2000 (defined in the OM Code as post-2000 plants). The first phase of the ASME effort incorporated IST provisions that specify full flow pump testing and other clarifications for post-2000 plants in the OM Code beginning with the 2011 Addenda. The second phase of the ASME effort incorporated preservice inspection, ISI, and surveillance provisions for pyrotechnic-actuated (squib) valves in the 2012 Edition of the OM Code.

As described in the following paragraphs, 10 CFR 50.55a(b)(3)(iii) includes four specific conditions.

The NRC regulations in 10 CFR 50.55a(b)(3)(iii)(A) require licensees within the scope of 10 CFR 50.55a(b)(3)(iii) to periodically verify the capability of POVs to perform their design-basis safety functions. While Mandatory Appendix III to the OM Code addresses this requirement for MOVs with the conditions specified in 10 CFR 50.55a, applicable applicants and licensees will need to develop programs to periodically verify the design-basis capability of other POVs. RIS 2000-03 describes attributes of a successful long-term periodic verification program for POVs by incorporating lessons learned from MOV performance at operating nuclear power plants and research programs. Implementation of Mandatory Appendix III to the OM Code as accepted in 10 CFR 50.55a(b)(3)(ii) satisfies 10 CFR 50.55a(b)(3)(iii)(A) for MOVs.

Paragraph (A) of 10 CFR 50.55a(b)(3)(iii) is consistent with the Commission policy for new reactors summarized in an NRC staff memorandum, “Consolidation of SECY-94-084 and SECY-95-132,” dated July 24, 1995, that (1) the design capability of safety-related POVs should be demonstrated by a qualification test prior to installation, (2) prior to initial startup, POV capability under design-basis differential pressure and flow should be verified by a preoperational test, and (3) during the operational phase, POV capability under design-basis differential pressure and flow should be verified periodically through a program similar to that developed for MOVs in GL 89-10. The condition in paragraph (A) of 10 CFR 50.55a(b)(3)(iii) specifies with the same level of detail as the condition in 10 CFR 50.55a(b)(3)(ii) that nuclear power plant licensees must establish a program to ensure the continued capability of MOVs in performing their design-basis safety functions. When establishing the MOV periodic verification condition, the NRC provided guidance in the final rule published September 22, 1999 (64 FR 51370), for licensees to develop acceptable programs that would satisfy the MOV periodic verification condition. Similarly, the NRC staff provided guidance in the FR notice for the final rule dated July 18, 2017 (82 FR 32934), and summarized herein, for new reactor applicants and licensees to develop acceptable programs to periodically verify the capability of POVs to perform their design-basis safety functions.

In NUREG-2124, the NRC staff found the provisions established by the COL applicant for VEGP Units 3 and 4 in its FSAR, Revision 5, Section 3.9.6.2.2, “Valve Testing,” to periodically verify the capability of POVs (such as AOVs, SOVs, and HOVs) to perform their design-basis safety

functions to be acceptable. In particular, VEGP Units 3 and 4 FSAR Section 3.9.6, “Inservice Testing of Pumps and Valves,” specifies the following:

> Power-operated valves other than active MOVs are exercised quarterly in accordance with OM ISTC, unless justification is provided in the inservice testing program for testing these valves at other than Code mandated frequencies. Although the design basis capability of power-operated valves is verified as part of the design and qualification process, power-operated valves that perform an active safety function are tested again after installation in the plant, as required, to ensure valve setup is acceptable to perform their required functions, consistent with valve qualification. These tests, which are typically performed under static (no flow or pressure) conditions, also document the “baseline” performance of the valves to support maintenance and trending programs. During the testing, critical parameters needed to ensure proper valve setup are measured. Depending on the valve and actuator type, these parameters may include seat load, running torque or thrust, valve travel, actuator spring rate, bench set and regulator supply pressure. Uncertainties associated with performance of these tests and use of the test results (including those associated with measurement equipment and potential degradation mechanisms) are addressed appropriately. Uncertainties may be considered in the specification of acceptable valve setup parameters or in the interpretation of the test results (or a combination of both). Uncertainties affecting both valve function and structural limits are addressed. Additional testing is performed as part of the air-operated valve (AOV) program, which includes the key elements for an AOV Program as identified in the JOG AOV program document, Joint Owners Group Air Operated Valve Program Document, Revision 1, December 13, 2000 (References 203 and 204) [JOG AOV Program Document, Revision 1, December 13, 2000 (ML010950310), and NRC comment letter dated October 8, 1999, to the NEI (ML020360077)]. The AOV program incorporates the attributes for a successful power-operated valve long-term periodic verification program, as discussed in Regulatory Issue Summary 2000-03, Resolution of Generic Safety Issue 158: Performance of Safety-Related Power-Operated Valves Under Design Basis Conditions, by incorporating lessons learned from previous nuclear power plant operations and research programs as they apply to the periodic testing of air- and other power-operated valves included in the IST program.
>
> For example, key lessons learned addressed in the AOV program include:
>
> - Valves are categorized according to their safety significance and risk ranking.
>
> - Setpoints for AOVs are defined based on current vendor information or valve qualification diagnostic testing, such that the valve is capable of performing its design-basis function(s).
>
> - Periodic static testing is performed, at a minimum on high risk (high safety significance) valves, to identify potential degradation, unless those valves are periodically cycled during normal plant operation, under conditions that meet or exceed the worst case operating conditions within the licensing basis of the plant for the valve, which would provide adequate periodic demonstration of AOV capability. If required based on valve

qualification or operating experience, periodic dynamic testing is performed to re-verify the capability of the valve to perform its required functions.

- Sufficient diagnostics are used to collect relevant data (e.g., valve stem thrust and torque, fluid pressure and temperature, stroke time, operating and/or control air pressure, etc.) to verify the valve meets the functional requirements of the qualification specification.

- Test frequency is specified and is evaluated each refueling outage based on data trends as a result of testing. Frequency for periodic testing is in accordance with References 203 and 204 of the JOG Program, with a minimum of 5 years (or 3 refueling cycles) of data collected and evaluated before extending test intervals.

- Post-maintenance procedures include appropriate instructions and criteria to ensure baseline testing is re-performed as necessary when maintenance on the valve, repair or replacement, have the potential to affect valve functional performance.

- Guidance is included to address lessons learned from other valve programs specific to the AOV program.

- Documentation from AOV testing, including maintenance records and records from the corrective action program are retained and periodically evaluated as a part of the AOV program.

The attributes of the AOV testing program described above, to the extent that they apply to and can be implemented on other safety-related power-operated valves, such as electro-hydraulic operated valves, are applied to those other power-operated valves.

Applicable applicants and licensees may follow the method described in the VEGP Units 3 and 4 FSAR to satisfy 10 CFR 50.55a(b)(3)(iii)(A), or they may establish a different method, subject to evaluation by the NRC during the licensing process or inspections.

4.2.13 Relationship Between Generic Letter 89-10, Generic Letter 96-05, EPRI Motor-Operated Valve Performance Prediction Methodology, Joint Owners Group, and Mandatory Appendix III for Motor-Operated Valves

On June 28, 1989, the NRC staff issued GL 89-10 in response to operating experience concerns about MOV performance at nuclear power plants. In GL 89-10, the NRC staff requested that nuclear power plant licensees and construction permit holders ensure the capability of MOVs in safety-related systems to perform their intended functions by reviewing MOV design bases, verifying MOV switch settings initially and periodically, testing MOVs under design-basis conditions where practicable, improving evaluations of MOV failures and necessary corrective actions, and trending MOV problems. In implementing MOV programs in response to GL 89-10, licensees and permit holders found that many MOVs could not be practicably tested under design-basis conditions.

As part of the industry response to the MOV issue, the Electric Power Research Institute (EPRI) initiated a program to develop a methodology for bounding MOV performance to demonstrate the design-basis capability when valve-specific test data are not available. The program included development of improved methods for prediction or evaluation of system flow parameters; gate, globe, and butterfly valve performance; and motor actuator rate of loading (load sensitive behavior) effects. The EPRI MOV Performance Prediction Methodology (PPM) includes computer models, software, and hand calculation models to implement individual valve and system models and methods. EPRI compared the predictions of the integrated methodology to valve test data from flow loop and in situ tests. EPRI determined that the thrust and torque predictions from the methodology bounded the measured data for 173 of the 176 total analyzed valve strokes. EPRI stated that the use of the computer model assumes that the valve is in good condition and that model users will need to ensure that an adequate internal valve preventive maintenance program is established for the thrust and torque requirements predicted by the model to remain valid. The NRC staff and its contractor Idaho National Engineering Laboratory (now referred to as Idaho National Laboratory) evaluated the topical report for the EPRI MOV PPM. The NRC staff approved the use of the EPRI MOV PPM, with limitations and conditions, specified in a safety evaluation dated March 15, 1996 (ML15142A761), and four supplements (ML090400621).

During the implementation of GL 89-10, the NRC staff accepted four methods that a licensee could use to demonstrate the design-basis capability of its safety-related MOVs. In descending order of acceptability, the four methods for demonstrating capability are as follows:

(1) Dynamic testing at or near design-basis conditions with diagnostics of each MOV where practicable. Valves dynamically tested at less than design-basis conditions may be extrapolated with proper justification. Although the valve factor derived from the test data might be low because of minimal valve operating history or recent maintenance that exposed the Stellite valve material to air, the dynamic testing provided assurance that the valve performance was predictable. The licensee would consider the need to increase the valve factor during its design-basis evaluation and setup based on test data from similar valves.

(2) Implementation of the EPRI MOV PPM as accepted in the NRC safety evaluations. This method was developed for those valves that could not be dynamically tested. The PPM required internal measurements of the valve to provide assurance that the valve performance was predictable. The NRC staff accepted the use of the PPM even when dynamic testing for an MOV was practicable.

(3) MOV valve grouping. Where valve-specific dynamic testing was not performed, and the PPM was not used, the staff accepted grouping of MOVs that were dynamically tested at the plant to apply the plant-specific test information to an MOV in the group. Using plant-specific data allowed the licensee to know the valve performance and maintenance history and helped provide confidence that the valve performance was predictable.

(4) The use of valve test data from other plants or research programs. The NRC staff ranks this as the least preferred approach (with the most margin required) because the licensee would have minimal information regarding the tested valve and its history. In such cases, the NRC inspectors would perform an available capability evaluation of the MOV to provide confidence that the MOV had significant capability margin to close GL 89-10 for that MOV.

Based on a series of inspections, the NRC staff closed its review of the GL 89-10 program at each nuclear power plant. On September 18, 1996, the NRC issued GL 96-05 requesting that each nuclear power plant licensee establish a program, or ensure the effectiveness of its current program, to verify on a periodic basis that safety-related MOVs continue to be capable of performing their safety functions within the current licensing bases of the facility. The program should ensure that the licensee can properly identify and account for changes in required performance resulting from degradation (such as those caused by age).

In response to GL 96-05, nuclear power plant licensees developed an industrywide JOG Program on MOV Periodic Verification. The JOG program included the following three phases:

(1) an interim plan of static diagnostic testing of safety-related MOVs at a frequency based on risk and margin

(2) a JOG testing program to evaluate potential valve degradation whereby each participating licensee performed three static and dynamic diagnostic tests on two selected valves over a 5-year period with a minimum of 1 year between tests

(3) a long-term plan of static diagnostic testing and, where necessary, dynamic diagnostic testing based on the JOG's evaluation of the valve performance data from the 5-year testing program

The JOG program tested over 150 different gate, globe, and butterfly valves in various applications, such as treated water, untreated water, hot water, cold water, and steam. The test results concluded that valves perform the same when they share the same attributes, such as valve type, fluid application, disk to seat material, disk to body material, and bearing material. The JOG program classified MOVs at nuclear power plants on the basis of their attributes and performance as follows:

- Class A: Valves within the scope of the JOG program that have been determined not to be susceptible to degradation in their operating requirements based directly on testing performed in the JOG program or on other suitable bases (e.g., EPRI MOV PPM) as discussed in the JOG program.

- Class B: Valves within the scope of the JOG program that have been determined not to be susceptible to degradation in their operating requirements based on testing performed in the JOG program, extended by analysis or engineering judgment to configurations and conditions beyond those tested.

- Class C: Valves within the scope of the JOG program that have been determined to be susceptible to changes in the required thrust or torque based on the test results from the JOG program.

- Class D: Valves that are determined to be outside the scope of the JOG program but within the scope of GL 96-05.

On February 27, 2004, the JOG submitted its topical report MPR-2524, "Joint Owners' Group (JOG) Motor-Operated Valve Periodic Verification Program Summary" (ML040720092), to the NRC for review. The NRC staff accepted the topical report in a safety evaluation report dated September 25, 2006 (ML061280315), and its supplement dated September 18, 2008 (ML082480638). MPR-2524-A, "Joint Owners' Group (JOG) Motor Operated Valve Periodic Verification Program Summary," issued November 2006 (ML063490194), updates the topical

report to reflect the NRC FSER and includes the JOG response to NRC staff requests for additional information and the FSER as appendices to the report. Nuclear power plant licensees committing to apply the JOG program in response to GL 96-05 are responsible for implementing the applicable conditions in the safety evaluation report and its supplement. In RIS 2011-13, "Follow Up to Generic Letter 96-05 for Evaluation of Class D Valves Under Joint Owners Group Motor-Operated Valve Periodic Verification Program," dated January 6, 2012, the NRC staff provided guidance for licensees in conducting periodic verification of the design-basis capability of safety-related MOVs outside the scope of the JOG program. The JOG program evaluates degradation of the operating requirements for valves such that the lessons learned from the JOG program can be applied to valves with any power actuators. The JOG program does not include actuator output capability as part of its MOV program, so the licensee will need to address this aspect of MOV periodic verification on a plant-specific basis.

The OM Code establishes requirements for PST and IST activities to assess the operational readiness of MOVs within its scope used in water-cooled reactor nuclear power plants. The NRC regulations in 10 CFR 50.55a(b)(3)(ii) address the incorporation of the OM Code provisions for MOVs into 10 CFR 50.55a. In particular, 10 CFR 50.55a(b)(3)(ii) states, in part, the following:

> Licensees must comply with the provisions for testing MOVs in OM Code, ISTC 4.2, 1995 Edition with the 1996 and 1997 Addenda, or ISTC-3500, 1998 Edition through the latest edition and addenda incorporated by reference in paragraph (a)(1)(iv) of this section, and must establish a program to ensure that MOVs continue to be capable of performing their design basis safety functions.

The 10 CFR 50.55a(b)(3)(ii) requirement for MOVs has two elements:

(1) Licensee IST programs for MOVs at nuclear power plants must meet the OM Code requirements as incorporated by reference in 10 CFR 50.55a, including the conditions specified in 10 CFR 50.55a(b)(3)(ii)(A) to (D).

(2) Licensees must implement an MOV program that provides continued assurance of the capability of MOVs to perform their design-basis safety functions.

The second element was a direct result of GL 89-10, further supported by GL 95-07 and GL 96-05. As noted above, GL 89-10 requested licensees to verify the design-basis capability of their safety-related MOVs by dynamic testing where practicable. GL 95-07 requested licensees to address concerns of potential pressure locking and thermal binding of power-operated gate valves. GL 96-05 requested licensees to develop programs to periodically verify MOV design-basis capability. The provisions in GL 96-05 superseded GL 89-10 for the periodic verification of MOV design-basis capability.

The OM Code committees combined the two elements of 10 CFR 50.55a(b)(3)(ii) by developing ASME OM Code Case OMN-1. The NRC staff approved Code Case OMN-1 with conditions in RG 1.192.

Code Case OMN-1 was incorporated into the OM Code beginning with the 2009 Edition as Mandatory Appendix III. The staff specified conditions for the implementation of Mandatory Appendix III in 10 CFR 50.55a(b)(3)(ii) when the applicable editions of the OM Code were incorporated by reference in 10 CFR 50.55a. Licensees may apply the lessons learned from their MOV programs, including implementation of the JOG MOV program, as accepted by the

plant-specific safety evaluation in response to GL 96-05, in meeting the minimum requirements of Mandatory Appendix III. Licensees will need to ensure that the conditions in 10 CFR 50.55a(b)(3)(ii) are met when implementing Mandatory Appendix III to the OM Code. As noted above, the JOG program applied only to the valve operating requirements such that licensees must provide periodic verification of the output capability of the MOV actuators. Licensees need to follow their commitment change process when updating their MOV program from the JOG final MOV test program to the new requirements of Mandatory Appendix III.

Mandatory Appendix III requires a one-time design-basis verification test of the capability of each MOV to meet its safety-related design-basis requirements. Mandatory Appendix III indicates that an engineering evaluation may be used to satisfy this requirement where justified. The staff considers the implementation of the EPRI MOV PPM in accordance with the NRC safety evaluations to be an acceptable engineering evaluation. For MOVs within the scope of the GL 89-10 and GL 96-05 programs, the testing and/or engineering analysis performed to close out those GLs may be used to meet the design-basis verification requirement in Mandatory Appendix III. For MOVs that were outside the scope of GL 89-10 and GL 96-05 but within the IST program, Mandatory Appendix III requires a one-time test and/or engineering analysis. In both cases, it is expected that licensees will formally document the design-basis verification test and/or engineering evaluation analysis for each MOV in the IST program.

Licensees that have evaluated MOVs using the EPRI MOV PPM to meet the requirements of a one-time design-basis verification test in Mandatory Appendix III will need to meet the EPRI condition of maintaining the valve in good condition for the EPRI MOV PPM to remain valid for that valve. A licensee should address the following aspects to provide assurance of acceptable valve condition:

- valve susceptibility to internal component degradation due to system operation and/or conditions
- diagnostic testing that monitors and trends valve operating parameters (thrust, torque, running loads, motor current, motor power, etc.)
- periodic valve internal inspection/rework
- verification of valves that relied on vendor drawings to capture the internal dimensions to perform the EPRI MOV PPM calculation if a periodic valve internal inspection/rework is deemed necessary

Following the initial demonstration of MOV design-basis capability, the IST program as required by Mandatory Appendix III of the OM Code as incorporated by reference in 10 CFR 50.55a with conditions will maintain the design-basis capability of MOVs by periodic exercising and diagnostic testing. The JOG program may be applied as part of the IST requirements specified in Mandatory Appendix III. The NRC staff considers that the implementation of Mandatory Appendix III for MOVs within the scope of the OM Code will meet the requirements of 10 CFR 50.55a(b)(3)(ii), provided that the specified regulatory conditions are satisfied.

In preparing to implement an edition of the OM Code that contains Mandatory Appendix III as their IST code of record (2009 Edition and more recent editions), licensees have requested guidance regarding the startup of Appendix III programs at their nuclear power plants. The NRC regulations in 10 CFR 50.55a(b)(3)(ii) state that licensees must establish a program to ensure that MOVs continue to be capable of performing their design-basis safety functions in addition to

the OM Code requirements. The transition to the Appendix III program of safety-related gate, globe, and butterfly valves with motor operators that were addressed initially by GL 89-10 and periodically by GL 96-05 programs should be straightforward. The incorporation of safety-related MOVs not diagnostically tested per GL 89-10 and GL 96-05 will be more challenging when implementing Appendix III.

Mandatory Appendix III includes several requirements related to the initial implementation of the program. For example, Paragraph III-3100, “Design Basis Verification Test,” requires MOV design-basis verification prior to initiating the Appendix III program. Paragraph III-3200, “Preservice Test,” requires that each MOV be tested during the PST period or before implementing IST. Paragraph III-3300, “Inservice Test,” requires IST to commence when an MOV is required to be operable to fulfill its required functions and shall be sufficient to assess changes in functional margin per paragraph III-6000. Subparagraph III-3300(c) requires the IST program to include a mix of static and dynamic MOV performance testing. Paragraph III-3310 states that the IST interval determination shall include (a) the IST interval shall be determined per paragraph III-6440, (b) if insufficient data exist to use paragraph III-6400, the initial IST interval shall be two RFOs or 3 years (whichever is longer) until sufficient data exist, and (c) the maximum IST interval shall not exceed 10 years.

With respect to MOVs diagnostically tested per GL 89-10 and GL 96-05, the licensee may consider the following: (1) paragraph III-3100 for MOV design-basis verification might be met as part of GL 89-10/96-05, (2) paragraph III-3200 for PST might have been met by diagnostic testing under GL 89-10/96-05, (3) paragraph III-3300 for IST commencement might be met by GL 96-05 periodic diagnostic testing if evaluation of margin is consistent with paragraph III-6000, (4) subparagraph III-3300(c) for mix of static and dynamic testing might be met if part of the JOG program and if the MOV was within the JOG scope, and (5) paragraph III-3310 for IST interval might be met if sufficient test data were obtained by GL 96-05 diagnostic testing to demonstrate the IST interval per paragraph III-6440 with the maximum IST interval not exceeding 10 years.

With respect to MOVs not diagnostically tested per GL 89-10 and GL 96-05, the licensee should consider the following: (1) paragraph III-3100 for design-basis verification must be met for each MOV, (2) subparagraph III-3100(d) indicates that engineering evaluation of operating experience may be used to verify design-basis capability for certain valve types (i.e., ball, plug, and diaphragm valves) where the need for design-basis verification testing has not been identified, (3) paragraph III-3200 for diagnostic PST must be met before implementing IST, (4) paragraph III-3300 for IST commences when an MOV is required to be operable, (5) subparagraph III-3300(d) indicates that evaluation of acceptable operating experience for dynamic MOV performance testing is not required for certain valve types (i.e., ball, plug, and diaphragm valves), and (6) MOVs not previously diagnostically tested must meet an initial IST interval of two RFOs or 3 years (whichever is longer) required in subparagraph III-3310(b) until sufficient data exist.

Licensees need to be prepared to implement Mandatory Appendix III when their code of record is updated to the 2009 or later Edition of the OM Code. Appendix III does not include a grace period for the startup of MOV diagnostic testing. For a new MOV or an MOV that was not within the scope of GL 89-10 and GL 96-05, the licensee may obtain design-basis capability information from the ASME QME-1 qualification program including the required post-installation test. Subparagraph III-3310(b) requires that if insufficient data exist to determine the inservice test interval in accordance with paragraph III-6400, then MOV IST shall be conducted every two refueling cycles or 3 years (whichever is longer) until sufficient data exist, from an applicable

MOV or MOV group, to justify a longer inservice test interval. If concerned about the schedule for Appendix III startup, licensees should contact their NRC project manager to discuss an alternative request.

4.2.14 Use of Operating Experience for Code Case OMN-28

When using Code Case OMN-28, a licensee must have a documented evaluation of operating experience for the valves to which the Code Case will apply. In September 2020, EPRI issued technical report (TR) (TR-3002019621) which incorporates industry operating experience for valves with stem-disk separation. However, the NRC safety evaluation dated May 5, 2022, identified operating experience in addition to the instances specified in the EPRI TR. Therefore, each licensee must have a documented engineering evaluation of operating experience for its applicable valves, including EPRI TR information, NRC safety evaluation information, and any other operating experience identified by the licensee. The licensee is only responsible for addressing operating experience for the valves for which Code Case OMN-28 will be applied at its nuclear power plant.

A user of Code Case OMN-28 needs to ensure that the entire body of operating experience applicable to the valves within the scope of Code Case OMN-28 will be evaluated to justify the application of Code Case OMN-28.

4.3 Safety and Relief Valves

4.3.1 Scope

Paragraph ISTA-1100 of the ASME OM Code, Subsection ISTA, defines the scope of the valves subject to IST provisions to include pressure-relief devices that protect systems (or portions of systems) that perform a required function in shutting down the reactor to the safe-shutdown condition, maintaining the safe-shutdown condition, or mitigating the consequences of an accident that results from overpressure. Pressure-relief valves, which are installed in systems to protect against overpressure, might not, of themselves, appear to perform a specific function to shut down the reactor, maintain it in a safe-shutdown condition, or mitigate the consequences of an accident. (Automatic depressurization valves in BWRs are an example of relief valves that perform both an overpressure protection function and a function to depressurize the primary system when opened on an automatic signal or by an operator.) However, they might be required to be included in the IST program and tested according to the schedules stipulated in Subsection ISTC and Mandatory Appendix I of the OM Code. Specifically, Subsection ISTC of the OM Code clarifies that its requirements apply only to pressure-relief devices required for overpressure protection. Updated IST programs are to include the testing of these devices.

Testing of “thermal relief valves” has been the subject of much discussion over the past several years. Contributing to some confusion, in many original system designs, so-called thermal relief valves were installed to protect isolated segments of piping that could be pressurized as a result of heating from some source but were widely viewed as having no safety-related function in mitigating the consequences of accidents or ensuring any other system safety function. GL 96-06, “Assurance of Equipment Operability and Containment Integrity During Design Basis Accident Conditions,” dated September 30, 1996, emphasized the importance of protecting certain isolated segments of piping from excessive thermally induced pressurization, especially where containment integrity could be affected. In recent years, ASME has changed Mandatory Appendix I to the OM Code to include specific requirements to periodically test or replace thermal relief valves.

The requirement to test safety and relief valves that provide overpressure protection is based on the requirements of Section III of the ASME BPV Code, as well as USAS B31.1, “USA Standard Code for Pressure Piping,” and USAS B31.7, “USA Standard Code for Nuclear Power Piping.” If the results of an overpressure protection “re-analysis” for a particular system indicate that a relief valve is not necessary, it may be removed from the scope of the IST program.

As required by ASME BPV Code, Section III, Article NX-7200, it is the Owner’s responsibility to prepare, certify, and file an Overpressure Protection Report for the facility. The Overpressure Protection Report defines the protected systems and the integrated overpressure protection provided. Article NX-7200 also contains requirements regarding verification that pressure-relief devices are not required and reconciliation of the Overpressure Protection Report following modifications.

4.3.2 Method of Testing Safety and Relief Valves

The NRC staff expects licensees to develop methods to test the entire assembly of safety and relief valves to demonstrate their operational readiness to perform the applicable safety functions. For example, the NRC staff does not consider testing of only a pilot assembly would be adequate to demonstrate the performance of the main valve disk for those types of safety and relief valves with pilot assemblies. The operational history of safety and relief valves does not support partial testing of valve assemblies.

Mandatory Appendix I, Section I-1120, “Limitations,” paragraph (a), states that the requirements of the appendix recognize differences between the installed operating conditions and the conditions under which a pressure-relief device may be tested. Paragraph (a) also states that 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. Licensees should ensure that the testing method used for safety and relief valves provides reasonable assurance that the test results reflect the performance of the safety and relief valves when installed in the nuclear power plant. Where the testing method does not reflect the design of the S/RVs or their installed conditions, the licensee should have an evaluation that demonstrates that the installed operating condition is comparable to the test condition, or that provides a correlation from the test condition to the operating condition of the safety and relief valves.

4.3.2.1 BWR Safety/Relief Valve Stroke Testing

In recent years, the NRC staff has received many requests for relief or TS changes or both related to the stroke testing requirements for BWR dual-function main steam S/RVs. The 2003 Addendum and earlier editions and addenda to Mandatory Appendix I to the OM Code require the stroke testing of S/RVs after they are reinstalled following maintenance activities. Some licensees have determined that in situ testing of the S/RVs can contribute to undesirable seat leakage of the valves during subsequent plant operation and have received approval to perform stroke testing at a laboratory facility coupled with in situ tests and other verifications of actuation systems as an alternative to the testing required by the OM Code. The revised subparagraph I-3410(d) in Mandatory Appendix I to the 2004 through 2022 Edition of the OM Code does not require licensees to stroke test S/RVs at reduced or normal system pressure following maintenance. Subparagraph I-3410(d) in the OM Code requires that each S/RV that has been removed for maintenance or testing and reinstalled shall have the electrical and pneumatic connections verified either through mechanical/electrical inspection or testing before the resumption of electric power generation. Several licensees have requested and obtained

NRC approval in accordance with 10 CFR 50.55a(f)(4)(iv) to use subparagraph I-3410(d) of the 2004 through 2022 Edition of the OM Code in place of subparagraph I-3410(d) of the 2001 Edition through the 2003 Addenda to the OM Code.

4.3.2.2 PWR Main Steam Safety Valve Set Pressure Testing

To reduce the need to remove valves from their installed position and the time required to perform set pressure testing, many PWR licensees perform testing of main steam safety valves using in situ testing equipment with operating steam pressure. One advantage of this method is that actual environmental and fluid temperature conditions are used, in lieu of duplicating them in a test laboratory. However, this method has introduced inaccuracies because the set pressure is determined by a combination of the measured system operating pressure and the applied assisting force provided by the testing device. This assisting force is applied by pneumatic pressure on a piston or diaphragm and is converted to an equivalent additional amount of system pressure by dividing the force by the valve disk area against which the system pressure acts. Inaccuracies in the value of the disk area have caused some inaccuracies in the set pressure determination, as discussed in IN 94-56, “Inaccuracy of Safety Valve Set Pressure Determination Using Assist Devices,” dated August 11, 1994.

4.3.3 Jack-and-Lap Process

IN 91-74, “Changes in Pressurizer Safety Valve Setpoints Before Installation,” dated November 25, 1991, states that the setpoint changes in Dresser pressurizer safety valves could result, in part, from changes made during a jack-and-lap procedure that is performed after setpoint testing and before installation to reduce seat leakage. This procedure may have lacked adequate controls.

Many licensees avoid performing setpoint testing after jack-and-lap maintenance because this testing could lead to leakage. Subsection ISTC and Mandatory Appendix I to the OM Code require that after repairing a valve or performing maintenance that could affect the valve’s performance, the licensee must demonstrate that the performance parameters are acceptable by testing the valve before returning it to service. The licensee must test pressure-relief devices as required by Subsection ISTC and Mandatory Appendix I following replacement, repair, and maintenance.

The NRC staff recommends that, if a licensee chooses to use the jack-and-lap process and not re-verify the set pressure of the valves, the licensee must determine whether the maintenance activity is of an extent that a setpoint test is required after the valve is reassembled and reinstalled. If the jack-and-lap process is controlled so that the setpoint will not be affected, the licensee may not need to perform a test. Action in accordance with this recommendation necessitates determination of the effect of this activity and evaluation within the quality controls and QA for the process. Controls include limits on the amount of material that is removed, the controls to ensure that the settings and adjustments of the valve parts that affect the setpoint are not changed, and the requirements in the maintenance procedure to address any unusual conditions that occur during the maintenance activity. The licensee may also consider industry experience to determine whether changes in the methods of performing this activity are necessary as plants accumulate more data. Because the NRC staff cannot make this determination by evaluating a relief request, relief is neither appropriate nor available for this activity.

4.3.4 Maintenance and Inspection of Safety/Relief Valves in Addition to ASME OM Code Requirements

Licensees should note that not all maintenance and inspection that may be needed to ensure continued functional capability of safety, relief, and pilot valves are necessarily performed as a result of IST required by the OM Code. In a recent case involving some BWR S/RVs, additional periodic maintenance and inspection of certain internal parts were necessary to check for excessive wear and eventual binding of the main disks. This was discovered on valves that had successfully passed required inservice tests and is discussed further in IN 2003-01, "Failure of a Boiling Water Reactor Target Rock Main Steam Safety/Relief Valve," dated January 15, 2003.

4.3.5 Scheduling of Safety/Relief Valve Testing

Mandatory Appendix I to the OM Code requires that licensees test a minimum size sample of valves within a valve group within a specified period. A penalty is also applied, in that additional valves must be tested when any sample fails to meet the necessary acceptance criteria. In determining the minimum acceptable sample size, fractions of valve numbers resulting from calculating the number of valves to be tested are to be rounded to the next higher whole number.

4.3.6 Use of ASME OM Code Case OMN-17

Many licensees have requested and obtained NRC authorization in accordance with 10 CFR 50.55a(z)(1) to use the provisions in OM Code Case OMN-17, "Alternative Rules for Testing ASME Class 1 Pressure Relief/Safety Valves," as an alternative to the 5-year test interval specified in the OM Code. Code Case OMN-17 allows an extension of the test frequency for S/RVs from 60 months to 72 months plus a 6-month grace period. The Code Case imposes a special maintenance requirement to disassemble and inspect each valve to verify that parts are free from defects resulting from the time-related degradation or maintenance-induced wear before the start of the extended test frequency. Although the OM Code does not require that S/RVs be routinely refurbished, refurbishment provides reasonable assurance that the S/RVs are operationally ready during the extended test interval. ASME published Code Case OMN-17 beginning with the 2009 Edition of the OM Code. RG 1.192, Revision 5, endorses Revision 1 of this Code Case with no conditions. The 2020 and 2022 Editions of the OM Code, Appendix I, subparagraph I-1320(a)(2), "Option 2: 6-Yr Test Interval," have incorporated Code Case OMN-17.

4.4 Miscellaneous Valves

The following issues and NRC recommendations apply to miscellaneous types of valves.

4.4.1 Postaccident Sampling System Valves

Section II.B.3 of NUREG-0737, "Clarification of TMI Action Plan Requirements," issued November 1980, details the requirements and capabilities of postaccident sampling systems (PASSs) for sampling both the reactor coolant and the containment atmosphere. The PASS consists of pumps and valves that perform these and other functions. The PASS also includes valves that perform a containment isolation function.

NRC Recommendation

The IST program applies to any PASS valves within the scope of 10 CFR 50.55a and the OM Code. Such valves in the PASS that perform a containment isolation function must be included in the IST program as Category A or A/C and must be tested to OM Code requirements except where relief has been granted or an alternative authorized.

The remaining valves in the PASS would typically be tested as required by the TS or other documents and need not be included in the IST program. However, the NRC staff recommends that if the licensee elects to include these valves in the IST or augmented IST program, a note should be included that the testing is beyond the scope of 10 CFR 50.55a.

In many cases, a licensee's TS have been amended to eliminate the requirements to have and maintain a PASS. If a PASS valve is eliminated from the TS but still performs a function within the scope of 10 CFR 50.55a and the OM Code, the valve should remain in the IST program.

4.4.2 Postmaintenance Testing After Stem Packing Adjustments and Backseating of Valves to Prevent Packing Leakage

Paragraph ISTC-3310 in OM Code, Subsection ISTC, requires that when a valve or its control system has been replaced or repaired, or has undergone maintenance that could affect the valve's performance, a new reference value shall be determined or the previous values reconfirmed by an inservice test before it is returned to service or immediately if not removed from service. Recent OM Code editions specify similar requirements for MOVs in Mandatory Appendix III, Section III-3400, and for AOVs in Mandatory Appendix IV, Section IV-3520.

A footnote to paragraph ISTC-3310 gives examples of maintenance, including adjustment of stem packing, limit switches, or control system valves and removal of the bonnet, stem assembly, actuator, obturator, or control system components. Backseating a valve may also affect its performance (e.g., cause damage to the valve or bind it into its backseat).

4.4.2.1 Stem Packing Adjustments

It may be necessary to adjust the stem packing during power operations to stop stem packing leaks on valves that must remain in position for operations to continue. Examples include MSIVs and main feedwater isolation valves. If the leakage does not pose a personnel safety hazard, licensees may adjust the packing without removing the valves from service. Licensees should exercise caution when adjusting valve stem packing. Licensees will need to have justification that packing adjustments do not adversely impact the operational readiness of the valve.

NRC Recommendation

The NRC staff has determined that it is acceptable for licensees to perform an engineering evaluation of the impact of adjusting valve stem packing to demonstrate that the performance parameters are within acceptable limits if a stroke test cannot be performed under current plant conditions. If it is necessary to adjust the stem packing to stop packing leakage and if a required stroke test or leak rate test is not practical in the current plant mode, the licensee must, at a minimum, justify by analysis that (1) the packing adjustment is within manufacturer-specified torque limits for the existing packing configuration and (2) the performance parameters of the valve are not adversely affected (including the stroke time of the valve). Packing adjustments beyond the manufacturer's limits may not be performed without (1) an engineering analysis

showing that the performance parameters of the valve are not adversely affected, and (2) input from the manufacturer, unless tests can be performed after adjustments. For example, licensees have demonstrated that returning the packing torque to the original value does not adversely impact the performance of the valve in a manner that would require retesting under paragraph ISTC-3310. This guidance also applies to section 3.4 in Code Case OMN-1. However, the licensee will need to evaluate any data available from previous testing with the packing torqued to the specified limit and must verify that the valve was leak tight and previously stroked within acceptable limits with the packing adjusted to the higher value.

Requesting relief under 10 CFR 50.55a(f) or an alternative under 10 CFR 50.55a(z) is not necessary because this action is in accordance with the OM Code requirements in paragraph ISTC-3310 (or III-3400 and IV-3520, as applicable) if the licensee can demonstrate that the performance parameters will not be adversely affected.

If practical, it is recommended that licensees perform a partial-stroke test (more than a brief bump off the backseat) to obtain further assurance that the valve stem is free to move. At the first opportunity when the plant enters an operating mode in which testing is practical, the licensee must test all valves that have had packing adjustments without postmaintenance testing. The maintenance procedure used to adjust the packing must include the limits, and any changes to the torque limits are subject to a 10 CFR 50.59 review. Licensees should avoid adjusting redundant valves without performing postmaintenance testing.

To properly implement this guidance, a licensee must evaluate valves individually, unless it has established a valve packing program in which designated limits, justified by test data, allow adjustments that do not affect performance parameters. If the licensee cannot demonstrate that the packing adjustment does not adversely affect performance parameters, the OM Code requirements must be met for postmaintenance testing. Therefore, the licensee must consider this issue for each valve individually.

Basis for Recommendation

The NRC staff would not require a licensee to shut down a plant to perform IST unless the licensee has no alternative to ensure that the operational readiness of components is maintained or a safety issue exists. The IST requirements do not prohibit or discourage a licensee from making limited adjustments to valve packing to stop a leak that may be adversely affecting the valve or surrounding components. Therefore, the licensee can perform an analysis of the packing adjustment and, upon demonstrating that the adjustment does not adversely affect the stroke time (or leakage rate) such that it would not exceed its limiting value, can make the adjustment without a postmaintenance stroke time measurement (or leakage test). Confirmatory testing must be performed at the first available opportunity when plant conditions allow testing. This guidance applies only to valves that need adjustment during power operation and cannot be fully stroked in the plant operating mode. The guidance does not apply merely as a convenience to the licensee and does not supersede any related guidance associated with GL 89-10. Any information would need to be included and documented in an evaluation, and the assessments would have to be valve specific. This guidance is also not applicable to the complete replacement of valve stem packing. Valve packing replacement would require a postmaintenance test in accordance with paragraph ISTC-3310 (or III-3400 and IV-3520, as applicable), or NRC authorization of an alternative request justified by the licensee in accordance with 10 CFR 50.55a(z) prior to implementation of such an alternative. As part of the alternative request, a complete valve packing replacement would require justification to provide assurance that the new packing load does not adversely impact valve performance. For

instance, a practice packing replacement might be performed on a similar valve in the training center to determine the potential increase in packing load and to establish procedures to specify the maximum packing torque that would be allowed during the actual valve maintenance operation.

4.4.2.2 Stem Backseating

Backseating a valve may stop packing leakage without the need to take the valve out of service to replace the packing. Licensees should exercise caution when backseating a valve because such maintenance can adversely affect the valve's functional capability. Licensees will need to have justification that backseating does not adversely impact the operational readiness of the valve in order to not perform testing in accordance with OM Code, paragraph ISTC-3310 (or III-3400 and IV-3520, as applicable). ISTC-3310 is referenced in this section for guidance in meeting Sections III-3400 and IV-3520 where applicable.

NRC Recommendation

If it is necessary to backseat a valve to stop a packing leak and a full-stroke test in accordance with the OM Code, paragraph ISTC-3310, is not practical in the current plant operating conditions, the licensee may submit an alternative request in accordance with 10 CFR 50.55a(z) to not perform the ISTC-3310 test with appropriate justification.

In lieu of a 10 CFR 50.55a(z) alternative request, the licensee must justify that (1) the backseating operation will not damage the valve stem, backseat, and bonnet, (2) the stem has not become stuck in the backseat by bumping the valve stem briefly away from the backseat, (3) the performance parameters of the valve and motor actuator are not adversely affected (including the stroke time of the valve) by the backseating operation, (4) any previous instances of backseating a valve at the plant did not damage the valve or cause performance problems, and (5) a full-stroke test will be performed at the first available opportunity. Requesting an alternative under 10 CFR 50.55a(z) is not necessary if this guidance is implemented because the NRC staff considers this action to be in accordance with the OM Code requirements in paragraph ISTC-3310. This guidance also applies to section 3.4 in Code Case OMN-1.

Recently, the NRC staff and licensee representatives have discussed a new approach for MOV electrical backseating to avoid damage to the valve stem, valve backseat, valve bonnet, and motor actuator, and to prevent sticking of the valve stem in the backseat. In particular, licensees have proposed the use of a motor current cutoff relay (MCCR) tool to backseat MOVs while meeting the requirements of OM Code, Subsection ISTC, paragraph ISTC-3310, without the need to full-stroke test the valve or briefly bump the valve off the backseat following MOV backseating. In such instances, licensees propose that MOV backseating using the MCCR tool would not be considered maintenance that could affect the function of an MOV that would require actions in accordance with ISTC-3310.

Where specific justification is documented prior to the planned MOV backseating, the NRC staff agrees that an NRC-authorized 10 CFR 50.55a alternative request from ISTC-3310 would not be needed for use of the MCCR tool for backseating an MOV without a full-stroke test or a brief bump off the backseat. The documented justification prior to the planned MOV backseating using the MCCR tool should be available for review by an NRC inspector upon request and include the following:

- qualification of the MCCR tool by the vendor or the licensee demonstrating its acceptable performance in controlling safety-related MOVs in accordance with the QA requirements of 10 CFR Part 50, Appendix B, or by a commercial grade dedication process.

- procedures for use of the MCCR tool including its calibration prior to each use and its control as measurement and test equipment at the nuclear power plant.

- an evaluation of the force, torque, and stress to be applied during the planned MOV backseating providing sufficient basis that the applied loads during backseating are within the capacity of the MOV such that damage to the valve (including internal parts) and the motor actuator would not result from the backseating operation.

- performance of a demonstration test in a laboratory or training center on a similar MOV that demonstrates proper performance of the MCCR tool and that the planned MOV backseating will not result in the valve sticking in the backseat, and that the stroke time will remain within the required limits.

- prior to the specific MOV backseating operation, performance of a pre-backseating check of the electrical control system to ensure that the MCCR tool is properly controlling the load to be applied to the MOV backseat.

- during the specific MOV backseating operation, the applied force, torque, and stress are verified by the MCCR tool and confirmed by qualified MOV diagnostic equipment such as used for GL 89-10 and GL 96-05 testing or OM Code, Appendix III testing.

- following the specific MOV backseating operation, the applied force, torque, and stress will be evaluated to verify that damage to the valve and motor actuator has not occurred, and that the applied load has not caused a concern for potential sticking of the valve in the backseat.

- the MOV will be full stroke tested at the next available plant opportunity, no later than the next refueling outage.

Basis for Recommendation

Considerable operating experience has been obtained with MOV backseating since NUREG-1482 was initially issued in 1995. The nuclear industry and the NRC staff understand the opportunities and challenges associated with backseating MOVs in nuclear power plants. The NRC staff has determined that the updated guidance in this revision to NUREG-1482 provides assurance that backseating will not damage an MOV while allowing additional flexibility with respect to the ISTC-3310 requirements.

4.4.3 Manual Valves

The OM Code includes IST requirements for manual valves that meet its scope requirements. To comply with the OM Code, manual valves must be included in the IST program and tested in

accordance with applicable OM Code requirements if they 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. Applicable tests could include exercising, leak testing, and position indication verification, at the frequency specified in the OM Code. For some valves, no tests are specified depending on their active/passive classification and their performance and design attributes. For example, a passive manual valve with no position indication has no tests specified. However, the valve must be listed in the IST program plan for compliance with 10 CFR 50.55a, unless excluded in accordance with the provisions in OM Code, Subsection ISTC, paragraph ISTC-1200, "Exclusions."

4.4.3.1 Manual Valve Exercise Interval

The 1998 Edition and earlier versions of the OM Code specified an exercise interval of 3 months for manual valves within the scope of the OM Code. In the 1999 Addenda to the OM Code, ASME revised paragraph ISTC-3540 to extend the exercise frequency for manual valves to 5 years. The NRC staff did not agree that there was sufficient justification to extend the exercise interval for manual valves to 5 years. At that time, the NRC staff reviewed licensees' IST programs to determine the performance of manual valves that could only be exercised at cold shutdown or RFOs. Based on its review, the NRC staff determined that a 2-year interval is justified for exercising manual valves. On September 26, 2002, in 67 FR 60520, the NRC revised 10 CFR 50.55a(b)(3)(vi) to specify that manual valves shall be exercised on a 2-year interval. Nonetheless, licensees are not prohibited from exercising manual valves more frequently than every 2 years. In the 2006 Addenda to the OM Code, ASME revised paragraph ISTC-3540 to change the exercise frequency for manual valves to 2 years. The 2-year interval requirement for exercising manual valves continues up to and including the 2022 Edition of the OM Code.

4.4.3.2 Power-Operated Valves with Manual Valve Capability

Power-operated valves (POVs) with manual valve capability within the scope of the IST Program need to meet the applicable requirements of the ASME OM Code of record as incorporated by reference in 10 CFR 50.55a for the specific nuclear power plant. For example, POVs (such as AOVs, MOVs, and SOVs) need to meet the POV requirements in the applicable section of the ASME OM Code as incorporated by reference in 10 CFR 50.55a. Where the licensee takes credit for the manual valve capability of the POV in the plant FSAR or technical specifications, the licensee also needs to meet the manual valve testing requirements in ASME OM Code, Subsection ISTC, Paragraph ISTC-3540, "Manual Valves," as incorporated by reference in 10 CFR 50.55a. The 2022 Edition of the ASME OM Code in Table ISTC-3500-1, "Inservice Test Requirements," specifies the test requirements for active manual valves in comparison to POVs. Note 1 in Table ISTC-3500-1 clarifies that when more than one distinguishing category characteristic is applicable, all requirements of each of the individual categories apply, although duplication or repetition of common testing requirements is not necessary.

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4.4.4 Pressure Isolation Valves

PIVs are defined as two normally closed valves in series that isolate the RCS from an attached low-pressure system. PIVs are located at all RCS/low-pressure system interfaces. As such, PIVs are located within the reactor coolant pressure boundary, which is defined in 10 CFR 50.2.

"Event V" PIVs are defined as two check valves in series at an RCS/low-pressure system interface, which may result in a LOCA that bypasses containment if they fail. The "Event V" PIVs comprise a subset of PIVs. "Event V" refers to the scenario described for this event in WASH-1400 (NUREG-75/014), "Reactor Safety Study: An Assessment of Accident Risk in U.S. Commercial Nuclear Power Plants," issued October 1975.

On April 20, 1981, the NRC issued orders to 32 PWRs and 2 BWRs, which required the specified licensees to conduct leak-rate testing of their PIVs, based on plant-specific, NRC-supplied lists of PIVs, and required the licensees to modify their TS accordingly. These orders are known as the "Event V Orders," and the valves listed are the "Event V" PIVs.

Currently, most operating plants operate using the STS in NUREG-1430 to NUREG-1434, "Standard Technical Specifications," which do not contain a listing of PIVs or Event V PIVs. Therefore, the NRC staff recommends that licensees should include a listing of PIVs (including Event V PIVs) in their IST programs to document IST testing requirements for each PIV. Licensees should also review their testing procedures to ensure that the PIVs are individually leak-rate tested. (This position supersedes Position 4 of GL 89-04, because the improved STS no longer contain PIV listings.)

4.4.4.1 Pressure Isolation Valve Discussion in Generic Letter 87-06

GL 87-06, "Periodic Verification of Leak Tight Integrity of Pressure Isolation Valves," dated March 13, 1987, supersedes Position 4 of GL 89-04, because the STS do not contain PIV listings. The NRC staff used licensees' responses to GL 87-06 as input for the resolution of Generic Issue 105, "Interfacing Systems LOCAs at Light-Water Reactors," which was evaluated by the NRC's Office of Nuclear Regulatory Research. NUREG/CR-5124, "Interfacing Systems LOCA: Boiling-Water Reactors," and NUREG/CR-5102, "Interfacing Systems LOCA: Pressurized Water Reactors," both issued February 1989, present the results of studies of interfacing system LOCAs. Generic Issue 105, which includes the issue discussed in GL 87-06, was closed by memorandum from E. Beckjord to J. Taylor, "Technical Resolution of Generic Issue 105 (GI-105), 'Interfacing Systems Loss-of-Coolant Accident (ISLOCA) in LWRs,'" dated June 3, 1993. Licensees should be aware of commitments made in response to GL 87-06 and abide by the appropriate commitment change process if necessary.

4.4.4.2 Leak Rate Testing of Pressure Isolation Valves

The leak rate testing specified in a plant's TS must meet the intent of paragraph ISTC-3600 of the OM Code. A licensee must ensure that each PIV is individually leak tested (or that the measured leakage is adjusted) in accordance with the differential pressure requirements of the OM Code. If the TS are not sufficiently detailed to ensure individual valve leak testing, the licensee is responsible for ensuring that the test procedures are themselves adequate for valves and valve combination leak testing.

NRC Recommendation

A licensee may consider the leakage testing performed to meet TS requirements to also satisfy IST requirements if the intent of the OM Code is met (e.g., leakage limits are established, corrective actions are taken as required, and valves are individually leak tested). However, a licensee must ensure that the test differential pressure specified in the TS, if applicable, is equivalent to the function maximum pressure differential, or that the measured leakage is adjusted to the function maximum pressure differential in accordance with the formula in paragraph ISTC-3630 of the OM Code.

Basis for Recommendation

Increasing pressure usually improves the seating of a valve. The OM Code allows that when leak testing those types of valves in which the service pressure will tend to diminish the overall leakage channel opening, as by pressing the disk into or onto the seat with greater force, the test differential pressure may be lower than the function maximum differential pressure.

The resulting leakage is to be adjusted according to the following formula from subparagraph ISTC-3630(b)(4) of the OM Code:

$$\frac{L\ (maximum)}{L(test)} = \sqrt[2]{\frac{dP(maximum)}{dP(test)}}$$

where:

L = leakage
dP = differential pressure

While the NRC staff has accepted other aspects of the TS, the licensee must ensure that any testing requirements that are not specifically detailed in the TS are, nonetheless, imposed on the PIVs to comply with the OM Code leakage testing requirements. Generally, the same test will be used to meet both TS and IST requirements. The major difference between TS and IST requirements is related to the acceptance criteria specified in some TS between a nominal leakage limit and the upper leakage limit. (If allowed by TS, the upper leakage limit is considered acceptable as the acceptance criteria for IST.)

If the list of PIVs is removed from the TS, the leakage testing must be described in detail in the safety analysis report or must be identified in accordance with the requirements of the OM Code.

4.4.4.3 Use of ASME OM Code Case OMN-23

The NRC accepts the use of OM Code Case OMN-23, “Alternate Rules for Testing Pressure Isolation Valves,” in RG 1.192 as an alternative to the leakage rate test frequency specified in subparagraph ISTC-3630(a) for RCS PIVs without the need to request NRC authorization of a proposed alternative under 10 CFR 50.55a(z). Code Case OMN-23 includes specific provisions for sampling PIVs as part of the alternative to the OM Code requirements. Therefore, licensees should be aware that some PIVs are subject to separate regulatory requirements in plant TS. Licensees must meet the NRC regulatory requirements in both 10 CFR 50.36 and 10 CFR 50.55a to maintain public health and safety at their nuclear power plants. Licensees

should ensure that they continue to meet TS requirements for PIVs when implementing Code Case OMN-23 or submit a license amendment request related to the TS requirements.

4.4.5 Containment Isolation Valves that Have Other Leak-Tight Safety Functions

Valves that function as CIVs may have additional safety functions (i.e., other than isolation), such as pressure isolation, train separation, or preventing diversion of flow. The leakage testing for 10 CFR Part 50, Appendix J, might not adequately test these additional functions based on the pressure or fluid medium. For such valves, the requirements of both Appendix J and OM Code, Subsection ISTC, paragraph ISTC-3600, apply.

4.4.6 Testing Individual Scram Valves for Control Rods in Boiling-Water Reactors

BWRs are equipped with bottom-entry hydraulically driven control rod drive mechanisms with high-pressure water providing the hydraulic power. Each control rod is operated by a hydraulic control unit, which consists of valves and an accumulator. The control rod drive pumps supply the hydraulic control unit with charging and cooling water, and the control rod operating cylinder exhausts to the scram discharge volume. Various valves in the control rod drive system perform an active function in scramming the control rods to rapidly shut down the reactor.

The NRC staff believes that the IST program should include those valves that must change position to provide the scram function. The valves should be tested in accordance with the requirements of the OM Code, Subsection ISTC, except where relief has been granted in a safety evaluation report. The 1996 Addenda to the OM Code and later editions and addenda require bi-directional exercise testing of check valves.

The control rod drive system valves that perform an active safety function in scramming the reactor are the scram discharge volume vent and drain valves, scram inlet and outlet valves, scram discharge header check valves, charging water header check valves, and cooling water header check valves. With the exception of the scram discharge volume vent and drain valves, exercising the other valves quarterly during power operations could result in rapid insertion of one or more control rods. If practical, licensees should test control rod drive system valves at the OM Code-specified frequency. However, for those control rod drive system valves for which testing could result in rapid insertion of one or more control rods, the rod scram test frequency identified in the facility's TS may be used as the valve testing frequency to minimize rapid reactivity transients and wear of the control rod drive mechanisms. This alternative test frequency, which is a deviation from the OM Code requirement, should be clearly stated and documented in the IST program document, and this alternative or relief requires NRC approval in accordance with 10 CFR 50.55a.

Industry experience has shown that normal control rod motion may verify the cooling water header check valve moving to its safety function position. This can be demonstrated because rod motion may not occur if this check valve were to fail in the open position. If this test method is used at the OM Code-required frequency, the licensee should clearly explain in the IST program document that this is how these valves are being verified to close quarterly.

Closure verification of the charging water header check valves requires that the control rod drive pumps must be stopped to depressurize the charging water header. This test should not be performed during power operation because stopping the pumps results in a loss of cooling water to all control rod drive mechanisms, and seal damage could result. Additionally, this test cannot be performed during each cold shutdown because the control rod drive pumps supply

seal water to the reactor recirculation pumps, and one of the recirculation pumps is usually kept running. Therefore, the hydraulic control unit accumulator pressure decay test, as identified in the facility's TS, may be used as the charging water header check valve alternative testing frequency for the reasons stated above. If the licensee's TS does not address this test, this closure verification should be performed at least during each RFO, and the IST program document should specifically address this alternative test frequency, which is a deviation from the OM Code requirement. This alternative or relief requires NRC approval in accordance with 10 CFR 50.55a.

The scram inlet and outlet valves are POVs that full stroke in milliseconds and are not equipped with indications for both positions; therefore, it may be impractical to measure their full-stroke time as required by the OM Code. Verifying that the associated control rod meets the scram insertion time limits defined in the plant's TS can be an acceptable alternative method of detecting degradation of these valves. Also, it may be impractical and unnecessary to trend the stroke times of these valves because they are indirectly stroke timed, and no meaningful correlation can be drawn between the scram time and valve stroke time. Furthermore, conservative limits are placed on the control rod scram insertion times. If the above test is used to verify the operability of scram inlet and outlet valves, it should be specifically documented in the IST program document, and this alternative or relief requires NRC approval in accordance with 10 CFR 50.55a, as discussed above.

4.4.7 Use of Appendix J, Option B, in Conjunction with Subsection ISTC Exercising Tests for Check Valves

The OM Code, Subsection ISTC, paragraph ISTC-3522, requires licensees to exercise Category C valves every 3 months. Paragraph ISTC-3620, "Containment Isolation Valves," also requires licensees to seat leak test those Category A valves in accordance with Appendix J to 10 CFR Part 50. Specifically, Option B of Appendix J allows a variable seat leak testing frequency, based on component performance, and allows test intervals for valves with acceptable performance to be extended to once every three RFOs. Therefore, for Category A/C valves, the OM Code requires two independent tests, including an exercising test and a seat leakage rate test.

The OM Code recognizes that when more than one distinguishing category characteristic applies, all requirements for each of the individual categories apply, although duplication or repetition of common testing requirements is not necessary. Therefore, a seat leak rate test is one acceptable method to verify the closure portion of an exercise test.

OM Code, Mandatory Appendix II, allows an alternative to the exercising testing requirements in the OM Code. The 1996 Addenda to the OM Code included two significant changes to IST of check valves to (1) correct certain anomalies in the way check valves were being exercised, and (2) codify a process for monitoring the valve's operating condition and performance. This integral two-part improvement to the OM Code provides interrelated requirements. Beginning with the 1996 Addenda, ASME modified Subsection ISTC 4.5.2, "Exercising Requirements," and Subsection ISTC 4.5.4, "Valve Obturator Movement," to require bi-directional testing to improve the detection of valve degradation and failure. The related change to Subsection ISTC 4.5.5, "Condition Monitoring Program," allowed the use of a condition monitoring process as an alternative to the exercising and testing requirements of Subsections ISTC 4.5.1 to 4.5.4. More recent OM Code editions include similar requirements in paragraphs ISTC-3520 and ISTC-3530 to continue bi-directional check valve testing. The condition monitoring process, defined in Mandatory Appendix II, allows licensees certain IST flexibility in establishing the types of test,

examination, and preventive maintenance activities and their associated intervals, when justified based on the valve's performance and operating condition.

NRC Recommendation

The use of Mandatory Appendix II to the OM Code for a condition monitoring program for check valves, with the regulatory conditions in 10 CFR 50.55a, provides the licensee with knowledge of the valve's operating condition, informed and verified expectations of the valve's performance over extended intervals, and a process to justify prudent IST interval extensions to reduce the burden of unnecessary IST. Therefore, the NRC staff recommends that licensees implement a condition monitoring program for check valves to justify extending the exercise test interval to the leak test frequencies specified in Option B of Appendix J. However, a licensee implementing a combined process should be mindful of grouping size and frequency in establishing this process, as this could be a limiting factor to implementation.

Basis for Recommendation

The use of Mandatory Appendix II to the OM Code, as incorporated by reference in 10 CFR 50.55a, provides licensees with knowledge of the valve's operating condition, monitors and verifies valve performance over extended intervals, and provides a process to justify prudent IST interval extensions to reduce the burden of unnecessary IST.

4.4.8 Pyrotechnic-Actuated Valves in New Reactors

Some designs for new nuclear power plants include pyrotechnic-actuated (squib) valves that have more safety significance than squib valves in currently operating nuclear power plants. In addition, squib valves for new reactors might have different designs and be much larger than squib valves used in current plants. In the 2012 through 2022 Editions, the OM Code has included provisions for PST and IST of squib valves in new reactors, also referring to them as explosively actuated valves. The NRC has incorporated by reference those editions of the OM Code in 10 CFR 50.55a without conditions for squib valve testing.

Applicants and licensees for new reactors will need to address the PST and IST provisions for squib valves consistent with the applicable regulatory requirements, license conditions, and FSAR provisions.

4.5 General Valve Topics

4.5.1 Categories

OM Code, Subsection ISTC, Paragraph ISTC-1300, "Valve Categories," specifies the following:

- *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 paragraph ISTA-1100

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

- *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 paragraph ISTA-1100

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

Under the OM Code, each valve will have different considerations regarding its leakage categorization of Category A or B. The NRC staff position on whether a valve is required by the OM Code to be Category A or allowed to be Category B depends on the specific circumstances of that valve. Table ISTC-3500-1 in the OM Code requires periodic leakage testing for Category A valves and does not require leakage testing for Category B valves.

A licensee might justify a valve as Category B depending on its application and specific aspects of its preventive maintenance program. The NRC staff has found that the categorization of valves as either Category A or Category B in the IST program required by the OM Code as incorporated by reference in 10 CFR 50.55a can be challenging for licensees, as shown in the NRC inspection reports IR 2020010 for Sequoyah Nuclear Plant, dated April 21, 2020 (ML20112F443), and IR 2021011 for Joseph M. Farley Nuclear Plant, dated December 13, 2021 (ML21347A401).

The OM Code specifies definitions of Category A and Category B valves that must be met based on leakage limits or inconsequential leakage for individual valves. When determining the proper categorization of a valve, a licensee should consider all applicable aspects. For example, the licensee should determine (1) whether the flow requirements for connected systems can be achieved with the maximum possible leakage through the valve, (2) the effect of any reduced system flows resulting from the leakage on the performance of other systems and components, such as the impact on pump performance and their pump curve assumptions, (3) the consequences of the loss of water from the system, (4) the effect that backflow through the valve may have on piping and components, such as the effect of high temperature and thermal stresses, (5) the impact of multiple valves leaking that might mask the leakage from individual valves, and (6) the radiological exposure to plant personnel and the public caused by the leak. The assumptions in the plant FSAR are a good source for determining whether leakage or no leakage from individual valves is assumed in the plant performance analysis. Based on any of the above considerations, licensees should assign the valve as Category A and should comply with the associated leak testing requirements.

Licensees may refer to IN 91-56 for information on the categories assigned to valves that function to close to prevent leakage above an assumed limit, thus preventing a plant from exceeding the limits of 10 CFR Part 100.

Subparagraph ISTC-3630(e) requires that leakage rate measurements be compared with the permissible leakage rate specified by the licensee for a specific valve or valve combination. If the licensee does not specify leak rates, permissible leak rates are provided in subparagraph ISTC-3630(e)(1) and (2). The OM Code provides neither criteria nor guidance concerning the methods that licensees should use to establish or specify the permissible leak rate of a particular valve. The OM Code recognizes that the leak behavior of a valve varies according to valve type and size, vendor, service conditions, safety-related functions, and other factors, and there is no simple leak rate rule that applies to all valves.

In general, licensees should set the leak rate limits within certain bounds. If the leak rate limits are too low, unnecessary valve repairs or adjustments can result. Leak rate limits that are too high could result in failure of the tests required by Appendix J to 10 CFR Part 50, thereby leading to concerns about the leak-tight integrity of the containment. Appropriate permissible leak rates can be developed and refined only by analyzing and trending the leak rate data for specific valves or for similar valves at other plants. Therefore, the NRC staff has not provided specific guidance on leak rates. Licensees should document their methods for establishing the initial permissible leak rates and procedures for verifying compliance with the leak rate limits.

OM Code, Subsection ISTC, Paragraph ISTC-3610, "Scope of Seat Leakage Rate Test," allows a licensee to justify that leak tightness of a Category A valve is demonstrated in the course of plant operation. In particular, ISTC-3610 states the following:

> Category A valves shall be leakage tested, except that valves that 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.

To apply ISTC-3610, the licensee should specify that the valve is Category A in the IST program plan with a note referencing ISTC-3610 and describe the plant operating procedures that demonstrate adequate seat leak-tightness for the valve. In accordance with ISTC-3610, the licensee will need to maintain a valve record providing the basis for concluding that the plant operational observations demonstrate adequate seat leak-tightness for that Category A valve. If so, the licensee would not be required to apply the 2-year leak testing requirements specified in paragraph ISTC-3630 for that Category A valve.

4.5.2 Risk Rankings

With respect to Mandatory Appendix III, the NRC regulations in 10 CFR 50.55a(b)(3)(ii)(C) allow a licensee to use an MOV risk ranking methodology that the NRC has accepted for the specific nuclear power plant as part of the implementation of Mandatory Appendix III. The NRC staff considers the component risk ranking methodology as accepted by an NRC safety evaluation for implementation of 10 CFR 50.69 at the specific nuclear power plant to be acceptable as an MOV risk ranking methodology in meeting 10 CFR 50.55a(b)(3)(ii)(C). However, there are some aspects to be careful of when using 10 CFR 50.69 for the MOV risk ranking methodology for Mandatory Appendix III. For example, Mandatory Appendix III, Paragraph III-3720, "Risk-Informed Criteria," states the following:

> Each MOV shall be evaluated and categorized using a documented risk ranking methodology that has been accepted by the regulatory authorities having jurisdiction at the plant site. This Appendix provides test requirements for high and low safety significant component (HSSC/LSSC) categories. If an Owner established more than two risk categories, then the Owner shall evaluate the intermediate SSCs and select HSSC or LSSC test requirements for those intermediate SSCs.

Although 10 CFR 50.69 specifies Risk-Informed Safety Class (RISC)-1, -2, -3, and -4 risk categories, the ranking is only "high" and "low" with respect to safety significance. Safety-related RISC-1 and RISC-3 are the two categories related to MOVs within the scope of the IST program.

With respect to Mandatory Appendix IV, Section IV-3800, “Risk-Informed AOV Inservice Testing,” specifies risk-informed considerations and risk-informed methodology requirements. Section IV-3820 states that Subsection ISTE provides an acceptable method of risk ranking that may be used to categorize AOVs. The NRC staff considers that the guidance described above for the use of the approved 10 CFR 50.69 risk ranking methodology for a specific nuclear power plant to risk rank MOVs under Mandatory Appendix III would also apply to Mandatory Appendix IV.

4.5.3 Active/Passive

Section ISTA-2000 in the OM Code defines active valves as “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.” Section ISTA-2000 defines passive valves as “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.” Therefore, a valve is defined as either active or passive when initially included in the IST program based on its required safety function. Valves are defined as active or passive based on the requirement to change obturator position to accomplish a required safety function. Should a valve have both an active and a passive safety function, it would be defined as an active valve. For example, Table ISTC-3500-1 indicates that Category C valves (such as safety, relief, and check valves) are active valves. A valve need not be classified as active if it is only temporarily removed from service or from its safety position, such as manually opening a sample valve for a short time to take a sample, while maintaining administrative control over the valve. A passive valve removed from service or in its nonsafety position for days, weeks, or months is expected to be classified as an active valve and satisfy the applicable OM Code requirements as incorporated by reference in 10 CFR 50.55a. If the plant is in an operating mode that does not require a passive valve to be maintained in its “passive” (safety) position, the position of the valve may be changed without imposing IST requirements on the valve. By contrast, if a valve is routinely repositioned during power operations (or has an active safety function), it is an active valve. If a valve is repositioned to create a new alignment (e.g., as a corrective action for a condition of another valve in the line), an evaluation (considering the impact on the IST program) may be necessary to ensure its operational readiness before placing the valve in a new position, as determined on a case-by-case basis.

In summary, the NRC staff notes that a valve is classified as active or passive by its safety function. If a valve is required to change obturator position to accomplish a required safety function, the valve is defined as active. The OM Code does not recognize valves that are active in one direction and passive in the other direction. The valve is either active or passive. The valves that are the subject of this question are required by the OM Code to be exercised and stroke timed in both the open and closed direction, since they have a safety function in both positions. The OM Code requires valves to be exercised to the position(s) required to fulfill its function(s). The summary of questions and answers from public workshops on IP 73756, dated July 18, 1997 (ML20154S165), discusses this topic in question 2.1.9. A licensee may not change the classification of a valve simply by establishing administrative controls over its position. CIVs (except where always closed) are always considered to be active components based on their safety function to prevent release of radioactive material from containment. Check valves are always considered to be active valves in the IST program.

As defined in OM Code, Subsection ISTA, paragraph ISTA-2000, passive valves maintain their obturator position and are not required to change obturator position to accomplish their required function. By this definition, passive valves that remain in their safety position upon loss of motive power do not need to be fail-safe tested in accordance with the OM Code.

It is important to classify CIVs as active valves (except where always closed) because they prevent the release of radioactive material from the containment. When classified as active in the IST program, CIVs are required to be tested to demonstrate their capability to close under design-basis conditions. If classified as passive, the CIV is not required to be tested to demonstrate its capability. There might be justification for a request for an alternative through the 10 CFR 50.55a(z) process.

5 SUPPLEMENTAL GUIDANCE ON INSERVICE TESTING OF PUMPS

5.1 Pump Inservice Testing Introduction

The OM Code, Subsection ISTB, categorizes pumps into two basic groups (Group A and Group B) with baseline (also called preservice) and periodic inservice pump tests. Pumps in the IST program are required to undergo baseline (preservice) tests, Group A tests, Group B tests, CPTs, and PPVTs, as applicable.

In accordance with the OM Code, the CPT allows less rigorous pump testing to be performed for certain pumps on a quarterly frequency while requiring a pump test to be performed with more accurate pressure and differential pressure instrumentation every 2 years at ±20 percent of pump design flow. In the 2012 Edition of the OM Code, the CPT flow rate was changed. This CPT flow rate is defined as the flow rate established by the Owner that is effective for detecting mechanical and hydraulic degradation during subsequent testing. The best efficiency point, system flow rates, and any other plant-specific flow rates are considered when determining this flow rate. The CPT was developed with the knowledge that some pumps, such as containment spray pumps, cannot be tested at the required high flow rates because of system design limitations. Subparagraph ISTB-3300(e)(1) of the OM Code requires licensees to establish reference values at the CPT flow rate for the CPT test. Subparagraph ISTB-3300(e)(2) of the OM Code requires that licensees establish reference values at the CPT flow rate for the Group A and Group B tests, if practical. If not practicable, the reference point flow shall be established at the highest practical flow rate.

ASME prepared Mandatory Appendix V to the OM Code to justify the relaxation of the upper end of the “acceptable range” and the “required action range” for flow and differential or discharge pressure for CPT in Subsection ISTB. The NRC regulations in 10 CFR 50.55a(b)(3) provide assurance that Mandatory Appendix V was applied to Subsections ISTB and ISTF in specific editions and addenda of the OM Code. In the 2020 and 2022 Editions of the OM Code, Mandatory Appendix V has been incorporated into Subsection ISTB. The 2020 and 2022 Editions of the OM Code also added definitions for baseline test and PPVT to section ISTB-2000. As described in Mandatory Appendix V, the licensee shall (a) identify those certain applicable pumps with specific design-basis accident flow rates in the Owner’s credited safety analysis (e.g., TS, technical requirements program, or updated safety analysis report) for inclusion in this program, (b) perform the PPVT at least once every 2 years, (c) determine whether the PPVT is required before declaring the pump operable following replacement, repair, or maintenance on the pump, (d) declare the pump inoperable if the PPVT flow rate and associated differential pressure (or discharge pressure for positive displacement pumps) cannot be achieved, (e) maintain the necessary records for the PPVTs, including the applicable test parameters (e.g., flow rate and associated differential pressure, or flow rate and associated discharge pressure, and speed for variable speed pumps) and their basis, and (f) account for the PPVT instrument accuracies in the test acceptance criteria.

5.1.1 Categories of Pumps for Inservice Testing

The OM Code requires that all pumps that the licensee identifies as part of an IST program must be categorized as either Group A or Group B pumps. Paragraph ISTB-2000 defines Group A pumps as “pumps that are operated continuously or routinely during normal operation,

cold shutdown, or refueling operation." Paragraph ISTB-2000 defines Group B pumps as "pumps in standby systems that are not operated routinely except for testing."

5.1.2 Testing Requirements and Frequency of Inservice Tests

The OM Code identifies various types of tests, such as preservice tests, Group A tests, Group B tests, CPTs, and PPVTs. All pumps receive a preservice test (referred to as a baseline test in the 2020 and 2022 Edition). Quarterly tests are performed on Group A pumps and Group B pumps. Every 2 years, each pump receives a CPT and a PPVT. The parameters measured during these tests depend on the specific group and type of test. A CPT or baseline test may be substituted for a Group A or Group B test. Similarly, a Group A test may be substituted for a Group B test, and a baseline test or preservice test may be substituted for any inservice test.

OM Code, Paragraph ISTB-3410, "Pumps in Regular Use," states the following:

> 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 section ISTB-6000.

OM Code, Paragraph ISTB-3420, "Pumps Out of Service," states the following:

> For a pump declared inoperable or not required to be operable, the test schedule need not be followed. Within 3 months before the pump 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.

OM Code, Paragraph ISTB-3430, "Pumps Lacking Required Fluid Inventory," states the following:

> Group B pumps lacking required fluid inventory (e.g., pumps in dry sumps) shall receive a comprehensive test at least once every 2 yr. except as provided in para. ISTB-3420. The required fluid inventory shall be provided during this test. A Group B test is not required.

NRC Recommendation

The 1995 Edition of OM Code, Subsection ISTB, introduced the CPT, which allows licensees to perform less rigorous pump testing for certain pumps on a quarterly frequency, while requiring licensees to perform a pump test with more accurate pressure/differential pressure instrumentation every 2 years at ±20 percent of pump design flow. The 2012 Edition of the OM Code changed the CPT flow rate. The CPT flow rate is established by the Owner to be effective for detecting mechanical and hydraulic degradation during subsequent testing. This change was made because for some pumps, testing within 20 percent of pump design flow might not have been an ideal point for detecting degradation, which is the purpose of the testing. When updating to the 2012 Edition or later editions of the OM Code, licensees should verify that the existing CPT test point meets the new definition. The PPVT under Mandatory Appendix V or paragraphs ISTB-5124, ISTB-5224, ISTB-5324, ISTF-5130, ISTF-5230, or ISTF-5330 is a test that verifies that a pump can meet the required (differential or discharge, as applicable)

pressure at its highest design-basis accident flow rate. If the required flow and differential pressure cannot be achieved, then the pump is in the action range, and corrective actions shall be taken in accordance with subparagraphs ISTB-6200(b) or ISTF-6200(b). Licensees should determine whether the requirements of Mandatory Appendix V or paragraphs ISTB-5124, ISTB-5224, ISTB-5324, ISTF-5130, ISTF-5230, or ISTF-5330, as applicable, can be met for the PPVT of specific pumps. If there are challenges in meeting the PPVT requirements for a specific pump, the licensee should contact the NRC project manager in advance of the due date for the PPVT.

5.2 Use of Variable Reference Values for Flow Rate and Differential Pressure During Pump Testing

Some system designs do not allow for testing at a single reference point or a set of reference points. In Revision 5 to RG 1.192, the NRC accepts Code Case OMN-9, "Use of a Pump Curve for Testing," with conditions and Code Case OMN-16, Revision 2, "Use of a Pump Curve for Testing," without conditions. Licensees should review the OM Code Case Applicability Index for the applicable editions and addenda of the OM Code for which the individual Code Cases may be applied directly through the use of RG 1.192. If the IST code of record for the nuclear power plant is not within the scope of the Applicability Index for the applicable Code Cases, the licensee will need to submit an alternative request to apply the specific Code Case or update its code of record to an applicable edition or addendum.

5.2.1 Reference Values

Licensees shall determine reference values from the results of PST or the first inservice test. The resultant reference values shall be at points of operation that are readily duplicated during subsequent tests, and the licensee shall compare all subsequent test results to the initial reference values or the new reference values established in accordance with the OM Code. Licensees shall establish reference values only 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, these conditions shall be analyzed.

The 2022 Edition of ASME OM Code Paragraph ISTB-3300, "Reference Values," in subparagraph (h) states that for smooth running pump measured vibration reference values less than 0.050 inch per second (ips), the owner may use 0.050 ips as the minimum reference value for one or more of the vibration points. ISTB-3300(h) also states that in such cases, the minimum reference value of 0.050 ips shall be used to define acceptable pump performance in accordance with Section ISTB-5000, "Specific Testing Requirements."

5.2.2 Reference Curves

If the establishment of specific reference values is impractical for a centrifugal or vertical line shaft pump, the licensee may establish reference curves. In so doing, the licensee needs to determine the reference curves from the data measured during PST or the first inservice test. In addition, the licensee needs to establish a reference curve from a minimum of five data points for each 20 percent of the maximum pump curve range, and the range of the reference curve needs to be sufficient to bound the points of operation that are expected during subsequent tests. The licensee then compares all results to the initial reference curves or the new values established in accordance with sections 5.2.3 and 5.2.4. In addition, the licensee establishes reference curves only 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,

the licensee may use a single reference value as the test quantity, provided it is at the minimum of the measured data. By contrast, if the licensee uses reference curves, the record of the test documents and justifies the reasons for doing so and the suitability of the methods used to develop the reference curves and acceptance criteria (see Section ISTB-9000).

5.2.3 Effect of Pump Replacement, Repair, and Maintenance on Reference Values or Reference Curves

When the repair, replacement, or routine servicing of the pump may have affected a reference value, a set of reference values, or a reference curve, the licensee determines a new reference value, a new set of reference values, or a new reference curve, or reconfirms the previous value (or curve) by an inservice test run before declaring the pump operable. The licensee then identifies any deviation between the previous and new set of reference values (or reference curves), and the record of the tests documents the verification that the new values (or curves) represent acceptable pump operations (see Sections ISTB-9000 and ISTF-9000).

The OM Code (2020 and 2022 Editions) has updated Paragraph ISTB-3310, “Effect of Pump Replacement, Repair, and Maintenance on Reference Values.” In particular, Paragraph ISTB-3311, “Replacement and Major Maintenance,” provides specific requirements following replacement, major maintenance, or routine servicing (e.g., impeller replacement), such that the existing baseline test data and reference values do not represent the installed pump. Paragraph ISTB-3312, “Routine Maintenance and Repair,” provides specific requirements for when a reference value or a set of reference values may have been affected by repair or routine maintenance. Paragraph ISTB-3313, “Baseline Test Deferral,” provides specific requirements for when the testing required by ISTB-3311 is impracticable due to plant operating conditions that would allow the testing to be deferred. Subsection ISTF has similar requirements.

Licensees should be aware that their code of record might have different requirements related to pump replacement, repair, and maintenance.

5.2.4 Establishment of Additional Sets of Reference Values or Reference Curves

If it is necessary or desirable, for a reason other than those discussed above, to establish an additional set of reference values or curves, the licensee runs an inservice test under the conditions of an existing set of reference values, or within the range of existing reference curves, and analyzes the results. If the operation is acceptable in accordance with section 7 of Code Case OMN-9 (section 16-6200 of OM Code Case OMN-16), a second test run under the new reference conditions needs to follow as soon as practicable, and the results of this test establish the additional set of reference values or reference curves. Whenever a licensee establishes an additional set of reference values or reference curves, the record of the tests documents and justifies the rationale for doing so (see Section ISTB-9000).

NRC Recommendation

The NRC accepts the use of pump curves for reference values of flow rate and differential pressure if the licensee clearly demonstrates, in a relief request, that it would be impractical to establish a fixed set of reference values. A relief request must include a description of the methodology for evaluating these pumps. To obtain approval for a proposed method of evaluating these pump parameters to detect hydraulic degradation and determine pump operability, the licensee must demonstrate that the acceptance criteria are equivalent to the OM

Code requirements as specified under test acceptance criteria in ISTB, Table ISTB-5121-1 or ISTB-5221-1 (depending on pump type), for allowable ranges using reference values and curves.

To use this test method, the licensee must plot a valid pump characteristic curve from empirical data or obtain one from the pump manufacturer and verify it with measurements taken when the pump was known to be in good operating condition. Additional guidance is given in sections 5.2.2, 5.2.3, and 5.2.4 of this document; the OM Code; and Code Case OMN-16, including RG 1.192.

Basis for Recommendation

Where it is not practical to return to the same flow configuration for each subsequent inservice pump test, the licensee must establish a method for evaluating the operational readiness of pumps in variable flow systems. This may be the case for service water or component cooling water systems and other systems where temperature or flow is controlled at a variety of locations. During quarterly pump testing, the licensee may not be able to manually control each of these local stations and duplicate the overall system reference conditions, as required by the OM Code.

Using the manufacturer's pump-specific curves for flow and differential pressure, the licensee may be able to evaluate the pump in as-found system conditions. In implementing this guidance, the licensee would confirm these values by performing in situ testing. Another method would be to plot pump curves over the range of conditions expected during the system's normal operation. It is also important to develop a method of evaluating pump vibration measurements taken with the pump operating over the range of possible as-found conditions, since this is a variable pump parameter. By evaluating these measurements of pump vibration, the licensee will ensure that a pump that is severely degraded, either hydraulically or mechanically, is declared inoperable and appropriate action is taken to address the degradation.

5.3 Allowable Variance from Reference Points and Fixed-Resistance Systems

Certain designs do not allow for the licensee to set the flow at an exact value because of limitations in the instruments and controls for maintaining steady flow. The characteristics of piping systems in other designs do not allow for the licensee to adjust the flow to exact values. Various editions and addenda for the OM Code specify requirements regarding variance around reference values for pump testing. The OM Code (2022 Edition) limits the variance from a reference value, stating that, as an example, "the resistance of the system shall be varied until the flow rate is as close as practical to the reference point with the variance not to exceed +2% or -1% of the reference point."

NRC Recommendation

The OM Code provides limited variance from a fixed reference value for pump testing. The NRC staff recommends that licensees follow the provisions of Code Case OMN-21, "Alternate

Requirements for Adjusting Hydraulic Parameters to Specified Reference Points," or the 2022 Edition of the OM Code.

Basis for Recommendation

Paragraph ISTB-3500 specifies the requirements for instrument fluctuations and describes the basis for allowing a variance from the acceptable range for the reference value of ±2 percent for Group A and Group B tests, and ±1/2 percent for pressure and differential pressure and ±2 percent for flow for preservice tests and CPTs. In addition, paragraph ISTB-3500 allows the use of symmetrical damping devices or averaging techniques to reduce instrument fluctuations to within ±2 percent or ±1/2 percent (as applicable) of the observed reading for values specified in the implementing procedures. Greater variances must be justified and acceptance criteria adjusted as necessary.

If an analog gauge is used, the required accuracy is percent full scale. For a digital gauge, the required accuracy is over the calibrated range. For a combination of gauges, the required accuracy is loop accuracy.

ASME developed Code Case OMN-21 to address the issue of meeting allowable variance from reference values in systems that are impractical to adjust the resistance of the system. The allowed tolerance for setting the fixed parameter must be established for each case individually, including evaluation of throttling capability. Licensees should consider improvements in throttling methods where system control is especially poor. A total throttling tolerance of +2/-1 percent of the flow rate reference value is considered as meeting the requirements of the OM Code sections. For a tolerance greater than +2/-1 percent of the flow rate reference value, a corresponding adjustment to acceptance criteria shall be made to compensate for the uncertainty, or an evaluation would be performed and documented justifying a greater tolerance. The IST program documents or implementing procedures must document the variance and the method for establishing the variance. RG 1.192, Revision 5, endorses Code Case OMN-21with no conditions.

The basis for the Code Case is as follows. The OM Code does not address the possibility that a flow rate or differential pressure may not be controllable to an exact value. When the OM Code specifies that the system resistance be varied until either the flow or differential pressure equals the corresponding reference value, it does not literally intend that the "set value" be precisely attained without any fluctuations. Licensees recognize that the reference value for certain pumps can be achieved only within a specified tolerance. Licensees shall attempt to set the repeatable parameter as close as possible to the reference value during each test.

The basis for allowing a variance of +2/-1 percent from the flow rate reference value deals with instrument fluctuations and system stability issues. The OM Code allows the use of symmetrical damping devices or averaging techniques to reduce instrument fluctuations to within 2 percent of the observed reading for values specified in the implementing procedures. Greater variances must be justified and acceptance criteria adjustments made as necessary. The limitation of 1 percent in the negative direction reduces the nonconservative impact on the variable parameter. The total 3 percent allowable variance provides for a reasonable throttling control range while minimizing the impact on trendability of the variable parameter.

Licensees should ensure that performance trending of pumps is capable of detecting degradation as early as possible. Larger variances in the reference parameter will induce scatter in the variable parameter data. Techniques such as data normalization, where recorded

test data are corrected by the known pressure to flow relationship, should be used when necessary to provide for accurate short-term trending.

5.4 Monitoring Pump Vibration in Accordance with Subsection ISTB of the OM Code

Subsection ISTB of the OM Code allows licensees to monitor pump vibration in units of either pump displacement (peak-to-peak) or pump velocity (peak) and includes acceptance criteria for both units of measurement. As specified in Table ISTB-3000-1, the measurement of pump vibration is required for preservice tests, Group A tests, and CPTs. However, the OM Code does not require vibration measurements for Group B tests or PPVTs.

NRC Recommendation

The NRC staff has determined that if the licensee uses Subsection ISTB of the OM Code as the basis for monitoring vibration in the IST program, the program must include all of the requirements for such monitoring. Licensees may update their programs in accordance with this position without further relief if they meet all related requirements for monitoring vibration in paragraph ISTB-3540 and Sections ISTB-5000 and ISTB-6000. However, Commission approval to use a later OM Code edition or addenda is still required pursuant to 10 CFR 50.55a(f)(4)(iv). Sections 1.1 and 2.1 contain further guidance.

In following this guidance, the frequency response range of the instrumentation must be as specified in subparagraph ISTB-3510(e) for both low-speed and high-speed pumps, unless the licensee demonstrates that the information gained at the low-frequency response does not apply for the bearing design of the pumps. In that event, the licensee must still provide an acceptable alternative to the required testing. Although the instruments in the low-frequency response ranges may not be widely used, the unavailability of instruments does not constitute sufficient justification for either obtaining relief from the frequency response range requirements of Subsection ISTB or obtaining authorization of an alternative to the requirements.

Basis for Recommendation

As shown in OM Code, Figure ISTB-5223-1, “Vibration Limits,” licensees may choose to use units of velocity, rather than displacement, in measuring vibration in pumps that operate above 600 revolutions per minute. Such an approach would enable the licensee to more rapidly detect wear in the antifriction bearing and other types of pump degradation and, thus, to perform repairs in a more timely manner.

Pump bearing degradation results in increased vibration at frequencies of 5 to 100 times the rotational speed of the pump. These high-frequency bearing vibrations may not significantly increase the measured displacement of pump vibration and could go undetected. However, the high-frequency vibrations would significantly increase the measured velocity of pump vibration, which could indicate the need for corrective action before the bearing fails. Because pump bearings vibrate at high frequencies, the measured vibration velocity indicates the mechanical condition of the pumps and reveals pump bearing degradation much more accurately than does measured vibration displacement.

Advantages of measuring vibration velocity, rather than displacement, to monitor the mechanical condition of pumps (with the exception of low-speed pumps) are widely acknowledged in the industry. Many licensees measure pump vibration velocity to detect pump

degradation and obtain advance warning of incipient pump bearing failure. With this advance warning, the licensee can plan and prepare for maintenance during scheduled outages instead of suffering losses resulting from unplanned outages to repair failed critical equipment. Subsection ISTB of the OM Code includes a set of allowable ranges for inservice pump vibration velocity and measured pump vibration displacement. These ranges are based on an evaluation of empirical data and various acceptance criteria for pump vibration velocity established by U.S. industries, academia, international industry, and foreign agencies.

The minimum frequency response range requirement is established from one-third of the minimum pump shaft rotational speed to at least 1000 hertz in order to encompass all noise contributors that could indicate degradation. Instruments with a frequency response range that meets these requirements for slow-speed pumps may not be widely used. However, the unavailability of instruments, alone, does not constitute adequate justification for obtaining relief or authorization of an alternative; however, it may be a significant element in the justification. The NRC has observed that, because of technology advancement and research in the field of instrumentation, vibration-measuring transducers meeting the OM Code requirements can now be procured from various suppliers at reasonable costs. Therefore, licensees should provide additional justification for alternative requests related to instruments. Additionally, frequencies less than running speed may not be indicative of problems for certain types of bearings; however, subharmonic frequencies may indicate rotor rub, seal rub, loose seals, or coupling damage. The justification for relief would typically discuss the type of bearings and other subharmonic concerns.

Subsection ISTB of the OM Code requires licensees to measure vibration in units of either pump displacement (peak-to-peak) or pump velocity (peak). Digital equipment can measure directly in peak units. The periodic update of the ISI and IST programs reflects the need for licensees to incorporate new technologies that have been incorporated into the codes and standards. The OM Code Committee responded to an inquiry (Interpretation 95-4, File OMI 94-2) explaining that the intent of the OM Code is to allow vibration to be measured in root mean square (rms) and mathematically converted to peak readings. Licensees are cautioned that the OM Code vibration acceptance criteria are in peak or peak-to-peak units, and the use of rms is not acceptable without a mathematical conversion. To comply with the requirements, licensees that use rms values for recording data must adjust the limits of Subsection ISTB or convert the data to peak values.

Several plants have requested an alternative to the vibration acceptance criteria of Subsection ISTB for smooth-running pumps, and the NRC has authorized such requests. However, licensees with such authorization must continue to assess the vibration data and monitor increases that may be indicative of a change. In one reported incident, a pump with very low vibration experienced an increase in vibration levels over three successive tests, although the levels remained below the criteria for smooth-running pumps. Upon investigating the cause of the increase, the licensee determined that the bearing had degraded and required replacement. ASME has issued Code Case OMN-22, “Smooth Running Pumps,” which is endorsed in RG 1.192, Revision 5, as acceptable for use without conditions up to the 2020 Edition. The 2022 Edition incorporates Code Case OMN-22.

5.5 Pump Flow Rate and Differential Pressure Instruments

The NRC has received requests for an alternative to continue using instruments that do not meet either the range or accuracy requirements of the OM Code. The OM Code requires each analog instrument to have a full-scale range that is three times the reference value or less, while

each digital instrument must be such that the reference values do not exceed 70 percent of the calibrated range of the instrument. The NRC has accepted Code Case OMN-6, "Alternate Rules for Digital Instruments," as specified in RG 1.192, which allows each digital instrument to be such that the reference values do not exceed 90 percent of the calibrated range of the instrument. Code Case OMN-6 has been incorporated into the 2012 through 2020 Editions of the OM Code. For Group A and Group B pumps, paragraph ISTB-3510 requires an accuracy of ±2 percent of full-scale for analog instruments, ±2 percent of total loop accuracy for a combination of instruments, or ±2 percent of reading over the calibrated range for digital instruments. For preservice tests and CPTs, the required instrument accuracy is ±1/2 percent for pressure and differential pressure instruments. The percentage accuracy is determined as a percentage of the actual measured value (e.g., flow rate determination shall be accurate to within ±2% of actual). Section 5.5.4 contains further discussion of loop accuracy.

5.5.1 Range and Accuracy of Analog Instruments

NRC Recommendation

When the range of a permanently installed analog instrument is greater than three times the reference value, but the accuracy of the instrument is more conservative than that required by the OM Code, the NRC staff may grant relief or authorize an alternative when the combination of the range and accuracy yields a reading that is at least equivalent to that achieved using instruments that meet the OM Code requirements (i.e., up to ±6 percent for Group A and B tests and ±1.5 percent for pressure and differential pressure instruments for preservice tests and CPTs). The use of a test gauge (in lieu of a permanent instrument) is acceptable if the reading is at least equivalent to that required by the OM Code. The NRC staff recommends that the IST records of licensees using temporary instruments should include an instrument number for tracing each instrument and a calibration data sheet for verifying that the instruments are accurately calibrated. The licensee need not obtain relief if the temporary instruments meet the range and accuracy requirements of the OM Code. If relief is requested, the licensee would typically describe the effect on each group of applicable pumps and would typically discuss adjustment of acceptance limits to account for the inaccuracies.

Basis for Recommendation

Because the IST requirements originally specified an instrument range of four times the reference values or less, the permanent instruments in many early-licensed plants do not meet the current requirements of the OM Code for an instrument range of three times the reference values or less. The NRC does not generally consider instrument installation or replacement an undue burden, and compliance with the instrument requirements in later editions of the OM Code does not constitute a backfit.

This position applies to the early-licensed plants but not for the purchase of replacement instruments that can be procured to meet the current requirements of the OM Code; therefore, for new instrument installations, licensees must meet the accuracy and range requirements (although the OM Code does not prohibit like-for-like instrumentation for the existing installation).

The licensee is not relieved of its responsibility to make modifications to comply with changes to IST provisions as a result of changes to the OM Code. Instrument modifications are considered practical in the context of 10 CFR 50.55a(f)(4). However, the use of any available instruments that meet the intent of the OM Code requirements for the actual reading would yield an

acceptable level of quality and safety for testing. Licensees are required to submit a proposed alternative in this case.

When the licensee submits a proposed alternative, it should separately address each group of affected pumps if the instruments are permanently installed. By contrast, a general proposed alternative may be authorized for temporary instrumentation. If the instruments do not meet the intent of the OM Code requirements, the NRC may require the licensee to adjust acceptance limits to account for the instrument inaccuracies.

Licensees are cautioned that the CPT requires more accurate instruments than those specified in earlier editions of the OM Code. As a result, licensees must verify that instrument accuracy is appropriate for the type of test being performed (Group A or Group B test versus a CPT). Licensees should also note that previously acceptable instruments may no longer be acceptable when updating to a more recent edition of the OM Code.

5.5.2 Use of Tank Level to Calculate Flow Rate for Positive Displacement Pumps

The NRC has received requests for proposed alternatives to use the tank level to calculate the flow rate in a system with a positive displacement pump when the system was not designed with a flow meter in the flow loop.

Paragraph ISTB-3550 of the OM Code requires licensees to measure the pump flow rate using a rate or quantity meter installed in the pump test circuit. If the meter does not directly indicate the flow rate, the record of the test shall identify the method used to reduce the flow data. In addition, subparagraph ISTB-5300(a) requires, for Group A tests and CPTs, a 2-minute run time after achieving stable pump conditions before recording data during the test.

NRC Recommendation

When flow meters are not installed in the flow loop of a system with a positive displacement pump, it is impractical to directly measure flow rate for the pump. The NRC staff has determined that, if the licensee uses the tank level to calculate the flow rate as described in paragraph ISTB-3550, the implementing procedure must include the calculational method and any test conditions needed to achieve the required accuracy. Specifically, the licensee must verify that the reading scale for measuring the tank level and the calculational method yield an accuracy within ±2 percent for Group A and B tests, preservice tests, and CPTs. If the meter does not directly indicate the flow rate, the record of the test shall identify the method used to reduce the flow data.

Basis for Recommendation

The OM Code requires licensees to measure the pump flow rate to determine the extent of any pump degradation. A minimum pump run time of 2 minutes is required to achieve stable performance parameters before recording data during the test.

Requiring licensees to install a flow meter to measure the flow rate and to guarantee the test tank size, such that the pump flow rate will stabilize and then be run for 2 minutes before recording data, would be a burden because of the design and installation changes to be made to the existing system. Therefore, compliance with the OM Code requirements would be a hardship.

The average flow rate is calculated by measuring the change in test tank level over a period of time and converting it to flow rate using the following standard formula:

$$Q\ (gpm) = C\ \Delta L\ (inch) / \Delta t\ (second)$$

Where: Q is flow rate in gallons per minute (gpm)
C is a constant that reflects tank dimensions and unit conversions
ΔL is the measured change in level in the tank in time Δt

Pump discharge pressure will match system pressure up to the shutoff head of the positive displacement pump. Because of the characteristics of a positive displacement pump, there should be virtually no change in pump discharge flow rate as a result of the rising tank level. Therefore, rising tank level will not have an impact on test results. By having approximately the same level in the tank at the beginning of each test, licensees can achieve repeatable results. In addition, the suction would be from a large source at a constant pressure, which will allow pump performance parameters to stabilize quickly. This method would provide reasonable assurance of operational readiness, provided that the licensee measures the test tank level in accordance with the accuracy requirements of OM Code, Table ISTB-3510-1. The implementing procedures should document the calculational method and test conditions required to achieve this accuracy. Therefore, the proposed alternative of using the tank level to calculate the flow rate provides reasonable assurance of operational readiness of the pump. Licensees must submit a request to implement this proposed alternative.

5.5.3 Use of Tank or Bay Level to Calculate Differential Pressure

The NRC has received requests for proposed alternatives to use the tank or bay level to calculate differential pressure when a direct measurement of inlet pressure or differential pressure is not available.

NRC Recommendation

When inlet pressure gauges are not installed in the inlet of a vertical line shaft pump, it is impractical to directly measure inlet pressure for use in determining differential pressure for the pump. The NRC staff has determined that, if the licensee uses the bay level to calculate the suction (inlet) pressure as described in subparagraph ISTB-3520(b), the implementing procedure must include the calculation. The licensee must also verify that the reading scale for measuring the level and the calculational method yield an accuracy within ±2 percent for Group A and B tests, and ±1/2 percent for preservice tests and CPTs. If direct measurements are impractical for other types of pumps with suction from a tank, the licensee must apply similar controls. The OM Code allows the licensee to determine differential pressure by obtaining the information from a differential pressure gauge or differential pressure transmitter, or by determining the difference between the pressure at a point in the inlet pipe and the pressure at a point in the discharge pipe (subparagraph ISTB-3520(b)). Therefore, the licensee may implement a calculational method without obtaining authorization of a proposed alternative because the OM Code allows for the determination of differential pressure from the discharge pressure and the pressure in the pump inlet.

Basis for Recommendation

The method is in accordance with a determination of differential pressure allowed by the OM Code. Although the inlet pressure is not directly measured, it is “measured” for the purpose of

determining the pressure at a point in the inlet. By including the calculation in the implementing procedures, the licensee can determine the differential pressure in a manner that is consistent and repeatable from test to test. This method will yield the information needed for monitoring the hydraulic condition of the applicable pumps without the need to install suction (inlet) pressure gauges, which may not be practical, depending on the design limitations in the inlet of the pump.

5.5.4 Accuracy of the Flow Rate Instrument Loop

As clarified in OM Code Interpretation 95-7 (1990 Edition, Subsection ISTB 4.6.1 and Table ISTB 4.6.1.1; 1987 Edition with 1988 Addenda, Part 6, paragraph 4.6.11 and Table 1, Instrument Accuracy) and Inquiries IN 91-3 (1987 Edition through 1990 Edition, Part 6, paragraph 4.6.1.1) and IN 91-037 (ASME BPV Code Section XI, 1977 Edition through later editions and addenda through the 1987 Addenda, Table IWP-4110-1, “Instrument Accuracy—Flowrate”), the accuracy requirements of analog instruments that are used to measure process flow apply only to the reference calibration of the instrument, such as that supplied by the instrument manufacturer, in determining loop accuracy. In determining instrument accuracy, the OM Code does not explicitly require the licensee to consider physical attributes (such as orifice plate tolerances), tap locations, environmental effects (such as temperature, radiation, or humidity), vibration effects (such as seismic) or process effects (such as temperature). However, factors associated with attributes that could affect the measurements include the effects of wear, accumulation of dirt or grease on an annular flow coefficient, and the reversed installation of a one-direction orifice plate.

NRC Recommendation

The OM Code requirements for instrument accuracy ensure that the instrument loop accuracy is adequate for monitoring pumps for degrading conditions. The accuracy for analog instruments specified in paragraph ISTB-3500 of the OM Code applies only to the calibration of the instruments. The NRC staff recommends that, when test results indicate that conditions in the pump or the test circuit have changed, licensees should consider corrective action for other attributes that could affect the overall loop accuracy of the measurements.

Basis for Recommendation

In ASME Code Interpretation 95-7 and ASME Code Inquiries IN 91-3 and IN 91-037, the ASME Code Committee states that the requirements for the final indication of flow rate on an analog instrument to be within 2 percent of full scale of actual process flow rate apply only to the calibration of the instrument and do not take into account physical attributes, environmental effects, vibration effects, or process effects.

5.6 Duration of Tests

OM Code, subparagraphs ISTB-5100(a), ISTB-5200(a), and ISTB-5300(a), “Duration of Tests,” require that, for measuring parameters as specified in Table ISTB-3000-1, each pump shall be run for at least 2 minutes after pump conditions are stable as the system permits. This duration is applicable to Group A tests and CPTs. No specific duration is provided for Group B tests or PPVTs.

NRC Recommendation

The NRC staff recommends, if practicable, that this duration also be applied to Group B pump tests and PPVTs.

Basis for Recommendation

The 2-minute run time is adequate after pump operation becomes stable. This 2-minute run time minimizes overheating of pumps that are tested using the minimum flow recirculation line. The NRC recommends that licensees should minimize the time pumps are operated on the minimum flow recirculation line. (See NRC Bulletin 88-04, "Potential Safety-Related Pump Loss," dated May 5, 1988.)

5.7 Adjustments for Instrument Inaccuracies

If the accuracy of plant instrumentation used for IST activities for pumps is not well understood, the test results may not be adequate to meet the licensee's safety analysis, even if they meet the OM Code requirements. For example, TS or the FSAR might require a pump to produce 1,000 gpm at 500 pounds per square inch differential (psid), but the IST reference values are 1,000 gpm (fixed) and 550 psid. The low end of the acceptable range for differential pressure from OM Code, Table ISTB-5121-1, for Group A and Group B tests (0.90) would be 495 psid, although conservatively set at 500 psid. If this test is also to prove operability of the pump in addition to meeting IST requirements, and the ±2 percent instrument inaccuracies were accounted for in flow rate and differential pressure, there is the possibility that the pump is putting out less than the required values. In this example, the instrument accuracies would need to be taken into account if they were not already considered when the design parameters were developed.

The PPVT is a test that verifies that a pump can meet the required (differential or discharge, as applicable) pressure at its highest design-basis accident flow rate. If the required flow and differential pressure cannot be achieved, then the pump is in the action range, and corrective actions shall be taken in accordance with subparagraphs ISTB-6200(b) or ISTF-6200(b), as applicable. The OM Code does not include specific accuracy requirements for instrumentation used to perform PPVTs. However, Note (1) of Table ISTB-3510-1, "Required Instrument Accuracy," and Table ISTF-3510-1, "Required Instrument Accuracy," specifies that the Owner shall select instrument accuracy such that the required parameters are verified when instrument accuracy is taken into account for the PPVT flow and pressure. Therefore, the licensee is responsible for addressing instrument accuracy when conducting a PPVT to verify that a pump can meet the required (differential or discharge, as applicable) pressure at its highest design -basis accident flow rate.

When pump test procedures are developed, limits in the safety analysis cannot be ignored. The IST requirements are written generally. If specific plant limits are more conservative, to ensure compliance with design-basis assumptions, such limits must be clearly indicated as the "operability" limits and used for acceptance criteria of IST. For example, when obtaining values using instrumentation that meets the accuracy requirements specified for IST activities, the value as-read would be used. If a licensee is attempting to perform a critical test, more accurate instrumentation may be necessary; however, the value recorded would be the value read if the accuracy of the instrumentation met the specified accuracy. Only when instruments are used that cannot meet the specified accuracy for a test would an adjustment be necessary to meet the OM Code. Design analyses might not account for instrument accuracy readings; however,

when the pump is selected, the designer generally chooses from a catalog of available sizes and picks one with margin above the analyses numbers.

In the determination of loop accuracy, it is intended that only the instrument manufacturer's reference accuracy be considered. It is not necessary to consider all uncertainties (such as environmental effects, process effects, vibration effects, etc.). For only IST testing, instrument uncertainty need not be included if only a single instrument is used and it is within the ISTB table range. However, the square root sum of squares of instrument uncertainty for the instrument loop would be required based on the ISTA-2000 definition. If testing is used for TS operability or is near the design limit and might cause an operability issue, instrument uncertainty must be considered for both single instrument and instrument loop use.

5.8 Pump Testing Using Minimum Flow Return Lines with or without Flow Measuring Devices

The NRC has received requests for proposed alternatives from licensees requesting approval of pump testing by using minimum flow return lines with or without measuring devices as an alternative to the IST requirements specified in Subsection ISTB of the OM Code.

As specified in section 5.1.2, the OM Code identifies various types of tests, such as preservice tests, Group A tests, Group B tests, CPTs, and PPVTs. All pumps receive a preservice test followed on a quarterly basis by the test associated with the pump category (Group A test for Group A pumps, and Group B test for Group B pumps), and at least once every 2 years by a CPT and PPVT (if applicable). A CPT may also be substituted for a Group A or Group B test. Similarly, a Group A test may be substituted for a Group B test, and a preservice test may be substituted for any inservice test.

Subparagraphs ISTB-5100(b), ISTB-5200(b), and ISTB-5300(b) of the OM Code allow the use of a bypass test loop for Group B tests, provided that it is designed to meet the pump manufacturer's operating specifications (e.g., flow rate and time limitations) for minimum flow operation. The bypass test loop may be used for Group A tests or CPTs, provided that the flow rate through the loop meets the requirements in paragraph ISTB-3300.

An inservice pump test requires that the pump parameters shown in Table ISTB-3000-1 must be measured and evaluated to determine pump condition and detect degradation. Pump differential pressure and flow rate are two parameters that are measured and evaluated together to determine pump hydraulic performance.

In cases where only the minimum-flow return line is available for pump testing, regardless of the test interval, the NRC staff's position is that flow instrumentation that meets the requirements of paragraph ISTB-3500 should be installed in the mini-flow return line. Installation of this instrumentation is necessary to provide flow rate measurements during pump testing so that these data can be evaluated with the measured pump differential pressure to monitor for pump hydraulic degradation.

When testing a pump using a minimum flow recirculation line, the guidance provided in NRC Bulletin 88-04 applies. Licensees should review operating conditions to ensure that a pump is not subject to dead head conditions, that the minimum flow line is adequately sized, and that operation will not damage the pump.

5.9 Alternative to or Relief from ASME OM Code Comprehensive Pump Testing Requirements

The NRC has received requests from licensees proposing an alternative to or relief from the CPT requirements specified in the OM Code.

Some designs do not allow a CPT at the flow requirements in the OM Code because of the original system design configuration.

Earlier OM Code editions and addenda required licensees to establish reference values for the CPT within ±20% of the design flow rate. Starting with the 2012 Edition of the OM Code, the CPT is required to be performed at the comprehensive test flow rate. This is defined as the flow rate established by the Owner that is effective for detecting mechanical and hydraulic degradation during subsequent testing. As specified by the OM Code, the best efficiency point, system flow rates, and any other plant-specific flow rates shall be considered when establishing the comprehensive test flow rate.

NRC Recommendation

For licensees with a code of record before the 2012 Edition of the OM Code, the NRC will evaluate the use of lower flow (reference values) other than ±20 percent of the design flow, as specified by subparagraph ISTB-3300(e)(1) for CPT, if the licensee's request for relief under 10 CFR 50.55a(f) or an alternative under 10 CFR 50.55a(z) clearly demonstrates the challenge in establishing a reference value within ±20 percent of the design flow for the CPT. For licensees with the 2012 Edition of the OM Code or later as the code of record, the OM Code requires them to establish a CPT flow rate that is effective for detecting mechanical and hydraulic degradation as defined in ISTB-2000.

For a request to perform the CPT with a flow other than that specified in the applicable OM Code edition or addenda, the licensee must meet the requirements for relief under 10 CFR 50.55a(f) or an alternative under 10 CFR 50.55a(z).

For either a relief or alternative request, the licensee should include (as a minimum, but not limited to) the following information in its submittal:

- Provide reason(s) for not performing the CPT at the required flow.
- Specify the maximum flow at which the CPT can be performed.
- Provide the estimated cost of any temporary or permanent system modification required to enable a CPT to be performed at the OM Code-required flow, along with any difficulty associated with implementing the modification.
- Provide all details (e.g., temporary modifications of piping, containment sump), including pump performance curves, if a full-flow test was performed during preservice or service of the plant.
- Provide pump performance curves and any other data associated with the pump's shop testing provided by the manufacturer.
- Provide the records and history of maintenance and repairs performed on the pump.

- Provide any appropriate compensatory actions being proposed to supplement the alternative testing, such as (but not limited to) the following examples:
  - testing at the best efficiency point (BEP) on a longer interval, with BEP defined as the capacity and head at which the pump efficiency is at its maximum
  - commitment to perform additional performance monitoring
  - adjustment of acceptance criteria
  - continuation of the previous OM Code testing, including taking overall vibration data quarterly
  - periodic sampling and analysis of the lube oil
- As applicable, describe the justification that the CPT requirements (1) are impractical to satisfy 10 CFR 50.55a(f)(5), (2) can be performed by an alternative that provides an acceptable level of quality and safety to satisfy 10 CFR 50.55a(z)(1), or (3) represent a hardship or unusual difficulty without a compensating increase in the level of quality and safety to satisfy 10 CFR 50.55a(z)(2).

NUREG/CP-0152, Volume 4, "Proceedings of the Seventh NRC/ASME Symposium on Valve and Pump Testing," issued July 2002, includes additional guidelines in a paper titled "Comprehensive Pump Testing Based on ASME OM Code Requirements and its Alternative and Related Relief Requests."

The NRC will review requests for relief from or an alternative to the CPT requirements in the applicable edition and addenda of the OM Code on a case-by-case basis.

5.10 Alternative to or Relief from ASME OM Code Pump Periodic Verification Testing Requirements

The NRC has received requests from licensees based on challenges in meeting the PPVT requirements specified in the OM Code.

ASME prepared the PPVT requirements in Mandatory Appendix V to the OM Code to provide justification for the relaxation of the upper end of the "acceptable range" and the "required action range" for flow and differential or discharge pressure for CPT in Subsection ISTB. The PPVT is a test that verifies a pump can meet the required (differential or discharge, as applicable) pressure at its highest design-basis accident flow rate. As described in Mandatory Appendix V, the licensee shall (1) identify those certain applicable pumps with specific design-basis accident flow rates in the Owner's credited safety analysis (e.g., TS, technical requirements program, or updated safety analysis report) for inclusion in this program, (2) perform the PPVT at least once every 2 years, (3) determine whether the PPVT is required before declaring the pump operable following replacement, repair, or maintenance on the pump, (4) declare the pump inoperable if the PPVT flow rate and associated differential pressure (or discharge pressure for positive displacement pumps) cannot be achieved, (5) maintain the necessary records for the PPVTs, including the applicable test parameters (e.g., flow rate and associated differential pressure, or flow rate and associated discharge pressure, and speed for variable speed pumps) and their basis, and (6) account for the PPVT instrument accuracies in the test acceptance criteria. If the required flow and differential pressure cannot be achieved, then the pump is in the action range,

and corrective actions shall be taken in accordance with subparagraph ISTB-6200(b) or ISTF-6200(b), as applicable.

The 2020 and 2022 Editions of the OM Code incorporate Mandatory Appendix V into Subsection ISTB in paragraphs ISTB-5124, ISTB-5224, and ISTB-5324, and Subsection ISTF in paragraphs ISTF-5130, ISTF-5230, and ISTF-5330.

Some designs of nuclear power plants have challenges in meeting the required flow and differential pressure to conduct a PPVT for certain pumps. Licensees may submit a relief request or an alternative request for NRC review where challenges are present with respect to the performance of a PPVT for a specific pump at their nuclear power plants.

NRC Recommendation

Licensees should determine whether the requirements of OM Code, Mandatory Appendix V or paragraph ISTB-5124, ISTB-5224, ISTB-5324, ISTF-5130, ISTF-5230, or ISTF-5330, as applicable, can be met for the PPVT of specific pumps at their nuclear power plants. If it is determined that there are challenges in meeting the PPVT requirements for a specific pump in advance of the required due date for the PPVT, it may be helpful for the licensee to contact the NRC project manager to arrange a preapplication meeting.

To obtain authorization for a proposed alternative method of performing the PPVT for a specific pump, the licensee must demonstrate that the requirements of 10 CFR 50.55a(z)(1) or (2) are met for the proposed alternative. For the NRC to grant relief from the PPVT requirements for a specific pump, the licensee must demonstrate that the requirements of 10 CFR 50.55a(f)(5) are met.

For proposed relief or an alternative, the NRC staff recommends that the following information be provided:

- Provide reason(s) for not performing the PPVT at the required flow
- Specify the maximum flow and differential pressure at which the PPVT can be performed compared to the PPVT flow and differential pressure requirements
- Provide the estimated cost of any temporary or permanent system modification required to enable a PPVT to be performed, along with any difficulty associated with implementing the modification
- Provide details (e.g., temporary modifications of piping), including pump performance curves, if a full-flow test was performed during preservice or service of the plant
- Provide pump performance curves and any other data associated with the pump's shop testing provided by the manufacturer
- Provide the records and history of maintenance and repairs performed on the pump
- Describe any compensatory actions being proposed to supplement the alternative testing, such as (but not limited to) the following examples:
  - testing at the BEP on a longer interval

- commitment to perform additional performance monitoring
- adjustment of acceptance criteria
- continuation of the previous OM Code testing, such as collecting vibration data quarterly
- periodic sampling and analysis of the lube oil

- As applicable, describe the justification that the PPVT requirements (1) are impractical to satisfy 10 CFR 50.55a(f)(5), (2) can be performed by an alternative that provides an acceptable level of quality and safety to satisfy 10 CFR 50.55a(z)(1), or (3) represent a hardship or unusual difficulty without a compensating increase in the level of quality and safety to satisfy 10 CFR 50.55a(z)(2)

The NRC will review requests related to the PPVT requirements on a case-by-case basis.

5.11 Waterleg Pumps

The NRC has received proposed alternatives from licensees of BWRs for Group A tests for waterleg pumps. Paragraph ISTB-3400 and Table ISTB-3400-1 of the OM Code specify that a Group A test must be performed quarterly for Group A pumps. The waterleg pumps are low-flow pumps that are required to operate whenever their respective ECCS trains are in the operable condition. As such, the pumps perform continuous duty on a recirculation line and provide makeup as needed. There is typically no flow instrumentation on the recirculation line, and the flow instrumentation on the main ECCS header is not sufficiently accurate to measure the low flow of the pumps. When requesting an alternative Group A test for a waterleg pump, a licensee should explain how the pump discharge pressure is monitored, how the main ECCS header is verified to be full of water, the pump vibration monitoring frequency, and any other maintenance or testing activity performed to ensure that the pump will continue to meet its intended function.

5.12 Smooth-Running Pumps

Pumps that have very low vibration reference values (less than or equal to 0.05 inch per second) are called smooth-running pumps. A small increase in smooth-running pump vibration during the OM Code-required IST causes the pump to exceed OM Code vibration acceptance criteria, which normally results in unnecessary corrective action. The NRC has authorized alternative vibration acceptance criteria for smooth-running pumps on a case-by-case basis in accordance with 10 CFR 50.55a(z).

Alternative requests for smooth-running pumps should specify a minimum vibration reference value (≤0.05 inch per second), and these smooth-running pumps must be included in a predictive maintenance (PdM) program. The importance of the PdM program for smooth-running pumps was demonstrated when a plant using NRC-authorized alternative vibration acceptance criteria noted a bearing failure that was not detected by the IST program but was detected through enhanced vibration monitoring as part of the plant's PdM program. During IST, corrective action was not required because the measured vibration was below the alert range specified by the OM Code. After the pump bearing failed, it became clear that a simple minimum vibration reference value alone is not sufficient to identify degradation of a smooth-running pump. PdM programs normally include bearing temperature trending, oil sampling and analysis, thermographic analysis, and enhanced vibration monitoring. The

objective of the PdM program should be to detect and correct problems involving the mechanical condition of the pump before the pump reaches its overall vibration alert limit.

ASME has issued Code Case OMN-22, “Smooth Running Pumps,” to eliminate the requirement for an alternative request. RG 1.192, Revision 5, endorses Code Case OMN-22 as acceptable for use without conditions up to the 2020 Edition. Code Case OMN-22 has been incorporated into the 2022 Edition. The OM Code 2022 Edition, subparagraph ISTB-3300(h), provides more details about reference values of vibration for smooth running pumps.

5.13 Vibration-Measuring Transducers

Subsection ISTB of the OM Code requires that the frequency response range of vibration -measuring transducers and their readout system be from one-third of the minimum pump shaft rotational speed to at least 1,000 hertz. Licensees have proposed alternatives to this OM Code requirement in accordance with 10 CFR 50.55a(z) for pumps with low shaft rotational speeds. Similar alternative requests submitted by licensees have been withdrawn following discussion with the NRC. The proposed alternatives state that the procurement and calibration of vibration-measuring transducers and their readout systems for the lower end of the OM Code-specified range were hardships because of the limited number of vendors supplying such equipment, the level of equipment sophistication, and the equipment cost. The NRC typically authorized these alternative requests in the past. However, vibration-measuring transducers and their readout system are now available from various suppliers at a reasonably low cost because of technology advancement and research in the field of instrumentation. Therefore, the NRC generally no longer authorizes licensee requests to use this alternative.

5.14 Motor Drivers for Pumps

Pump drivers are outside the scope of the OM Code, with the exception of vibration testing for vertical line shaft pumps where the driver is an integral part of the pump (see subparagraph ISTB-3540(b)). Most pumps are driven by electric motors, which are connected by coupled shafts. Motor vibration attributable to coupling misalignment may not be realized or measured at the pump, and small changes in the vibration of a motor can significantly affect pump operation and operational readiness.

Institute of Electrical and Electronics Engineers (IEEE) Standard 741-2022, “IEEE Standard for Criteria for the Protection of Class 1E Power Systems and Equipment in Nuclear Power Generating Stations,” briefly addresses the vibration issue and refers to IEEE C37.96-2012, “IEEE Guide for AC Motor Protection,” for motors. IEEE 741-2022 includes the testing and the surveillance requirements and lists several standards in the reference section for testing. IEEE C37.96-2012 provides additional information on the vibration of electric motors because of its significant impact on bearings, lubricants, protective devices, and other elements. DG-1354/RG-1.238, “Criteria for the Protection of Class-1E Power Systems and Equipment for Nuclear Power Plants,” endorses this standard.

5.15 Pumps in New Reactors

Subsection ISTF in the OM Code provides IST requirements for pumps in new reactors. The Subsection ISTF provisions for pumps in new reactors specify an inservice test on a quarterly frequency. The NRC has incorporated by reference Subsection ISTF in 10 CFR 50.55a; newer Code Editions include the PPVT requirements within the Subsection.

In Commission papers SECY-90-016 and 93-087, the NRC indicated that new nuclear power plants should be designed to accommodate full-flow testing of pumps within the scope of the IST program. The capability to perform full-flow testing should be reflected in the development of the IST activities for pumps in new reactors.

The NRC staff will inspect the development and implementation of the IST program (including full-flow testing of pumps) during the construction and operation of new nuclear power plants.

6 STANDARD TECHNICAL SPECIFICATIONS

NUREG-1482 does not include guidance for the implementation of STS. Nuclear power plant licensees should refer to separate guidance for compliance with their TS.

7 IDENTIFICATION OF CODE NONCOMPLIANCE

7.1 Nonconforming Conditions

Section 2.1.4 in this NUREG provides details on this topic.

7.2 Starting Point for Technical Specification Required Action Completion Times

The STS in NUREG-1430 through NUREG-1434 and NUREG-2194, “Standard Technical Specifications, Westinghouse Advanced Passive 1000 (AP1000) Plants,” provide details on this topic.

8 RISK-INFORMED INSERVICE TESTING

8.1 Introduction

The NRC regulations at 10 CFR 50.55a(f) require, in part, that certain pumps and valves meet the requirements of the OM Code.

RG 1.175 describes an acceptable alternative approach for applying risk insights from probabilistic risk assessment, in conjunction with established traditional engineering information, to make changes to a nuclear power plant's IST program. The approach described in RG 1.175 addresses the high-level safety principles specified in RG 1.174 and attempts to strike a balance between defining an acceptable process for developing risk-informed IST programs without being overly prescriptive. The resultant risk-informed IST programs will use plant resources more effectively while still maintaining acceptable levels of quality and safety. However, licensees may propose other approaches for consideration by the NRC staff. The approaches presented in RG 1.175 should be seen as examples of acceptable practices, and licensees should have some flexibility in satisfying regulatory requirements on the basis of their accumulated plant experience and knowledge. As discussed in RG 1.175, licensees proposing to implement a risk-informed IST program are required to submit a request to implement an alternative to the OM Code in accordance with 10 CFR 50.55a(z).

OM Code, Subsection ISTE, describes the development of an overall risk-informed IST program. As indicated in 10 CFR 50.55a(b)(3)(viii), licensees may not implement the risk-informed approach for IST of pumps and valves specified in Subsection ISTE in the 2009 Edition through the 2017 Edition of the OM Code, without first obtaining NRC authorization in accordance with 10 CFR 50.55a(z)(1). In 82 FR 32934 (July 18, 2017), the NRC discusses the aspects that need to be addressed when submitting a request to implement Subsection ISTE in the 2009 Edition through the 2017 Edition of the OM Code. The NRC staff has reviewed Subsection ISTE in the 2020 and 2022 Editions of the OM Code and found it acceptable to implement without conditions or an alternative request as part of the incorporation by reference of those editions of the OM Code in 10 CFR 50.55a.

A nuclear power plant licensee or applicant may propose implementation of 10 CFR 50.69 in a license amendment request submitted for NRC review. Implementation of 10 CFR 50.69 allows for risk-informed treatment of SSCs as an alternative to certain special treatment requirements in the NRC regulations. The IST provisions required by 10 CFR 50.55a are among the special treatment requirements removed for safety-related pumps, valves, and dynamic restraints that are categorized by a probabilistic risk assessment as having low safety significance (RISC-3), if the NRC approves a license amendment request for implementation of 10 CFR 50.69 for a specific nuclear power plant. Appendix B to this NUREG provides information on the treatment of pumps, valves, and dynamic restraints for the implementation of 10 CFR 50.69 at nuclear power plants.

8.2 Discussion

Unless a licensee chooses to implement Subsection ISTE of the 2020 or 2022 Editions of the OM Code, or a licensee is implementing 10 CFR 50.69 for RISC-3 SSCs, the alternative approach described in RG 1.175 must be authorized by the NRC pursuant to 10 CFR 50.55a(z)(1) on a plant-specific basis prior to implementation. Because 10 CFR 50.55a(z)(1) places no restrictions on the scope of alternatives that may be authorized,

licensees may propose risk-informed alternatives to their entire IST program, or they may propose alternatives that are more limited in scope (e.g., for a particular system or group of systems, or for a particular group of components). When proposing risk-informed alternatives under 10 CFR 50.55a(z)(1), the NRC staff expects the licensee's proposal to address the principles described in RG 1.175, including those related to implementation and monitoring.

If a licensee proposes a risk-informed alternative to the OM Code test requirements, the application should contain a summary description of the proposed alternative. The summary description should specify the key technical and administrative aspects necessary to describe and control the risk-informed alternative. The NRC staff will review and approve this summary description pursuant to 10 CFR 50.55a(z)(1) and, as such, the summary description will serve as the framework within which the licensee may make future changes to its risk-informed alternative without having to resubmit it for NRC approval.

8.3 Online Inservice Testing

In an effort to shorten RFOs, many licensees are trying to perform as much maintenance, testing, and surveillance as possible with the nuclear power plant online.

For example, several licensees have submitted requests to obtain NRC authorization for an alternative to conduct IST activities once per refueling cycle, rather than during the RFO as prescribed by the OM Code. In preparing (and evaluating) such alternative requests, licensees (and the NRC staff) should consider several factors to ensure that the proposed alternative provides an acceptable level of quality and safety.

If a licensee is testing a particular pump or valve during RFOs, the licensee may have determined that it is impractical to test the pump or valve quarterly during operation. The licensee's IST program document should, therefore, discuss the basis for deferring the testing from quarterly (and during cold shutdowns) to RFOs. Alternative requests to perform testing once each refueling cycle with the nuclear power plant online should be prepared in light of the RFO justification for each affected valve or group of valves. If necessary, the licensee should revise the RFO justification to be consistent with the alternative request.

Licensees (and the NRC staff) should also consider whether the testing can be accomplished within the allowed outage time permitted by any applicable TS. In general, the time necessary to complete the testing should be significantly less than the allowed outage time. This is to preclude TS violations or the need to issue exigent TS amendments or notices of enforcement discretion. In addition, licensees should not conduct noncorrective maintenance/testing activities at power if the associated postmaintenance testing cannot reasonably be accomplished until the next outage.

Sometimes, there is a tradeoff between testing these components at power (e.g., when they may be needed to mitigate the consequences of an accident) and testing them during outages (e.g., when there may be greater reliance on shutdown cooling or when other equipment is necessarily out of service). Licensees should quantitatively or qualitatively address the risks associated with testing components online, rather than testing during the RFO. If the proposed testing could have a significant risk impact, or if its justification includes risk-related arguments, the alternative request should be prepared and reviewed in accordance with RG 1.174, as applicable. Licensees should also identify any compensatory measures to be established as a means to reduce the impact (e.g., risk and operational worker safety) of testing with the nuclear power plant at power. Licensees should also provide information, if relevant, on how testing at

power (rather than testing during RFOs) will affect scheduled maintenance work windows for the applicable system (i.e., whether the testing can be completed within the work windows or whether it will extend either the shutdown or at-power work windows). In addition, licensees will need to develop a new estimate of the maintenance unavailabilities that reflects the increased maintenance activities at power and will need to document the basis for the new estimate (e.g., use plant logs or maintenance data to include, in the current estimate of the maintenance unavailabilities, those activities that were being performed during shutdown that will now be performed at power).

At times, testing (or the disassembly and inspection of components) during RFOs can be more advantageous than at-power operations from a worker safety perspective (for example, systems may be cold and depressurized). When requesting NRC authorization to perform testing with the nuclear power plant online, licensees should consider worker safety and should discuss whether the applicable components can be adequately isolated and restored.

In section 11.2.3 of NUMARC 93-01, NUMARC, now NEI, provided additional guidance for conducting online maintenance and testing. It states, in part, the following:

> On-line maintenance [and testing] should be carefully managed to achieve a balance between the benefits and potential impacts on safety, reliability or availability. For example, the margin of safety could be adversely impacted if maintenance is performed on multiple equipment or systems simultaneously without proper consideration of risk, or if operators are not fully cognizant of the limitations placed on the plant due to out of service equipment. On-line maintenance should be carefully evaluated, planned, and executed to avoid undesirable conditions or transients, and to thereby ensure a conservative margin of core safety.

8.4 ASME Risk-Informed Code Cases

Over the past several years, ASME has developed a series of risk-informed OM Code Cases related to testing pumps and valves that include risk-informed provisions, including the following examples:

- OMN-1, “Alternative Rules for Preservice and Inservice Testing of Active Electric Motor-Operated Valve Assemblies in Light-Water Reactor Power Plants”
- OMN-3, “Requirements for Safety Significance Categorization of Components Using Risk Insights for Inservice Testing of LWR Power Plants”
- OMN-4, “Requirements for Risk Insights for Inservice Testing of Check Valves at LWR Plants”
- OMN-7, “Alternative Requirements for Pump Testing”
- OMN-11, “Risk-Informed Testing for Motor-Operated Valves”
- OMN-12, “Alternative Requirements for Inservice Testing Using Risk Insights for Pneumatically and Hydraulically Operated Valve Assemblies in Light-Water Reactor Power Plants”

- OMN-26, “Alternate Risk-Informed and Margin Based Rules for Inservice Testing of Motor Operated Valves”

Certain OM Code Cases are listed as approved in tables 1 and 2 of the specific revision to RG 1.192 that has been incorporated by reference into 10 CFR 50.55a. Licensees may voluntarily use these Code Cases, without additional NRC staff approval, as an alternative to complying with the OM Code provisions that have been incorporated by reference into 10 CFR 50.55a, provided that the licensee uses the Code Cases with the conditions specified in RG 1.192 (i.e., the Code Case is generally acceptable, but the NRC staff has determined that the alternative requirements must be supplemented to provide an acceptable level of quality and safety).

When using ASME’s risk-informed OM Code Cases, licensees must perform the testing and performance monitoring of individual components as specified in the risk-informed component Code Cases (e.g., OMN-1, OMN-3, OMN-4, OMN-7, OMN-11, OMN-12, and OMN-26), as modified by any conditions specified in RG 1.192.

OM Code Case OMN-26 allows risk-informed alternatives to Mandatory Appendix III, paragraphs III-3310, III-3700, III-3721, and III-3722, to extend the maximum inservice test interval beyond 10 years. The maximum inservice test intervals allowed under Mandatory Appendix III (as well as Code Case OMN-1) are limited to 10 years regardless of the available MOV functional margin or MOV risk significance or both. This maximum 10-year test interval limit is based on the scope and results of the MOV testing under the JOG program established in response to GL 96-05. Based on the many years since the beginning of the GL 96-05 MOV programs, the Code Case suggests that many MOVs have a stable functional margin or have high margin where functional degradation is of minimal concern. The Code Case allows licensees to justify extended maximum inservice test intervals based on their high or low safety significance, and low, medium, high, or very high functional margin.

In addition, Code Case OMN-26 allows licensees to justify further extensions of the maximum inservice test interval if the MOV is routinely operated at design-basis pressure conditions. Consistent with Mandatory Appendix III and 10 CFR 50.55a(b)(3)(ii)(B), the Code Case continues to require that high safety-significant MOVs that can be operated during plant operation shall be exercised quarterly, unless the potential increase in core damage frequency and large early release frequency associated with a longer exercise interval is small. In Code Case OMN-26, table 1, for HSSC MOVs allows a maximum inservice test interval of up to 12 years and table 2 for LSSC MOVs allows a maximum inservice test interval of up to 16 years based on the functional margin if the MOV is routinely operated at design-basis pressure conditions. The Code Case includes several important requirements for implementing these maximum inservice test intervals, such as (1) the MOV operation at design-basis pressure conditions must occur no less frequently than once an RFO, (2) to utilize these intervals, test strokes at or exceeding design-basis system conditions must be in the applicable safety function direction(s) and have no applicable operating experience, degradation, or diagnostic test anomaly with the potential for adverse impact on MOV functional margin or the capability of the MOV to perform its design-basis function, and (3) operating plants that have acquired the requisite test data to satisfy Mandatory Appendix III, paragraph III-3310(b) or III-3722(c), must complete one cycle of collecting diagnostic test data at an extended test interval, minimum 9 years and maximum 12 years, before extending the test interval by engineering evaluation to the maximum 16-year test interval. Table 2 for LSSC MOVs allows a maximum inservice test interval of 12 years based on functional margin. Licensees should be aware that the JOG program evaluated only the potential increase in thrust and torque required to operate valves

over a 10-year period. Therefore, licensees are responsible for justifying the thrust and torque required to operate valves to perform their safety functions beyond the JOG program's 10-year period when implementing Code Case OMN-26.

9 SUPPLEMENTAL READING

American Society of Mechanical Engineers, NQA-1, “Quality Assurance Requirements for Nuclear Facility Applications.”

American Society of Mechanical Engineers, Boiler and Pressure Vessel Code, Section III, “Rules for Construction of Nuclear Facility Components—Division 1.”

American Society of Mechanical Engineers, Boiler and Pressure Vessel Code, Section XI, “Rules for Inservice Inspection of Nuclear Power Plant Components—Division 1.”

American Society of Mechanical Engineers/American National Standards Institute, Operation and Maintenance of Nuclear Power Plants, Division 1, OM Code: Section IST, 1995 Edition through 2022 Edition.

American Society of Mechanical Engineers, Standard QME-1, “Qualification of Active Mechanical Equipment Used in Nuclear Power Plants,” 2007 and 2017 Editions.

U.S. Code of Federal Regulations, Part 50, “Domestic Licensing of Production and Utilization Facilities,” Chapter 1, Title 10, “Energy.”

U.S. Code of Federal Regulations, Part 52, “Licenses, Certifications, and Approvals for Nuclear Power Plants,” Chapter 1, Title 10, “Energy.”

U.S. Code of Federal Regulations, Part 100, “Reactor Site Criteria,” Chapter 1, Title 10, “Energy.”

National Technology Transfer and Advancement Act of 1995, Pub. L. No. 104-113, 1995.

NRC Office Instruction LIC-102, “Review of Relief Requests, Proposed Alternatives, and Requests to Use Later Code Editions and Addenda,” Revision 3, April 6, 2020, ML18351A218.

Nuclear Management and Resources Council (NUMARC, now NEI), NUMARC 93-01, “Industry Guideline for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants,” Revision 2, April 1996, ML101020415.

Nuclear Energy Institute, NEI-96-07, “Guidelines for 10 CFR 50.59 Implementation,” Revision 1, November 2000, ML003771157.

Joint Owners’ Group AOV Committee, “Joint Owners Group Air-Operated Valve Program,” Revision 1, December 13, 2000, ML010950310; and NRC comment letter to Nuclear Energy Institute, October 8, 1999, ML020360077.

“Joint Owners’ Group (JOG) Motor Operated Valve Periodic Verification Program Summary,” Revision A, November 2006, ML063490194.

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APPENDIX A
GUIDELINES FOR INSERVICE EXAMINATION, TESTING, AND SERVICE LIFE MONITORING PROGRAM FOR DYNAMIC RESTRAINTS (SNUBBERS) IN WATER-COOLED REACTOR NUCLEAR POWER PLANTS

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ABBREVIATIONS

ASME	American Society of Mechanical Engineers
BPV Code	Boiler and Pressure Vessel Code
BWR	boiling-water reactor
CFR	*Code of Federal Regulations*
COL	combined license
COR	code of record
Cr	circular
DTPG	defined test plan group
FR	*Federal Register*
FSAR	final safety analysis report
GL	generic letter
IN	information notice
ISI	inservice inspection
IST	inservice testing
ITAAC	inspections, tests, analyses, and acceptance criteria
LBHS	large-bore hydraulic snubber
LCO	limiting condition for operation
LWR	light-water reactor
NRC	U.S. Nuclear Regulatory Commission
OM Code	ASME “Operation and Maintenance of Nuclear Power Plants,” Division 1, “OM Code: Section IST”
PWR	pressurized-water reactor
RCP	reactor coolant pump
RG	regulatory guide
RIS	regulatory issue summary
SLM	service-life monitoring
SRM	staff requirements memorandum(a)
TS	technical specification(s)

TRM	technical requirements manual

A.1 INTRODUCTION

A.1.1 Regulatory Basis

Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a, "Codes and standards," defines the requirements for applying industry codes and standards to boiling- or pressurized-water-cooled nuclear power facilities. Each of these facilities is subject to the conditions in paragraphs (a), (b), (f), and (g) of 10 CFR 50.55a, as they relate to inservice inspection (ISI) and inservice testing (IST). Originally, before September 8, 1992, all ISI and IST requirements were specified in paragraph (f) of 10 CFR 50.55a. By a rulemaking effective September 8, 1992 (see Volume 57 of the *Federal Register* (FR), page 34666 (57 FR 34666; August 6, 1992), the U.S. Nuclear Regulatory Commission (NRC) established paragraph (f) of 10 CFR 50.55a to separate the IST requirements from the ISI requirements in paragraph (g). The IST requirements for pumps and valves fall under paragraph (f), whereas ISI of components (including supports) falls under paragraph (g). Snubber inservice examination and testing requirements fall under paragraph (g) of 10 CFR 50.55a.

The NRC regulations in 10 CFR 50.55a list all the American Society of Mechanical Engineers (ASME) codes that have been incorporated by reference, including the ASME Code for Operation and Maintenance of Nuclear Power Plants (OM Code) and the ASME Boiler and Pressure Vessel (BPV) Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," which the NRC has approved for use, with conditions.

As of August 30, 2024, the NRC regulations in 10 CFR 50.55a(a)(i) incorporate by reference the 1974 Edition through the 2021 Edition of the ASME BPV Code, Section XI. Originally, the ASME BPV Code, Section XI, Article IWF-5000, "Inservice Inspection Requirements for Snubbers," specified the requirements for inservice examination and testing of snubbers, but in the 2006 Addenda of the ASME BPV Code, Section XI, this article has been deleted. Similarly, as of August 30, 2024, the NRC regulations in 10 CFR 50.55a(a)(iv) incorporate by reference the 1995 Edition through the 2022 Edition (except the 2011 and 2015 Editions) of the OM Code. Subsection ISTA of the OM Code provides general requirements for IST of pumps and valves and for inservice examination and testing of snubbers. Subsection ISTD, "Preservice and Inservice Examination and Testing of Dynamic Restraints (Snubbers) in Light-Water Reactor Power Plants," specifies the inservice requirements for dynamic restraints. Based on those requirements, each nuclear power plant licensee must establish a snubber program and specify the snubbers included in the program, as well as the examination and test plans, in accordance with the applicable provisions of the ASME BPV Code, Section XI, or the OM Code.

The NRC regulations in 10 CFR 50.55a(f)(4) state, in part, the following:

> When using the 2006 Addenda or later of the ASME BPV Code, Section XI, the inservice examination, testing, and service life monitoring requirements for dynamic restraints (snubbers) must meet the requirements set forth in the applicable ASME OM Code as specified in paragraph (b)(3)(v)(B) of this section. When using the 2005 Addenda or earlier edition or addenda of the ASME BPV Code, Section XI, the inservice examination, testing, and service life monitoring requirements for dynamic restraints (snubbers) must meet the requirements set forth in either the applicable ASME OM Code or ASME BPV Code, Section XI as specified in paragraph (b)(3)(v) of this section.

The NRC regulations in 10 CFR 50.55a(g)(4) state similar requirements.

ASME BPV Code, Section XI, provides the rules for the ISI of nuclear power plant components. The OM Code provides the rules for the IST of nuclear power plant pumps, valves, and snubbers.

The regulations in 10 CFR 50.55a(f)(4)(ii) and 10 CFR 50.55a(g)(4)(ii) require the use of the latest edition and addenda of the code that have been incorporated by reference no more than 18 months prior to the beginning of each inspection interval. This version of code is considered to be the "code of record" for the inspection interval. Appendix C to this document provides additional information on the code of record designation and its association with the IST interval.

The regulations in 10 CFR 50.55a(f)(4)(iv) specify that IST of pumps and valves and inservice examination, testing, and service-life monitoring (SLM) of dynamic restraints (snubbers) may meet the requirements set forth in subsequent editions and addenda of the OM Code that are incorporated by reference in 10 CFR 50.55a(a)(1)(iv), subject to the conditions listed in 10 CFR 50.55a(b), and subject to NRC approval. Similarly, the regulations in 10 CFR 50.55a(g)(4)(iv) specify that inservice examination of components (including supports and snubbers) and system testing of components may meet the requirements set forth in subsequent editions and addenda of the ASME BPV Code, Section XI (or the OM Code for snubber examination and testing), that are incorporated by reference in 10 CFR 50.55a(a), subject to the conditions listed in 10 CFR 50.55a(b), and subject to NRC approval. Portions of editions or addenda may be used, provided that all related requirements of those editions or addenda are met. NRC approval is not required when updating the IST code of record for snubbers before the start of a snubber IST interval in which the updated snubber IST code of record will be used and when using the latest edition incorporated by reference in 10 CFR 50.55a(a)(1)(iv) in its entirety, subject to the conditions listed in 10 CFR 50.55a(b) . When requesting to use editions and addenda of the Code that have not yet been incorporated by reference, licensees must request authorization to do so as an alternative to the regulations pursuant to 10 CFR 50.55a(z). Further information appears in NRC Regulatory Issue Summary (RIS) 2004-12, "Clarification on Use of Later Editions and Addenda to the ASME OM Code and Section XI," dated July 28, 2004.

Where a snubber examination and test requirement of the ASME BPV Code, Section XI, or OM Code is determined to be impractical for a facility, the NRC's regulations allow the licensee to submit an alternative request from the given requirement, along with information to support the determination. Alternative requests generally detail the reasons for deviating from the code requirements and propose alternative testing methods or frequencies. Pursuant to 10 CFR 50.55a(z)(1)–(2), the Commission may authorize the licensee to implement an alternative to the code requirements, provided that the alternative ensures an acceptable level of quality and safety or the code requirement presents a hardship without a compensating increase in the level of quality and safety.

The regulations in 10 CFR 50.55a(b)(3)(v) state, in part, that Article IWF-5000 of the ASME BPV Code, Section XI, must be used when performing ISI examinations and tests of snubbers at nuclear power plants, except as conditioned in 10 CFR 50.55a(b)(3)(v)(A)– (B) as follows:

(A) *Snubbers: First provision*. Licensee may use Subsection ISTD, "Preservice and Inservice Examination and Testing of Dynamic Restraints (Snubbers) in Light-Water Reactor Power Plants," ASME OM Code, 1995 Edition through the latest edition and addenda incorporated by

reference in paragraph (a)(1)(iv) of this section, in place of the requirements for snubbers in the editions and addenda up to the 2005 Addenda of the ASME BPV Code, Section XI, IWF-5200(a) and (b) and IWF-5300(a) and (b), by making appropriate changes to their technical specifications or licensee-controlled documents. Preservice and inservice examinations must be performed using the VT-3 visual examination method described in IWA-2213.

(B) *Snubbers: Second provision.* Licensees must comply with the provisions for examining and testing snubbers in Subsection ISTD of the ASME OM Code and make appropriate changes to their technical specifications or licensee-controlled documents when using the 2006 Addenda and later editions and addenda of Section XI of the ASME BPV Code.

Therefore, if a plant's code of record is the 2006 Addenda or later editions of the ASME BPV Code, Section XI, the licensee must use the OM Code requirements for snubber inservice examination and testing.

A.1.2 Regulatory History of NRC Staff Guidance on Examination, Testing, and Service-Life Monitoring of Snubbers

Since the start of commercial operation of nuclear power plants, inservice visual examination and functional testing of snubbers have been regulatory requirements. Originally, these requirements were imposed by the surveillance requirements in plants' technical specifications (TS). There are three surveillance requirements for snubbers: (1) visual inspection or examination, (2) functional or operational testing, and (3) snubber SLM. Visual inspection is the observation of the condition of installed snubbers to identify those that are damaged, degraded, or suspected to be inoperable because of physical means, leakage, corrosion, or environmental exposure. TS surveillance testing uses statistical sampling to validate the functionality of the tested population within an assumed quality confidence level. Only a sample of the installed snubbers is actually tested. Functional testing is performed to verify operational readiness by verifying that the tested snubber operates within the specified performance limits. The functional test typically involves removing the snubber from service and testing it on a specially designed test machine. The performance of visual examinations is a separate process that complements the functional testing program and provides additional confidence in snubber population reliability. The TS specifies a schedule for snubber visual examinations and functional testing, which is usually based on refueling outage intervals. The typical original TS-specified SLM is as follows:

> A record of the service life of each snubber: the date at which the designated service life commences and the installation and maintenance record on which the designated service life is based shall be maintained.
>
> Concurrent with the first inservice visual inspection and at least once per 18 months (which is now 24 months) thereafter, the installation and maintenance records for each snubber shall be reviewed to verify that the indicated service life has not been exceeded or will not be exceeded prior to the next scheduled snubber service life review. If the indicated service life will be exceeded prior to the next scheduled service life review, the snubber service life shall be reevaluated, or the snubber shall be replaced or reconditioned so as to extend its service life beyond the date of the next scheduled life

review (during the refueling outage). This reevaluation, replacement or reconditioning shall be indicated in the records.

Improved TS for various boiling- and pressurized-watercooled nuclear power plants (see NUREG-1430 through NUREG-1434, Revision 5, "Standard Technical Specifications," issued September 2021, and NUREG-2194, Revision 1, "Standard Technical Specifications, Westinghouse Advanced Passive 1000 (AP1000) Plants," issued January 2024) allow licensees to relocate inservice examination and testing requirements for snubbers from the TS to the plant's technical requirements manual (TRM). However, licensees that relocate their snubber ISI and testing requirements from the TS to the TRM must still comply with the requirements in 10 CFR 50.55a.

Until 1990, the ASME code requirements addressing inservice examination and testing of snubbers were contained in the ASME BPV Code, Section XI, Article IWF-5000. Article IWF-5000 referenced the ASME/American National Standards Institute (ANSI) Standard for Operation and Maintenance of Nuclear Power Plants, Part 4 (OM-4), 1987 Edition with 1988 Addenda, for preservice and inservice examinations and testing of snubber requirements. In 1990, ASME published the initial edition of the OM Code, which provided rules for inservice examination and testing of snubbers, incorporating most of the requirements of ASME OM-4 (1987/1988 Addenda).

The 1990 Edition of the OM Code consisted of one section, Section IST, "Rules for Inservice Testing of Light-Water Reactor Power Plants." This section was divided into four subsections: ISTA, "General Requirements"; ISTB, "Inservice Testing of Pumps in Light-Water Reactor Power Plants"; ISTC, "Inservice Testing of Valves in Light-Water Reactor Power Plants"; and ISTD, "Preservice and Inservice Examination and Testing of Nuclear Power Plant Dynamic Restraints (Snubbers)." At that time, the inservice examination and testing of snubbers was governed (under rulemaking) by the ISI requirements of Section XI of the ASME BPV Code, 1989 Edition, Article IWF-5000. Therefore, Subsection ISTD was not incorporated by reference in 10 CFR 50.55a at that time.

On December 11, 1990, the NRC issued Generic Letter (GL) 9009, "Alternative Requirements for Snubber Visual Inspection Intervals and Corrective Actions." The alternative visual inspection schedule specified in GL 90-09 was based on the number of unacceptable snubbers found during the previous inspection interval, relative to the sizes of the various snubber populations or categories. Such a schedule reduces future occupational radiation exposure and is highly cost effective. The alternative inspection interval was based on a fuel cycle of up to 24 months. GL 90-09 allowed licensees to extend snubber inservice visual examination intervals up to 48 months.

At that time, most licensees revised their snubber examination and testing documents (such as TS, TRMs, or licensee-controlled documents) based on GL 90-09. Similarly, in the 1995 Edition of the OM Code, Table ISTD 6.5.2-1 (now OM Code-2022, Table ISTD4252-1) incorporated all the visual examination requirements stated in GL 90-09. In addition, during the incorporation of Code Case OMN-13 into the 2022 Edition of the OM Code, the notes for Table ISTD-4252-1 were revised, with a note added referencing the new Paragraph ISTD-4253, "Additional Requirements for 10-Year Interval."

In 2000, for the first time, the NRC updated the regulations in 10 CFR 50.55a(b)(3)(v) to state that for the examination and testing of snubbers, licensees could use the guidance in Subsection ISTD of the OM Code, 1995 Edition, with the 1996 Addenda, in lieu of the ASME

BPV Code, Section XI. In 2012, the regulations in 10 CFR 50.55a(b)(3)(v) were updated to provide information about the use of ASME BPV Code, Section XI, and the OM Code for snubber examination and testing. The regulation at 10 CFR 50.55a(b)(3)(v)(A) states, in part, that licensees may use the requirements in Subsection ISTD of the OM Code, from the 1995 Edition through the latest edition and addenda of the OM Code incorporated by reference in 10 CFR 50.55a(a), in place of the snubber requirements in the editions and addenda up to the 2005 Addenda of ASME BPV Code, Section XI. The regulation at 10 CFR 50.55a(b)(3)(v)(B) states that licensees must comply with the provisions for examining and testing snubbers in Subsection ISTD of the OM Code when using the 2006 Addenda or later editions and addenda of Section XI of the ASME BPV Code.

Snubber inservice examination and testing provisions are specified in the editions and addenda of ASME BPV Code, Section XI, up through the 2005 Addenda. In the 2006 Addenda, these provisions were removed. Thus, licensees using the 2006 Addenda or later editions and addenda of the ASME BPV Code, Section XI, do not have the option of using the Section XI provisions for inservice examination and testing of snubbers. These licensees must perform snubber examination and testing in accordance with the OM Code, Subsections ISTA and ISTD, or obtain relief or an alternative from the NRC.

A.1.3 NRC Recommendations and Guidance

The recommendations in this NUREG supplement the guidance in the OM Code and the ASME BPV Code, Section XI, for inservice examination and testing of snubbers. This document has been written based on the requirements in the 2022 Edition of the OM Code and the 2019 Edition of the ASME BPV Code, Section XI, which are incorporated into 10 CFR 50.55a(a). To the extent practical, this document specifies the applicable section, subsection, or paragraph of the applicable document for each item of guidance (subsections of 10 CFR 50.55a; the OM Code; the ASME BPV Code, Section XI; regulatory guides (RGs); etc.).

The guidance presented here is voluntary and may be used for requesting relief under 10 CFR 50.55a(f) or 10 CFR 50.55a(g), or for authorization of an alternative under 10 CFR 50.55a(z). Licensees may also request relief or the use of an alternative that is not in conformance with this guidance. The NRC may grant relief or authorize the alternative if the licensee has addressed all aspects of the relief or alternative in an acceptable manner.

This document specifically discusses applicable portions of Articles IWA-1000, IWA-2000, IWA-4000, IWF-5000, and IWF-6000 of ASME BPV Code, Section XI, and Subsections ISTA and ISTD, Nonmandatory Appendices A (with Supplement) through H, to the OM Code, which licensees should implement pursuant to 10 CFR 50.55a(g)(4). It also provides guidance for licensees to use 10 CFR 50.55a(f)(4)(ii), 10 CFR 50.55a(f)(4)(iv), 10 CFR 50.55a(g)(4)(ii) and 10 CFR 50.55a(g)(4)(iv) in updating their snubber inservice examination and testing program to the requirements of the ASME BPV Code, Section XI, or the OM Code, as applicable.

A.1.4 Synopsis of Report

This appendix follows the format of a typical inservice examination and testing snubber program plan, including development and implementation, general guidance, and code noncompliance.

Section A.2 describes existing inservice examination and testing requirements, discusses the scope of the snubber program, and describes guidance for presenting information in snubber

programs. It also provides specific recommendations on snubber and large-bore (steam generator and reactor coolant pump (RCP)) snubber-related issues.

Sections A.5 lists references related to snubbers.

The discussion in this appendix is intended to clarify the existing requirements of the codes and regulations. As such, it may provide recommendations to ensure that licensees continue to meet the applicable codes and other regulatory requirements.

A.2 DEVELOPING AND IMPLEMENTING AN INSERVICE EXAMINATION AND TESTING PROGRAM FOR SNUBBERS

Licensees may use the following guidance for developing and implementing snubber inservice examination and testing programs. This guidance supplements existing requirements and previously approved guidance on inservice examination and testing.

A.2.1 Compliance Considerations

The regulations in 10 CFR 50.55a(f) state that IST of pumps, valves, and dynamic restraints (snubbers) that are classified as ASME Code Class 1, 2, or 3 must meet the requirements (except design and access provisions and preservice examination requirements) set forth in editions and addenda of the OM Code. This inservice examination, along with testing, is intended to assess the reliability and operational readiness of snubbers.

The regulations in 10 CFR 50.55a(g) state that ISI of components (including supports) that are classified as ASME Code Class 1, 2, or 3 must meet the requirements (except design and access provisions and preservice examination requirements) in Section XI of specified editions and addenda of the ASME BPV Code (or the OM Code, for snubbers). This ISI, along with testing, is intended to assess the reliability and operational readiness of snubbers.

The regulations in 10 CFR 50.55a(f)(4)(ii) and 10 CFR 50.55a(g)(4)(ii) state that inservice examination and testing of snubbers conducted during successive inspection intervals must be conducted in compliance with the requirements of the latest edition and addenda of the OM Code incorporated by reference in the version of 10 CFR 50.55a(a) that is in effect no more than 18 months before the start of the interval, subject to the conditions listed in 10 CFR 50.55a(b). This code edition is called the code of record.

Up to the 2017 Edition, the OM Code specifies in ISTA-3200, “Administrative Requirements,” that the user of the code must comply with the latest edition and addenda of the OM Code adopted by the regulatory authority 12 months before the issuance of an operating license or 12 months before initial fueling under a combined license (COL), and 12 months before the start of successive IST intervals. As this NUREG cannot authorize alternatives to the OM Code, until the OM Code is updated to reflect the 18-month provisions in 10 CFR 50.55a(f)(4)(ii) and 10 CFR 50.55a(g)(4)(ii), licensees will need to submit alternative requests to follow the latter provisions rather than the 12-month provisions in ISTA-3200. In 10 CFR 50.55a(f)(7), the NRC staff has added a regulatory requirement for submittal of IST plans by nuclear power plant licensees within 90 days of their implementation.

The regulations in 10 CFR 50.55a(f)(4)(iv) and 10 CFR 50.55a(g)(4)(iv), respectively, allow IST of components (valves, pumps, and snubbers) and ISI of components (including supports) to meet the requirements set forth in editions and addenda subsequent to the code of record that are incorporated by reference in 10 CFR 50.55a(a), subject to conditions listed in 10 CFR 50.55a(b) and subject to NRC approval. Requests for approval to use later editions or addenda previously incorporated by reference in 10 CFR 50.55a may be made through letters to the NRC (see RIS 2004-12 for further clarification).

Licensees wishing to use editions or addenda of the ASME code (or portions of the code) that have not been incorporated by reference must first request authorization to use these later editions or addenda as an alternative to the regulations, pursuant to 10 CFR 50.55a(z). When

licensees choose to use any or all portions of more recent editions or addenda, they must meet all related requirements of those editions or addenda, and such requests are subject to NRC approval in accordance with 10 CFR 50.55a(f)(4)(iv) or 10 CFR 50.55a(g)(4)(iv).

The NRC may authorize alternatives to code examination and testing requirements, provided that licensees have requested such authorization in the form of alternative requests, or in a similar format that includes a discussion of the requirements, a description of the proposed alternative, and the justification for authorization of the alternative. The regulations in 10 CFR 50.55a include the following provisions for authorizing alternatives or granting relief:

- The regulation at 10 CFR 50.55a(z)(1) allows the NRC to authorize alternatives if the proposed alternatives will provide an acceptable level of quality and safety. The NRC will normally authorize an alternative pursuant to this provision only if the licensee proposes a method of examination or testing that is equivalent to, or an improvement of, the method specified by the code, or if the examination or testing will comply or is consistent with later code editions approved by the NRC in 10 CFR 50.55a(a).

- The regulation at 10 CFR 50.55a(z)(2) allows the NRC to authorize an alternative if compliance with the code requirement would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. The NRC may authorize an alternative pursuant to this provision if, although the proposed alternative does not comply with the code, the increase in overall plant safety and quality attained by complying with the code requirement would not be justified in light of the difficulty associated with compliance.

    - The regulations at 10 CFR 50.55a(f)(6)(i) and 10 CFR 50.55a(g)(6)(i) state that the Commission will evaluate determinations that requirements of the code of record, pursuant to 10 CFR 50.55a(f) or 10 CFR 50.55a(g), are impractical. The Commission may grant relief and may impose such alternative requirements as it determines are authorized by law, giving due consideration to the burden upon the licensee that could result if the requirements were imposed on the facility.

The NRC may grant relief pursuant to this provision or may authorize alternatives if the licensee demonstrates that the design or access limitations make the code requirement impractical. Thus, the NRC staff's evaluation considers the burden created by imposing the code requirements on the licensee.

For licensees using their TS to govern inservice examination and testing of snubbers, 10 CFR 50.55a(f)(5)(ii) and 10 CFR 50.55a(g)(5)(ii) require that if a facility's revised IST or ISI program conflicts with the TS, the licensee shall apply to the NRC for amendment of the TS to conform the TS to the revised program. Therefore, when performing IST or ISI interval updates in accordance with 10 CFR 50.55a(f)(4) or 10 CFR 50.55a(g)(4), licensees must submit any required amendments to ensure that their TS remain consistent with the new code of record or NRC-authorized alternative used in lieu of the code requirements. The TS governing the snubber IST and ISI programs do not eliminate the 10 CFR 50.55a requirements to update the program at periodic intervals or to obtain NRC authorization for alternatives to the code requirements when appropriate.

The NRC expects licensees to ensure that their snubber examination and testing programs are in compliance with 10 CFR 50.55a(f) or 10 CFR 50.55a(g) (which point to the OM Code provisions for snubber inservice examination and testing, respectively) or with authorized

alternatives. If licensees discover that their programs are not meeting the requirements of 10 CFR 50.55a(f) or 10 CFR 50.55a(g) or authorized alternatives, they shall take appropriate actions to bring their programs back into compliance and ensure that noncompliant structures, systems, and components are operable. In certain circumstances involving snubber programs at nuclear power plants that are not in compliance with NRC requirements, enforcement discretion has been provided. The NRC expects licensees of nuclear power plants that do not meet the 10 CFR 50.55a requirements for snubber inservice examination and testing as described in RIS 2010-06, "Inservice Inspection and Testing Requirements of Dynamic Restraints (Snubbers)," dated June 1, 2010, to enter any noncompliance into their corrective action programs and to correct the noncompliance by meeting the applicable ASME code requirements or by submitting requests for relief to the NRC.

A.2.1.1 ASME Code Case Applicability

ASME Code Cases represent alternatives or additions to the ASME codes. Code Cases are ASME's official method of replying to inquiries to clarify the intent of existing code requirements, or of establishing alternatives to existing code requirements. ASME develops Code Cases through a consensus process. A Code Case may be issued to provide alternative rules when justified, to permit early implementation of an approved revision when the need is urgent, or to provide rules not covered by existing provisions of the ASME code.

The NRC reviews new or revised Code Cases to determine their acceptability for incorporation by reference in 10 CFR 50.55a through RGs. Accordingly, the NRC staff has developed RG 1.192, "Operation and Maintenance Code Case Acceptability: ASME OM Code," as well as RG 1.193, "ASME Code Cases Not Approved for Use."

The regulations at 10 CFR 50.55a(a)(3)(iii) incorporate by reference RG 1.192. Licensees may implement the Code Cases listed in RG 1.192 without obtaining further NRC review or approval, as long as they use each Code Case in its entirety along with any supplemental conditions specified in RG 1.192, and as long as the licensee's ISI or IST code of record is applicable to the Code Case. RG 1.193 lists Code Cases not approved for general use. Licensees requesting the NRC's approval to implement a Code Case listed in RG 1.193 must show, at minimum, that the use of the Code Case will provide adequate protection of public health and safety is provided if the Code Case is applied by the licensee or applicant.

A licensee wishing to use a Code Case with an edition or addendum of the code to which it is not applicable has two options:

(1) The licensee may request to use the Code Case as an alternative, beyond its stated applicability, and receive authorization by the NRC pursuant to 10 CFR 50.55a(z).

(2) If the Code Case is applicable to an edition or addendum of the code later than the version of the code being used by the licensee, the licensee may update its program for inservice examination and testing of snubbers to the later version of the code, pursuant to 10 CFR 50.55a(f)(4)(iv) or 10 CFR 50.55a(g)(4)(iv), and then use the Code Case, provided the Code Case has been approved for use in RG 1.192 and incorporated by reference into 10 CFR 50.55a. Note that the later version of the code must also have been incorporated by reference into 10 CFR 50.55a, the licensee must update the snubber program meet to all related requirements of the later code and the Commission must specifically approve the use of the later code.

The NRC may authorize the use of a Code Case that has not yet been approved for use in RG 1.192 if a licensee requests its use under 10 CFR 50.55a(z). The authorization of a specific licensee to use a Code Case that is not listed in RG 1.192 does not authorize any other licensee to use the Code Case. Broad, generic authorizations to use Code Cases that are in the process of being incorporated into RG 1.192 through the use of the 10 CFR 50.55a(z) alternative process may amount to de facto rulemaking and circumvent public involvement in the rulemaking process. Therefore, each authorization must be necessarily limited to the licensee requesting it.

If RG 1.193 identifies a Code Case as being unacceptable, the NRC is unlikely to approve a licensee request to use that Code Case (whether by exemption, authorization of alternatives, or granting of relief). Licensees requesting NRC approval to implement a Code Case listed in RG 1.193 must show, at minimum, that the use of the Code Case will provide adequate protection of public health and safety.

A.2.1.2 Conditions to the ASME OM Code

A.2.1.2.1 10 CFR 50.55a(b)(3)(v)—OM Condition: Snubbers ISTD

Article IWF-5000 of ASME BPV Code, Section XI, must be used when performing inservice examinations and tests of snubbers at nuclear power plants, except as conditioned in paragraphs 10 CFR 50.55a(b)(3)(v)(A)–(B) as follows:

(A) *Snubbers: First provision*. Licensees may use Subsection ISTD, "Preservice and Inservice Examination and Testing of Dynamic Restraints (Snubbers) in Light-Water Reactor Power Plants," ASME OM Code, 1995 Edition through the latest edition and addenda incorporated by reference in [10 CFR 50.55a(a)(1)(iv)], in place of the requirements for snubbers in the editions and addenda up to the 2005 Addenda of the ASME BPV Code, Section XI, [Articles] IWF-5200(a) and (b) and IWF-5300(a) and (b), by making appropriate changes to their technical specifications or licensee-controlled- documents. [When using Subsection ISTD as an alternative,] Preservice and inservice examinations must be performed using the VT–3 visual examination method described in IWA-2213.

(B) *Snubbers: Second provision.* Licensees must comply with the provisions for examining and testing snubbers in Subsection ISTD of the ASME OM Code and make appropriate changes to their technical specifications or licensee-controlled documents when using the 2006 Addenda and later editions and addenda of Section XI of the ASME BPV Code.

This condition in 10 CFR 50.55a(b)(3)(v) allows licensees using the 1995 Edition through the latest edition and addenda up to the 2005 Addendum of ASME BPV Code, Section XI, to optionally use Subsection ISTD of the OM Code in place of the requirements for snubbers in Section XI of the ASME BPV Code. The condition in 10 CFR 50.55a(b)(3)(v)(A) also states that snubber preservice and inservice examinations must be performed using the VT-3 visual examination method (as described in IWA-2213) when using Subsection ISTD of the OM Code. The NRC imposed the VT-3 visual examination requirement to ensure that licensees use an appropriate visual examination method or scope for the examination of integral and nonintegral snubber attachments, such as lugs, bolting, and clamps, when using Subsection ISTD as an alternative to the ASME BPV Code, Section XI.

Licensees that use the 2006 Addenda or later editions and addenda to Section XI of the ASME BPV Code must follow the requirements of Subsection ISTD of the OM Code for snubbers because in these editions and addenda of the ASME BPV Code, the scope of Section XI does not include snubber inservice examination and testing requirements. The condition in 10 CFR 50.55a(b)(3)(v) does not invoke the VT-3 visual examination requirement for licensees using the 2006 Addendum or later editions and addenda to ASME BPV Code, Section XI, because ASME revised Figure IWF-1300-1, "Illustrations of Typical Support Examination Boundaries," in the 2006 Addenda to Section XI to clarify that integral and nonintegral snubber attachments are within the scope of Section XI and not within the scope of the OM Code. Therefore, the visual examination method specified in the 2006 Addendum and in later editions and addenda to the ASME BPV Code, Section XI, applies to the examination of integral and nonintegral snubber attachments.

A.2.1.2.2 10 CFR 50.55a(b)(3)(vii)—Snubber Visual Examination Interval Extension

This condition prohibits the extension of operational readiness testing intervals for snubbers through the use of OM Code Case OMN-15, Revision 2, when implementing Subsection ISTD, paragraph ISTD-4253, and Note 7 of Table ISTD-4252-1, in the 2022 Edition of the ASME OM Code, incorporated by reference in paragraph (a)(1)(iv) of this section.

A.2.1.3 Snubber Program Controls

Various types of supports are used in nuclear power plants to support piping systems and equipment. A snubber is considered a type of component standard support. Some licensees have incorrectly inferred that 10 CFR 50.55a does not govern the inservice examination and testing of snubbers because (1) 10 CFR 50.55a(g) addresses components (including supports) without mentioning snubbers, (2) snubber examination and testing was historically covered by TS, and (3) improved TS allow snubber examination and testing requirements to be relocated from the TS to the TRM. To clarify this issue, in 2012, The NRC added mention of snubbers to 10 CFR 50.55(g). Licensees have the option to control the inservice examination and testing of snubbers through their TS or other licensee-controlled documents. For licensees using their TS to govern the inservice examination and testing of snubbers, 10 CFR 50.55a(g)(5)(ii) requires that if a revised ISI program for a facility conflicts with the TS, the licensee shall apply to the Commission to amend the TS to conform the TS to the revised program. When performing ISI program updates in accordance with 10 CFR 50.55a(g)(4), licensees must submit any required amendments or alternative requests for approval to ensure that their TS remain consistent with the new ISI program. The TS, TRM, or other licensee-controlled documents governing the snubber inservice examination and testing program do not eliminate the 10 CFR 50.55a requirements to update the program at periodic intervals in accordance with 10 CFR 50.55a(g)(4) or to request and receive NRC authorization for alternatives to the code requirements when appropriate. The NRC issued RIS 2010-06 to inform the licensees and clarify the NRC's rules and regulations regarding snubber inservice examination and testing, in accordance with 10 CFR 50.55a, at nuclear power facilities.

A.2.1.4 ASME/ANSI OM-4 and ASME OM Code

The 2005 Addenda and earlier editions of ASME BPV Code, Section XI, Article IWF-5000, provide ISI requirements for snubbers. Article IWF-5000 states that snubber examination and testing shall be performed in accordance with OM-4. In the 2006 Addenda of ASME BPV Code, Section XI, examination and testing requirements for snubbers were deleted. The current ASME

BPV Code, Section XI, IWF-1220, Endnote 39, states that snubber examination and test requirements can be found in the OM Code. OM-4 and the OM Code are two different ASME codes. OM-4 and the OM Code are not interchangeable. While using ASME BPV Code, Section XI, licensees must use OM-4, while OM Code licensees must use Subsection ISTD.

A.2.1.5 Voluntary Use of Later Editions and Addenda of the ASME Code

The regulations in 10 CFR 50.55a(f)(4) and 10 CFR 50.55a(g)(4) establish the effective edition and addenda of the OM Code or ASME BPV Code, as applicable, to be used by licensees in performing IST of pumps and valves and ISI of components (including supports). A snubber is a type of component standard support.

The regulations in 10 CFR 50.55a(f)(4)(ii) and 10 CFR 50.55a(g)(4)(ii) provide requirements for the use of the latest edition and addenda of the applicable ASME code that has been incorporated by reference into 10 CFR 50.55a. The ASME code edition or addenda identified as applicable to the IST and ISI interval is considered to be the code of record for the IST and ISI interval. Appendix C to this document provides additional information on the code of record designation and its association with the IST interval.

In a 10 CFR 50.55a rulemaking effective August 2024, the NRC modified 10 CFR 50.55a(f)(4)(iv) and 10 CFR 50.55a(g)(4)(iv) with respect to the voluntary use of later editions and addenda of the OM Code. For IST programs, 10 CFR 50.55a(f)(4) now states the following:

> Inservice tests of pumps and valves may meet the requirements set forth in subsequent editions and addenda that are incorporated by reference in paragraph (a)(1)(iv) of this section, subject to the conditions listed in paragraph (b) of this section, and subject to NRC approval. Portions of editions or addenda may be used, provided that all related requirements of the respective editions or addenda are met. NRC approval is not required when updating the IST code of record before the start of an IST interval in which the updated IST code of record will be used and when using the latest edition incorporated by reference in (a)(1)(iv) of this section in its entirety, subject to the conditions listed in paragraph (b) of this section (or the optional ASME Code Cases listed in NRC Regulatory Guide 1.147 or NRC Regulatory Guide 1.192 as incorporated by reference in paragraphs (a)(3)(ii) and (iii) of this section, respectively).

If planning to voluntarily update to more recent editions or addenda of the OM Code other than at the start of an IST or ISI interval, licensees should recognize that the incorporation by reference of these code editions and addenda does not imply that NRC approval has already been granted for their use in lieu of the code of record for a specific licensee. Licensees planning to apply later editions or addenda of the ASME code during an IST or ISI interval must request NRC approval to do so in a letter to the NRC. In such cases, licensees may not update their IST and ISI programs without NRC approval to use the later code editions or addenda. Licensees proposing to use later code editions or addenda in full or in part must meet all related requirements of those editions or addenda; any deviations are subject to NRC approval in accordance with 10 CFR 50.55a(f)(4)(iv) and 10 CFR 50.55a(g)(4)(iv). The regulations do not specify when a licensee should submit the request to apply a later edition or addendum of the ASME code. They specify only that the licensee must receive NRC approval before using a later

code edition or addendum if the IST or ISI program is not updated at the start of an IST or ISI interval.

For licensees planning to update their IST or ISI programs during an IST or ISI interval, significantly less written documentation is needed to support requests to use later code editions or addenda that 10 CFR 50.55a(a) incorporates by reference than would be needed for other types of requests for relief from or alternatives to the codes. For example, licensees are not required to provide specific justification for requests to use later code editions and addenda that 10 CFR 50.55a(a) incorporates by reference. This is because the NRC has reviewed and accepted the provisions of those code editions and addenda, with any appropriate conditions, as part of the process for incorporating them by reference in the regulations. The purpose of the NRC's review and approval of the use of later code editions and addenda is to ensure consistency in the use of the appropriate code editions and addenda in IST and ISI activities for nuclear plant components.

To use editions or addenda of the ASME code that have not been incorporated by reference into 10 CFR 50.55a, licensees must first request authorization to use these editions or addenda as an alternative to the regulations pursuant to 10 CFR 50.55a(z). The NRC staff issued RIS 2004-12 and RIS 2004-16, "Use of Later Editions and Addenda to the ASME Code Section XI for Repair/Replacement Activities," dated October 19, 2004, to clarify this matter.

A.2.2 Scope of Inservice Examination and Testing Programs

General Design Criterion 1, "Quality standards and records," of Appendix A, "General Design Criteria for Nuclear Power Plants," to 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities," requires, in part, that components important to safety be tested to quality standards commensurate with the importance of the safety functions to be performed. Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," to 10 CFR Part 50 describes the requisite quality assurance program, which includes testing for safety-related components. In addition, 10 CFR 50.55a(g) requires that licensees use ASME BPV Code, Section XI, or the OM Code for inservice examination and testing of components covered by the code. Each licensee has the responsibility to demonstrate the continued capability of all components within the scope of its snubber inservice examination and testing program. RGs provide additional NRC guidance on scope and classification. In short, the ASME code defines the scope, 10 CFR 50.55a incorporates by reference the code with conditions, and RGs provide additional guidance. For plants licensed before creation of the general design criteria, the licensee should verify that the scope of its ISI and IST programs is consistent with the applicable licensing requirements.

Each licensee has the responsibility to demonstrate the continued functionality of all snubbers within the scope of their snubber examination and testing program. The NRC staff considers the ASME code to apply to dynamic restraints (snubbers) installed in piping systems. The snubber program, including implementing procedures, is subject to the requirements of 10 CFR Part 50, Appendix B, as well as either the OM Code, Subsection ISTA, or the ASME BPV Code, Section XI, Article IWA. Changes to the scope, test methods, or acceptance criteria shall be reviewed under the requirements of 10 CFR 50.59, "Changes, tests and experiments"; 10 CFR 50.55a; and 10 CFR 50.65, "Requirements for monitoring the effectiveness of maintenance at nuclear power plants" (Maintenance Rule), as appropriate.

A.2.2.1 Basis for Scope Requirements

The requirements for the scope of components to be included in an inservice examination and testing of snubber program are addressed in 10 CFR 50.55a(f)(4) and 10 CFR 50.55a(g)(4), and the OM Code.

The NRC regulations in 10 CFR 50.55a(f)(4) state the following:

> Throughout the service life of a boiling or pressurized water-cooled nuclear power facility, pumps and valves that are within the scope of the ASME OM Code must meet the inservice test requirements (except design and access provisions) set forth in the ASME OM Code and addenda that become effective subsequent to editions and addenda specified in paragraphs (f)(2) and (3) of this section and that are incorporated by reference in paragraph (a)(1)(iv) of this section, to the extent practical within the limitations of design, geometry, and materials of construction of the components. The inservice test requirements for pumps and valves that are within the scope of the ASME OM Code but are not classified as ASME BPV Code Class 1, Class 2, or Class 3 may be satisfied as an augmented IST program. This use of an augmented IST program is acceptable without prior NRC approval provided the basis for deviations from the ASME OM Code, as incorporated by reference in this section, demonstrates an acceptable level of quality and safety, or that implementing the Code provisions would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety, where documented and available for NRC review. When using the 2006 Addenda or later of the ASME BPV Code, Section XI, the inservice examination, testing, and service life monitoring requirements for dynamic restraints (snubbers) must meet the requirements set forth in the applicable ASME OM Code as specified in paragraph (b)(3)(v)(B) of this section. When using the 2005 Addenda or earlier edition or addenda of the ASME BPV Code, Section XI, the inservice examination, testing, and service life monitoring requirements for dynamic restraints (snubbers) must meet the requirements set forth in either the applicable ASME OM Code or ASME BPV Code, Section XI as specified in paragraph (b)(3)(v) of this section.

The NRC regulations in 10 CFR 50.55a(g)(4) state the following:

> Throughout the service life of a boiling or pressurized water-cooled nuclear power facility, components (including supports) that are classified as ASME BPV Code Class 1, Class 2, and Class 3 must meet the requirements, except design and access provisions and preservice examination requirements, set forth in Section XI of editions and addenda of the ASME BPV Code that become effective subsequent to editions specified in paragraphs (g)(2) and (3) of this section and that are incorporated by reference in paragraph (a)(1)(ii) or (iv) of this section for snubber examination and testing of this section, to the extent practical within the limitations of design, geometry, and materials of construction of the components. Components that are classified as Class MC pressure retaining components and their integral attachments, and components that are classified as Class CC pressure retaining components and their integral attachments, must meet the requirements, except design and access provisions and preservice examination requirements, set forth in Section XI of the ASME BPV Code and addenda that are incorporated by reference in paragraph (a)(1)(ii) of this section

> subject to the condition listed in paragraph (b)(2)(vi) of this section and the conditions listed in paragraphs (b)(2)(viii) and (ix) of this section, to the extent practical within the limitation of design, geometry, and materials of construction of the components. When using the 2006 Addenda or later of the ASME BPV Code, Section XI, the inservice examination, testing, and service life monitoring requirements for dynamic restraints (snubbers) must meet the requirements set forth in the applicable ASME OM Code as specified in paragraph (b)(3)(v)(B) of this section. When using the 2005 Addenda or earlier edition or addenda of the ASME BPV Code, Section XI, the inservice examination, testing, and service life monitoring requirements for dynamic restraints (snubbers) must meet the requirements set forth in either the applicable ASME OM Code or ASME BPV Code, Section XI as specified in paragraph (b)(3)(v) of this section.

The OM Code defines the scope by stating that IST programs (snubber programs) shall include all snubbers that are required to perform a specific function in (1) shutting down the reactor to a safe shutdown condition, (2) maintaining the safe-shutdown condition, (3) mitigating the consequences of an accident, or (4) ensuring the integrity of the reactor coolant pressure boundary. Therefore, the scope of components to be included in a snubber inservice examination and testing program must encompass the components covered in Subsection ISTA of the OM Code.

Paragraph ISTA-1100 of the OM Code refers to components that are “credited to mitigate the consequences of an accident.” The NRC regulations in 10 CFR 50.2, “Definitions,” define safety-related- structures, systems, and components as follows:

> Safety-related structures, systems and components means those structures, systems and components that are relied upon to remain functional during and following design-basis events to assure:
>
> (1) The integrity of the reactor coolant pressure boundary
>
> (2) The capability to shut down the reactor and maintain it in a safe shutdown condition; or
>
> (3) The capability to prevent or mitigate the consequences of accidents which could result in potential offsite exposures comparable to the applicable guideline exposures set forth in § 50.34(a)(1) or § 100.11 of this chapter, as applicable.

The language of ISTA-1100 is consistent with that of 10 CFR 50.2, in that both refer to mitigating the consequences of accidents; the only difference is that ISTA-1100 does not cite specific exposure guidelines from the NRC regulations. Therefore, the NRC staff interprets the requirements specified in ISTA-1100 for the scope of snubber IST programs (which say that IST programs must include all snubbers that are required to perform a specific function in (1) shutting down the reactor to a safe-shutdown condition, (2) maintaining the safe-shutdown condition, (3) mitigating the consequences of an accident, or (4) ensuring the integrity of the reactor coolant pressure boundary) as being consistent with the definition of “safety-related” as specified in the NRC regulations. A licensee or applicant could use the identification of the safety-related snubbers with respect to design-basis events in its final safety analysis report (FSAR) to identify the snubbers covered by this paragraph in ISTA-1100. Furthermore, other NRC requirements might apply to safety-related components relied on to mitigate other events,

such as anticipated transients without scram, station blackouts, and low-temperature overpressure transients, which are outside the scope of the OM Code.

Snubbers within the scope of 10 CFR 50.55a are included in the scope of 10 CFR 50.65. Licensees may elect to consolidate testing for snubbers, designating any non-Code components as such in the snubber program.

Tables A1 and A2 (which appear at the end of section A.2) provide examples of systems with snubbers that licensees typically include in their IST programs. These tables may be used for developing a licensee's snubber examination and testing program. The tables are not intended to be all-inclusive, but they may form the basis for the initial review of the scope of a licensee's snubber program.

Figure A-1 (which appears at the end of section A.2) provides a quick reference for the regulatory requirements stated in ASME BPV Code, Section XI, and the OM Code for the inservice examination and testing program for snubbers. For complete details, see 10 CFR 50.55a.

A.2.2.2 Snubbers Attached to Steam Generators and Reactor Coolant Pumps

Pressurized-water reactor (PWR) plants are subject to special requirements with regard to the testing of snubbers attached to the steam generators and RCPs. These are generally large-bore hydraulic snubbers (LBHSs). LBHSs are defined as units with rated capacities of 50 kips or greater. Unlike smaller hydraulic snubbers, LBHSs were exempt from inservice functional testing prior to 1980, primarily because test equipment of sufficient size was unavailable. In 1980 and 1984, the NRC issued GLs to all licensees requesting modification of plant TS to include LBHS testing provisions. Initial tests revealed many cases in which LBHSs were either out of specified tolerance or completely inoperable. Subsequently, the NRC developed Generic Issue 113, "Dynamic Qualification and Testing of Large Bore Hydraulic Snubbers," with the objective of evaluating the reliability of LBHSs in operating commercial nuclear power plants.

NUREG/CR-5416, "Technical Evaluation of Generic Issue 113: Dynamic Qualification and Testing of Large Bore Hydraulic Snubbers," issued August 1992, provided major recommendations for LBHSs. This effort was in coordination with the industry, vendors, and snubber manufacturers. As a result, the NRC established specific IST recommendations for LBHSs installed on PWR steam generators or RCPs. The NRC recommended that these snubbers be tested as a separate test population, and a requirement to ensure this was eventually incorporated into the OM Code. Although Generic Issue 113 focused on hydraulic snubbers, the resulting requirement does not specify a snubber size or type to which it applies.

Therefore, all licensees are reminded that their snubber inservice examination and testing programs shall include their steam generator snubbers and RCP snubbers, regardless of size or type. The code requirement is that snubbers attached to steam generators and those attached to RCPs be designated as at least one separate defined test plan group (DTPG) for testing purposes, as specified in ISTD-5253. -Large-bore snubbers (greater than 50 kips) located on piping or other components may be included in the general snubber population for testing and examination purposes.

A.2.2.3 Testing of NonCode Snubbers

The regulations in 10 CFR Part 50, Appendices A and B, require licensees to test all safety-related components to demonstrate that they will perform satisfactorily in service. The regulations in 10 CFR 50.55a address the ISI and IST programs for components within the scope of the ASME code; however, they do not address components that are not covered by the ASME code but that are within the scope of 10 CFR Part 50, Appendices A and B.

It is reasonable for licensees to include noncode snubbers in their snubber inservice examination and testing programs (or in other licensee-developed examination and testing programs), rather than implementing separate programs for code and noncode snubbers, to periodically demonstrate the operational readiness of noncode snubbers. However, the program should handle these voluntarily included noncode components appropriately, following all the provisions of the program and any applicable regulatory requirements unless otherwise stated in the implementing procedures for the program. Licensees are expected to follow all provisions of their self-imposed programs.

If a licensee is unable to meet certain code provisions for the noncode components covered by the program, the regulations (i.e., those of 10 CFR 50.55a) do not require the licensee to submit a relief request to the NRC. Nonetheless, the licensee should maintain documentation that ensures the continued functionality of the non-safety-related components through the tests performed, and such documentation should be available for NRC staff inspection at the plant site.

A.2.2.4 Use of ASME BPV Code, Section XI, IWF-1230, to Exempt Snubbers from Inservice Examination and Testing in the Snubber Program

ASME BPV Code, Section XI, IWF-1230, “Supports Exempt from Examination,” states that the supports exempt from the examination requirements of Article IWF-2000, “Examination and Inspection,” include those connected to piping and other items exempt from volumetric, surface, or VT-1 or VT-3 or general visual examination under IWB-1220(a)–(c); IWC-1221 and IWC-1222; IWD-1220(a)–(d); and IWE-1220(a), IWE1220(c), and IW-E-1220(d). In addition, the portions of supports that are inaccessible by being encased in concrete, buried underground, or encapsulated by guard pipe are also exempt from the examination requirements of Article IWF-2000. The 2005 Addenda and earlier editions of ASME BPV Code, Section XI, IWF-2100, state that “the requirements of this Article IWF-2000 apply to the examination and inspection of component supports, but not to the inservice test requirements of IWF-5000 (snubbers).”

Therefore, if other regulatory requirements are not considered, IWF-1230 alone might be interpreted as exempting certain snubbers that are intended to be within the scope of Article IWF-5000 for licensees using the 2005 Addenda or earlier editions of ASME BPV Code, Section XI (i.e., IWF-1230 might exempt some safety-related snubbers or non-safety-related snubbers that are important to safety). The NRC staff concludes that such licensees cannot use IWF-1230 to exempt snubbers. Similarly, licensees using the OM Code for inservice examination and testing cannot use IWF-1230 to exempt snubbers. Any deviations from the scope of the snubber program as described in ISTA-1100 of the OM Code and in other regulatory requirements must be approved as an alternative request by the NRC.

A.2.2.5 Reserved

A.2.3 Code-Class Systems Containing Safety-Related Snubbers

The plant safety analysis report, TS, and other documents list the systems and components (i.e., snubbers) that must function to support the safe operation and shutdown of the plant. Tables A-1 and A-2 (which appear at the end of section A.2) provide examples of systems with snubbers that licensees typically include in their IST programs for PWRs and boiling water- reactors (BWRs). The tables may be used for developing a licensee's snubber examination and testing program. These tables are not intended to apply to all plants. The systems and components listed are not considered safety-related at every plant, and they are not necessarily classified as Code Class 1, 2, or 3. (The NRC provides information on quality group and code classifications in RG 1.26, "Quality Group Classifications and Standards for Water-, Steam-, and Radioactive-Waste-Containing Components of Nuclear Power Plants," and Section 3.2.2, "System Quality Group Classification," of NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition.") The licensee's safety analysis report generally contains a section describing the code classification of components. The scope of the snubber inservice examination and testing program must be consistent with the safety analysis report.

A.2.4 Snubber Inservice Examination and Testing Programs and Their Documentation

The regulations in 10 CFR 50.55a(g)(4) state, in part, that throughout the service life of a boiling- or pressurized-water-cooled nuclear power facility, ASME Code Class 1, 2, and 3 components (including supports) must meet the ISI and testing requirements of ASME BPV Code, Section XI (or the OM Code for snubber inservice examination and testing), as incorporated by reference in 10 CFR 50.55a(a). To meet the requirements of the OM Code, licensees shall establish a snubber inservice examination, testing, and SLM program to verify the operational readiness of snubbers. The snubber program shall include (1) visual examination, (2) operational readiness functional testing, and (3) SLM requirements as specified in the OM Code.

A.2.4.1 Snubber Programs for Licensees Using the 2005 Addenda and Earlier Editions of ASME BPV Code, Section XI

Licensees using ASME BPV Code, Section XI, for their snubber inservice examination and testing program need to consider the following information:

- Subsection IWA addresses the general requirements for inservice examination and testing of snubbers.
- Article IWF-5000 addresses inservice examination and testing requirements for snubbers.
- Subarticle IWA-1400(c) requires that the Owner shall submit certain plans and reports to the enforcement and regulatory authorities.
- Article IWA-4000 provides the requirements for repair and replacement activities, including for snubbers.

- Article IWA-6000 addresses the records and reports that are required for the snubber examination and testing programs.

- Paragraph IWA-6210 states that the Owner shall prepare plans for preservice and inservice examinations and tests to meet the requirements of ASME BPV Code, Section XI. Article IWF-1000 addresses the scope and responsibility for inservice inspection of snubbers as a subset of components support examination.

- Subsections ISTA and ISTD of the OM Code may be used in lieu of ASME BPV Code, Section XI, Article IWF-5000, as allowed by 10 CFR 50.55a(b)(v)(A).

A.2.4.2 Snubber Programs for Licensees Using the OM Code

Licensees using the OM Code for the snubber inservice examination and testing program need to consider the following:

- Subsection ISTD addresses the preservice and inservice examination and testing of dynamic restraints (snubbers) in water-cooled reactor nuclear power plants.

- Subsection ISTA includes general requirements (including scope) for the inservice examination and testing of snubbers.

- Paragraph ISTA-3200 states that IST plans shall be filed with the regulatory authorities. This includes snubber examination and testing plans. (The 2020 and 2022 Editions of the OM Code have removed this requirement and the NRC has added a corresponding requirement in 10 CFR 50.55a(f)(7).)

- Section ISTA-9000addresses the records and reports that are required for these examination and testing programs.

- Paragraph ISTA-9210 states that the Owner shall prepare plans for preservice and inservice examinations and tests to meet the requirements of the OM Code.

- Paragraph ISTA-9220 states that the Owner shall prepare examination and test records in accordance with the requirements of this article, in conjunction with the applicable subsection of the OM Code (i.e., ISTD).

- Nonmandatory Appendix A, and the supplements to it, describe voluntary guidance for licensees to use in preparing their examination and test plans.

A.2.4.3 Snubber Programs for Licensees Using NRC-Authorized Alternative or Relief

Licensees not using the requirements of either ASME BPV Code, Section XI, or the OM Code for their snubber programs must submit a request for relief from or an alternative to the Code requirements. NRC-authorized alternatives allowing licensees to use TRMs or other licensee-controlled documents in lieu of the ASME BPV Code, Section XI, or the OM Code to govern their snubber programs do not preclude the need for licensees to submit snubber examination and test plans to the regulatory authorities as defined in subarticle IWA-1400(c) and paragraph ISTA-3200 (now supplemented by 10 CFR 50.55a(f)(7)). An NRC-authorized

alternative is applicable only for the duration for which it is authorized and only to the requested sections or paragraphs of the ASME code, not the entire ASME code.

A.2.4.4 Snubber Programs and Their Bases

Some licensees use TRMs or other licensee-controlled documents for their snubber inservice examination and testing programs, in lieu of the ASME BPV Code, Section XI, or OM Code requirements. TRMs or other licensee-controlled documents serve as the bases for most snubber programs, and most snubber programs across the industry are similar. Many licensees have already updated their snubber programs to comply with and incorporate the OM Code; others are in the process of updating them. For such licensees, as a minimum, the updated snubber program documentation shall contain sufficient information to verify alignment with the OM Code. Bases documents typically include a description of the methodology used in preparing the snubber program plans. They must also clearly state where and how the licensee maintains a list of program snubbers.

Although the regulations do not require bases documents, they help licensees ensure the consistent implementation of their snubber programs throughout the course of typical organizational (including personnel) changes. A good bases document also enables the plant staff to understand the snubber categorization process, as well as the basis for examination and testing requirements. The bases document can also serve as a useful reference for reviews performed under 10 CFR 50.59 when changes are made to a facility.

As a minimum, the typical snubber program bases document should address following three elements, as described in the OM Code:

(1) visual examination requirements
(2) functional testing requirements
(3) SLM requirements

The document should detail the individual aspects of each element, providing clear definitions and descriptions, as outlined in the following sections. It should also clarify the basis for inclusion in the program, providing references to applicable code sections or licensing commitments where appropriate.

To help ensure consistency throughout the industry, licensees are encouraged to use these guidelines when developing snubber programs and their bases.

A.2.4.4.1 Inservice Visual Examination (Description, Definitions, and Basis of Each Item)

At a minimum, licensees should address the following aspects of the items related to inservice visual examination of snubbers:

- integral and nonintegral attachments to snubbers (see section A.2.8)
- snubber categorization
- subsequent examination intervals
- inservice examination sample size

- method of visual examination (Owner's procedure when using the 2006 Addenda or later editions of the OM Code; VT-3 method when using the 2005 Addenda or earlier editions of the OM Code)

- inservice examination failure evaluation

- inservice examination corrective action

- NRC-authorized alternatives (or relief requests), if applicable

- Code Cases used for visual examination, if applicable

A.2.4.4.2 Inservice Operational Readiness or Functional Testing (Description, Definitions, and Basis of Each Item)

At a minimum, licensees should address the following aspects of the items related to inservice operational readiness or functional testing of snubbers items:

- functional test frequency

- DTPGs

- testing sample plan (10 percent testing sample plan or 37 testing sample plan) used and initial sample size(s) anticipated for each DTPG (recognizing that 10 percent plan samples may vary slightly over the course of an interval because of ongoing station modifications or replacement; the bases document may be periodically updated to reflect significant changes but is not expected to be a day-to-day "living" document)

- additional sample size for each plan (based on selected sample plan of 10 percent testing sample plan or 37 testing sample plan)

- failure evaluation requirements and methods (referencing applicable documents)

- test failure mode grouping methodology (referencing applicable documents)

- corrective actions for each sample plan and failure mode grouping identified (referencing applicable documents)

- NRC-authorized alternatives (or relief requests), if applicable

- Code Cases used for functional testing of snubbers, if applicable

A.2.4.4.3 Service-Life Monitoring Program

Licensees are responsible for establishing, maintaining, and implementing an SLM program for all the snubbers in the scope of 10 CFR 50.55a(g). The purpose of the SLM program is to optimize and supplement (1) the inservice examinations under ISTD-4200, "Inservice Examination," which are performed only once every 24 months, 48 months, or 10 years based upon plant performance, and (2) the inservice operational readiness testing under ISTD-5200, "Inservice Operational Readiness Testing," which is performed on only 10 percent of selected

snubbers or 37 snubbers. The SLM program shall be based on the snubber manufacturers' recommendations, operating environment, snubber design limits, snubber types (mechanical or hydraulic), modification and maintenance history, and test records of snubbers. The SLM program is strengthened by the use of requirements in ISTD-6100 through ISTD-6500, additional visual examination and operational readiness testing of snubbers beyond the requirements of ISTD-4200 and ISTD-5200, and optional condition monitoring activities (such as stroking and greasing of mechanical snubbers).

Licensees must develop the SLM program as defined in OM Code, Section ISTD-6000, or in accordance with an approved alternative or relief request. SLM must consider all the maintenance record data available for snubbers while evaluating or reevaluating the service life. Nonmandatory Appendix F to Subsection ISTD provides additional guidance on developing an SLM program. The SLM program is the primary instrument for assuring the continued reliability of the snubber population at a plant. The statistical method of sample testing provides point-in-time assessment of population functionality, but in general it is not an effective tool for either maintaining or improving reliability. This is because such functional testing is conducted only periodically for small samples (10 percent or 37 snubbers) and it is not predictive in nature. Based on studies of snubber aging, discussed in NUREG/CR-5870, "Results of LWR Snubber Aging Research," issued May 1992, the NRC recommended that licensees perform SLM of snubbers in addition to statistical testing. Most licensees have included some reference to SLM in their existing programs. Subsection ISTD of the OM Code also includes SLM alongside its snubber examination and IST requirements. Although many licensees have updated their snubber programs to incorporate OM Code requirements, the updated programs often simply reference plant procedures for snubber examinations and testing, without citing the applicable sections of the OM Code. The NRC expects program documentation to describe how specific SLM requirements are satisfied.

Records of all snubber-related activities (e.g., repairs, replacements, maintenance, corrective actions, failures) must be documented and considered for the SLM program.

A.2.4.5 Snubber Lista and Controlled Databases

In preparing and maintaining a snubber list or database, licensees are expected to consider the ability to produce reports providing adequate information for both implementation and assessment of the snubber program. The following are suggested headings that might be used for reports that list snubbers, together with descriptions of the information that licensees might give under each heading:

- Title: Give the report name, including the applicable plant and unit.
- Reference information: Include references to maintenance and location of controlled snubber data. This may be a controlled station database from which reports and lists are generated as needed.
- Program/report revision and revision date: Give the revision number and date (on each page).
- System, code class, and group: List applicable information such as plant system, ASME code class, and type of snubber (hydraulic or mechanical).

- Snubber identification: List a unique identifier for each snubber. This identifier should be used consistently in all documentation for the snubber inservice examination and testing program and all related design information, such as system piping and instrumentation diagrams, isometrics, test procedures, and relief requests or proposed alternatives.

- Drawings: List the applicable isometrics, support drawings, or figures that depict the snubber.

The following items might not normally be included in lists of individual snubbers, as they typically apply to entire populations. These items should be included as annotations for any individual snubbers for which a specific frequency or relief request/proposed alternative applies on a unique basis.

- Test frequency: List the actual frequency for each examination and test to be performed.

- Relief request(s)/proposed alternative(s): Identify any applicable relief requests or proposed alternatives in the snubber list.

A.2.4.6 Snubber Program Plan Documentation and Submittal to the NRC

The regulations in 10 CFR 50.55a(g)(4) require that, throughout the service life of a boiling- or pressurized-water-cooled nuclear power facility, ASME Code Class 1, 2, and 3 components (including supports) meet the requirements of ASME BPV Code, Section XI (or the OM Code for snubbers examination and testing), as incorporated by reference in 10 CFR 50.55a(a). The applicable OM Code, Subsection ISTA, as supplemented by 10 CFR 50.55a(f)(7), provides the documentation and submittal requirements for IST and inservice examination of certain components in light-water nuclear power plants. Licensees must submit their snubber examination and testing plans and their updates at the intervals specified in these requirements.

The following are the documentation requirements for snubber program plans and reports in various cases:

(1) For licensees using the 2005 Addenda and earlier editions of ASME BPV Code, Section XI to govern their snubber programs:

Subarticle IWA-1400(c) notes that Owners have the responsibility to prepare plans, schedules, and ISI summary reports and to submit these plans and reports to the enforcement and regulatory authorities having jurisdiction at the plant site.

Article IWA6000 provides the requirements for preparation, submittal, and retention of records and reports.

(2) For licensees using the OM Code to govern their snubber programs:

Subarticle ISTA-3200(a) requires that plans for inservice examination and testing of snubbers be filed with the regulatory authorities having jurisdiction at the plant site. This requirement is contained in the 2017 Edition of the OM Code, but ASME is removing this requirement beginning with the 2020 Edition of the OM Code. The NRC has added a corresponding requirement in 10 CFR 50.55a(f)(7) addressing submittal of the IST program plan by nuclear power plant licensees.

Section ISTA-9000 provides the requirements for preparation, submittal, and retention of records and reports.

Nonmandatory Appendix A and its supplement describe voluntary guidance for licensees to use when developing snubber inservice examination and testing plans.

(3) For licensees that have obtained an NRC-authorized alternative permitting them to use TRMs or other licensee-controlled documents in lieu of ASME BPV Code, Section XI, or the OM Code to govern their snubber programs:

NRC-authorized alternatives permitting the use of TRMs or other licensee-controlled documents to govern snubber programs do not provide relief from the requirement to submit snubber examination and test plans and reports to the regulatory authorities. As noted in the first two items above, submittal is required by either the ASME BPV Code, Section XI; the OM Code; or 10 CFR 50.55a, as applicable.

A.2.5 Relief Requests and Proposed Alternatives

Relief Requests

Licensees can request that the NRC grant relief from a requirement of the ASME BPV Code, Section XI, or the OM Code in accordance with 10 CFR 50.55a(g)(5)(iii), 10 CFR 50.55a(g)(5)(iv), 10 CFR 50.55a(f)(5)(iii), and 10 CFR 50.55a(f)(5)(iv). Such requests are made under what is called “relief.”

The regulations at 10 CFR 50.55a(g)(4) require licensees to examine and test snubbers in the snubber program to the “extent practical” within the limitations of the design, geometry, and materials of construction. The regulations at 10 CFR 50.55a(f)(5)(iii)–(iv) and 10 CFR 50.55a(f)(6)(i) use the term “impractical” instead of “extent practical.” The terms “extent practical” and “impractical” apply to inservice examination and test requirements in ASME BPV Code, Section XI, or the OM Code that licensees cannot perform because of the design, geometry, or materials of construction.

In accordance with the regulations, when updating a program to a later edition of the ASME BPV Code, Section XI, or the OM Code, licensees must implement the updated program at the beginning of an interval. The regulations state that in cases in which a licensee has determined that a snubber examination or test specified in the ASME BPV Code, Section XI, or the OM Code is impractical and will not be included in the revised snubber program, it must submit a relief request demonstrating the basis for its determination to the NRC no later than 12 months after the end of the previous interval, or 12 months after the start of the current interval. However, experience has shown that licensees also identify impractical test provisions during intervals. In such cases, licensees may request relief as soon as they identify the condition. In place of the code requirements deemed impractical, the licensee would examine or test the snubbers involved using the method proposed in the relief request in the period of time from the beginning of the new interval or time of discovery (or from the time of identification) using the method granted by the NRC for the applicable snubber program interval.

Alternative Requests

Licensees can request that the NRC authorize an alternative to a requirement of the ASME BPV Code, Section XI, or the OM Code in accordance with 10 CFR 50.55a(z). Requests made under 10 CFR 50.55a(z) are called “alternatives.”

ASME BPV Code, Section XI, and the OM Code establish the requirements for inservice examination and testing of snubbers to assess their operational readiness in light-water reactor nuclear power plants. The requirements are constantly being reviewed and improved to maintain the safe and reliable operation and maintenance of nuclear power plants.

It is understood that not all plants are designed in the same way, and that at some plants the general requirements of the ASME BPV Code, Section XI, or the OM Code may not be applicable or compliance may be difficult. Licensees may propose alternatives to ASME code requirements provided that (1) the alternative would provide an acceptable level of quality and safety under 10 CFR 50.55a(z)(1), or (2) compliance with the specified requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety under 10 CFR 50.55a(z)(2). Hardships generally involve the need to reduce radiation exposure to as low as is reasonably achievable, challenges to operators, or plant equipment components that are unique in design.

A licensee must not implement proposed alternatives to the requirements of the ASME BPV Code, Section XI, or the OM Code under 10 CFR 50.55a(z) until the NRC staff has completed its evaluation and authorized the alternative.

Rarely, the NRC may grant verbal authorizations for an alternative under 10 CFR 50.55a(z). This may happen when, because of unforeseen circumstances, licensees need NRC authorization before the agency is able to issue its written safety evaluation as described in NRC Office Instruction LIC-102, Revision 3, “Review of Relief Requests, Proposed Alternatives, and Requests to Use Later Code Editions and Addenda,” dated April 6, 2020 (Agencywide Documents Access and Management System Accession No. ML18351A218). Section 2.5.5 of the main body of NUREG-1482, Revision 4, provides more details.

Currently, most licensees are using the OM Code to meet the requirements of 10 CFR 50.55a for snubber inservice examination and testing. A few licensees are using licensee-controlled documents or procedures, such as the following, in lieu of ASME code requirements:

- TS
- TRMs
- final safety analysis report
- updated final analysis report
- selected licensee commitments
- licensee-controlled specifications
- equipment control guidelines
- other licensee-controlled procedures

In 2008, the NRC staff identified several instances in which licensees had used TRMs or other licensee-controlled documents and procedures that did not meet the requirements of their code of record for the ISI and IST of snubbers, without requesting NRC approval to use these

alternatives. The NRC issued RIS 2010-06 to inform licensees of its rules and regulations on snubber inservice examination and testing, as established in 10 CFR 50.55a(g).

Licensees should also be aware that it may be inappropriate to make substantive changes to licensing documents under the 10 CFR 50.59 process. Any changes to TRMs or other licensing documents must be evaluated in view of the original relief request and assessed to determine the appropriate change process.

Approved alternative and relief requests are applicable only for the interval for which the request was submitted and approved. If a licensee wishes to continue using the alternative or relief request beyond that interval, it must submit a new request for the next interval.

A.2.6 Snubber Program Plan and its Update Documents

As described in section A.2.4.6, licensees must submit their snubber inservice examination and testing program plans to the NRC. The agency uses these plans in preparing for NRC inspections and addressing other licensing actions that may arise. To facilitate these regulatory activities, the NRC requests that licensees submit updated program plan documents whenever they make significant changes to their snubber programs during the 10-year interval between required plan submittals. These interim informational submittals are generally considered "good faith" and not a regulatory requirement. Interim updates to the snubber plan do not require alternative or relief requests as long as the plan remains consistent with the regulations. That is, deletions from or additions to the snubber program do not necessarily require NRC approval, unless commitments to obtain such approval exist as a result of prior approved requests or similar commitments.
The burden is on each licensee to verify that its snubber program is complete and includes all snubbers that require inservice examination and testing. The NRC staff expects each licensee to maintain an updated snubber examination and testing program plan that is consistent with changes in plant configuration. If a licensee deletes a particular snubber from its snubber program plan, the NRC staff recommends that the licensee document the basis for the deletion in an appropriate manner. Such changes do not require approval, unless cumulative changes will have a significant effect on the examination or testing plans.

Conversely, if a system modification results in the addition of a snubber to the snubber program plan, the licensee needs to ensure that the new snubber is incorporated into the program in a way that satisfies the code and licensing requirements or to submit a relief or alternative request for NRC review and approval, as appropriate.

Originally, 10 CFR 50.55a(g) required that the snubber program plan and its updates be developed and aligned with the plant's ISI interval. Currently, however, most licensees have transitioned their snubber programs from ASME BPV Code, Section XI, to the OM Code. Therefore, their snubber program plans may be aligned with their IST intervals. Licensees should provide details about this alignment, including the start and end dates of the relevant intervals, in the snubber program plan and the applicable IST interval or ISI interval document. Appendix C to this document gives more information on the code of record designation.

A.2.7 Repair and Replacement of Snubbers

Paragraphs ISTD-1500 and ISTD-1600 of the OM Code state that snubber repair and replacement activities shall be performed in accordance with the applicable requirements in ASME BPV Code, Section XI. In particular, repair and replacement of snubbers should be

performed using Article IWA-4000 of the applicable version of ASME BPV Code, Section XI. Licensees may use the NRC-approved ISI Code Cases listed in RG 1.147, "Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1," such as Code Case N-508-4, "Rotation of Serviced Snubbers and Pressure Retaining Items for the Purpose of Testing, Section XI, Division 1."

A.2.8 Inservice Inspection of the Integral and Nonintegral Attachments of Supports Containing Snubbers

ISI of integral and nonintegral attachments, such as lugs, bolts, pins, and clamps, must be performed in accordance with ASME BPV Code, Section XI, Subsection IWF, or other applicable subsections. Subsection ISTD of the OM Code covers inservice examination and testing of snubbers (pin-to-pin) inclusive and does not address the inspection of integral and nonintegral attachments, such as lugs, bolting, pins, and clamps.

A.2.9 Developing Snubber Program for New Nuclear Power Plants

Under 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants," a combined license (COL) applicant is responsible for developing a plant-specific IST program (or snubber examination and testing program). The Commission's staff requirements memorandum (SRM), dated September 11, 2002, for SECY-02-0067, "Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC) for Operational Programs (Programmatic ITAAC)," dated April 15, 2002, states that ITAAC for an operational program are unnecessary if the program and its implementation are fully described in the COL application and found to be acceptable by the NRC. SRM-SECY-02-0067 also states that the burden is on the COL applicant to provide the necessary and sufficient programmatic information for approval of the COL without ITAAC. In SRM-SECY-04-0032, "Staff Requirements—SECY-04-0032—Programmatic Information Needed for Approval of a Combined License Without Inspections, Tests, Analyses and Acceptance Criteria," dated May 14, 2004, the Commission defined "fully described" as meaning that the program is clearly and sufficiently described in terms of the scope and level of detail to allow a reasonable assurance finding of acceptability. The Commission also noted that required programs should always be described at a functional level and at an increasing level of detail where implementation choices could materially and negatively affect the program's effectiveness and acceptability. SECY-05-0197, "Review of Operational Programs in a Combined License Application and Generic Emergency Planning Inspections, Tests, Analyses, and Acceptance Criteria," dated October 28, 2005, summarizes the NRC's position on the full description of operational programs to be provided by COL applicants.

COL applicants provide descriptions of the snubber examination and testing program for NRC review as part of their COL applications. In some cases, the COL applicant incorporates by reference in its final safety analysis report the description of the snubber examination and testing program provided in the design certification documentation, such as the design control document or design certification final safety analysis report. To date, COL applicants have described their snubber examination and testing programs based on the requirements in OM Code, Subsection ISTD. The guidance in this NUREG may be used in developing and implementing the IST program, including the snubber inservice examination and testing program for new nuclear power plants.

The NRC staff reviews the description of the IST program (including the snubber examination and testing program) in the COL application, with its incorporation by reference of IST provisions in the applicable design certification documentation, as part of its safety evaluation

for the COL application. The staff inspects the development and implementation of the IST program after COL issuance.

A.2.10 Technical Specification Improvement to Modify Requirements Regarding the Addition of Limiting Condition for Operation 3.0.8 on the Inoperability of Snubbers

Limiting Condition for Operation (LCO) 3.0.8 provides a delay time for entering a supported system TS when the inoperability is due solely to an inoperable snubber. On November 24, 2004, the NRC staff issued a *Federal Register* notice (69 FR 68412) giving a model safety evaluation and model application addressing the addition of LCO 3.0.8 for inoperable snubbers on supported systems in TS. The purpose of this model is to permit the NRC to efficiently process amendments that propose to modify requirements by adding LCO 3.0.8 to TS to provide a delay time for entering a supported system TS when the inoperability is due solely to an inoperable snubber, provided the risk is assessed and managed, as generically approved by the *Federal Register* notice. Licensees of nuclear power reactors to which the model applies may request amendments using the model application.

Table A-1 Typical Systems or Portions of Systems in the Scope of 10 CFR 50.55a Whose Snubbers are Included in the Snubber Inservice Examination and Testing Program for a PWR (Nonexhaustive)

Typical Safety-Related, Code-Class System in PWRs
Reactor coolant system and flow paths for establishing natural circulation
Main steam system
High-pressure safety injection system
Chemical and volume control or makeup system
Low-pressure safety injection system
Shutdown cooling, residual heat removal, or decay heat removal systems
Containment spray system
Main feedwater system
Auxiliary feedwater system
Primary containment system
Component cooling water system
Spent fuel pool/pit cooling system
Service water system
Emergency diesel generator systems (if within the scope of 10 CFR 50.55a)
Ventilation systems
Instrument air system (if within the scope of 10 CFR 50.55a)

Table A-2 Typical Systems or Portions of Systems in the Scope of 10 CFR 50.55a Whose Snubbers are Included in the Snubber Inservice Examination and Testing Program for a BWR (Nonexhaustive)

Typical Safety-Related, Code-Class System in BWRs
Nuclear boiler and reactor recirculation system
Main steam system
High-pressure core coolant injection system
High-pressure core spray system
Reactor core isolation cooling system (if safety related)
Reactor water cleanup system
Residual heat removal system
Spent fuel pool cooling system
Feedwater coolant injection and isolation condenser system (if applicable)
Standby liquid control system
Main feedwater system
Primary containment system
Closed cooling or component cooling water system
Service water system
Control rod drive system (portions within the scope of 10 CFR 50.55a)
Emergency diesel generator systems (if within the scope of 10 CFR 50.55a)
Ventilation systems
Instrument air system (if within the scope of 10 CFR 50.55a)
Traversing incore probe system (if within the scope of 10 CFR 50.55a)

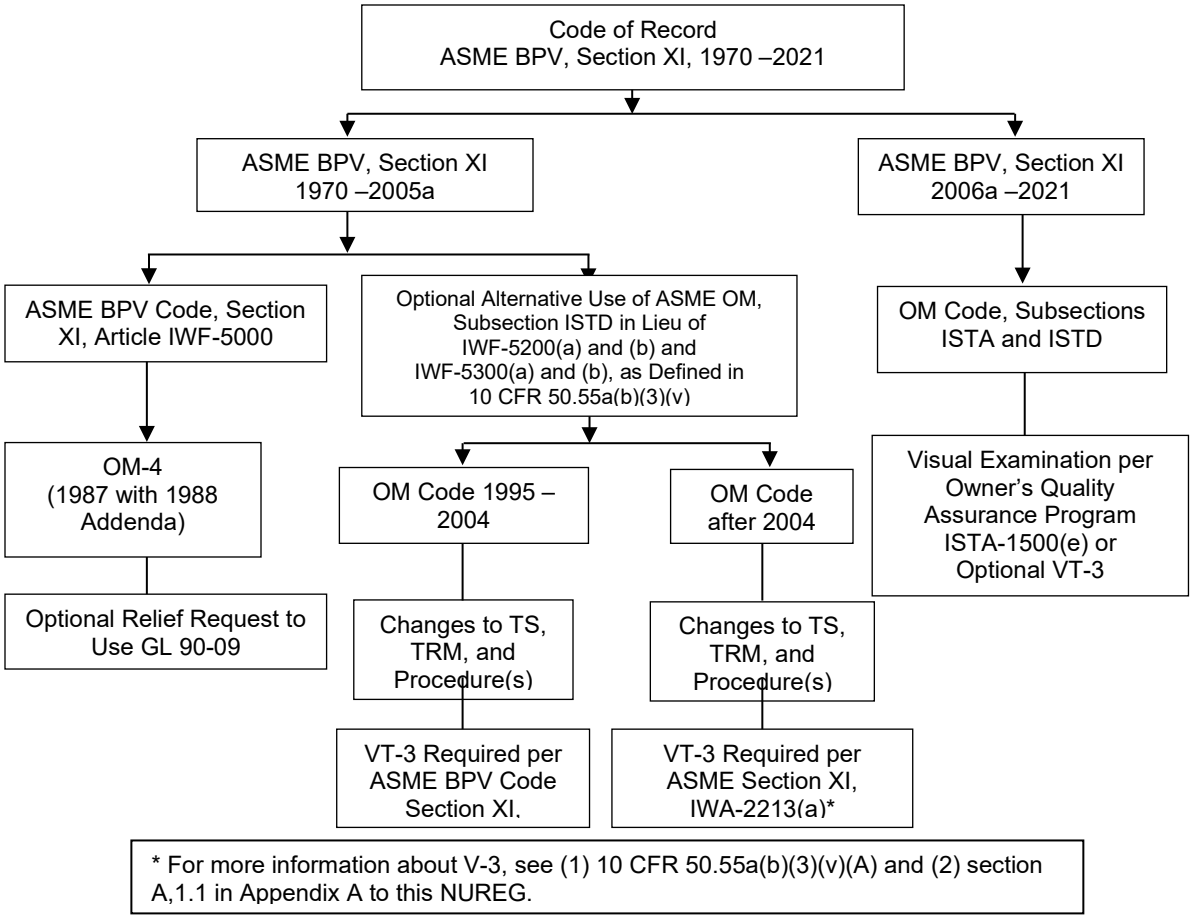

Figure A-1 Use of the ASME OM Code for Snubber Programs When Using Different Versions ofASME BPV Code, Section XI

A.3 SUPPLEMENTAL GUIDANCE ON PROGRAMS FOR INSERVICE EXAMINATION AND TESTING OF SNUBBERS

A.3.1 Use of Code Case OMN-13, Revision 4

- Code Case OMN-13, Revision 4, "Performance Based Requirements for Extending Snubber Inservice Visual Examination Interval at LWR Power Plants," may be used to extend the visual examination interval beyond 48 months, if the applicable conditions specified in Code Case OMN-13 are met.

- Code Case OMN-13, Revision 4, section 3.7(b), requires that if the cumulative number of unacceptable snubbers exceeds the applicable values in Table ISTD-4252-1, the use of Code Case OMN-13 ends.

- Code Case OMN-13, Revision 4, is endorsed in RG 1.192, Revision 5, issued March 2024, with no conditions.

A.3.1.1 Applicability

- Code Case OMN-13, Revision 4, establishes specific requirements that must be met to allow extension of the visual examination interval beyond the maximum interval allowed by Table ISTD-4252-1.

A.3.1.2 General Requirements

- Code Case OMN-13, Revision 4, can be implemented only after the requirements of paragraph ISTD-4251 and subparagraphs ISTD-4252(a)–(c) have been satisfied, and previous examinations in accordance with Table ISTD-4252-1 have been performed at a maximum interval of two fuel cycles (48 months).

- While a licensee is using Code Case OMN-13, Revision 4, all general requirements must remain implemented during any extension of the visual examination interval of 10 years.

- While a licensee is using Code Case OMN-13, Revision 4, if the total number of failures exceeds the requirement of column B of Table-4252-1, the use of Code Case OMN-13 for the current examination interval will end. Details are given in section 3.7(b) of Code Case OMN-13, Revision 4.

- To use Code Case OMN-13 again, the general requirements must be reestablished and implemented as specified in Section 2.0, "General Requirements," of Code Case OMN-13.

A.3.1.3 Limitations

- OM Code, Subsection ISTD shall be implemented prior to the use of Code Case OMN-13.

A.3.2 Use of Code Case OMN-15, Revision 4

- Code Case OMN-15, Revision 4, "Performance Based Requirements for Extending the Snubber Operational Readiness Testing Interval at LWR Power Plants," may be used to extend the snubber functional testing interval up to 10 years.

- During any test campaign using Code Case OMN-15, if the entire DTPG population requires testing, use of Code Case OMN-15 must be discontinued. The testing requirements of Subsection ISTD shall apply for that DTPG.

- Code Case OMN-15, Revision 4, is endorsed in RG 1.192, Revision 5, with no conditions.

A.3.2.1 Applicability

- Code Case OMN-15, Revision 4, establishes specific conditions and requirements that must be met for extending the test requirements specified in paragraphs ISTD-5200 and ISTD-5240 and replacing the test plan specified in paragraphs ISTD-5260, ISTD-5300, and ISTD-5400.

A.3.2.2 Limitations

- OM Code, Subsection ISTD shall be implemented before the use of Code Case OMN-15. Section 3.0, "Limitations," of Code Case OMN-15, Revision 4, gives additional limitations.

- Code Case OMN-15, Revision 4 shall not be used in conjunction with Code Case OMN-13.

A.3.3 Compensating Strut

The term "compensating strut" is a proprietary trade name that is often used generically to refer to a type of snubber that locks completely and does not allow displacement under load. Compensating struts are used to restrain piping systems and equipment during seismic events or other abnormal dynamic or transient loads at some nuclear power plants. Subsection ISTD of the OM Code does not address compensating struts as separate devices since they are considered a type of mechanical snubber. All the regulatory requirements of 10 CFR 50.55a and the OM Code, Subsections ISTD and ISTA, apply to compensating struts that are used to restrain piping and equipment in plants. Therefore, licensees shall include compensating struts in their snubber inservice examination and testing programs.

For clarification, commonly understood definitions of mechanical snubbers and compensating struts are as follows:

- Mechanical Snubber—An acceleration- or velocity-limiting device that provides restraint to a component or system during a sudden application of abnormal forces but allows free motion during normal thermal movement. Acceleration or velocity is maintained at the design threshold without locking; hence, the mechanical snubber will not become locked in a fixed position by a sustained, uninterrupted force.

- Compensating Strut—An acceleration-sensitive device that provides restraint to a component or system during a sudden application of abnormal forces but allows free motion during normal thermal movement. When the predetermined threshold acceleration is exceeded, the compensating strut locks up, becoming a rigid restraint, and allows no further free motion until the applied force drops to or near zero.

A.3.4 Development of a Combined Snubber Program for a Fleet with Multiple Power Plants

In developing a combined snubber program for a fleet comprising multiple power plants, the licensee should use the guidelines in section A.2 and the following:

- Applicable ISI or IST intervals, including start and end dates, should be included and identified for each plant and unit.

- The editions and addenda of ASME BPV Code, Section XI, and the OM Code that are used to develop a common document should be specified for each plant and unit.

- The test plan to be used (10 percent sample or 37 snubbers sample) for each plant and unit should be specified.

- A separate DTPG for large-bore snubbers attached to steam generators and RCPs shall be specified, as required by OM Code, paragraph ISTD-5253.

- Licensees using the 1995 through 2020 Edition of the OM Code should specify for each applicable plant and unit whether that are using Code Case OMN-13. For plants at which the Code Case may be implemented at a later date, the licensee must submit a revised plan at the time of implementation (use of language such as “Code Case OMN-13 may be used” is inappropriate).

- While using Code Case OMN-13, licensees must document the cumulative number of unacceptable snubbers. If the number of unacceptable snubbers exceeds the applicable values in Table ISTD-4252-1, the current examination interval and use of Code Case OMN-13 will end.

- If using the 2022 Edition of the OM Code, the licensee should specify, for each applicable plant and unit, whether it is implementing the requirements of paragraph ISTD-4253 and Note 7 of the Table ISTD-4252-1 to extend the visual examination beyond 48 months When extending the visual examination beyond 48 months, the licensee is prohibited from applying Code Case OMN-15, Revision 2, to extend the operational readiness testing interval for snubbers. (10 CFR 50.55a(b)(3)(vii))

- The licensee should specify the use of Code Case OMN-15 for each applicable plant and unit. For plants at which the code case may be implemented at a later date, the licensee must submit a revised plan at the time of implementation (use of language such as “Code Case OMN-15 may be used” is inappropriate).

A.3.5 Importance of Lubricant (Grease) in Mechanical Snubbers for Service-Life Monitoring

Industry operating experience has shown that the failure modes of mechanical snubbers may not always be identifiable by visual examination. Functional testing is more effective than visual examination in confirming snubber operational readiness. However, under the requirements of the OM Code or ASME BPV Code, Section XI, only a small sample of the snubber population (10 percent sample testing plan or 37 snubber sample testing plan) is selected for functional testing at each refueling outage. This means that it may be decades before all of a nuclear power plant's snubbers are tested. Furthermore, some snubbers may never be tested during their service life.

Certain common failure modes therefore need to be addressed as part of SLM. One of these is the potential degradation of lubricant (grease) in a snubber. The design of a mechanical snubber allows free thermal movement of a component during normal operating conditions but restrains the component during abnormal dynamic conditions. Adequate lubrication plays an essential role in this function.

Based on operating experience, most snubber failures are caused by some type of grease degradation, such as (1) oil separation from grease, (2) dried or "caked" grease, (3) excessive grease, (4) sticky or tacky grease, and (5) hardened or missing grease. A well-planned SLM program for snubbers can minimize the occurrence of snubber failures due to grease degradation. An effective SLM program should include provisions for preventive maintenance of mechanical snubbers (such as regreasing, manual exercising, partial disassembly for internal inspection, or additional functional testing), based on the results of performance monitoring and the evaluation of the service conditions for snubbers.

NRC Information Notice IN 94-48, "Snubber Lubricant Degradation in High-Temperature Environments," dated June 30, 1994, summarizes the degradation of lubricants used in mechanical snubbers placed in a high-temperature environment. In addition to high temperatures, the NRC staff has observed that other factors may contribute to snubber grease degradation, including the following:

- piping or equipment vibration
- extended exposure to elevated temperatures (e.g., high room temperatures, high fluid temperatures, or the installation of snubbers in close proximity to high-temperature components)
- a hazardous environment at the snubber location
- aging of the snubber and grease
- the installation of a snubber from spare inventory, without a recent preservice test
- use of grease beyond the shelf life recommended by the manufacturer

A key factor in the determination of the effective service life of mechanical snubbers during SLM is the condition of the grease and the shelf life of any replacement grease. IN 2015-09,

"Mechanical Dynamic Restraint (Snubber) Lubricant Degradation Not Identified Due to Insufficient Service Life Monitoring," dated September 24, 2015, provides more details.

A.4 GUIDANCE FOR CATEGORIZATION OF SNUBBERS DURING IMPLEMENTATION OF 10 CFR 50.69

The NRC staff has found considerable uncertainty among licensees regarding how to categorize snubbers when preparing to implement 10 CFR 50.69 at nuclear power plants. Revision 3 to NUREG-1482 contains a section providing guidance for licensees on categorizing snubbers as part of 10 CFR 50.69 programs. Based on a public comment, the NRC staff has omitted this section from Revision 4 to NUREG-1482 and will use other means to provide guidance on categorizing snubbers in 10 CFR 50.69 programs. Licensees may review the background on snubber categorization for 10 CFR 50.69 programs in the associated FRN (69 FR 68008).

A.5 SNUBBER-SPECIFIC SUPPLEMENTAL READING

U.S. Nuclear Regulatory Commission, Regulatory Issue Summary 2010-06, “Inservice Inspection and Testing Requirements of Dynamic Restraints (Snubbers),” June 1, 2010, Agencywide Documents Access and Management System Accession No. ML101310338

U.S. Nuclear Regulatory Commission, Enforcement Guidance Memorandum 10-001, “Dispositioning Violations of Inservice Examination and Testing Requirements for Dynamic Restraints (Snubbers),” June 1, 2010, ML101390020.

U.S. Nuclear Regulatory Commission, Generic Issue 113, “Dynamic Qualification Testing of Large Bore Hydraulic Snubbers,” NUREG-0933, “Resolution of Generic Safety Issues,” Main Report with Supplements 1–35.

Pacific Northwest Laboratory, PNL-SA-20219, “ASME Subsection ISTD Recommendations Based upon NPAR Snubber Aging Research Results,” December 1991, ML040290285.

NRC Generic Letters

Generic Letter (GL) 80-99, “Technical Specification Revisions for Snubber Surveillance,” November 20, 1980, ML093430363.

GL 84-13, “Technical Specification for Snubbers,” May 3, 1984.

GL 89-09, “ASME Section III Component Replacements,” May 8, 1989.

GL 90-09, “Alternative Requirements for Snubber Visual Inspection Intervals and Corrective Actions,” December 11, 1990.

NRC Inspection Enforcement Bulletins

Bulletin (BL) 73-03, “Defective Hydraulic Shock Suppressors and Restraints,” July 27, 1973.

BL 73-04, “Defective Bergen-Patterson Hydraulic Shock Absorbers,” August 17, 1973.

BL 75-05, “Operability of Category I Hydraulic Shock and Sway Suppressors,” April 14, 1975.

BL 78-10, “Bergen-Paterson Hydraulic Shock Suppressor Accumulator Spring Coils,” June 27, 1978.

BL 79-02, “Pipe Support Base Plate Designs Using Concrete Expansion Anchor Bolts,”

BL 79-14, Revision 1, Supplement 2, “Seismic Analysis for As-Built Safety-Related Piping Systems,” September 7, 1979.

BL 81-01, Revision 1, “Surveillance of Mechanical Snubbers,” January 27, 1981.

NRC Information Notices

Information Notice (IN) 79-01, “Bergen-Paterson Hydraulic Shock and Sway Arrestors (HSSA),” February 2, 1979.

IN 79-05, “Use of Improper Materials in Safety-Related Components,” March 16, 1979.

IN 83-13, “Design Misapplication of Bergen-Paterson Standard Strut Restraint Clamp,” March 21, 1983.

IN 83-20, “ITT Grinnell Figure 306/307 Mechanical Snubber Attachment Interference,” April 13, 1983.

IN 83-47, “Failure of Hydraulic Snubbers as a Result of Contaminated Hydraulic Fluid,” July 12, 1983.

IN 84-67, “Recent Snubber Inservice Testing with High Failure Rates,” August 17, 1984.

IN 84-73, “Downrating of Self-Aligning Ball Bushings Used in Snubbers,” September 14, 1984.

IN 86-102, “Repeated Multiple Failures of Steam Generator Hydraulic Snubbers Due to Control Valve Sensitivity,” December 15, 1986.

IN 89-30, “High Temperature Environments at Nuclear Power Plants,” March 15, 1989.

IN 94-48, “Snubber Lubricant Degradation in High-Temperature Environments,” June 30, 1994.

IN 95-09, “Use of Inappropriate Guidelines and Criteria for Nuclear Piping and Pipe Support Evaluation and Design,” January 31, 1995.

IN 97-16, “Preconditioning of Plant Structures, Systems, and Components before ASME Code Inservice Testing or Technical Specification Surveillance Testing,” April 4, 1997.

IN 2015-09, “Mechanical Dynamic Restraint (Snubber) Lubricant Degradation Not Identified Due to Insufficient Service Life Monitoring,” September 24, 2015.

NRC Inspection Enforcement Circulars

Circular (Cr) 76-05, “Hydraulic Shock and Sway Suppressors—Maintenance of Bleed and Lock-Up Velocities on ITT Grinnell’s Model Nos.—Fig. 200 and Fig. 201, Catalog PH-74-R,” October 8, 1976.

Cr 78-07, “Damaged Components of a Bergen-Paterson Series 25000 Hydraulic Test Stand,” May 31, 1978.

Cr 79-25, “Shock Arrestor Strut Assembly Interference.”

Cr 81-05, “Self-Aligning Rod End Bushings for Pipe Supports.”

NUREG/CRs

NUREG/CR-4279, Vol. 1, “Aging and Service Wear of Hydraulic and Mechanical Snubbers Used on Safety-Related Piping and Components of Nuclear Power Plants: Phase I Study,” February 1986, ML040230419.

NUREG/CR-5386, “Basis for Snubber Aging Research: Nuclear Plant Aging Research Program,” January 1990, ML040360184.

NUREG/CR-5870, “Results of LWR Snubber Aging Research,” May 1992, ML040340438.

APPENDIX B
GUIDANCE FOR TREATMENT OF PUMPS, VALVES, AND DYNAMIC RESTRAINTS DURING IMPLEMENTATION OF 10 CFR 50.69

The NRC staff originally prepared NUREG-1482 in 1995 to provide guidance for the implementation of IST Programs required by 10 CFR 50.55a at nuclear power plants prior to the development of 10 CFR 50.69, “Risk-informed categorization and treatment of structures, systems and components for nuclear power reactors.”

Based on the absence of an NRC-accepted guidance document for the treatment of SSCs when implementing 10 CFR 50.69, the NRC staff prepared Appendix B in Revision 3 to NUREG-1482 to specify the Commission direction for the implementation of the 10 CFR 50.69 treatment requirements in the NRC Federal Register Notice (FRN) for the 10 CFR 50.69 regulations. No significant changes to NUREG-1482, Appendix B, were made in the draft Revision 4 to NUREG-1482 from Revision 3 to NUREG-1482.

The NRC regulations in 10 CFR 50.69(d) specify RISC-3 treatment requirements that must be met by licensees when implementing their 10 CFR 50.69 license amendment. In the FRN, the Commission discusses actions needed by licensees to meet the treatment requirements in 10 CFR 50.69(d) and the plans for NRC inspections of the treatment of RISC-3 SSCs for licensees implementing 10 CFR 50.69 at their nuclear power plants. The NRC is conducting inspections of 10 CFR 50.69 programs with respect to categorization and treatment of SSCs at individual nuclear power plants, and issuing violations for noncompliance with those regulations.

The NRC staff has found during NRC inspections and industry meetings that licensees do not understand the 10 CFR 50.69 requirements for the treatment of RISC-3 SSCs at nuclear power plants. See the NRC staff response to comments on draft Revision 4 to NUREG-1482 for specific details of those statements in ADAMS ML25262A190.

At nuclear power plants, the same licensee personnel will likely be responsible for both the IST Program and the 10 CFR 50.69 treatment program for pumps, valves, and snubbers. Therefore, it is recommended that licensees read the FRN associated with 10 CFR 50.69 (69 FR 68008) to learn the Commission direction for meeting the 10 CFR 50.69 requirements to avoid adverse safety consequences from inadequate implementation of 10 CFR 50.69 at their nuclear power plants.

SUPPLEMENTAL READING

U.S. Code of Federal Regulations, Part 50, "Domestic Licensing of Production and Utilization Facilities," Chapter I, Title 10, "Energy."

Nuclear Energy Institute 00-04, "10 CFR 50.69 SSC Categorization Guideline," July 2005, Agencywide Documents Access and Management System Accession No. ML052910035.

U.S. Nuclear Regulatory Commission, "Risk-Informed Categorization and Treatment of Structures, Systems and Components for Nuclear Power Reactors," 69 FR 68008, November 22, 2004.

U.S. Nuclear Regulatory Commission, Inspection Procedure 37060, "10 CFR 50.69 Risk-Informed Categorization and Treatment of Structures, Systems, and Components Inspection," September 2011.

U.S. Nuclear Regulatory Commission, NUREG/CR-6752, "A Comparative Analysis of Special Treatment Requirements for Systems, Structures, and Components (SSCs) of Nuclear Power Plants with Commercial Requirements of Non-Nuclear Power Plants," January 2002, ML020330051.

U.S. Nuclear Regulatory Commission, Regulatory Guide 1.201, Revision 1, "Guidelines for Categorizing Structures, Systems, and Components in Nuclear Power Plants According to Their Safety Significance," May 2006.

APPENDIX C
GUIDANCE FOR CODE OF RECORD INTERVAL

On July 17, 2024 (with subsequent correction), the U.S. Nuclear Regulatory Commission (NRC) issued a modification of Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a, "Codes and standards" (see Volume 89 of *the Federal Register* (FR), page 58039 (89 FR 58039)), with an effective date of August 16, 2024. The NRC staff response to public comments (Agencywide Documents Access and Management System Accession No. ML23291A328) for the rule provides additional discussion of the changes to 10 CFR 50.55a.

The following is a summary of the information in the *Federal Register* notice related to the code of record interval.

Overall Summary

With certain conditions, the 2024 10 CFR 50.55a rulemaking revises the NRC requirement for nuclear power plant licensees to update the codes of record for their inservice examination, inservice testing (IST), and inservice inspection (ISI) programs. Prior to the rulemaking, licensees were required to update the code of record every 10 years. This rulemaking revises that requirement so that licensees can update the code of record after the completion of an ISI and IST interval, with a maximum of two consecutive ISI and IST intervals before a required update. This revision applies to licensees that are implementing the 2017 Edition, or later editions, of the American Society of Mechanical Engineers (ASME) Code for Operation and Maintenance of Nuclear Power Plants (OM Code) and the 2017 Edition, or later editions, of the ASME Boiler and Pressure Vessel (BPV) Code, Section XI, as incorporated by reference into 10 CFR 50.55a as the codes of record of their IST and ISI programs. This revision to the NRC's regulations implements Commission direction in SRM-SECY-21-0029, dated November 8, 2021, in response to SECY-21-0029, "Rulemaking Plan on Revision of Inservice Testing and Inservice Inspection Program Update Frequencies Required in 10 CFR 50.55a," dated March 15, 2021.

The NRC revised the requirements in 10 CFR 50.55a(f)(4) and 10 CFR 50.55a(g)(4) to refer to the term "code of record interval" instead of "120-month interval." This term, as well as others, is included in the new definitions in 10 CFR 50.55a(y). Under the new rule, licensees may maintain the same code of record in their IST and ISI programs for two consecutive IST or ISI intervals. As a result of public comments, the NRC revised the final rule to update the language of 10 CFR 50.55a(f)(4)(iv) and 10 CFR 50.55a(g)(4)(iv) to allow licensees to use a later edition of the OM Code and ASME BPV Code, Section XI, as incorporated by reference into 10 CFR 50.55a, at the start of a new IST or ISI interval without submitting a request to the NRC for approval. As a result of these changes, licensees are required to update their Code of Record after two consecutive ISI or IST intervals. Licensees may update their codes of record at the end of each ISI or IST interval if preferred.

Discussion of Code of Record Interval Limitations for Inservice Testing Programs

In this rulemaking, the NRC included rule language that specifies that licensees may update their IST codes of record every two consecutive IST intervals, provided that the licensee implements the 2017 Edition, or later edition, of the OM Code, as incorporated by reference into 10 CFR 50.55a, for its IST programs. This would allow up to a 25-year maximum code of record interval based on two consecutive IST intervals, each up to 12 years (assuming the use of Code

Case OMN-31; see below), plus the one-time 1-year extension for IST programs as specified in the OM Code. The NRC does not intend that the code of record interval exceed 25 years, even if ASME extends the IST interval beyond 12 years in the OM Code. Licensees implementing the 2017 Edition, or later edition, of the OM Code may immediately utilize the extended code of record interval. The up-to-25 year code of record interval begins on the date that the licensee incorporates the 2017 Edition or later edition of the OM Code as its code of record for the IST program. Licensees choosing to update to newer approved editions at the start of a new IST interval instead of maintaining the code of record for another IST interval may do so without NRC approval, based on the new language in 10 CFR 50.55a(f)(4)(iv) and 10 CFR 50.55a(g)(4)(iv). Licensees seeking to use a later edition in the middle of an IST interval must submit an exemption request for NRC review and approval under 10 CFR 50.12, "Specific exemptions."

The rulemaking also updated the Regulatory Guides (RGs) on acceptable code cases. In Revision 5 to RG 1.192, "Operation and Maintenance Code Case Acceptability, ASME OM Code," issued March 2024, the NRC conditionally accepted OM Code Case OMN-31, "Alternative to Allow Extension of ISTA-3120 Inservice Examination and Test Intervals From 10 Years to 12 Years," as a voluntary alternative to the 10-year interval specified in the OM Code for applicants and licensees implementing the 2017 Edition or later edition of the OM Code, as incorporated by reference in 10 CFR 50.55a, as the code of record for their IST program. As a result of public comments, the NRC added a new condition in RG 1.192 requiring that OMN-31 be implemented at the start of a new IST interval. Implementation of OMN-31 in the middle of an IST interval creates complications related to existing testing and examination schedules and alternatives that were approved assuming a 10-year IST interval. Licensees seeking to apply OMN-31 in the middle of an IST interval would need to obtain an exemption under 10 CFR 50.12.

For clarification, beyond the information provided in the FR notice, the only interval that is extended as a result of this rulemaking is the code of record interval, as defined in 10 CFR 50.55a(y). IST programs may have other intervals that coincide with 120 months or 10 years, but they are not generically impacted by this rulemaking. The impact of the code of record interval change on other durations and intervals is further discussed below in this appendix.

Implementation of Code of Record Interval Extensions

The NRC does not intend the extension of the code of record interval to affect the orderly implementation of IST programs. Therefore, the final rule is designed to synchronize the requirements of the ASME Codes and 10 CFR 50.55a as much as possible. For licensees with codes of record prior to the2017 Edition of the OM Code, as incorporated by reference in 10 CFR 50.55a, the final rule specifies that the code of record interval for the IST programs shall be the same as the IST interval. This is consistent with the current requirements. For licensees whose code of record is the 2017 or later edition of the OM Code, the final rule specifies that the code of record interval for the IST program may be up to two consecutive IST intervals.

The NRC does not intend to require licensees using the 2017 Edition or later edition of the OM Code to maintain the same code of record for the two consecutive 120-months IST intervals. Accordingly, the NRC modified 10 CFR 50.55a(f)(4)(iv) to ensure that licensees and applicants maintain the ability to update their code of record at the end of each IST interval without NRC approval. These licensees also may implement the extended code of record interval immediately. The code of record interval for these licensees, based on the definitions in

10 CFR 50.55a(y), is two consecutive IST intervals (not 20 or 24 years). (Further discussion appears in the section “Midinterval Implementation” below.) Therefore, these licensees may update their code of record either at the end of the current IST interval or at the end of the subsequent IST interval.

The concept of a 120-month interval was mentioned repeatedly in 10 CFR 50.55a. For clarity, in 10 CFR 50.55a(y) the NRC defined certain terms, including “IST code of record,” “ISI code of record,” “code of record interval,” “IST interval,” “ISI interval,” “IST program,” and “ISI program.” The NRC updated the language throughout 10 CFR 50.55a to be consistent with the definitions.

Beyond the provisions of the *Federal Register* notice, as noted above, extending a licensee’s code of record interval does not generically extend all 10-year intervals. However, when it comes to implementing extensions of the code of record interval, the following guidelines apply.

With respect to Code Cases, licensees that were using a given Code Case before the effective date of its revision may continue to use the previous version until the next update to the code of record for the ISI or IST program, as applicable. This relieves licensees of the burden of having to update their ISI or IST programs each time a Code Case is revised by ASME and approved for use by the NRC. Code Cases apply to specific editions and addenda, and Code Cases may be revised if they are no longer accurate or adequate. Therefore, licensees choosing to continue using a Code Case in a later code of record interval (e.g., after updating the edition or addenda used as the code of record) for the ISI or IST program must implement the latest version of the Code Case incorporated by reference in 10 CFR 50.55a and listed in the regulatory guides.

With respect to relief from impractical IST requirements, as requested in accordance with 10 CFR 50.55a(f)(5)(iv), neither the rulemaking language about the code of record interval nor the application of Code Cases OMN-31 or N-921 extends the approval timeframe for previously granted relief requests. At the end of the inservice examination and test interval, the licensee must reassess whether the IST requirement continues to be impractical and submit an updated relief request if necessary.

With respect to alternative requests in accordance with 10 CFR 50.55a(z), the NRC will address the duration of each new authorized alternative in the safety evaluation, describing its review of the request consistent with the current procedures for evaluating alternative requests. Existing NRC-approved alternatives were likely authorized based on the IST or ISI interval. Neither the rulemaking language describing the code of record interval nor the application of Code Case OMN-31 or N-921 extends the approval timeframe for existing NRC-approved alternatives. Licensees should refer to the NRC safety evaluation to determine the timeframe for which the alternative is authorized and resubmit the request at an appropriate time to maintain compliance with IST and ISI requirements.

Licensees may request future alternatives based on the code of record interval. As such, a licensee may propose an alternative with a duration based on the code of record interval beginning on a specified date, corresponding to one or two specified IST Intervals, during which a particular edition of the ASME OM Code is used as the code of record. The alternative would not be authorized for other codes of record

Licensees are currently required to submit various documents, such as IST plans and schedules or ASME BPV Code, Section XI, flaw evaluations, to the NRC for each IST or ISI interval. The language in this rulemaking regarding the code of record intervals does not alter those submittal requirements in any way. Therefore, licensees should carefully distinguish requirements that

apply to the code of record interval from those that apply to the IST or ISI interval. For example, 10 CFR 50.55a(f)(7) requires IST plans to be submitted within 90 days of their implementation for the applicable 120-month IST program interval. This rule revises the terms used in 10 CFR 50.55a(f)(7) for consistency with the new definitions, but licensees must still submit their IST plans within 90 days of their implementation for the applicable IST interval.

Midinterval Implementation

The NRC recognizes that a licensee might consider updating its code of record for the IST program to a more recent edition (such as the 2017 Edition or later edition) during an IST interval to take advantage of the allowance in the rule to double the code of record interval. Similarly, a licensee might consider implementing Code Case OMN-31 during an IST interval. The NRC staff notes that in such cases, complications may arise from the need to reconcile OM Code requirements and requests that were granted or authorized for a 10-year IST interval relative to the code edition previously specified in the licensee's IST program. The NRC will review midinterval requests by licensees to update the code of record for the IST program to a more recent edition in accordance with the existing process described in 10 CFR 50.55a(f)(4)(iv) and Regulatory Issue Summary 2004-12, "Clarification on Use of Later Editions and Addenda to the ASME OM Code and Section XI," dated July 28, 2004. Licensees making such requests should evaluate the impact of updating the code of record on their IST program, including both completed and planned IST activities. Licensees should review previously authorized alternatives under 10 CFR 50.55a(z), as well as previously granted relief requests, and determine whether they need to be resubmitted for approval because of the duration specified in each request and authorization. If such reviews and approvals are completed, licensees may take advantage of the extended code of record interval afforded by the rule.

The NRC staff notes that the code of record interval is defined as two consecutive IST intervals (rather than 20 or 24 years). A licensee that updates the code of record during an IST interval would be able to maintain the same code of record for the remainder of the current IST interval and the entirety of the subsequent IST interval. At the end of the subsequent IST interval, however, the licensee must update its code of record, since two consecutive IST intervals have passed. For example, a licensee begins a new IST interval in January 2020. In 2025, the licensee requests to implement the 2017 Edition of the OM Code under 10 CFR 50.55a(f)(4)(iv). If the NRC were to approve this request, the IST interval would end in January 2030 (i.e., 10 years from January 2020, when the IST interval began), while the code of record interval would extend to 2040. If the licensee chooses to implement OMN-31 in January 2030, the IST interval and the code of record interval would extend to 2042.

Upon the effective date of this final rule, a licensee already implementing the 2017 Edition or later edition of the OM Code for the IST program would continue its ongoing 10-year IST interval with that edition as the code of record for the IST program. At the end of the ongoing 10-year IST interval, the licensee would assess the IST program as required in the OM Code, including the need to resubmit requests for alternatives or relief that expired at the end of the 10-year IST interval. At that point, the licensee could keep the same code edition as the code of record for the subsequent IST interval, and NRC approval would not be required to do so. At the end of that subsequent IST interval, the licensee would update its code of record to the latest code edition incorporated by reference in 10 CFR 50.55a no more than 18 months before the beginning date of the next IST interval and submit any alternative or relief requests for the next IST interval.

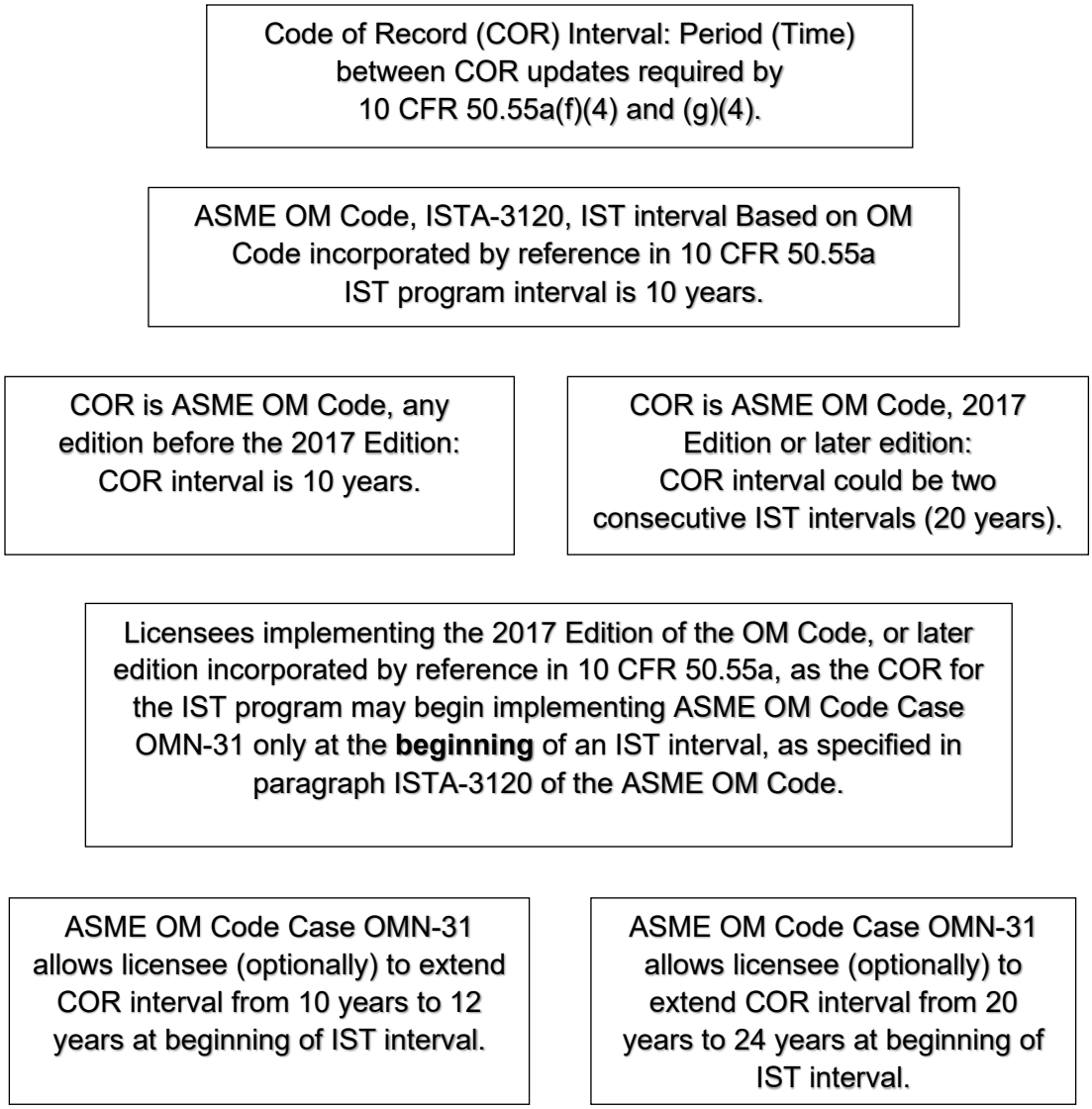

Figure C-1 Use of 10 CFR 50.55a(y), 10 CFR 50.55a(f)(4), and ASME OM Code, Paragraph ISTA-3120

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Nicholas Hansing, Project Manager

11. ABSTRACT (200 words or less)

In Revision 4 of NUREG-1482, "Guidelines for Inservice Testing at Nuclear Plants," the staff of the U.S. Nuclear Regulatory Commission (NRC) discusses the applicable regulations for the inservice testing of pumps and valves, and the examination and testing of dynamic restraints (snubbers) at commercial nuclear power plants. NUREG-1482, Revision 0, issued April 1995; Revision 1, issued January 2005; Revision 2, issued October 2013; and Revision 3, issued July 2020, also described these topics. This NUREG report replaces prior revisions to NUREG-1482 and is applicable, unless stated otherwise, to all editions and addenda of the American Society of Mechanical Engineers Code of Operation and Maintenance of Nuclear Power Plants, which Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(a) incorporates by reference (*Federal Register*, Vol. 87, No. 207, pages 65128–65157, dated October 27, 2022).

12. KEY WORDS/DESCRIPTORS (List words or phrases that will assist researchers in locating the report.)

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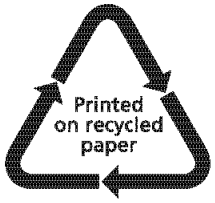

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