JAN 3 1 1974

50-247

J. G. Keppler, Director, Region III

FEEDWATER LINE VIBRATION PROBLEMS

As discussed during our telephone conversation on January 30, Indian Point 2 experienced a through wall rupture in one of their feedwater lines inside the containment which apparently resulted from a water hammer. The corrective action was to change the configuration of the feedwater line. The Surry plants also made line modifications earlier which were prompted by the same cause. Turkey Point 3 and 4 recently experienced vibration problems in the feedwater lines to the steam generators, which had long runs of horizontal piping to the steam generators. Their fix was to cut the feedwater line and re-rout the pipe (See attached sketch). All of the above modifications were made to eliminate long pipe runs directly to the steam generator, thereby reducing the probability for generating air or steam bubbles in the FW line.

The Cook Units may use the same model of steam generator (FW entry above tube bundle) and may encounter similar problems. The Zion plants may also be a candidate. You may wish to investigate the potential for these problems with the licensee.

Original signed by
L.L. Beratan

L. L. Beratan
Senior Structural Engineer
Technical Assistance Branch, RO

Attachments:
1. Sketch
2. W Letter dated January 10, 1974

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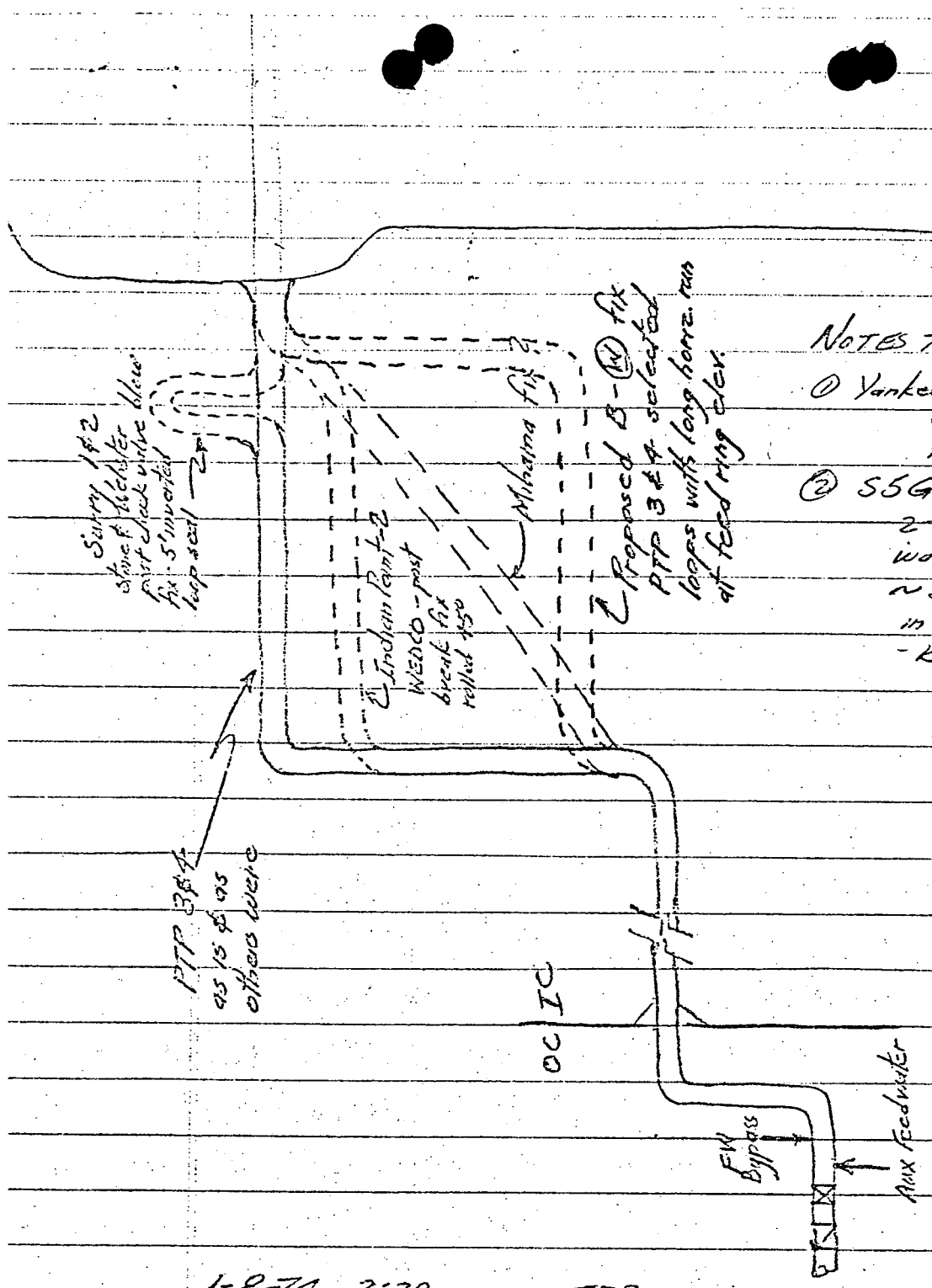
SURNAME ▶	LLBeratan:arj	GWReinmuth				
DATE ▶	1/31/74	1/31/74				

Form AEC-318 (Rev. 9-53) AECM 0240 GPO c43—16—81405-1 445-678



NOTES TO SELF:

① Yankee Rowe FW lines modified some time ago for water hammer prob. – T. Lordi 1-9-74

② SSG plant - Idaho - 5" FW lines 2-loop sub prototype - had water hammer probs & added ~3' loop seal type mod. at SG in 1968 - fix solved water hammer - K.E. Beatty 1-9-74

1-8-74 2:30 pm per JRB

Positive recommendations from (W) (T. Lordi) will be sent as follows:

Eliminate potential for steam entering horizontal run of feedwater line at the SG feedwater ring elevation by - in order of pref.

1. 90° down at SG, vertical as far as possible, then run to existing line.
2. 45° or some ∠ down at SG, run on slope to existing line.
3. Install conventional loop seal (i.e. loop down) at SG.

Note: Adams & Miller of Bechtel are on site to ck 4th line. JR

ATTACHMENT 2

Westinghouse Electric Corporation Power Systems

Nuclear Service Division
Box 2728
Pittsburgh, Pennsylvania 15230

January 10, 1974

FPS-74-003

Mr. J. R. Bensen, Manager
Power Resources-Nuclear
Florida Power & Light Company
P. O. Box 3100
Miami, Florida 33101

Subject: Florida Power & Light Company
Turkey Point Units 3 & 4
Steam Generator Feedwater Piping

Dear Mr. Bensen:

Regarding the apparent water hammer experienced in the Unit 4 (and possibly Unit 3) steam generator feedwater lines, we offer this summary of our experience with this phenomenon for your consideration.

While we have no definitive description of the conditions existing at the time of the water hammer at Turkey Point, the situation appears to be very similar to the experience of the Yankee-Rowe Plant several years ago. In that instance, it was Westinghouse's opinion that the water hammer was caused by violent reaction between the cold feedwater and the steam entrapped in the feedwater pipe. Corrective action was to reroute the feedwater pipe to provide a seal (trap) just before entering the steam generator. This prevented the draining of the feedwater line when the feed ring was uncovered. No further water hammers were experienced. Since that time our design practices, as documented in the Westinghouse Steam Systems Design Manual, require the feed ring to be at the highest elevation in the feedwater line downstream of the feed control valves. No water hammer had been reported since this practice was instituted until the Mihama Unit No. 2 experience. Much like Turkey Point, the layout at Mihama consisted of approximately 25 feet of horizontal feedwater piping at the same elevation as the feed ring.

Briefly, the conditions leading to the water hammer at Mihama were as follows:

> During Hot Functional Testing, a steam generator lo-lo level reactor trip was simulated. For the purposes of the test, the steam generator water level was maintained at lo-lo, below the feedwater ring, for approximately 20 minutes. After the test the water hammer occurred during steam generator level make-up

with the auxiliary feedwater pump. Subsequent inspection of the feedwater train revealed damage to the main feedwater pipe snubbers, to the auxiliary feedwater pump mechanical seal, and to the auxiliary feedwater pump pressure gauge. A later inspection of the steam generator internals found no damage.

From this experience we have identified those conditions which invite a destructive water hammer in the feedwater lines:

1. High steam generator temperature and pressure
2. Cold water in the feed line
3. Feed ring uncovered by low water level in the steam generator
4. No feed flow for enough time (several minutes) to permit draining of the feed ring and any horizontal run feed pipe followed by
5. Cold feedwater added at a significant rate.

We believe that all five of these conditions are necessary to generating a water hammer, but we cannot quantify them. (That is, what feed temperature is "cold"?, what minimum length of horizontal piping is necessary, etc.)

However, based on the earlier Yankee-Rowe experience, Westinghouse recommended to Mihama that the feed line be altered to provide a loop seal or otherwise eliminate the horizontal run. This same "fix" has been sucessfully applied to VEPCO's Surry Station where a severe water hammer was also encountered. Their problem was further enhanced by the fact that the feedwater lines were at a higher elevation than the feedwater ring in some cases. The installation of loop seals appears to have corrected their problem.

Regarding the steam generator feedwater line water hammer experienced at Indian Point, our evaluation to date has not yet definitely isolated the mechanism. We have only tentatively concluded that it could well have been the result of a "shock ride" set-up by a malfunctioning feedwater check valve. As a conservative measure, however, we have recommended the installation of loop seals, for their installation also has the horizontal run of piping at the same elevations as the feedwater nozzles.

Based on these various occurrences of this water hammer phenomenon and the subsequent fix employed, we recommend that the Turkey Point steam generator feedwater lines be modified to preclude the possibility of draining any part of the line into the steam generator, i.e., ensure that the feed lines remain water filled during all operating conditions by making the feedwater nozzle the highest point in the feedwater system downstream of the feed regulating valve, and, minimize as much as possible the length of interconnecting horizontal piping on the same elevation as the feedwater nozzle.

In consideration of the existing configuration of the feedwater line at Turkey Point, this objective can be met by a number of arrangements:

1. The addition of loop seals immediately at the feedwater nozzles
2. Exiting immediately down from the feedwater nozzle through a 90° elbow, or
3. Exiting immediately down through a 45° elbow on a diagonal from the feedwater nozzle to some lower point in the existing feedwater line.

Any of these alternatives would be acceptable as they each serve to prevent drainage of the pipe between the steam generator feedwater nozzle and the feedwater regulating valve.

We request that we be advised immediately of the configuration to be used and the resulting steam generator feedwater nozzle loads imposed by the modified feedwater lines.

We further suggest that all points of rigid support of the feed line, i.e., suspected high stress points, from the feedwater nozzle to at least the containment penetration, be evaluated for possible damage.

Very truly yours,

T. A. Lordi, Project Engineer
Field Service-Southern Region
Operating Plants Service

TAL/jls