

## TOPICAL REPORT EVALUATION

### INSTRUMENTED INSPECTION TECHNIQUE AS AN ALTERNATIVE TO THE HYDROSTATIC TESTING REQUIREMENTS FOR ASME CLASS 1, 2, AND 3 SYSTEMS AND COMPONENTS

SUBMITTED BY H.A.F.A. INTERNATIONAL INCORPORATED  
TOPICAL REPORT HAFA 135 (N)  
APRIL 1985

#### 1.0 BACKGROUND

Pressure tests of nuclear power plant systems and components are performed primarily to determine their preoperational and continued inservice structural integrity and leak tightness. 10 CFR 50.55a states in part that pressure tests of systems and components of boiling and pressurized water-cooled nuclear power facilities shall be performed in accordance with the requirements of Section XI of the ASME Boiler and Pressure Vessel Code. The owners of the facilities are required to update the testing programs to later approved editions and addenda of Section XI at ten-year intervals and, in many instances, compliance with the newer requirements is impractical because of the existing system or component design. In such cases, the Regulation allows relief to be granted by the Commission if the necessary findings can be made. The Regulation also allows proposed alternatives to the requirements to be used when authorized by the Director of the Office of Nuclear Reactor Regulation if the alternatives would provide an acceptable level of quality and safety or compliance with the specified requirements would result in hardship or unusual difficulties without a compensating increase in the level of quality and safety.

As an alternative method for pressure testing systems and components, H.A.F.A. International Incorporated submitted to the staff for review the topical report, "Instrumented Inspection Technique as an alternative to the Hydrostatic Testing Requirements for ASME Class 1, 2, and 3 Systems and Components." This report is evaluated for application of the alternative method to pressure tests required by Section XI.

## 2.0 SCOPE AND SUMMARY OF REVIEW

The information and data contained in the topical report were presented to demonstrate that the Instrumented Inspection Technique is capable of detecting and locating external system leakage, intersystem valve leakage, reducing personnel exposure to radiation, detecting small leaks, eliminating overpressurization of lower pressure rated piping and components, and is therefore a suitable alternative to Section XI requirements for hydrostatic tests. The staff's review considers the Code requirements and the impracticalities associated with implementation of the requirements, and application of the Instrumented Inspection Technique as an alternative. Although the Topical report refers to hydrostatic testing, its intent is to apply to pressure testing in general, i.e., system leakage tests, system functional tests, system hydrostatic tests, and system pneumatic tests. The staff's review therefore encompasses pressure tests in general.

Based on our review and evaluation, we have concluded that sufficient information has been presented to support the conclusion that the Instrumented Inspection Technique is a suitable alternative for the pressure test requirements of Section XI. Application of the alternative method provides added assurance of system and component structural integrity and leak tightness when compared to conventional pressure testing methods. Implementation of the Instrumented Inspection Technique is not intended to circumvent Section XI Code requirements for pressure tests but to provide an added margin of reliability of the test results. The staff finds that the Code requirements, where practical to meet, will be complied with and in situations where the requirements are impractical, the regulations will be followed prior to implementation of the alternative testing method. However, the Code requirement for the four-hour hold time prior to visual examination of insulated systems and components may be reduced to two hours if the alternative method is utilized.

The remainder of this safety evaluation includes summaries of Section XI Code requirements for pressure tests and the topical report, and the bases for our conclusions.

### 3.0 CODE REQUIREMENTS

The Section XI Code requirements for pressure tests given below are a summary of those from the 1980 Edition through Winter 1981 Addenda. These requirements are cited for explanatory purposes only and are not cited to limit the alternative testing method to the requirements in this edition and addenda.

### 3.1 SYSTEM TEST REQUIREMENTS

The Code requires that pressure retaining components within each system boundary be subjected to system pressure tests under which conditions visual examination, VT-2<sup>1</sup>, is performed. The required system pressure tests are defined as:

(a) Systems Leakage Test - A pressure test conducted following opening and reclosing of a component in the system after pressurization to nominal operating pressure.

(b) System Functional Test - A pressure test conducted to verify operability of systems (or components) not required to operate during normal plant operation while under system operating pressure.

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<sup>1</sup> A VT-2 is a visual examination that is conducted to locate evidence of leakage from pressure retaining components or abnormal leakage from components with or without leakage collection systems as required during conduct of system pressure or functional tests.

(c) System Inservice Test - A pressure test conducted to perform visual examination VT-2 while the system is in service under operating pressure.

(d) System Hydrostatic Test - A pressure test conducted during a plant shutdown at a pressure above nominal operating pressure or system pressure for which overpressure protection is provided.

(e) System Pneumatic Test - A pressure test conducted in lieu of a hydrostatic pressure test.

Pressure and temperature requirements are defined for the type of test being performed and the system or component Code Class. System boundaries are located at the intersection of Code Class changes and the pressure test hold time depends on whether or not the system or component is insulated.

For Class 1 systems and components, all pressure tests except the hydrostatic test are required to be performed at not less than the nominal operating pressure associated with 100% rated reactor power. The hydrostatic test is required to be performed at not less than 1.10 times the nominal operating pressure at 100°F or less. However, the pressure can be lowered incrementally with increasing temperature to 1.02 times the operating pressure at a temperature of 500°F provided limiting conditions specified in the Technical Specifications are not violated.

For Class 2 systems and components, all pressure tests are required to be performed at nominal operating pressure except the hydrostatic test pressure is required to be at least 1.10 times the lowest pressure setting of safety or relief valves provided for overpressure protection for systems with a design temperature of 200°F (93°C) or less and 1.25 times this pressure for systems with a design temperature above 200°F (93°C).

The system inservice test and system functional test of Class 3 systems are required to be performed at nominal operating pressure. The test pressure requirements for hydrostatic tests are the same as those for Class 2 systems, i.e., 1.10 times the lowest setting of safety or relief valves provided for overpressure protection for systems with a design temperature of 200°F (93°C) or less and at least 1.25 times this pressure for systems with a design temperature above 200°F. For systems not provided with safety or relief valves, the system design pressure is required to be used during the hydrostatic test.

Test temperature for Class 1, 2 & 3 systems and components constructed of ferritic steel is required to meet the criteria specified for fracture prevention. For systems constructed of austenitic steel, test temperature limitations are not required to meet fracture prevention criteria. The pressure test hold time is required to be ten (10) minutes for systems that are not insulated and four (4) hours for insulated systems.

The accuracy of test gages used in pressure testing is required to provide results accurate to within 0.5% of full scale. The test gages are required to be calibrated against a standard dead weight tester or a calibrated master gage. The test gages are required to be calibrated before each test or series of tests, where a series of tests is a group of tests that use the same pressure test gage or gages and that are conducted within a period not exceeding two (2) weeks.

#### 4.0 SUMMARY OF TOPICAL REPORT

The information contained in the topical report included (1) rationale for the alternative testing, (2) a description of the Instrumented Inspection Technique, and (3) the results of tests performed on systems at four facilities. A summary of these aspects is given below.

#### 4.1 TESTING RATIONALE

Section XI Code requirements for pressure tests fail to address the problem of intersystem leakage or adequately address small external leakage since small leakages may not penetrate insulation or appear at breaks in the insulation. To implement the requirements of the Code, in many instances, involves system preparations which could entail removal of valve internals, blanking safety or relief valves, pin blocking spring hangers, shutting down both units of a two-unit site when testing shared systems, and exposing testing personnel to accumulated doses of radiation which could be lowered in keeping with the aims of ALARA (As Low As Reasonably Achievable).

The Instrumented Inspection Technique is capable of eliminating or reducing many of the problems associated with implementing the Code requirements for pressure tests while meeting the intent of the Code and addressing problems that are potentially safety significant.

#### 4.2 DESCRIPTION OF THE INSTRUMENTED INSPECTION TECHNIQUE

( PROPRIETARY INFORMATION )



4.3 TEST RESULTS OF IIT APPLICATION ON SYSTEMS AT SEVEN PLANTS

( PROPRIETARY INFORMATION )

## 5.0 EVALUATION

### 5.1 APPLICATION OF IIT AS AN ALTERNATIVE PRESSURE TESTING METHOD

The Instrumented Inspection Technique (IIT) is a pressure testing method that is performed in accordance with the rules of Section XI and the Regulation, 10 CFR 50.55a. The equipment employed enables testing personnel to locate leaks faster, detect smaller leaks, and detect intersystem leaks. The IIT is therefore an alternative pressure testing method that provides superior quality and safety over conventional testing and is thus an acceptable alternative.

### 5.2 APPLICATION OF IIT AS AN ALTERNATIVE TO IMPRACTICAL CODE REQUIREMENTS

#### 5.2.1 Test Pressure Requirement

Attaining and holding the Code required test pressures in portions of Class 1, 2, and 3 systems have been cited in many instances by a number of licensees to be impractical to perform at their facilities. Supporting information justifying their determinations was provided to the Commission and relief from performing these tests at Code required test pressures was granted after review and evaluation. Sufficient data on small leaks in water-filled systems have been taken and the results analyzed to demonstrate that small leaks can be detected by IIT and that the changes in the leakage rates between normal operating pressures and the Code required pressures are relatively small. Based on the leak detection



capabilities of IIT, the staff finds that its application in situations where the Code required test pressures are impractical to attain and hold, and the tests are performed at normal operating pressure, will provide added assurance that small leaks at the lower pressures will be detected. We therefore find IIT to be an acceptable alternative method to be used for impractical Code test pressure requirements.

#### 5.2.2 Test Hold Time

The Code requirement for pressure test hold time of four (4) hours prior to visual examination of insulated systems is based on allowing sufficient time to elapse for a leaking fluid to penetrate the insulation and be detected by the VT-2 (visual) inspection. Since small leaks can be detected by IIT, it is not necessary to require the four-hour hold time. Leakage detected by IIT can be located prior to or after achieving the required pressure. The staff finds that a two-hour hold time is adequate for insulated systems prior to the VT-2 inspection when using IIT as the alternative testing method.

### 6.0 CONCLUSIONS AND RECOMMENDATIONS

- (1) Based on our review and evaluation of the information and data presented in the topical report, we conclude that the IIT will provide added assurance of the structural integrity and leak tightness of systems and components subjected to pressure tests and that the testing method provides an increase in the level of quality and safety, and is therefore an acceptable alternative testing method.

- (2) Application of IIT where Code requirements are impractical to meet also increases the level of quality and safety because of the leak detection capabilities of the method employed.
- (3) The four-hour hold time requirement for insulated systems may be reduced to two-hours because of the small leak detection and location capabilities of IIT. Visual (VT-2) examination of the systems as required by Section XI should be performed after the two-hour hold time.
- (4) Prior to implementation of IIT, a system safety and operational review should be performed and testing procedures approved as described in the topical report. Impractical Code requirements and supporting information to justify the impracticalities should be submitted to the Commission for evaluation as required by Regulations.