# CT-1913

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1

January 26, 1955

Mr. E. P. Igne, ACRS Staff Member Advisory Committee on Reactor Safeguards U. S. Nuclear Regulatory Commission 1717 H Street, 10th Floor Washington, D. C. 20555

Dear El,

Attached is a brief commentary on the Structural Engineering Subcommittee Meeting in Albuquerque, NM. I really was disappointed in what has come out of the model tests. The experimental instrumentation was probably well done but the use and purpose of the test program seems to have been lost in the maze of detail.

Thanks for giving me the opportunity to review the activity.

Sincerely,

8804130274 880126 PDR ACRS CT-1913 PDR COMMENTARY ON STRUCTURAL ENGINEERING SUBCOMMITTEE MEETING IN ALBURQUERQUE, NEW MEXICO, JANUARY 22, 1988

## Prepared by: M. Bender, Querytech Associates, Inc. January 25, 1988

The Structural Engineering Subcommittee meeting in Albuquerque was an opportune time to develop an updated impression of the status of containment structural evaluation methods based on activities since the last meeting. One year ago. There were no unusual developments displayed in the course of the meeting but I am concerned about the understanding of those implementing the structural engineering program at Sandia as to the purpose of the research program. There doesn't appear to be knowledgeable planning, and even though the program has an advisory set of consultants who could provide such guidance, it does not display well understood objectives.

As Dr. Seiss pointed up in his comments, the tests should expose the behavior of these containment structures as they approach failure and not the failure characteristics, per se. However, the approach to failure may permit leakage of the liner and concrete cracking within acceptable limits that may be defined by global strain, local strain, crack size, leakage rate and similar characteristics. There may be more than one stage of structural degradation that could be tolerated below failure limits. There was no evidence that the program had really addressed the basis for defining failure. The commentary on the use of the test for PRA purposes highlights this problem of understanding. How would the PRAs use the results?

What follows is a brief discussion of what I learned from the meeting and review of available documents.

## CONCRETE CONTAINMENT TEST PROGRAM

The model test was terminated because of failures in the vicinity of penetrations that appeared to be a consequence of attachment stud behavior rather than key structural features of the model. The only clear test result was to demonstrate that attachment studs can have a significant effect on the behavior of a thin metal liner if the metal liner stress exceeds yield strength. There was no attempt to perform a structural assessment of the studs prior to the test, nor were they intended to be the focal point of the test program.

The conclusions derivable from of the model test about containment structures were, therefore, disappointing. The key structural elements of the vessel, itself, were not tested sufficiently to determine whether the analytical methods would predict failure. What was shown was that, up to the point of leakage exceeding the capacity of the gas supply system, the critical structural elements (base-cylinder junction, the cylinder itself and the discontinuities at the cylinder-head), had not reached their structural limit-state.

If the test is to have any meaning, the liner should be repaired at the points of failure; the studs in the vicinity of the penetrations taken out of the structural system and the test continued until one of those key structural elements does fail.

#### TEST EVALUATION

The predictions of failure by the participants in the evaluation program as reported in NUREG/CR-4913 gave an interesting display of evaluation approaches of varying sophistication. The discussions of the reasoning behind the evaluation methods were of considerable value and if examined by knowledgeable safety experts, might give some insight into what evaluation methods are bestmost suited to regulatory purposes. It doesn't appear that any action of this sort is currently planned.

### FUTURE TEST PROGRAM

Aside from the above proposal to continue the test until other structural elements reac' the failure limit-state there did not appear to be much thought to what purpose would be served by future test work. This reviewer sees little value in a post mortem examination of the liner failure. It can't be related to current liner designs or to those that might be planned in the future, although attachment effects on the liner are always a pertinent consideration.

The tests of the penetration closure gaskets didn't appear to have any correlation with "severe accident" assessment although some of the participants seemed to think that all of these tests were needed for Probabilistic Risk Assessemnt. It would be interesting to see a few examples of how the results might be used for this purpose.

The proposed tests of bellows seals could be of some value but tests performed without preconsideration of design practices and the bellows design basis will not give meaningful results. Even with such design enalysis there is considerable doubt as to what needs to be known.

COMPARISON BETWEEN THE STEEL VESSEL MODEL TESTS AND SEQUOYAH

Regrettably there was not sufficient time to discuss the planned

comparison of the Sequoyah vessel installation and the model tests. Failure mode is important but only if it affects the dispersal of fission products in a severe accident. Design margin is the main information that can be gained from model tests, but it isn't clear that the experimentalists have any interest in design margin or why it might be important.

#### OVERALL CONCLUSION

There are some side benefits from these tests, even though the results are not of interest to the mainstream of nuclear safety regulation. The test program does provide a forum for discussion of the structural evaluation methodology by safety experts and their consultants. The results are useful in drawing the interest of a younger generation of structural specialists who will be needed if the future needs of nuclear safety are to be provided.

The advisory panel to Sandia should be reorganized to provide more personnel with knowledge of how the results might be applied. It is not presently clear that those involved really appreciate how the test results could be used.