From: "Parry II, John" <PARRYJ@coned.com> CON Ed
To: "'jmt1@nrc.gov'" <jmt1@nrc.gov> JTrapp, RI
Date: Mon, Oct 2, 2000 5:11 PM
Subject: RE: SGTF Calculation

Jim - Charlie Hayes provided a copy of the calculation that was performed back in March to determine the 109 gpm. I dropped a copy of the calculation in the Resident inspectors office today and asked them to send it to you. If you do not have it tomorrow please let me know and I will track it down. I'm at 914-788-3368. Jack

> -----Original Message-----
> From: James Trapp [SMTP:JMT1@nrc.gov]
> Sent: Friday, September 29, 2000 11:38 AM
> To: PARRYJ@coned.com
> Cc: BEH.kp1_po.KP_DO@nrc.gov
> Subject: SGTF Calculation
>
> After reviewing the data you sent on the leak rate, we still come up with
> a different answer. It could be because we're missing some critical
> information such as Tave. We would appreciate feedback on what's the
> basis for the difference in results. Thanks!
>
> Indian Point Unit 2
> SGTF Leak Rate Calculation
>
> Objective
>
> Calculate the IP2 SGT leak rate during the February 15, 2000 SG tube
> failure prior to the reactor trip.
> Assumptions
>
> * 1% change in pressurizer level ~ 125 gallons
> * AveTavg is constant between 19:17 and 19:29
> * Failure occurs @19:17 and letdown is isolated @19:29 duration of 12
> minutes
> * RCP seal injection flow into RCS remains constant during time of
> interest
>
> Calculation

net between unmeasured "goes-in" and "goes-out"

>
> Steam Generator Tube Leak Rate = [(total integrated charging flow+
> integrated RCP seal flow into RCS)-total integrated letdown flow (between
> 19:17 to 19:29)+ %change in pressurizer level*120]/ 12minutes
>
> Total integrated charging flow =1208 gallons - charging flow during 12
> minutes of interest =
> 60gpm*2min+({113+60}/2)*1min+113gpm*2min+100gpm*3min+119gpm*4min
>
> Total integrated letdown flow = 1044 gallons - letdown flow during 12
> minutes of interest = 12 min*87gpm
>
> Total integrated RCP seal injection flow into RCS = 324 gallons - (87 gpm
> letdown - 60 gpm charging)*12 minutes

J/34

\>
\> Decrease in Pressurizer Level in gallons between 19:17 and 19:29 = 1125
\> gallons - (45%-36%)*125gallons/%
\>
\> Steam Generator Tube Leak Rate = [(1208 gal+324 gal)-1044
\> gal]+1125]/12minutes = 134 gpm
\> Conclusion
\>
\> The Steam Generator Tube Leak Rate prior to the reactor trip on February
\> 15, 2000 was approximately 134 gallons per minute.
\>
\>

CC: "Parry II, John" <PARRYJ@coned.com>, "McCann, John...

Indian Point Unit 2
SGT Failure Risk Perspective

The licensee presented a risk analysis at the NRC Regulatory Conference. The licensee analysis determined that Yellow, not Red was the appropriate risk level for the steam generator findings. The key assumptions made in the licensee's analysis was that based on the 2000 SG inspection results, the likelihood of a tube leak (<225gpm) was much higher than a full tube rupture. A sophisticated method was employed to determine the frequency of tubes failures which leak versus rupture. The licensee used this input to split SGTR calculations into 2 categories based on leak rate. The lower leak rate (higher probability) SGTFs had were modelled with relaxed success criteria because of the additional time available for operator actions and the ability to use the charging pump if the SI pumps were to fail. These assumptions resulted in a lower delta-CDF value (delta CDF ~ 6.7E-6 (White)). The licensee also provided a site specific delta-CDF to delta-LERF correlation. The NRC's analysis used a conservative assumption provided in appendix H of the SDP guidance. The site specific LERF/CDF correlation reduced the fraction of SGTF sequences which result in core damage by nearly an order of magnitude. Using this assumption the licensee determined the delta-LERF was ~ 4.5E-6 (Yellow).

Key Assumptions

- Delta-CDF to Delta-LERF Conversion - NUREG-1560, "Individual Plant Examination Program: Perspectives on Reactor Safety and Plant Performance, Vol. 1 & 2, Figure 12.23, provides the conditional containment failure probability (CCDP) for large dry plus subatmospheric PWR containments. The CCDP is the probability that containment will be bypassed if a core damage event occurs. The CCDP for containment bypass is dominated by SGTR. From Figure 12.23 it can be determined that the worse case CCDP for SGTR containment bypass events is 0.45 (Prairie Island) followed by Ginna at 0.4 with the majority of other plants at ~ 0.1. Therefore, ConEdison's estimate of 0.13 for the delta-cdf to delta-LERF is reasonable.

- Initiating Event Frequency - ConEdison's risk analysis of this event used a complex monte carlo estimate to establish an initiating event frequency for the actual conditions in the steam generator. The analysis was very in-depth and resulted in a conditional SG tube failure probability of .28 for leaks between 75 gpm and 225 gpm and a conditional probability of a rupture of greater than 225 gpm of .039. This analysis used the 2000 eddy current testing results to determine the magnitude and quanity of existing flaws, crack growth rate estimates, and material properties and tube stress levels to estimate the size and frequency of tube ruptures. These results are not consistent with the sparse industry experience of actual failures in NUREG/CR-6365 which describes 2 PWSCC failures one at Surry (~330gpm) and one at Doel (~135 gpm). Since the licensee's analysis results are not consistent with actual industry experience, the NRC's estimate of 0.5 tube ruptures should continue to be used.

Analysis

- Spontaneous Ruptures - From the IPE the contribution of CDF from SGTR's is 1E-6. Dividing this by the revised initiating event frequency due to the performance issue (change IE frequency from nominal 1.3E-2/yr to .5/yr) will result in the spontaneous rupture delta-cdf for these findings. Delta CDF ~ 1E-6/.5=2E-6, Delta LERF=2E-6*.13=2.6E-7

Delta-CDF ~ 2E-6 Delta-LERF ~ 2.6E-7

- Induced Ruptures (Secondary Depressurizations) - using a initiating event frequency for a stuck open safety valve plus a steam line break inside containment from NUREG\CR-5750, Table 3-1 (5E-3+1E-3=6E-3) (less than the NRC's estimate for depressurization events 7.6E-3/year stated in IR 2000-10). Other assumptions 1/4 Sgs suspectible (all other defects passed burst test - negligible leakage at SLB conditions), probability depressurization will result in a rupture .5 (less than 1 used in IR 2000-10 due to insights from Regulatory Conference i.e all tubes with flaws met 3 times delta P burst margin criteria), human error probability 1E-2. The delta-CDF contribution is [(6E-3/4)*.5)]*.01= 7.5E-6. Since containment bypass is assumed delta-LERF ~7.5E-6

Delta-CDF ~ 7.5E-6 Delta-LERF ~ 7.5E-6

- ATWS induced SG Tube Ruptures - based on the licensee's PRA the ATWS contribution to delta-CDF is 5E-7. A conservative assumptions is that all ATWS CD sequences lead to a SGTR . Delta LERF ~ 6.5E-8.

Delta CDF ~ 5E-7 Delta LERF ~ 6.5E-8

Final Results

- **Total delta CDF ~ 1E-5 (Yellow) Total Delta LERF ~ 7.83E-6 (Yellow)**

Conclusion

The NRC's analysis for determining risk of this condition documented in IR 2000-10 determined a Red significance finding for both Delta-CDF and Delta-LERF. The licensee provided additional information at the Regulatory Conference that was used to modify the previous analysis. The risk estimates, while in excess of those determined by CE show that Yellow would be the proper significance color for these findings. This assessment also shows that an extensive analysis of the licensee's monte carlo initiating event frequency is not needed and would not be an effective use of NRC resources.