TABLE 3.7-3

SAFETY RELATED HYDRAULIC SNUBBERS*

SNUBBER NO.	SYSTEM SNUBBER INSTALLED ON, LOCATION AND ELEVATION	ACCESSIBLE OR INACCESSIBLE (A or I)	HIGH RADIATION ZONE** (Yes or No)	ESPECIALLY DIFFICULT TO REMOVE (Yes or No)
AUXILIARY FEEDWATER SYSTEM				DELETE
6C-EBB-4-H6	Containment, 619'	I	Yes	No
6C-EBB-4-H7	Containment, 623'	I	Yes	No
6C-EBB-4-H9	Containment, 599'	I	Yes	No
6C-EBB-4-H11	Containment, 595'	I	Yes	No
6C-EBB-4-H11	Containment, 595'	I	Yes	No
6C-EBB-4-H14	Containment, 615' CHANGE ELEVATION TO 618'	A	Yes	No
6C-EBB-4-H15	Containment, 622'	A	Yes	No
6C-EBD-14-H4	Auxiliary Building, 593'	A	No	No
COMPONENT COOLING WATER SYSTEM				
36-HBC-1-H16	Auxiliary Building, 597'10"	A	No	No
36-HBC-1-H23	Auxiliary Building, 597'10"	A	No	No
36-HBC-1-H28	Auxiliary Building, 597'10"	A	No	No
36-HBC-1-H30	Auxiliary Building, 597'10"	A	No	No
36-HBC-23-H33	Auxiliary Building, 597'10"	A	No	No
CONTAINMENT SPRAY SYSTEM				
34-HCB-4-H27	Containment, 643'	I	Yes	No

Docket No. 50-346
License No. NPF-3
Serial No. 842
July 30, 1982

Attachment II

Safety Evaluation

for

Auxiliary Feedwater Header Replacement

This safety evaluation addresses the scope of work which includes:

A. Hole drilling through the shell and shroud of the steam generators.

B. Stabilization of the existing auxiliary feedwater internal header.

C. Removal of the external auxiliary feedwater nozzle thermal sleeve and installation of a blind flanged cover on this nozzle.

D. Installation of an external header with eight (8) injection nozzles.

E. Modification of the mirror insulation to accommodate the external header installation.

The above work scope relates to changes to the steam generators and the auxiliary feedwater system.

The safety function of the steam generators is to act as a heat sink for reactor coolant and forms a portion of the primary pressure boundary.

The safety function of the auxiliary feedwater system is to a) provide feedwater in the event of loss of main feedwater, b) promote natural circulation in the event of loss of forced circulation, and c) provide a condensing surface high in the primary system and under two phase conditions in the primary system.

The discussion which follows addresses the safety concerns for each of the five work scope areas. It should be noted that the NRC has considered at least portions of these modifications as constituting an unreviewed safety question.

A. Work Scope: Hole drilling through the shell and shroud of the steam generators.

Safety Concerns:

1. Steam generator (SG) shell integrity.

2. Tube damage from drilling.

3. Generation of loose particles.

The ASME Code acceptability and justification for the structural adequacy of the eight (8) new 5 inch holes was confirmed by B&W. This analysis included a fatigue exemption analysis per ASME Section III, N-415.1, reinforcement calculations, and calculation of minimum distance requirements to adjacent openings including other 5 inch holes, the existing auxiliary feedwater nozzle, and the existing 16 inch diameter secondary manway. This document was added as an addenda to the original OTSG Stress Report.

The operations involved in the hole drilling had the potential of damaging periphery steam generator tubes and generated debris. To assure their integrity, all periphery tubes underwent eddy current examination in the potentially affected region (between the 15th tube support plate and the upper tube sheet) after completion of the hole drilling and stabilization work. As a result of the examination a total of 7 tubes (4 in SG1-2 and 3 in SG1-1) were plugged. Three (3) of 7 tubes were identified as being pluggable prior to work on the steam generators.

Concern for loose debris generated by the drilling operations was alleviated by acceptable cleanup of the affected regions, confirmed by visual examination.

Based on the above, this work scope (hole drilling) does not represent a concern to the health and safety of the public nor an unreviewed safety question.

B. Work Scope: Stabilization of the existing auxiliary feedwater internal header.

Safety Concerns:

1. Loose parts - brackets, dowel pins, shims.
2. Tube damage from operations.
3. Adequacy of the attachment to prevent subsequent tube damage.
4. Bypass flow between the header and shroud.

All brackets and dowel pins have been removed and/or recovered from SG1-1 and all brackets and seven of the eight dowel pins have been removed and/or recovered from SG1-2. The missing pin which is 3/4 inches in diameter and 2 11/16 inches long does not represent a significant safety concern. The bases for this statement is given in Attachment B to TED to NRC letter dated July 15, 1982 (Serial No. 839).

Two shims were used in the stabilization of the header in SG1-1 (at locations P7 & P8). The shims which measure approximately 8" long x 1¼" wide x 1/8" thick were used to partially fill the header to shroud gap to aid in the header to shroud fillet weld in those two

locations. Visual examination confirmed that the shims were securely held in place to preclude them from becoming loose parts.

As with the hole drilling, the stabilization operations had the potential for damaging periphery SG tubes. Steps to assure tube integrity were previously addressed under hole drilling.

In order to assure that the internal auxiliary feedwater header does not cause steam generator damage during operation, the adequacy of the attachment needed to be verified. B&W provided the design parameters for the stabilization process. Included in the consideration were requirements for visual and non-destructive examinations of the header to verify its "soundness". These examinations were carried out with acceptable results. B&W also verified the structural integrity of the internal auxiliary feedwater header tiedown design using ASME Code requirements.

Included in the stabilization requirements was the need to maintain a minimum 1/8" clearance between the steam generator tubes (unplugged) and the header. An engineering justification for this 1/8" dimension was given by B&W. Post-stabilization examinations confirmed that this criteria was met or exceeded.

Bypass flow between the header and shroud was analyzed by B&W. This analysis concluded that the bypass flow effects on performance are negligible.

To assure long term integrity of the attachment, visual inspections will be made of the secured internal header and attachment welds through selected opening(s) during the next two refuelings and at the 10 year ISI.

Based on the above, this work scope (stabilization) has been properly reviewed and analyzed and does not present a concern to the health and safety of the public nor an unreviewed safety question.

C. Work Scope: Removal of the external auxiliary feedwater nozzle thermal sleeve and installation of a blind flanged cover on this nozzle.

Safety Concerns:

1. Effects on nozzle due to potential splashback from dislodged thermal sleeve.

2. Compliance with ASME Code.

The nozzle areas were examined using dye-penetrant and ultra-sonic testing techniques. No indications were found which would suggest that the nozzles were subjected to severe thermal stresses from a splashback (of cold auxiliary feedwater) phenomena. Unrelated indications were found in the safe-end to nozzle weld on the nozzle on SG1-1. These were appropriately dispositioned and repaired utilizing approved procedures.

B&W addressed the ASME Code compliance for the flanged closure.

Hydrostatic testing requirements are addressed in TED to NRC letter, dated June 22, 1982 (Serial No. 830).

Based on the above, this work scope (old nozzle closure) does not represent a concern to the health and safety of the public nor an unreviewed safety question.

D. Work Scope: Installation of an external header with eight (8) injection nozzles.

Safety Concerns:

1. Compliance with ASME Code.
2. Water hammer effects.
3. High energy pipe break analysis.
4. Thermal sleeve analysis.
5. Riser flange attachment to SG shell.
6. Auxiliary feedwater delivery.

The external header has been designed, fabricated, and installed in accordance with Section III of the ASME Code for Class 2 piping. B&W provided the ASME stress analysis for the external header. Hydrostatic testing requirements for the header are addressed in TED to NRC letter, dated June 22, 1982 (Serial No. 830).

Waterhammer potential of the AFW external header design has been reviewed and concluded not to be a problem. B&W documented that the external AFW header design incorporates features known to reduce the potential for and consequences of waterhammers. Those features are: a) top discharge nozzles to preclude header ring draining and suppress slug formation, and b) short horizontal runs to limit slug acceleration and waterhammer shock. Toledo Edison also concludes that these design features have been demonstrated to be effective in B&W plants with similar AFW external feedwater header design and in other vendor feedwater systems.

The auxiliary feedwater system within the containment is considered high energy piping and thus was subjected to a high energy line break analysis by Bechtel. The analysis showed that a rupture in a 3" riser at the point where it joins the ring header would overstress the adjacent pipe nozzle, and if the header were unrestrained, the adjacent nozzles could fail. This could cause separation of the header from the risers which could subsequently damage safety related equipment. For this reason, six pipe break restraints were added on each of the steam generator ring headers. Jets resulting from all pipe breaks and cracks were also reviewed and determined not to impinge on any components required for a safe shutdown. These analyses and actions alleviate concerns arising from high energy pipe breaks.

The thermal sleeve stresses were analyzed by B&W. The analysis provides a basis for demonstrating that the AFW thermal sleeve is capable of withstanding 300 cycles of AFW injection transients. This analysis was done according to the ASME Code for Class I components. A more detailed and less conservative analysis will be prepared at a later date which will extend the allowable number of AFW injection cycles.

The riser flange attachment to the steam generator shell was also analyzed per ASME Code requirements. However, due to the large number of AFW initiation cycles (7000/40 years) and other ASME Code requirements, it was necessary to limit the design life to 5 years until additional refined calculations can be done. Another analysis substantiates that the stresses on the shell, thermal sleeve bearing area, and studs meet ASME Code requirements. Future inspections will need to confirm the corrosion allowance of .032" dia. assumed for the bearing area.

The external auxiliary feedwater header design configuration is similar to that used successfully on 5 other operating B&W plants. There are a few minor differences between the existing design and the retrofit design. B&W reviewed the primary differences. The significant differences are discussed in Section 4.3.3 of Attachment A of TED to NRC letter, dated July 15, 1982 (Serial No. 839). Briefly, the main differences are: a) three inch higher injection point in the retrofit design, b) larger effective throat area in the thermal sleeve in the retrofit design, c) flow distribution orifices in the flanges of the vertical risers in the retrofit design, d) thermal sleeve design of the retrofit utilizies inconel for improved fatigue characteristics, and e) retrofit headers are not insulated as is the case of the existing designs. The changes have been concluded in the referenced documents to result in a retrofit design which is as good as or better than the existing external AFW header design relative to flow performance and tube loadings.

The matter of flow-induced vibration of steam generator tubes due to auxiliary feedwater injection was also addressed by B&W. This analysis concluded that the stress and deflection for the retrofit design were significantly reduced from the original arrangement. Amplitudes at 300 gpm per nozzles were found to be acceptable. With Davis-Besse's eight (8) nozzle arrangements, this would envelope auxiliary feedwater flow up to 2400 gpm per steam generator. At Davis-Besse, with both steam-driven pumps supplying one steam generator, maximum flow would be approximately 1690 gpm at 1050 psi steam generator pressure.

Regarding penetration of cooling water to the steam generator tubes for the external header vs. the internal header design, a B&W review indicated that there is almost no difference in tube wetted surface area (about 1% less for the external header) between the two designs. This is attributed to the greater penetration of the external header design which all but completely offsets the effect of the wider peripheral distribution of cooling water by the internal header.

This study, as well as the ECCS assumptions are based on a 6 nozzle arrangement. The eight nozzle arrangement would be expected to provide more wetted tubes than the six nozzle arrangement for the same auxiliary feedwater flow.

Based on the above, this work scope (installation of external header) has been properly reviewed and analyzed and does not present a concern to the health and safety of the public nor an unreviewed safety question.

E. Work Scope: Modification of the mirror insulation to accommodate the external header installation.

Safety Concerns: 1. Effects on containment heat load.

The mirror insulation design was changed to accommodate the eight inlet nozzles. The header and risers are uninsulated and therefore a small gain in heat load to containment can be expected. B&W has estimated that the heat loss from the external headers on both generators will not exceed approximately 0.08×10^6 BTU/hr. This represents a small percentage of the present capacity of the three containment air cooler units which each have a normal operation capacity of 1.8×10^6 BTU/hr. The additional heat gain is thus judged to be not significant and this work scope (insulation changes) does not represent an unreviewed safety question.

In addition to the concerns addressed above, an overriding concern for the entire modification was maintaining proper chemistry control on both the primary and secondary side of the steam generator in order to prevent, as much as possible, steam generator tube degradation. Special procedures were prepared and followed under the guidance of the Chemistry & Health Physics personnel in order to maintain proper chemistry control. Future eddy current examinations will assess long-term tube integrity.

Summary

Based on the above review which has been discussed in detail by Toledo Edison personnel on the Station Review Board and Company Nuclear Review Board, the conclusion has been reached that the modifications and work performed pose no undue risk to the health and safety of the public.

bj c/2