November 15, 1989

Docket Nos. 50-335, 50-389
License Nos. DPR-67, NPF-16

Florida Power and Light Company
ATTN: Mr. J. H. Goldberg
Executive Vice President - Nuclear
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Juno Beach, FL 33408-0420

Gentlemen:

SUBJECT: POTENTIALLY INVALID LEAK DETECTION TESTS USED AS AN ALTERNATIVE FOR REQUIRED ASME, SECTION XI HYDROSTATIC TESTS

As a result of several inspections by the NRC into the pressure tests conducted at a number of nuclear power plants by HAFA International Incorporated (HAFA) using each licensee's examination procedure as an alternative to the hydrostatic pressure tests required by Section XI of the ASME Code for Calss 1, Calss 2 and Class 3 components and systems, we have concldued that the tests and, therefore, the test results may be invalid. These pressure tests were conducted pursuant to the approved topical report, HAFA 135 (P), "Instrumented Inspection Technique as an Alternative to Hydorstatic Testing Requirements for ASME Classes 1, 2 and 3 Systems and Components," dated April 1985.

For your further understanding of this issue, we have provided an Enclosure, a brief technical discussion of the factors which provide the bases for the NRC staff to conclude that the Instrumented Inspection Technique (IIT) tests may be invalid. Inasmuch as IIT tests were conducted at St. Lucie, we request that you evaluate your examination procedure and the IIT test data. If you confirm that these tests are invalid, you should identify all ASME Class 1, Class 2 and Class 3 systems and components subject to the hydrostatic pressure testing requirements of ASME, Section XI, which were tested using the IIT tests described in the topical report cited above. This should be limited to the time period from November 7, 1985, to the present.

If you determine that any of the IIT tests conducted at your plant in the period from November 7, 1985, to the present are valid, please inform the Office of Nuclear Reactor Regulation of your determination including the bases for your determination and a brief description of the component or system and the date of the IIT test.

In addition, IIT tests using acoustic emission leak detection instruments only (e.g., tests on steam generators) are beyond the scope of the NRC staff's approval of the HAFA topical report cited above.

In the event that you confirm that the IIT tests conducted at your facility are invalid, you should determine whether the affected systems can be judged functionally OPERABLE based on structural integrity considerations available for the systems.

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If you determine that the components or systems identified are OPERABLE but a question exists as to full compliance with all applicable regulatory requirements, develop corrective actions in accordance with the requirements of Section XVI of Appendix B to 10 CFR Part 50. The timeliness of corrective actions, if needed, should be consistent with the safety significance of the concern.

If you have any questions on this matter, please contact Jerome Blake at 404-331-5539.

Sincerely,

Stewart D. Ebneter
Regional Administrator

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As stated

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ENCLOSURE

SUMMARY OF NRC INSPECTION CONCLUSIONS

INSTRUMENTED INSPECTION TECHNIQUE (IIT) 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 (P)
APRIL 1985

1.0 INTRODUCTION

1.1 BACKGROUND

Topical report HAFA 135 (P) was submitted by letter dated April 2, 1985 (Reference 1). The staff reviewed the subject document based on the NRC policy and guidance provided in NUREG-0390, Vol. 7, No. 2, "Topical Report Review Status," dated October 15, 1984. This topical report was approved by the staff in a letter dated November 7, 1985 (Reference 2), which then permitted its use in referencing in license applications to the extent specified and under the limitations delineated in the topical report and the associated NRC proprietary and nonproprietary safety evaluations. The NRC Licensing Topical Report Program requires that a proposed revision to an approved topical report be submitted and reviewed by the staff in accordance with the same requirements and procedures as apply to a new topical report (paragraph 12.0, NUREG-0390). Proposed revisions to topical reports which the NRC considers to significantly alter the report scope will be assessed review fees as for a new topical report (paragraph 13.0, NUREG-0390). Proposed revisions to topical report HAFA 135 (P) have not been submitted for staff review.

The NRC has recently conducted a series of inspections pertaining to the implementation of the IIT methodology. Based on this information, the staff now has serious questions regarding the effectiveness of the IIT, qualification of the examination personnel, the technical adequacy of the examination procedure in terms of control of test equipment and acceptance criteria, the required controls exercised by licensees on the plant-approved examination procedures and the documentation of test results. The staff has initiated formal action to withdraw the approval of topical report HAFA 135 (P) pursuant to NUREG-0390.

1.2 CODE REQUIREMENTS (Circa 1985)

The staff's original review of the topical report considered the ASME Section XI requirements for pressure tests summarized below from the 1980 Edition through Winter 1981 Addenda. These requirements were cited for explanatory purposes only and were not intended to limit the alternative testing method to the requirements in this edition and addenda.

1.2.1 SYSTEM TEST REQUIREMENTS

The Code requires that pressure-retaining components within each system boundary be subjected to system pressure tests; in these pressure tests, visual examination, VT-2[1], 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.

(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).

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[1]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.

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.

1.2.2 OTHER CODE REQUIREMENTS

The 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 stainless steel, test temperature limitations are not required to meet fracture prevention criteria. The pressure test hold time is required to be 10 minutes for systems that are not insulated and 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 2 weeks.

2.0 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.

2.1 TESTING RATIONALE

The topical report claimed that the ASME Section XI requirements for pressure tests failed 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 claimed to be 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.

2.2 DESCRIPTION OF THE INSTRUMENTED INSPECTION TECHNIQUE

(PROPRIETARY INFORMATION)

2.3 TEST RESULTS OF IIT APPLICATION ON SYSTEMS AT SEVEN PLANTS

(PROPRIETARY INFORMATION)

3.0 SCOPE AND SUMMARY OF ORIGINAL STAFF REVIEW

The information and test data contained in topical report HAFA 135 (P) 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 regarded the attributes described above as the IIT concept that would be implemented by reference in license applications pursuant to its letter dated November 7, 1985.

The staff's original review considered the Code requirements and the impracticalities associated with implementation of these Code 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 original review, therefore, encompassed pressure tests in general.

The staff determined that sufficient information was presented in topical report HAFA 135 (P) to support the conclusion that the Instrumented Inspection Technique is a suitable alternative for the pressure test requirements of ASME Section XI. Implementation of the Instrumented Inspection Technique was not intended to circumvent ASME Section XI requirements for pressure tests but to provide an added margin of reliability of the test results. The staff found 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 4-hour hold time prior to visual examination of insulated systems and components may be reduced to 2 hours if the alternative method is utilized. The staff regards the conditions described above as limitations associated with the acceptance of topical report HAFA 135 (P) as defined in its letter dated November 7, 1985.

The staff's safety evaluation concluded that "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."

4.0 STAFF EVALUATION

4.1 TYPES OF PRESSURE TESTS

HAFA personnel conducted two types of pressure tests, IIT and IIT Acoustic Leak Testing, at several plant sites. The first type, IIT was used to detect pressure boundary and inter-subsystem leakage by the Leak Measuring Devices (LMDs) and the Acoustic Leak Sensing Equipment (ALSE) monitoring of the pressurized boundaries. When the staff approved the IIT concept, the qualification tests were at quasi-static conditions, i.e., the boundary valves were either leak-tight or monitored for quantifiable low levels of leakage. In actual practice, the IIT may have been conducted as a dynamic test. Therefore, small amounts of leakage through the pressure boundary may not be detected by the instrumentation. Further, the licensee's examination procedure does not address the required action when maintenance is performed on the boundary valves after the test.

A second test known as the "IIT Acoustic Leak Testing of Pressure Retaining Components" was performed by HAFA personnel. This is an acoustic emission leak test without flow measurement. The staff did not approve this methodology in its November 7, 1985 letter. This examination is discussed in the topical report but the supporting information from HAFA concluded that the test results from the method were inconclusive.

4.2 SITE INSPECTIONS

The NRC staff recently conducted a series of inspections pertaining to the implementation of the IIT methodology. The inspections included observations of the Instrumented Inspection Technique in progress, implementation of IIT procedures, review of test data and records, personnel qualification/certification records and quality assurance involvement with inservice inspection. The overall audit included selected issues that encompass the activities of all licensees with written approval to perform IIT as an alternative to the ASME Section XI pressure tests that are required by the regulations and the plant Technical Specifications. The staff also conducted an inspection at the offices of HAFA International Incorporated in Riviera Beach, Florida, during the week of September 11, 1989, in order to interview HAFA personnel and to observe demonstrations of instrumentation on the HAFA test loop.

4.3 REVIEW OF IIT IMPLEMENTING PROCEDURES

The pressure tests using IIT were performed based on a written examination procedure that was reviewed and approved by the licensee's plant management. In general, personnel employed by HAFA International Inc. implemented the licensee's examination procedure, supervised the installation of instrumentation, conducted the test, evaluated the data and documented the results.

The NRC staff approved the concept of the IIT methodology as defined in topical report HAFA 135 (P) and subject to the limitations and conditions delineated in the staff's safety evaluation report. A licensee that referenced the topical report has the responsibility for the preparation of examination procedures and the control of the inspection process. The licensee was required to identify the plant-specific system boundary subject to inspection and assure that the selection of the instrumentation was consistent with the approved concept. Based on the recent NRC activities, the staff concluded that the examination procedures were not adequate to control significant test parameters, as explained in subsequent sections of this report.

4.4 SIGNIFICANT TEST PARAMETERS

The HAFA personnel had considerable discretion with regard to the implementation of the licensee's examination procedure. Changing certain significant test parameters could effect the validity of the test, the interpretation of the data and the reproducibility of the documented results. Based on the conclusions of the recent inspections, the staff now considers the following subjects as issues pertaining to the examination procedures:

(a) Acoustic Leak Sensing Equipment (ALSE)

1. The examination procedure defines the location of the ALSE transducers on a sketch, normally one per boundary valve. A technical justification is not available that shows the distance between tranducers mounted at the plant sites which are consistent with the qualification tests described in topical report HAFA 135 (P) and, therefore, the claim that leakage through the pressure boundary could be located by acoustic leak sensors cannot be substantiated.

2. The frequency and characteristics of the acoustic sensors are not defined.

3. The acoustic background noise must be checked prior to performing the test. The background noise could be large in relationship to the measured test signal. Written guidance is not provided regarding the acceptable background noise, the number of measurements, or the interval of time between measurements.

4. The inspector observed the ALSE transducers attached to the valve body with adhesive tape. The acceptable method of transducer attachment should be defined for different size valves, surface conditions, and test temperatures.

(b) Placement of Test Equipment

1. From the review of test records at several plants, the staff found cases where some of the pressure test boundary valves were neither instrumented with LMDs nor ALSE and, therefore, undetected leakage could have occurred through the boundary valves.

2. The staff also found cases where ALSE transducers were mounted at the boundary valves but LMDs were not installed. Therefore, the amount of pressure boundary leakage (i.e., crack or packing leakage) within the test boundary could not be quantified.

(c) Test Results

1. The Acceptance Standard for the test is no through wall leakage from the test boundary in some examination procedures. This is established by visual examinations during system walk downs; however, the examination procedure does not have guidance for the evaluation of the data from the IIT instrumentation.

2. Some licensees do not have plant personnel or other support staff who could make an independent assessment of the data from the IIT instrumentation.

3. The examination procedure does not define the required action in the event that instrumentation is known to have malfunctioned.

(d) Personnel Qualification/Certification

1. The qualifications of nondestructive examination personnel is defined in paragraph IWA-2300 of ASME Section XI. The staff's approval of the IIT concept described in topical report HAFA 135 (P) on November 7, 1985 did not supersede the established Code requirements for personnel qualification.

2. Questions regarding the qualifications/certification of certain HAFA level III personnel were raised during a quality assurance audit by a licensee. HAFA International Incorporated apparently resolved this issue with the licensee using a "grandfathering" procedure based on an informal telephone conversation with the NRC staff. HAFA construed this telephone conversation as NRC approval to replace a written examination requirement with "grandfathering."

4.5 INSPECTION AT THE HAFA OFFICES

The staff conducted an inspection at the offices of HAFA International Incorporated during the week of September 11, 1989 that included interviews of personnel and review of test records. A test loop was also available at this location to demonstrate the validity of the Instrumented Inspection Technique methodology. This demonstration was conducted under the most favorable conditions as compared to a plant site environment. The staff concluded that a significant undetected pressure boundary leak could exist in a system that was instrumented with Leak Measuring Devices and Acoustic Leak Sensing Equipment in a manner that was typical to the installation used in the licensed facilities.

5.0 CONCLUSIONS

Based on the information described above, the staff has reassessed its conclusions regarding the Instrumented Inspection Technique. The staff has determined that the IIT methodology as implemented is ineffective, problems exist with the qualification of examination personnel, licensees failed to assure the technical adequacy of the examination procedures in terms of the control of test equipment and acceptance criteria, licensees failed to exercise adequate controls on contractor personnel, and the documentation of test results was not adequate to perform an independent review of the examination process.

6.0 REFERENCES

1. Letter dated April 2, 1985 from H. H. Askwith, HAFA, to C. O. Thomas, NRC, Subject: Topical Report HAFA 135 (P)

2. Letter dated November 7, 1985 from C. O. Thomas, NRC, to H. H. Askwith, HAFA, Subject: Acceptance for Referencing of Licensing Topical Report HAFA 135 (P).