From: Steven Long NRR
To: Patrick Milano NRR
Date: 3/5/01 7:56AM
Subject: Answer to Anonymous Question #1

Pat,

The attached file has my suggested answer to the first question.

Let me konw if you think it needs to be changed in some way. We need to be careful not to make mis-statements.

Steve

CC: Patrick O'Reilly, Sunil Weerakkody

J/66

Question 1: How reasonable are the IP2 calculations? - The first event discovered latent failures that were not picked up during surveillance testing or maintenance. Also, first trip was "spurious," it was only "luck" that trip occurred before the tube rupture event occurred. (There was no other reactor trip in between these two event.) Had the latent failures in the plant

Response:

To respond fully to this question, it is appropriate first to consider what analyses were performed and what was left out, then to decide what the effect would have been if the additional factors had been included.

What calculations were done:

For specific events, RES calculates the conditional core damage probability (CCDP), but not the conditional large early release probability (CLERP) as part of the Accident Sequence Precursor (ASP) Program. NRR calculates the deltas in core damage frequency (ΔCDF) and large early release frequency (ΔLERF) for off-normal conditions identified by inspection activities.

RES performed two CCDP calculations for the two events at IP2. One evaluated the CCDP for the August 1999 LOSP event. When it was determined that the tube was weak during the LOSP event, the CCDP was reevaluated to consider the potential for SGTR to complicate the sequences that would lead to core damage and make them more likely, but there is not much effect on the overall CCDP. No attempt was made to to calculate the CLERP, but the RES analyst does agree that the tube degradation that existed at the time of the event would increase the fraction of the CCDP that is CLERP.

RES also calculated the CCDP for the February 2000 SGTF event. RES did not attempt to include the effects of an elevated potential for a LOSP and potential SBO following reactor trip due to the conditions revealed by the previous spurious trip event. If that were to be included, it would require some evaluation of the probability for the February event to be the first trip since the miscalibration set up the consequential LOSP upon trip. A logical way to do that would be to use $1-e^{-\lambda t}$ where λ is the trip frequency and t is the period between the calibration problem and the SGTF event. On the other hand, if the flaw that was missed happened to be weaker when the inspection occurred, it could have failed sooner, compared to the miscalibration event. Perhaps 0.5 is as close as we can get to the probability that these two problems would have compounded each other in a single event.

Region I, recognizing the potential for interaction of the two conditions, did attempt to calculate a CCDP and CLERP for a *hypothetical* event in which the LOSP conditions of the August event were assumed to occur following the trip associated with the February SGTF event. The effect was not great (39% increase) because the actual failures during the August LOSP event did not preclude mitigation of the February SGTF event. This calculation did include the effects of complications such as increased human error rates due to greater complexity and operator stress levels. It did not include some of the factors that RES has considered that lower the final results, so this numerical result is more useful from a relative importance perspective. If we apply a factor of 0.5 to account for the probability of the events occurring together, the effect would be only about a 20% increase in the CCDP and CLERP for the tube failure, alone.

As part of the SDP process, NRR estimated a ΔCDF for the last year of the period of operation with the degraded tube strength. This estimate included the potential for spontaneous rupture, pressure induced rupture and thermally induced rupture on CDF and LERF. However, this calculation did not include the higher frequency for core damage due to SBO from the conditions that existed until they were revealed by the August trip and LOSP event. Including it would substantially affect the ΔLERF calculation, but insignificantly affect the ΔCDF results. If this calculation had used the "high/dry" portion of the (current draft) ASP CCDP for the LOSP event, rather than the normal LOSP contribution to CDF, it would have estimated a "high-dry" CDF of at least 4.6×10^{-5} for the last year of plant operation, instead of the 1-to-2 $\times 10^{-5}$/RY value that was used in the significance determination process.

Do these calculations adequately capture the risk of the plant operations:

The questions raise the issues: 1) would it change our regulatory decisions for this situation at this plant if we had include these combined effects more fully, and 2) could concurrence of two conditions be important factors for other regulatory decisions at other plants?

It is clear that, for Indian Point 2, the resulting separate yellow and red findings for the new reactor overnight process put the plant into our most vigorous regulatory response framework, so the method used didn't result in an under-response in this case. If the weakened tube was included in the SDP for the LOSP event, it would have produced a ΔLERF that would have been in the "red" range instead of the "yellow" range. If the SBO frequency implications of the LOSP event were included in the SDP for the tube failure event, the range of results for the sensitivity case analysis would have been entirely within the red range, instead of bracketing the red/yellow threshold.

However, for other cases where the results may be a pair of "whites" or a "white" and a "yellow," when evaluated separately, there may be potential for a "red" when taken together. That could change our regulatory response. As discussed in response to question 4, the written SDP procedures have been revised to make it clear that it is our intent to quantify the effects of concurrent conditions to the extent that it is feasible to do so. However, this is complicated because PRA cutsets involve multiple equipment failures. So, multiple performance errors on the part of a licensee may (or may not) have multiple effects on the same cutsets. If so, it is a difficult logic problem to capture the full risk impact of each performance problem without making the sum of the results for all the performance problems exceed the total change in the plant's risk over the period(s) of concern.