

U. S. NUCLEAR REGULATORY COMMISSION

REGION III

Report No.: 50-255/89026(DRS)

Docket No.: 50-255

License No.: DPR-20

Licensee: Consumers Power Company  
1945 West Parnall Road  
Jackson, MI 49201

Facility Name: Palisades Site

Inspection At: Covert, Michigan 49043 and  
HAFA International, Riviera Beach, FL 33419

Inspection Conducted: August 21 through October 23, 1989

Inspectors: J. M. Jacobson  
J. M. Jacobson (Team Leader)

12/8/89  
Date

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D. H. Danielson, Chief  
Materials and Processes Section

12/8/89  
Date

Inspection Summary

Inspection on August 21 through October 23, 1989 (Report No. 50-255/89026(DRS))

Areas Inspected: Announced special team inspection of alternate test methods performed in lieu of ASME Section XI required hydrostatic testing (73053, 73755). This inspection was initiated in response to allegations concerning the validity of the alternate testing (99014).

Results: One violation with multiple examples was identified: failure to adequately control the pressure testing of plant systems (Paragraphs 2.b and 2.c).

Based on the results of the inspection, the following weaknesses were noted:

- ° Though Quality Assurance involvement was evident, technical reviews of the implementing test procedures were inadequate.
- ° Documentation reviews of the completed tests appeared to be nonexistent.

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## DETAILS

### 1. Persons Contacted

#### Consumers Power Company (CPC)

- +J. Slade, Plant Manager
- +K. Toner, Project Superintendent
- \*+R. VanWagner, ISI Supervisor
- \*+D. Malone, Licensing Engineer
- \*+T. Fauty, ISI Coordinator

#### U.S. Nuclear Regulatory Commission (U.S. NRC)

- +D. H. Danielson, Chief, Materials and Processes Section
- \*+J. M. Jacobson, Metallurgist

#### Southwest Research Institute (SWRI)

- \*D. W. Jolly, Institute Scientist

- \*Denotes those attending the interim exit meeting on August 22, 1989.
- +Denotes those participating in the final exit meeting via telephone on October 23, 1989.

### 2. Allegation Followup (RIII-89-A-0036)

The concerns addressed in this inspection report were extracted from correspondence with, and interviews of, two former employees of HAFA International Inc. The concerns relate to the testing performed on plant systems by HAFA, utilizing the "Instrumented Inspection Technique" (IIT) as an alternative to the ASME Code required hydrostatic test.

This inspection was conducted as a joint effort by both Region III and NRR staff. A consultant from SWRI was utilized to aid in the technical evaluation of the acoustic leak sensing testing associated with the IIT. In addition to the review of test related documentation performed at the plant, an inspection at the HAFA facility was also conducted.

#### a. Background

Topical Report HAFA 135(P) was submitted for NRC review by letter dated April 2, 1985. 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, which then permitted its use by reference in licensee applications to the extent specified and under the limitations delineated in the topical report and the associated NRC proprietary and nonproprietary safety evaluations.



The staff's original review of the topical report considered the ASME Section XI requirements for pressure tests 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.

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) is performed to locate evidence of leakage. 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. The pressure test hold time is required to be a minimum of 10 minutes for uninsulated components and four hours for insulated components.

For Class 1 systems and components, 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, 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 designed for over 200°F. These requirements also apply to Class 3 components.

The information and test data contained in topical report HAFA 135(P) were presented to demonstrate that the IIT is capable of detecting and locating external system leakage, intersystem valve leakage, reducing personnel exposure to radiation, detecting small leaks, eliminating the potential for 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 determined that sufficient information was presented in topical report HAFA 135 (P) to support the conclusion that the IIT is a suitable alternative for the pressure test requirements of ASME Section XI. 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.

HAFA personnel conducted two types of pressure tests under the umbrella of "IIT." The first type of test was used to detect pressure boundary and intersystem leakage utilizing leak measuring devices (LMD's). The purpose of the LMD's (flow meters) was to measure the replacement volume of flow necessary to maintain the test pressure. Exit flow through potentially leaking boundary valves was also to be measured. Any difference between make-up flow and the measured exit flows was, ostensibly, system external leakage. This instrumentation was to be supplemented by acoustic leak sensing equipment (ALSE) to aid in identifying leak locations. A supporting ASME VT-2 type examination could be performed in conjunction with the IIT.

The second type of test utilized acoustics without flow measurement for the detection of leakage. This type of testing was performed on both water filled and steam systems. The NRC staff did not approve this methodology in its November 1985 letter. This type of examination is briefly mentioned in the topical report, however, supporting test information demonstrated inconclusive results.

b. Concerns

(1) Allegation

The treasurer of HAFA also performed the function of QA manager. This would appear to conflict with the requirements of 10 CFR 50, Appendix B, Article 1.

NRC Review

Due to the death of the individual hired by HAFA as QA Manager, the treasurer took over the position for a period of time.

Conclusion

This allegation was substantiated in that the treasurer of HAFA did temporarily perform the function of QA manager. Though it is understood that HAFA is a small company, it is considered inappropriate for this individual to perform the QA function as sufficient independence from cost and schedule was not demonstrated.



(2) Allegation

Test engineers submitted written exams prepared by themselves as evidence of qualification for acoustic testing. This practice violates the intent of the ASNT SNT-TC-1A "Recommended Practice".

NRC Review

The qualification records of several individuals were reviewed and interviews were conducted to determine their validity. Records, in general, were found to be in a state of disarray, incomplete, and in one instance a resume was found to misrepresent the individual's academic credentials. The results of this review are forwarded via distribution of this inspection report to the NRC's Vendor Branch for information.

Conclusion

Interviews with the HAFA staff indicated that the subject individuals had not submitted completed exams, developed by themselves, as evidence of proficiency. This allegation could not be substantiated in that no documented evidence of the alleged practice was noted.

(3) Allegation

Each sensor/channel was not individually evaluated for reliability before, during, and after testing.

NRC Review

A review of test logs, procedures, and interviews with test personnel indicated that a pencil-lead break functional check was performed prior to testing. Interim or post-test functional checks were not performed, and attenuation measurements were not obtained to determine the adequacy of sensor spacing.

Conclusion

This allegation was substantiated in that interim and post checks on sensor channels were not performed. The pencil-lead break check performed prior to testing is not considered an acceptable method of sensor calibration due to the fast rise/decay transient as opposed to the continuous signal produced by a leak. Interim and post verification of channel sensitivity is considered essential in the evaluation of test data.

10 CFR 50, Appendix B, Criterion XI requires that test procedures include provisions for assuring that all prerequisites for a given test have been met. The procedural deficiency in the area of sensor calibration is an example of a violation of this criterion (255/89026-01A).

(4) Allegation

A band pass filter of 100-300 KHz was used when experience shows leaks to most likely be below 100 KHz.

NRC Review

A review of test logs, procedures, and interviews with test personnel indicated that indeed, a 100-300 KHz band pass filter was used during the testing.

Conclusion

This allegation was substantiated in that a 100-300 KHz band pass filter was utilized; however, the technical significance is minimal.

Water leaks produce a relatively wide spectrum of acoustic frequencies. Water leaks usually induce frequencies greater than 100 KHz in the piping.

(5) Allegation

Claims of real time RMS data gathering were made when the electronics and software were not equipped to do this; also voltmeters were used for this purpose without technical justification.

NRC Review

A review of test logs, procedures, equipment characteristics, and personnel interviews was performed. Electronic circuits, such as those employed by the HAFA equipment, produce an analog DC voltage response representative of the true RMS voltage. Since leak detection depends on a change in signal with respect to a change in pressure and not an absolute value, a voltmeter, though not ideal, may be used.

Conclusion

This allegation was substantiated in that the true RMS voltages were not being recorded. The overall technical significance of this practice is minimal. The question of whether the HAFA data gathering practice can be considered "real time" or not, is arguable, and not considered significant.

(6) Allegation

Temporary secretaries were used to take real time data when the test leader was not at the test locations.



### NRC Review

This allegation implies that untrained, unsupervised personnel were utilized as data takers. Interviews with both plant and HAFA personnel indicated that data takers were adequately trained for their function and worked in conjunction with more experienced test personnel.

### Conclusion

This allegation could not be substantiated and furthermore, the reading of a digital meter at prescribed intervals is not considered to be a function requiring extensive training. No evidence of unqualified test personnel being utilized to evaluate data was noted.

## (7) Allegation

Background measurement practices were inadequate.

### NRC Review

A review of test logs, procedures, and personnel indicated that background measurements were appropriate. A review of the data evaluation criteria indicates that the sensitivity of the leak detection process is inversely proportional to background noise amplitude.

### Conclusion

This allegation could not be substantiated in that background noise measurements appeared to be appropriate. However, qualification testing to define the relationship between background noise level and leak detection sensitivity was not performed. It is critical that the sensitivity of the leak detection system not change during the course of the test.

10 CFR 50, Appendix B, Criterion XI requires, in part, that procedures include provisions for assuring that the test is performed under suitable environmental conditions. The lack of a qualified, defined relationship between background noise level and leak detection sensitivity is another example of a violation of this criterion (255/89026-01B).

## (8) Allegation

Why weren't readings taken over the entire pressure ramp?

### NRC Review

Interviews with personnel indicated that a power failure occurred in the containment during the pressure ramp. This power failure caused some loss of data.

### Conclusion

This allegation was substantiated in that acoustic readings were not available for a considerable portion of the pressure ramp. Since the detection of leakage depends on the change in acoustic signal with respect to a change in pressure, the lack of portions of data erodes the validity of this test.

### (9) Allegation

The test leader hand marked a blank computer generated graph to indicate pressures when the instrumentation software was not capable of this.

### NRC Review

A review of the test documentation revealed that some graphic representations of test data had been developed. It was apparent that points on the computer generated graph format had been hand marked. These graphic representations were reviewed against tabulated data and verified to be accurate.

### Conclusion

The implication of the allegation is that deception was intended. The data points were verified to be accurate and the use of a computer generated format is not considered unusual. The graphical representation of data, whether computer or hand plotted, is a commonly used aid for evaluating that data. This allegation could not be substantiated in that deception is not suspected.

### (10) Allegation

The allexer stated that he observed cross talk between instrument channels when servicing the equipment, but this problem was not reported.

### NRC Review

A review of test documentation did not disclose indications of equipment problems due to cross talk between channels. Interviews with test personnel indicated that occasionally the LED indicator for some channels would be constantly on. This condition indicates that the signal level was constantly above the preset threshold level but, does not affect the RMS measurement.

### Conclusion

This allegation could not be substantiated in that no indications of cross talk between instrument channels were noted upon review of the test data.



(11) Allegation

Malfunctioning channels, debonded sensors, and failed coaxial cables were not reported.

NRC Review

A review of test data did not disclose indications of failed equipment. Interviews with test personnel indicated that equipment problems were corrected before the start of the test.

Conclusion

During the installation of electronic test equipment in the plant, it is not considered unusual to experience the problems noted by the alleger. Records of test data and interviews with test personnel indicated that equipment problems were corrected before the actual test. This allegation could not be substantiated.

(12) Allegation

An evaluation of HAFAs acoustic leak detection method, authored by Dr. M. Hamstad of the University of Denver, was challenged by the alleger.

NRC Review

This report was reviewed for information only. The report in question was not submitted to the NRC for formal review or use in supporting HAFAs claims.

Conclusion

A technical review of the subject report is not within the scope of this inspection.

c. Additional Inspection of the IIT Process

Though the alleger's concerns were directed primarily at the acoustic leak testing of the steam and feedwater systems, the NRC inspection team also reviewed the IIT testing of water filled systems. As previously stated, this methodology utilized LMD instrumentation supplemented by acoustics to ostensibly detect and locate test boundary leakage.

The testing concept which was approved by the NRC staff included LMD instrumentation at all boundary valves. Accurate measurement of the replacement volume, necessary to maintain test pressure and leakage volumes through all test boundary valves was required. Theoretically, if no external leakage is present, the algebraic sum of the inlet

flow and all outlet flows will be zero. Additionally, it was the staff's understanding that the entire test boundary would be instrumented with acoustic sensors.

A sample review of the test data indicates that the implementation deviated from the approved concept. This review disclosed that some test boundary valves were not instrumented at all, while others were instrumented with acoustic sensors only. In either case, an accurate measurement of boundary valve leakage could not be quantified. Additionally, the ability of the acoustic sensor to detect small intersystem valve leakage has not been demonstrated. Furthermore, acoustic sensors were not placed along the test boundary at prescribed intervals.

The basis of relief from Code required hydrostatic test pressures and hold times when utilizing the IIT process, was the ability of the methodology to quickly detect and locate small leaks in the test boundary. The deviations in the implementation described above eroded the basis for the reduced test pressures and hold times. Additionally, a demonstration of the IIT process performed at the HAFA facility showed that the leak detection sensitivity was insufficient. Small pinholes due to erosion/corrosion or tight cracks in the piping would not be detected. Based on a review of the test procedures utilized for conducting the tests, it was determined that inadequate detail contributed to the deviations described above. Procedures reviewed include:

#### Palisades Procedures

- |   |        |
|---|--------|
| ° IIT of Main Steam Line                      | RO-108 |
| ° IIT of Critical Service Water Header B      | RU-107 |
| ° IIT of Aux Feedwater Pump Suction Piping    | RO-109 |
| ° IIT of Aux Feedwater Pump P8A/P8B Discharge | RO-110 |
| ° IIT of Aux Feedwater System P8C Discharge   | RO-111 |

#### HAFA Procedures

- |   |          |
|---|----------|
| ° Application of Acoustic Emission Meters for Leak Sensing    | 12.14    |
| ° Application of IIT Acoustic Testing During IIT Leak Testing | MP-3-01  |
| ° IIT Acoustic Leak Testing of Pressure Retaining Components  | OP-13.02 |

The following are examples of procedural deficiencies noted:

- ° Acoustic sensor placement is not consistent with that experimentally qualified (approximately 20 feet maximum spacing).



- ° Excessive discretion regarding LMD placement was left to the test leader.
- ° Guidance for the evaluation of the IIT data was not provided.

10 CFR 50, Appendix B, Criterion XI requires, in part, that test procedures incorporate acceptance limits and that adequate test instrumentation is available and used. The procedural deficiencies noted above are additional examples of a violation of this criterion (255/89026-01C).

The acoustic testing performed on the steam and feedwater systems, as previously stated, is beyond the scope of that approved by the NRC staff. Additional problems associated with the acoustic leak testing are detailed in Enclosure 3.

d. Conclusions

Based on the information described above and inspections at other facilities, the staff has reassessed its conclusions regarding the IIT. 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, and licensees failed to exercise adequate control of contractor personnel.

The inspection team has concluded that the IIT performed on the plant systems is invalid. The VT-2 visual examinations were performed at operating pressures and for the most part at reduced hold times which is not consistent with ASME Code requirements. Per NRC letter to CPC dated November 2, 1989, operability determinations on affected systems should be made and a plan for corrective actions established.

With regard to the concerns brought to the NRC's attention, this allegation is considered closed.

3. Exit Interview

The Region III inspector met with the licensee representatives (denoted in Paragraph 1) on August 21, 1989, and at the conclusion of the inspection on October 23, 1989, via telephone. The inspector summarized the purpose and findings of the inspection. The licensee representatives acknowledged this information. The inspector also discussed the likely informational content of the inspection report with regard to documents or processes reviewed during the inspection. The licensee representatives did not identify any such documents/processes as proprietary.