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Alabama Power
the southern electric system

September 23, 1980

Docket No. 50-348
No. 50-364

Mr. James P. O'Reilly
U. S. Nuclear Regulatory Commission
Region II
Suite 300
101 Marietta Street, N.W.
Atlanta, Georgia 30303

Dear Mr. O'Reilly:

In response to I.E. Bulletin 80-18, "Maintenance of Adequate Minimum Flow Thru Centrifugal Charging Pumps Following Secondary Side High Energy Line Rupture," dated July 24, 1980, Alabama Power Company submits the enclosed response for Units 1 and 2 of Farley Nuclear Plant.

If there are any questions, please advise.

Very truly yours,

F. L. Clayton, Jr.

RWS:de

Enclosures

cc: Mr. R. A. Thomas
Mr. G. F. Trowbridge
Mr. L. L. Kintner (w/enclosures)
Mr. E. A. Reeves (w/enclosures)
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Enclosure

Item

1. Perform the calculations, outlined in the enclosure, for your plant.

Response

Calculations were performed to evaluate the centrifugal charging pumps utilized in Joseph M. Farley Nuclear Plant Units 1 and 2. This evaluation was intended to determine if each of these pumps would maintain a minimum flowrate of 60 gpm to the RCS, at the pressurizer safety valve pressure setpoint, during parallel pump operation.

The J. M. Farley Units 1 and 2 centrifugal charging pump (CCP) developed head data, was corrected, taking into account any inaccuracies, and used to construct maximum (strong pump) and minimum (weak pump) flow versus head curves. These curves were used to determine the flowrate delivered by the strong pump at the weak pump flowrate of 60 gpm. This flowrate was then used in calculating the head loss in the safety injection and RCP seal injection piping. The head losses from the injection piping resistance, RCS pressure drop and the elevational differences between the RWST and the pressurizer safety valves were evaluated against the weak pump developed head at 60 gpm to obtain the maximum RCS pressure at which 60 gpm through the weak CCP will be guaranteed.

The results of this calculation indicated that the maximum RCS pressure at which 60 gpm flowrate is maintained through the weak CCP is 1959 psig and 2366 psig respectively for Units 1 and 2. Comparing these maximum RCS pressures to the safety valve pressure setpoint of 2510 psig, it is evident that the 60 gpm minimum flowrate required for continuous CCP operation could not be guaranteed.

Item

2. If availability of minimum cooling flow for the CCP's is not assured for all conditions by the calculations in 1:

   a. Make modifications to equipment and/or procedures, such as those suggested in the enclosure, to insure availability of adequate minimum flow under all conditions. If modifications are made as described in the attachment for interim modification II, verify that the Volume Control Tank Relief Valve is operable and will actuate at its design setpoint.

   b. Justify that any manual actions necessary to assure adequate minimum flow for any transient or accident requiring SI can and will be accomplished in the time necessary.

   c. Verify that any manipulations required (valve opening or closing, along with the instrumentation necessary to indicate need for the action or accomplishment of the action, etc.) can be accomplished without offsite power available.

   d. Justify that flow available from the CCP's with the modifications in place will be sufficient to justify continued applicability of any safety related analyses which take credit for flow from the CCP's (LOCA, HELB, etc.).

   e. Justify that all Technical Specifications based on the Item 2.d analyses remain valid.

Response

(2.a.) Alabama Power Company has implemented, for both Units 1 and 2, modifications to equipment and procedures to ensure the availability of adequate minimum flow under all conditions. These modifications consist of the following:

1. The charging pump minimum flow isolation valves have been modified to the extent that they no longer automatically close on the receipt of a safety injection actuation signal.

2. Farley Units 1 and 2 procedures have been revised to reflect the following:

   a. Verification that CCP miniflow return is aligned directly to the CCP suction during normal operation with the valve in the alternate return path to the volume control tank locked closed.

b. Emergency operating procedures have been revised to instruct the operator to:

1. Close the CCP miniflow isolation valves when the actual RCS pressure drops to the calculated pressure for manual RCP trip (1300 psig).

2. Reopen the CCP miniflow isolation valves should the wide range RCS pressure subsequently rise to greater than 1900 psig.

(2.b.) The above outlined modification to assure minimum CCP flow includes instructing the operator to close the CCP miniflow isolation valves when the RCS pressure drops to the calculated pressure for manual reactor coolant pump trip. This operator action time is thus consistent with operator action time presently required following plant transients. In addition, Westinghouse performed generic sensitivity analyses (Attachment 1) which demonstrate that operator action to close the CCP miniflow valves can be delayed for ten (10) minutes without unacceptable impact. These analyses were performed for those transients which initiate safety injection and are sensitive to CCP flow delivery.

(2.c.) The charging pump miniflow isolation valves are motor operated valves powered from the diesel generators upon loss of offsite power.

(2.d.) As discussed in item 2.b., Attachment 1 discusses the impact of the recommended operating procedure modifications on the results of the various accidents which initiate safety injection and are sensitive to CCP flow delivery. These sensitivity analyses indicate that the incorporation of the above outlined modifications, to assure minimum CCP flow, result in no unacceptable impact.

(2.e.) Technical Specifications for CCP operation have been reviewed against the analysis described in item 2.d above. These specifications remain valid.

Item

3. Provide the results of calculations performed under Item 1, and describe any modifications made as a result of Item 2 (include the justifications requested).

Response

The results of the calculations that were performed and a description of the modifications that have been implemented for both Units 1 and 2 including justifications are provided in the foregoing discussions.

Attachment 1

Secondary System Rupture

Sensitivity analyses have been performed for secondary high energy line ruptures to evaluate the impact of reduced safety injection flow due to normally open miniflow isolation valves. These analyses indicate an insignificant effect on the plant transient response.

A. Feedline Rupture

Following a feedline rupture, the reactor coolant pressure will reach the pressurizer safety valve setpoint within approximately 100 seconds assuming maximum safeguards with the power-operated relief valves inoperable. With minimum safeguards, the reactor coolant pressure will not reach the pressurizer safety valve setpoint until approximately 300 seconds. The time that the reactor coolant system pressure remains at the pressurizer safety valve setpoint is a function of the auxiliary feedwater flow injected into the non-faulted steam generators and the time at which the operator is assumed to take action. With the miniflow isolation valves open, the peak reactor coolant system pressure and the water discharged via the pressurizer safety valves are insignificantly changed from the FSAR results.

B. Steamline Rupture

The effects of maintaining the miniflow isolation valves in a normally open position was also investigated following a main steamline rupture. For the condition II "credible" steamline rupture, the results of the transient with the miniflow valves open showed that the licensing criterion (no return to criticality after reactor trip) continues to be met. The condition III and IV main steamline ruptures were also reanalyzed assuming the miniflow valves were open. The results of the analysis showed that, even with reduced safety injection flow into the core, no DNB occurred for any rupture.

Small Loss of Coolant Accidents

Sensitivity analyses have been performed to evaluate the impact of reduced safety injection flow on small break loss of coolant accidents (LOCA's). These analyses indicated that miniflow isolation can be delayed, but it must occur at some time into the small break LOCA transient in order to limit the peak clad temperature (PCT) penalty.

The modification delays miniflow isolation and reduces SI flow delivered by approximately 45 gpm at 1250 psia during the delay time period. The impact of this modification was evaluated based on two isolation times: 1) The time equivalent to the RCP trip time, and 2) approximately 10 minutes in the transient, or just prior to system drain to the break for the worst small break sizes. The second time was evaluated to determine the impact if the operator does not isolate miniflow within the proposed prescribed time. The spectrum of small break sizes are considered to encompass all possible small break scenarios. Only cold leg break locations are considered since they will continue to be limiting in terms of PCT.

A. Very small breaks that do not drain the RCS or uncover the core, and maintain RCS pressure above secondary pressure (< ∿2" diameter).

   For these break sizes, it is quite possible that the operator may never isolate the miniflow line, since the pressure setpoint will not be reached, and continued pumped SI degradation will persist. However, this will have no adverse consequences in terms of core uncovery and PCT. No core uncovery will be expected for the degraded SI case, similarly to the base comparison case with full SI. The only effect would be a slightly lower equilibration pressure for a given break size.

B. Small breaks that drain the RCS and result in the maximum cladding temperatures (2" < diameter < 6").

   This range of break sizes represents the worst small break size for most plants as determined utilizing the currently approved October 1975 Evaluation Model version, as shown in WCAP-8970-P-A. If miniflow is isolated at the RCP trip setpoint rather than the "S" signal, a reduction in safety injection flow of less than 45 gpm results, averaged for the approximately 50 second period of time separating the two events. This reduction in RCS liquid inventory results in core uncovery less than one second earlier, and has a negligible impact on PCT. If miniflow is isolated at the time of core uncovery, or approximately 10 minutes for break sizes in this range, a greater reduction in RCS liquid inventory results in a core uncovery 10 seconds earlier in the transients resulting in less than a 10°F PCT penalty for the worst size small break. This would not result in any present FSAR small break analysis becoming more limiting than the corresponding large break LOCA FSAR analysis.

C. Small break sizes larger than the worst break through the intermediate break sizes (≥ 6" diameter).

   Break sizes in this range have been determined to be non-limiting for small break utilizing the currently approved October 1975 Evaluation Model, WCAP-8970-P-A. If miniflow isolation occurs at the RCP trip time for these break sizes, the negligible effect on PCT presented above also applies. Similarly, if isolation occurs prior to core uncovery, the small (< 10°F) PCT penalty will result as well. However, for these larger break sizes, the time of first core uncovery occurs prior to 10 minutes. If miniflow isolation is not performed until 10 minutes, reduced SI will be delivered during the core uncovery time, which can have a greater impact on PCT. Studies indicate a potential PCT penalty of 40°F resulting for these non-limiting break sizes if miniflow is not isolated until 10 minutes. This is not expected to shift the worst break size to larger breaks, since these breaks are typically hundreds of degrees less than smaller limiting small breaks analyzed with the currently approved Evaluation Model.

For all FSAR small LOCA analyses, one complete train failure is assumed. It is clear that two charging pumps without miniflow isolation provides more flow than one pump with miniflow isolation. The impact presented in this evaluation maintains the one train failure and assumes no miniflow isolation for the remaining pump. If both pumps were operating, the PCT results would be much lower than present FSAR calculations even if miniflow isolation is not assumed to occur for the two pump case. In this situation, the plant FSAR small break calculations remain conservative.

These sensitivity studies form the basis for the recommended modifications to the emergency operating procedures. The accidents evaluated are relatively insensitive to the recommended modifications. Further, the accidents evaluated will give results that satisfy acceptance criteria as long as the CCP miniflow is isolated within 10 minutes of event initiation. However, small LOCA sensitivity studies with one SI train operating confirm that small LOCA analyses require miniflow isolation within 10 minutes.

To comply with the recommended modifications, the operator can isolate miniflow at any point in the depressurization transient prior to RCS pressure reaching the RCP trip setpoint. Should a repressurization transient occur, the operator can open CCP miniflow at any point between the RCP trip setpoint and 2000 psig. Such operator actions will ensure that plant accidents satisfy acceptance criteria and protect the CCP's from consequential damage during the repressurization transient that accompanies a secondary system high energy line repture at high initial power levels.