NUREG-1482
Revision 1

Guidelines for Inservice Testing at Nuclear Power Plants

Final Report

U.S. Nuclear Regulatory Commission
Office of Nuclear Reactor Regulation
Washington, DC 20555-0001

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Guidelines for Inservice Testing at Nuclear Power Plants

Final Report

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ABSTRACT

In Revision 1 of NUREG-1482, the staff of the U.S. Nuclear Regulatory Commission (NRC) gives licensees guidelines and recommendations for developing and implementing programs for the inservice testing of pumps and valves at commercial nuclear power plants. Specifically, the staff discusses the applicable regulations; the components to be included in an inservice testing program; and the preparation and content of cold shutdown justifications, refueling outage justifications, and requests for relief from the Code requirements promulgated by the American Society of Mechanical Engineers (ASME). The staff also gives specific guidance on the types of relief that are acceptable to the NRC and advises licensees on how to use this information at their facilities. In addition, the staff discusses the revised standard technical specifications for the inservice testing program and gives guidance on the process a licensee may follow upon identifying an instance of noncompliance with the ASME Code.

As an update of NUREG-1482, Revision 1 incorporates regulatory changes up to and including the 2004 Edition of Title 10, Part 50, of the *Code of Federal Regulations*. The "code of record" for this revision is the *ASME Code for Operation and Maintenance of Nuclear Power Plants*, 1998 Edition through the 2000 Addenda. References to the 1995 Edition with 1996 Addenda are shown in [brackets].

Revision 0 of NUREG-1482 is still valid and is to remain in use for those licensees who have not updated their inservice testing programs to the *ASME Code for Operation and Maintenance of Nuclear Power Plants*, 1995 Edition with 1996 Addenda, or a later edition of the Code.

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EXECUTIVE SUMMARY

The staff of the U.S. Nuclear Regulatory Commission (NRC) is issuing this update to NUREG-1482 to assist the industry in eliminating unnecessary requests for relief and to provide guidelines and acceptable examples that might prove useful to licensees who are considering an inservice testing (IST) method as an alternative to that required by the *Code for Operation and Maintenance of Nuclear Power Plants* (OM Code) promulgated by the American Society of Mechanical Engineers (ASME). In issuing this revision of NUREG-1482, the staff hopes that the guidance provided will assist the industry in establishing a consistent IST approach. Nonetheless, implementation of the guidance is strictly voluntary and may change depending on advancements in IST techniques or technology. This revision of NUREG-1482 also discusses examples of the use of portions of later editions and addenda of the OM Code, which licensees may implement if the requirements stated in the related recommendations are met.

Specifically, the NRC staff is issuing Revision 1 to NUREG-1482 for the following purposes:

(1) Provide guidance on portions of the OM Code, 1998 Edition through the 2000 Addenda, that the staff has determined are acceptable for licensees to implement pursuant to Title 10, Section 50.55a(f)(4)(iv), of the *Code of Federal Regulations* (10 CFR 50.55a(f)(4)(iv)). This guidance generally also applies to the requirements of the 1995 Edition of the OM Code, including the 1996 Addenda, and any differences are discussed where relevant.

(2) Provide guidance on information that licensees must include in relief requests or alternatives in order to ensure more efficient and effective review and approval by the NRC staff.

(3) Clarify common IST issues that have been identified as a result of NRC inspections, licensees' telephone calls or meetings, public meetings, and NRC staff participation on ASME OM Committees.

(4) Indicate the NRC staff's views on the acceptability of, or the need for caution in, applying certain ASME OM interpretations.

(5) Consolidate references to various documents that apply to IST.

(6) Clarify the information to be included in an IST program, the format for relief requests and alternative cold shutdown/refueling outage justifications, and the scope of IST programs.

(7) Clarify the staff's views on certain ASME Code requirements or NRC regulatory positions.

In this revision, the staff discusses IST guidance, issues, and questions that have been discussed during the staff's participation in ASME Code Committee meetings and technical meetings with licensees and industry groups regarding this and other generic correspondence. The guidance also reflects lessons learned during the staff's review and evaluation of relief requests and proposed alternatives, as well as review of inspection findings and responses.

The voluntary nature of the guidance differs from the previously approved positions in Generic Letter (GL) 89-04, "Guidance on Developing Acceptable Inservice Testing Programs," which were not entirely voluntary. The guidance also includes approval and use of the *ASME Operations and Maintenance Standards*, which the NRC has incorporated by reference into 10 CFR 50.55a. In addition, the guidance approves the use of portions of those standards, pursuant to 10 CFR 50.55a(f)(4)(iv), before this regulation would take effect for individual licensees' updated 10-year interval IST programs. Most importantly, this revision identifies the actions that those licensees who choose to use the guidance must take to satisfy 10 CFR 50.55a(f)(4)(iv), and will ensure that such implementations are acceptable. In addition, the guidance should prove useful to licensees who are developing and implementing the regulations and ASME Code requirements and, as such, is part of the NRC's plan for improving IST programs.

The requirement governing the use of specific ASME OM Code editions and addenda is set forth in 10 CFR 50.55a. As later editions and addenda of the ASME OM Code are incorporated by reference into 10 CFR 50.55a, the NRC staff will update NUREG-1482, as needed, to reflect the changes in Code requirements or other regulatory positions and criteria. In the meanwhile, Revision 0 of NUREG-1482 is still valid and is to remain in use for those licensees who have not updated their programs to comply with the 1995 Edition (with the 1996 Addenda) or a later edition of the OM Code.

PREFACE

On April 3, 1989, the staff of the U.S. Nuclear Regulatory Commission (NRC) issued Generic Letter (GL) 89-04, "Guidance on Developing Acceptable Inservice Testing Programs." That generic letter addressed frequently encountered issues, such as code testing requirements, relief requests, procedural implementation, and technical specification requirements and provisions for operability; included 11 technical positions that the NRC staff uses in reviewing licensees' requests for relief from the inservice testing (IST) program requirements of the *Code for Operation and Maintenance of Nuclear Power Plants* (OM Code) promulgated by the American Society of Mechanical Engineers (ASME); and described alternatives to the Code requirements that are acceptable to the staff. The implementation requirements for the positions in GL 89-04 were not entirely voluntary, since the staff explicitly asked certain licensees to implement the stated positions. However, the guidance herein is strictly voluntary.

Certain terms in this document have gradations of regulatory significance to licensees:

- In discussing NRC regulations or requirements of the OM Code, as incorporated into the regulations, the staff consistently uses the terms ***shall, must, requires,*** or ***requirements*** to indicate their mandatory nature. In the context of implementing guidance herein, the term ***must*** is sometimes used with provisions that are intended for voluntary implementation by licensees to indicate that, if a licensee chooses to implement the guidance presented in a given section, the licensee must follow all provisions in that section without deviation in order to receive credit for satisfactorily meeting the related guidance.

- The word ***should*** is used (1) in reiterating previously approved NRC staff positions or requirements promulgated by generic letter or other approved generic correspondence, and (2) in stating staff recommendations for voluntary implementation (in the "NRC Recommendations" sections).

- The terms ***NRC recommendation***, ***staff recommendation***, ***recommends***, ***acceptable to the staff***, ***acceptable***, ***licensee may***, and ***licensee typically would*** are used to discuss issues that have been evaluated in, and reflect NRC staff findings from, previous plant-specific safety evaluations related to IST relief requests, NRC inspection reports, meetings (including ASME Code Committee meetings, meetings with licensees, and NRC/ASME symposia), and other generic correspondence.

The guidance herein is similar in appearance to NRC staff positions given in a regulatory guide because of the terms discussed above, and because certain recommendations indicate acceptable alternatives to Code requirements. However, this guidance is not equivalent to staff positions in a regulatory guide or other generic correspondence, because this guidance is strictly intended for voluntary implementation by licensees. *Licensees may still need to seek approval for certain recommendations through the process described in Title 10, Section 50.55a, of the* Code of Federal Regulations *(10 CFR 50.55a).*

As an update of NUREG-1482, Revision 1 incorporates regulatory changes up to and including the 2004 Edition of 10 CFR Part 50. The "code of record" for this revision is the *ASME Code for Operation and Maintenance of Nuclear Power Plants*, 1998 Edition through the 2000 Addenda. References to the 1995 Edition with 1996 Addenda appear throughout this document, and are shown in [brackets].

Revision 0 of NUREG-1482 is still valid and is to remain in use for those licensees who have not updated their programs to comply with the 1995 Edition (with the 1996 Addenda) or a later edition of the OM Code.

ABBREVIATIONS

ADS	automatic depressurization system
ALARA	as low as reasonably achievable
ANSI	American National Standards Institute
AOV	air-operated valve
ASME	American Society of Mechanical Engineers
BEP	best efficiency point
BWR	boiling-water reactor
BWST	borated water storage tank
CFR	*Code of Federal Regulations*
CPT	comprehensive pump test
CRD	control rod drive
CVCS	chemical and volume control system
DBD	design-basis document
ECCS	emergency core cooling system
FR	*Federal Register*
FSAR	final safety analysis report
GDC	General Design Criterion
GE	General Electric Company
GL	generic letter
GSI	generic safety issue
HCU	hydraulic control unit
HOV	hydraulic-operated valve
HPCI	high-pressure coolant injection
IEEE	Institute of Electrical and Electronics Engineers
IN	information notice
IP	inspection procedure
ISI	inservice inspection
IST	inservice testing
JOG	Joint Owners' Group
LCO	limiting condition for operation
LOCA	loss-of-coolant accident
LWR	light-water reactor
MOV	motor-operated valve
MSIV	main steam isolation valve
MSSV	main steam safety valve

NEI	Nuclear Energy Institute (formerly NUMARC)
NIC	Nuclear Industry Check Valve Group
NOED	Notice of Enforcement Discretion
NRC	U.S. Nuclear Regulatory Commission
NRR	Office of Nuclear Reactor Regulation (NRC)
NUMARC	Nuclear Management and Resources Council (now NEI)
OM	Operations and Maintenance
PASS	post-accident sampling system
PIV	pressure isolation valve
PORV	power-operated relief valve
POV	power-operated valve
PRA	probabilistic risk assessment
PTC	Performance Test Code
PWR	pressurized-water reactor
P&ID	piping and instrument diagram
RCIC	reactor core isolation cooling
RCPB	reactor coolant pressure boundary
RCS	reactor coolant system
RG	regulatory guide
RHR	residual heat removal
RIS	regulatory issue summary
RWST	refueling water storage tank
RWT	refueling water tank
SAR	safety analysis report
SBLC	standby liquid control
SGCV	Code Committee Sub-Group on Check Valves (ASME)
SI	safety injection
SOV	solenoid-operated valve
SR	surveillance requirement
SRP	Standard Review Plan
SSC	system, structure, and/or component
S/RV	safety/relief valve
STS	Standard Technical Specifications
TS	technical specification(s)
UFSAR	updated final safety analysis report
WGC	Working Group Committee (IEEE)
WGCV	Working Group on Check Valves (ASME)

1. INTRODUCTION

1.1 Regulatory Basis

Title 10, Section 50.55a, of the *Code of Federal Regulations* (10 CFR 50.55a) 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), (f), and (g) of 10 CFR 50.55a, as they relate to inservice inspection (ISI) and inservice testing (IST). By rulemaking effective September 8, 1992 (see *Federal Register*, Vol. 57, No. 3152, p. 34666, dated 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 2004 revision of 10 CFR 50.55a(b)(3) incorporates by reference the 1998 Edition through the 2000 Addenda of the *Code for Operation and Maintenance of Nuclear Power Plants* (OM Code) promulgated by the American Society of Mechanical Engineers (ASME), in which Subsections ISTB and ISTC specify the IST requirements for pumps and valves, respectively.[1] Based on those requirements, each of the NRC's nuclear power plant licensees must establish IST programs, 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.

Where a test requirement of the OM Code is determined to be impractical for a facility, the NRC's regulations allow the licensee to submit a request for relief from the given requirement, along with information to support the determination. Relief requests generally detail the reasons for deviating from the Code requirements and propose alternative testing methods or frequencies. The Commission is authorized to evaluate licensees' relief requests, and may grant the requested relief or impose alternative requirements, considering the burden that the licensee might incur if the Code requirements were enforced for the given facility. Pursuant to 10 CFR 50.55a(a)(3)(i) and (ii), the Commission may also 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 latest revision of 10 CFR 50.55a(f)(4)(iv) specifies that licensees' inservice testing of pumps and valves may meet the requirements in editions and addenda of the OM Code that were published more recently than those that are incorporated by reference in 10 CFR 50.55a(b), subject to Commission approval and the limitations and modifications listed in 10 CFR 50.55a(b). When requesting to use editions and addenda of the ASME Code that have not been incorporated by reference, licensees must request authorization to use these later editions and addenda as an alternative to the regulations pursuant to 10 CFR 50.55 a(a)(3). Licensees may also use portions of various editions or addenda, provided that they meet all related requirements of the respective editions or addenda. In addition, licensees may implement the more recent Code

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[1] Note that 10 CFR 55.55a(b)(3)(iii) allows the use of Code Case OMN-1 with some restrictions; 10 CFR 55.55a(b)(3)(vi) restricts the exercising interval for manual valves to 2 years (rather than 5 years as defined in the OM Code); and 10 CFR 50.55a(b)(3)(iv) defines the modifications to apply when implementing OM Code Appendix II, "Check Valve Conditioning Monitoring Program."

editions, or portions thereof, pursuant to 10 CFR 50.55a(f)(4)(iv) without requesting relief, based on the approval stated in Sections 3, 4, and 5 of this document, provided that their IST programs include documentation concerning the licensee's specific implementation of the later requirements. Request for approval to use later editions and addenda previously incorporated by reference in 10 CFR 50.55a may be via letter to the NRC. See RIS 2004-12 for further clarification.

1.2 Regulatory History

The NRC previously issued guidance for implementing IST requirements. After publishing the rule that established the IST requirements (see *Federal Register*, Vol. 41, No. 30, p. 6256, dated February 12, 1976), the NRC sent letters to notify operating licensees of the new rule. In November 1976, after receiving inquiries from licensees regarding acceptable methods for complying with the regulation, the NRC issued letters to licensees to transmit "NRC Staff Guidance for Complying with Certain Provision of 10 CFR 50.55a(g), 'Inservice Inspection Requirements'."

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. That generic letter included 11 technical positions that the staff uses in reviewing licensees' IST program relief requests and described alternatives to the Code requirements that the staff considered acceptable. In GL 89-04, the staff also approved 6 of the11 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 staff approved these alternatives upon recognizing that it might be impractical to perform the required testing, and enforcing the requirements might pose an unnecessary burden on licensees. The staff then addressed the 11 positions in Appendix A to the previous revision of this NUREG-series report. By contrast, the staff now addresses the 11 positions and related guidance within the body of NUREG-1482, Revision 1.

GL 89-04 stated that licensees must document their uses of Positions 1, 2, 6, 7, 9, and 10 in the IST program, but did not require the documentation to take the form of a relief request. Provided that the licensee followed the provisions of GL 89-04, the generic letter 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)]. For convenience, most licensees documented their uses of these positions in relief requests; however, other forms of program documentation were acceptable as long the provisions of the referenced positions were clearly documented — and discussed in adequate detail — to substantiate conformance with those provisions. Certain licensees may have submitted relief requests to ensure that their conformance was adequately documented in their IST program, even though documentation in the program would also have been acceptable, as stated in GL 89-04.

The staff held four public meetings to discuss GL 89-04 and stated that the generic letter was a first step toward resolving various problems associated with developing and implementing IST programs at nuclear power plants. The 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 ASME Code committees, and meeting with licensees and industry groups.

The 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. That letter contained useful information about how to apply the guidance in GL 89-04 and discussed issues of interest to licensees who attended the public meetings. In a subsequent letter, dated September 16, 1991, the staff issued "Supplement to Minutes of the Public Meetings on Generic Letter 89-04" to address a question on stop-check valve testing.

In the 1988 and 1989 Addenda to Section XI of the OM Code, ASME and the American National Standards Institute (ANSI) revised Subsections IWP and IWV to simply reference Parts 6 and 10 of the 1987 Edition of the ASME OM Code (OM-1987, OM-6 and OM-10, respectively). ASME/ANSI also rewrote the OM standards (albeit without making any significant technical changes) and, in 1990, the Board on Nuclear Codes and Standards subsequently approved the revised standards as the "*Code for Operation and Maintenance of Nuclear Power Plants*, ASME OM Code-1990." The OM-1990 edition of the Code includes pump, valve, and snubber IST requirements, as well as requirements for snubber examination.

At the time of this writing, the "code of record" for this revision is the *ASME Code for Operation and Maintenance of Nuclear Power Plants*, 1998 Edition through the 2000 Addenda. Certain tests and measurements required by previous editions of the OM Code have been clarified, revised, or eliminated since the issuance of the 1990 Code. Many of the issues identified in GL 89-04 have been addressed. The guidance presented in this revision of NUREG-1482 incorporates and addresses those issues that still require guidance and clarification.

Since the NRC issued GL 89-04, the staff has improved its guidance regarding IST 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 regular (biennial) symposia on testing pumps and valves. To date, the NRC has held eight symposia, and the ninth is planned for July 2006. The NRC intends to continue to improve its IST-related guidance through continued participation in Code and technical organizations, as well as regular updates of the agency's published guidance as future needs arise.

1.3 NRC Recommendations and Guidance

As an update of NUREG-1482, Revision 1 incorporates regulatory changes up to and including the 2003 Edition of 10 CFR Part 50. The "code of record" for this revision is the *ASME Code for Operation and Maintenance of Nuclear Power Plants*, 1998 Edition through the 2000 Addenda. References to the 1995 Edition with 1996 Addenda appear throughout this document, and are shown in [brackets].

Revision 0 of NUREG-1482 is still valid and is to remain in use for those licensees who have not updated their programs to comply with the 1995 Edition (with the 1996 Addenda) or a later edition of the OM Code.

The recommendations herein supplement the guidance and technical positions in GL 89-04. Note that specific relief is required to implement the guidance in GL 89-04. However, relief justification may refer to the positions in the GL with clarifying information to clearly show how it would apply to a licensees situation. This document is written for the latest edition of the OM

Code incorporated into Paragraph (b) of 10 CFR 50.55a. To the extent practical, this document reflects the applicable section, subsection, or paragraph of the appropriate documents (subsections of 10 CFR Part 50, OM Code, regulatory guides, etc.).

The guidance presented herein may be used for requesting relief. However, licensees may also request relief that is not in conformance with the guidance. The NRC may reference a recommendation contained in this document in future safety evaluations and may grant relief or authorize the alternative if the licensee has addressed all of the aspects included in the applicable section, where applicable.

This document specifically discusses Subsections ISTA, ISTB, and ISTC, as well as Appendices I and II, of the OM Code, which licensees may implement pursuant to 10 CFR 50.55a(f)(4)(iv). It also gives the requisite approval for licensees to use 10 CFR 50.55a(f)(4)(iv) in updating their IST programs to the requirements of the OM Code.

If a licensee chooses to implement the guidance contained herein for issues approved under 10 CFR 50.55a(f)(4)(iv), deviations from the guidance require Commission approval. In addition, if a licensee implements any or all of these recommendations, the licensees' IST program document must discuss the licensee's specific use of each recommendation (e.g., in notes, lists, or detail). If a licensee updates its program to the requirements of OM Subsection ISTB for inservice testing of pumps and Subsection ISTC for valve testing (including appendices, in their entirety), the NRC recommends that the introductory section of the licensee's IST program document should include a statement to that effect, but it need not state the use of the sections listed above.

1.4 Synopsis of Report

This revision of NUREG-1482 follows the format of a typical IST program plan, including Development and Implementation, General Guidance, Valves, Pumps, Technical Specifications, Code Noncompliance, and Risk-Informed IST.

Section 2, "Developing and Implementing an IST Program," describes existing IST requirements, discusses the scope of the IST program, and describes guidance for presenting information in IST programs, including cold shutdown justifications, refueling outage 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 requirements of the OM Code.

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

Rather, these discussions are intended to clarify the existing requirements of the Code or the regulations and, as such, they may provide recommendations to ensure that licensees continue to meet the Code and other regulatory requirements

Sections 6, 7, and 8 then discuss the revised standard technical specifications, the process licensees should follow when they identify a Code nonconformance, and the development of a risk-informed IST program. Section 9 presents a list of related references.

Finally, the appendices to this document include a copy of a White Paper promulgated by the Nuclear Energy Institute (NEI), entitled "Standard Format for Requests from Commercial Reactor Licensees Pursuant to 10 CFR 50.55a, Revision 1" dated June 2004. The NEI White Paper provides sample templates for the appropriate form and content of a relief request.

The guidance in this document is similar in appearance and content to NRC staff positions given in a regulatory guide because it uses terms such as ***shall, must,*** or ***requires*** to indicate mandatory considerations; ***should*** to state staff recommendations or reiterate previously approved NRC staff positions; and ***recommendation***, ***acceptable to the staff,*** or ***licensee may*** to reflect NRC staff findings from previous plant-specific safety evaluations related to IST relief requests. The guidance in this document is also similar to that given in a regulatory guide because certain recommendations indicate acceptable alternatives to Code requirements. However, this guidance is not equivalent to staff positions in a regulatory guide, because it is strictly intended for ***voluntary*** implementation by licensees. *Licensees may still need to seek approval for some of these recommendations through the process described in 10 CFR 50.55a.*

1.5 Record of Revisions

This update of NUREG-1482 incorporates regulatory changes up to and including the 2003 Edition of 10 CFR Part 50. The "code of record" for this revision is the *ASME Code for Operation and Maintenance of Nuclear Power Plants*, 1998 Edition through the 2000 Addenda. References to the 1995 Edition with 1996 Addenda are shown in [brackets]. Certain tests and measurements required by previous editions of the Code have been clarified, revised, or eliminated since the issuance of the 1990 Code. This revision of NUREG-1482 incorporates and addresses those changes, which are reflected in the revised guidance.

Revision 0 of NUREG-1482 is still valid and is to remain in use for those licensees who have not updated their programs to the 1995 Edition with the 1996 Addenda or later code.

1.6 Future Revisions

The requirement governing the use of specific ASME OM Code Editions and Addenda is provided in 10 CFR 50.55a. As the NRC revises 10 CFR 50.55a over time to incorporate (by reference) later Editions and Addenda to the ASME OM Code, the staff will update NUREG-1482, as needed, to reflect the changes in Code requirements or other regulatory positions and criteria.

2. DEVELOPING AND IMPLEMENTING AN INSERVICE TESTING PROGRAM

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

2.1 Compliance Considerations

In the *Code of Federal Regulations,* Title 10, Section 50.55a, entitled "Codes and Standards" (10 CFR 50.55a), states requirements for IST of certain safety-related pumps and valves that must be tested according to the requirements of the *Code for Operation and Maintenance of Nuclear Power Plants* (OM Code) promulgated by the American Society of Mechanical Engineers (ASME). This testing is intended to assess the operational readiness of the stated components. Specifically, the regulations state that the tests conducted during the initial and successive 120-month intervals must be based on the requirements in the applicable edition and addenda of the Code, to the extent practical, within the limitations of design, geometry, and materials of construction, as described in 10 CFR 50.55a(f)(4).

In addition, Paragraph 50.55a(f)(4)(ii) requires that IST conducted during each 120-month interval following the initial interval must be conducted in compliance with the requirements of the latest edition and addenda of the Code incorporated by reference in the version of 10 CFR 50.55a(b) that is in effect 12 months before the start of the interval. The 2002 Edition of 10 CFR Part 50, gives approval for licensees to implement the 1995 Edition of the OM Code with the 1996 Addenda, in its entirety or in part, for their IST programs. The 2004 Edition of 10 CFR Part 50 gives approval for licensees to implement the 1998 OM Code with the 2000 Addenda subject to limitations and modifications. Request for approval to use later editions and addenda previously incorporated by reference in 10 CFR 50.55a may be via letter to the NRC. See RIS 2004-12 for further clarification. However, pursuant to 10 CFR 50.55a(f)(4)(iv), licensees' IST programs may meet the requirements of editions and addenda of the Code (or portions thereof) that are more recent than those incorporated in 10 CFR 50.55(b). When requesting to use editions and addenda of the ASME Code that have not been incorporated by reference, licensees must request authorization to use these later editions and addenda as an alternative to the regulations pursuant to 10 CFR 50.55 a(a) (3). When licensees choose to use any or all portions of a revised edition, they must meet all related requirements of the respective editions or addenda, and such exceptions are subject to Commission approval in accordance with 10 CFR 50.55a(f)(4)(iv).

The regulations specify the "upper-tier" requirements for IST, and the requirements of the OM Code, as incorporated by reference into the regulations, have the force of law. To augment the regulations, a plant's Technical Specifications (TSs) include general and specific requirements for IST and other surveillance testing of pumps and valves. Similarly, the plant's safety analysis includes information concerning 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.

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.

The regulations are the authority governing the implementation of the various IST requirements. Therefore, licensees must meet the regulations when they find a conflict between the regulations and any of the lower-tier requirements (program or procedures). The staff gives guidance on cases where 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 approval of an alternative pursuant to 10 CFR 50.55a(a)(3)(i) or (ii), the licensee need not use that alternative if it subsequently determines that continued compliance with the Code requirements is warranted or necessary for particular circumstances that may preclude implementation of the approved 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, the licensee typically reviews the IST requirements to determine whether it must change the program for the affected components.

Sections 4.05 or 5.5 of the Standard Technical Specifications, as applicable, together with the corresponding plant-specific technical specifications, state that IST of ASME Code Class 1, 2, and 3 pumps and valves shall be performed in accordance with the OM Code and applicable addenda as required by 10 CFR 50.55a. According to the regulation, if a revised IST program conflicts with the facility's technical specifications, the licensee shall apply to the NRC to amend the technical specifications to conform with the revised program, or otherwise meet the requirements of the technical specifications and 10 CFR 50.55a (see 10 CFR 50.55a(f)(5)(ii)). This provision in the rule specifies actions to be taken by a licensee when a revised inservice inspection (testing) program for a facility conflicts with the technical specifications (see 41 FR 6256, "Statements of Consideration," dated February 12, 1976).

The NRC may authorize alternatives to Code testing requirements submitted as relief requests or in a similar format that includes a discussion of the requirements, a description of the proposed alternative, and the justification for approval of the alternative. 10 CFR 50.55a includes the following provisions for accepting alternatives or granting relief:

- 10 CFR 50.55a(a)(3)(i) allows the NRC to authorize alternatives if "the proposed alternatives would provide an acceptable level of quality and safety." The NRC will normally approve 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 code, or if the testing will comply or is consistent with later Code editions approved by the NRC in 10 CFR 50.55a(b).

- 10 CFR 50.55a(a)(3)(ii) 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 approve an alternative pursuant to this provision if, although the proposed alternative testing does not comply with the Code, the increase in overall plant safety and quality attained by complying with the Code requirement is not justified in light of the difficulty associated with compliance.

- 10 CFR 50.55a(f)(6)(i) includes the following provision:

  The Commission will evaluate determinations... that Code requirements are impractical. The Commission may grant relief and may impose such alternative requirements as it determines is 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 impose alternatives if the licensee demonstrates that the design or access limitations make the Code requirement impractical. Thus, the staff's evaluation considers the burden created by imposing the Code requirements on the licensee.

2.1.1 ASME Code Case Applicability

Code Cases are typically formatted in terms of an *Inquiry* [as from a licensee] and *Reply* [by the applicable ASME Code Committee]. Oftentimes the *Inquiry* and *Reply* are accompanied by an *Applicability* statement that identifies the specific Editions an Addenda of the ASME Code to which the *Reply* applies. However, the ASME Code Committees do not always 1) include an *Applicability* statement or 2) identify all of the editions and addenda to which the *Reply* applies. As a result, several licensees have questioned whether they could use certain ASME Code Cases without additional interaction with the regulatory authority having jurisdiction at the plant site.

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

a. Have the alternative to use the Code Case, beyond its stated applicability, authorized by the NRC pursuant to 10 CFR 50.55a(a)(3), or

b. If the Code Case is applicable to an Edition or Addendum of the ASME Code later than the version of the Code being used by the licensee, the licensee could update to the later version of the Code pursuant to 10 CFR 50.55a(f)(4)(iv) or (g)(4)(iv) and then use the Code Case, provided the Code Case has been approved for use in the appropriate Regulatory Guide and incorporated by reference into 10 CFR 50.55a. Note that the later version of the ASME Code must also have been incorporated by reference into 10 CFR 50.55a, the licensee must update all related requirements of the respective Edition or Addenda, and the update must be specifically approved by the Commission.

Licensee should not use ASME Code Cases with Editions and Addenda of the ASME Code to which they do not apply and that are not specifically approved for use by the NRC. More specifically, licensees should not "reconcile" the Applicability of Code Cases without consulting with the applicable ASME Code Committee.

In incorporating the OM Code by reference in 10 CFR 50.55a, the NRC staff recognized the need for a new regulatory guide that would approve OM Code cases. Such a regulatory guide would perform a function similar to that of existing Regulatory Guide (RG) 1.147, which approves ASME Code cases applicable to Section XI of the ASME Boiler and Pressure Vessel Code.

Accordingly, the NRC staff 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." Both these two new regulatory guides were issued for the first time in June 2003. In Revision 1 to NUREG-1482 the NRC states, "The licensee may implement the Code cases listed in RG 1.192 without obtaining further NRC review, if the Code cases are used in their entirety, with any supplemental conditions specified in the regulatory guide." Specifically, RG 1.192 lists the following Code cases as being acceptable to the NRC for application in licensees' OM IST programs:

- OMN-2, "Thermal Relief Valve Code Case."
- OMN-5, "Testing of Liquid Service Relief Valves Without Insulation."
- OMN-6, "Alternate Rules for Digital Instruments."
- OMN-7, "Alternative Requirements for Pump Testing."
- 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."
- OMN-13, "Requirements for Extending Snubber Inservice Visual Examination Interval at LWR Power Plants."

In addition, RG 1.192 lists the following OM Code cases as being "conditionally acceptable," meaning that they are acceptable to the NRC for application in licensees' OM IST programs within the limitations described in RG 1.192:

- OMN-1, "Alternative Rules for Preservice and Inservice Testing of Certain 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-9, "Use of a Pump Curve for Testing."
- OMN-11, "Motor-Operated Valve Risk-Based Inspection Code Case."
- OMN-12, "Alternative Requirements for Inservice Testing Using Risk Insights for Pneumatically and Hydraulically Operated Valve Assemblies in Light-Water Reactor Power Plants."

Code Cases OMN-1, OMN-3, OMN-4, OMN-11, and OMN-12 are risk-informed Code cases. Regulatory Guide 1.175, "An Approach for Plant-Specific, Risk-Informed Decision-Making: Inservice Testing," describes an acceptable alternative approach for applying risk insights from probabilistic risk assessment (PRA), 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. Until such time as a risk-informed regulation is promulgated and included in the regulations, the alternative approach described in RG 1.175

must be authorized by the NRC pursuant to 10 CFR 50.55a(a)(3)(i) on a plant-specific basis before being implemented by a given licensee. However, because 10 CFR 50.55a(a)(3)(i) 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 risk-informed IST methods without first obtaining NRC staff review and approval. Section 8 of this document discusses risk-informed IST in greater detail.

RG-1.193, "ASME Code Cases Not Approved for Use," does not presently identify any OM Code cases related to IST of pumps and valves that are unacceptable for implementation. However, if future revisions of the guide identify a Code case as being unacceptable, licensees may not implement the specified Code case without first obtaining NRC approval. Licensees may request the NRC's approval to implement a Code case listed in the guide under the provisions of 10 CFR 50.55a(a)(3), which permits the use of alternatives to the Code requirements referenced in 10 CFR 50.55a, provided that the proposed alternative results in an acceptable level of quality and safety, by addressing the NRC's concern and submitting a plant-specific relief request.

An IST program, including implementing procedures, is subject to the requirements of 10 CFR Part 50, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," and ASME OM Code Section ISTA. Changes to the scope, test methods, or acceptance criteria should be reviewed to the requirements of 10 CFR 50.59, 10 CFR 50.55a and 10 CFR 50.65 as appropriate.

The TSs for some plants may include IST requirements that are more restrictive than the regulations. Section 6 of this document describes how licensees may amend their TS requirements for IST to better address the regulations as the governing requirements.

2.2 Scope of Inservice Testing Programs

The intent of General Design Criterion (GDC) 1 (defined in Appendix A to 10 CFR Part 50) Criterion XI (defined in Appendix B to 10 CFR Part 50) is that all components (such as pumps and valves) that are necessary for safe operation must be tested to demonstrate that they will perform satisfactorily in service. Among other things, GDC 1 requires that components that are important to safety must be tested to quality standards that are commensurate with the importance of the safety function(s) to be performed. Appendix B to 10 CFR Part 50 describes the requisite quality assurance program, which includes testing, for safety-related components. In addition, 10 CFR 50.55a(f) requires that licensees must use the ASME OM Code for inservice testing of components that are covered by the Code. Each licensee has the responsibility to demonstrate the continued operability of all components within the scope of their IST program. The regulatory guides augment those requirements by providing additional NRC guidance regarding scope and classification. In short, *the ASME Code defines the scope, 10 CFR 50.55a endorses the Code with clarifications, and regulatory guides provide additional guidance.*

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). Specifically, 10 CFR 50.55a(f)(4) states, "Throughout the service life of a boiling- or pressurized-water-cooled nuclear power facility, pumps and valves which are classified as ASME Code Class 1, Class 2, and Class 3 must meet the inservice test requirements... set forth in the ASME OM Code."

ASME Code Class 1 components include all components within the reactor coolant pressure boundary. Draft RG 1.26, "Quality Group Classifications and Standards for Water-, Steam-, and Radioactive-Waste-Containing Components of Nuclear Power Plants," Revision 3, dated February 1976, provides guidelines for establishing the quality group classification (and ASME Code classification) for water-, steam-, and radioactive-waste-containing components of nuclear power plants, other than those in the reactor coolant pressure boundary (i.e., ASME Code Class 2 and 3 components).

The ASME OM Code is incorporated by reference in 10 CFR 50.55a(b)(3). The OM Code defines the scope by stating that IST programs shall include pumps and valves 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. 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 ASME Code Class 1, 2, and 3 components that are covered in Section ISTA of the ASME Code.

Subsection ISTA 1100 [1.1] of the OM Code refers to components that are "needed to mitigate the consequences of an accident." This statement is intended to provide confidence that the health and safety of the public will be protected in the event of certain accidents and anticipated transients at a nuclear power plant. The term "accident" is also used throughout the Commission's regulations. For example, Appendix B to 10 CFR Part 50 establishes quality assurance requirements for the design, construction, and operation of "structures, systems, and components that prevent or mitigate the consequences of postulated accidents that could cause undue risk to the health and safety of the public." Similarly, 10 CFR Part 100 describes structures, systems, and components that must be designed to remain functional during and following a "safe shutdown earthquake" as those necessary to ensure (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 that could result in potential offsite exposures comparable to the guideline exposures.

In establishing such requirements, the Commission uses the term "accident" to describe a broad range of possible adverse events at a nuclear power plant. Therefore, although most of the accidents of concern to IST are addressed in the accident analyses chapter, licensees should be aware that the plant's final safety analysis report (FSAR) may address other accident analyses that need to be considered within the context of IST.

Thus, an introductory section of the IST program document submitted to the NRC for each plant must state the plant's safe-shutdown condition (i.e., hot standby, hot shutdown, cold shutdown, etc.). If the scope in Section ISTA appears to be broader than that specified in 10 CFR 50.55a, the more narrow scope applies.

Components within the scope of 10 CFR 50.55a are included in the scope of 10 CFR 50.65, "Requirements for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants" (the "Maintenance Rule"). Licensees may elect to consolidate testing for pumps and valves, designating any non-Code components as such in the IST program.

The plant's FSAR (or equivalent) defines the equipment that is necessary to meet specific functions. If the FSAR indicates that a system or component is Code Class 1, 2, or 3, that system or component is within the scope of 10 CFR 50.55a. By contrast, if the FSAR states that a system or component is designed, fabricated, and maintained as Code class at the option of the Owner as permitted by Subsection ISTA-1320 [1.3.2], the application of the related OM Code requirements is also optional.

Tables 2.1 and 2.2 (which appear at the end of this chapter) provide 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 completed to date, the 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 (CRD) system check valves
(j) keep fill systems

Licensees should review the safety significance of these components to ensure that their IST is adequate to demonstrate their continued operability. 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 do not apply to BWRs. Each licensee should review the list and determine which items apply to its facility.

2.2.3 Testing of Non-Code Components

An IST program is also a reasonable vehicle to periodically demonstrate the operability of pumps and valves that are not covered by the Code. Thus, if a licensee chooses to include non-Code components in its ASME Code IST program (or some other licensee-developed testing program) and, as a result, is unable to meet certain Code provisions, the regulations (10 CFR 50.55a) do not require the licensee to submit a relief request to the NRC. Nonetheless, the licensee should maintain documentation that provides assurance of the continued operability of the non-Code components through the performed tests, and such documentation should be available for staff inspection at the plant site.

Therefore, while 10 CFR 50.55a delineates the testing requirements for ASME Code Class 1, 2, and 3 pumps and valves, licensees should not limit their inservice testing to only those pumps and valves that are covered by 10 CFR 50.55a. For example, the emergency diesel generator air start system is typically not Code Class 1, 2, or 3 and, therefore, 10 CFR 50.55a does not require licensees to test the related components under the provisions of the ASME Code. Nonetheless, emergency diesel generator air start, cooling water, and fuel oil transfer systems are considered safety-related and, as such, Appendices A and B to 10 CFR Part 50 require that they must be included in the scope of a component testing program and must undergo the required testing.

Licensees may implement deviations from the Code for non-Code components without NRC review and approval, and need not document such deviations as "relief requests." Nonetheless, a notation in the licensee's IST program document would help to identify the deviations and clarify that they relate to non-Code components. If it is not clear that the deviations relate to non-Code components, the staff might assume that the licensee is not meeting the requirements of 10 CFR 50.55a. Some licensees use the relief request format to document such deviations, while other licensees place notes, footnotes, or brief descriptions in their program documents.

2.2.4 Commitments to Include Components in IST Programs

If a licensee includes a component in the IST program, the component is considered to be within the scope of the program and may only be removed if the licensee meets the applicable criteria of 10 CFR 50.55a and 50.59. Similarly, if the TSs require a licensee to test a component in accordance with the IST program, it is considered to be within the scope.

As a result of the review of design-basis documents (DBDs), many licensees have reassessed the scope of their IST programs and considered deleting certain systems from the programs. To delete entire systems from the IST program, a licensee would perform a review and prepare documentation in accordance with 10 CFR 50.59 (if necessary).

Plants licensed under NUREG-0800, the NRC's "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants" (also known as the SRP), may have classified certain systems as Code Class 3, even though those systems would not have been classified as such in earlier plants. The SRP recommends (rather than requiring) that licensees should classify such systems as Quality Group C (which corresponds to Code Class 3 in Draft RG 1.26). Draft RG 1.26 states that it does not cover systems such as instrument and service air, diesel engines, their generators and auxiliary support systems, diesel fuel, emergency and normal ventilation, fuel handling, and radioactive waste management systems; however, these systems should be designed, fabricated, erected, and tested to quality standards that are commensurate with the safety function(s) to be performed.

The licensee is responsible for determining whether a system requires the Code Class 3 classification, or whether that classification is optional under Section ISTA 1320 [1.3.2]. Specifically, Section ISTA 1320 [1.3.2] 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 rules 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, as noted in Position 11 of GL 89-04. (Note that NRC approval may be necessary, as determined by the evaluation conducted in accordance with 10 CFR 50.59.)

2.3 Code Class Systems Containing Safety-Related Pumps and Valves

The plant safety analysis report (SAR), technical specifications (TSs), and other documents list the systems and components that must function to support the safe operation and shutdown of the plant. Tables 2.1 and 2.2 (which appear at the end of this chapter) list systems and components that are typically included in the IST programs for pressurized-water reactors (PWRs) and boiling-water reactors (BWRs). These tables are not intended to apply to all plants; the listed systems and components are not considered safety-related at every plant, and are not necessarily classified as Code Class 1, 2, or 3. (For information on quality group and Code classifications, see RG 1.26 and Section 3.9.6 of NUREG-0800.) The licensee's safety analysis generally contains a section describing the Code classification of components. The IST program scope must be consistent with the SAR.

2.4 IST Program Document

Within this discussion of the IST program document, Section 2.4.1 applies to pumps, while Section 2.4.2 applies to valves. These sections describe the information that licensees generally need to prepare the related sections of the IST program document.

The OM Code includes the rules for inservice testing of nuclear power plant components:

- Section ISTA includes general requirements for testing components.
- Subsection ISTA 9000 [3] addresses the records and reports that are required for these inspection and testing programs.
- Subsection ISTA 9210 [3.2.1] states that the owner shall prepare plans for preservice and inservice examinations and tests to meet the requirements of the OM Code.

- Subsection ISTA 9220 [3.2.2] states that licensees shall prepare examination, test, replacement, and repair records in accordance with the requirements of the respective articles of the OM Code.

- Articles ISTB 9000 [7] and ISTC 9000 [6] include additional guidance for the information that the IST program document must include for pumps and valves that perform safety functions.

- Appendix A to the OM Code gives 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 enough information to allow NRC inspectors to determine whether the testing complies with the Code requirements for test method and frequency. The tables could also note applicable NRC positions or recommendations for each pump or valve.

It is intended that the IST program should 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 staff recommends that the program plan submitted to the NRC should include documentation of the use of positions contained herein, as well as GL 89-04 positions, and Code cases.

2.4.1 Pumps

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

<u>Title</u>: List the applicable plant and unit.

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

<u>Program revision or revision date</u>: List the program or page revision number and date (on each page). List the revision number for each program change submitted.

<u>System, Code class, and group</u>: List the plant system, Code class, and valve group, and briefly describe the service of the pump.

<u>Pump identification</u>: 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 instrument diagrams (P&IDs), test procedures, and relief requests.

<u>Piping and instrument diagram number</u>: List the applicable P&ID or figure that depicts the pump in the system.

<u>Drawing coordinates</u>: List the coordinates of the pump on the P&ID.

Test parameters: List each of the five parameters in Tables ISTB-5200-1, 5300-1, and 5300-3 [4.1-1] for each pump. A column or a footnote is typically used to list factors that affect testing. List a relief request or Code case number where the testing will not be performed in accordance with the Code. Notes can be used where Code testing would otherwise be required. A relief request is not required if the test requirement is exempted by the Code.

Relief request(s): List any applicable relief requests in the pump table. Table 2.3 is an example of a data table for pumps.

2.4.2 Valves

In preparing valve tables, licensees should consider the following information, which includes headings and a description of the text that licensees could include under each heading. Table 2.4 lists common abbreviations used in valve data tables.

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 pump; this identifier should be used consistently in all IST program documentation and design information such as P&IDs, test procedures, and relief requests. If valves such as excess flow check valves are grouped together in the table, the number of valves and the valve number must be clearly indicated.

Piping and instrument diagram 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 (i.e., gate, globe, check, relief).

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

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

Code category: Specify the Code category (or categories), as defined in Subsection ISTC 1300 [1.4]. This determines the applicable subsections of the Code. For example, a motor-operated gate valve could be in Code Category A or B, while a self-actuated check valve could be in Category C or A/C.

Active/Passive: State whether a valve is active or passive, as defined in Subsection ISTC 2000 [ISTC 1.1 and ISTC 1.3]. Requirements vary based on the function of the valve. A valve need not be considered 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. 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 required to ensure operational readiness before positioning the valve in a new position, as determined on a case-by-case basis.

Safety position: List the safety function position(s), specifying 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.

Test frequency: List the actual frequency for each test to be performed. If it would be impractical or burdensome to perform the test at the frequency specified in the Code, reference cold shutdown or refueling outage justifications or relief requests for the alternative test frequency.

Relief requests and cold shutdown/refueling outage justifications: List any applicable relief request(s). In addition, when the testing is deferred to cold shutdowns or refueling outages, reference the technical justification (cold shutdown justification or refueling outage justification) for the test frequency.

Remarks: Include any pertinent information that is not stated elsewhere in the table such as a brief functional description of the valve. Also list any applicable GL 89-04 positions, and note any special conditions.

2.4.3 Piping and Instrument Diagrams

The staff recommends that licensees' program submittals should include P&IDs or system drawings to assist in locating the pumps and valves that are included in the program, and such drawings should be the latest revision at the time the program is submitted to the NRC. This information will assist the staff in reviewing relief requests or proposed alternatives. Inservice inspection 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 staff may request a set of full-size drawings for use in evaluating relief requests. A partial submittal of the program containing relief requests 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, the staff recommends that licensees should revise and resubmit the drawings in the next periodic submittal of revisions to the program document. The staff also recommends that licensees should include applicable drawings with relief request submittals that are very detailed and are submitted to supplement the IST program. Such drawings are helpful because the NRC's technical staff who review relief requests do not maintain a set of SARs for each plant and do not receive a copy of the IST program plan (which generally contains the applicable drawings). Drawings are helpful in reviewing relief requests, regardless of whether they are submitted as part of the program document or as an attachment applicable to any relief request or proposed alternative.

2.4.4 Bases Document

The staff recommends that each licensee should 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," dated November 1992. Bases documents have typically included a description of the methodology used in preparing the IST program, with a list of each pump and valve in a system within the boundaries for a Code class, 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 will 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 necessarily a "licensing-basis document," the bases document is a useful reference for reviews performed under 10 CFR 50.59 when changes are made to a facility.

2.4.5 Deferring Valve Testing to Cold Shutdown or Refueling Outages

Exercising valves on a cold shutdown or refueling outage frequency does not constitute a deviation from the Code. Subsection ISTC 3520 [4.2.2] provides guidance for testing valves during cold shutdown or refueling outages if it is impractical to test during operation. The licensee must list the affected valves in the program document and include cold shutdown or refueling outage justifications for each affected valve or group of valves. The staff recommends that licensees should include these cold shutdown and refueling outage 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 refueling outages 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 refueling outages), even though the use of nonintrusive techniques is recommended where practical. However, the NRC would continue to require the quarterly partial-stroke testing as applicable. (See also Section 3.1.1)

A licensee may request relief from quarterly testing where such testing would impose a hardship (e.g., entering a limiting condition for operation of 3 to 4 hours in duration, repositioning a breaker from "off" to "on," and necessitating for 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 refueling outages. NUREG/CR-5775, "Quantitative Evaluation of Surveillance Test Intervals Including Test-Caused Risks," dated March 1992, describes a method for making this comparison.

In the event of a planned or unplanned maintenance outage, a licensee may decide to test valves in a cold shutdown mode, rather than waiting for the refueling outage. 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 3560 [4.2.7] 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 may also 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 would require major plant or hardware modifications
- testing has a high potential to cause a reactor trip
- testing could cause system or component damage
- testing could create excessive plant personnel hazards
- existing technology 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 staff does not supersede the TS requirements. For example, if testing is specified as part of the TS surveillance, the cycling of non-redundant 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.

Licensees are expected to comply with required test frequencies. The 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; however, the staff expects licensees to expend a reasonable "good faith" effort.

This issue is further discussed in Sections 3 and 4, which give guidance on deferring testing.

2.5 Relief Requests and Proposed Alternatives

A licensee may submit a request for the NRC to review and approve relief from requirements of the Code, or to authorize the use of proposed alternatives. The staff recommends that the basis for relief should address the following considerations:

(1) Does the proposed alternative provide an acceptable level of quality and safety? (10 CFR 55a(a)(3)(i))

(2) Would compliance with the specified requirement result in a hardship or unusual difficulty without a compensating increase in the level of quality and safety? (10 CFR 55a(a)(3)(ii))

(3) Would it be impractical to comply with the Code requirements? (10 CFR 55a(f)(6)(i))

The justification must include adequate information for the staff to determine if the relief can be granted or the alternative can be authorized (e.g., as applicable, damage to equipment, hazards to personnel, and the possibility of a plant trip). NRC approval is required before a licensee may implement proposed alternatives that must be authorized pursuant to 10 CFR 50.55a(3). By contrast, a licensee may implement proposed alternative testing while the NRC is reviewing requests for relief from Code requirements made pursuant to 10 CFR 50.55a(f)(6)(i), if the licensee has determined that the requirements are impractical.

Within 10 CFR 50.55a, the regulation uses the term "extent practical" several times with respect to ISI and IST requirements for nuclear power plant components. For example, 10 CFR 50.55a(f)(4) states that "pumps and valves which are classified as ASME Code Class 1, Class 2, and Class 3 must meet the requirements... set forth in Section XI of editions of the ASME Boiler and Pressure Vessel Code... *to the extent practical* within the limitations of design, geometry, and materials of construction of the components." "Extent practical" is a common term used in a general context. However, it is helpful to clarify how the NRC staff has used the terms "practical" and "impractical" in implementing the requirements of 10 CFR 50.55a.

Webster's Dictionary defines "practical" as "capable of being used." With respect to ASME Code requirements, the NRC staff has interpreted "practical" requirements to mean those that are actually capable of being implemented within the limitations of design, geometry, and materials of construction of the component. Conversely, the staff has interpreted "impractical" requirements to mean those that are incapable of being implemented within the limitations of design, geometry, and materials of construction of the component. Where a licensee determines that an ASME Code requirement is impractical, the NRC staff may grant relief from the requirement, giving due consideration to the burden that might be imposed on the licensee if the NRC enforced the requirement. Impractical conditions include the following situations:

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

Nuclear power plant licensees may also propose alternatives to ASME Code requirements — even when such requirements would be "practical" to implement — if the proposed alternatives would provide an acceptable level of quality and safety or if compliance with the specified requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety pursuant to 10 CFR 50.55a(a)(3)(i) and 10 CFR 50.55a(a)(3)(ii), respectively. The NRC staff has interpreted "hardship" to mean a high degree of difficulty or an adverse impact on plant operation, as illustrated by the following examples:

- having to enter multiple TS limiting conditions for operation
- raising ALARA concerns
- replacing equipment or in-line components
- creating significant hazards to plant personnel

The staff performs a detailed review of each relief request, grants relief from the requirements or authorizes an alternative to those requirements, and may impose alternative requirements. When granting relief, the NRC considers the burden that would be imposed upon the licensee if the agency enforced the specified requirements.

2.5.1 Justifications for Relief

In determining whether to grant relief from the Code requirements or to authorize alternatives, the NRC staff considers the merits of the submitted technical information. In requesting relief, the licensee would typically identify the specific Code requirement and associated paragraph for which relief 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 staff in previous safety evaluations for plant-specific requests) may include the following examples:

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

(2) Compliance with the Code is impractical because of design limitations. Imposition of the Code requirements would require significant system redesign and modifications. For example, a flow meter does not meet the accuracy requirements of ISTB 3510 [4.7.1] and Table ISTB 3500-1 [4.7.1-1] 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).

(3) 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.

(4) The need to keep personnel radiation exposure as low as reasonably achievable (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 doing 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 refueling outages 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. The NRC has not established "predetermined acceptable limits" for deferring an IST activity, based on maintaining occupational exposure ALARA.

(5) Testing as required by the 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.

(6) Failure of a component during testing could disable multiple trains of a reactor safety system. 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 (see Section 3.1.2).

Inconvenience or administrative burden are not, in and of themselves, adequate justification for deviating from the Code requirements. Similarly, entering a TS limiting condition for operation (LCO) is not, in and of itself, adequate justification for deviating from the Code-specified frequency, except when entering the LCO would be prohibited because the total system function would be out of service (see Section 3.1.2).

2.5.2 Categories of Relief Requests

The NRC staff categorizes relief requests as follows:

- General: A general relief request is appropriate when the requested relief applies to a broad range of similar components in the program, such as all pumps or all containment isolation valves.

- Specific: A relief request is specific when the requested relief applies only to a single component or a specified group of similar components in the program, such as service water pump discharge check valves.

2.5.3 Content and Format of Relief Requests

As a minimum, the staff recommends that each relief request should include the following information:

- Title and relief request number: Title each relief request and specify a unique identifier. The identifier should remain unique to avoid confusion when later revisions are made. Examples include (1) "Relief Request Number 1," (2) "Safety Injection Pumps Relief Request," or (3) "Check Valves in Series Relief Request."

- 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.

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

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

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

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

- ASME Code test requirement(s): List and describe the Code requirement(s) from which relief is being requested.

- Basis for relief: Clearly state the legal basis under which relief is requested, and then explain the reasons why complying with the Code requirements is impractical, poses a hardship, or otherwise should not be enforced. Include justification for each test frequency deferral (e.g., quarterly to cold shutdown), and state and justify the proposed frequency. 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 Code requirement, and provide a technical basis for its acceptability.

- 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 request, or include them in the IST program document and reference them in the relief request.

- References: List references to SAR sections, technical specifications, and other pertinent documents (e.g., applicable position of GL 89-04). Any document referenced in the relief 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 staff and the public), rather than merely referencing the document.

In June 2004, the NEI issued a White Paper, entitled "Standard Format for Requests from Commercial Reactor Licensees Pursuant to 10 CFR 50.55a, Revision 1." This White Paper, included as Attachment A to NUREG-1482, Revision 1, provides useful guidance for determining the appropriate regulatory requirement under which a "relief request" is submitted for NRC approval, as well as the appropriate format and content to use in the request. The term "relief request" is used loosely in this instance to denote the various types of submittals allowed by 10 CFR 50.55a, including alternatives to the regulation [10 CFR 50.55a(a)(3)], impractical relief requests [10 CFR 50.55a(f)(6)(i)], and requests to use later Code Editions and Addenda [10 CFR 50.55a(f)(4)(iv)]. The NRC staff has reviewed the NEI White Paper and encourages licensees to use the specified format and content.

2.6 Program Documents

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 10-year interval program submittals, the NRC would like to receive up-to-date program documents when the licensee makes significant changes to the IST program to facilitate these regulatory activities.

As long as the IST program is consistent with the regulations, ASME 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, and that all such components are tested to the extent practical. If a licensee deletes a particular component from its IST program, the staff recommends that the licensee should document the reason in an appropriate place.

The 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 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. Conversely, if a system modification results in the addition of a component to the IST program, the licensee should ensure that it meets the Code requirements or the provisions of GL 89-04, or that a relief request is submitted for NRC review and approval, as appropriate.

Table 2.1 Typical Systems and Components in an Inservice Testing Program for a Pressurized-Water Reactor

Typical safety-related, Code-class systems in pressurized-water reactors	**Typical components in an inservice testing program**
Reactor coolant system and flowpaths for establishing natural circulation	Power-operated relief valves 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 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 (RWST) borated water storage tank (BWST), and refueling water tank (RWT), 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 Pressurized-Water Reactor (continued)

Typical safety-related, Code-class systems in pressurized-water reactors	**Typical components in an inservice testing 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, 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
Auxiliary feedwater system	Auxiliary feedwater 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

Table 2.1 Typical Systems and Components in an Inservice Testing Program for a Pressurized-Water Reactor (continued)

Typical safety-related, Code-class systems in pressurized-water reactors	**Typical components in an inservice testing program**
Primary containment system	Containment isolation valves (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
Service water system	Service water pumps and suction/discharge check valves Valves in flowpath to auxiliary feedwater 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

Table 2.1 Typical Systems and Components in an Inservice Testing Program for a Pressurized-Water Reactor (continued)

Typical safety-related, Code-class systems in pressurized-water reactors	**Typical components in an inservice testing program**
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 power-operated relief valves (PORVs) Air supply to MSIVs

Table 2.2 Typical Systems and Components in an Inservice Testing Program for a Boiling-Water Reactor

Typical safety-related, Code-class systems in boiling-water reactors	Typical components in an inservice testing program
Nuclear boiler and reactor recirculation system	Primary system isolation valves Excess flow check 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 core coolant injection (HPCI) system	Pump and suction/discharge check valve 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)
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 (if safety-related)	Pump and suction/discharge check valve RCIC pump turbine valves Excess flow check valves Isolation valves
Reactor water cleanup system	Containment isolation valves

Table 2.2 Typical Systems and Components in an Inservice Testing Program for a Boiling-Water Reactor (continued)

Typical safety-related, Code-class systems in boiling-water reactors	Typical components in an inservice testing program
Residual heat removal (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 (SBLC) system	SBLC pumps and suction/discharge check valves Relief valves Injection line valves Explosively-actuated squib valves
Main feedwater system	Isolation valves

Table 2.2 Typical Systems and Components in an Inservice Testing Program for a Boiling-Water Reactor (continued)

Typical safety-related, Code-class systems in boiling-water reactors	Typical components in an inservice testing program
Primary containment system	Containment isolation valves 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
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 residual heat removal service water flowpath
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

Table 2.2 Typical Systems and Components in an Inservice Testing Program for a Boiling-Water Reactor (continued)

Typical safety-related, Code-class systems in boiling-water reactors	**Typical components in an inservice testing program**
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 (ADS) valve accumulator check valves ADS pilot valves
Traversing incore probe system (if within the scope of 10 CFR 50.55a)	Containment isolation valves

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	M-402 Sh. 1	D-4	A	(1)	(2)	Q/2Y	Q/2Y	Q/2Y
	RHR-02	M-402 Sh. 2	G-4		(1)	(2)	Q/2Y	Q/2Y	Q/2Y
	RHR-03	M-402 Sh. 2	F-5		(1)	(2)	Q/2Y	Q/2Y	Q/2Y
Auxiliary Feedwater	AFW-01	M-408 Sh. 1	B-5	B	(1)	(2)	Q/2Y	Q/2Y	2Y
	AFW-02	M-408 Sh. 1	B-8		(1)	(2)	Q/2Y	Q/2Y	2Y
	AFW-03	M-408 Sh. 1	B-11		Q/2Y	(2)	Q/2Y	Q/2Y	2Y
Service Water	SWS-01	M-335 Sh. 1	F-9	A	(1)	(2)	Q/2Y	PR-3	PR-2
	SWS-02	M-335 Sh. 2	D-4		(1)	(2)	Q/2Y	PR-3	PR-2
	SWS-03	M-335 Sh. 3	E-8		(1)	(2)	Q/2Y	PR-3	PR-2
	SWS-04	M-335 Sh. 4	C-4		(1)	(2)	Q/2Y	PR-3	PR-2
Standby Liquid Control	SLC-01	M-367 Sh. 1	D-9	B	(1)	2Y	(3)	Q/2Y	2Y
	SLC-02	M-367 Sh. 1	D-4		(1)	2Y	(3)	Q/2Y	2Y

Note (1): Pump is directly coupled to a constant 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, inlet
- dP Differential Pressure
- PR Pump Relief Request
- Q Quarterly
- V Vibration

Table 2.4 Useful Abbreviations for Valve Data Tables

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	Explosive 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
Test(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	Explosive 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 refueling outage
	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 refueling outage

3. GENERAL GUIDANCE ON INSERVICE TESTING

3.1 Inservice Test Frequencies and Extensions for Valve Testing

The *Code for Operation and Maintenance of Nuclear Power Plants* (OM Code), promulgated by the American Society of Mechanical Engineers (ASME), generally specifies quarterly testing of valves. Section ISTC of the Code allows licensees to defer valve exercising to cold shutdown or refueling outages if it is not practical to exercise the valves during plant operation. The staff of the U.S. Nuclear Regulatory Commission (NRC) may approve relief to extend a test interval for extenuating circumstances in which (1) compliance would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety, or (2) the system design makes compliance impractical. 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. Any relief request would typically include a technical justification for the deferment. Table 3.1 (below) lists the tests and associated test frequencies required by the Code.

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

Test	Frequency
Measure pump parameters	Once every 3 months (Group A, B) Bienially (Comprehensive Test) Exceptions: • Pumps in systems that are out-of-service • Group B Pumps lacking required fluid inventory
Exercise Category A and B valves	Once every 3 months Exceptions: • Extension because of impracticality • Valves in regular use • Valves in systems out of service
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 in systems out of service
Verify remote position indication	Once every 2 years
Observe operation of fail-safe actuators for applicable valves	Once every 3 months, except for extension because of impracticality

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

Test	Frequency
Leak-test Category A and A/C valves	Once every 2 years[2]
Test safety and relief valves, primary containment vacuum relief valves, and non-reclosing pressure relief devices	Test interval specified by OM Appendix I
Exercise check valves	Once every 3 months Exceptions: • Extension because of impracticality • Valves in regular use • Valves in systems out of service
Test explosively actuated valves	20 percent tested once every 2 years. Charges shall not be older than 10 years.

3.1.1 Deferring Valve Testing to Each Cold Shutdown or Refueling Outage

The OM Code allows licensees to test valves during cold shutdowns if it is impractical to test the valves quarterly during plant operation. Subsection ISTC 3500 [4.2] provides guidance and alternatives. Therefore, exercising valves during cold shutdown outages does not constitute a deviation from the Code and does not require a relief request if the licensee determines that quarterly testing is impractical. Similarly, the OM Code allows licensees to test valves during each refueling outage if it is impractical to test the valves during cold shutdowns. In such instances, the licensee must identify the valves for which testing is deferred and the inservice testing (IST) program document must specify the basis for determining that quarterly and/or cold shutdown testing is impractical.

In 1976, the NRC staff issued guidance in the form of letters to licensees, which included examples of valves to be specifically excluded from exercising (cycling) tests during plant operations. This guidance may not apply in all cases; for example, high-pressure coolant injection (HPCI) turbine steam supply and pump discharge valves may be tested quarterly during pump testing. The excluded valves include the following examples:

(1) 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 non-redundant valves in lines such as a single discharge line from the refueling water storage tank (RWST) or accumulator discharge lines in pressurized-water reactors (PWRs) and the HPCI turbine steam supply and HPCI pump discharge in boiling-water reactors (BWRs). Other valves may fall into this category under certain system configurations

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2 An allowance for demonstration of the leak tight function during the course of operation is treated as an exception to the scope of ISTC3600 [4.3], with certain provisions for record requirements, and the test frequency for valves not subject to the exception continues to be once every 2 years (ISTC3630 [4.3.3]).

or plant operating modes. For example, when one train of a redundant system (such as an emergency core cooling system, or ECCS) is inoperable, non-redundant valves in the remaining train should not be cycled because their failure would cause a loss of total system function.

(2) 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.

(3) 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 has 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 residual heat removal/shutdown cooling system and, in some cases, certain ECCS valves.

If a technical specification (TS) surveillance requires a test, even when one train is out of service, the possible safety consequences of performing the test have been weighed against the benefits of testing. The guidance herein and in the NRC's 1976 letters to licensees does not supersede the TS requirements.

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 refueling outages 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 refueling outages), even though the use of nonintrusive techniques is recommended where practical. However, the NRC would continue to require the quarterly partial-stroke testing as applicable. (See also Section 2.4.5)

A licensee may request relief from quarterly testing where such testing would impose a hardship (e.g., entering a limiting condition for operation of 3 to 4 hours in duration, repositioning a breaker from "off" to "on," and necessitating for 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 refueling outages. NUREG/CR-5775, "Quantitative Evaluation of Surveillance Test Intervals Including Test-Caused Risks," dated March 1992, 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 IST Cold Shutdown Testing

Although Section 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.

Subsection ISTC 3520 [4.2.2] 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 a refueling outage.

Valves that must be operable during cold shutdown may be tested during plant operation in accordance with either Subsection ISTC 3520 [4.2.2], "Exercising Requirements," or Subsection ISTC 3550 [4.2.5]; "Valves in Regular Use." By contrast, Subsection ISTC 3550 [4.2.5] 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

Subsection ISTC 3520 [4.2.2] specifies that valves that are tested on a refueling outage frequency should be tested before returning the plant to operation at power. Several licensees have indicated that they cannot test certain valves until power ascension begins. The NRC staff has included this section to provide guidance for such valves and to indicate that the operability TSs would control the timing for testing such valves. It is intended that the IST program document will identify such valves as being tested on a refueling outage 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 refueling outages); however, Section ISTC uses different language in discussing valves that are tested on a cold shutdown frequency.

Before beginning power ascension from a refueling outage, licensees normally complete the tests of those valves that are tested during each refueling outage. However, for valves that can only be tested 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. If maintenance has been performed on a valve during the outage, the licensee is required to consider the valve "inoperable" until post-maintenance testing has been completed in accordance with the operability requirements in the TS. This situation could also apply to valves that are tested during power ascension or at power following a cold shutdown outage.

NRC Recommendation

The OM Code requires licensees to complete all valve testing that is scheduled for performance during a refueling outage before returning the plant to operation; however, for valves that must be tested during power ascension and for which TS requirements (for the valves or the associated system) determine when the valves are required to be operable, the testing may be scheduled for refueling outages or during cold shutdown conditions. The NRC has determined that Subsection ISTC 4520 [4.2.2(h) and 4.5.2(h)] is acceptable for all licensees to implement. Therefore, relief is not required, provided that the licensee meets all requirements of these provisions.

Basis for Recommendation

The staff has determined that the guidance in this section is consistent with Subsection ISTC 3520 [4.2.2(h) and 4.5.2(h)] and the TS requirements and, therefore, is acceptable for meeting these provisions.

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

According to 10 CFR 50.44, "Standards for Combustible Gas Control System in Light-Water-Cooled 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 TSs specify the maximum oxygen concentrations allowed. Since hydrogen generation is not a concern during cold shutdown or refueling outages, the TSs 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, Subsection ISTC 3500 [4.2] allows licensees to perform testing during cold shutdown outages because it is not practical to test such valves during power operation. The 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 staff considers it impractical to de-inert the containment merely to conduct regularly scheduled valve testing, and the ASME Code allows licensees to defer such testing to a refueling outage when the containment is de-inerted for refueling or other reasons. The staff has also 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 Subsection ISTC 3570 [4.2.7] may apply for valves in systems that are out-of-service.

Basis for Recommendation

Section ISTC of the OM Code allows licensees to extend the test interval to defer valve testing to refueling outages 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 valves that cannot be tested unless the containment is de-inerted.

Unless the licensee has some other reason to enter the drywell during cold shutdown outages, it is impractical to de-inert the drywell during such outages merely to perform valve testing because of 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). Most plants with custom TSs must reduce the primary containment oxygen content to less than 4 percent within 24 hours of placing the reactor mode switch in the "run" position. If, for any reason, the licensee is unable to establish the proper oxygen concentration, the plant must return to the startup mode. Plants using the standard technical specifications are also restricted, in that the licensee must establish the proper oxygen content within 24 hours of exceeding 15-percent thermal power. If, for any reason, the licensee is unable to establish the proper oxygen concentration, the plant must enter a shutdown action statement. In either case, the return to power could be significantly delayed.

3.1.1.4 Stopping Reactor Coolant 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 the reactor coolant pumps, such as component cooling and the supply and return of seal water during cold shutdown. Exercising these valves while the reactor coolant pumps are operating could result in pump damage, and stopping the pumps could extend the cold shutdown period.

NRC Recommendation

The staff recommends that licensees should test the affected valves on a refueling outage schedule and during plant outages when the reactor coolant pumps are stopped for a sufficient period of time, but not more often than once every 92 days.

Basis for Recommendation

Section ISTC of the OM Code allows licensees to extend the test interval to defer testing to refueling outages when it is not practical to perform the tests during power operation or cold shutdown outages. The NRC staff has determined that licensees need not schedule valve testing that requires stopping and restarting reactor coolant pumps during each cold shutdown solely to allow for the testing of such 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 reactor coolant pumps are stopped for a sufficient period of time. However, valves are to be tested at least during each refueling outage.

3.1.2 Entry into a Limiting Condition for Operation To Perform Testing

Unless accompanied by some other acceptable rationale, the necessity to enter into an LCO to perform IST would not be sufficient justification to defer testing until a cold shutdown or refueling outage. Therefore, the NRC staff issued Generic Letter (GL) 87-09, "Sections 3.0 and 4.0 of the Standard Technical Specifications (STS) on the Applicability of Limiting Conditions for Operation and Surveillance Requirements," dated May 4, 1987, to provide guidance on the following three issues regarding the applicability of LCOs and surveillance requirements:

(1) unnecessary restrictions on mode changes by TS 3.0.4, and inconsistent application of exceptions thereto

(2) unnecessary shutdowns caused by TS 4.0.3 when licensees inadvertently exceed surveillance intervals

(3) two possible conflicts with TS 4.0.3 and 4.0.4:
- surveillance requirements that become applicable as a result of action requirements
- surveillance requirements associated with TS 4.0.4

The enclosures to GL 87-09 included the following statement regarding the bases for TSs 3.0.1 – 3.0.4 and entry into an LCO:

> It is not intended that the shutdown ACTION requirements be used as an operational convenience which permits (routine) voluntary removal of a system(s) or component(s) from service in lieu of other alternatives that would not result in redundant systems or components being inoperable. The specified time limits of the ACTION requirements are applicable from the point in time it is identified that a Limiting Condition for Operation is not met. The time limits of the ACTION requirements are also applicable when a system or component is removed from service for surveillance testing or investigation of operational problems. Individual specifications may include a specified time limit for the completion of a Surveillance Requirement when equipment is removed from service. In this case, the allowable outage time limits of the ACTION requirements are applicable when this limit expires if the surveillance has not been completed.

In GL 87-09, the NRC staff stated its position that the structure of the referenced TS accounts for entry into an LCO to perform surveillance testing. If the time allowed for equipment to be out-of-service is not sufficient to perform a surveillance test, a TS change request may be appropriate to allow additional out-of-service time for surveillance, provided that such a change would not compromise safety. The NRC issued guidance on entry into an LCO, as documented in NRC Inspection Manual Part 9900, "Technical Guidance: Maintenance — Voluntary Entry into Limiting Conditions for Operation Action Statements

To Perform Preventive Maintenance," dated April 18, 1991, which provides safety principles for the performance of preventative maintenance that renders the affected system or equipment inoperable.

When a licensee removes a train from service to perform surveillance testing, the TSs typically require the other train to be operable. The staff, therefore, recommends that licensees should minimize the out-of-service time of the tested train. The probability of a design-basis accident occurring during the short period of time a train is out-of-service is considered low, while the assurance of component operational readiness through surveillance testing provides an increased level of safety. However, IST that involves completely removing a system from service may not be acceptable for safety. Licensees must generally avoid entering into multiple LCOs (although the safety analysis may not prohibit certain situations and plant configurations).

If a system or subsystem is designed to realign automatically during testing and, therefore, is not considered out-of-service, the licensee need not enter an LCO. If a licensee intends to rely on the automatic action of a component (such as repositioning of a valve), the staff will expect the licensee to have conducted appropriate testing and maintenance on the component to provide confidence that it is capable of automatically performing its safety function from its condition during testing. The NRC has approved relief requests for situations that would have required operators to manually manipulate one or more valves to restore a system to an operable status if the system function became required during IST.

Therefore, if a licensee chooses to defer testing from quarterly to cold shutdown or refueling outages, the relief request must include other justification in addition to entry into an LCO. If the deferral is not justified by additional bases, the licensee must perform tests quarterly or during cold shutdown (as justified), with entry into the LCO to complete IST within the out-of-service time allowed by the TSs. Unless accompanied by some other acceptable rationale, the necessity to enter into an LCO to perform IST is not sufficient justification to defer testing until a cold shutdown or refueling outage.

3.1.3 Scheduling of Inservice Tests

Most TSs define the test frequencies and intervals that the OM Code specifies for IST activities. Any changes to this test frequency, such as testing a specific pump every 184 days (biannually), would require a TS change and a relief request to extend the test interval, unless otherwise allowed by the Code.

NRC Recommendation

To eliminate ambiguity concerning the periods stated in the Code, the staff recommends that licensees should use the stated test frequency definitions (as shown in Table 3.2, below), even if the TSs do not include the frequencies. For example, Subsection ISTC 3510 [4.2.1] requires licensees to test Category A and B valves "nominally every 3 months." For quarterly testing, the staff recommends that licensees should 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."

Table 3.2 ASME OM Code Terms for Inservice Testing Activities

Term	Required frequency for IST activities (at least once every)
Monthly	31 days
Quarterly (or Every 3 months)	92 days
Yearly (or Annually)	366 days
Refueling	refueling outage
2 years	24 months

In accordance with the TSs, licensees must perform each applicable test within the specified time interval, with a maximum allowable extension not to exceed 25 percent of the test interval. However, licensees should not extend the test intervals for safety and relief valves defined in Appendix 1 to the OM Code, other than to coincide with a refueling outage. If the conjunction ***and*** is used in specifying test frequencies (such as "once every refueling outage ***and*** following modifications or maintenance"), licensees must perform the test at both specified frequencies. By contrast, if the conjunction ***or*** is used in specifying test frequencies (such as "once every refueling outage ***or*** once every 2 years"), licensees may perform the specified test at either specified frequency. Licensees may also apply a 25-percent extension to the 2-year interval, unless the TS or relief request stipulates "whichever is more conservative," or another statement to that effect.

The Code specifies performing the tests throughout extended shutdown periods for operable equipment. 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). The OM Code provisions in Subsections ISTB 3420 [5.4] and ISTC 3570 [4.2.7] specify that licensees need not follow the test schedule if the system in which the component was installed was declared inoperable or was not required to be operable. However, this applies only if the out-of-service component was not out-of-service to be repaired or replaced, and the component must be tested within 3 months of the system being returned to service.

Basis for Recommendation

This recommendation is based on the standard technical specifications, which the NRC staff have developed, reviewed, and approved. The specified intervals and extensions apply directly to IST, which is a TS surveillance requirement for certain pumps and valves. In Interpretation XI-78-01, the ASME Code Committee clarified the intent of the "2-year" frequency specified for verifying position indication and performing leak rate testing, stating that the Code test and examination frequency relates to periods of time, rather than refueling outages. The Code references refueling outages to preclude the necessity to shut down the plant solely for IST. The OM Code specifies that licensees must perform the valve position indicator test and leak rate test at least every 2 years, without regard to the frequency of refueling outages.

The NRC recommendation for extended shutdown periods is consistent with TS and Code requirements, whichever are more conservative. Responding to inquiry IN 92-025A, the ASME Code Committee stated that Subsection ISTC 3510 [4.2.1 and 4.5] intends that testing be conducted every 3 months, including during extended shutdown periods, for valves other than those declared inoperable in accordance with ISTC 3570 [4.2.7]. The OM Committee made a similar clarification in OM Interpretation 93-1, stating that it is intended that testing be conducted every 3 months, including during extended periods, for valves other than those declared inoperable or not required to be operable.

3.2 Start of the Time Period in Technical Specification Action Statements

Subsection ISTB 6200 [6.2.2] states, "If the measured test parameters fall within the required action range..., the pump is to be declared inoperable." Subsection ISTC 5224 [4.2.9] also indicates that valves failing to meet acceptance criteria shall be declared inoperable. In addition, in GL 87-09 and the bases for TS 4.0.5, the NRC staff issued guidance regarding the time period for evaluating component operability. Specifically, the bases for TS 4.0.5 included the following statement:

> Under the terms of this specification, the more restrictive requirements of the Technical Specifications take precedence over the ASME Boiler and Pressure Vessel Code and applicable Addenda. The Technical Specification definition of OPERABLE does not allow a grace period before a component that is not capable of performing its specified function is declared inoperable.

In addition, in Position 8 of GL 89-04, the NRC staff stated that a pump or valve that exhibits performance in a required action range must be declared inoperable, and the TS action period must be started as soon as the data is recognized as being in the specified action range (or a valve exceeds a limiting stroke time or fails to exhibit the required change of disk position). Pumps and valves covered by the OM Code are frequently in systems covered by the TSs. Upon declaring a component inoperable, a licensee may be required to place the plant in an action statement, which generally allows a specific time period for continued operation. If the equipment remains inoperable after the time period, the licensee may be required to take action, such as to begin a plant shutdown.

NRC Recommendation

The NRC staff recommends that licensees' test procedures should include test parameter reference values and acceptance criteria to enable the licensee to quickly determine the condition of a component. Using this information would allow those responsible for conducting the test to determine whether the data meet the acceptance criteria and would ensure that the pump or valve is operable. At a minimum, the staff recommends that the determination should be made by the same duty shift that performed the test, unless the test results are not available before the end of the shift, in which case, the on-coming duty shift may need to make the determination.

After declaring a component inoperable and determining that an engineering analysis of the condition is appropriate to determine whether the component can be returned to service, the analysis would typically be performed within the time allowed by the TS action statement. A preliminary analysis may be acceptable as a basis for declaring the pump or valve operable and exiting the action statement, with a more detailed analysis to follow. The preliminary analysis would typically contain sufficient basis on which to determine that a component is operable in its degraded condition, with the component placed on an increased test frequency as specified in the Code, if applicable. In performing the analysis, the licensee would also typically determine that the redundant train(s) are operable to perform the safety function of the affected equipment. The operability of a redundant train may be determined on the basis of its last surveillance, the maintenance condition of the system, and a determination that the cause of the degradation of the affected equipment does not also apply to the equipment in the redundant train. Testing may be appropriate, but might not be allowed if all trains of the system would be inoperable during testing.

The more detailed analysis would follow in a timely manner; that is, within a time period appropriate to the circumstances and level of detail necessary to complete the analysis. Upon completion of the detailed analysis, the licensee would take appropriate actions relative to the operability of the component. The licensee's analysis would address the condition of the component (and not be based solely on a system condition), with a conclusive determination of the cause of the degradation to ensure that redundant components would not be degraded by the same cause. To complete an engineering analysis, the licensee would not typically exceed the time allowed in the applicable LCO.

Basis for Recommendation

The limits established for IST are based on Code provisions or the limits specified in either the TS or the safety analysis, whichever are more conservative. Each plant's safety analysis includes the minimum required performance parameters for a component to meet the most limiting conditions under which the plant may need to operate for various scenarios.

For example, a pump may have three times the capacity necessary to meet the maximum analyzed capacity for accident conditions. The reference values for the pump and the Code-specified action limits may be much higher than the necessary capacity of the pump since the Code limits are not based on system requirements (see Sections 5.6 and 5.7 and GL 91-18). However, in exceeding the Code limits, the pump might exhibit degraded performance and might soon fail. Note that if the testing indicates that instruments are erratic, the test may be discontinued and the instruments re-calibrated (or replaced by a calibrated instrument that meets the Code requirements for accuracy, range, vibration parameters, etc.) without declaring the pump inoperable.

Upon finding a pump or valve in the Code-specified action range, the TSs (if applicable) would require the licensee to declare the pump or valve inoperable while reviewing the test results and making comparisons to previous test results to evaluate its condition and determine whether it can be returned to an operable status. If the licensee finds that the component is operable and is not in danger of further degradation over an acceptable period of time, the licensee's engineering analysis might justify returning the component to an operable status until such time that repairs can be performed, as allowed by the Code. However, if the licensee confirms that the component is inoperable or determines that the condition will soon result in further degradation, immediate action will be necessary to repair or replace the component.

This NRC recommendation allows the licensee to conduct a preliminary engineering analysis to assess operability of the component. If a preliminary analysis is performed, the staff will expect the licensee to perform a more detailed analysis in a timely manner after declaring a component operable based on a preliminary analysis. The more detailed analysis may result in determining that the component is incapable of performing its safety function, with the licensee taking appropriate subsequent actions. The staff also expects that few detailed analyses will result in declaring the component inoperable.

3.3 120-Month Updates Required by 10 CFR 50.55a(f)(4)(ii)

After the initial 120-month interval, in accordance with 10 CFR 50.55a(f)(4)(ii), licensees must conduct inservice tests during successive 120-month intervals to verify the operational readiness of pumps and valves within the scope of the ASME Code. In conducting these inservice tests, licensees must comply with the provisions of the latest edition and addenda of the Code incorporated by reference in 10 CFR 50.55a(b) 12 months before the start of the 120-month interval, subject to the limitations and modifications listed in paragraph (b). In addition, 10 CFR 50.55a(f)(5)(iv) specifies that licensees must list any test requirements that are found to be impractical for the new interval, such that "the basis for this determination be demonstrated to the satisfaction of the Commission not later than 12 months" from the start of the interval. Therefore, the staff recommends that licensees should submit relief requests for new intervals approximately 6 months before the start of the interval to allow adequate time for NRC review and approval.

3.3.1 Extension of Interval

The IST interval may be extended in accordance with Subsection ISTA 3120(d) [2.2.3(d)]:

> Each IST interval may be extended or decreased by as much as 1 year. Adjustments shall not cause successive intervals to be altered by more than 1 year from the original pattern of intervals.

Subsection ISTA 3120(e) [2.2.3(e)] 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.

NRC Recommendation

In establishing the date for the new interval, licensees must establish the next updated program to the latest edition of the Code incorporated in the regulation 12 months before the new date. For example, if a licensee has an extension from December 14, 2000, to September 16, 2001, in accordance with the Code, the licensee's program for the new interval must meet the edition of the Code incorporated in 10 CFR 50.55a(b) as of September 16, 2000. When extending its 10-year IST interval by as much as 1 year, as allowed by ISTA 3120(d) [2.2.3(d)], licensees may continue to apply the same Code edition and addenda from its current 120-month interval during this extended 1-year period. The staff recommends that licensees should inform the NRC of any extension before the date that would have been the end of the current interval. An extension beyond 1 year (other than for extended outages, as permitted by ISTA 3120(e) [2.2.3(e)]) requires NRC approval of an alternative to or exemption from the Code provisions or 10 CFR 50.55a, as applicable.

Basis for Recommendation

While it is not mandatory to maintain identical intervals for inservice inspection (ISI) and IST, it is often desirable in order to maintain the same edition of the Code for all plant activities related to ISI and IST. Even though 10 CFR 50.55a does not discuss extending the intervals, the Code is incorporated by reference in the regulation and, therefore, has the same effect as the regulation. Although NRC approval is not required for 1-year extensions of the interval, licensees would avoid any discrepancies in the interval dates by informing the NRC of the extension and documenting it in the IST program document. Because the Code does not allow extension beyond 1 year (other than for extended outages), such an extension would require NRC approval of an alternative to or exemption from the Code provisions in order to comply with the regulatory requirements.

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 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 to be concurrent, licensees may request a one-time alternative to or exemption from 10 CFR 50.55a or the Code, as applicable. If a licensee prefers not to request an alternative or exemption, the establishment of concurrent intervals would require that the licensee must perform program updates for a particular unit more often than once every 120 months. 10 CFR 50.55a(f)(4)(iv) permits IST of pumps and valves to meet the provisions in subsequent Code editions and addenda (or portions thereof) that are incorporated by reference in 10 CFR 50.55a(b), subject to the limitations and modifications listed, and subject to Commission approval. This regulation allows licensees to update their programs before the end of a 120-month interval with Commission approval.

NRC Recommendation

If a licensee elects to use the same Code edition for multiple units, the regulation requires that the licensee must request an alternative to or exemption from the regulation or the Code, as applicable, to extend a unit's interval by more than 1 year in order to place multiple units on a concurrent interval for IST. To establish concurrent intervals without an alternative or exemption, the licensee must update the referenced edition of the 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 Code allowance for an extension would result in concurrent intervals. If the licensee elects to use 10 CFR 50.55a(f)(4)(iv) to update to later editions of the Code, this section gives the requisite approval for the IST program, if the licensee uses the following guidelines:

(1) Without obtaining an alternative or exemption, the licensee may perform the IST program for multiple units using the same edition of the Code at concurrent intervals if the initial interval for combining the programs is established such that no single unit is tested at an interval of more than 120 months (or no greater than the interval extension allowed by the Code). Thus, the licensee must use the interval for the first unit that was licensed for commercial operation to establish the interval dates and establish the correct Code edition according to the most recent required for either unit.

(2) To exceed 120 months, other than as addressed in the Code for an extension, the licensee must first obtain approval of an alternative to or exemption from 10 CFR 50.55a; therefore, establishing two units on the same interval requires an alternative or exemption unless the licensee intends to repeatedly update both units more often than the required 120 months. That is, the licensee will test each unit according to the most recent edition of the Code required for either unit.

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

By obtaining an alternative or exemption, a licensee may test multiple units at the same interval. However, the licensee may choose to update without requesting an alternative or exemption in order to periodically maintain an IST program with a more current edition of the Code.

The regulations allow for concurrent intervals among multiple units if the licensee updates the program each time an interval is due for either unit. The preferred manner for establishing concurrent intervals is to consider each unit on the same 120-month interval, with updates occurring at the end of the 120 months through an alternative or exemption. While the example presented is acceptable for IST programs in which test frequencies for components other than safety and relief valves do not exceed 18 to 24 months, licensees might need to adjust this arrangement for IST intervals that are longer than 5 years, such as might be found in risk-informed and performance-based testing programs.

3.3.3 Implementation of Updated Programs

Updating the IST program to a revised edition and addenda of the 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 comprehensive pump test 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 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 should revise the implementing procedures according to the appropriate requirements. When the testing requires baseline values to be reestablished to meet Code changes, this would typically involve establishing the new baseline (reference) values during the first quarterly or cold shutdown outage test performed in the new interval, if not before. Before performing tests during the first refueling outage, 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 refueling outage, licensees must complete all tests that are required to be performed during the refueling outage, as required by the Code (ISTC 3500 [4.2] and Appendix I, Section 1300 [1.3]). If a licensee determines that timely implementation is not possible, the staff recommends that the licensee should submit a schedule to the NRC (1) before the beginning of the interval, or (2) before startup from the refueling outage if the interval begins while a plant is shut down for refueling.

For 120-month updated programs, the staff recommends that licensees should submit relief requests before the interval start date to allow adequate time for NRC review and approval within 12 months after the interval start date (i.e., submit the updated program at least 3–6 months before the start date.)

In accordance with the regulations, when updating a program to a later edition of the ASME Code, licensees must implement the updated program at the beginning of a 120-month interval. The regulations state that, where a pump or valve test specified by the Code is determined to be impractical and is not included in the revised IST program, the licensee must demonstrate the basis for the determination to the satisfaction of the Commission not later than 12 months after each 120-month interval. However, experience has shown that licensees also identify impractical test provisions throughout the interval. In such cases, the staff recommends that licensees should 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 in the period of time from the beginning of the new interval (or from the time of identification) until the NRC staff completes its evaluation (e.g., if 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, the licensee cannot meet the Code requirements because of design limitations and an alternative method may not comply with the Code requirements). Relief requests that relate to proposed alternatives to the Code requirements (rather than to "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 then the Code-specified method, the licensee must continue to meet the Code requirements until the NRC staff completes its evaluation).

Basis for Recommendation

When licensees update their IST programs to a revised edition and addenda of the Code, the NRC staff recognizes that changes might be completed over a period of time to allow for adequate review and approval; however, the 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 and approval of the relief requests and proposed alternatives for the next interval.

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 Code edition in use. Some individuals responsible for the IST programs were not aware that the *Code of Federal Regulations* is updated throughout the year through issuance of the *Federal Register*. Therefore, when those individuals revised their programs, they used the bound version of 10 CFR Part 50 to determine the Code edition cited in 10 CFR 50.55a(b) 12 months before the interval start date. However, a more recent edition may have been incorporated by reference in 10 CFR 50.55a(b) as noticed in the *Federal Register*, which may have resulted in the program being developed to an incorrect edition of the Code.

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

NRC Recommendation

The NRC staff recommends that licensees should include the interval dates and Code edition in each IST submittal, regardless of whether it is for an entire program or only a partial submittal containing new or revised relief requests. The staff must ensure that the interval dates are correct and that the evaluation is performed using the edition of the Code from which the licensee is requesting relief. The staff also recommends that the individuals responsible for developing and maintaining the IST program should be aware of the regulatory changes made in 10 CFR 50.55a throughout the year, and should review any new or revised requirements for any effect on the IST program.

For phasing in a new edition or addenda of the Code before the start of a new interval (or during an ongoing interval), the staff recommends that licensees should 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 Code (1) during the 12 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 Code that is more recent than that incorporated by reference in 10 CFR 50.55a(b).

Basis for Recommendation

The NRC has noted incorrect interval dates and Code editions cited in IST program submittals. The Code stipulates that licensees shall calculate the inspection interval according to the number of calendar years that have passed since the power unit was placed into commercial service. For information purposes, the annual "NRC Information Digest" (NUREG-1350) lists the licensing and commercial operation dates for nuclear power plants. 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, 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 Code, the regulations may have required use of a more recent edition than the licensee actually used. Therefore, it is important that the IST program document state the Code edition and addenda used to develop the program.

3.4 Skid-Mounted Components and Component Subassemblies

The Code-class 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 auxiliary feedwater pump turbine drivers, steam traps, and air supply system check valves and solenoid-operated valves for main steam isolation valves. If the licensee's safety analysis report (SAR) identifies these components as ASME Code Class 1, 2, or 3, they are subject to IST. By contrast, if the SAR does not identify these components as ASME Code Class 1, 2, or 3 (or indicates that they are maintained as Code class, but are not required to be Code class), they are not subject to IST in accordance with 10 CFR 50.55a. Nonetheless, these components may be subject to periodic testing in accordance with Appendices A and B to 10 CFR Part 50.

NRC Recommendation

Subsections ISTB 1200(c) [1.2(c)] and ISTC 1200(c) [1.2(c)] define the components that are subject to IST. The staff has determined 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 discusses this approach in the IST program document. This is acceptable for both Code class components and non-Code class components that are tested and tracked by the IST program.

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 Code Classes 1, 2, and 3. In Draft Regulatory Guide 1.26, "Quality Group Classifications and Standards for Water-, Steam-, and Radioactive-Waste-Containing Components of Nuclear Power Plants," the NRC gives guidance on classifying components for quality groups A, B, C, and D (Code Classes 1, 2, and 3, and ASME VIII/ANSI B31.1, respectively). (For additional guidance, licensees should review Section 3.9.6 of NUREG-0800, the NRC's Standard Review Plan.) When many of the components were procured, the requirements for IST did not apply and, thus, the components may not have included features for IST. 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), provided that testing the major component is adequate to test the function of the system component.

For components that are outside the scope of 10 CFR 50.55a, relief requests are not necessary. The NRC's position concerning testing components that are outside the scope of 10 CFR 50.55a is discussed in Section 2.2.3. Testing of skid mounted check valves are specifically discussed in section 4.1.10.

3.5 Pre-Conditioning of Pumps and Valves

3.5.1 Background

The 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 ASME OM Code. Criterion XI, "Test Control," in Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," to 10 CFR Part 50 specifies that licensees must establish a test program to ensure that all testing required to demonstrate that structures, systems, and components (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.

In this revision of NUREG-1482, the NRC staff provides guidance concerning potential preconditioning of pumps and valves at a nuclear power plant prior to tests conducted under the IST program. In Revision 0 of NUREG-1482 (April 1995), the staff noted that the ASME Code does not specifically require licensees to test components in the as-found condition (except for safety and relief valves). The staff indicated, however, that degradation mechanisms might not be identified unless as-found testing is performed. The staff, therefore, concluded that most inservice testing 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).

3.5.2 NRC Guidance

In Information Notice (IN) 97-16, "Preconditioning of Plant Structures, Systems, and Components Before ASME Code Inservice Testing or Technical Specification Surveillance Testing," the NRC staff discussed the longstanding concern regarding unacceptable preconditioning of plant SSCs before testing. The staff noted that experience has demonstrated that some testing cannot be performed without disturbing or altering the equipment. The staff also indicated 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 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 staff has provided guidance to the NRC's regional offices and inspectors with respect to preconditioning of plant equipment prior to ASME Code and TS testing. This guidance is found in the following documents (see Section 9 for the locations of 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 provided 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 ASME Code.

NRC Inspection Manual, Part 9900, defines preconditioning as the "alteration, variation, manipulation, or adjustment of the physical condition of an SSC before Technical Specification surveillance or ASME Code testing." 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.

Some activities would constitute unacceptable preconditioning of a pump or valve to be tested under the IST program. NRC Inspection Manual, Part 9900, defines unacceptable preconditioning of an SSC as an activity that alters one or more of the SSC's operational parameters and, thereby, 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, 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 NRC Inspection Manual, Part 9900, 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.

3.5.3 ASME Code Guidance

The ASME 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. One such instance is found in Sections I-3300 and I-7300 of the OM Code's mandatory Appendix I, "Inservice Testing of Pressure Relief Devices in Light-Water Reactor Nuclear Power Plants," which specify that no maintenance, adjustment, disassembly, or other activity that could affect as-found set-pressure or seat tightness data for pressure relief devices is permitted before testing. Another instance is found in Section 3.3 of ASME Code Case OMN-1, "Alternative Rules for Preservice and Inservice Testing of Certain Electric Motor-Operated Valve Assemblies in Light-Water Reactor Power Plants, OM Code-1995, Subsection ISTC," which specifies that inservice tests of motor-operated valves 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 inservice testing. Where the ASME Code does not specify provisions for as-found testing of a pump or valve, 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. Where the ASME Code does not provide specific provisions related to as-found testing of a pump or valve in the IST program, the staff considers acceptable preconditioning to include such activities as (1) periodic venting of pumps, which is not routinely scheduled directly prior to testing but may occasionally be 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; and (4) unavoidable movement attributable to the setup and connection of test equipment. In each instance of acceptable preconditioning, the 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 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 NRR project manager if questions arise regarding potential preconditioning of a pump or valve to be tested under the IST program.

3.6 Testing in the As-Found Condition

The Code does not specifically require licensees to test components in the "as-found" condition (except for safety and relief valves). Sections 1300 [1.3], 1350 [1.3.5] and 3300 [3.3] of the OM Code's mandatory Appendix I require licensees to measure the initial lift of safety relief valves to determine whether additional valves are to be tested. In addition, Sections 3300 [3.3] and 7300 [7.3] of Appendix I specify that licensees must periodically test all pressure relief devices and may not perform any maintenance, adjustment, disassembly, or other activity that could affect the as-found set pressure or seat tightness data before testing.

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 may not be identified if the licensee does not perform any as-found testing. However, the staff encourages licensees to perform as-found testing, where practical. The staff also cautions licensees to consider the timing of maintenance with regard to the required test intervals and the potential for pre-conditioning. Post-maintenance testing is required when the maintenance could have affected the valve's performance. As-found testing may also apply to pumps in a similar fashion. Most inservice testing 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 pre-conditioning prior to actuation).

3.7 Testing at Power

In an effort to shorten refueling outages, many licensees are trying to perform as much maintenance, testing, and surveillance as possible with the nuclear power plant on line. For example, several licensees have submitted relief requests to obtain NRC approval to conduct inservice testing once per refueling cycle, rather than during the refueling outage as prescribed by the Code. In preparing (and evaluating) such relief 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 pump or valve during refueling outages, 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 refueling outages. Relief requests to perform testing once each refueling cycle with the nuclear power plant on line should be prepared in lieu of the refueling outage justification for each affected valve or group of valves. If necessary, the licensee should revise the refueling outage 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 technical specification. 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 (NOEDs). In addition, licensees should not conduct non-corrective maintenance/testing activities at power if the associated post-maintenance testing cannot reasonably be accomplished until the next outage.

Sometimes, there is a tradeoff between testing these 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 on line, rather than testing during the refueling outage. 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, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis," and Appendix D to SRP Chapter 19, 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.[3] If relevant, licensees should also provide information on how testing at power (rather than testing during refueling outages) 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 refueling outages can be more advantageous than at-power operations from a worker safety perspective (for example, systems may be cold and depressurized). When requesting NRC approval to perform testing with the nuclear power plant on line, 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, Rev. 2, "Industry Guideline for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," the Nuclear Management and Resources Council (NUMARC, now NEI) provided additional guidance for conducting online maintenance and testing. It states, in part—

> 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 of maintenance 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. This configuration risk management does not address the relative merits of testing at power versus testing during refueling outages.

4. SUPPLEMENTAL GUIDANCE ON INSERVICE TESTING OF VALVES

The staff of the U.S. Nuclear Regulatory Commission (NRC) has developed the following recommendations for valves that may be a part of an inservice testing (IST) program at nuclear power plants. The types of valves discussed herein are covered by the *Code for Operation and Maintenance of Nuclear Power Plants* (OMa-2000 Edition) promulgated by the American Society of Mechanical Engineers (ASME). Specifically, these include check valves (Section 4.1), power-operated valves (Section 4.2), safety/relief valves (Section 4.3), and other miscellaneous valves (Section 4.4).

4.1 Check Valves

The NRC staff considers check valves, and other automatic valves designed to close without operator action after an accident and for which flow is not blocked, as "active" valves that would be classified as such in the IST program (reference, for example, Section B 3.6.3 of the Westinghouse Revised Standard Technical Specifications). 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 was 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 IST.

The ASME 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. The Code also defines valves for which seat leakage is limited to a specific maximum amount in the closed position for fulfillment of their required function(s) as Category A 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.

Whereas the 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.

The categorization of a check valve is not solely dependent on the function performed by the valve, such as whether it is a containment isolation valve. 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 may 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 NRC Information Notice 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. Position 4.1.1 herein discusses backflow testing of check valves in series.

Subsection ISTC 3550 [4.2.5] 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 Subsection ISTC 3150 [4.2.1]. Even if licensees "exercise" check valves in accordance with Subsection ISTC 3550 [4.2.5], they need to be included in the valve list 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 (e.g., Point Beach Nuclear Plant, Units 1 and 2), 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. Position 2 in GL 89-04 states that if a potentially generic problem is identified through disassembly and inspection during a refueling outage, the licensee must inspect all valves in the group in that plant during the refueling outage. If the other plant is not also in a refueling outage, inspection of the valves in the group that are installed in that plant may be deferred to the next refueling outage 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 (below), although the focus is slightly different, in that all of the valves in the group are tested, while the nonintrusive techniques are applied to only one valve of the group; therefore, all valves in the group must be in the same nuclear power plant.

The NRC issued the following information notices (INs) on IST for check valves:

- IN 82-08 "Check Valve Failures on Diesel Generator Engine Cooling System."
- IN 83-03 "Check Valve Failures in Raw Water Cooling System of Diesel Generators."
- IN 83-54 "Common Mode Failure of Main Steam Isolation Non-Return Check Valves."
- IN 88-70 "Check Valve Inservice Testing Program Deficiencies."
- IN 2000-21 "Detached Check Valve Disc Not Detected by Use of Acoustic and Magnetic Nonintrusive Test Technique."

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 may perform a safety function in the closed position. For example, the valves may be required to prevent the gross diversion of flow rather than to be leak-tight. The Code requires that each valve that performs 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 is addressed Subsection ISTC 5223 [4.5.7] of OMa-2000a [1996a], as follows:

> ISTC 5223 [4.5.7] Series Valve Pairs. If two check valves are in a series configuration without provisions to verify individual reverse flow closure (e.g., keepfill pressurization valves) and the plant safety analysis assumes closure of either valve (but not both), the valve pair may be operationally tested closed as a unit. If the plant safety analysis assumes that a specific valve or both valves of the pair close to perform the safety function(s), the required valve(s) shall be tested to demonstrate individual valve closure.

NRC Recommendation

Both valves in a series pair must be tested to demonstrate individual valve closure if the plant safety analysis credits or otherwise requires both valves. For example, General Design Criterion (GDC) 14 in Appendix A to Title 10, Part 50, of the *Code of Federal Regulations* (10 CFR Part 50) requires licensees to test the valves in the reactor coolant pressure boundary to demonstrate extremely low probability of abnormal leakage. Pressure isolation valves 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 Technical Specifications (TSs) and the Code.

Systems containing series pair valves may 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 refueling outage. 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 Subsection ISTC 5223 [4.5.7], because the plant safety analysis assumes closure of either valve (but not both), and the tested unit closure capability is questionable, both valves must be declared inoperable and corrective actions must be taken for both valves.

If it is not practical to flow test the pair of valves in accordance with the 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 must not use these methods to verify leak tightness, which requires Category A valve testing. Relief is not required to perform testing of each valve in the valve pair.

Basis for Recommendation

The requirements of Subsections ISTC 4.5.7 and ISTC 4.5.4(c) are contained in the NRC's endorsement of OMa-1996 on September 22, 1999, as published in a regulatory amendment to 10 CFR 50.55a.

Subsections ISTC 5221(a) and/or 5221(c) [4.5.4(a) and /or 4.5.4(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 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 Code alternative allows the valve pair to be operationally tested closed as a unit, the NRC staff previously determined that both valves must be included in the IST program and must be operationally tested as a pair to prevent reverse flow. The NRC staff specified that upon observing leakage, the licensee must disassemble, inspect, and repair or replace both valves (as necessary) before return to service.

4.1.2 Exercising Check Valves with Flow and Nonintrusive Techniques

The Code requires both an open and close test for check valves and that licensees exercise check valves 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 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 may not 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 Code.

NRC Recommendation

The licensee may use nonintrusive techniques for IST of check valves. Relief is not required except as would be necessary for the testing frequency if the test interval extends beyond each refueling outage as allowed by the OM Code. The licensee may use nonintrusive techniques to verify the valve's capability to open, close, and fully stroke if it is qualified for the application in accordance with the plant's quality assurance 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 quality assurance 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 quality assurance program, and the NRC inspector may examine the licensee's records.

Basis for Recommendation

The NRC 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 quality assurance program requirements. These techniques are considered "other positive means" in accordance with Subsection ISTC 5221(a)(3) [4.5.4(a)(3)]. It is the licensee's responsibility to qualify and document the results in accordance with the plant's quality assurance program requirements. Appendix B to 10 CFR Part 50 provides for the quality assurance program, which includes, 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. Information on qualification of nonintrusive testing is provided in the summary of the NRC's public workshops on the revision of NRC Inspection Procedure 73756, dated July 18, 1997. 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 discussed in NRC Information Notice 2000-21 are summarized in the following paragraphs.

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 if 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 ASME OM Code requires both an open and close test for check valves and that licensees 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 maximum required accident condition flow through the valve. 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 non-instrumented 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 inservice testing is to evaluate and investigate the possibility of degradation of individual components and to take corrective action before a component fails. Verification of total header flow rate might not identify a problem, developing or occurring, with an individual check valve in one of the parallel flowpaths. 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 flowpath 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 a safety evaluation dated January 24, 1992, 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 "maximum required accident condition flow" is the largest flow rate for which a licensee takes credit in a safety analysis for this component in any flow configuration. The safety analyses are those contained in the plant's final safety analysis report (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), verification of design (safety) function is testing to confirm the capability of forward flow through the system. In addition to verifying its 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 Impractical Full-Flow Testing

Full-flow testing of a check valve may be impractical 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 ASME Code requirements, licensees must, as a minimum, address and document the following items in the IST program. (Any alternative techniques for meeting ASME Code requirements must be submitted to the NRC for approval pursuant to 10 CFR 50.55a (a)(3)(i).)

(1) the impracticality of performing a full-flow test

(2) a description of the alternative technique used and a summary of the procedures being followed

(3) a description of the method and results of the program to qualify the alternative technique for meeting the ASME Code

(4) a description of the instrumentation used and the maintenance and calibration of the instrumentation

(5) a description of the basis used to verify that the baseline data has been generated when the valve is known to be in good working order, such as recent inspection and maintenance of the valve internals [components]

(6) 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

The NRC's position for 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 ASME 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 ASME Code requirements must be submitted to the NRC for approval pursuant to 10 CFR 50.55a(a)(3)(i).

The guidance established for full-flow testing of check valves in Position 1 of GL 89-04 remains valid for inservice testing. The OM-1994 and subsequent editions include the use of nonintrusive testing as other positive means for demonstrating check valve exercising. The criteria listed in the NRC 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

The guidance provided in GL 98-04 regarding disassembly and inspection of certain check valves is included in OMa-2000, Subsection ISTC 5221(c) [4.5.4(c)] for use if the test methods of Subsections ISTC 5221(a) [4.5.4(a)] and ISTC 5221(b) [4.5.4(b)] are impractical, or sufficient flow cannot be achieved.

NRC Recommendation

In Position 2 of GL 89-04, the NRC staff established the following guidance regarding testing check valves by disassembly:

> The sample disassembly and inspection program involves grouping similar valves and testing a different valve in each group during each refueling outage. The sampling technique requires that each valve in the group be the same design (manufacturer, size, model number, and materials of construction) and have the same service conditions including valve orientation.
>
> Additionally, at each refueling outage sampling the licensee must verify that the disassembled valve is capable of full-stroking 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 is expected to be performed.
>
> A different valve of each group is required to be disassembled, inspected, and manually full-stroke exercised at each successive refueling outage, 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, the remaining valves in that group must also be disassembled, inspected, and manually full-stroke exercised during the same outage. Once this is completed, the sequence of disassembly must be repeated unless the valve group is in the Condition Monitoring Program alternative and an extension of the interval can be justified.

The personnel performing the disassembly/inspection must be qualified to evaluate the condition of the valve and to assess its continued operability. 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/inspections. GL 89-04 alone did not impose any requirements for visual testing certifications (such as VT-3) beyond those currently in the ASME Code. Nonetheless, licensees must implement the provisions of ANSI/ASME N45.2.6, "Qualifications of Inspection, Examination, and Testing Personnel for Nuclear Power Plants," according to their commitments based on the implementation section of RG 1.58, "Qualification of Nuclear Power Plant Inspection, Examination, and Testing Personnel." The NRC staff encourages those licensees that have not formally committed to follow RG 1.58 to review the ANSI standard and regulatory guide for guidance in developing a program for the qualification of IST personnel.

Basis for Recommendation

The staff provided guidance for the use of sample disassembly and inspection of certain check valves in Position 2 of GL 89-04. In OMa-2000, Subsection ISTC 5221(c) [4.5.4(c)] provides for the use of sample disassembly and inspection with GL 89-04 guidance.

Specifically, Subsection ISTC 5221(c) [4.5.4(c)] provides requirements for sample disassembly and inspection of certain check valves, if the test methods of Subsections ISTC 5221(a) [4.5.4(a)] and ISTC 5221(b) [4.5.4(b)] are impractical, or if sufficient flow cannot be achieved or verified. The NRC endorsed these Code requirements in its regulatory amendment to 10 CFR 50.55a, which was published on September 22, 1999.

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 some 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 proves 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. ISTC-5221 [4.5.4].

ASME Code-class check valves that perform a safety function in the closed position and are frequently not reverse flow tested include the following examples:

(a) main feedwater header check valves
(b) pump discharge check valves on parallel pumps
(c) keep-fill check valves
(d) check valves in steam supply lines to turbine-driven AFW pumps
(e) main steam non-return valves
(f) chemical and volume control system (CVCS) volume control tank outlet check valves

4.1.5.1 Closure Capability of Check Valves that Do Not Have Defined Seat Leakage Limits

When performing a test to verify closure capability of a check valve that does not have a defined seat leakage limit, the achievement of the necessary system flow rate through the intended flowpath might be an adequate demonstration of the closure capability of a check valve. For example, when verifying the closure capability of the check valves on the discharge of parallel pumps, achievement of the required safety flow rate from one running pump with the idle pump's discharge check valve providing the barrier for recirculation flow would be considered an acceptable test configuration. In addition, the licensee should evaluate the consequences of reverse flow through the check valve. This evaluation should consider the loss of water from that system and connecting systems, the effect that the leakage might have on components and piping downstream of the valve, and any increase in radiological exposure resulting from the leakage.

A plant's safety analysis may include a leakage limit for a particular valve, or may only require that the valve closes to inhibit gross leakage. When a valve has a safety-related function to close to prevent diversion of flow between trains of a system, there may be a leakage limit based on the total system requirements. The Code does not specifically require these valves to be Category A. The basis for assigning valves to categories should be available for inspection.

Licensees may refer to NRC Information Notice 91-56, "Potential Radioactive Leakage to Tank Vented to Atmosphere" regarding information concerning 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.

4.1.5.2 Listed Systems

In reference to the examples of valves that are not frequently backflow tested (listed in Section 4.1.5, above), all of the listed systems do not necessarily apply to each plant. As a minimum, a licensee should evaluate the listed systems to determine whether they apply to its facility and should make any necessary modifications to its IST program. Examples (d), (e), and (f) are specific to pressurized-water reactors (PWRs), while Example (a) may apply to both PWRs and boiling-water reactors (BWRs). Example (f) may serve an important safety function at some PWRs to separate the non-safety-grade water source from the safety-grade source.

4.1.5.3 Permissible Leak Rates

Subsection ISTC-3630(e) [4.3.3(e)] requires that the plant owner (licensee) must specify a permissible leak rate for a specific valve. If the licensee does not specify leak rates, permissible leak rates are provided in Subsection ISTC 3630(e) [4.3.3(e)]. It should be noted that the OM Code does not provide either criteria or guidance concerning the methods 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 limits are too low, unnecessary valve repairs or adjustments can result. Leak 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 regarding the leak-tight integrity of the containment. Appropriate permissible leak rates can only be developed and refined 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 concerning leak rates. Licensees should document their methods for establishing the initial permissible leak rates and procedures for verifying compliance with the leak rate limits.

4.1.5.4 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 that the 1996 Addenda to the OM Code requires bidirectional 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 ASME Code requirements of Subsection ISTC-5221 [4.5.4]. 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.

When no other means of verification is 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 Subsection ISTC 3310 [3.4], because disassembly and inspection can increase the probability of human error when the valve is reassembled. Licensees may investigate the use of nonintrusive testing techniques and may implement such techniques if they are demonstrated to be effective to assess 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.

If closure testing using flow can only be done at an extended interval, the licensee should close the valve using a hand wheel or hand switch on a quarterly frequency, in conjunction with the flow test on the extended interval, if practical.

4.1.5.5 Other Positive Means of Verification

Subsection ISTC 5221 [4.5.4] allows for other positive means of verification. 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.

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 during plant operation or cold shutdown, it is acceptable for the licensee to extend the check valve quarterly exercise test (both open and close) to the refueling outage when the closure verification may be performed in conjunction with the Type C leak rate test conducted in accordance with Option A of Appendix J to 10 CFR Part 50. Licensees may also perform the open exercise test during the refueling outage or anytime during the fuel cycle interval.

NRC Recommendation

If no other practical means is available, it is acceptable for licensees to extend the quarterly closure exercise test to a refueling frequency. In such instances, the licensee must develop a refueling outage 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 a refueling outage. 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 a refueling outage 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. Therefore, since the closure test is extended to the refueling outage by the refueling justification, the quarterly open exercise test may also be extended to the refueling outage or may be performed anytime during the fuel cycle interval.

Basis for Recommendation

OM Subsection ISTC 5221(a) [4.5.4(a)] states that valve obturator movement observations shall be made by a direct indicator 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.

OM Subsection ISTC 3522(e) [4.5.2(e)] states that if exercising is not practical during plant operation and cold shutdowns, it shall be performed during refueling outages. A refueling outage justification shall document the extension of the exercise test to the refueling outage.

OM Subsection ISTC 3522(a) [4.5.2(a)] states that open and close exercise tests need only be performed at an interval when it is practical to perform both tests. This 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

In OMa-2000, Subsection ISTC-5221(b), "Valve Obturator Movement," in part, requires 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. (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 Code requirements through the OMa-1996 Addenda, Subsection ISTC 4.5.4(b) requires that, if a manual mechanical exerciser is used for IST movement of the obturator, the force or torque to initiate disc movement shall not vary by more than 50 percent from an established reference value. Licensees have continuously 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 be continually consistent and appropriate for use in IST.

The NRC has received a number of requests for relief from the requirement that force or torque to initiate disc movement not vary by more than 50% of the reference value. Licensees have also requested that the ASME OM Working Group on Check Valves (WGCV) reexamine this requirement. The WGCV reexamination resulted in the code change in OMa-2000, Subsection ISTC 5221(b), "Valve Obturator Movement," which is discussed above. This change requires the owner to specify the acceptance criteria within certain 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.

Basis for Recommendation

Mechanical exercisers are attached to a hinge pin that is fixed to the disc 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 effect the opening or closing response of the disc to flow conditions, depending upon the lever arm's location relative to the disc. The counterweight modification involves the use of a packing gland to seal the hinge pin penetration of the valve body. The seal packing introduces variations over time with regard to the required disc opening force and opening and closing responses of the disc, depending upon 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. Disc opening and closing friction forces may also change as a result of valve preventive maintenance activities.

4.1.8 Check Valve Bidirectional Testing and Condition Monitoring Program

Bidirectional 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. Two significant OM Code changes, in Subsections ISTC 4.5.4(a) and ISTC 4.5.5, respectively, were introduced in OMa-1996. Specifically, those changes included (1) a requirement for bidirectional exercise testing of the disc 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 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 Code changes were developed so that licensees who elect not to implement condition monitoring in their IST program, would be required to bidirectionally test check valves as a default set of testing and examination requirements.

OMa-1996, Subsection ISTC 4.5.4(a), "Valve Obturator Movement," in part, requires 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 positive-indicating device) or by other positive means (e.g., changes in system pressure, flow, level, temperature, seat leakage, testing, or nonintrusive testing and examination).

OMa-1996, Subsection ISTC 4.5.5, "Condition Monitoring Program," in part, provides 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 Appendix II, "Condition Monitoring Program."

NRC Recommendation

The required testing or examination of the check valve obturator movements to both the open and closed positions, as required by OMa-2000, Subsection ISTC 3522 [4.5.4(a)], 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.

The NRC staff considers the condition monitoring program approach of OMa-2000, Appendix II, for check valve IST with the regulatory modifications 10 CFR 50.55a(b)(3)(iv), to be an improvement over present Code requirements, and encourages licensees to implement the condition monitoring alternative.

Basis for Recommendation

The NRC incorporated OMa-1996 by reference in 10 CFR 50.55a on September 22, 1999. In OMa-1996, Subsection ISTC 4.5.4(a) included the requirement that the necessary obturator movement during exercise testing must be demonstrated by performing both open and closed tests. The NRC agrees with the need for a required demonstration of bidirectional exercise testing of the movement of the check valve disc. 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 disc would not be detected during forward flow tests. The detached disc 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. The most recent example of an undetected detached check valve disc lying at the bottom of the valve body is captured in the discussion of the event described in IN 2000-21. 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 the ASME OM Code, Appendix II, "Condition Monitoring Program," as incorporated by reference in 10 CFR 50.55a (published in the *Federal Register* on September 22, 1999), 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 bidirectional 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 ASME OM Code Committee, Sub-Group on Check Valves (SGCV), has completed proposed changes to Section ISTC of the ASME OM Code to address the regulatory modification issues. These changes were issued as part of OMb-2003.

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, OM-1998 added Subsection ISTC 3800, "Instrumentation," to provide specific requirements for instrumentation that is used in the testing and examination of valves. Specifically, in OMa-1998, Subsection ISTC 3800 requires that instrumentation, including both measuring and test equipment and permanent plant instrumentation, used for valve testing and examination activities, shall (1) be properly controlled, calibrated, and adjusted in accordance with the owner's quality assurance program, and (2) have the accuracy, range, and repeatability characteristics necessary to verify compliance with the requirements of this subsection. In addition, instrumentation accuracy shall be considered when establishing valve test acceptance requirements.

NRC Recommendation

In OMb-2000, ISTC 3800, "Instrumentation," specifies requirements for instrumentation that is used in performing IST for check valve testing and examination activities. 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 of safety-related check valves. IST should be performed in a way that permits the results to be compared for indications of valve degradation trends. When instrumentation that is used in valve testing and examination is not properly controlled and calibrated, any valve degradation indications may be masked, thereby diminishing the usefulness of the valve test results.

Basis for Recommendation

The instrumentation requirements and quality assurance activities specified in OMb-2000, Subsection ISTC 3800, are needed to properly verify compliance with 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 quality assurance 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 that is 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 OMa-1996. Subsection ISTC 1200(c) [1.2(c)] of OMa 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, Subsection ISTC 1200(c) [1.2(c)], 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 determined by the Owner to be adequately tested."

NRC Recommendation

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 owner must determine that the check valves are adequately tested. The NRC staff expects that, as part of the owner'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 owner should review the safety significance of the identified valves to ensure that the IST is adequate to demonstrate their continued operability. The documentation that provides assurance of the continued operability of the valves through the performed tests should be available at the plant site.

Basis for Recommendation

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

4.2 Power-Operated Valves

Power-operated valves (POVs) are equipped with actuators that use motive force to change the position of the valve obturator. The types of actuators include motor actuators, pneumatic actuators, hydraulic actuators, and solenoid actuators. In addition, in the ASME OM Code, Section ISTC defines a power-operated relief valve (PORV) as a POV that can perform a pressure-relieving function and is remotely actuated by either a signal from a pressure-sensing device or a control switch. Certain valves, such as main steam isolation valves and valves that have a fail-safe function, may actuate open (or closed) on spring force. The ASME Code includes provisions for exercising, stroke-time testing, leak testing, and position-verification testing of POVs in the IST program. In the following sections, the NRC staff provides guidance concerning the implementation of specific Code provisions and associated regulatory requirements.

4.2.1 Stroke-Time Testing for Power-Operated Valves

In the ASME OM Code, Subsection ISTC 5113 specifies that active POVs shall have their stroke times measured when exercised in accordance with the nominal 3-month schedule specified in Subsection ISTC 3500. Stroke-time testing may indicate degradation in the performance of POVs. NRC requirements and guidance for supplementing the ASME Code provisions for stroke-time testing are discussed later in this document.

The ASME Code includes provisions for establishing reference values and limiting values for POV stroke times. Subsection ISTC 3300 [3.3] states that reference values shall be determined from the results of preservice testing or inservice testing. Subsections ISTC 5113, 5121, 5131, 5141, and 5151 also state that limiting values for stroke time for various types of POVs shall be specified by the owner. In addition, Subsections ISTC 5114, 5122, 5132, 5142, and 5152 include a set of acceptance criteria for the reference value of the stroke time for POVs, and specify various corrective actions to be taken if those criteria are not satisfied. If the limiting value of stroke time is exceeded, Subsections ISTC 5115, 5123, 5133, 5143, and 5153 state that the POV shall be immediately declared inoperable.

The 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 Technical Specifications (TS) or safety analysis. In Position 5 of GL 89-04, the NRC staff provided guidance for establishing limiting values of stroke times.

NRC Recommendation

The limiting value of full-stroke time should be based on the reference (or average) 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 that is 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 limiting condition for operation (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 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 Subsection ISTC 3320 [3.5], 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.

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 TSs provide assurance that important plant systems are capable of performing their safety functions in a timely manner during selected plant accidents, the provisions of the ASME OM Code are intended to ensure the continued operability of particular plant components. The distinct bases for these two documents (i.e., TSs and ASME Code) lead to criteria that may differ significantly. Nonetheless, the TSs and ASME 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 component or system being declared inoperable.
For example, 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 Subsections ISTC 5115, 5123, 5133, 5143, and 5153 [4.2.9] the data may be analyzed to verify that the new stroke time represents acceptable POV operation.

4.2.2 Stroke-Time Measurements for Rapid-Acting Valves

In the ASME Code, Subsections ISTC 5114, 5122, 5132, 5142, and 5152 allow licensees to establish the limiting stroke time of 2 seconds for POVs that stroke in less than 2 seconds. The 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.

The traditional method of stroke timing POVs was to use stopwatches to measure the stroke time from initiation of the signal at the handswitch to the change in position-indicating lights (switch to light). The traditional method includes signal processing time from the switch to the valve actuator. Monitoring stroke times for valves that stroke in milliseconds using diagnostic equipment that measures only actual valve travel is acceptable to indicate degrading trends; however, the method does not indicate increases that could occur in the signal to the valve, which may be important in meeting safety analysis limits for certain valves. Typically, the valves that would benefit from this monitoring are rapid-acting valves. The traditional method would have a set limit of 2 seconds, which masks any signal processing time unless a gross change occurs. If measuring the stroke times locally needs to be supplemented by a periodic test to include the signal processing times, a periodic 2-second limit test could be performed to augment the IST. The Code does not specify a particular method, so there would be no conflict in using more than one method.

NRC Recommendation

The NRC staff recommends that licensees should determine whether continued reliance on the 2-second limiting stroke time criterion in the ASME Code is appropriate when the actual stroke time can be measured in milliseconds.

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 ASME Code provisions to allow licensees not to measure the stroke times of enclosed solenoid-operated valves (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 adequate assurance of its operational readiness. If the frequency provisions of the 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(a)(3). 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 should use advanced diagnostic techniques to obtain stroke-time measurements in accordance with the frequency provisions of the Code, and should also use those advanced techniques or maintenance programs to monitor the degradation of SOV performance. In addition, the 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, Vol. 6, "Operating Experience Feedback Report: Solenoid-Operated Valve Problems," 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 Stroke-Time Test Provisions of the ASME Code

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

With respect to motor-operated valves (MOVs), the NRC's regulations in 10 CFR 50.55a require that licensees who are implementing the ASME OM Code (beginning with the 1995 Edition) must supplement the provisions for MOV stroke-time testing specified in the Code with a program to ensure that the MOVs continue to be capable of performing their design-basis safety functions. In a *Federal Register* notice (64 FR 51370) dated September 22, 1999, the NRC discussed the implementation of MOV programs in response to GL 89-10, "Safety-Related Motor-Operated Valve Testing and Surveillance" (June 1989), and GL 96-05, "Periodic Verification of Design-Basis Capability of Safety-Related Motor-Operated Valves" (September 1996), as a means of satisfying the requirement to supplement MOV stroke-time testing.

The NRC established Generic Safety Issue (GSI) 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 air-operated valves (AOVs), hydraulic-operated valve (HOVs), and solenoid-operated valves (SOVs). In Regulatory Issue Summary (RIS) 2000-03, "Resolution of Generic Safety Issue 158, 'Performance of Safety Related Power-Operated Valves Under Design-Basis Conditions'," dated March 15, 2000, the NRC closed GSI-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 are needed. In RIS 2000-03, the staff stated that it would continue to work with industry groups on an industry-wide approach to the POV issue and to provide timely, effective, and efficient resolution of the concerns regarding POV performance.

NRC Recommendation

The NRC staff recommends that licensees should apply their MOV programs established and implemented in response to GL 89-10 and GL 96-05 to supplement the provisions in the ASME Code for MOV stroke-time testing in accordance with the requirements in 10 CFR 50.55a. The staff also recommends that licensees should consider information provided in RIS 2000-03, as well as lessons learned from their own MOV programs, to improve confidence in the capability of other POVs to perform their safety functions.

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 ASME 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 staff discusses industry activities to improve POV performance.

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 Joint Owners' Group (JOG) Program on MOV Periodic Verification as an industry-wide effort to evaluate potential degradation of MOV operating requirements for a wide range of gate, globe, and butterfly valves. On October 30, 1997, the NRC staff issued a safety evaluation accepting (with certain conditions) the JOG Program on MOV Periodic Verification. Most licensees have since committed to implement the JOG MOV program as part of their response to GL 96-05. JOG has completed its MOV dynamic testing program and has submitted a topical report describing the long-term MOV periodic verification program. The NRC staff is reviewing the JOG topical report and plans to prepare a safety evaluation with any appropriate conditions on its acceptance. In the meanwhile, licensees are implementing their GL 96-05 programs and will apply the provisions of the recent JOG topical report consistent with their commitments to the JOG program. The staff considers the MOV design-basis capability verification performed by licensees in response to GL 89-10 and the MOV periodic verification program being conducted by licensees under GL 96-05, including any appropriate modifications in response to the recent JOG topical report and the applicable NRC safety evaluation, to satisfy the requirement in 10 CFR 50.55a to supplement the MOV stroke-time test provisions of the ASME Code.

Although the NRC has not established new regulatory requirements to address performance issues for POVs other than MOVs, current 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 must 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 must monitor the performance of structures, systems, and components (SSCs) in a manner sufficient to provide reasonable assurance that such SSCs are capable of fulfilling their intended functions. With respect to AOV air systems, the NRC staff issued GL 88-14, "Instrument Air Supply System Problems Affecting Safety-Related Equipment," to ask licensees to verify (by test) that AOVs will perform as expected in accordance with all design-basis events. The 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"; and NUREG/CR-6654, "A Study of Air-Operated Valves in U.S. Nuclear Power Plants." In RIS 2000-03, the staff provided a list of attributes of a successful POV design capability and long-term periodic verification program based on lessons learned from staff reviews of valve programs and plant visits. The staff also prepared several information notices (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"; IN 85-84, "Inadequate Inservice Testing of Main Steam Isolation Valves"; and IN 96-48, "Motor-Operated Valve Performance Issues," which described lessons learned from MOV programs that are applicable to other POVs.

ASME has initiated efforts to improve the Code provisions for assessing the operational readiness of POVs in IST programs at nuclear power plants. For example, ASME is working to upgrade the IST provisions for MOVs in the Code and Code Cases. ASME is also developing 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. Examples of the improved IST provisions that ASME is developing for POVs are discussed in the next section of this document.

In addition to the NRC and ASME, the nuclear industry is taking action to address POV performance issues. As discussed above, the industry initiated 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, a Joint Owners' Group on Air-Operated Valves (JOG AOV) has 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 Nuclear Energy Institute dated October 8, 1999. The 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.

4.2.5 Alternatives to Stroke-Time Testing

Given the weakness in stroke-time testing for assessing the operational readiness of POVs, ASME developed alternatives to the Code provisions for stroke-time testing of POVs. ASME is also incorporating risk insights as part of its development of these alternatives. In the longer term, ASME is considering modifying the Code provisions for stroke-time testing of POVs.

As an alternative to MOV stroke-time testing, ASME developed Code Case OMN-1, "Alternative Rules for Preservice and Inservice Testing of Certain Electric Motor-Operated Valve Assemblies in LWR Power Plants," which provides periodic exercising and diagnostic testing for use in assessing the operational readiness of MOVs. In Code Case OMN-11, "Risk-Informed Testing of Motor-Operated Valves," ASME provides additional guidance for use with 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. With respect to AOVs and HOVs, ASME developed Code Case OMN-12, "Alternate Requirements for Inservice Testing Using Risk Insights for Pneumatically and Hydraulically Operated Valve Assemblies in Light-Water Reactor Power Plants (OM Code 1998, Subsection ISTC)," to provide an alternative to the 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.

NRC Recommendation

The NRC staff recommends that licensees implement ASME Code Cases OMN-1, OMN-11, and OMN-12, as accepted by the NRC (with certain conditions) in the regulations or RG 1.192, as alternatives to the stroke-time testing provisions in the ASME Code for applicable POVs.

Basis for Recommendation

As part of the ASME Code Committee process, industry experts have developed ASME 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. The ASME Code Cases incorporate risk insights to emphasize IST provisions for POVs that are determined to have the highest safety significance. The NRC has reviewed and accepted several of these Code Cases with certain conditions. For example, RG 1.192 allows licensees with an applicable code of record to implement ASME Code Case OMN-1 (in accordance with the provisions in the regulatory guide) as an alternative to the Code provisions for MOV stroke-time testing, without submitting a request for relief from their code of record. In RG 1.192, the staff also accepts (with certain conditions) the use of the risk-informed provisions in Code Case OMN-11 by applicable licensees, in conjunction with Code Case OMN-1. RG 1.192 also allows licensees with an applicable code of record to implement Code Case OMN-12 for AOVs and HOVs (with certain conditions) in lieu of the 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 Code Cases may submit a request for relief to apply those Code Cases consistent with indicated conditions to provide an acceptable level of quality and safety.

4.2.6 Main Steam Isolation Valves

In IN 85-84, "Inadequate Inservice Testing of Main Steam Isolation Valves," the NRC staff described an inadequacy in the IST of MSIVs Specifically, the staff stated that two different licensees were testing their MSIVs using the nonsafety-related instrument air to achieve closure. Fail-safe IST of MSIVs as required by Subsection ISTC 3560 [4.2.6] necessitates the removal of the instrument air supply and electric power. Concerns related to MSIVs are described in IN 94-08, "Potential for Surveillance Testing To Fail To Detect an Inoperable Main Steam Isolation Valve," and IN 94-44, "Main Steam Isolation Valve Failure To Close on Demand Because of Inadequate Maintenance and Testing."

NRC Recommendation

The staff recommends that licensees should review their inservice and fail-safe testing to ensure compliance with Code requirements.

Basis for Recommendation

The practice of performing IST of components that are relied on to mitigate the consequences of accidents 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.[4]

In its Service Information Letter 477, General Electric (GE) described a related concern for boiling-water reactors (BWRs) in which excessive tightening of gland flanges in the MSIV can prevent the valve from closing in response to spring force alone. During a postulated design-basis accident in which a recirculation line breaks with the MSIVs open, containment pressure may increase significantly, and may exert an opening force on the valve actuators inside containment. Under such circumstances, the MSIV springs alone will not close the MSIV unless the spring force can overcome the combination of the opening force caused by containment pressure and the resistive force caused by stem packing friction. 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. GE noted that this would necessitate measurement of the actual valve stem travel because the final 10 percent of stem travel coincides with the weakest spring force. GE stated that, by monitoring position switches alone, a utility could not determine that the valve is fully closed because the switches monitor the valve only when it is 90-percent open or 90-percent closed. One BWR identified that the MSIVs would not pass local leak rate testing after closing on spring force only.

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

OM Subsection ISTC 3700 [4.1] requires that valves with remote position indicators must be observed at least once every 2 years to verify that valve position is accurately indicated. Many valves (such as sealed solenoid valves and valves with enclosed stems) 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

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[4] With regard to MSIVs, some plants perform a partial-stroke exercise quarterly during power operation. The revised standard technical specification bases for MSIV surveillance requirements states that "MSIVs should not be tested at power, since even a part-stroke exercise increases the risk of a valve closure when the unit is generating power."

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 position.

NRC Recommendation

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(s). This is consistent with Subsection ISTC 3700 [4.1]. The staff determined that the use of this portion of the OM Code would not require relief if the licensee implements all requirements of Subsection ISTC 3700 [4.1]. No other related requirements apply. However, Commission approval is still required pursuant to 10 CFR 50.55a(f)(4)(iv).

For certain types of valves that can be observed locally, but for which valve stem travel does not ensure that the stem is attached to the disk, the local observation should be supplemented by observing an operating parameter as required by Subsections ISTC 3700 and 3520 [4.1, 4.2, and 4.5].

Basis for Recommendation

Accurate position indication for safety-related valves is important for reactor operation under all plant conditions. The Code requires licensees to verify the accuracy of the remote position indication for all valves in the IST program that have remote position indication. Subsection ISTC 3700 [4.1] states that where local observation is not possible, licensees shall use other indications to verify operation. Such indications are also useful to ensure that a valve disk is connected to the stem. Licensees are not able to verify the accuracy of remote position indication by local observation of many valves, such as those with enclosed stems or sealed solenoid valves, where the valves do not have position indicators, such as pointers, on the valve actuators.

Many positive means are available to verify the indication that a valve is open or closed. For example, leak-rate testing may yield positive indication that the disk is in the closed position. In addition, an in-line flow rate instrument can indicate system flow or flow stoppage. System pressures or differential pressure across a valve seat may also give a positive indication of actual valve position.

4.2.8 Requirements for Verifying Position Indication

The Code does not restrict the verification of position indication to only active valves. OM Table ISTC 3500-1 [3.6-1] indicates that the licensee must also locally verify the position indication for Category B passive valves. The Code does not require licensees to verify the indication at the remote panels. 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 that respond to system conditions would be exempt from IST as discussed in Subsection ISTC 1200 [1.2]. However, some control valves also perform safety or fail-safe functions (e.g., fail open, fail closed, fail as-is), and such valves must be tested in accordance with the requirements for IST. The 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 only be performed 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 Code-defined frequency.

NRC Recommendation

Control valves that perform a safety or fail-safe function must be tested in accordance with the Code provisions for IST to monitor the valves for degrading conditions. The NRC staff recommends that licensees should apply ASME Code Case OMN-8, as accepted in RG 1.192, if concerns exist regarding IST of control valves with fail-safe functions. 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.

4.2.10 Pressurizer Power-Operated Relief Valve Inservice Testing

Power-operated relief valves (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 Section III, but many have been used as low-temperature overpressure protection valves.

NRC Recommendation

The staff recommends that licensees should consider previous NRC guidance that the PORVs should be included in the IST program as Category B valves and should be tested to the OM Code. 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 Subsections ISTC 3500 [4.2] and ISTC 5100 [4.4] for exercising quarterly during power operation are "not practical" and, therefore, exercising may be performed during cold shutdown conditions.

Subsection ISTC 3310 [3.4] 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 PORVs Masked by Downstream Indications During Testing") where improper evaluation of testing failed to identify the incorrect reassembly of a PORV.

Previously approved NRC guidance included in GL 90-06 (see below) indicates that, because the PORVs function during reactor startup and shutdown to protect the reactor vessel and coolant system from low-temperature overpressurization 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 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

The NRC's guidance on the IST requirements for PORVs is included in GL 90-06, "Resolution of Generic Issue 70, 'Power-Operated Relief Valve and Block Valve Reliability,' and Generic Safety Issue 94, 'Additional Low-Temperature Overpressure Protection for Light-Water Reactors,' Pursuant to 10 CFR 50.54(f)." In IN 89-32, "Surveillance Testing of Low-Temperature Overpressure-Protection Systems," the NRC discussed 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 low-temperature overpressure systems to prevent exceeding the limits in Appendix G to 10 CFR Part 50. Compliance with the guidance in GL 90-06 has been coordinated between the plants and the NRC project managers for each plant on a case-by-case basis.

4.3 Safety and Relief Valves

4.3.1 Scope

Subsection ISTA 1100 [1.1] defines the scope of the valves subject to IST 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, may 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 may be required to be included in the IST program and tested according to the schedules stipulated in Section ISTC and Appendix I of the OM Code. Specifically, OM sub-section ISTC clarifies that its requirements apply only to pressure-relief devices required for overpressure protection. The testing of these devices is to be included in 120-month updated IST programs.

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. Generic Letter 96-06, Assurance of Equipment Operability and Containment Integrity During Design-Basis Accident Conditions," 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 made changes to 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 Code, as well as the *USA Standard Code for Pressure Piping* (USAS B31.1) and the *USA Standard Code for Nuclear Power Piping* (USAS B31.7). 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.

4.3.2 Method of Testing Safety and Relief Valves

4.3.2.1 BWR Safety/Relief Valve Stroke Testing

In recent years, the NRC staff has received numerous requests for relief and/or TS changes related to the stroke testing requirements for BWR dual-function main steam safety/relief valves (S/RVs). Both Appendix I to the OM Code and the plant-specific TSs require stroke testing of S/RVs after they are reinstalled following maintenance activities. Several 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 and TSs.

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 (MSSVs) 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."

4.3.3 Jack-and-Lap Process

In IN 91-74, "Changes in Pressurizer Safety Valve Setpoints Before Installation," the NRC stated 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. Section ISTC and Appendix I of 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 Section ISTC and Appendix I following replacement, repair, and maintenance.

The 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 quality assurance 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 and Relief Valves in Addition to 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 is necessarily performed as a result of inservice testing 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 Main Steam Safety/Relief Valve."

4.3.5 Scheduling of Safety and Relief Valve Testing

Appendix I to the OM Code requires that licensees must 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 of the 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.

4.4 Miscellaneous Valves

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

4.4.1 Post-Accident Sampling System Valves

NUREG-0737, "Clarification of TMI Action Plan Requirements," Section II.B.3, details the requirements and capabilities of post-accident sampling systems (PASSs) for sampling both the reactor coolant and the containment atmosphere. The PASS consists of pumps and valves that perform these and possibly 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 ASME 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 Code requirements except where relief has been granted.

The remaining valves in the PASS would typically be tested as required by the TSs or other documents and need not be included in the IST program. However, the staff recommends that if the licensee elects to include these valves in the 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 TSs have been amended to eliminate the requirements to have and maintain a PASS. If a PASS valve is eliminated from the TSs but still performs a function within the scope of 10 CFR 50.55a and the ASME OM Code, the valve should remain in the IST program.

4.4.2 Post-Maintenance Testing After Stem Packing Adjustments and Backseating of Valves to Prevent Packing Leakage

Subsection ISTC 3310 [3.4] requires that, upon performing maintenance of a valve in a manner that could affect its performance, the licensee shall, before returning the valve to service, test it to demonstrate that the performance parameters are within acceptable limits. Adjusting stem packing is an example of maintenance that could affect performance. Backseating a valve may also affect its performance (e.g., cause damage to the valve or bind it into its back seat).

It may be necessary to adjust the stem packing during power operations in order 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. Alternatively, backseating a valve may stop packing leakage without the need to take the valve out of service. Licensees should exercise caution when performing such maintenance, as improper backseating or adjustment of valve stem packing could adversely affect the valve's functional capability.

NRC Recommendation

The staff has determined that it is acceptable for licensees to perform an engineering evaluation of the impact of adjusting valve stem packing or backseating a valve 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 or backseat a valve 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, (2) the backseating does not deform the valve stem, and (3) the performance parameters of the valve are not adversely affected. In addition, the licensee must perform a confirmatory test at the first available opportunity when plant conditions allow testing. 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.

Examples of such valves are MSIVs and main feedwater isolation valves, which must remain open to continue power operations. The licensee must 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, or from previous instances of backseating a valve.

Relief is not appropriate because this action is in accordance with the Code requirements if the licensee can demonstrate that the performance parameters will not be adversely affected.

In implementing this guidance, licensees must perform a partial-stroke test, if practical, 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 or been backseated without post-maintenance 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 post-maintenance testing. Backseating procedures should include precautions to prevent stem deformation.

To 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. Specific or general relief is not appropriate for this activity. If the licensee cannot demonstrate that the packing adjustment does not adversely affect performance parameters, the Code requirements must be met for post-maintenance testing. Therefore, the licensee must consider this issue for each valve individually.

Basis for Recommendation

The NRC 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 unless a safety issue exists. The IST requirements do not prohibit or discourage a licensee from making limited adjustments to 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 post-maintenance 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.

NRC IN 87-40, "Back Seating Valves Routinely to Prevent Packing Leakage," gives information related to backseating valves. Both Westinghouse and General Electric had issued guidance on performing backseating to minimize deformation to valve stems. Backseating is not listed as an example of a maintenance activity in OM Subsection ISTC 3310 [3.4]. The licensee would have to assess the effect of backseating on valve operation and determine whether post-maintenance testing is required. Test results for MOV programs to address GL 89-10 and GL 96-05 may indicate whether backseating of a particular valve affects its stroke time. Any information would need to be included and documented in an evaluation, and the assessments would have to be valve-specific.

4.4.3 Manual Valves

The staff has received questions about the requirements for including manual valves in the IST program. The Code includes manual valves that meet the scope requirements of 10 CFR 50.55a. To comply with the OM Code, manual valves must be exercised in accordance with applicable requirements of Section ISTC if the licensee's safety analysis credits the manual valve to perform a specific function in shutting down the reactor to a safe shutdown condition, maintaining the safe shutdown condition, or mitigating the consequences of an accident. Manual valves that perform only a pressure boundary safety function are omitted from the scope of the IST program. If the manual valve is included in actions in emergency operating procedures, but is not credited in the safety analysis, it does not fall within the scope of the IST program; however, such a valve may be periodically tested at an appropriate frequency to ensure that it can function satisfactorily. Applicable tests could include exercising, leak testing, and position indication verification, at the frequency specified in the Code. Passive manual valves that have position indication could be subject to position indication verification.

4.4.3.1 Manual Valve Exercise Interval

On August 3, 2001, the NRC published *Federal Register* notice (66 FR 40626) to amend 10 CFR Part 50 to endorse the ASME OM Code, 1998 Edition with the 1999 and 2000 Addenda. As part of that amendment, 10 CFR 50.55a(b)(3)(vi) included a modification to OM Code 1998. That modification changed the manual valve exercise interval to 2 years, rather than 5 years as specified in the 1999 and 2000 Addenda to the ASME OM Code. The 1998 Edition and earlier versions of the ASME Code specified an exercise interval of 3 months for manual valves within the scope of the Code. The 1999 Addenda to the ASME OM Code revised Subsection ISTC 3540 to extend the exercise frequency for manual valves to 5 years; however, the NRC staff did not agree that there is sufficient justification to extend the exercise interval for manual valves to 5 years. The staff's review of licensees' IST programs indicated that manual valves are exercised every 3 months except in instances where it is impractical to operate valves during unit operation. In such instances, the valves are exercised when the unit is in a cold shutdown or refueling outage condition, and the exercise frequency cannot exceed 2 years. Therefore, a 2-year interval is justified for exercising manual valves because the available manual valve exercise data supports a 2-year interval. Nonetheless, licensees are not prohibited from exercising manual valves more frequently than every 2 years.

4.4.4 Pressure Isolation Valves

Pressure isolation valves (PIVs) are defined as two normally closed valves in series that isolate the reactor coolant system (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 (RCPB), 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 the "Reactor Safety Study" (WASH-1400).

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 TSs accordingly. These Orders are known as the "Event V Orders," and the valves listed therein are the "Event V" PIVs.

Currently, plants are required to operate within the Improved Standard Technical Specifications (STS) which do not contain a listing of PIVs or Event V PIVs. Therefore, the staff recommends that licensees should include a listing of PIVs (including Event V PIVs) in their 10-year 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 PIV Discussion in Generic Letter 87-06

Generic Letter 87-06 supersedes Position 4 of GL 89-04, because the STS do not contain PIV listings. The 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 investigated by the NRC's Office of Nuclear Regulatory Research. The results of studies of interfacing system LOCAs are provided in NUREG/CR-5124, "Interfacing Systems LOCA: Boiling-Water Reactors," and NUREG/CR-5102, "Interfacing Systems LOCA: Pressurized-Water Reactors." Generic Issue 105, which included 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. Pressure isolation valves need to be included in and tested by the IST programs if they are not included as part of a licensees technical specifications.

4.4.4.2 Leak Rate Testing of PIVs

The leak rate testing specified in a plant's TSs must meet the intent of Subsection ISTC 3600 [4.3]. A licensee should 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 TSs are not sufficiently detailed to ensure individual valve leak testing, the licensee is responsible to ensure that the test procedures are themselves adequate for individual valve leak testing.

NRC Recommendation

A licensee may consider the leakage testing performed to meet TS requirements to also meet 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 TSs, 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 Subsection ISTC 3630 [4.3.3] of the OM Code.

Basis for Recommendation

Increasing pressure usually improves the seating of a valve. The 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 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 TSs, the licensee must ensure that any testing requirements that are not specifically detailed in the TSs are, nonetheless, imposed on the pressure isolation valves 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 are related to the acceptance criteria specified in some TSs 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 TSs, the leakage testing must be described in detail in the SAR or must be identified as in accordance with the requirements of the OM Code.

4.4.5 Containment Isolation Valves That Have Other Leak-Tight Safety Functions

Valves that function as containment isolation valves 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 Appendix J may not adequately test these additional functions based on the pressure or fluid medium. For such valves, the requirements of both Appendix J and Subsection ISTC 3600 [4.3] 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 (HCU), which consists of valves and an accumulator. The HCU is supplied charging and cooling water from the control rod drive pumps, 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 has determined that those ASME Code-Class valves that must change position to provide the scram function should be included in the IST program and should be tested in accordance with the requirements of Section ISTC except where relief has been granted in a safety evaluation report. Bi-directional exercise testing of check valves is required by the 1996 Addenda to the ASME Code (and later editions and addenda).

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 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 TSs 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 should be clearly stated and documented in the IST program document.

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 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 HCU accumulator pressure decay test, as identified in the facility's TSs may be used as the charging water header check valve alternative testing frequency for the reasons stated above. If this test is not addressed in the licensee's TSs, this closure verification should be performed at least during each refueling outage, and this alternative test frequency should be specifically addressed in the IST program document.

The scram inlet and outlet valves are power-operated valves 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 Code. Verifying that the associated control rod meets the scram insertion time limits defined in the plant's TSs 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 may 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.

4.4.7 Use of Appendix J, Option B, in Conjunction with ISTC Exercising Tests

In the ASME OM Code, Subsection ISTC 3522 [4.5] requires licensees to exercise Category C valves every 3 months. ISTC 3620 [4.3.2] also requires licensees to seat leak test Category A valves (containment isolation valves) in accordance with Appendix J to 10 CFR Part 50. If leak rate requirements are based on an Appendix J program. 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 refueling outages. Therefore, for Category A/C valves, the Code requires two independent tests, including an exercising test and a seat leakage rate test.

The 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.

The Appendix II Check Valve Condition Monitoring Program allows an alternative to the exercising testing requirements in the OMa-1996 Addenda. The OMa-1996 Addenda included two significant changes to IST of check valves to (1) correct certain anomalies in the way check valves are currently being exercised, and (2) codify a process for monitoring the valve's operating condition and performance. This integral two-part improvement to the Code provides interrelated requirements. ASME modified Subsection ISTC 4.5.2, "Exercising Requirements," and Subsection ISTC 4.5.4, "Valve Obturator Movement," to require bidirectional testing to improve on the detection of valve degradation and failure. The related change to Subsection ISTC 4.5.5, "Condition Monitoring Program," allowed the use of a codified condition monitoring process as an alternative to the exercising and testing requirements of Subsections ISTC 4.5.1 – 4.5.4. The condition monitoring process, defined in Appendix II, "Check Valve Condition Monitoring Program," gives 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 the alternative Appendix II Condition Monitoring Program, with the regulatory modifications, 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 staff recommends that licensees should implement the condition monitoring program to justify extending the exercise test interval to the leak test frequencies specified in Option B of Appendix J.

Basis for Recommendation

The use of the Appendix II Condition Monitoring Program, 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.

5. SUPPLEMENTAL GUIDANCE ON INSERVICE TESTING OF PUMPS

5.1 General Pump Inservice Testing Issues

In 1995, OM Code Section ISTB introduced a new approach to pump testing, in which pumps are divided into two basic groups with an enhanced baseline or preservice and three periodic tests (i.e., Group A, Group B, and Comprehensive). This modified pump testing program is commonly referred to as the Comprehensive Pump Test (CPT). The pump grouping criterion of ISTB is based on the way the pumps are operated at the plant.

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. 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. Subsection ISTB-3300(e)(1) [4.3(e)(1)] of the OM Code requires licensees to establish reference values within ±20 percent of the design flow for the CPT.

5.1.1 Categories of Pumps for Inservice Testing

The OM Code requires that all pumps that the licensee identifies as part of an inservice testing (IST) program must be categorized as either Group A or Group B pumps. Subsection ISTB-2000 [1.3] defines Group A as "pumps that are operated continuously or routinely during normal operation, cold shutdown, or refueling operation." By contrast, the Code 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 four types of tests, including Preservice, Group A, Group B, and Comprehensive tests. 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, etc.), and at least once every 2 years by a Comprehensive test. A Comprehensive test 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.

OM ISTB-3410 [5.3], "Pumps in Regular Use," states—

> Group A pumps that are operated more frequently than 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 reference conditions, and the quantities specified were determined, recorded, and analyzed per Article ISTB 6000.

OM ISTB-3420 [5.4], "Pumps in Systems Out of Service," states—

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

In Generic Letter (GL) 87-09, the NRC clarified its position about the 1-week Code allowance in the Bases section of Standard Technical Specification 4.0.5, as follows:

> Specification 4.0.5 establishes the requirement that inservice inspection of ASME Code Class 1, 2, and 3 components, and inservice testing of ASME Code Class 1, 2, and 3 pumps and valves shall be performed in accordance with a periodically updated version of Section XI of the *ASME Boiler and Pressure Vessel Code* or ASME OM Code and Addenda as required by 10 CFR 50.55a.... Under the terms of this specification, the more restrictive requirements of the Technical Specifications take precedence over the ASME Code and applicable Addenda. The requirements of Specification 4.0.4 to perform surveillance activities before entry into an OPERATIONAL MODE or other specified condition takes precedence over the ASME Code provisions which allows pumps to be tested up to one week after return to normal operation.

Therefore, to comply with the applicable TS and GL 87-09 guidance, if the testing schedule is not maintained during plant shutdowns, the affected pump(s) must be tested before entering an operational mode that requires the pump(s) to be operable. The only exceptions to this guidance apply to those plants that have TS allowances that explicitly state otherwise.

The improved Standard Technical Specifications address the IST Program in Section 5.5.8 under Section 5.0, "Administrative Controls." This program provides controls for inservice testing of ASME Code Class 1, 2, and 3 components. It also provides (1) testing frequencies specified in Section XI of the *ASME Boiler and Pressure Vessel Code*, (2) the provisions of Surveillance Requirements (SRs) 3.0.2 and 3.0.3 that are applicable to IST activities, and (3) a statement that nothing in the *ASME Boiler and Pressure Vessel Code* shall be construed to supersede the requirements of a Technical Specification.

NRC Recommendation

In 1995, OM Code Section ISTB introduced the new 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. This section also discusses previously issued guidance and experience. The licensee shall follow the applicable Technical Specification or Improved Technical Specification, as applicable.

When updating the IST program to the ASME OM Code licensees must also ensure that their improved standard technical specification refer to the OM code and not to the ASME B&PV Code, Section XI.

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 such cases, it may be necessary to plot pump curves to use as the basis for variable reference points. Consequently, the ASME Code Committee introduced Code Case OMN-9, Revision 0, "Use of Pump Curves for Testing," which the NRC staff subsequently included in RG 1.192, "Operations and Maintenance Code Case Acceptability, ASME OM Code." That regulatory guide lists the OM Code Cases that the NRC staff finds acceptable for licensees to implement in their IST programs for light-water-cooled nuclear power plants. In particular, the staff accepted Code Case OMN-9, with the condition that (1) when the repair, replacement, or routine servicing of a pump may have affected a reference curve, the licensee must determine a new reference curve, or reconfirm an existing reference curve, in accordance with Section 3 of Code Case OMN-9; and (2) if it is necessary or desirable, for some reason other than that stated in Section 4 of Code Case OMN-9, to establish an additional reference curve or set of curves, the licensee must determine the new curves in accordance with Section 3 of Code Case OMN-9. The use of OMN-9 requires relief because OMN-9 is only applicable to the ASME OM Code-1990 through ASME OMb Code 1992. It is not applicable to 1995 or later Code editions.

5.2.1 Reference Values

Licensees shall determine reference values from the results of Preservice testing 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 Code. Licensees shall only establish reference values 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.

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 shall determine the reference curves from the data measured during Preservice testing or the first inservice test. In addition, the licensee shall establish a reference curve from a minimum of three data points for each 20 percent of the maximum pump curve range, and the range of the reference curve shall be sufficient to bound the points of operation that are expected during subsequent tests. The licensee shall then compare all results to the initial reference curves or the new values established in accordance with Sections 5.2.3 and 5.2.4, below. In addition, the licensee shall only establish reference curves 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 shall document and justify the reasons for doing so and the suitability of the methods used to develop the reference curves and acceptance criteria. (See Subsection ISTB 9000 [7].)

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 shall determine new reference value, set of reference values, or a new reference curve or reconfirm the previous value (or curve) by an inservice test run before declaring the pump operable. The licensee shall then identify any deviation between the previous and new set of reference values (or reference curves), and the record of the tests shall document the verification that the new values (or curves) represent acceptable pump operations. (See ISTB-9000 [7].)

5.2.4 Establishment of Additional Sets of Reference Values or Reference Curves

If it is necessary or desirable, for some reason other than discussed above, to establish an additional set of reference values or curves, the licensee shall run an inservice test under the conditions of an existing set of reference values, or within the range of existing reference curves, and shall analyze the results. If the operation is acceptable in accordance with Section 7 of Code Case OMN-9, a second test run under the new reference conditions shall follow as soon as practicable, and the results of this test shall 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 shall document and justify the rationale for doing so. (See ISTB-9000 [7].)

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 to be used in 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 Code requirements as specified under test acceptance criteria in ISTB Table[s] ISTB-5200-1 [5.2.1-2, or 5.2.2.1, or 5.2.3.1] 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 above; the OM Code; and Code Case OMN-9, including RG 1.192.

The use of OMN-9 requires relief because OMN-9 is only applicable to the ASME OM Code-1990 through ASME OMb Code 1992. It is not applicable to 1995 or later Code editions.

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 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. The Code does not allow for variance from a fixed reference value, stating only that "[t]he resistance of the system shall be varied until either the measured differential pressure or the measured flow rate equals the corresponding reference value." Licensees have requested relief to establish a range of values similar to using a pump curve, but with a very narrow band. For example, one licensee proposed to use a reference curve with the tolerance around the selected value of flow to be ±2 percent. Plant implementing procedures may instruct operators to set the flow to 1,500 gpm [94.6 L/s]. When this step is performed, the operator would attempt to set the flow as close as possible to 1,500 gpm [94.6 L/s] and maintain it steadily at approximately 1,500 gpm [94.6 L/s].

NRC Recommendation

The staff has determined that, if the design does not allow for establishing and maintaining flow at an exact value, achieving a steady flow rate or differential pressure at approximately the set value does not require relief for establishing pump curves. The allowed tolerance for setting the fixed parameter must be established for each case individually, including the accuracy of the instrument and the precision of its display. This will necessitate verification of the effect of precision on accuracy as considered in the design of the instrument gauge. For Group A and Group B tests, a total tolerance of ±2 percent of the reference value is allowed without prior NRC approval; for Preservice and Comprehensive tests, the allowable total tolerance is ±½ percent for pressure and differential pressure, ± 2 percent for flow. For a tolerance greater than the allowed percent (which may be necessary depending on the precision of the instrument), the licensee may make a corresponding adjustment to acceptance criteria to compensate for the uncertainty, or may perform and document an evaluation to justify a greater tolerance. In using this guidance, the IST program document or implementing procedures must document the variance and the method for establishing it.

The intent is that the variance in the reference value setting may be ±2 percent for Group A and Group B tests and ±½ percent for Preservice and Comprehensive tests without requiring relief. Nonetheless, any variance in the setting will have an impact on test results.

Basis for Recommendation

The OM Code does not address the likelihood that it may not be possible to control a flow rate or differential pressure to an exact value. When the Code specifies that the system resistance must be varied until either the flow or differential pressure equals the corresponding reference value, it does not intend the "set value" to have an acceptable range as stated in the ISTB test acceptance criteria, including ISTB Table[s] ISTB-5200-1 [5.2.1-2, or 5.2.2.1, or 5.2.3-1]. The acceptance criteria apply only to the parameter being determined after the resistance is varied. Licensees should recognize that the reference value for certain pumps can only be achieved within a specified tolerance. Licensees may set the repeatable parameter as close as possible to the reference value during each test, rather than treating any variance in the value with a pump curve. If, upon establishing trends in data, the licensee determines that the parameter varies such that the readings are outside the accuracy of the instrument, the licensee may need to establish pump curves and propose an alternative to the Code requirements for the applicable pumps. (See Section 5.2.)

Subsection ISTB 3500 [4.7.1] specifies the requirements for instrument fluctuations and describes the basis for allowing a variance from the reference value of ±2 percent for Group A and Group B tests, and ±½ percent for pressure and differential pressure, ±2 percent for flow for Preservice and Comprehensive tests. In addition, Subsection ISTB 3500 [4.7.1] allows the use of symmetrical damping devices or averaging techniques to reduce instrument fluctuations to within ±2 percent or ±½ 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.

5.4 Monitoring Pump Vibration in Accordance with ISTB

OM Section ISTB 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 OM Table ISTB-3000-1 [4.1-1], the measurement of pump vibration is required for Preservice, Group A, and Comprehensive tests. However, the Code does not require vibration measurements for Group B tests. The staff has determined that if the licensee uses OM Section ISTB 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 Subsections ISTB 3540 [4.7.4], ISTB 5000 [5.2], and ISTB 6000 [6.2]. However, Commission approval to use a later Code edition or addenda is still required pursuant to 10 CFR 50.55a(f)(4)(iv). See sections 1.1 and 2.1, for further guidance.

In following this guidance, the frequency response range of the instrumentation must be as specified in Subsection ISTB 3510(f) [4.7.1(f)] 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 Section ISTB, or obtaining approval of an alternative to the requirements.

Basis for Recommendation

As shown in OM Figure ISTB-5200-1 [5.2.1], "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 (rpm). Such an approach would enable the licensee to more rapidly detect wear in the anti-friction bearing and other types of pump degradation and, thus, effect 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 nuclear licensees measure pump vibration velocity to detect pump degradation and obtain advance warning of incipient pump bearing failure. Upon obtaining 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.

OM Section ISTB 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 Hz 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 approval 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 Code requirements can now be procured from various suppliers at reasonable costs. Additionally, frequencies less than running speed may not be indicative of problems for certain types of bearings; however, subharmonic frequencies may be indicative of rotor rub, seal rub, loose seals, or coupling damage. The type of bearings and other subharmonic concerns would typically be discussed in the justification for relief.

OM Section ISTB 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 10-year 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. However, there is continuing debate concerning whether the use of root mean square (rms) measurement within the ASME OM Code is acceptable for determining the operational readiness of pumps. The OM Code Committee responded to an inquiry (File OMI 94-2) explaining that the intent of the OM Code is to allow vibration to be measured in rms and mathematically converted to peak readings. Licensees are cautioned that the Code vibration acceptance criteria are in peak or peak-to-peak units, and the use of root mean square (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 OM Section ISTB, or convert the data to peak values.

Several plants have requested an alternative to the vibration acceptance criteria of Section ISTB for smooth-running pumps, and the NRC has approved such requests. However, licensees with such approval 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.

5.5 Pump Flow Rate and Differential Pressure Instruments

The NRC has received requests for relief to continue using instruments that do not meet either the range or accuracy requirements of the Code. The 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 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. For Group A and Group B pumps, OM Subsection ISTB 3510 [4.7.1] 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 and Comprehensive tests, the required instrument accuracy is ± ½ percent for pressure and differential pressure instruments.

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 Code, the staff may grant relief when the combination of the range and accuracy yields a reading that is at least equivalent to that achieved using instruments that meet the 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 and Comprehensive tests). 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 Code. When using temporary instruments, the staff recommends that the licensee's IST records should include an instrument number for use in tracing each instrument and a calibration data sheet for use in 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 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 4 times the reference values or less, the permanent instruments in many early-licensed plants do not meet the current requirements of the 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 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 Code; therefore, for new instrument installations, licensees must meet the accuracy and range requirements (although the 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 as a result of changes to the Code. Instrument modifications are considered practical in the context of 10 CFR 50.55(a)(f)(4). However, the use of any available instruments that meet the intent of the Code requirements for the actual reading would yield an acceptable level of quality and safety for testing. Licensees are required to submit a relief request in this case.

When the licensee submits a relief request, it should separately address each group of affected pumps if the instruments are permanently installed. By contrast, a general relief request may be acceptable for temporary instrumentation. If the instruments do not meet the intent of the Code requirements, the NRC may require the licensee to adjust acceptance limits to account for the instrument inaccuracies.

Licensees are cautioned that the Comprehensive Pump Test (CPT) requires more accurate instruments than those specified in earlier editions of the Code. As a result, licensees must verify that instrument accuracy is appropriate for the type of test being performed (Group A or

Group B versus a Comprehensive test). Licensees should also note that previously acceptable instruments may no longer be acceptable when updating to a more recent edition of the Code.

5.5.2 Use of Tank Level to Calculate Flow Rate for Positive Displacement Pumps

The NRC has received requests for relief 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.

OM Subsection ISTB 3550 [4.7.5] requires licensees to measure the pump flow rate using a rate or quantity meter 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, Subsection ISTB-5300(a) [5.6.3] requires a 2-minute run time in order to achieve stable pump performance parameters 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 staff has determined that, if the licensee uses the tank level to calculate the flow rate as described in Subsection ISTB 3550 [4.7.5], 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, and Preservice and Comprehensive Tests. 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 in order to determine the extent of any pump degradation. A minimum pump run time of 2 minutes is required in order 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 in 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 Code requirements would be 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:

$$Q\ (GPM) = \Psi \Delta L\ (inch) / \Delta t\ (Second)$$

Where: Q is flow rate
Ψ is a constant which 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 Table ISTB-3500-1 [4.7.1-1]. 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. Licensees must submit a relief 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 relief 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 staff has determined that, if the licensee uses the bay level to calculate the suction (inlet) pressure as described in Subsection ISTB 3520(b) [4.7.2(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 ±½ percent for Preservice and Comprehensive tests. If direct measurements are impractical for other types of pumps with suction from a tank, the licensee must apply similar controls. The 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 (Subsection ISTB 3520(b) [4.7.2(b)]). Therefore, the licensee may implement a calculational method without obtaining relief because the ASME 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 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 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 Interpretations 95-7 (OM-1990, Subsection ISTB 4.6.1 and Table ISTB 4.6.1.1; OM-1987 with OMa-1988, Part 6, Para. 4.6.11 and Table 1, "Instrument Accuracy") and Inquiries IN 91-3 (OM-1987 through OMc-1990, Part 6, Para. 4.6.1.1) and IN 91-037 (ASME 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 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 annubar flow coefficient, and the reversed installation of a one-direction orifice plate.

NRC Recommendation

The 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 OM Subsection ISTB 3500 [4.7] applies only to the calibration of the instruments. The 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 applies only to the calibration of the instrument and does not take into account physical attributes, environmental effects, vibration effects, or process effects.

5.6 Operability Limits of Pumps

Operability limits of pumps must always meet, or be consistent with, licensing-basis assumptions in a plant's safety analysis. GL 91-18 provides additional guidance on operability of components.

Inservice testing is intended to provide assurance of the continued operability of pumps and valves. To provide this assurance, it is considered acceptable for a TS action statement to be entered on infrequent occasions in order to test a component. Where a system must be taken out of service to perform a test, it is likely that, in the event of a plant emergency, the system could be automatically or promptly realigned for operation. Where one train of a safety system will be disabled for an extended period or both trains of the system must be made inoperable to perform a test, the licensee should propose an alternative testing schedule that provides for verification of component operability with testing performed during periods (e.g., refueling outages) when availability of the system is not essential to plant safety.

The staff has determined that licensees must comply with the values and acceptance criteria set forth in OM ISTB-5220 [5.2] and its referenced tables. Licensees must obtain relief if expanded ranges are needed outside the scope of ISTB acceptance criteria, sections, tables and figures. The relief request must include the licensee's basis for the expanded ranges, as well as the basis for finding that the expanded ranges will identify degraded conditions. In either case, the basis for acceptable pump performance would pertain to the pump and not the system, although pump performance must meet system requirements to remain in an analyzed condition.

Basis for Recommendation

The limits contained within the three ranges identified as the Acceptable Range, Alert Range, and Required Action Range refer to the pump, rather than the system. That is, the ranges are for the pump test data. If these ranges cannot be met, the licensee can, for example, specify new range limits for differential pressure from a range of 0.93 – 1.03 to a range of 0.89 – 1.05. Using the less-conservative ranges, the Code requires the licensee to show that the overall pump performance has not degraded from its intended function. Establishing limits that are more conservative than the Code limits may be necessary to ensure that design limits are met. NRC information notice 97-90 describes situations where ASME acceptance ranges were greater than those assumed in the accident analysis. As discussed in other sections of this NUREG, IST acceptance criteria does not supersede the requirements delineated in a licensee's design or license basics.

5.7 Duration of Tests

Subsection ISTB-5100 [5.6], "Duration of Tests," requires that for measuring parameters as *specified in Table ISTB-3000-1* [4.1-1], *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 and Comprehensive pump tests. The staff recommends that this duration also be applied to Group B pump tests.

Basis for Recommendation

The 2-minutes 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," and Position 9 of GL 89-04, "Pump Testing Using Minimum-Flow Return Line With or Without Flow Measuring Devices.")

5.8 Adjustments for Instrument Inaccuracies

If the accuracy of plant instrumentation used for IST is not well understood, the test results may not be adequate to meet the licensee's safety analysis, even if they meet the Code requirements. For example, TSs or the safety analysis report require a pump to produce 1,000 gpm at 500 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 Table ISTB-5100-1 [5.2.1-2] (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 taken into account for 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.

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 "information only" or for IST, 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 Code. Design analyses may not account for instrument accuracy readings; however, when the pump selection is made, the designer generally selects from a catalog of available sizes and chooses one with margin above the analyses numbers.

In the determination of loop accuracy, it is intended that only the instrument manufacturers reference accuracy be considered. It is not necessary to consider all uncertainties (such as environmental effects, process effects, vibration effects, etc.).

5.9 Pump Testing Using Minimum Flow Return Lines With or Without Flow Measuring Devices

The NRC has received relief requests 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 as specified in the Section ISTB of the OM Code.

As specified in Section 5.1.2 above, the Code identifies four types of tests, including Preservice, Group A, Group B, and Comprehensive tests. 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, etc.), and at least once every 2 years by a Comprehensive test. A Comprehensive test 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.

Subsections ISTB 5100(b), 5200(b), and 5300(b) [3.2] 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, time limitations) for minimum flow operation. The bypass test loop may be used for Group A or Comprehensive tests, provided that the flow rate through the loop meets the requirements specified in Subsection ISTB 3300 (4.3).

An inservice pump test requires that the pump parameters shown in Table ISTB 3000-1 [4.1-1] 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 staff's position is that flow instrumentation that meets the requirements of Subsection ISTB 3500 [4.7] 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 this data can be evaluated with the measured pump differential pressure to monitor for pump hydraulic degradation. The guidance provided in GL 89-04, Position 9 still applies.

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 and that the minimum flow line is adequately sized and that operation will not damage the pump.

5.10 Alternative to ASME OM Code Comprehensive Pump Testing Requirements

The NRC has received relief requests from licensees requesting approval of alternatives to the Comprehensive Pump Testing (CPT) requirements specified in Subsection ISTB-3300 [4.3], "Reference Values" of the OM Code.

The CPT was developed with the knowledge that some pumps, such as containment spray pumps, cannot presently be tested at the required high flow rates because of system design limitations. Consequently, Subsection ISTB 3300(e)(1) [4.3(e)(1)] requires licensees to establish reference values within ±20 percent of the design flow for the CPT.

Some designs do not allow a CPT at a pump design flow of ±20 percent because of the original system design configuration. In such cases, it may be necessary to use the pump's recirculation line for IST; however, recirculation lines are not typically designed to accommodate ±20 percent of the design flow.

NRC Recommendation

The NRC accepts the use of lower flow (reference values) other than ±20 percent of the design flow, as specified by OM Section ISTB for CPT, if the licensee's relief request clearly demonstrates the impracticality of establishing a reference value within ±20 percent of the design flow for the CPT.

To obtain approval for a proposed alternative method of performing the CPT with a flow other than as specified in Subsection ISTB 3300 [4.3] and measuring pump parameters to detect hydraulic degradation and determine pump operability, the licensee must demonstrate that the acceptance criteria are equivalent to the CPT Code requirements in Subsection ISTB 3300 [4.3].

To show the impracticality, the licensee should include (as a minimum, but not limited to) the following information in the submitted relief request:

(1) Provide reason(s) for not performing the CPT at the required flow of ±20 percent of pump design flow.

(2) Specify the maximum flow at which the CPT can be performed.

(3) Provide the estimated cost of any temporary or permanent system modification required to enable a CPT to be performed at ±20 percent of pump design flow, along with any difficulty associated with implementing the modification.

(4) Provide all details (e.g., temporary modifications of piping, containment sump, etc.), including pump performance curves, if a full-flow test was performed during preservice or service of the plant.

(5) Provide pump performance curves and any other data associated with the pump's shop testing provided by the manufacturer.

(6) Provide the records and history of maintenance and repairs performed on the pump.

(7) Provide any appropriate compensatory actions being proposed to supplement the alternative testing, such as (but not limited to) the following examples:
   (a) testing at the best efficiency point (BEP) on a longer interval; BEP is defined as the capacity and head at which the pump efficiency is at its maximum
   (b) commitment to perform additional performance monitoring
   (c) adjustment of acceptance criteria
   (d) continuation of the previous Code testing, including taking overall vibration data quarterly
   (e) periodic sampling and analysis of the lube oil

Additional guidelines are included in NUREG/CP-0152, Volume 4, Proceedings of the Seventh NRC/ASME Symposium on Valve and Pump Testing, entitled "Comprehensive Pump Testing Based on ASME OM Code Requirements and its Alternative and Related Relief Requests."

This guidance requires relief because the Code does not allow for a reference value of flow for Comprehensive pump tests, other than at flow rates within ±20 percent of pump design flow. The NRC will review any relief requests on a case-by-case basis.

5.11 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. Most pumps are driven by electric motors, which are connected via coupling 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 have significant effects on pump operation and the operational readiness.

The issues related to motor drivers for pumps are under consideration by a Working Group Committee (WGC) of the Institute of Electrical and Electronics Engineers (IEEE), which will address issues related to the operation, maintenance, aging, and testing of Class 1E equipment in nuclear power generating stations. The WGC will also develop and update IEEE standard criteria for the testing of nuclear power generating station safety systems.

6. REVISED STANDARD TECHNICAL SPECIFICATIONS

6.1 Introduction

The purpose of a pump or valve inservice test is to assess the operational readiness of the component. Inservice tests are designed to detect component degradation by assessing component performance in relation to operating characteristics when the component was "known to be operating acceptably." Thus, the data obtained during these tests provide insight into the ability of a component to perform its safety-related function under design-basis conditions until the next test. In contrast, TS surveillance requirements typically assess system capability (e.g., the ability of a system or component, such as a pump) to deliver the flow rate assumed in an accident analysis at the time of the test. The surveillance acceptance criteria would be "greater than or equal to the required developed head," where the "required developed head" is derived from the licensee's current licensing basis (e.g., accident analyses). TS surveillance requirements typically do not have alert and required action ranges, as would an inservice test. However, licensees often develop test procedures that satisfy both the TS surveillance and IST requirements.

6.2 Discussion

Previously, Standard Technical Specifications contained a requirement similar to the following:

> Inservice testing of ASME Code Class 1, Class 2, and Class 3 pumps and valves shall be performed in accordance with Section XI of the ASME Boiler and Pressure Vessel Code and applicable Addenda as required by 10 CFR 50.55a(f), except where specific written relief has been granted by the NRC pursuant to 10 CFR 50.55a(f)(6)(i).

The revised Standard Technical Specifications reflect the fact that 10 CFR 50.55a requires licensees to establish and implement an IST program and, therefore, it is unnecessary to include such a requirement in a licensee's technical specifications. Rather, the Administrative section of the revised Standard Technical Specifications includes the following requirements for an IST program:

Inservice Testing Program

This program provides controls for inservice testing of ASME Code Class 1, 2, and 3 components. The program shall include the following:

(a) Testing frequencies specified in Section XI of the *ASME Boiler and Pressure Vessel Code* and applicable addenda, as follows:

ASME Boiler and Pressure Vessel Code and applicable Addenda terminology for inservice testing activities	Required Frequencies for performing inservice testing activities
Weekly	At least once per 7 days
Monthly	At least once per 31 days
Quarterly or (every 3 months)	At least once per 92 days
Semiannually (or Biennially or Every 6 months)	At least once per 184 days
Every 9 months	At least once per 276 days
Yearly (or Annually)	At least once per 366 days
Biennially (or Every 2 years)	At least once per 731 days

(b) The provisions of Surveillance Requirement (SR) 3.0.2 are applicable to the above required frequencies for performing inservice testing activities.

(c) The provisions of SR 3.0.3 are applicable to inservice testing activities.

(d) Nothing in the *ASME Boiler and Pressure Vessel Code* shall be construed to supersede the requirements of any TS.

Surveillance Requirement 3.0.2, referenced above, permits a 25-percent extension of the Code-specified test interval to facilitate scheduling and in consideration of plant operating conditions that may not be suitable for conducting the inservice test (e.g., transient conditions or other ongoing surveillance or maintenance activities). The 25-percent extension is not intended to be used repeatedly or merely as an operational convenience to extend test intervals beyond those specified.

Surveillance Requirement 3.0.3, referenced above, allows for a 24-hour delay to complete a missed inservice test before having to declare the associated system inoperable. It also states that a risk evaluation shall be performed for any inservice test that is delayed by more than the 24-hour period, and the risk impact shall be managed.

The IST program is referenced in the TS surveillance requirements for certain systems, as illustrated by the following example:

Surveillance	Frequency
Verify each ECCS pump's developed head at the test flow point is greater than or equal to the required developed head.	In accordance with the inservice testing program
Verify each pressurizer safety valve is OPERABLE in accordance with the inservice testing program. Following testing, lift settings shall be within ±1%.	In accordance with the inservice testing program
Verify the isolation time of each automatic power operated containment isolation valve is within limits.	In accordance with the inservice testing program or 92 days

If the inservice test is not performed within the 24-hour delay period, the associated LCO must immediately be declared not met, and the applicable condition(s) must be entered. Similarly, when the inservice test is performed within the 24-hour delay period but the inservice test is not met, the associated LCO must immediately be declared not met, and the applicable condition(s) must be entered. Guidance on resolving degraded and nonconforming conditions is included in GL 91-18, Revision 1, "Information to Licensees Regarding NRC Inspection Manual Section on Resolution of Degraded and Nonconforming Conditions," and is further discussed in Chapter 7 of this NUREG-series report.

It is noted that when a licensee updates their program to the ASME OM Code, it may be necessary to submit a TS change to refer to the OM Code as the appropriate Code of Record.

7. IDENTIFICATION OF CODE NONCOMPLIANCE

7.1 Nonconforming Conditions

Generic Letter 91-18 gives guidance on resolving degraded and nonconforming conditions. However, a licensee's first step should be to ensure that it is in compliance with its technical specifications (TSs). If not, the licensee should discuss the discrepancy with the NRC and define an appropriate course of action. Such action might include seeking a notice of enforcement discretion (NOED) or an exigent TS amendment. If a licensee determines that the degraded or nonconforming condition relates to an ASME Code noncompliance and has not resulted in a known TS violation, the licensee should follow the guidance in GL 91-18.

Perhaps the most common example of an ASME Code noncompliance that can also result in a TS violation is a missed IST surveillance. One licensee encountered such a problem after converting to the improved Standard Technical Specifications. The plant was a boiling-water reactor (BWR) and, following an outage, the licensee discovered an error in the IST procedure used during the outage to exercise a transversing in-core probe system inboard nitrogen purge isolation valve. The licensee initially concluded that the valve was operable but was nonconforming according to guidance contained in GL 91-18. After discussions with the NRC staff, however, the licensee concluded that the limiting condition for operation (LCO) governing operability of the subject valve had to be declared not met in accordance with TS SR 3.0.3. Specifically, TS SR 3.0.3 allowed 24 hours to complete a missed surveillance; otherwise, the LCO must be declared not met and the applicable TS Action entered. The licensee's IST program description contained in the TS Administration Control section stated that SR 3.0.3 was applicable to IST testing activities, and the licensee was unable to perform the surveillance within the 24-hour period allowed by SR 3.0.3. The licensee eventually requested and was granted a NOED to allow continued operation until the condition could be rectified. This example emphasizes that in cases of ASME Code noncompliance, a licensee should always consult the TS first for the appropriate course of action.

In cases where components exceed the ASME Code required action range and the required action range is more conservative than the TS or SAR limit, the corrective action may not be limited to replacement or repair; it may be an analysis to demonstrate that the specific performance degradation does not impair operability and that the pump or valve will still perform its safety function. These actions would be accomplished in accordance with the guidance in GL 91-18 and the applicable edition and addenda of the ASME Code.

If a licensee determines that, because of a nonconforming condition, a component is inoperable, the requirements of the TS LCOs must be met. At that time, a licensee may determine that testing is not in the best interest of safety and may seek enforcement discretion from the NRC.

7.2 Starting Points for Time Periods in Technical Specification Action Statements

In many cases, pumps or valves covered by the ASME OM Code also exist in systems covered by TSs and, if declared inoperable, would cause the plant to enter an Action statement. These Action statements generally have a time period after which, if the equipment is still inoperable, the plant is required to take some specific action, such as commencing plant shutdown.

ASME OM Code, Subsections ISTC 5115, 5123, 5133, 5143 and 5153 [4.2.9] state, "If the valve is retested and the second set of data also does not meet the acceptance criteria, the data shall be analyzed within 96 hours... or the valve shall be declared inoperable."

The potential exists for a conflict between the aforementioned data analysis interval versus the TS Action statement time period.

In accordance with GL 89-04, as soon as the licensee recognizes that the data are within the Required Action Range for pumps or exceed the limiting value of full-stroke time for valves, the associated component must be declared inoperable and the TS Action time must be started.

If a test is under way (regardless of whether test data have been taken) and it is obvious that a gauge is malfunctioning, the test may be halted and the instruments should be promptly recalibrated. One example might be a wildly fluctuating gauge. It should be noted, however, that, in many situations where anomalous data are indicated, it may not be clear that the problem lies with the gauge. In such cases, the licensee should attribute the problem to pump performance. The licensee would then declare the pump inoperable and evaluate the condition of the pump during the time allotted by the applicable Technical Specification.

8. RISK-INFORMED INSERVICE TESTING

8.1 Introduction

10 CFR 50.55a, "Codes and Standards," paragraph (f), "Inservice Testing Requirements," requires, in part, that Class 1, 2, and 3 pumps and valves must meet the requirements of the *Code for Operation and Maintenance of Nuclear Power Plants* (OM Code). The OM Code replaced the Section XI rules for the inservice testing of pumps and valves. General requirements related to inservice testing are contained in Subsection ISTA of the OM Code, while the IST requirements for pumps are contained in Subsection ISTB and the IST requirements for valves are contained in Subsection ISTC.

Regulatory Guide (RG) 1.175, "An Approach for Plant-Specific, Risk-Informed Decision-Making: Inservice Testing," August 1998, describes an acceptable alternative approach for applying risk insights from probabilistic risk assessment (PRA), 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 inservice testing programs without being overly prescriptive. The resultant risk-informed IST programs will have improved effectiveness with regard to the utilization of plant resources, while still maintaining acceptable levels of quality and safety. However, licensees may propose other approaches for consideration by the NRC staff. It is intended that the approach presented in RG 1.175 should be regarded as examples of acceptable practices, and that licensees should have some degree of flexibility in satisfying regulatory requirements on the basis of their accumulated plant experience and knowledge.

8.2 Discussion

Until such time as a risk-informed alternative to the current Code requirements is incorporated by reference into the regulations, the alternative approach described in RG 1.175 must be authorized by the NRC pursuant to 10 CFR 50.55a(a)(3)(i) on a plant-specific basis prior to implementation. Because 10 CFR 50.55a(a)(3)(i) places no restrictions on the scope of alternatives that may be authorized, 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). In either case, the 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 ASME 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(a)(3)(i) 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 refueling outages, many licensees are trying to perform as much maintenance, testing, and surveillance as possible with the nuclear power plant on line. For example, several licensees have submitted relief requests to obtain NRC approval to conduct inservice testing once per refueling cycle, rather than during the refueling outage as prescribed by the Code. In preparing (and evaluating) such relief 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 refueling outages, 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 refueling outages. Relief requests to perform testing once each refueling cycle with the nuclear power plant on line should be prepared in light of the refueling outage justification for each affected valve or group of valves. If necessary, the licensee should revise the refueling outage 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 Technical Specification (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 (NOEDs). In addition, licensees should not conduct non-corrective maintenance/testing activities at power if the associated post-maintenance testing cannot reasonably be accomplished until the next outage.

Sometimes, there is a tradeoff between testing these 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 on line, rather than testing during the refueling outage. 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, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis," and Appendix D to Standard Review Plan (SRP) Chapter 19, (NUREG 0800) 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.[5] If relevant, licensees should also provide information on how testing at power (rather than testing during refueling outages) 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

[5] It should be noted that the assessment of risk resulting from performance of maintenance 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. This configuration risk management does not address the relative merits of testing at power versus testing during refueling outages.

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 refueling outages can be more advantageous than at-power operations from a worker safety perspective (for example, systems may be cold and depressurized). When requesting NRC approval to perform testing with the nuclear power plant on line, 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, Rev. 2, "Industry Guideline for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," the Nuclear Management and Resources Council (NUMARC, now NEI) provided additional guidance for conducting online maintenance and testing. It states, in part—

> 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.

8.4 ASME Risk-Informed Code Cases

Over the past several years, ASME has developed a series of risk-informed Code Cases related to testing pumps and valves, including the following examples:

- OMN-1, "Alternative Rules for Preservice and Inservice Testing of Certain 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, "Motor-Operated Valve Risk-Based Inspection Code Case."
- OMN-12, "Alternative Requirements for Inservice Testing Using Risk Insights for Pneumatically and Hydraulically Operated Valve Assemblies in Light-Water Reactor Power Plants."

The Code Cases listed as approved in Tables 1 and 2 of RG 1.192, "Operation and Maintenance Code Case Acceptability, ASME OM Code Case," have been incorporated by reference into 10 CFR 50.55a. Licensees may voluntarily use these Code Cases, without additional staff approval, as an alternative to complying with the ASME 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 in order to provide an acceptable level of quality and safety).

When using ASME's risk-informed 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, and OMN-12), as modified by any conditions specified in RG-1.192.

The ASME Committee on Operation and Maintenance of Nuclear Power Plants (ASME OM Committee) is in the process of developing a new Subsection ISTE of the OM Code, which will address risk-informed inservice testing.

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------ Information Notice 86-50, "Inadequate Testing to Detect Failures of Safety-Related Pneumatic Components or Systems," June 18, 1992.

------ Information Notice 87-01, "RHR [Residual Heat Removal] Valve Misalignment Causes Degradation of ECCS in PWRs," January 6, 1987.

------ Information Notice 87-40, "Back Seating Valves Routinely to Prevent Packing Leakage," August 31, 1987.

------ Information Notice 88-70, "Check Valve Inservice Testing Program Deficiencies," August 29, 1988.

------ Information Notice 89-32, "Surveillance Testing of Low-Temperature Overpressure-Protection Systems," March 23, 1989.

------ Information Notice 89-62, "Malfunction of Borg-Warner Pressure Seal Bonnet Check Valves Caused by Vertical Misalignment of Disk," August 31, 1989.

------ Information Notice 91-56, "Potential Radioactive Leakage to Tank Vented to Atmosphere," September 19, 1991.

------ Information Notice 91-74, "Changes in Pressurizer Safety Valve Setpoints Before Installation," November 25, 1991.

------ Information Notice 94-08, "Potential for Surveillance Testing To Fail To Detect an Inoperable Main Steam Isolation Valve," February 1, 1994.

------ Information Notice 94-44, "Main Steam Isolation Valve Failure To Close on Demand Because of Inadequate Maintenance and Testing," June 16, 1994.

------ Information Notice 94-56, "Inaccuracy of Safety Valve Set Pressure Determination Using Assist Devices," August 11, 1994.

------ Information Notice 96-02, "Inoperability of PORVs Masked by Downstream Indications During Testing," January 5, 1996.

------ Information Notice 96-48, "Motor-Operated Valve Performance Issues," August 21, 1996.

------ Information Notice 97-16, "Pre-Conditioning of Plant Structures, Systems, and Components before ASME Code Inservice Testing or Technical Specification Surveillance Testing," April 4, 1997.

------ Information Notice 97-90, "Use of Non-Conservative Acceptance Criteria in Safety Related Pump Surveillance Tests," December 30, 1997.

----- Information Notice 2000-21, "Detached Check Valve Disc Not Detected by the Use of Acoustic and Magnetic Non-Intrusive Test Technique," December 15, 2000.

----- Information Notice 2003-01, "Failure of a Boiling Water Reactor Main Steam Safety/Relief Valve," January 15, 2003.

----- Regulatory Information Summary 2004-12, "Clarification on Use of Later Editions and Addenda to the OM Code and Section XI," July 28, 2004.

----- "Inspection Manual" (sections published periodically).

Part 9900, "Technical Guidance: Maintenance — Voluntary Entry into Limiting Conditions for Operation Action Statements To Perform Preventive Maintenance," April 18, 1991, available on the NRC's public Web site at http://www.nrc.gov/reading-rm/doc-collections/insp-manual/technical-guidance/tglcopm.pdf.

Part 9900, "Technical Guidance: Maintenance — Preconditioning of Structures, Systems, and Components Before Determining Operability," available on the NRC's public Web site at http://www.nrc.gov/reading-rm/doc-collections/insp-manual/technical-guidance/tgprecond.pdf

Inspection Procedure (IP) 61726, "Surveillance Observations," available on the NRC's public Web site at http://www.nrc.gov/reading-rm/doc-collections/insp-manual/inspection-procedure/ip61726.pdf.

Inspection Procedure (IP) 62707, "Maintenance Observation," available on the NRC's public Web site at http://www.nrc.gov/reading-rm/doc-collections/insp-manual/inspection-procedure/ip62707.pdf.

Inspection Procedure (IP) 62708, "Motor-Operated Valve Capability," available on the NRC's public Web site at http://www.nrc.gov/reading-rm/doc-collections/insp-manual/inspection-procedure/ip62708.pdf.

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------ Letter from W.T. Russell to R.K. Buckles, September 15, 1994.

------ Memorandum from Frederick J. Hebdon, Director, Project Directorate II-3, Division of Reactor Projects I/II, NRC 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," dated July 2, 1996 [ADAMS Accession No. 9607150019]

------ Memorandum from E. Beckjord to J. Taylor, "Technical Resolution of Generic Issue 105 (GI-105), 'Interfacing Systems Loss-of-Coolant Accident (ISLOCA) in LWRs'," June 3, 1993.

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------ NUREG/CP-0111, "Proceedings of the Symposium on Inservice Testing of Pumps and Valves," October 1990.

------ NUREG/CP-0123, "Proceedings of the Second NRC/ASME Symposium on Valve and Pump Testing," July 1992.

------ NUREG/CP-0123, "Proceedings of the Second NRC/ASME Symposium on Valve and Pump Testing," Supplement 1, November 1992.

------ NUREG/CP-0137, "Proceedings of the Third NRC/ASME Symposium on Valve and Pump Testing," July 1994.

------ NUREG/CP-0152, "Proceedings of the Seventh NRC/ASME Symposium on Valve and Pump Testing," July 2002.

------ NUREG/CR-5102, "Interfacing Systems LOCA: Pressurized-Water Reactors," February 1989.

------ NUREG/CR-5124, "Interfacing Systems LOCA: Boiling-Water Reactors," February 1989.

------ NUREG/CR-5775, "Quantitative Evaluation of Surveillance Test Intervals Including Test-Caused Risks," March 1992.

------ NUREG/CR-6644, "Generic Issue 158: Performance of Safety-Related Power-Operated Valves Under Operating Conditions."

------ NUREG/CR-6654, "A Study of Air-Operated Valves in U.S. Nuclear Power Plants."

------ (Draft) Regulatory Guide 1.26, "Quality Group Classifications and Standards for Water-, Steam-, and Radioactive-Waste-Containing Components of Nuclear Power Plants," Revision 3, February 1976.

------ Regulatory Guide 1.58, "Qualification of Nuclear Power Plant Inspection, Examination, and Testing Personnel," Revision 1, September 1980."

------ Regulatory Guide 1.147, "Inservice Inspection Code Case Acceptability — ASME Section XI Division 1," Revision 11, October 1994.

------ Regulatory Guide 1.174, "An Approach for using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis," Revision 1, November 2002.

------ Regulatory Guide 1.175, "An Approach for Plant-Specific, Risk-Informed Decision-Making: Inservice Testing," August 1998.

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------ Regulatory Guide 1.193, "ASME Code Cases Not Approved for Use," June 2003.

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Attachment A

NEI White Paper, Entitled
"Standard Format for Requests
from Commercial Reactor Licensees
Pursuant to 10 CFR 50.55a," Revision 1
dated June 2004

NEI

NUCLEAR ENERGY INSTITUTE

James W. Davis
DIRECTOR, OPERATIONS
NUCLEAR GENERATION DIVISION

June 7, 2004

TO: Administrative Points of Contact

SUBJECT: Revision 1 to Standard Format for Requests Pursuant to 10 CFR 50.55a

Revision 1 to the NEI white paper entitled, "Standard Format for Requests from Commercial Reactor Licensees Pursuant to 10 CFR 50.55a" is attached for industry information and voluntary use. The paper provides standard formats for plant-specific requests for the Nuclear Regulatory Commission (NRC) approval of proposed alternatives, reliefs, or other requests submitted pursuant to 10 CFR 50.55a, "Codes and standards."

The guidance can help licensees determine the appropriate regulatory requirement under which a request should be submitted to the NRC for approval. It differentiates the various requirements within 10 CFR 50.55a and provides standardized "templates" for use in preparing plant-specific requests for NRC approval. The objective is to identify necessary supporting information in a consistent and complete manner, thereby reducing NRC review time and fees.

A summary of the changes made to Revision 0 (October 2002) are listed on page ii of the white paper.

A copy of the revised paper will be forwarded to the NRC for information. If you have questions or comments, please contact Mike Schoppman at 202-739-8011; mas@nei.org.

Sincerely,

James W. Davis

Attachment

c: Mr. Eric J. Leeds, NRC
Mr. William Reckley, NRC

1776 I STREET, NW SUITE 400 WASHINGTON, DC 20006-3708 PHONE 202.739.8105 FAX 202.785.4019 jwd@nei.org

NEI White Paper
Revision 1

Standard Format for Requests from Commercial Reactor Licensees Pursuant to 10 CFR 50.55a

June 2004

Acknowledgements

NEI acknowledges the assistance of the Licensing Action Task Force (LATF) Steering Group in coordinating this White Paper. The primary author is Mr. Dale Wuokko of FirstEnergy Corporation.

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Don Woodlan, TXU / STARS
Dale Wuokko, FirstEnergy / B & W Owners Group

Summary of Changes from Revision 0

- Added an "Acknowledgements" page i
- Added a "Summary of Changes" page ii
- Added a "Table of Contents" page iii
- Updated references to current Regulatory Guide revisions.
- Added section on 10CFR50.55a exemption requests.
- Rearranged the sequence of text in the body of the paper such that it is the same as the sequence of the templates.
- Template 7 from Revision 0 (Information to Support NRC Re-Approval of a 10 CFR 50.55a Request for Use During a New 10-Year Interval Inservice Inspection or Inservice Testing Program) has been deleted. NRC has requested that licensees include the information from previous submittals when they submit 10-year updates. Retrieval of information that precedes the implementation of NRC's ADAMS document retrieval system is inefficient and adds labor hours to the NRC staff review.
- Template 8 from Revision 0 is renumbered Template 6 in Revision 1.
- Template 6 from Revision 0 is renumbered Template 7 in Revision 1.

TABLE OF CONTENTS

STANDARD FORMAT FOR REQUESTS FROM COMMERCIAL REACTOR LICENSEES PURSUANT TO 10 CFR 50.55a

1.0 Purpose

This White Paper provides guidance for voluntary use by commercial reactor licensees. It provides a standard format for plant-specific requests for Nuclear Regulatory Commission (NRC) approval of a proposed alternative to, or relief from, the inservice inspection or inservice testing requirements of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel (BPV) Code and the ASME Code for Operation and Maintenance of Nuclear Power Plants (OM Code) pursuant to 10 CFR 50.55a, "Codes and standards."

The guidance is provided to assist licensees in determining the appropriate regulatory requirement under which a request is to be submitted to the NRC for approval and the appropriate content to provide in a request. It does so by differentiating the various regulatory requirements contained within 10 CFR 50.55a and providing standardized "templates" that licensees may use when preparing plant-specific requests for NRC approval. The objective is to identify necessary supporting information in a consistent and complete manner, thereby reducing NRC review time and associated fees charged to licensees.

Although the term "relief request" is commonly used to describe all requests for NRC approval to deviate from the ASME BPV and OM Code (hereafter referred to as the "Code") requirements of 10 CFR 50.55a, the regulation differentiates between the terms "relief," "proposed alternative," and "later Code Edition and Addenda." Accordingly, it is recommended that licensees use the term "10 CFR 50.55a request" to describe a proposed licensing action that requests NRC approval of deviations from the Code requirements referred to in 10 CFR 50.55a.

A standardized submittal format is provided in Appendices A (cover letter and optional commitment page), B (templates for different types of request), and C (flow chart for determining which template to use). The standard format describes the type and extent of information that should be included in a licensee submittal for items that cannot be fully inspected or tested in accordance with the Code. Italicized information in brackets represents request-specific information that should be provided by the licensee.

2.0 Applicable Regulatory Requirements

2.1 Incorporation of ASME Code in 10 CFR 50.55a by Reference

The ASME publishes a new edition of the Code every three years, and new addenda are published every year. The latest editions and addenda that the NRC has approved for use are referenced in 10 CFR 50.55a(b). The ASME also publishes Code Cases for Sections III and XI quarterly and Code Cases for the OM Code yearly. These Code Cases provide alternatives developed and approved by the ASME, or that explain the intent of existing Code requirements.

10 CFR 50.55a(b) states that Code Cases accepted in the following NRC Regulatory Guides[1] can be used by a licensee without additional NRC approval:

- Regulatory Guide 1.84, Revision 32, "Design, Fabrication, and Materials Code Case Acceptability, ASME Section III," June 2003.
- Regulatory Guide 1.147, "Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1," June 2003.
- Regulatory Guide 1.192, "Operation and Maintenance Code Case Acceptability, ASME OM Code," June 2003.

Limitations on the implementation of these approved Code Cases are stated in Sections 50.55a(b)(4), (b)(5), and (b)(6), respectively.

NRC approval to use other Code Cases can be requested by a licensee pursuant to 10 CFR 50.55a(a)(3)(i) or 10 CFR 50.55a(a)(3)(ii). If authorized by the NRC, the specified Code Case version can be used until the licensee updates its Code of Record for the component or until the end of the associated 10-year Inservice Testing (IST) or Inservice Inspection (ISI) program, as applicable.

Regulatory Guide 1.193, "ASME Code Cases Not Approved for Use," June 2003, contains Code Cases that the NRC had determined not to be acceptable for use on a generic basis. A brief description of the basis for the determination is provided with each Code Case. Nonetheless, licensees may submit a 10 CFR 50.55a(3) request by addressing the NRC concerns with a specific Code Case.

[1] In the Federal Register dated September 22, 1999 (64 FR 51370), the NRC endorsed the ASME Operation and Maintenance (OM) Code as a replacement for the ASME Code Section XI inservice testing requirements for nuclear power plant pumps and valves.

10 CFR 50.55a requests do not involve license amendments. Rather, the NRC issues evaluation letters and safety evaluations to authorize a licensee's alternative and grant relief, or give permission to deviate from the Code.

The chart in Appendix C at the end of this White Paper may be used as an aide in determining the appropriate type of 10 CFR 50.55a request to prepare for submittal to the NRC. The chart includes cross-references to the 10 CFR 50.55a request templates that are included with this White Paper.

2.2 Alternatives to Code Requirements

Licensees may propose an alternative to the Code requirement by demonstrating that:

- The alternative provides an acceptable level of quality and safety pursuant to 10 CFR 50.55a(a)(3)(i), or
- Compliance with the Code requirement would result in hardship or unusual difficulty without a compensating increase in quality or safety pursuant to 10 CFR 50.55a(a)(3)(ii).

2.3 Use of Later Code Editions and Addenda

Licensees may propose using later Code editions and addenda pursuant to 10 CFR 50.55a(f)(4)(iv) for inservice testing items, or 10 CFR 50.55a(g)(4)(iv) for inservice inspection items, subject to the limitations and modifications listed in 10 CFR 50.55a(b). In order to use portions of later ASME Code editions or addenda, all related requirements of the respective editions or addenda must be met, except where specific exception is provided in the NRC's approval.

2.4 Relief from Code Requirements

Licensees may demonstrate that compliance with the Code requirement is impractical (not just inconvenient) and request relief pursuant to 10 CFR 50.55a(f)(5)(iii) for inservice testing items, or 10 CFR 50.55a(g)(5)(iii) for inservice inspection items.

2.5 Augmented Inservice Inspection (ISI)

The NRC may require additional examinations of Code systems and components through stipulating an augmented inservice inspection program. An augmented examination is required by 10 CFR 50.55a(g)(6)(ii)(A) for reactor vessel shell welds. Means to request NRC approval to differ from the requirements are provided within the regulation.

- Should a licensee determine it is unable to examine, due to interference by another component or part geometry, more than 90 % of the examination volume of each reactor vessel shell weld specified in 10 CFR 50.55a(g)(6)(ii)(A)(2), an alternative must be proposed. The licensee is required to submit information to the NRC to support its determination. The licensee must propose an alternative that would provide an acceptable level of quality and safety pursuant to 10 CFR 50.55a(a)(3)(i) and 10 CFR 50.55a(g)(6)(ii)(A)(5).

- Pursuant to 10 CFR 50.55a(g)(6)(ii)(A)(4), when performing the augmented examination, a licensee may, in accordance with 10 CFR 50.55a(g)(6)(ii)(A)(5), take credit for the Section XI reactor vessel examination already completed if it does the following:

  - First, perform the one-time augmented inspection specified in 10 CFR 50.55a(g)(6)(ii)(A)(2), and then

  - Submit a request pursuant to 10 CFR 50.55a(g)(6)(ii)(A)(5) and 10 CFR 50.55a(a)(3)(i) based on an alternative providing an acceptable level of quality and safety.

2.6 Re-approval of Requests under a New 10-Year Interval

10 CFR 50.55a requests are approved by the NRC for each 10-Year Interval Inservice Inspection Program or Inservice Testing Program. As a result, licensees must re-submit for NRC review and approval any 10 CFR 50.55a requests it desires to carry over to a new 10-Year Interval from the previous 10-Year Interval. Changes in the applicable Code edition or addenda, as referenced in 10 CFR 50.55a(b), can affect the need for the request, the type of request, or the basis for the request. Should the same request be necessary, licensees must submit a new request for the new 10-Year Interval for NRC review and approval.

To reduce the level-of-effort necessary for the NRC to re-review the same request, the licensee should provide references to the previous request and resultant NRC approval. In addition, the licensee may choose to provide:

- A confirming statement that the circumstances and basis for the previous NRC approval have not changed,

- A brief discussion of any changes to the related Code section(s) and their effect on the request,

- A brief discussion of any aging factors applicable to the Code component since approval the prior request, and

- A brief discussion of any related changes in the technology regarding inspection or testing of the Code component.

2.7 Temporary Non-Code Piping Repairs

Section XI specifies acceptable repair methods for flaws that exceed Code acceptance limits in Class 1, 2, and 3 piping that is in service. A Code repair is required to restore the structural integrity of flawed Code piping regardless of the operational mode of the plant when the flaw is detected. Those repairs not in compliance with Section XI (or NRC-approved Code Cases) are considered non-Code repairs that require NRC review and approval of a licensee 10 CFR 50.55a request. Pursuant to 10 CFR 50.55a(g)(5)(iii), licensees may request relief due to impracticality and propose an alternative repair.

2.8 Temporary Verbal Relief

On rare occasions, the NRC staff may grant verbal authorization as an alternative under 10 CFR 50.55a(a)(3) when, due to unforeseen circumstances, licensees need NRC authorization before the NRC staff is able to issue a safety evaluation and accompanying letter. Verbal relief is not required under 10 CFR 50.55a(f)(5)(iv) or (g)(5)(iv) when an examination or test is impractical and is not currently included in the inservice inspection program or inservice testing program, because the licensee can submit the request in accordance with the normal process under 10 CFR 50.55a(f)(5)(iii) or (g)(5)(iii).

Temporary verbal authorization for an alternative under 10 CFR 50.55a(a)(3) requires the following:

- The proposed alternative is submitted to the NRC in writing.
- The licensee explains the unexpected circumstances surrounding the request and justifies why it could not submit the proposed alternative to the NRC early enough for the NRC staff to process it using the normal request process.
- The NRC staff has completed its review and determined that the proposed alternative is technically justified, but has not yet formally documented it in a safety evaluation.
- The section chiefs of the appropriate NRC technical branch and the NRC/NRR Division of Licensing Project Management have agreed to the verbal authorization.

The NRC staff will issue the final written authorization within 30 days after providing verbal authorization.

2.9 10 CFR 50.55a Exemption Requests

As discussed earlier, 10 CFR 50.55a provides for the proposal and approval of alternatives to and relief from Code requirements. It is not necessary to obtain an exemption from 10 CFR 50.55a because the regulation itself provides for approval of alternatives and reliefs. However, for non-ASME Code requirements of 10 CFR 50.55a, an exemption from the requirement would be necessary in accordance with 10 CFR 50.12, "Specific exemptions."

3.0 Timing of 10 CFR 50.55a Requests and Approvals

10 CFR 50.55a(f)(4)(ii) requires that the Inservice Test Program be revised every 10 years to meet the latest edition and addenda of the Code incorporated into 10 CFR 50.55a(b). If there are conflicts between the revised Inservice Test Program and the plant's Operating License (i.e., Technical Specifications), the licensee must submit a 10 CFR 50.90 license amendment request to the NRC in accordance with 10 CFR 50.55a(f)(5)(ii) to conform the Technical Specifications to the revised program. This application is required to be submitted to the NRC at least six months prior to the start of the revised program. No timing for NRC approval is stipulated. However, since the licensee is required to comply with both the requirements of the Inservice Test Program and the Technical Specifications, the licensee should maintain close contact with the NRC with a goal of obtaining NRC approval of the Technical Specification change within the six-month period.

In lieu of submitting a license amendment application to resolve a Technical Specification conflict with the Inservice Test Program, the licensee may submit (with the Inservice Test Program) a 10 CFR 50.55a request for relief under 10 CFR 50.55a(f)(5)(iii) from the specific Code requirement. Such requests are required by 10 CFR 50.55a(f)(5)(iv) to be approved by the NRC within 12 months after the end of the associated 10-Year Interval. However, licensees should submit these requests as needs arise and not wait until the 10-Year Interval is completed. Examples where these requests would fall under the impracticality of compliance perspective are:

- A Code inservice test requirement that causes entry into a Technical Specification Limiting Condition for Operation that could lead to a shutdown of the plant.

- A Code inservice test requirement that has the potential to cause a reactor trip.

Requirements for Inservice Inspection Program, similar to those discussed above for Inservice Test Programs, can be found in 10 CFR 50.55a(g).

In situations where a licensee is preparing for an upcoming Code examination or test that involves the use of a new 10 CFR 50.55a request, and the licensee desires to obtain the NRC's approval prior to commencing the examination or test, the licensee should discuss the situation with the NRC and submit the request at least six months in advance of the desired issuance date. Since the NRC can tailor or limit the approval to the situation, the NRC may not need to delay its issuance of the requested approval, regardless of whether the actual need situation is determined by the examination or test to exist.

4.0 Templates for 10 CFR 50.55a Requests

This White Paper includes the following 10 CFR 50.55a request guidance:

- Standard template for licensee cover letter to NRC (Appendix A)
- An optional page listing the regulatory commitments made by the licensee in the request (Appendix A).
- Seven standard templates for submitting requests (Appendix B)

  1. A proposed alternative that provides an acceptable level of quality and safety (10 CFR 50.55a(a)(3)(i)).
  2. A proposed alternative to complying with a Code requirement that would otherwise result in hardship or unusual difficulty without a compensating increase in quality or safety (10 CFR 50.55a(a)(3)(ii)).
  3. Use of a later Code edition and addenda for inservice testing (10 CFR 50.55a(f)(4)(iv), or inservice inspection (10 CFR 50.55a(g)(4)(iv)).
  4. An impractical Code requirement for inservice testing (10 CFR 50.55a(f)(5)(iii)).
  5. An impractical Code requirement for inservice inspection (10CFR 50.55a(g)(5)(iii)).
  6. Multiple items that are suitable for presenting in a tabular format in order to reduce preparation and review time of repetitive text in any of the requests described above.

7. Under the augmented reactor vessel shell welds inservice inspection program, a proposed alternative due to inability to examine more than 90% of the reactor vessel shell weld (10 CFR 50.55a(g)(6)(ii)(A)(5) and 10 CFR 50.55a(a)(3)(i)).

- A chart for use in determining the appropriate 10 CFR 50.55a regulation under which to seek NRC approval of the 10 CFR 50.55a request (Appendix C).

5.0 References:

1. 10 CFR 50.55a, "Codes and Standards."

2. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, Office Instruction No. LIC-102, "Relief Request Reviews," July 18, 2002.

3. Regulatory Guide 1.84, "Design, Fabrication, and Materials Code Case Acceptability, ASME Section III," June 2003.

4. Regulatory Guide 1.147, "Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1," June 2003.

5. Regulatory Guide 1.192, "Operation and Maintenance Code Case Acceptability, ASME OM Code," June 2003.

6. Regulatory Guide 1.193, "ASME Code Cases Not Approved For Use," June 2003.

7. NRC Regulatory Guide 1.175, "An Approach for Plant-Specific, Risk-Informed Decisionmaking: Inservice Testing."

8. NRC Regulatory Guide 1.178, "An Approach for Plant-Specific Risk-Informed Decisionmaking: Inservice Inspection of Piping."

9. Federal Register, Final Rule, "Incorporation by Reference of ASME BPV and OM Code Cases," 68 FR 40469-40478, July 8, 2003.

10. Enclosure 2 to NRC Letter from H.N. Berkow to W.R. McCollum, Catawba Nuclear Station, "Technical Position on ASME Code Repair Requirements for ASME Class 3 Service Water System Piping," January 4, 1996.

11. NRC Memorandum from J.A. Norberg, Mechanical Engineering Branch, to M.J. Virgilio, Assistant Director for Region IV and V Reactors, "Waterford 3 TIA for Interpretation of 'Practical' as Used in ASME Code Section XI, IWV-3412(a)," August 8, 1991.

12. Generic Letter 90-05, "Guidance for Performing Temporary Non-Code Repair of ASME Code Class 1, 2, and 3 Piping," June 15, 1990.

13. NUREG-1482, "Guidelines for Inservice Testing at Nuclear Power Plants," April 1995.

14. NUREG/CR-6396, "Examples, Clarifications, and Guidance on Preparing Requests for Relief from Pump and Valve Inservice Testing Requirements (INEL-95/0512)," February 1996.

15. Generic Letter No. 91-18, Revision 1, "Information to Licensees Regarding NRC Inspection Manual Section on Resolution of Degraded and Nonconforming Conditions," October 8, 1997.

16. Information Notice 98-42, "Implementation of 10 CFR 50.55a(g) Inservice Inspection Requirements," December 1, 1998.

APPENDIX A

STANDARD TEMPLATE FOR LICENSEE COVER LETTER TO NRC

[LICENSEE COVER LETTER]

[Date] 10 CFR 50.55a

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D.C. 20555-0001

SUBJECT: *[Plant/Unit Name(s)]*
Docket No(s). *[50-__, 50-__]*
[Brief Descriptive Title, Including the Applicable Ten-Year Interval and whether for the Inservice Test Program or Inservice Inspection Program]

REFERENCES: *[As necessary]*

Dear Sir or Madam:

Pursuant to 10 CFR 50.55a *[continue with applicable relief request section reference]*, *[licensee]* hereby requests NRC approval of the following request for the *[identify the applicable ten-year interval inservice testing or inspection program]*: *[provide a brief summary of the request].* The details of the 10 CFR 50.55a request are enclosed

[Licensee] requests approval by *[date]* based on *[justification]*.

[If the request is "risk-informed" inservice testing, include a statement that the guidance in Regulatory Guide 1.175, "An Approach for Plant-Specific, Risk-Informed Decisionmaking: Inservice Testing," has been followed, or considered.]

[If the request is "risk-informed" inservice inspection, include a statement that the guidance in Regulatory Guide 1.178, "An Approach for Plant-Specific Risk Informed Decisionmaking: Inservice Inspection of Piping," has been followed or considered.]

[Optional: Include or attach a listing of formal licensee commitments that support the NRC's approval of the request].

If you have any questions or require additional information, please contact *[licensee's point of contact for the NRC Office of Nuclear Reactor Regulation]* at *[telephone number]*.

Sincerely,

[Signature]

[Name and Title]

Enclosures
[10 CFR 50.55a Request]
[List of Commitments (Optional)]

cc: *[Regional Administrator]*
[Plant/Unit Resident Inspector]
[NRR Project Manager]

List of Regulatory Commitments (Optional)

The following table identifies those actions committed to by *[Licensee]* in this submittal. Any other statements are provided for information purposes and are not considered to be regulatory commitments. Please direct questions regarding these commitments to *[name of Licensee contact].*

REGULATORY COMMITMENTS	DUE DATE/EVENT
[List commitments made in the request.]	*[Add due dates or events by which the corresponding commitment must be completed.]*

APPENDIX B

SEVEN TEMPLATES FOR 10 CFR 50.55a REQUESTS

1. Proposed Alternative in Accordance with 10 CFR 50.55a(a)(3)(i)

   [alternative provides an acceptable level of quality & safety]

2. Proposed Alternative in Accordance with 10 CFR 50.55a(a)(3)(ii)

   [requirement would cause a hardship or unusual difficulty without a compensating increase in the level of quality or safety]

3. Request in Accordance with 10 CFR 5055a(f)(4)(iv) for IST Item(s), or 10 CFR 50.55a(g)(4)(iv) for ISI Items

   [use of subsequent ASME Code Edition and Addenda]

4. Relief Requested in Accordance with 10 CFR 50.55a(f)(5)(iii)

   [inservice testing impracticality]

5. Relief Requested in Accordance with 10 CFR 50.55a(g)(5)(iii)

   [inservice inspection impracticality]

6. Repetitive/Duplicative 10 CFR 50.55a Requests

   [tabular format for repetitive or duplicative requests]

7. Proposed Alternative in Accordance with 10 CFR 50.55a(g)(6)(ii)(A)(5) and 10 CFR 50.55a(a)(3)(i)

   [augmented reactor vessel shell weld examination]

TEMPLATE 1

10 CFR 50.55a Request Number *[Licensee assigns unique designation]*

Proposed Alternative
in Accordance with 10 CFR 50.55a(a)(3)(i)

--Alternative Provides Acceptable Level of Quality and Safety--

(This can be requested for both inservice inspection items and inservice testing items.)

1. **ASME Code Component(s) Affected**
   [Provide a description of, the class type, and the quantity of ASME Code components affected. Ensure that each affected component, weld, etc. is listed, not just referenced generically. For example, include the component number, the weld identification numbers, etc.]

2. **Applicable Code Edition and Addenda**
   [Provide the Code Edition and Addenda that are applicable to the program interval for the request.]

3. **Applicable Code Requirement**
   [Provide the specific Code requirement (e.g., section, subsection, and paragraph and the text of the Code requirement) for which use of the proposed alternative is being requested. Each request should contain only one Code requirement for which use of the proposed alternative is being requested.]

4. **Reason for Request**
   [Provide a brief description of how the Code requirement applies to the situation and the reason for the request.]

5. **Proposed Alternative and Basis for Use**
   [Describe the proposed alternative to the applicable Code requirement. Sketches may be provided. Provide technical justification as to how the proposed alternative will provide an acceptable level of quality and safety to that of the applicable Code requirement. Note: Do not discuss impracticality, burden, hardship, or unusual difficulty. State when the proposed alternative will be performed. Provide a concluding statement clearly stating the proposed alternative and to what ASME Code requirement it is an alternative.]

6. **Duration of Proposed Alternative**
[Provide the duration of the authorized alternative. Note: The duration must be within the program interval. Note: For approval of a Code Case to be used as the alternative, also state "the use of the Code Case is requested until the NRC publishes the Code Case in a future revision of the applicable Regulatory Guide."]

7. **Precedents (Optional)**
[Cite any identified precedents (including plant name, docket number, and approval TAC number/date) which have similar situations and NRC staff approval. If approved by the NRC staff for the plant's previous interval, cite the submittal and approval TAC number/date.]

8. **References (Optional)**
[This section is necessary only if references beyond those in Section 7 above should be identified.]

TEMPLATE 2

10 CFR 50.55a Request Number *[Licensee assigns unique designation]*

Proposed Alternative
in Accordance with 10 CFR 50.55a(a)(3)(ii)

--Hardship or Unusual Difficulty
without Compensating Increase in Level of Quality or Safety--

(This can be requested for both inservice inspection items
and inservice testing items.)

1. **<u>ASME Code Component(s) Affected</u>**
   [Provide a description of, the class type, and the quantity of ASME Code components affected. Ensure that each affected component, weld, etc. is listed, not just referenced generically. For example, include the component number, the weld identification numbers, etc.]

2. **<u>Applicable Code Edition and Addenda</u>**
   [Provide the Code Edition and Addenda that are applicable to the program interval for the request.]

3. **<u>Applicable Code Requirement</u>**
   [Provide the specific Code requirement (e.g., section, subsection, and paragraph and the text of the Code requirement) from which relief is being requested. Each relief request should contain only one Code requirement from which relief is being requested.]

4. **<u>Reason for Request</u>**
   [Provide a brief description of how the Code requirement applies to the situation and the reason for the request. Describe the hardship or unusual difficulty the Code requirement causes and why there is no compensating increase in level of quality or safety. Examples of hardship or unusual difficulty include: a need to enter multiple Technical Specification action statements, radiation ALARA concerns, hardware changes, or creating significant hazards to plant personnel. Note: Do not mention impracticality.]

5. **Proposed Alternative and Basis for Use**
   [Describe the proposed alternative to the applicable Code requirement. Sketches may be provided. Provide technical justification for its use. (For inservice testing items, discuss why the proposed alternative provides reasonable assurance that the component or system is operationally ready. For inservice inspection items, discuss why the proposed alternative provides reasonable assurance of structural integrity.) State when the proposed alternative will be performed. Provide a concluding statement clearly stating the proposed alternative and to what ASME Code requirement it is an alternative.]

6. **Duration of Proposed Alternative**
   [Provide the duration of the authorized alternative. Note: The duration must be within the program interval. Note: For a Code Case to be used as the alternative, also state "the use of the Code Case is requested until the NRC publishes the Code Case in a future revision of the applicable Regulatory Guide."]

7. **Precedents (Optional)**
   [Cite any identified precedents (including plant name, docket number, and approval TAC number/date) which have similar situations and NRC staff approval. If approved by the NRC staff for the plant's previous interval, cite the submittal and approval TAC number/date.]

8. **References (Optional)**
   [This section is necessary only if additional references beyond those in Section 7 above should be identified.]

TEMPLATE 3

10 CFR 50.55a Request Number *[Licensee assigns unique designation]*

Request in Accordance with 10 CFR 5055a(f)(4)(iv) for IST Item(s), or 10 CFR 50.55a(g)(4)(iv) for ISI Item(s)

-- For use of subsequent ASME Code Edition and Addenda --

(This can be requested for both inservice inspection items and inservice testing items.)

1. **ASME Code Component(s) Affected**
   [Provide a description of the ASME Code class and type of components affected. Affected components may be referenced generically (for example, "all check valves," or "Class 2 welds within the containment penetration area").]

2. **Applicable Code Edition and Addenda**
   [Provide the Code Edition and Addenda that are applicable to the program interval for the request.]

3. **Proposed Subsequent Code Edition and Addenda (or Portion)**
   [The subsequent Code and Addenda must be incorporated by reference in 10 CFR 50.55a(b). Provide the subsequent Code Edition and Addenda that are proposed to be used. Cite the Federal Register notice (if known, such as 64 FR 51370). If only a portion of the subsequent Code Edition and Addenda is to be used, then specify the particular paragraph. A technical justification for using a subsequent Code Edition and Addenda (or portion thereof) is unnecessary. If the subsequent Code Edition and Addenda are not incorporated by reference in 10 CFR 50.55a(b), then the request must be submitted as a proposed alternative (see Templates 1, 2, 4, or 5). Provide a concluding statement clearly stating to what ASME Code components the subsequent Code Edition and addenda will be applied.]

4. **Related Requirements**
   [Discuss any modifications or limitations listed in 10 CFR 50.55a(b) that apply to this subsequent Code Edition and Addenda. Also, discuss any pertinent information that might be provided in the Federal Register's Statement of Consideration when the regulation was issued. For use of a portion of a subsequent Code Edition and Addenda provide any related requirements in the

subsequent Code Edition and Addenda that would need to be implemented. For example, if a check valve condition-monitoring program is proposed to be used, then a related requirement would be the bi-directional testing of other check valves not in the program.]

5. **Duration of Proposed Request**
[Provide the duration of the approved use of a subsequent Code Edition and Addenda. The duration must be within the program interval.]

TEMPLATE 4

10 CFR 50.55a Request Number *[Licensee assigns unique designation]*

Relief Request in Accordance with 10 CFR 50.55a(f)(5)(iii)

--Inservice Testing Impracticality--

(Note: Licensees request under 10 CFR 50.55a(f)(5)(iii). The NRC grants under 10 CFR 50.55a(f)(6)(i).)

1. **ASME Code Component(s) Affected**
   [Provide a description of, the class type, and the quantity of ASME Code components affected. Ensure that each affected component, weld, etc. is listed, not just referenced generically. For example, include the component number, the weld identification number, etc.]

2. **Applicable Code Edition and Addenda**
   [Provide the Code Edition and Addenda that are applicable to the program interval for the request.]

3. **Applicable Code Requirement**
   [Provide the specific Code requirement (e.g., section, subsection, and paragraph and the text of the Code requirement) for which use of the proposed alternative is being requested. Each request should contain only one Code requirement for which use of the proposed alternative is being requested.]

4. **Impracticality of Compliance**
   [Provide a brief description of how this Code requirement applies to the situation and the impracticality reason for the request. Describe why the inservice testing Code requirement is impractical. Do not mention hardship or unusual difficulty. Sources of inservice testing impracticality include:
   - *Being inaccessible for testing (provide drawings or figures, as appropriate, to show specific limitations or obstructions);*
   - *Potential to cause a reactor trip, damage to a system or a component, or an excessive personnel hazard;*
   - *Requiring a major hardware modification;*
   - *Existing technology will not provide meaningful results.*

If basing impracticality on a physical limitation or obstruction, describe or provide drawings or sketches. If basing the impracticality on radiation exposure of test personnel, provide the following information:

- *The total estimated rem exposure involved in the testing;*
- *The radiation levels in the test area;*
- *The use of flushing or shielding to reduce radiation levels;*
- *Any other considerations (e.g., the potential for doing remote inspections, or the ALARA impacts of previous inspections if performed).]*

5. **Burden Caused by Compliance**
[Describe the burden that would be caused by attempting to comply with the Code requirement, such as replacing a component, redesigning a system, or shutting down the plant. Do not mention hardship or unusual difficulty.]

6. **Proposed Alternative and Basis for Use**
[Describe the proposed alternative. Provide technical justification as to why the proposed alternative testing provides reasonable assurance that the component or system is operationally ready. State when the proposed alternative inspection will be performed. Provide a concluding statement clearly stating the proposed alternative and to what ASME Code requirement it is an alternative.]

7. **Duration of Proposed Alternative**
[Provide the duration of the authorized alternative. Note: The duration must be within the program interval. Note: For approval of a Code Case to be used as the alternative, also state "the use of the Code Case is requested until the NRC publishes the Code Case in a future revision of the applicable Regulatory Guide."]

8. **Precedents (Optional)**
[Cite any identified precedents (including plant name, docket number, and approval TAC number) which have similar situations and NRC staff approval. If approved by the NRC staff for the plant's previous interval, cite the submittal and approval TAC number/date.]

9. **References (Optional)**
[This section is necessary only if references beyond those in Section 8 above should be identified.]

TEMPLATE 5

10 CFR 50.55a Request Number *[Licensee assigns unique designation]*

Relief Request
in Accordance with 10 CFR 50.55a(g)(5)(iii)

--Inservice Inspection Impracticality--

(Note: Licensees request under 10 CFR 50.55a(g)(5)(iii).
The NRC grants under 10 CFR 50.55a(g)(6)(i).)

1. **ASME Code Component(s) Affected**
   [Provide a description of, the class type, and quantity of ASME Code components affected. Ensure that each affected component, weld, etc. is listed, not just referenced generically. For example, include the component number, the weld identification number, etc.]

2. **Applicable Code Edition and Addenda**
   [Provide the Code Edition and Addenda that are applicable to the program interval for the request.]

3. **Applicable Code Requirement**
   [Provide the specific Code requirement (e.g., section, subsection, and paragraph and the text of the Code requirement) for which use of the proposed alternative is being requested. Each request should contain only one Code requirement for which use of the proposed alternative is being requested.]

4. **Impracticality of Compliance**
   [Provide a brief description of how this Code requirement applies to this situation and the impracticality reason for the request. Describe why the inservice inspection Code requirement is impractical. Do not mention hardship or unusual difficulty. Causes of impracticality include:
   - *Being inaccessible for inspection (provide drawings or figures, as appropriate, to show specific limitations or obstructions);*
   - *Potential to cause a reactor trip, damage to a system or component, or an excessive personnel hazard;*
   - *Requiring a major hardware modification;*
   - *Existing technology will not provide meaningful results.*

If basing the impracticality on radiation exposure of examination personnel, provide the following information:

- *The total estimated rem exposure involved in the examination;*
- *The radiation levels in the examination area;*
- *The use of flushing or shielding to reduce radiation levels;*
- *Any other considerations.]*

5. **Burden Caused by Compliance**
[Describe the burden that would be caused by attempting to comply with the Code requirement, such as replacing a component, redesigning the system, or shutting down the plant. Do not mention hardship or unusual difficulty.]

6. **Proposed Alternative and Basis for Use**
[Describe the proposed alternative. Sketches may be provided. Provide technical justification as to why the proposed alternative inspection provides reasonable assurance of structural integrity. State when the proposed alternative inspection will be performed. Provide a concluding statement clearly stating the proposed alternative and to what ASME Code requirement it is an alternative.]

7. **Duration of Proposed Alternative**
[Provide the duration of the authorized alternative. Note: The duration must be within the program interval. Note: For approval of a Code Case being used as the alternative, also state "the use of the Code Case is requested until the NRC publishes the Code Case in a future revision of the applicable Regulatory Guide."]

8. **Precedents (Optional)**
[Cite any identified precedents (including plant name, docket number, and approval TAC number) which have similar situations and NRC staff approval. If approved by the NRC staff for the plant's previous interval, cite the submittal and approval TAC number/date.]

9. **References (Optional)**
[This section is necessary only if references beyond those in Section 8 above should be identified.]

TEMPLATE 6

10 CFR 50.55a Request Numbers *[Licensee assigns unique designations as listed in the following Table 1.]*

Repetitive/Duplicative 10 CFR 50.55a Requests

--Tabular format for repetitive or duplicative requests--

A tabular format is suitable for preparing 10 CFR 50.55a requests where the information to be submitted is of a repetitive, duplicative nature (e.g., requests associated with limited weld examinations). The tabular format can display succinctly a large quantity of information by referencing specific explanatory paragraphs. This reduces repetitive text. An example is provided below and on the next page that contains the type of information provided for Inservice Inspection impracticalities.

1. **ASME Code Component(s) Affected**
   Refer to Table 1, Columns 1 and 2.

2. **Applicable Code Edition and Addenda**
   ASME Code Section XI – *[Add Edition and Addenda]*

3. **Applicable Code Requirement**
   Refer to Table 1, Column 3.

4. **Impracticality of Compliance**
   A. *[Apply guidance of applicable Template.]*
   B. *[Apply guidance of applicable Template.]*
   C. *[Apply guidance of applicable Template.]*
   D. *[Apply guidance of applicable Template.]*

5. **Burden Caused by Compliance**
   A. *[Apply guidance of applicable Template.]*
   B. *[Apply guidance of applicable Template.]*

6. **Proposed Alternative and Basis for Use**
   A. *[Apply guidance of applicable Template.]*
   B. *[Apply guidance of applicable Template.]*
   C. *[Apply guidance of applicable Template.]*

7. **Duration of Proposed Alternative**
   [Apply guidance of applicable Template.]

TEMPLATE 6 EXAMPLE

Table 1 - Repetitive/Duplicative Reliefs Requested in Accordance with 10 CFR 50.55a(g)(5)(iii), Inservice Inspection Impracticality

[Add number] 10-Year Interval – Inservice Inspection Program
ASME Code Section XI – *[Add Edition and Addenda]*

REQUEST NUMBER	1. ASME CODE COMPONENT (AREA OR WELD TO BE EXAMINED)	2. COMPONENT ID NO.	3. APPLICABLE CODE REQUIREMENT (100% WELD COVERAGE)	4 IMPRACTICALITY OF COMPLIANCE	5. BURDEN CAUSED BY COMPLIANCE	6. PROPOSED ALTERNATIVE AND BASIS FOR USE	7. DURATION OF PROPOSED ALTERNATIVE
A1	NC System Pressurizer Surge Nozzle to Lower Head Weld	1PZR-W1	Exam Category B-D Item No. B03.110.001 Fig. IWB-2500-7(b) 48.2% Volume Coverage	See Paragraph 4.A	See Paragraph 5.A	See Paragraph 6.A	See Paragraph 7
A2	NC System Main Loop Piping Austenitic SS Branch Nozzle Weld	2NC13-WN9	Exam Category B-J Item No. B09.031.003 Fig. IWB-2500-9 22.87% Volume Coverage	See Paragraph 4.B	See Paragraph 5.A	See Paragraph 6.A	See Paragraph 7
A3	NC System Steam Generator 2B Auxiliary Feedwater Nozzle to Shell Weld	2SGB-06A-18	Exam Category B-J Item No. C02.021.001 Fig. IWC-2500-4(a) 75.00% Volume Coverage	See Paragraph 4.C	See Paragraph 5.A	See Paragraph 6.B	See Paragraph 7
A4	NS System Containment Spray Heat Exchanger Inlet Nozzle to Channel Head Weld	2BNSHX-3-N1	Exam Category C-B Item No. C02.021.004 Fig. IWC-2500-4(a) 49.03% Volume Coverage	See Paragraph 4.D	See Paragraph 5.B	See Paragraph 6.C	See Paragraph 7

TEMPLATE 7

10 CFR 50.55a Request Number *[Licensee assigns unique designation]*

Proposed Alternative
In Accordance with 10 CFR 50.55a(g)(6)(ii)(A)(5)
and 10 CFR 50.55a(a)(3)(i)

--Augmented Reactor Vessel Shell Weld Examination--

1. **<u>ASME Code Component(s) Affected</u>**
   [Provide a description of the affected welds. Ensure that each affected component, weld, etc. is listed, not just referred to generically. For example, include the component number, the weld identification number, etc.]

2. **<u>Applicable Code Edition and Addenda</u>**
   [Provide the Code Edition and Addenda that is applicable to the program interval for the proposed alternative].

3. **<u>Applicable Code Requirement</u>**
   [Provide the Code requirement (e.g., section, subsection, and paragraph and the text of the Code requirement) for which use of the proposed alternative is being requested (i.e., the examination of more than 90% of each weld volume). Each request should contain only one Code requirement for which use of the proposed alternative is being requested.]

4. **<u>Determination of Limits of Weld Volume Examination</u>**
   [Provide the reason that limits the weld volume examination as compared to the Code requirement. Describe the means by which the limits of the weld volume examination were determined, the percent of each weld volume that was examined, and why more of the weld volume could not be examined. If the Code-required examination cannot be performed due to a limitation or obstruction, describe or provide drawings showing the specific limitation or obstruction. Do not mention hardship or unusual difficulty.]

5. **<u>Proposed Alternative and Basis for Use</u>**
   [Describe the proposed alternative. Sketches may be provided. Provide technical justification as to why the proposed alternative provides an acceptable level of quality and safety, and reasonable assurance of structural integrity. Provide a concluding statement clearly stating the proposed alternative and to what ASME Code requirement it is an alternative.]

6. **Duration of Proposed Alternative**
[Provide the duration of the authorized alternative. Note: The duration must be within the program interval.]

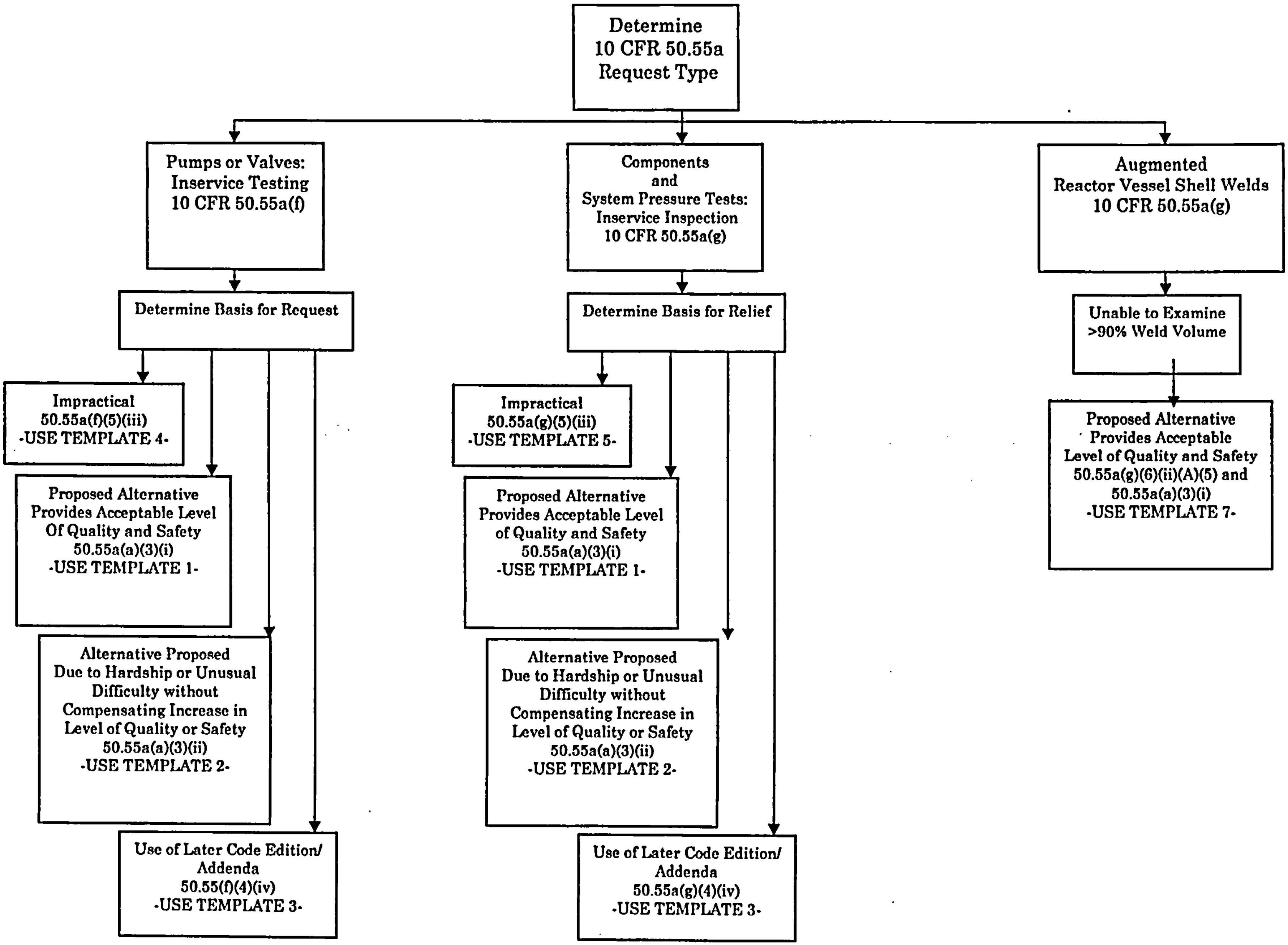
7. **Precedents (Optional)**
[Cite any identified precedents (including plant name, docket number, and approval TAC number) which have similar situations and NRC staff approval. If approved by the NRC staff for the plant's previous interval, cite the submittal and approval TAC number/date.]

8. **References (Optional)**
[This section is necessary only if references beyond those in Section 7 above should be identified.]

APPENDIX C

10 CFR 50.55a
REQUEST DETERMINATION CHART

10 CFR 50.55a REQUEST DETERMINATION CHART



NRC FORM 335 (2-89) NRCM 1102, 3201, 3202

U.S. NUCLEAR REGULATORY COMMISSION

BIBLIOGRAPHIC DATA SHEET

(See instructions on the reverse)

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Final Report

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5. AUTHOR(S)

S.M. Unikewicz

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Division of Engineering
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

9. SPONSORING ORGANIZATION - NAME AND ADDRESS *(If NRC, type "Same as above"; if contractor, provide NRC Division, Office or Region, U.S. Nuclear Regulatory Commission, and mailing address.)*

Same as above

10. SUPPLEMENTARY NOTES

S.M. Unikewicz, NRC Project Manager

11. ABSTRACT *(200 words or less)*

In Revision 1 of NUREG-1482, the staff of the U.S. Nuclear Regulatory Commission (NRC) gives licensees guidelines and recommendations for developing and implementing programs for the inservice testing of pumps and valves at commercial nuclear power plants. Specifically, the staff discusses the applicable regulations; the components to be included in an inservice testing program; and the preparation and content of cold shutdown justifications, refueling outage justifications, and requests for relief from the Code requirements promulgated by the American Society of Mechanical Engineers (ASME). The staff also gives specific guidance on the types of relief that are acceptable to the NRC and advises licensees on how to use this information at their facilities. In addition, the staff discusses the revised standard technical specifications for the inservice testing program and gives guidance on the process a licensee may follow upon identifying an instance of noncompliance with the ASME Code.

As an update of NUREG-1482, Revision 1 incorporates regulatory changes up to and including the 2003 Edition of Title 10, Part 50, of the Code of Federal Regulations. The "code of record" for this revision is the ASME Code for Operation and Maintenance of Nuclear Power Plants, 1998 Edition through the 2000 Addenda. References to the 1995 Edition with 1996 Addenda are shown in [brackets].

Revision 0 of NUREG-1482 is still valid and is to remain in use for those licensees who have not updated their inservice testing programs to the ASME Code for Operation and Maintenance of Nuclear Power Plants, 1995 Edition with 1996 Addenda, or a later edition of the Code.

12. KEY WORDS/DESCRIPTORS *(List words or phrases that will assist researchers in locating the report.)*

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