GI-193

"ECCS Suction Concerns"

Information Request Submitted to the BWROG

September 4. 2008

Introduction

An overall NRC assessment of this issue is available at:
http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr0933/sec3/193.html

GI-193 potentially affects all BWRs and is related to both large break and medium break LOCAs. However, at this time, it appears that the Mark I containment type may be the limiting case.

For that reason, current information needs focus on the following areas, all related to Mark I BWRs:

- Current industry state-of-knowledge of topics related to GI-193
- Low pressure ECCS pump start timing
- Wetwell geometry and strainer design considerations
- BWR Mark I suppression pool test facilities

Information Need 1: Existing industry design knowledge concerning void/bubble formation and its impact on low pressure, high flow ECCS pumps

Question 1.1: To what extent are the low pressure ECCS pumps, LPCI and core spray, capable of operating in an environment with potential voiding/air binding which may occur during the first few moments of the LOCA accident?

Question 1.2: Have any studies been performed, for purposes not associated with GI-193, which might provide insight into the extent of voiding in the suppression pool during and immediately following blowdown during a large break LOCA and the effect if might have on low pressure ECCS pump performance? Examples of previous studies which may be of tangential assistance include those industry studies associated with LOCA pool dynamic loads, the impact of pool swell and local pool temperature limits.

Question 1.3: How would an operator monitor air binding in ECCS pump during the early stages of a large LOCA?

Information Need 2: LOCA low pressure ECCS pump timing

Discussion: The potential vulnerability described in GI-193 is strongly related to low pressure ECCS pump start timing in that the low pressure ECCS pumps, LPCI and core spray, are expected to start up at about the same time that the bubble formation and agitation is at or near its peak. Typically, the pumps run first on minimum flow and then ramp up to full flow for the design basis LOCA, once the injection valve permissive of low reactor pressure is reached.

LPCI and CS pump start timing appears to be plant specific and motive power specific. For example, the timing of the ECCS pump starts appears to be dependent upon the availability of offsite power. In some cases, Browns Ferry 1 large break LOCA, for example, it appears that the ECCS pumps are staged on faster when offsite power is not available than when it is available. This may not be the general case, however, since for other plants, e.g., Hatch, the opposite appears true, namely, that the pumps start faster when offsite power is available. This would pose a situation in which the most challenging scenario from the impact of voiding may not be the design basis LOCA since that assumes simultaneous LOCA combined with loss of offsite power, thus necessitating a diesel powered start for the ECCS pumps.

To assess the impact of voiding, it appears that the approximately the first 5 minutes following onset of the large LOCA and the first 15 minutes following onset of a medium LOCA will be the most critical because that is the intersection of the maximum void production/agitation along with the start/ramp up of the ECCS pumps resulting in the potential for the pumps to fail or be shut down.

Question 2.1: Please provide a representative time history for a typical BWR Mark I for approximately the first 5 minutes following onset of a *large break LOCA* and 15 minutes following onset of *a medium break LOCA*, displaying:

- associated reactor vessel permissives impacting pump start, e.g., reactor low pressure
- staging of LPCI and core spray trains (i.e., all start at once or in stages), and
- duration of time pumps are in minimum flow

for both:

- (1) the DBA case of simultaneous LOCA/LOOP and
- (2) the case of offsite power available, in which the pumps would be started from offsite power

Information Need 3: Wetwell/Downcomer/Suction Strainer Considerations

Discussion: The extent and impact of the voiding phenomena appear to be dependent upon the physical proximity of the ECCS suction strainer and the downcomer. It appears possible that, in the worst case scenario in which the two are closely aligned, a slug of water and bubbles through the downcomer, resulting from the LOCA, could be carried directly into the suction strainer. It is also possible that the worst case alignment may not occur for all the downcomers at that plant. In other words, there may be a limited number of downcomers/strainer setups where the worst case geometry prevails.

Question 3.1: Please provide information pertaining to downcomers vis-à-vis the ECCS LPCI and CS suction strainers:

- A representative range of downcomer/strainer geometries, specifically, the distance between the downcomer and the suction strainer and relative angle between the two; and an indication if a typical plant has the same geometry across all downcomers.

- The worst case geometry between downcomer and strainer, i.e., the closest in proximity so as to maximize water jet impingement into the strainer during blowdown.

- The "typical" geometry between the downcomer and strainer

- Characteristics of a typical ECCS suction strainer in enough detail to allow a computer model to be generated. Include dimensions of the openings and design flow rate/pressure drop.

Question 3.2: Did any analyses or testing related to the suction strainer redesign program (addressing debris blockage) assess whether the revised suction strainers might deter or promote gas entrainment into the ECCS suction? In other words, have any studies taken place to evaluate the extent to which bubbles formed during blowdown would pass through the strainers given their design flow rates and the strainer openings?

Question 3.3: Other than the Brown's Ferry plants, do any other Mark I's have a common ring header below the suppression pool used for ECCS suction?

Information Need 4: Available test facilities

Question 4.1: Are any tests facilities still available for Mark I containments that could be instrumented to measure voiding and void transport under LOCA blowdown conditions?