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## U.S. Nuclear Regulatory Commission

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May 2, 1989

TO: ALL HOLDERS OF OPERATING LICENSES OR CONSTRUCTION PERMITS FOR  
NUCLEAR POWER PLANTS

SUBJECT: EROSION/CORROSION-INDUCED PIPE WALL THINNING  
(GENERIC LETTER 89 - 08)

Pursuant to 10 CFR 50.54(f), the U.S. Nuclear Regulatory Commission (NRC) is requiring information to assess safe operation of reactors when erosion/corrosion significantly degrades piping and components of high-energy carbon steel piping systems. The principal concern is whether the affected plants continue to meet their licensing basis when erosion/corrosion degrades the pressure boundary to below the applicable code design value.

Main feedwater systems, as well as other power conversion systems, are important to safe operation. Failures in these systems of active components such as valves or pumps or of passive components such as piping can result in undesirable challenges to plant safety systems required for safe shutdown and accident mitigation. Failure of high-energy piping, such as feedwater system piping, can result in complex challenges to operating staff and the plant because of potential system interactions of high-energy steam and water with other systems, such as electrical distribution, fire protection, and security. All licensees have committed to adhere to criteria, codes and standards for high-energy piping systems described in licensing documents. Such commitments are a part of the licensing basis for the facility. An important part of this commitment is that piping will be maintained within allowable thickness values.

Our concerns regarding this issue were prompted by incidents at Surry Unit 2 and the Trojan plant. The Surry incident occurred on December 6, 1986, and it was caused by catastrophic failure of feedwater piping. The Trojan incident was discovered in June 1987, which was the first time that pipe wall thinning led to piping replacement in the safety-related portion of the feedwater lines. In addition to these two cases, incidents of pipe wall thinning or rupture because of erosion or erosion/corrosion have been reported at many other nuclear power plants. In many of these cases, the licensees had inspected the two-phase lines for some years, but it was not until the Surry incident that they started to examine some single-phase lines. Many licensees discovered pipe wall thinning in the single-phase lines. Some of the reported incidents are listed below:

1. A pipe rupture at Haddam Neck occurred in March 1985. The pipe ruptured downstream of a normal level control valve for a feedwater heater. The actual rupture was approximately 1/2 inch by 2 1/4 inches, and the failure was caused by flow impingement. The eroded section of pipe was replaced. In addition, corresponding pipes of similar systems were examined.
2. A catastrophic pipe rupture at Surry Unit 2 occurred in December 1986. The break was located in an elbow in the 18-inch line about 1 foot from the 24-inch header. A 2- by 4-foot section of the wall of the suction

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line to the A main feedwater pump was blown out. Investigation of the accident and examination of data by the licensee, NRC, and others led to the conclusion that failure of the piping was caused by erosion/corrosion of the carbon steel pipe wall.

3. During the June 1987 outage at the Trojan Nuclear Plant, it was discovered that at least two areas of the straight sections of the main feedwater piping system had experienced wall thinning to an extent that the pipe wall thickness would have reached the minimum thickness required by the design code (ANSI B31.7, "Nuclear Power Piping") during the next refueling cycle. These areas are in safety-related portions of the ASME Class 2 piping inside the containment. In addition, numerous piping components of the nonsafety-related portions of the feedwater lines were also found to have suffered extensive wall thinning.
4. During the September 1988 outage, the licensee for Surry Unit 2 discovered that pipe wall thinning had occurred more rapidly than expected. On the suction side of one of the main feedwater pumps, an elbow installed during the 1987 refueling outage lost 20 percent of its 0.500-inch wall in 1.2 years. In addition, wall thinning is continuing in safety-related main feedwater piping and in other nonsafety-related condensate piping. The exact cause of the accelerated wall thinning is still under investigation by both the licensee and the NRC.

In light of the above experiences, the NRC issued six information notices (86-106 and Supplements 1, 2, and 3; 87-36, and 88-17) and Bulletin 87-01 addressing this problem. The staff review of licensees' responses to the bulletin indicates that the pipe wall thinning problem is widespread for single-phase and two-phase high-energy carbon steel systems. The systems and components reported as having experienced pipe wall thinning are listed in Section 6 of the attachment to this letter. The staff review also showed that wall thinning in single phase feedwater-condensate systems is more prevalent among pressurized-water reactors (PWRs) but also occurs in boiling-water reactors (BWRs).

The staff audited 10 operating plants (7 PWRs and 3 BWRs) in late 1988 to assess implementation of erosion/corrosion monitoring programs by licensees and to ensure that adequate guidance was provided for corrective actions and other activities regarding repair and replacement of degraded piping and components. Detailed audit findings are described in Section 7 of NUREG-1344, which is enclosed with this letter. In general, all licensees have developed and put in place an erosion/corrosion monitoring program that meets the intent of NUMARC guidelines (Appendix A of NUREG-1344). In addition, all licensees have completed their initial examination as recommended by NUMARC. However, the staff found that none of these licensees has implemented formalized procedures or administrative controls to ensure continued long-term implementation of its erosion/corrosion monitoring program for piping and components within the licensing basis. Therefore, you should provide assurances that a program, consisting of systematic measures to ensure that erosion/corrosion does not lead to degradation of single phase and two phase high-energy carbon steel systems has been implemented. The detailed information should not be submitted for NRC review.

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Additional insight into the phenomena related to erosion/corrosion of carbon steel components is provided in the enclosure to this letter (NUREG-1344).

You are required to submit your response, signed under oath or affirmation, as specified in 10 CFR 50.54(f), within 60 days of receipt of this letter. Your response will be used to determine whether your license should be modified, suspended, or revoked. Your response should include information on whether or not you have implemented or intend to implement a long term erosion/corrosion monitoring program that provides assurances that procedures or administrative controls are in place to assure that the NUMARC program or another equally effective program is implemented and the structural integrity of all high-energy (two phase as well as single phase) carbon steel systems is maintained. If this program is not yet implemented you should include the scheduled implementation date.

This request is covered by the Office of Management and Budget Clearance Number 3150-0011, which expires December 31, 1989. The estimated average burden is 200 man-hours per addressee response, including assessing the actions to be taken, preparing the necessary plans, and preparing the response. This estimated average burden pertains only to these identified response-related matters and does not include the time for actual implementation of the recommended actions.

Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to the Records and Reports Management Branch, Division of Information Support Services, Office of Information Resources Management, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555; and to the Paperwork Reduction Project (3150-0011), Office of Management and Budget, Washington, D.C. 20503.

Sincerely,

James G. Partlow  
Associate Director for Projects  
Office of Nuclear Reactor Regulation

Enclosures:

1. NUREG-1344
2. Listing of Recently Issued  
Generic Letters