AP1000DCDFileNPEm Resource

From: DeBlasio, John J. [deblasjj@westinghouse.com]
Sent: Wednesday, June 09, 2010 2:41 PM
To: Buckberg, Perry
Subject: FW: RAI-SRP5.4.1 CQVB-01 Draft R!
Attachments: RAI-SRP5 4 1-CQVB-01 Draft R1.doc

Is this okay.

From: DeBlasio, John J.
Sent: Wednesday, June 09, 2010 1:43 PM
To: Buckberg, Perry
Cc: Melton, Michael A
Subject: RAI-SRP5.4.1 CQVB-01 Draft R!

Attached is a revised response to RAI-SRP5.4.1-CQVB-01. This revision is based on several discussions with the NRC. Please review and provide any comments to this version of the draft response. If you have any questions, please send me a reply. I am currently in the NRC Shield Building at the Chase Hotel.

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412 916-6730 Cell Phone

Hearing Identifier: AP1000_DCD_Review
Email Number: 412

Mail Envelope Properties (61EA882EF664FC40AEFFD704C920596705FBB4D830)

Subject: FW: RAI-SRP5.4.1 CQVB-01 Draft R!
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From: DeBlasio, John J.

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Recipients:
"Buckberg, Perry" <Perry.Buckberg@nrc.gov>
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MESSAGE	540	6/9/2010 2:42:39 PM
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AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-SRP5.4.1-CQVB-01
Revision: ~~0~~Draft 1

Question:

Variable frequency drives, discussed in DCD section 5.4.1.2.1, are used for RCP startup and operation when the reactor trip breakers are open. There is no discussion of variable speed drive overspeed trips in the DCD, and there are no ITAAC for ensuring that such trips exist, are properly designed, are tested, and are operational. The variable frequency drives for the AP1000 RCPs are non-safety related and could potentially fail (or be mis-calibrated) in a way that would result in flow rates in the reactor coolant system in excess 104% best estimate analysis referenced in the DCD. Paragraph 5.1.4.4 of Revision 16 of the DCD states that the "Mechanical design flow is the conservatively high flow used as the basis for the mechanical design of the reactor vessel internals, fuel assemblies, and other system components. Mechanical design flow is established at 104 percent of best-estimate flow."

Is it possible for the variable frequency drives to fail or be mis-calibrated in a way that would result in reactor coolant system flow in excess of 104 percent? If so, please describe the provisions for ensuring that failure of the variable frequency drives will not cause a RCP overspeed condition in excess of the 104 percent best estimate flow rate?

The basis for the methodology should be incorporated into the AP1000, Tier 2 information.

Westinghouse Response:

For AP1000 plants located in the United States, the source of power to the reactor coolant pumps must be switched from the variable frequency drives (VFD) to unit transformers (grid) before the reactor trip breakers are closed. This is ensured by adherence to Technical Specification 3.4.4, RCS Loops. Therefore, when the reactor is critical the speed of the reactor coolant pumps is controlled by the grid and not the VFDs. Therefore potential overspeed conditions resulting from a failure of the VFDs is limited to periods of reactor coolant system heatup and cooldown when the reactor coolant pumps are operating on the VFDs. Since the reactor is not critical during these times, any pump overspeed which occurs during these periods does not compromise core cooling or result in a reactor power transient that would be required to be mitigated by safety systems.

The VFDs will be programmed with a few specific pump speed setpoints (which are maintained within ±0.5hz steady state). The VFD does have non-safety controls, and therefore, a failure in the VFD which could result in the reactor coolant pump speed exceeding the setpoint, while unlikely, is possible. The mechanical design flow (104% of best estimate flow) is the maximum allowed continuous flow assuming lower than expected loop resistance and/or higher than expected pump performance. Therefore, mechanical design flow is the design basis flow for component analyses over 60 years of operation and is the assumed initial flow for transient

evaluations of components. The reactor internals, fuel, and other system components, however, are designed to comply with Level B service limits for transient conditions up to 120 percent of mechanical design flow. An example of a transient in which the reactor coolant pump exceeds 104 percent of best estimate flow is the Large Step Load Decrease with Steam Dump transient in which the electrical load on the generator is lost. In this transient, steam is dumped and the turbine is throttled back in order to continue operation at reduced power (house load level). For the 120 percent flow to be exceeded, would require multiple similar failures in more than one VFD simultaneously.

Even if the pump speed exceeds 120 percent of mechanical design flow for a short time (assuming 30 minutes for the operator to shut down the pumps) no damage to the fuel or reactor internals would be expected that would prevent the core from being cooled. No fuel failures from fretting wear would be expected to occur in the 30 minutes required for the operator to shut down the pumps. Fuel assembly bowing and damage to the top nozzle springs could be the consequences of flow rates above 120 percent. Similarly, no steam generator tube failures are expected to occur over this short time period of very high flow. Damage could occur to reactor internals components, such as guide tube bending or distortion. However, all control rods are already inserted in the core prior to the initiation of such a postulated event and removal of decay heat from the core is not expected to be challenged. Therefore, Westinghouse believes that although this event could cause hardware damage which would require inspection and possible repair/replacement, it would not result in a challenge to the AP1000 safety systems or risk to the public. Even in the extreme case of a resulting failure of a steam generator tube, the resulting releases would be bounded by the DCD Chapter 15 analysis of a steam generator tube rupture.

Most of the time during heatup and cooldown operations the reactor coolant pumps will be operating at less than full speed, which provides additional margin to the transient evaluation flow of 120% of mechanical design flow. Overspeed of the pump during system heatups and cooldowns, ~~therefore,~~ c~~w~~ould ~~only~~ pose a risk to overheating the reactor coolant pump motor. However p~~P~~ump motor protection is provided not only by the VFD controls, but also by IEEE standard protection equipment (non-safety) such as high current protection.

~~Therefore, Westinghouse believes that sufficient design features are in place to provide reactor coolant pump investment protection if there is a failure in the VFD speed control setpoint.~~

Westinghouse believes that additions to the AP1000 DCD Tier 2 information are not necessary to address this issue.

Design Control Document (DCD) Revision:
None

PRA Revision:
None

Technical Report (TR) Revision:
None