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TO: Mr. George Lear

FROM: Iowa Elec. Light & Pwr. Co.  
Cedar Rapids, Iowa  
Lee Liu

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DESCRIPTION *re 10-27-77 meeting*

Consists of a report on the status of Iowa Electric's evaluation of the potential effect of multiple subsequent actuations of relief valves on the torus & torus support system.

PLANT NAME: Duane Arnold  
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(4-P)

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IOWA ELECTRIC LIGHT AND POWER COMPANY

General Office

CEDAR RAPIDS, IOWA

November 1, 1977  
IE-77-2028

LEE LIU  
VICE PRESIDENT - ENGINEERING



Mr. George Lear, Chief  
Operating Reactors Branch 3  
Division of Operating Reactors  
Nuclear Regulatory Commission  
Washington, D.C. 20555

Dear Mr. Lear:

This is to report on the status of Iowa Electric Light and Power Company's evaluation of the potential effect of multiple subsequent actuations of relief valves on the torus and torus support system for the Duane Arnold Energy Center (DAEC). Provided below is a brief statement of the recent history of this matter during October, 1977; a summary of the results presented by General Electric during an October 27, 1977 meeting with the NRC; and the results of an independently performed conservative evaluation. The results presented herein lead to the conclusion that this postulated event does not constitute a threat to the DAEC containment boundary.

Recent investigations by the General Electric Company (GE) have determined that the system which controls the relief valves as described in the BWR/6 GESSAR 238 Nuclear Island should be modified. GE first discussed this with the NRC staff on October 6, 1977 in Bethesda. During that discussion, the NRC staff requested that GE report in writing and also address this matter as it applies to GE reactors located in Mark I and II Containments. This was done in an October 11, 1977 letter addressed to Mr. Norman C. Mosley, Director of the Division of Reactor Construction Inspection.

Prior to the October 11, 1977 letter, this matter, as it related to Mark I Containments, was discussed by the NRC staff and GE during a telephone call on October 7, 1977. A comprehensive series of relief valve discharge tests had been conducted at the Monticello plant in June, 1976. Based on data from these tests, GE concluded and advised during the October 7, 1977 telephone call to the NRC that postulated multiple subsequent actuations of relief valves in Mark I Containments do not constitute a threat to public health and safety.

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Since those initial discussions and the October 11 letter, GE and the Mark I Owners Group have been conducting further evaluations, both generic and plant unique, to assess the responses of Mark I Containments to postulated loadings resulting from multiple subsequent actuation of relief valves. These evaluations are based upon the use of analytical procedures which modify the Monticello test results to account for plant unique differences. The details of these plant unique evaluations were presented to the NRC staff by the Mark I Owners Group during a meeting in Bethesda on October 27, 1977. At the conclusion of that meeting, the staff requested that Iowa Electric Light and Power Company (IELP) submit a letter on the DAEC docket which documents the bases of the conclusion that loadings on the containment of the DAEC resulting from this postulated event do not constitute a threat to public health and safety. This letter responds to that request.

As mentioned above, the evaluation which was described to the staff on October 27 utilized results from the 1976 Monticello relief valve test. The report of this test provided, among other things, torus shell stresses and torus support column loads for first actuations of a single valve as well as first actuations of two and three valves simultaneously. Also, this same information is provided for subsequent actuations of a single valve. The basic data base was used for various numbers of subsequent relief valve discharges. GE also conducted transient analyses and reviewed startup test and operating data for actual observed transients for many plants. Based upon this information, GE concluded that, on a most probable basis, none of the operating plants with Mark I containments would experience more than three (3) simultaneous subsequent actuations of relief valves due to isolation events. Column loads and shell stresses for the Monticello torus corresponding to the subsequent actuation of three relief valves were estimated by use of the available test data. Relief valve discharge clearing loads on the torus shell were computed for a single representative Monticello relief valve discharge line geometry and torus geometry. Similarly, this calculation was made using DAEC geometry. The ratio of the two computed results was used to correct the Monticello column loads to obtain predicted DAEC column loads for the postulated three valve, subsequent actuation case. This ratio as well as the ratio between Monticello and DAEC shell thicknesses were used to predict DAEC torus shell stresses for the postulated loading.

The results were compared with ultimate capacities which had been computed using Mark I Short Term Program (STP) Criteria procedures. As reported on October 27, this evaluation resulted in the conclusion that sufficient margin against containment failure exists.

Specifically, it was reported that for three simultaneous subsequent actuations at DAEC combined with dead load and seismic loads, maximum shell stress was estimated at 12455 psi. This is well below the ASME Section III, Class MC code allowable. The maximum ratio of the estimated column load to the ultimate capacity of the column and its attachment to the shell (i.e., the STP Strength Ratio) was 0.49.

Iowa Electric Light and Power Company and its consultant, NUTECH, recognize that there are a number of judgments which have to be made to arrive at the above-described DAEC plant unique results. The first of these is the assumption that three valves are an upper boundary of the most probable estimate of the number of valves which will experience subsequent actuation. In order to qualify this assumption, IELP instructed GE to conduct a DAEC plant unique transient analysis in order to determine the number of valves which could discharge more than once during an isolation transient. The plant unique analyses was conducted for an equilibrium core at end-of-cycle conditions using the same conservative input used for reload licenses. The preliminary results of this analysis indicate that up to two valves could experience multiple actuations. Other matters of judgment are such things as the procedure used to add column loads obtained from the various test runs made during the Monticello test to obtain loads corresponding to DAEC discharge locations as well as the multiplier which is used to adjust first actuation results in order to obtain subsequent actuation loads, i.e., the "hot pop multiplier". The results reported on October 27 were based upon values and calculational methods subject to engineering judgment. With this in mind, we have reviewed the results with a two valve subsequent actuation in order to establish a range of estimates for DAEC plant unique shell stresses and column loads for the isolation event. As a result of this effort, our analysis indicates that basic torus shell membrane stress will not exceed ASME, Section III, Class MC code allowables and the torus support system STP Strength Ratio will not exceed 0.60.

The DAEC has experienced nine Group I isolation events (MSIV closure). Of the isolation events, only one has resulted in multiple sequential actuation of relief valves. This event was a startup test from an initial power level of 99% rated. The test results indicated that 25 subsequent actuations occurred, but it cannot be determined how many valves experienced multiple actuations. Only three Group I isolation events have occurred since the startup test program. This demonstrates that the results of the GE transient models are very conservative when applied to the DAEC.

An additional isolation event occurred this afternoon. Information concerning multiple actuations for this event will be forwarded as soon as available.

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To assure ourselves that multiple subsequent actuations are not a concern at the DAEC, the following action is being taken:

- (1) Iowa Electric will modify the topworks of the two low-set-point reliefs, such that the two low-set-point reliefs discharge to bays not adjacent to each other. This results in torus support strength ratio improvement of 20% for the two valve subsequent actuation case to 0.48 using conservative assumptions. This action will be completed prior to December 1, 1977.
- (2) Procedures will be implemented as appropriate, similar to GE's recommendations contained in preliminary SIL 250, to reduce the probability/consequences of multiple subsequent actuations of relief valves.
- (3) A subsequent evaluation and action plan, if needed, will be submitted within 60 days.

Iowa Electric has been evaluating modifications to be installed to meet Long Term Program LOCA loads. The proposed modifications will also reduce STP strength ratios for multiple subsequent actuation of relief valves. We will keep you advised of any modifications approved for installation at the DAEC.

From the above it can be concluded that continued safe operation of the DAEC is assured. Multiple subsequent relief valve actuations are predicted by conservative models, but operating experience demonstrates that the models are very conservative. Inspections of the torus after Group I isolation events have occurred demonstrate adequate safety margins. This letter report has been reviewed by the DAEC Operations Committee and DAEC Safety Committee and found not to involve significant hazards considerations.

Very truly yours,



Lee Liu  
Vice President, Engineering

LL/KAM/ms

cc: K. Meyer  
D. Arnold  
R. Lowenstein  
R. Clark (NRC)  
L. Root  
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