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NRC BULLETIN 88-08, SUPPLEMENT 3:
THERMAL STRESSES IN PIPING CONNECTED TO REACTOR COOLANT SYSTEMS

This letter responds to Supplement 3 to Bulletin 88-08 requesting licensees to note, within the original scope of review and reporting requirements of Bulletin 88-08, that periodic valve seat leakage through packing glands could result in unacceptable thermal stresses in unisolable piping connected to Reactor Coolant Systems.

Boston Edison Company has reviewed the thermal stratification events described in the Supplement 3. As a result we have re-reviewed systems connected to Reactor Coolant Systems to determine whether unisolable sections of piping can be subjected to stresses from temperature stratification or oscillation that could be induced by periodic valve seat leakage through packing glands. Our review concluded Pilgrim Nuclear Power Station has configurations similar to configurations discussed in Supplement 3. As such, we have enclosed our revised response to the Bulletin 88-08 describing the results of our review and planned actions.

RG Bird
R. G. Bird

Enclosure

WGL/amm/3501

Commonwealth of Massachusetts)
County of Plymouth)

Then personally appeared before me, Ralph G. Bird, who being duly sworn, did state that he is Senior Vice President - Nuclear of Boston Edison Company and that he is duly authorized to execute and file the submittal contained herein in the name and on behalf of Boston Edison Company and that the statements in said submittal are true to the best of his knowledge and belief.

My commission expires: October 5, 1995 Peter M Kahler
DATE NOTARY PUBLIC

cc: On next page

IE16
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ENCLOSURE

NRC BULLETIN 88-08, SUPPLEMENT 3:
THERMAL STRESSES IN PIPING CONNECTED TO REACTOR COOLANT SYSTEMS

INTRODUCTION

Supplement 3 to Bulletin 88-08 requested licensees to note periodic valve seat leakage through packing glands could result in unacceptable thermal stresses in unisolable piping connected to Reactor Coolant Systems (RCS). This can occur when hot reactor coolant flows from the reactor coolant system in a horizontal run of piping to a leaking first isolable valve away from the RCS. This could cause thermal stratification in the piping. The configuration, causing thermal stratification, as described in Supplement 3 is a closed gate valve located below the RCS leaking past the seat and through the packing gland.

The actions required by licensees within the scope of the Bulletin 88-08 are:

1. Review all piping connected to the RCS to determine whether unisolable sections of piping connected to the RCS can be subjected to stresses from temperature stratification or temperature oscillations that could be induced by leaking valves.

2. For any unisolable sections of piping connected to the RCS that may have been subjected to excessive thermal stresses, examine nondestructively the welds, heat affected zones and high stress locations, including geometric discontinuities in that piping to provide assurance there are no existing flaws.

3. Plan and implement a program to provide continuing assurance that unisolable sections of all piping connected to the RCS will not be subjected to combined cyclic and static thermal and other stresses that could cause fatigue failure during the remaining life of the unit.

SCOPE OF REVIEW

This review examined all piping reviewed for the original scope to the Bulletin 88-08. The original review included all piping connected to the Reactor Coolant Systems. The piping configurations were reviewed to determine whether they meet the configuration described in Supplement 3 (i.e., the lines are below a hot RCS source, the line is normally stagnant, and there is a horizontal run of piping that could experience a stratified thermal condition if valve leakage was present).

Valve types considered that could leak and cause thermal stratification included gate, globe, safety and check valves. Leakage could occur at either the body/bonnet joint, stem packing gland, check valve hinge pin capscrews or check valve hinge pin packing glands.

Valve positions considered included the closed gate valve, open gate or globe valve, closed check valves and safety valves. Open valves are included because body/bonnet leakage and packing gland leakage in an open valve in a stagnant line could also cause thermal stratification.

The isolable piping considered consisted of piping between the hot RCS and the first closed valve away from the RCS (i.e., either a closed gate, closed globe or closed check valve). Piping beyond the first closed valve was not included in the review.

Valves in piping located above hot RCS systems were not considered since the piping is always hot between the RCS and the valves. Boundary valves and open valves located in vertical pipe lines were not considered since this configuration would cause uniform heating of the line as the hot water would first displace the cold water if there were a leak in the valve.

Instrument sensing lines (including sample lines) were not considered since they are 3/4" or 1" lines and any significant leakage would heat the entire line. Any small leakage would be noticed at the instruments and the leak would be corrected. A small amount of leakage flow would cool as the energy associated with the small amount of leakage would dissipate before the leakage flow could reach the instrument.

Similarly, process drain lines are similar to the instrument lines and were not considered (i.e., they are small diameter (3/4", 1", 1-1/2" or 2") pipes). Since they are insulated and located close to the hot source piping, the drain piping would be warm due to heat conduction from the process line. Any leakage would result in a more uniform temperature in the line due to the small diameter of the line.

<u>RESULTS OF REVIEW</u>

The review identified six configurations where the first isolable valve was in a stagnant horizontal line located below the Reactor Coolant System. They are:

1. RHR head injection line to check valve 1001-64 (4").

2. RHR return line to check valve 100-68A including open gate valve 100-33A (18").

3. RHR return line to check valve 1001-68B including open gate valve 1001-33B (18").

4. Core Spray (CS) Injection line to check valve 1401-9A (10").

5. Core Spray (CS) Injection line to check valve 1401-9B (10").

6. Standby Liquid Control line to check valve 1101-15 (1-1/2").

The standby liquid control valve 1101-15 was not considered for further evaluation, as the configuration is similar to the process drain line (i.e., a small line in close proximity to the hot source).

For the remaining 5 configurations, Action 2 of the bulletin requires an examination of piping that may have been subjected to excessive thermal stresses to assure that there are no existing flaws. There are ten welds in these 5 configurations. All ten welds are included in our IGSCC surveillance examination program (Generic Letter 88-01). The Core Spray and the RHR return line piping was replaced in 1984 as part of the IGSCC pipe replacement.

The following are welds located in horizontal pipe runs that might have been subjected to thermal stratification.

VALVE #	ISI ISOMETRIC NOS.	ISI WELD NO.	RFO #8 IGSCC INSPECTION STATUS	REMARKS
RHR HEAD INJECTION LINE				
1001-64	ISI-I-10-5A	10-HS-18	Scheduled	
		10-HS-19	Scheduled	
RHR A LINE				
1001-68A	ISI-I-10-1	10R-IA-5	Scheduled	High stress
1001-33A		10R-IA-6	*	
		10R-IA-7	*	
RHR B LINE				
1001-68B	ISI-I-10-1	10R-IB-5	Inspected in RFO #7	High stress
1001-33B		10R-IB-6	Not Scheduled	
		10R-IB-7	Not Scheduled	
CS A LINE				
1400-9A	ISI-I-14-1	14R-A-13	Added to schedule	
CS B LINE				
1400-9B	ISI-I-14-1	14R-B-13	Added to schedule	

* Subsequent inspection will be performed based upon the results of scheduled examination of weld #10R-IA-5.

CORRECTIVE ACTIONS

EXAMINATION OF WELDS

For the 5 unisolable lines (10 welds) that might be subjected to thermal stratification, the Core Spray and RHR A and B return lines (8 welds) were part of the IGSCC pipe replacement.

Valve 1001-68B experienced a seat leak in 1985 which may have caused that piping (RHR B return) to have been subjected to excessive thermal stresses. One of the highest stress welds in this line is weld 10R-IB-5. No flaws were identified when this weld was examined during RFO #7. Therefore, the 10R-IB-6 and 7 welds are not scheduled for examination in RFO #8. One of the highest stress welds in the RHR A return line, 10R-IA-5, is scheduled for examination in RFO #8. If this examination indicates any flaws in the weld, the other two susceptible welds in the line will also be examined.

RHR head injection line check valve 1001-64 experienced shaft leakage which has been repaired. This leakage may have subjected that piping to excessive thermal stresses. Welds 10-HS-18 and 19 are scheduled for examination in RFO #8. Core Spray A and B line welds 14R-A-13 and 14R-B-13 may also have been subjected to excessive thermal stresses and have been added to the RFO #8 IGSCC Inspection Schedule.

The IGSCC examinations are a high sensitivity weld examination and are conducted with experienced personnel qualified under the EPRI/NRC/BWROG NDE coordination plan for IGSCC Research. This is the type of examination which will be performed on the welds. This meets the requirements of Supplement 2 of IEB 88-08.

In summary, the additional review of the welds due to Bulletin 88-08 Supplement 3 requirements resulted in two additional welds to be examined during the next refueling outage.

CONTINUING PROGRAM (Post RFO #8)

Bulletin 88-08 requires the continued assurance that all unisolable sections of piping connected to the RCS not be subjected to combined cyclic and static thermal and other stresses that could cause fatigue failure during the remaining life of the plant. For Pilgrim Station, the affected configurations are those with check valves as the isolation valve. These valves do not exhibit a cyclic thermal fatigue by the heating/cooling of the valve seat, but instead will leak continuously once leakage starts. The metal will "wire draw" or the gland material will deform and will not reseal once leakage has begun. Therefore, without a cyclic thermal heatup/cooldown present in the piping, failure due to cyclic thermal fatigue will not occur.

For thermal stratification conditions, higher stresses in the piping could occur. As a result, this condition will be assessed by inspecting the valves noted above during subsequent refueling outages for evidence of external leakage. If leakage is found, then the welds associated with the valve will be examined to determine if flaws have been introduced by the thermal stratification condition.

SUMMARY

IEB 88-08 SUPPLEMENT 3

THERMAL STRESSES IN PIPING CONNECTED TO REACTOR COOLANT SYSTEMS

Supplement 3 to IEB 88-08 requested that licensees note that periodic valve seat leakage through packing glands could result in unacceptable thermal stresses in unisolable piping connected to the reactor coolant systems. This leakage could lead to thermal stratification in the piping when a thin layer of hot water flows in the top segment of the pipe, from the hot reactor coolant system to a leaking valve.

The original bulletin identified a thermal stratification condition caused by higher pressure cold water leaking past a valve. This lead to a thin layer of cold water flowing in the bottom segment of the pipe, from higher pressure system to the reactor coolant system.

Supplement 3 further identifies a cyclic pipe thermal condition caused by intermittant flow through a gate valve. Intermittant flow occurs when the hot water flows through a gate valve. Intermittant flow occurs when the hot water leaks past the seat and through the gland, warms the valve causing the valve to heat up, expand, seal tight and then stop the seat leakage. The valve then cools, contracts, loosens the seal and starts to leak again.

Per the original bulletin requirements, licensees are required to review systems connected to the Reactor Coolant System to determine whether unisolable sections of piping connected to the RCS can be subject to stresses from temperature stratification or temperature oscillations that could be induced by leaking valves, and that were not evaluated in the design analysis of the piping.

All connections to the Pilgrim Reactor Coolant System originally reviewed per the bulletin requirements were reviewed to determine if any unisolable portions of piping could be subject to the thermal conditions described in Supplement 3 to IEB 88-08.

There were five configurations identified in the review which met the configurations identified by Supplement 3. These are:

1. RHR return valve 1001-68A and valve 1001-33A (18")
2. RHR return valve 1001-68B and valve 1001-33B (18")
3. RHR head injection valve 1001-64 (4")
4. Core Spray Injection valve 1401-9A (10")
5. Core Spray Injection valve 1401-9B (10")

Note: Valve 1001-68B had a seat leak in 1985.

All five isolable valves are check valves. Four are tilting disc check valves with hinge pins and packing glands and one is a swing check valve, with a hinge pin and gasketed cap screw. Two valves are normally open gate valves in the RHR return lines. The possible leak path considered is either a leak thru the packing gland, cap screw or a body bonnet leak. In any case the leak is continuous as no mechanism is identified to cause the leak to stop.

There were no configurations identified in the review that would meet the Supplement 3 requirements which included close gate valves as the first valve away from the Reactor Coolant System.

Therefore for the Pilgrim Nuclear Power Station there are no conditions identified ~~in~~ which could cause a cyclic pipe thermal condition caused by leakage through a gate valve seat and packing gland. There are five cases identified where thermal stratification is possible.

If configurations are identified that may have been subjected to stresses from temperature stratification or temperature oscillations, the bulletin requires that the piping be inspected to determine if there are any flaws. In addition a program is required to be implemented to provide continuing assurance these configurations not be subjected to static thermal stresses that could cause fatigue failure during the remaining life of the unit.

The piping other than the RHR head injection piping was all replaced in 1984 as part of the IGSCC piping replacement. This piping has seen only one operating cycle. It is subject to inspection as part of the IGSCC surveillance program. Boston Edison will inspect the piping as a part of the IGSCC program (GL 88-01) during the next refueling outage. This amounts to ten (10) welds.

Boston Edison will implement a program of inspection and analyses of the welds to provide continuing assurance that fatigue failure will not occur during the remaining life of the unit. This program will be implemented prior to the end of the next refueling outage. The program will consist of a visual examination of the seven noted valves for indication of any external leakage at the packing gland, capscrew and at the body bonnet joint. If there is indication of leakage, then additional inspections (UT) will be performed on the effected piping per the requirements of the bulletin. The UT examinations may be combined into the scope of the IGSCC Surveillance program.

Per IEB 88-08 Supplement 2, enhanced ultrasonic testing (UT) and experienced examination personnel are required to detect cracks in stainless steel piping. All of the examinations that will be performed are on piping required to receive IGSCC examinations. This is an enhanced examination performed by experienced personnel and thus meets Supplement 2 requirements.

This UT examination will be performed on the piping identified by the visual examination as having experienced external leakage at the packing gland, cap screw or body bonnet joint.

<u>COST</u>: 1. The cost of visual or UT inspection is $5000/Weld. Due to Bulletin requirements only two (2) welds will be added to the IGSCC Schedule and two additional welds would be inspected if an already scheduled IGSCC weld indicates any problem. The total cost for inspection will be either $10,000 or $20,000 for RFO #8 and thereafter, for each subsequent refueling outages. These expenses will be included in the IGSCC Scope of Work by QA/QC.

2. If weld failures are detected, the cost for subsequent analysis, potential weld/pipe/valve replacements are not estimated. Such costs should be included in the expense contingency budget.

3. NED is considering the entire scope of inspection requirements which include IST, ISI & IGSCC. The budget considerations for this scope of work is being addressed.

WGL/3819