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NRC INSPECTION MANUAL

PART 9900: TECHNICAL GUIDANCE

PRECOND.TG

MAINTENANCE - PRECONDITIONING OF STRUCTURES, SYSTEMS, AND COMPONENTS BEFORE DETERMINING OPERABILITY

A. PURPOSE

This document presents guidance on evaluating the acceptability of preconditioning of Structures, Systems and Components (SSCs) before the performance of operability, surveillance, or conformance testing.

B. BACKGROUND

Technical Specification (TS) surveillance and American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) in-service testing (testing) is performed to verify that operability and performance (or condition) characteristics of SSCs have not degraded below specific acceptance criteria during a specified period. The NRC expects surveillance and testing processes of SSCs to be evaluated in an "as-found" condition. However, it is recognized that preventive maintenance activities are sometimes performed immediately before testing, and these activities may involve manipulations of the SSCs that would constitute "preconditioning" the equipment rather than testing it in the "as-found" condition. Whether such preconditioning is acceptable, depends on the circumstances.

C. DISCUSSION

1. Definitions applicable to this technical guide follow:

   a. Preconditioning (of SSCs)
   The alteration, variation, manipulation, or adjustment of the physical condition of an SSC before Technical Specification surveillance or ASME Code testing.

b. Acceptable Preconditioning (of SSCs)

The alteration, variation, manipulation, or adjustment of the physical condition of an SSC before Technical Specification surveillance or ASME Code testing for the purpose of protecting personnel or equipment or to meet the manufacturer's recommendations. Preconditioning for purposes of personnel protection or equipment preservation should outweigh the benefits gained by testing only in the as-found condition. This preconditioning may be based on the equipment manufacturer's recommendations or on industry-wide operating experience to enhance equipment and personnel safety. This preconditioning should have been evaluated and documented in advance of the surveillance. It is recognized that this inspection guidance does not supersede the testing requirements of ASME Section XI for relief valves.

The following are examples of acceptable preconditioning:

(1) The running of prelube booster pumps prior to diesel starts is allowed by NUREG 1431, "Standard Technical Specifications - Westinghouse," when documented and approved in technical specifications.

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

(3) Gas accumulation in the suction piping of pumps or condensate accumulation in turbine steam supply lines can result in an equipment performance degradation. Verifying pump suction piping is gas free and turbine steam supply lines are condensate free prior to planned equipment operation, including surveillance testing, is a good operating practice

and may improve equipment reliability. Performing these evolutions may be acceptable provided that it does not remove a pre-existing adverse condition without proper identification and evaluation. However, routine uncontrolled pump venting or draining turbine steam supply lines directly preceding surveillance testing without proper controls is unacceptable preconditioning.

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

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

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

(6) Turbine steam supply lines can be drained prior to surveillance testing provided that evolution has proper controls. A technical evaluation is required to support that the condensate drained would not have an adverse effect on the turbine operation. If an unacceptable amount of condensate is drained, an operability evaluation of the as-found condition is required.

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

c. Unacceptable Preconditioning (of SSCs)

The alteration, variation, manipulation, or adjustment of the physical condition of an SSC before or during technical specification surveillance or ASME Code testing that will alter one or more of an SSC's operational parameters which results in acceptable test results. Such changes could mask the actual as-found condition of the SSC and possibly result in an inability to verify the operability of the SSC. In addition, unacceptable

preconditioning could make it difficult to determine whether the SSC would perform its intended function during an event in which the SSC might be needed. Influencing test outcome by performing valve stroking, preventive maintenance, pump venting or draining, or manipulating SSCs does not meet the intent of the as-found testing expectations described in NUREG-1482, "Guidelines for In-service Testing at Nuclear Power Plants"(April 1995), and may be unacceptable.

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

(1) Electrical

(a) Inspectors noted that electrical loads were removed from a number of 480-volt circuit breakers before surveillance testing was performed. In addition, surveillance procedures instructed technicians to inspect, clean, and lubricate several breakers before performing as-found testing. Accordingly, a violation for failure to maintain appropriate test controls in accordance with 10 CFR Part 50, Appendix B, Criterion XI, "Test Control," was issued.

(2) Mechanical

(a) Four air-operated containment spray flow control valves were unacceptably preconditioned before stroke time surveillance testing by having the valve stems lubricated. Accordingly, a violation was issued for failure to develop appropriate test controls in accordance with 10 CFR Part 50, Appendix B, Criterion XI. The licensee's administrative procedures failed to ensure that these stroke time tests were performed under suitably controlled conditions.

(b) During observation of surveillance testing, inspectors noted that certain heat exchangers had their air-operated inlet valve and outlet valves controlled by a single hand switch on the main control room panel. The safety function of these air-operated valves was to open or to remain open in response to an accident signal. A surveillance test was performed quarterly to ensure that the opening function was intact and was not degrading. During the test, with the valves closed, the hand switch was taken to the open position and the opening stroke time for the "A" valve was recorded. At the same time, the "B" valve cycled open. After both valves were closed, the hand switch was again taken to the open position, and the opening time for the

"B" valve was recorded. The inspectors considered the manner in which this test was conducted to constitute inappropriate preconditioning of the "B" valves. Since the stroke time test of the "A" valve was performed first during each test, the stroke time of the "B" valve was always checked a short time after the "B" valve had been cycled with the "A" valve. Therefore, an as-found stroke time anomaly for one of the "B" valves may not be detected if the pretest stroke eliminated the anomaly. Accordingly, a violation for failure to maintain appropriate test control in accordance with Criterion XI of Appendix B to 10 CFR Part 50 was issued.

(c) Inspectors identified the practice of operating the turbine-driven auxiliary feedwater pumps immediately before performing surveillance tests and the practice of venting the residual heat removal pumps immediately before performing surveillance tests as examples of unacceptable preconditioning. The failure to test safety-related equipment under suitably controlled conditions and in accordance with design and licensing bases was cited as a violation of 10 CFR Part 50, Appendix B, Criterion V, "Instructions, Procedures, and Drawings."

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

(3) Instrumentation and Control

(a) Inspectors noted that the surveillance procedure for the containment and drywell hydrogen analyzer calibrations required technicians to check and adjust reagent gas flow before obtaining the as-found calibration data. However, adjusting the reagent gas flow could affect the as-found condition of the analyzer and invalidate the test results. The inspectors determined that the test procedure was

inadequate. Accordingly, a violation was issued on the basis of TS 5.4.1.a, which requires that specific written procedures be established for surveillance tests as described in Regulatory Guide 1.33, "Quality Assurance Program Requirements."

2. Effects of scheduling on preconditioning

a. Industry initiatives to maximize the availability of SSCs by integrating several maintenance and/or surveillance activities into one evolution may inadvertently introduce unrecognized equipment preconditioning. Plant and/or equipment outage schedule pressures may also be a reason to integrate maintenance and surveillance testing. For example, to expedite their outage schedule, some licensees have routinely performed TS surveillance tests after the maintenance activity so that the surveillance test can also serve as the post maintenance test. This could inadvertently result in unacceptable preconditioning. Baseline performance or condition data must be recorded if a post maintenance test is used as the operability test of record. The baseline data are necessary to compare to future test data to determine degraded equipment conditions that develop over time. It does not, however, demonstrate equipment operability over a surveillance interval.

b. Inspectors should be aware that task scheduling of apparently unrelated testing activities can result in inadvertent preconditioning. For periodic testing, the scheduled order of individual tests may change and impact other tests that were not affected during previous testing cycles. Therefore, the potential for unacceptable preconditioning is always present. An example of this situation is given below.

(1) A facility scheduled testing to support the in-service testing (IST) program for emergency diesel generator (EDG) air-start valves. The air-start valve testing was scheduled for performance following preparation for technical specification EDG operability surveillance testing. The preparation for the operability test allowed the diesel engine to be prelubricated and rolled over using the air-start system with all the cylinder test indicator petcocks open to assure that the cylinders did not contain water or other incompressible material that could damage the engine. This preparation for the EDG operability test could result in the preconditioning of the air-start valve IST. Specifically, by performing the EDG air-start valve IST immediately following the prelubrication, the air-start valves may not be considered to be in an as-found condition. Therefore, the inspector would have to determine if the activity associated with preparation

for the EDG technical specification operability test could result in preconditioning and increase the chance of success for the IST of the air start valves.

3. Preventive Maintenance

   a. Except where there is a need to protect personnel or prevent equipment damage, preventive maintenance should not be performed before TS surveillance testing. To the greatest extent possible, SSCs should be tested in the as-found condition in order to determine if they would be capable of performing their intended function and to collect as-found performance or condition baseline data.

   b. After performing preventive or corrective maintenance, the licensee should perform post maintenance testing to verify that the SSCs are capable of performing their intended function and to establish new performance baseline data where appropriate. Depending on the extent of the maintenance activity, all or parts of the surveillance activity might be performed to ensure that the ability of the SSC to perform its intended function has not been adversely affected by the maintenance activity. If Post Maintenance Testing is not conducted, the licensee should justify the operational readiness through previous test information.

4. During routine testing observations, the inspector should question any actions by the licensee that could be construed as preconditioning and should determine if those actions have been appropriately evaluated by the licensee and are acceptable.

5. The following 10 CFR Part 50 requirements should be reviewed when considering potential violations:

   a. Appendix A, Design Criteria

      (1) Criterion 18 - *Inspection and Testing of Electric Power Systems* "The systems shall be designed with a capability to test periodically (1) the operability and functional performance of the components of the systems, such as onsite power sources, relays, switches, and buses, and (2) the operability of the systems as a whole and, under conditions as close to design as practical, the full operational sequence that brings the systems into operation, including operation of applicable portions of the protection system, and the transfer of power among the nuclear power unit, the offsite power system, and the onsite power system."

(2) Similar wording is used in Criterion 21 - *Protection System Reliability and Testability;* Criterion 37 -*Testing of Emergency Core Cooling System;* Criterion 40 - *Testing of Containment Heat Removal;* Criterion 43 -*Testing of Containment Atmosphere Cleanup Systems*; Criterion 46 - *Testing of Cooling Water System;* and Criterion 54 - *Piping Systems Penetrating Containment.*

b. Appendix B, *Quality Assurance Criteria*

(1) Criterion II, Quality Assurance Program "Activities affecting quality shall be accomplished under suitably controlled conditions."

(2) Criterion V, Instructions, Procedures, and Drawings "Activities affecting quality shall be prescribed by documented instructions, procedures, or drawings, of a type appropriate to the circum-stances and shall be accomplished in accordance with these instructions, procedures, or drawings."

(3) Criterion XI, Test Control "A test program shall be established to assure that all testing required to demonstrate that structures, systems, and components will perform satisfactorily in-service is identified and performed in accordance with written test procedures which incorporate the requirements and acceptance limits contained in the applicable design documents. . . . Test procedures shall include provisions for assuring that all prerequisites for the given test have been met, that adequate test instrumentation is available and used, and that the test is performed under suitable environmental conditions. Test results shall be documented and evaluated to assure that test requirements have been satisfied."

(Note that Criteria II, V and XI to Appendix B have been the basis for most violations issued for preconditioning.)

c. *Codes and Standards*, 10 CFR 50.55a

(1) References ASME Code Section XI for safety related SSCs.

d. *ASME Code Section XI*

(1) Requires that new reference values (or baseline) are recorded after a valve or its control system has been replaced, repaired, or undergone maintenance that could have affected the valve's performance.

(2) Requires that new reference values (or baseline) be obtained each time a pump has undergone maintenance, repair, or replacement and that these new values be compared to initial reference values in order to determine operability.

D. CONCLUSION

1. Preconditioning may or may not be acceptable, depending on circumstances associated with the particular test condition. The inspector should be aware that maintenance activities may mask identification of SSC degradation. Specifically, an activity performed by a licensee to precondition an SSC which causes acceptable performance at that specific time would not be considered to be within the intent of the NRC regulations under 10 CFR 50.55a or under Appendix B to 10 CFR Part 50. It is recognized, however, that routine preventive maintenance, such as valve lubrication and pump venting, might coincide occasionally with the in-service test program. In those cases, the effect of such maintenance needs to be evaluated to ensure that the ability to assess the operational readiness of the SSC and to trend degradation in SSC performance is not adversely affected.

2. At a minimum, the following questions should be considered when evaluating the acceptability of preconditioning:

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

If the answer is YES to any of these questions and it meets the definition of "Unacceptable Preconditioning (of SSCs)" in Section C.1, the preconditioning is unacceptable and the inspector should evaluate whether a violation of the NRC regulations has occurred. (See Section C.1 for some examples of unacceptable preconditioning.)

3. To insure consistency in the implementation of this guidance, the Quality Assurance, Vendor Inspection and Maintenance Branch should be consulted prior to the final determination of acceptability or unacceptability of the preconditioning.

E. REFERENCES

- NRC Information Notice 97-16, "Preconditioning of Plant Structures, Systems, and Components Before ASME Code In-Service Testing or Technical Specification Surveillance Testing"

- "Regulatory Acceptability of Prelubricating Valves Prior to Surveillance Testing" (Task Interface Agreement (TIA 96-007)) Memo date June 24, 1996 from R. Wessman to F. Hebdon

- "Codes and Standards" 10 CFR 50.55a,

- ASME Code Section XI, OM 10, "In-Service Testing of Valves," paragraph 3.4, "Effect of Valve or Actuator Replacement, Repair, and Maintenance on Reference Values"

- ASME Code Section XI, OM 06, "In-Service Testing of Pumps, "paragraph 4.4, "Effect of Pump Replacement, Repair, and Maintenance on Reference Values"

- Inspection Procedure 61726, "Surveillance Operations"

- Inspection Procedure 62707, "Maintenance Observation"

- NUREG-1482, "Guidelines for Inservice Testing at Nuclear Power Plants"(April 1995)

- NUREG-1216 , "Safety Evaluation Report Related to the Operability and Reliability of Emergency Diesel Generators Manufactured by Transamerica DeLaval, Inc."(August 1986)

- NRC Information Notice 96-24, "Preconditioning of Molded-Case Circuit Breakers Before Surveillance Testing"

END