UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION
WASHINGTON, D.C. 20555

January 27, 1988

NRC INFORMATION NOTICE NO. 88-01: SAFETY INJECTION PIPE FAILURE

Addressees:

All holders of operating licenses or construction permits for nuclear power reactors.

Purpose:

This information notice is to alert addressees to a potentially generic problem concerning the reliability of piping in safety-related systems due to valve leakage which results in thermal cycling of the piping. Recipients are expected to review the information for applicability to their facilities and consider actions, if appropriate, to preclude similar problems from occurring at their facilities. However, suggestions contained in this information notice do not constitute NRC requirements; therefore, no specific action or written response is required.

Description of Circumstances:

On December 9, 1987, while restarting Farley Unit 2 after a refueling outage, the licensee noted increased moisture and radioactivity within containment. The unidentified leak rate for the RCS was determined to be 0.7 gpm. After entering containment to identify the location of the leak, licensee personnel determined that the leak could not be isolated. The reactor, which was at 33 percent power, was shut down to facilitate repair.

By ultrasonic testing, the licensee found an indication of a crack on the interior surface of the 6-inch ECCS piping connected to the cold leg of RCS Loop B. The indication was located at a weld connecting an elbow and a horizontal spool, as shown in Attachment 1. Further, the indication was on the underside of the pipe and extended circumferentially 60 degrees in both directions from the bottom of the pipe. The crack extended through the wall for approximately 1 inch at the center of the indication. Visual and metallographic examinations showed that the weld had failed as a result of fatigue after roughly one million stress cycles. The licensee examined the operating records and determined that the number of stress cycles imposed by starting up and shutting down and by safety injections was significantly less than the relevant design criteria.

On the basis of this information, the licensee postulated that the stress loads were (1) thermal and created by valve leakage or convective flow cells or (2) mechanical and created by flow-induced vibrations. To test these postulations, the licensee replaced the failed piping and installed sensors for temperature and acceleration near the location of the failed weld and at a location 25 to 30 inches upstream from the failed weld, that is, on the other side of the check valve. The licensee also installed sensors at similar locations on the ECCS pipe connected to Loop C. At each location the sensors were distributed circumferentially around the pipe.

Data from the sensors demonstrated that there was an adverse temperature distribution in the Loop B ECCS piping as shown in Attachment 1. The circumferential temperature difference at the location of the failed weld was 215° F. Further, the temperature at the bottom of the pipe fluctuated as much as 30° F in 30 seconds. This spatial and temporal distribution was caused by failure of the valve in the bypass pipe around the boron injection tank (BIT) to seat properly. The valve, which is shown in Attachment 2, is believed to be the cause of failure of the weld. Leakage through the valve apparently caused the check valves in the Loop B ECCS pipe to partially open, or chatter, admitting relatively cold coolant to the unisolable portion of the pipe between the nozzle and the first check valve. Temporarily redirecting the valve leakage away from the ECCS manifold changed the temperature distribution, as shown in Attachment 1. It should be noted that there may be other safety-related piping in both PWRs and BWRs which could experience similar fatigue due to thermal cycling.

Data from the temperature sensors for Loop C indicated that the check valves in that pipe were not chattering and that the temperature distribution was normal. Further, none of the accelerometers indicated adverse mechanical stress cycling.

Examination of the analysis of record for the small-break, loss-of-coolant accident indicated that double-ended failure of the unisolable ECCS pipe may not have been enveloped.

Discussion:

A generic safety question may exist for those plants having dual purpose pumps that are used for charging the RCS with coolant during normal operation and injecting emergency core coolant at high pressure following an accident. During normal operation, with one of the pumps providing charging flow to the RCS via the normal charging piping and with a leaking valve allowing coolant to flow to the ECCS manifold, pressure in the manifold will exceed RCS pressure and check valves in the ECCS piping will open admitting relatively cold coolant to the RCS. The flow rate via this additional path or paths is determined by the throttling that occurs in the leaking valve. If the check valves in more than one ECCS pipe open, then more than one unisolable ECCS failure may occur. Subjecting the flawed piping to excessive stresses induced by a seismic event, water hammer, or some other cause conceivably could result in simultaneous double-ended failure of more than one ECCS pipe.

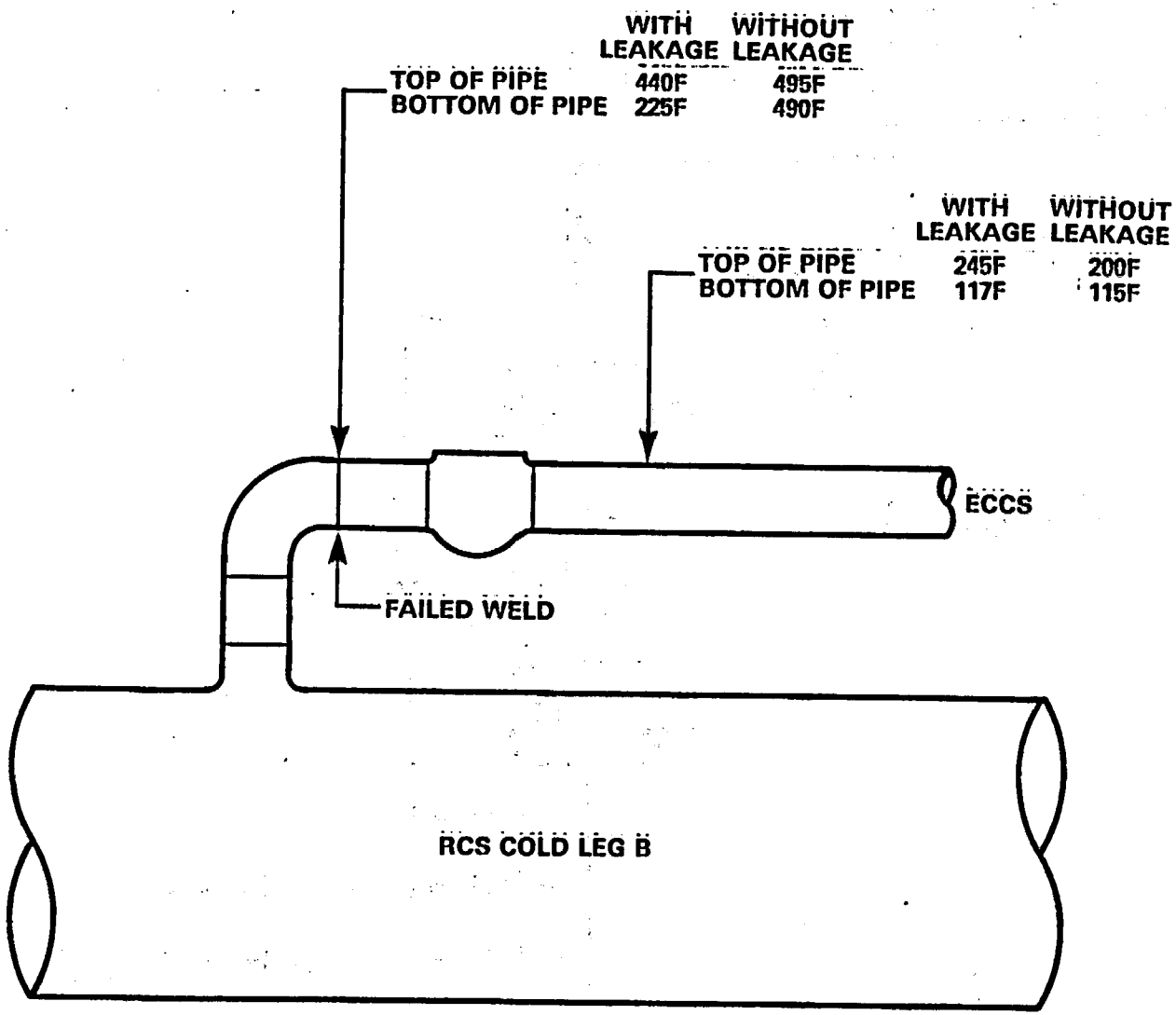
Corrective action for this common-mode failure would include redesigning the piping, instrumenting unisolable and adjacent portions of the piping to detect cyclic or abnormal thermal stresses, instrumenting the ECCS manifold to detect pressure resulting from valve leakage, or providing additional surveillance.

No specific action or written response is required by this information notice. If you have any questions about this matter, please contact the technical contact listed below or the Regional Administrator of the appropriate regional office.

Charles E. Rossi, Director
Division of Operational Events Assessment
Office of Nuclear Reactor Regulation

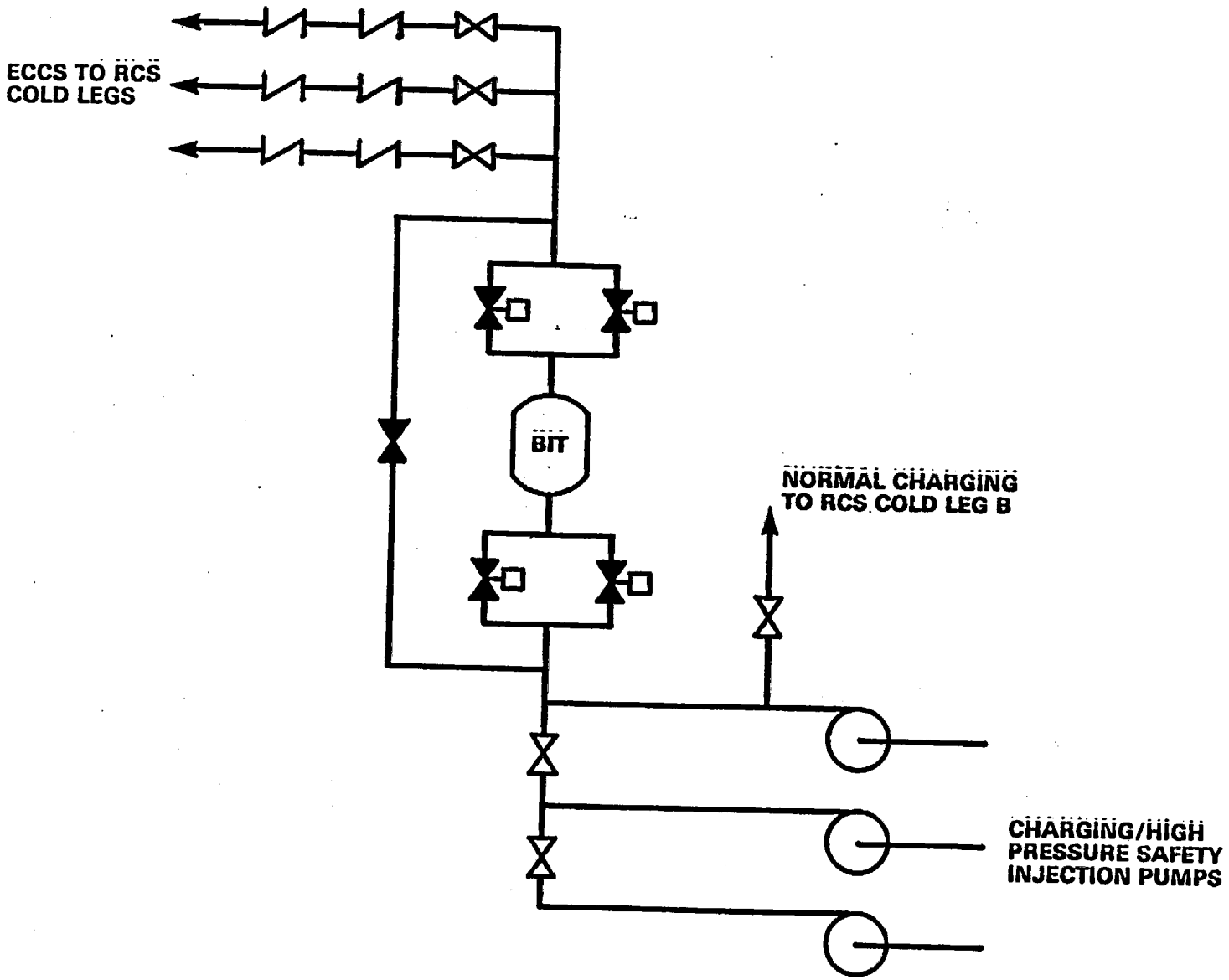
Technical Contact: Roger Woodruff, NRR
(301) 492-7096

Attachments:
1. Farley 2 Temperature Data
2. Farley 2 ECCS
3. List of Recently Issued NRC Information Notices



FARLEY 2 TEMPERATURE DATA

ATTACHMENT 1



FARLEY 2 ECCS

ATTACHMENT 2

LIST OF RECENTLY ISSUED NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
86-81, Supp. 1	Broken External Closure Springs on Atwood & Morrill Main Steam Isolation Valves	1/11/88	All holders of OLs or CPs for nuclear power reactors.
87-67	Lessons Learned from Regional Inspections of Licensee Actions in Response to IE Bulletin 80-11	12/31/87	All holders of OLs or CPs for nuclear power reactors.
87-66	Inappropriate Application of Commercial-Grade Components	12/31/87	All holders of OLs or CPs for nuclear power reactors.
87-28, Supp. 1	Air Systems Problems at U.S. Light Water Reactors	12/28/87	All holders of OLs or CPs for nuclear power reactors.
87-65	Plant Operation Beyond Analyzed Conditions	12/23/87	All holders of OLs or CPs for nuclear power reactors.
87-64	Conviction for Falsification of Security Training Records	12/22/87	All nuclear power reactor facilities holding an OL or CP and all major fuel facility licensees.
87-35, Supp. 1	Reactor Trip Breaker Westinghouse Model DS-416, Failed to Open on Manual Initiation From the Control Room	12/16/87	All holders of OLs or CPs for nuclear power reactors.
87-63	Inadequate Net Positive Suction Head in Low Pressure Safety Systems	12/9/87	All holders of OLs or CPs for nuclear power reactors.
87-62	Mechanical Failure of Indicating-Type Fuses	12/8/87	All holders of OLs or CPs for nuclear power reactors.

OL = Operating License
CP = Construction Permit

Corrective action for this common-mode failure would include redesigning the piping, instrumenting unisolable and adjacent portions of the piping to detect cyclic or abnormal thermal stresses, instrumenting the ECCS manifold to detect pressure resulting from valve leakage, or providing additional surveillance.

No specific action or written response is required by this information notice. If you have any questions about this matter, please contact the technical contact listed below or the Regional Administrator of the appropriate regional office.

Charles E. Rossi, Director
Division of Operational Events Assessment
Office of Nuclear Reactor Regulation

Technical Contact: Roger Woodruff, NRR
(301) 492-7096

Attachments:
1. Farley 2 Temperature Data
2. Farley 2 ECCS
3. List of Recently Issued NRC Information Notices

* See previous Concurrence

OFC	:*EAB:NRR	:*EAB:NRR	:*C:EAB:NRR	:*D:DEST	:*C:GCB	:D:DOEA	:
NAME	:RWoodruff*	RLobel*	:WLanning*	:LShao*	:CBerlinger	:CERossi	: :
DATE	:1/11/88	:1/11/88	:1/12/88	:1/13/88	:1/15/88	:1/27/88	:

OFFICIAL RECORD COPY

Corrective action for this common-mode failure would include redesigning the piping, instrumenting unisolable and adjacent portions of the piping to detect cyclic or abnormal thermal stresses, instrumenting the ECCS manifold to detect pressure resulting from valve leakage, or providing additional surveillance.

No specific action or written response is required by this information notice. If you have any questions about this matter, please contact the Regional Administrator of the appropriate regional office or this office.

Charles E. Rossi, Director
Division of Operational Events Assessment
Office of Nuclear Reactor Regulation

Technical Contact: Roger Woodruff, NRR
(301) 492-7096

Attachments:
1. Farley 2 Temperature Data
2. Farley 2 ECCS
3. List of Recently Issued Information Notices

DISTRIBUTION
EAB R/F
WLANNING
RWOODRUFF R/F
RLOBEL
CROSSI
CBERLINGER
LSHAO

TECH:ED:
AThomas
/ /88

* See previous Concurrence

OFC	:EAB:NRR	:EAB:NRR	:C:EAB:NRR	:D:DEST	:C:GCB	:D:DOEA	:
NAME	:RWoodruff*	RLobel*	:WLanning*	:LShao*	:CBerlinger	:CERossi	: :
DATE	: / /88	: / /88	: / /88	: / /88	: 11/15/88	: / /88	:

OFFICIAL RECORD COPY

Assurance that this common mode failure does not occur could be provided by redesign of the piping, instrumenting unisolable and adjacent portions of the piping to detect cyclic or abnormal thermal stresses, instrumenting the ECCS manifold to detect pressure resulting from valve leakage, or providing additional surveillance.

No specific action or written response is required by this information notice. If you have any questions about this matter, please contact the Regional Administrator of the appropriate regional office or this office.

Charles E. Rossi, Director
Division of Operational Events Assessment
Office of Nuclear Reactor Regulation

Technical Contact: Roger Woodruff, NRR
(301) 492-7096

Attachments:
1. Farley 2 Temperature Data.
2. Farley 2 ECCS.
3. List of Recently Issued Information Notices.

DISTRIBUTION
EAB R/F
WLANNING
RWOODRUFF R/F
RLOBEL
CROSSI
CBERLINGER
LSHAO

TECH:ED:
AThomas
1/14/88

OFC	:EAB:NRR	:EAB:NRR	:OEAB:NRR	:D:DEST	:C:GCB	:D:DOEA	:
NAME	:RWoodruff:db	RLobel	:WLanning	:LShao	:CBerlinger	:CERossi	: :
DATE	: 1/11/88	: 1/14/88	: 1/13/88	: 1/13/88	: / /88	: / /88	:

OFFICIAL RECORD COPY

DATE: 2-10-88

TO: RECORD SERVICES BRANCH

FROM: TI

CENTRAL FILES VERSION OF MASS MAILING ENCLOSED. NO FURTHER DISTRIBUTION NECESSARY EXCEPT AS NOTED BELOW.

RETURN DOCUMENT TO