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

October 7, 1988

NRC INFORMATION NOTICE NO. 88-80: UNEXPECTED PIPING MOVEMENT ATTRIBUTED TO THERMAL STRATIFICATION

Addressees:

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

Purpose:

The purpose of this information notice is to alert addressees to unexpected thermal movement of the pressurizer surge line attributed to thermal stratification. It is expected that recipients will review the information for applicability to their facilities and consider actions, as appropriate, to avoid similar problems. However, suggestions contained in this information notice do not constitute NRC requirements; therefore, no specific action or written response is required.

Description of Circumstances:

The licensee for the Trojan plant has observed the results of unexpected movement of the pressurizer surge line at every refueling outage since 1982 when monitoring of the line movements began. The monitoring program was implemented after removal of a thermal sleeve that was found to have cracked attachment welds. During the last refueling outage, the licensee found that, in addition to unexpected gap closures in the pipe whip restraints, one restraint was in actual contact with the piping although the shims and gap sizes had been adjusted on the basis of previous analysis. The recent investigation indicated that the movement of piping was caused by thermal stratification in the line. This phenomenon was not considered in the original piping design.

Discussion:

Unexpected piping movements are highly undesirable because of potential high piping stress that may exceed design limits on fatigue and stresses. The problem can be more acute when the piping expansion is restricted, such as through contact with pipe whip restraints. Plastic deformation could result, which could lead to functional impairment of the line. The Trojan licensee's report indicated that thermal stratification might have occurred in the pressurizer surge line during heatup, cooldown, and steady-state operation of the plant.

8810030255
881007
PDR I&E Notice 88-080

During a typical plant heatup, water in the pressurizer is heated to about 440°F. A steam bubble is then formed in the pressurizer. Although the exact phenomenon is not thoroughly understood, as the hot water flows (at a very low flowrate) from the pressurizer through the surge line to the hot-leg piping, the hot water rides on a layer of cooler water, causing the upper part of the pipe to be heated to a higher temperature than the lower part. The differential temperature could be as high as 300°F, based on limitations on plant operation. Under this condition, analysis has shown that differential thermal expansion of the pipe metal causes the pipe to deflect.

In the specific configuration of the pressurizer surge line in the Trojan plant, the line deflected downward, contacted two pipe whip restraints, and underwent plastic deformation, which resulted in the permanent deformation of the pipe.

On the basis of the evaluation of the Trojan event, the staff concludes that the thermal stratification hypothesis for the pressurizer surge line movement is supportable by the observations. The licensee for Trojan is required by the American Society of Mechanical Engineers Boiler and Pressure Vessel Code to reconcile the pipe stresses and fatigue evaluation if any significant differences are observed between the measured data and the analytical results for the hypothesized conditions. The staff evaluation indicates that the thermal stratification phenomenon could occur in all PWR surge lines. The staff's concerns include unexpected bending, and thermal striping as they affect the overall integrity of the surge line for its design life (e.g., the increase of fatigue).

No specific action or written response is required by this information notice. However, the staff may consider further generic communications on the subject. If you have any questions about this matter, please contact the technical contacts listed below or the Regional Administrator of the appropriate regional office.

Charles E. Rossi

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

Technical Contacts: S. N. Hou, NRR
(301) 492-0904

N. P. Kadambi, NRR
(301) 492-1153

Attachment: List of Recently Issued NRC Information Notices

LIST OF RECENTLY ISSUED
NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
88-79	Misuse of Flashing Lights for High Radiation Area Controls	10/7/88	All holders of OLs or CPs for nuclear power reactors.
88-69, Supp 1	Movable Contact Finger Binding in HFA Relays Manufactured by General Electric (GE)	9/29/88	All holders of OLs or CPs for nuclear power reactors.
88-78	Implementation of Revised NRC-Administered Requalification Examinations	9/22/88	All holders of OLs or CPs for nuclear power reactors.
88-77	Inadvertent Reactor Vessel Overfill	9/22/88	All holders of OLs or CPs for BWRs.
88-76	Recent Discovery of a Phenomenon not Previously Considered in the Design of Secondary Containment Pressure Control	9/19/88	All holders of OLs or CPs for nuclear power reactors.
88-75	Disabling of Diesel Generator Output Circuit Breakers by Anti-Pump Circuitry	9/16/88	All holders of OLs or CPs for nuclear power reactors.
88-74	Potentially Inadequate Performance of ECCS in PWRs During Recirculation Operation Following a LOCA	9/14/88	All holders of OLs or CPs for W and B&W-designed nuclear power reactors.
88-73	Direction-Dependent Leak Characteristics of Containment Purge Valves	9/8/88	All holders of OLs or CPs for nuclear power reactors.
88-72	Inadequacies in the Design of dc Motor-Operated Valves	9/2/88	All holders of OLs or CPs for nuclear power reactors.

OL = Operating License
CP = Construction Permit

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

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE, $300

FIRST CLASS MAIL
POSTAGE & FEES PAID
USNRC

PERMIT No. G-67