REFERENCE 5

Ed C... NRC

COPY FOR: ~~Mr. ...~~

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

April 10, 1981

The Honorable Morris K. Udall
Chairman, Subcommittee on Energy
and the Environment
Committee on Interior and Insular Affairs
United States House Of Representatives
Washington, D. C. 20515

Dear Mr. Chairman:

On May 28, 1980 I wrote to you concerning the safety implications of control systems and dynamic characteristics of nuclear power plants. My comments then were intended to dispute the official NRC position that "safety systems will mitigate control system failures at any power".

One of the specific points I raised then, by way of an example of what Failure Mode and Effects Analyses (FMEA's) of control systems can and should uncover, was the likelihood of overcooling transients, generated by control system malfunctions in the secondary side of a Pressurized Water Reactor, as described in Reference 7 of that letter. Such transients can cause the reactor vessel to cool-down to about 150 °F in about 15 minutes, while the ECCS repressurizes it to about 2400 psi. This compound transient, known as pressurized thermal shock, is capable of catastrophically fracturing a reactor vessel that has been exposed to a neutron fluence corresponding to only a few Full Power Years Equivalent (FPYE) of operation, and has a high copper content of about 0.4% in its walls or welds.

A reactor vessel fracture is one of the most serious accidents a reactor may experience. Depending on its location and mode, it is almost certain that it will cause a core meltdown with all its public health and safety ramifications, on which, I am sure, I need not elaborate for you. Considering the high consequences of such an accident, then, one should ask what are the chances of it taking place. Unfortunately, such an accident is very likely and increasingly so. It is very likely because it may be caused by one or more failures in the non-safety control systems in the secondary side, and this is substantially supported by operational experience. It is increasingly so because as time goes on the neutron fluence to which the vessels of all reactors are exposed is increasing, and for several of them, I believe that a dangerous level has already been reached. I believe that this level is probably as low as 4 FPYE of operation for vessels with high copper alloy walls or welds. This is supported by analyses performed for the NRC, indicating that the overcooling transient that took place at Rancho Seco on March 20, 1978 would have caused such a vessel to rupture, had it been in operation for about 10 FPYE. However, that transient was not as severe as we can expect on a reasonable worst case basis. Furthermore, a recent discovery of a discrepancy existing

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between the estimated vs. the measured values of neutron fluence for the Maine Yankee reactor vessel indicates a generic problem that makes things worse. The results of dosimetry measurements indicate the actual neutron fluence to be some 2.3 times higher than that estimated in the Maine Yankee Final Safety Analysis Report. Moreover, as you may recall, one of the measures ordered by NRC after the TMI-2 accident was to have all reactor operators not turn off the ECCS once it had been initiated. This might be desirable in some cases of accidents, but not necessarily in every case. For overcooling transients, without a large LOCA, the continued operation of ECCS compounds the accident by contributing to the cool-down process, and, most importantly, by repressurizing the primary system.

The pressurized thermal shock phenomena have not been the subject of experimental work by the NRC nor the industry. Nor have the control systems and their implications to safety been reviewed and analyzed. These crucial shortcomings pose some questions on the effectiveness of the regulatory process, which you may as easily as I ponder, but the immediate concern is to assure the safety of operating plants. Faced with the realities that we are faced today, and taking the approach that if we err, we should err in the direction of safety, it is apparent to me that those PWR's with high copper alloy vessels or welds, that have operated for 4 FPYE must be shutdown until this matter is resolved in the technical arena. It is conceivable that after additional and plant specific studies additional measures may be required.

Even though the Commission and the ACRS would probably respond to your letter of December 24, 1980 on the safety implications of control systems in a few months, I believe that this matter is serious and pressing enough, that requires a decision now. I believe that the Commission, with Congressional assistance and appreciation of the issues involved, will respond constructively.

If I can be of further assistance, please let me know.

Respectfully,

Demetrios L. Basdekas

Demetrios L. Basdekas
Reactor Safety Engineer

cc: Congressman Lujan
Congressman Markey
Chairman Hendrie

Enclosure 2

SUMMARY OF THE INDEPENDENT CAPABILITY OF THE NRC STAFF AND ITS CONTRACTORS IN THE TECHNOLOGY RELATED TO PRESSURIZED THERMAL SHOCK

The analysis of thermal shock to pressure vessels requires the ability to identify and analyze power plant system transients and then compute the pressure vessel transient temperatures, thermal and load stresses, and failure or fracture potential.

For the specification of the power plant system transients, the NRC staff has developed in-house capability to identify and analyze these transients for ranges of postulated plant conditions. NRC contractors, including BNL, INEL, Sandia, ORNL and Los Alamos, have contributed to the development of methods and codes for these analyses. Experiments with model systems and components provide test data for code validation.

For the analysis of the pressure vessel temperature transients and fracture potential, the NRC staff has developed computerized methods independently from more extensive and detailed methods being developed by ORNL under NRC contract. The NRC staff now also has the capability of running remotely the ORNL code on the ORNL computer with local print-out and plotting of the results.

Significant progress has been made at BNL in the measurement and calculational prediction of neutron irradiation of pressure vessels under NRC contract. The methods are used to determine neutron irradiation for specific plants with various peripheral arrangements of fuel assemblies.

The HSST program at ORNL will include a new pressurized thermal shock test facility. This will provide a unique capability in testing pressure vessels to failure to determine safety margins.

The NRC staff includes personnel with wide experience and numerous publications in the areas of systems analyses, materials applications, the effects of neutron irradiation on material properties, the effects of residual elements on weld properties and the application of fracture mechanics to pressure vessel potential failure and fracture.

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Chairman Hendrie	FINAL REPLY	[illegible] 7/30/81	☐ CHAIRMAN
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			OTHER:

DESCRIPTION ☒ LETTER ☐ MEMO ☐ REPORT ☐ OTHER

Request Commission's view re Basdekas' concerns about pressurized thermal shock that might occur following certain kinds of overcooling transients resulting from control system malfunctions

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Incoming From: Rep Morris K. Udall

To: Hendrie Date 5/1/81

Subject: re Demetrios Basdekas concerns about pressurized thermal shock that might occur following overcooling transients resulting fm malfunctions

XXX Prepare reply for signature of:

XXX Chairman Date due Comm: May 22

☐ Commissioner ____

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