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Dr. John A. O'Brien
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U. S. Nuclear Regulatory Commission
Mail Stop 1130-SS
Washington, D. C. 20555

Dear John:

SUBJECT: NRC Staff Position on Dynamic Loads, Particularly Water Hammer

Since I am postulating low probability events, I definitely do not wish to have this letter get into the Public Document Room. I would prefer that it not be copied, and prefer it be destroyed.

In my opinion, the Staff position with regard to water hammer is unrealistically optimistic. It works on the a priori assumption that previous water hammers in nuclear systems represent upper bound energy levels. This is based on after-the-fact calculations of energy levels for a limited number of water hammer or water slugging events. These calculations yield values that are a small fraction of the theoretical energy bound. While I do not anticipate cases of water hammer near the theoretical upper bound, I would not be surprised if some were to occur that are several times the existing calculated levels.

The Staff also labors under some misconceptions that aren't necessarily valid. There is a concern for the global effect of seismic events while dynamic events such as water hammer are dismissed on the basis of redundancy, etc. In the following, I shall attempt to cite some positive aspects, followed with points where I find the Staff position unrealistically optimistic. I shall use an example, not necessarily valid, that attacks their rather cavalier dismissal of such events.

With regard to positive actions, I admit definite progress has been made. For example:

- Events such as the H. B. Robinson and Turkey Point failures where dynamic loads resulting from relief valve closure blew the valves off the header were

corrected by modifying an admittedly lousy weld joint design. Apparently, the industry learned a lesson because we haven't had any more such failures.

- In the early 1970's, there were a large number of water slugging events where a valve was opened into a voided line and pipes were bent, hangers pulled out of the wall, etc. Techniques such as jockey pumps to fill the voided lines have markedly minimized such events. I'm doubtful they have totally eliminated them.

- Steam-water reactions, particularly those induced from the steam generator, have been virtually eliminated through installation of J-tubes. Again, I am not sure that steam-water reactions have been eliminated.

The preceding represent three major areas where positive action has been taken. I could cite valve chatter, etc., as other areas, but they may be secondary.

Now let's examine the more negative side:

- As indicated, I am doubtful we have experienced feasible, more energetic water hammers. An examination of the industrial literature will reveal water hammers that catastrophically failed piping. These are still possible.

- Earlier incidents of water hammer or water slugging tended to be dismissed because they "only" pulled out all supports for a hundred feet or more of piping rather than failing the pipe. These support failures served as excellent energy absorbers minimizing damage to piping. Since then, we have gone in the wrong direction: namely, using large embedment plates, larger bolts, bigger lugs on the piping. etc. These measures almost certainly transfer the energy absorption to the pipe. In the opinion of the PVRC Steering Committee and some of the prestigious consultants for the NRC Task Group on Seismic Design, ASME III has gone in the wrong direction. The piping supports are too strong and the equipment supports too weak. Bosnak's group feels the same. Hopefully, we can change it in time, but that probably will be for new plants, not a backfit requirement. We may wish to make it a requirement along with requiring removal of excessive supports based on increased damping values.

- Another problem pertains to the BWR IGSCC in larger pipes. The new appendix to ASME XI addresses the seismic case. I'm not sure we will see the same margins for more

severe dynamic events. Ev Rodabaugh raised this concern and I intend to take it to ASME XI for consideration. There are other concerns we need to address with regard to this appendix. We probably acted too precipitously, but there was a very real need.

- Let me address another concern. The Staff dismisses water hammer on the basis of redundant systems. Let me postulate a relatively unlikely, but not impossible, scenario. If we had a steam-water reaction at the feedwater-steam generator interface, we could get a shock wave traversing the pipe. We may get one in the steam generator that could break several tubes. This is a classic initiator for pressurized thermal shock and all the redundant systems available won't help in a reactor pressure vessel with a high transition temperature. While I admit this scenario is unlikely, it points out the weakness in the Staff position.

With regard to the ACRS questions, I suspect a meaningful PRA would be extremely expensive and much more difficult than the LLNL PRA's on pipe failure. Inputs would be virtually non-existent with the exception of events such as turbine trip and valve closure. Furthermore, the upper bound values would be virtually impossible to live with.

Summarizing, water hammer problems have been reduced but not eliminated; the Staff position strikes me as unduly optimistic; positive action may be necessary to correct the multiple problem of too many supports and too strong supports.

Very truly yours,

Spencer

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