96-735

BWRVIP

BWR Vessel &
Internals Project _____ *Issue Management and Resolution*

MEMORANDUM

December 13, 1996

Document Control Desk
U. S. Nuclear Regulatory Commission
11555 Rockville Pike
Rockville, MD 20852

Attention: C. E. Carpenter

Subject: GE Services Information Letter on Jet Pump Riser Pipe Cracking

Enclosed for your information is one copy of GE Nuclear Energy Services Information Letter SIL No. 605, "Jet Pump Riser Pipe Cracking," December 6, 1996. This information is being provided to keep you informed of industry activities related to jet pump cracking.

The BWRVIP will continue to provide you with information on this subject as it becomes available. The BWRVIP plans to discuss this subject with NRC management at the meeting scheduled for January 16, 1997.

If you have any questions on this subject please contact the undersigned at (205) 992-7121.

Sincerely,

Warren Bilanin for

Robin Dyle
Technical Chairman
BWRVIP Assessment Committee
Southern Nuclear Operating Company

6004 1/1

170047

RD-10-1

Jet pump riser pipe cracking

SIL No. 605

December 6, 1996

During a recent refueling outage at a BWR plant, cracks were detected in two jet pump riser pipe elbows located inside the reactor vessel in the vicinity of the field–fabricated circumferential weld joining the riser elbow to the recirculation inlet thermal sleeve. This is the first time that cracking has been detected in the vicinity of jet pump riser pipe circumferential welds. The purpose of this SIL No. 605 is to disseminate information on this cracking and provide recommendations to owners of GE BWRs with jet pumps so that an appropriate course of action can be developed.

Discussion

Jet pumps are used as part of the reactor recirculation system in BWR/3, 4, 5, and 6 plants. They are installed in the annulus between the core shroud and the reactor pressure vessel (RPV), and each vessel contains between 12 and 24 jet pumps. There are several BWR jet pump designs, however the basic jet pump configuration is the same for all jet pump plants (Figure 1).

Each jet pump assembly consists of a riser assembly, two inlet–mixer assemblies, two diffuser assemblies, and a riser brace. The riser assembly elbow is a 10–inch, 90–degree short–radius elbow, fabricated from Type 304 stainless steel. The riser assembly elbow is welded to the recirculation inlet nozzle thermal sleeve. The riser assembly is supported near the top by the riser brace, which is welded to the riser pipe and to pads on the RPV wall. Some additional lateral support is provided at the diffuser inlet interface. The entrance end of each inlet–mixer assembly is clamped to the top of the riser transition piece by the beam–bolt assembly. The exit end of the inlet–mixer forms a slip fit joint with the entrance end of the diffuser.

The cracks were detected by visual inspection in two jet pump riser pipe elbows located inside the reactor vessel in the vicinity of the field–fabricated circumferential weld joining the riser elbow to the recirculation inlet thermal sleeve. The root cause of the cracking has not yet been determined, however, the indications are characteristic of Intergranular Stress Corrosion Cracking (IGSCC), in that they show evidence of branching. The evaluation into the cause of the cracking is still in progress.

NRC IE Bulletin Number 80–07 (Reference 1) and SIL No. 330 (Reference 2) recommended three criteria to detect jet pump beam failure (comparison of recirculation pump flow to pump speed/flow characteristics, comparison of individual jet pump diffuser to lower plenum differential pressure readings, and comparison of total core flow to established power/core flow relationships). Of these criteria, the first two have the capability to detect riser pipe failure. Another parameter that has the capability to detect riser pipe failure is the ratio of total loop jet pump suction flow to total loop jet pump drive flow.

GE Nuclear Energy has performed a safety evaluation in accordance with 10CFR Part 21. GE concluded that the consequences of the observed cracking do not pose a substantial safety hazard.

Recommended action

GE Nuclear Energy recommends that owners of GE BWRs/3,/4,/5, and /6 consider the following:

1. Jet pump monitoring should include an evaluation of the ratio of total loop jet pump suction flow to total loop jet pump drive flow. This ratio should not differ by more than 10% from its characteristic value. Failure to meet this criteria is indication of a possible jet pump malfunction.

2. GE BWRs currently in a refueling outage should consider a visual inspection of the jet pump riser pipe welds to assess the integrity of the pipe welds. Inspection during the current

outage may not be necessary, based on plant unique evaluations of the following:

- Years of reactor operation
- Availability of recent inspection data for these welds
- Implementation of IGSCC mitigation measures, such as Hydrogen Water Chemistry
- Low incidence of IGSCC based on recent inspection history of other reactor internals

3. GE BWRs should consider a visual inspection of the jet pump riser welds as a part of future outage inspection activities. Based on currently available information, a visual inspection is adequate for detection of cracking.

References

(1) NRC NUREG/CR-3052 – "Close-out of IE Bulletin 80-07: "BWR Jet Pump Assembly Failure", published November 1984.

(2) General Electric Services Information Letter No. 330, "BWR Jet Pump Beam Cracks", June 1980.

(3) General Electric Services Information Letter No. 330, Supplement 1, "BWR/4 Jet Pump Beam Cracks", February 1981.

(4) General Electric Services Information Letter No. 330, Supplement 2, "GE BWR/6 Jet Pump Inlet Mixer Ejection", October 1993.

To receive additional information on this subject or for assistance in implementing a recommendation, please contact your local GE Nuclear Energy Service Representative.

This SIL pertains only to GE BWRs. The conditions under which GE Nuclear Energy issues SILs are stated in SIL No. 001 Revision 4, the provisions of which are incorporated into this SIL by reference.

Product references

B11 and B13 — Reactor Assembly
B21 and B22 — Nuclear Boiler System
B31 and B33 — Reactor Recirculation System

Technical source

B. A. McAllister

Issued by

Original signed by

R. M. Fairfield, Project Manager
Service Information Communications
GE Nuclear Energy
175 Curtner Avenue, San Jose, CA 95125

Figure 1 - Typical jet pump assembly