



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D. C. 20555

CHAIRMAN

March 20, 1987

The Honorable Edward J. Markey  
Committee on Energy and Commerce  
U.S. House of Representatives  
Washington, DC 20515

Dear Congressman Markey:

I am responding to your letter of January 30, 1987, concerning the NRC's Office of Analysis and Evaluation of Operational Data (AEOD) 1984 Engineering Evaluation Report on Erosion in Nuclear Power Plants. As mentioned in your letter, the AEOD report identified 140 events related to erosion of various components. The report is an AEOD engineering evaluation and, like other engineering evaluations, was a general review to assess whether or not a more detailed case study was needed.

Since the report is an engineering evaluation, it contains only suggestions for review and consideration. The report does not recommend any action on the part of NRC. This is consistent with NRC policy that AEOD office recommendations be made on the basis of case studies which are more formal and require extensive reviews including technical community peer review.

The NRC program offices of Nuclear Reactor Regulation (NRR), Inspection and Enforcement (IE), Nuclear Material Safety and Safeguards (NMSS) and Nuclear Regulatory Research (RES) evaluated the report to determine the need for immediate action, long term action, prioritization as a new generic issue, or additional study. The staff concluded that no immediate action was needed. The AEOD report states that "there does not appear to be a direct relationship between these events and a specific safety problem that needs immediate attention." The staff was aware of the ongoing efforts by industry, begun two years earlier, to address erosion in the types of piping systems identified in the AEOD report.

The report was distributed to staff for review of the long term and generic safety implications. Although the AEOD report provided useful information for ongoing NRC programs, the review did not identify the need for any new generic issues. The instances of erosion-corrosion noted in the AEOD report occurred in two phase systems (steam containing some moisture), single phase systems with suspended solids, and single phase systems in bypass piping downstream of orifices or valves installed to

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control flow. These problems had already been identified within the industry and appropriately acted upon, in some cases several years before the AEOD report was issued. Several utilities had implemented voluntary programs prior to the issuance of NRC IE Information Notice 82-22 and Institute of Nuclear Power Operation (INPO) Significant Operator Event Report (SOER) 82-11.

Erosion-corrosion in single phase systems of carbon steel material had also been known to cause thinning in heat exchangers at regions of local flow disturbance, such as J-tubes in certain nuclear steam generators, and in conventional boiler feedwater tube inlets. Voluntary programs have been used to monitor and repair such thinning.

Gross thinning due to erosion-corrosion in large diameter single phase piping systems, resulting in the kind of catastrophic piping failure experienced at Surry, had not been previously experienced. Instead, more localized through-wall thinning with leakage has been experienced, and this has been limited to minimum flow bypass lines.

The NRC is extremely concerned about any degradation of nuclear power plant equipment which has relevance to the safety of the plant. We will continue to monitor individual plant performance and overall industry experience in this area. Where plant specific problems occur, the need for generic action will be assessed and corrective measures will be evaluated for their acceptability and effectiveness.

Answers to the specific questions in your January 30, 1987 letter are enclosed.

Commissioner Asselstine disagrees with this letter. He will provide his views in a separate letter.

Sincerely,

*Lando W. Zach Jr.*  
Lando W. Zach, Jr.

Enclosures:

1. Answers to Specific Questions
2. IE Information Notice No. 82-22
3. Relevant Internal Letters and Memoranda
4. Report on the Technical Meeting dated 1/30/87
5. Minutes of Technical Meeting dated 2/4/87

cc: Rep. Philip Sharp

QUESTION 1. When did regular testing and monitoring of steam pipes begin? What prompted this action? Please provide all appropriate documentation.

ANSWER.

Regular testing and monitoring of safety-related piping began on a generic basis when the American Society of Mechanical Engineers issued Section XI of the ASME Boiler and Pressure Vessel Code in 1970. Regulatory requirements for these inspections are set forth in 10 CFR 50.55a(g). The ASME Code requires that certain welds and heat affected base material adjacent to welds in piping be examined periodically. The purpose of these examinations is to detect cracks in these areas so that corrective action can be taken to protect the integrity of the piping pressure boundary. Neither the Code nor NRC regulations require the examination of pipe walls outside of welds or associated heat affected zones.

In addition to the above requirements, we understand that some licensees have voluntarily been examining piping weldments and associated heat affected base material in non-safety related piping including those in steam lines in this category. In addition to the measurement of weldments and heat affected zones for cracking, some licensees voluntarily initiated inspection programs for pipe wall thinning, either before or just after the issuances of NRC IE Information Notice 82-22 and TNPO SOER 82-11 in 1982. The issuance of IE Notice 82-22 was due to failures at several plants in 1982 in non-safety related steam extraction lines. A copy of IEN 82-22 is enclosed.

QUESTION 2.

Why did the NRC not require testing and monitoring on water systems, given the data in the AEOD Engineering Evaluation Report? Please explain in detail, including all internal letters and memoranda on this subject.

ANSWER.

The data in the AEOD report (the frequency and consequences of pipe erosion problem) and the information available prior to the AEOD report, did not suggest that new NRC regulatory action was needed to protect plant workers or the public from any undue radiological health risks. As discussed in the response to question #5, the staff is evaluating the effects of considering on-site non-radiological injuries or fatalities on our prioritization process.

Copies of all relevant internal letters and memoranda are enclosed.

QUESTION 3. Did the NRC provide licensees with the June 11, 1984 Report on Erosion in Nuclear Power Plants, or any of its conclusions? If so, when? If not, why not?

ANSWER.

In accordance with standard NRC policy on AEOD Engineering Evaluations, this study was provided to licensees and the industry in general in the following ways:

1. Copies of the "Transmittal of AEOD Engineering and Technical Evaluation Reports" (July 17, 1984 memorandum for C. J. Heltemes) were sent to the Institute for Nuclear Power Operations (INPO); the Nuclear Safety Analysis Center (NSAC) and the Nuclear Operations Analysis Center (NOAC) at the Oak Ridge National Laboratory.
2. An abstract of the Engineering Evaluation was published in the November 1984 issue of "Power Reactor Events" (NUREG/BR-0051 Vol.6, No. 3). All licensees receive at least three copies of the Power Reactor Events publication with one copy going directly to the plant manager. Instructions were also included for obtaining a copy of the report itself from the NRC Public Document Room.

QUESTION 4.

Are there other systems the NRC has identified which were expected to last for the life of the plant but which may be subject to early failure? Please identify each such system, and any NRC research or inspection effort dedicated to each system.

ANSWER.

NRC has a number of research programs in place which are investigating both systems and components for their potential for early failure due to aging effects. These programs are designed to identify specific aging mechanisms and determine what steps will be necessary to deal with the aging phenomenon. Results from this research will be used to determine whether requirements mandating replacement of specific systems or components at designated times are needed.

While our knowledge and understanding of aging mechanisms and their effect on systems and components is increased through our research programs, we believe that most aging phenomena can be readily managed and do not pose a safety problem provided the necessary compensatory measures (maintenance, surveillance, repair, replacement, etc.) are effectively implemented. Such measures have identified portions of piping systems, valves, pumps, electrical items, steam generators and other items in nuclear plants requiring repair or replacement.

With proper maintenance and surveillance programs in place, combined with required inservice inspection and test of safety related systems and components, the effect of aging is being adequately addressed by the utilities. As results from our aging research indicate the need for change, such as increased inspection frequency, changes will be made wherever appropriate.

QUESTION 5. What actions does the NRC plan in response to the Surry accident? Does the Commission expect increased inspection of secondary systems? If not, why not?

ANSWER

The Nuclear Regulatory Commission has organized a coordinated interoffice effort addressing the many aspects of the Surry accident involving the Offices of Nuclear Reactor Regulation, Inspection and Enforcement and Nuclear Regulatory Research. NRC is coordinating its efforts with the Electric Power Research Institute (EPRI) and the Institute for Nuclear Power Operations (INPO).

One of the first actions taken by the NRC was to convene a panel of nationally recognized experts in the technical disciplines related to the Surry failure. This panel met in an open public meeting on January 15, 1987. Two memoranda related to that meeting are enclosed. The technical review of the Surry failure at the January 15th meeting (in which there was extensive industry participation) provided some of the basis for the NRC coordinated effort.

The specific tasks which the NRC Offices have underway are the following:

- a) Prioritization of the Surry event using the criteria described in NUREG 0933 to establish the safety significance, recognizing that the failure of feedwater piping is a required design basis event for the plant.
- b) Review of the method for treating on-site non-radiological injuries or fatalities as part of the prioritization and cost-benefit analysis processes in order to determine whether or not there is need for revision to the prioritization process for these events.
- c) Preparation of a report to the appropriate national codes and standards bodies to make them aware of the facts surrounding the Surry event so that they may consider appropriate revisions to their documents.

QUESTION 5. (Continued)

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- d) Preparation and issuance of a Supplement to the TE Information Notice IN 86-106 to provide the industry with additional information made available since the event.
- e) Collection of information from licensees related to wall thinning measurements together with correlation and dissemination of the data.
- f) Review of the role of states, OSHA and the NRC dealing with non-radiological accidents.

Depending on the outcome of the above tasks, particularly those relative to safety significance of events in non-safety related systems with potential for affecting only on-site personnel, action will be taken to ensure that any necessary inspections of secondary non-safety related systems will be made.

The results of a preliminary survey made by the utilities indicates that of 29 plants which have inspected main feedwater piping to date, all have measured pipe wall thickness well within allowable limits. Only the two Surry units have detected severe wall thinning of this piping. INPO promptly issued a Significant Event Report following the event and is evaluating need for further action. EPRI has in preparation a technical white paper to provide information on the subject.

QUESTION 6.

Please provide a status report regarding the Commission's review of plant life extension. Include in the status report all NRC programs and industry programs dedicated to this effort, how much money is being spent, and what technical questions are being addressed.

ANSWER

The Commission has initiated the development of a policy on extending nuclear power plant licenses beyond 40 years. A request for public comment regarding this policy was published in the Federal Register on November 6, 1986 with a 60 day comment period. Due to numerous requests for extension, the comment period was extended until February 2, 1987. The staff hopes to brief the Commission by May 30, 1987 on the public comments received.

The staff plans to provide the Commission with an Information Paper by Sept. 1987 reporting on the possible options for relicensing and staff plans for completion of the development of a proposed policy on license renewal. A Commission Paper on Proposed License Renewal Policy is planned for Sept. 1988, with any required necessary implementing regulations to be published for initial comment about Sept. 1989. We believe that the final regulation might become effective during 1992. The NRC funded research programs dealing with the technical basis in support of life extension will cost \$1.15M in FY 87 and about \$2.7M in FY 88. The above figures represent work clearly identified as associated with decisions regarding operation beyond normal operating life, usually about 40 years. However, a great deal of our work, especially associated with aging, will provide an essential base for making life extension decisions. Some of the major policy questions to be addressed concerning life extension are contained in the Federal Register notice of November 6, 1986. The technical questions to be addressed are associated with the ability to identify, understand and predict potential degradation mechanisms such as fatigue, radiation damage, wear, creep, erosion, and water hammer their effect on service life of specific components and systems, and the effect of degradation on overall plant safety.

Industry has been increasingly active over the last few years in the area of license renewal beyond 40 years. A joint industry, EPRI, and DOE program was initiated in 1984 to identify issues associated with life extension. In 1985, detailed technical studies funded jointly by DOE and EPRI were started on two pilot

plants (Surry 1 and Monticello) and a study on the regulatory aspects of life extension was commissioned by AIF's National Environmental Studies Project. Preliminary results were presented at a joint industry/EPRI/DOE life extension seminar in August 1986. Industry has established a framework to continue its efforts and integrate life extension activities. A steering committee called NUPLEX (Nuclear Plant Life Extension) has been established to coordinate the efforts of several working groups focusing on technical activities, codes and standards, licensing matters, and policy considerations.

Organizations which generate National Consensus Codes and Standards, particularly those associated with our national professional technical societies, such as ASME, IEEE, and ASCE, are also becoming very active in this area. ASME is planning to establish a special coordinating committee to direct the overall thrust of plant life extension activities associated with all national standards writing bodies.



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OFFICE OF THE  
SECRETARY

4/2/87

NOTE FOR: Document Control Desk

FROM: Correspondence & Records Branch

The enclosed document(s) are to be entered  
into the DCS. An advanced has been sent to  
the Public Document Room.

UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
OFFICE OF INSPECTION AND ENFORCEMENT  
WASHINGTON, D. C. 20555

July 9, 1982

TE INFORMATION NOTICE NO. 82-22: FAILURES IN TURBINE EXHAUST LINES

Addressees:

All nuclear power reactor facilities holding an operating license or construction permit.

Purpose:

This information notice is provided as an early notification of events that may have safety significance. It is expected that recipients will review the information for applicability to their facilities. No specific action or response is required at this time.

Description of Circumstances:

On June 28, 1982, Duke Power Company's Oconee Unit 2, while operating at 95% power, experienced a 4-ft<sup>2</sup> rupture of a 24-in.-diameter, long-radius elbow in the feedwater heat extraction line which is supplied steam from the high-pressure turbine exhaust. The rupture has been attributed to piping degradation that results from steam erosion. The operator, upon hearing steam noise and observing the absence of main steam (turbine header) line pressure, believed a steambline break had occurred and manually tripped the reactor. The main turbine automatically tripped as a result of the reactor trip. Systems and related parameters responded as expected following the reactor trip and subsequent recovery.

The steam jet destroyed a non-safety-related electrical load center in the lower elevation of the turbine building and certain non-safety-related instrumentation in the vicinity, but did not render any essential equipment inoperable. Two persons suffered steam burns, serious enough to be hospitalized overnight.

Initial indication of extraction steambline degradation at the Oconee facility was discovered in 1976 when a pinhole leak occurred on a similar line in Unit 3. Subsequent to this discovery, a maintenance surveillance program utilizing ultrasonic examination of extraction steam lines was begun. In 1980, two elbows on Unit 3 identical to the failed elbow on Unit 2 were replaced because of steam erosion.

In March 1982, prior to the failure, ultrasonic inspection revealed substantial erosion of the Unit 2 elbow in the extraction line; however, the erosion was less than the licensee's criterion for rejection. The licensee theorizes that

IN 82-22  
July 9, 1982  
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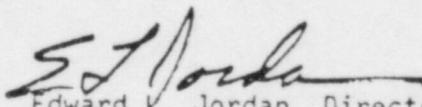
sustained reduced power operation and resultant lower quality steam contributed to accelerated erosion and failure of the elbow. Additionally, the previous inspection program may not have identified the section where the line was thinnest.

The failed elbow and the identical elbow on the other "C" feedwater heater supply line have been replaced.

The two corresponding 24-in. elbows on Oconee Unit 1 were ultrasonically inspected on July 1, 1982. The inspection revealed that a 4-in.<sup>2</sup> area in one of the elbows had been reduced in thickness from 0.375 in. to 0.100 in. Power operation was subsequently adjusted to 80% and the "C" feedwater heaters isolated so that the affected steam line was maintained at 125 psig with no steam flow. The factor of safety based on material yield at the above pressure is slightly greater than two. Elbow replacement will be performed on Unit 1 after returning Unit 2 to power.

In addition, the Institute of Nuclear Power Operations (INPO) has identified four other similar failures of steamlines also apparently resulting from steam erosion. These failures resulted in plant shutdown. They are Vermont Yankee on 1/27/82; Trojan 1 on 1/9/82; Zion 1 on 2/12/82; and Browns Ferry 1 on 6/24/82. For example, in Vermont Yankee, a leak occurred in the 12-in.-diameter drain line between the "C" moisture separator and the heater drain tank, blowing steam into the heater bay area. On Zion 1 a steam leak occurred in the 150 psig high-pressure exhaust steam line from the Unit 1 turbine. The leak originated from an 8-in. crack on a weld joining 24-in.-diameter piping with the 37.5-in.-diameter high pressure steam exhaust pipe leading to the moisture separator reheat. INPO will issue a Significant Event Report on Nuclear Notepad shortly and is preparing a Significant Operating Experience Report which is expected to contain recommendations on this subject.

If you have any questions regarding this matter please contact the Regional Administrator of the appropriate NRC Regional Office, or this office.



Edward L. Jordan, Director  
Division of Engineering and  
Quality Assurance  
Office of Inspection and Enforcement

Technical Contact: O. Merrill  
301-492-4513

Attachment:  
List of Recently Issued IE Information Notices