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U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D. C. 20555

Subject: McGuire Nuclear Station, Unit 2
Docket Number 50-370
Resolution of NRC Concerns Relative to the December 27, 1993 LOOP/SI Event and Potential for Blowdown of Two Steam Generators

On April 12, 1994, a conference call was held between Duke Power and the NRC, to discuss a concern on the part of the NRC regarding the potential for an uncontrolled blowdown of two steam generators. This concern was raised following the December 27, 1993 loss of offsite power (LOOP) and consequent safety injection event at McGuire. Attached are responses to the concerns discussed in the conference call, including: an analysis of the status of the FSAR Chapter 15 licensing basis (Attachment 1), a listing of actions taken to reduce the likelihood of safety injections occurring as a result of postulated future LOOP events (Attachment 2), and a discussion of actions taken regarding pertinent emergency procedures (Attachment 3). Note that Attachments 1 and 3 are also applicable to Catawba Nuclear Station. The actions to be taken (Attachment 2) at Catawba have not been finalized; they are uder review, and are likely to be similar.

If you have any questions, or would like additional information, please call Scott Gewehr at (704) 382-7581, or Jacky Lee at (704) 382-7565.

Very truly yours,

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Attachment 1

Discussion of the FSAR Chapter 15 Licensing Basis for Blowdown of More than One Steam Generator During a Steam Line Break Event

Background

Section 15.1.5.1 of the McGuire and Catawba FSARs contains the following statement:

> For any break, in any location, no more than one steam generator would experience an uncontrolled blowdown even if one of the (main steam) isolation valves fails to close.

The break analyzed in Section 15.1.5 of the FSAR is a 1.4 ft^2 rupture immediately downstream of the steam line flow restrictor, i.e., between the affected steam generator and its MSIV. Therefore, the MSIVs do not prevent the blowdown of this generator. However, blowdown of any other steam generator through such a break is prevented by two MSIVs in series, the one on the steam line with the break and the one on the steam line connected to the additional steam generator whose blowdown is being postulated. For a break downstream of the MSIVs, closure of the MSIVs prevents any steam generator from blowing down. For this scenario, a separate failure is required for each steam generator to blow down, e.g., blowdown of one steam generator requires a single MSIV failure while blowdown of two steam generators requires two MSIV failures.

In the December 27, 1993 McGuire Unit 2 event the B steam generator, even in the absence of a pipe break, blew down through a MSIV which did not close completely and then through sixteen 1.48 in^2 (0.16 ft^2 total) drain line valves. This raises the question of whether the licensing basis would continue to have been met if a break had also occurred, upstream of the MSIV, on a different steam line.

Relative Blowdown Rate of Open Drain Line Valves vs. FSAR Chapter 15 Assumed Break

The break analyzed in Section 15.1.5 of the FSAR is a 1.4 ft^2 break, the size of the integral flow restrictor within the steam generator outlet nozzle. To maximize the return to power in the analysis, the Section 15.1.5 assumed initial condition is zero power. The blowdown in this analysis would be different from a break initiated from full power. In an attachment to WOG-84-235, dated September 11, 1984,

the releases from a 1.4 ft^2 break from 102% power are shown. This analysis used a minimum auxiliary feedwater flow rate and minimum initial steam generator inventory in order to maximize U-tube bundle uncovery. The results show a steam line isolation at 10.95 seconds with a blowdown of the initial steam generator inventory by 140 seconds. This latter time is inferred from the time in the analysis at which the break mass flow rate stabilizes, indicating that the releases are coming only from continued feedwater addition.

An additional analysis of a 1.4 ft^2 break from 102% power is shown in Tables 6-54 and 6-55 of the McGuire FSAR. This analysis used a maximum auxiliary feedwater flow rate and maximum initial steam generator inventory in order to maximize inventory released to containment. The results show a steam line isolation completed between 7.5 and 8 seconds, with a blowdown of the initial steam generator inventory by 403 seconds. This latter time is again inferred from the time in the analysis at which the break mass flow rate stabilizes.

In the December 27, 1993, McGuire Unit 2 event, the initial condition was also full power, with a nominal steam generator inventory and an auxiliary feedwater flow rate somewhere between the assumptions in the two analyses previously cited. The plant data show a steam line isolation at 10:14 pm, and the steam generator wide range level indication shows a dry steam generator no earlier than 11:19 pm. It should also be noted that the failed MSIV, 2SM-5, at its most closed position had an area of 0.52 ft^2, more than three times the effective total area of the sixteen drain line valves. Therefore, the limiting area in this blowdown was the drain line valves, not the partially open MSIV.

Effect on Licensing Basis Analysis of Single MSIV Failure and Additional Steam Generator Blowdown via Drain Line Valves

By comparing these three cases, it can be seen that blowdown for a 1.4 ft^2 break from full power lasts anywhere from 130 to 395 seconds after steam line isolation, depending on the assumptions on steam generator initial inventory and feedwater flow rate. In the actual event at McGuire Unit 2, blowdown for a 0.16 ft^2 "break" from full power lasted 3900 seconds (the 65 minutes from 10:14 pm to 11:19 pm) after steam line isolation. In addition to the break size difference, the line losses are larger for the drain line valves failure since the 1.4 ft^2 break is assumed to be immediately downstream of the steam generator rather than beyond the MSIVs, through the equalization header, and

somewhere along the various steam extraction lines. Due to the long period required for blowdown of a steam generator through these drain lines, any positive reactivity inserted by this cooldown would easily be compensated for by previous, continued, or restarted borated water injection from the ECCS pumps. The time of minimum DNBR in the FSAR Section 15.1.5 analysis is at 234 seconds the time of peak heat flux from McGuire FSAR Table 15-13 for the nonlimiting offsite power lost case and much earlier than the time at which the slow blowdown of a second steam generator would begin to affect the RCS. The limiting offsite power maintained case has an even earlier time of minimum DNBR. It should also be noted that changing the single failure assumption to an MSIV would result in the availability of two trains of ECCS to inject borated water, causing a more rapid core shutdown. In summary, the FSAR Section 15.1.5 steam line break minimum DNBR analysis would be unaffected by a simultaneous blowdown of a second steam generator due to a failed open MSIV as long as the rate of blowdown of this second steam generator is limited by the area of the sixteen 1.48 in^2 steam line drain valves downstream of the MSIVs.

Attachment 2

Actions Taken to Reduce the Likelihood of Safety Injections Occurring on Postulated Future McGuire Loss of Offsite Power (LOOP) Events

Modification to the Failure Status of the Steam Line Drain Valves

Duke Power plans to modify all sixteen of the steam line drain valves so that they fail closed if offsite power is lost to one of the nuclear units at McGuire. This modification is currently planned for completion prior to the restart from the next refueling outage at each unit.

Revised Emergency Procedures and Enhanced Operator Training

A. Changes to technical procedures:

1. Changed the step checking for an uncontrolled cooldown in the Reactor Trip/Safety Injection procedure to check for cold leg temperature instead of reactor vessel average temperature if reactor coolant pumps are off. This is a WOG ERG Rev 1B change which had not yet been implemented.

2. Changed the use of the foldout page. In the past the SRO read the foldout page to the crew. Now the SRO hands out the foldout page to the two ROs, gives them approximately 30 seconds to read the foldout page, asks whether they understand the items on it, and then goes on with the procedure.

B. Training on technical changes:

1. An Operator Training Package was sent out to all licensed personnel communicating these changes.

2. These changes were covered in a live lecture in requal with the licensed operators in the LOOP lecture given by the Operations Support Manager.

C. Changes to administrative procedures:

1. The Operations Management Procedure (OMP) for shift turnover was changed to specifically name an "Offsite Communicator" whose duties are to provide timely, accurate communications to the offsite agencies. The offsite communicator was also listed on the shift

manning chart that the control room SROs fill out on shift to ensure they meet minimum manning requirements.

2. The OMP for use of abnormal and emergency procedures was enhanced to include a section dealing with control room crew responsibilities during transients and with the command and control communication model which is used in the control room.

D. Training on the administrative procedure changes:

1. An Operator Training Package was distributed to all licensed operators on the change to the shift turnover OMP which included an additional management expectation statement that only accurate information was to be given to the NRC and not "speculative" information.

2. The problems encountered with the notification to the NRC during the LOOP event and the change to the shift turnover OMP were covered in the live lecture given by the Operations Support Manager in licensed operator requal.

3. An Operator Training Package was distributed to all licensed operators on the change to the use of abnormal and emergency procedures.

E. Other Training Enhancements:

1. Enhanced license operator training to include practicing NRC notifications both in the classroom and on the simulator.

All these actions are complete except for E, which is a continuing action.

Attachment 3

Emergency Procedure Instructions Regarding Intentional RCS Depressurization to Limit Steam Generator U-tube ΔP to less than 1600 psi

- Immediately after the December 27, 1993, event, the NRC was given a written discussion of the basis for this procedural instruction as an attachment to the operability evaluation supporting McGuire Unit 2 restart.

- On July 1, 1993, Duke Power submitted direct work request DW-93-040 to the Westinghouse Owners Group (WOG) Operations Subcommittee asking them to determine whether such an action should be part of emergency procedures either on a generic or plant specific basis.

- On March 31, 1994, Catawba Nuclear Station implemented emergency procedures more closely based on Revision 1B of the WOG Emergency Response Guidelines. Pending resolution of the direct work request mentioned above, these new procedures do not contain the subject instruction.

- On June 30, 1994, McGuire Nuclear Station is scheduled to implement emergency procedures more closely based on Revision 1B of the WOG Emergency Response Guidelines. Pending resolution of the direct work request mentioned above, these new procedures also will not contain the subject instruction.

- If the direct work request is dispositioned to allow utilities to implement the instruction on a plant specific basis, Duke Power will at that time reconsider its decision to remove this instruction.