UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION II
101 MARIETTA ST., N.W., SUITE 3100
ATLANTA, GEORGIA 30303

Gentlemen:

The enclosed Information Notice provides early notification of events that may have safety significance. It is expected that recipients will review the Information Notice for possible applicability to their facilities.

Sincerely,

James P. O'Reilly
Regional Administrator

Enclosure:
IE Information Notice No. 82-09

IE31

Distribution for IE Information Notice No. 82-09 (INFORMATION)
March 31, 1982

Addresses	In Reference To
1. Alabama Power Company Attn: R. P. McDonald Vice President-Nuclear Generation Post Office Box 2641 Birmingham, AL 35291	50-348 Farley Unit 1 50-364 Farley Unit 2
2. Carolina Power and Light Company Attn: J. A. Jones Senior Executive Vice President and Chief Operating Officer 411 Fayetteville Street Raleigh, NC 27602	50-325 Brunswick Unit 1 50-324 Brunswick Unit 2 50-400 Harris Unit 1 50-401 Harris Unit 2 50-261 Robinson Unit 2
3. Duke Power Company Atin: L. C. Dail, Vice President Design Engineering P. O. Box 33189 Charlotte, NC 28242	50-491 Cherokee Unit 1 50-492 Cherokee Unit 2 50-493 Cherokee Unit 3
4. Duke Power Company Attn: W. O. Parker, Jr. Vice President, Steam Production P. O. Box 2178 Charlotte, NC 28242	50-369 McGuire Unit 1 50-370 McGuire Unit 2 50-269 Oconee Unit 1 50-270 Oconee Unit 2 50-287 Oconee Unit 3 50-413 Catawba Unit 1 50-414 Catawba Unit 2
5. Florida Power and Light Company Attn: R. E. Uhrig, Vice President Advanced Systems and Technology P. O. Box 529100 Miami, FL 33152	50-335 St. Lucie Unit 1 50-389 St. Lucie Unit 2 50-250 Turkey Point Unit 3 50-251 Turkey Point Unit 4
6. Florida Power Corporation Attn: J. A. Hancock, Vice President Nuclear Operations P. O. Box 14042, Mail Stop C-4 St. Petersburg, FL 33733	50-302 Crystal River Unit 3

Addresses	In Reference To
7. Georgia Power Company Attn: R. J. Kelly Executive Vice President P. O. Box 4545 Atlanta, GA 30302	50-321 Hatch Unit 1 50-366 Hatch Unit 2 50-424 Vogtle Unit 1 50-425 Vogtle Unit 2
8. Mississippi Power and Light Company Attn: N. L. Stampley Vice President of Production P. O. Box 1640 Jackson, MS 39205	50-416 Grand Gulf Unit 1 50-417 Grand Gulf Unit 2
9. Offshore Power Systems Attn: A. R. Collier, President P. O. Box 8000 Jacksonville, FL 32211	50-437 FNP 1-8
10. South Carolina Electric and Gas Company Attn: T. C. Nichols, Jr., Vice President Power Production and System Operations P. O. Box 764 Columbia, SC 29218	50-395 Summer Unit 1
11. Tennessee Valley Authority Attn: H. G. Parris Manager of Power 500A Chestnut Street Tower II Chattanooga, TN 37401	50-438 Bellefonte Unit 1 50-439 Bellefonte Unit 2 50-259 Browns Ferry Unit 1 50-260 Browns Ferry Unit 2 50-296 Browns Ferry Unit 3 50-518 Hartsville Unit 1 50-519 Hartsville Unit 2 50-520 Hartsville Unit 3 50-521 Hartsville Unit 4 50-553 Phipps Bend Unit 1 50-554 Phipps Bend Unit 2 50-327 Sequoyah Unit 1 50-328 Sequoyah Unit 2 50-390 Watts Bar Unit 1 50-391 Watts Bar Unit 2 50-566 Yellow Creek Unit 1 50-567 Yellow Creek Unit 2
12. Virginia Electric and Power Company Attn: R. H. Leasburg Vice President Nuclear Operations P. O. Box 26666 Richmond, VA 23261	50-338 North Anna Unit 1 50-339 North Anna Unit 2 50-404 North Anna Unit 3 50-280 Surry Unit 1 50-281 Surry Unit 2

Addresses | In Reference To

13. Institute of Nuclear Power Operation
Attn: R. W. Pack
Lakeside Complex
1820 Waterplace
Atlanta, GA 30339

14. Southern Company Services, Inc.
ATTN: O. Batum, Manager
Nuclear Safety & Licensing
Department
P. O. Box 2625
Birmingham, AL 35202

15. Department of Energy
Clinch River Breeder Reactor
Plant Project Office
ATTN: Chief, Quality Improvement
P. O. Box U
Oak Ridge, TN 37830

16. EDS, Nuclear, Inc.
ATTN: E. H. Verdery
330 Technology Park/Atlanta
Norcross, GA 30092

SSINS No.: 6835
Accession No.:
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IN 82-09

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

March 31, 1982

IE INFORMATION NOTICE NO. 82-09: CRACKING IN PIPING OF MAKEUP COOLANT LINES AT B&W PLANTS

Description of Circumstances:

On January 21, 1982, Crystal River Unit 3 commenced shutdown to investigate an unidentified 0.9-gpm primary leak. During power reduction the leak rate increased to about 1.0 gpm and the plant proceeded to hot standby conditions.

A visual inspection inside the reactor building at this time revealed the leak was associated with a 2½-inch check valve (MOV-43) in the makeup line to the 26-inch reactor coolant (RC) loop A inlet line. This line is used for normal makeup of reactor coolant but is also part of the redundant high-pressure injection system. After the insulation was removed from the affected valve a 140° circumferential crack in the check valve body near the valve-to-safe end weld (i.e., valve end toward RC inlet nozzle) was found. The leak was nonisolatable and the plant promptly proceeded to cold shutdown conditions in accordance with plant technical specifications.

The check valve was removed and liquid penetrant testing (LPT) was performed on the accessible inside diameter (ID) surfaces including 5 inches into the 2½-inch line on the inlet side of the affected valve. This inspection disclosed an extensive network of heat-check type cracks around the safe end ID surface. A similar condition was observed inside the valve body from the discharge side up to the disc seat area. The valve inlet side and connecting piping were not affected. The most severe cracking in the safe end appeared to have penetrated up to 25 percent of the wall thickness. A visual inspection also revealed the thermal sleeve inside the high-pressure injection (HPI) nozzle was loose and showed evidence of wear in areas of contact. Some cracking of the thermal sleeve was also observed.

As a result of the Crystal River 3 findings, Duke Power Company initiated a radiographic examination of the RC inlet nozzle connections on the two HPI lines used for normal makeup at Oconee Unit 3 to determine the thermal sleeve conditions. This examination disclosed that in one of the makeup nozzles the thermal sleeve was loose, the four thermal sleeve retaining button welds on the safe end side were missing, and the thermal sleeve was slightly displaced in the upstream direction of flow. Action was then taken to remove the pipe extension to replace the affected thermal sleeve. Further findings and expanded inspection as a result of this action are summarized below.

Investigation and Findings:

A. Crystal River

A metallurgical investigation of the affected valve body indicated two crack initiation sites. One was inside on the valve body at a machine mark (i.e., weld counterbore area) and one was on the outside diameter (OD) at the valve-to-weld transition (geometrical discontinuity). The cracks progressed through the wall on a slightly different plane and merged about mid-wall of the valve body. Scanning electron microscope examination of the fracture features disclosed the cracks propagated transgranularly and exhibited clearly defined grain structure striations characteristic of cyclic fatigue failure. Cracks in the thermal sleeve and safe end sections exhibited similar fracture morphology. No evidence of corrosion interaction from chemical attack was identified.

During the design phase, Babcock and Wilcox (B&W) performed the stress analysis on the primary system up to the affected check valve which is the design code (USAS B31.7-USAS B31.1) interface boundary. Gilbert Associates, as architect-engineer, performed the balance of plant design. The B&W design calculations for the HPI lines included a pipe section that was not installed during plant construction. The potential thermal discontinuity at this point is believed to be partly responsible for the cracking and is currently being evaluated by both organizations.

Based on the above findings, the mode of cracking was tentatively attributed to thermal cycle fatigue. However, the synergistic thermal-hydraulic effects contributing to the failure mechanism are yet to be determined. Contributing factors being investigated include operational design limits and setpoints with regard to makeup water temperature and flow rate, minimum bypass flow, and system thermal-hydraulic parameters around the HPI nozzle used for makeup.

B. Oconee

When the pipe extension at Oconee 3 was removed to gain access to the thermal sleeve in order to repair it, liquid penetrant testing (LPT) disclosed cracks on the ID surfaces of the makeup/HPI pipe extension and nozzle safe end. Crack features were similar in nature to those found at Crystal River. Reportedly, the cracks penetrated up to 20 percent of the thickness of the pipe wall. The other makeup nozzle assembly was examined by radiography and a special ultrasonic testing (UT) technique developed by B&W for this purpose. No indication of cracking or degraded thermal sleeve conditions was observed. Further UT and radiographic testing (RT) of the two remaining HPI nozzle assemblies indicated a loose thermal sleeve in one of the nozzles (Nozzle 3B1).

At Oconee 2, results of the UT and RT indicate the thermal sleeve in one of the makeup nozzles may be loose and the retaining button welds on the safe end side are missing. Cracking was also found in the safe end and pipe extension. The other makeup nozzle showed no indications of a degraded thermal sleeve or cracking. Examination of the two remaining HPI nozzle assemblies indicated a loose thermal sleeve (i.e., retaining weld buttons missing) in one and a crack in the rolled area of the other nozzle thermal sleeve.

At Oconee 1, examination of the four HPI nozzle penetrations to the RC loop inlet line showed no evidence of degradation.

Discussion:

In B&W design plants the line(s) for normal makeup of reactor coolant are also part of the redundant high pressure injection system. These plants do not have a regenerative heat exchanger in the makeup coolant circuit. Therefore, during operations, the potential exists for the makeup coolant temperature to be much lower than the reactor coolant temperature in the loop. Fluid temperature fluctuations resulting from mixing in the HPI nozzle coupled with hydraulic effects are thought to be primary contributors to the cracking problem at Crystal River and at the Oconee plants. Although the cracking location is within the scope of the LOCA (loss-of-coolant accident) safety analysis, the existence of cracking in an area not routinely included in the program of ISI represents an unacceptable challenge to system integrity.

An evaluation of the cracking problem and its resolution has been requested of the B&W Regulatory Response Group.

Pressurized-water reactor systems of the Combustion Engineering and Westinghouse designs do have a regenerative heat exchanger in the makeup coolant line which is a separate, dedicated system. During normal power operation the makeup coolant enters the nozzle at temperatures on the order of 50°-150°F below the temperature of the reactor coolant loop respectively. However, transients may occur in which the makeup flow rate is greater than the letdown flow rate. Depending on the frequency and duration of these transients, the makeup coolant might not be heated to the expected temperature. Therefore, the potential may exist for large temperature fluctuations in the makeup nozzle to cause problems similar to those discussed above. Past experience has shown similar thermal fatigue problems with nozzle-thermal sleeve assemblies in other systems of both BWR (NEDO-21821, 1978) and PWR (WCAP-7477 and NEDO-9693-1980) designs.

This IE Information Notice is provided as an early notification of a potentially significant matter that is still under review by the NRC staff. If NRC evaluation so indicates, further licensee action may be requested. In the interim, we expect that licensees will review this information for applicability to their facilities.

No written response to this Information Notice is requested. If you need additional information, please contact the Regional Administrator of the appropriate NRC Regional Office.

Attachment:
Recently Issued IE Information Notices

Attachment
IN 82-09
March 31, 1982

RECENTLY ISSUED
IE INFORMATION NOTICES

Information Notice No.	Subject	Date of Issue	Issued to
82-09	Cracking in Piping of Makeup Coolant Lines at B&W Plants	03/31/82	All power reactor facilities holding an OL or CP
82-08	Check Valve Failures on Diesel Generator Engine Cooling System	03/26/82	All power reactor facilities holding an OL or CP
82-07	Inadequate Security Screening Programs	03/16/82	All power reactor facilities holding an OL or CP
82-06	Failure of Steam Generator Primary Side Manway Closure Studs	03/12/82	All power reactor facilities holding an OL or CP
82-05	Increasing Frequency of Drug-Related Incidents	03/10/82	All power reactor facilities holding an OL or CP
82-04	Potential Deficiency of Certain AGASTAT E-7000 Series Time-Delay Relays	03/10/82	All power reactor facilities holding an OL or CP
82-03	Environmental Tests of Electrical Terminal Blocks	03/04/82	All power reactor facilities holding an OL or CP
82-01 Rev. 1	Auxiliary Feedwater Pump Lockout Resulting from Westinghouse W-2 Switch Circuitry Modification	02/26/82	All power reactor facilities holding an OL or CP
80-32 Rev. 1	Clarification of Certain Requirements for Exlusive-Use Shipments of Radio-active Materials	02/26/82	All facility, materials and Part 50 licensees
82-02	Westinghouse NBFD Relay Failures in Reactor Protection Systems at Certain Nuclear Power Plants	01/27/82	All power reactor facilities holding an OL or CP

OL = Operating License
CP = Construction Permit