The exceptions are the Prairie Island 1&2 and Shearon Harris IPEs. In the Prairie Island 1&2 IPE, the conditional probability of bypass is almost 45% of total CDF, of which two-thirds is attributed to temperature-induced SGTR and one third to SGTR initiated events. In the Shearon Harris IPE, the conditional probability for containment bypass is about 0.1, half of which is attributed to temperature-induced SGTR. The high probability of temperature-induced SGTR in these IPEs results from the consideration of reactor coolant pump (RCP) restart and the high value used for the probability of steam generator tube thermal failure for cases where the RCP is on (0.5 versus 0.01 used in other IPEs).

These submittals report that the procedural guidance requires the operators to restart the RCPs when inadequate core-cooling conditions are indicated. This restart clears the RCP seals and establishes a natural circulation path, resulting in increased steam generator tube heating and the potential for a temperature-induced SGTR. Secondary side depressurization, also included in the procedures for restoring heat removal, can increase the pressure differential across the tubes and may further increase the potential for failure. However, some of the IPEs cite primary side depressurization as a way to reduce the probability of temperature-induced SGTR. In the Seabrook IPE, the addition of an alternative independent emergency feedwater pump, that could be used during high-pressure core melt sequences is also listed as an improvement for reducing temperature-induced SGTR. Most IPEs do not consider the effect of RCP restart, and in some that do, a low probability of temperature-induced SGTR is used on the basis of the expected limited duration of RCP operation. This variability in the treatment of temperature-induced SGTR in the IPEs indicates the large uncertainty associated with this issue. Figure 12.26 shows for each plant in this group the fractional contribution to CDF from ISLOCA and SGTR initiators as well as their combined contribution. The figure also indicates the bypass fraction used in the Level 2 analysis. The difference between the Level 1 total contribution and the Level 2 values is principally because of the induced SGTR found in the individual analyses. As the figure shows, this difference is non-existent or small in most cases but there are some significant exceptions.

After the Prairie Island IPE, the highest bypass probability is predicted in the Ginna IPE (approximately 0.4), the majority of which results from the CDF analysis. Ginna has the highest bypass frequency found in any of the IPEs for plants with large, dry containments, almost 4E-5/ry. Another IPE with a high bypass conditional probability (almost 0.3) is the Zion IPE, nearly all of which is attributed to SGTR, derived from the CDF analysis. The IPEs for Braidwood and Byron report a low SGTR likelihood because credit is taken for a new steam generator design that uses smaller diameter tubes. These tubes reduce the leakage from primary to secondary side in the event of a rupture, and reduce the likelihood of core damage during the initial 24 hours.

12.3.1.4 Late Failure Perspectives

The containment phenomena that may cause late containment failures in large dry containments include (1) overpressurization with high temperatures due to non-condensible gases and steam or due to combustion processes, (2) containment basemat melt-through due to basemat penetration by core debris, and (3) vessel structural support failure due to core debris erosion.

The IPE results show that the dominant late containment failure mode is containment overpressurization, which occurs when CHR capability is lost. For some of the IPEs, fan coolers, which are not designed as engineered safeguards features, are credited for CHR. Late containment failure probabilities for the large dry containments considered in the IPEs range from negligible to about 0.7 with an average value of about 0.3.

Basemat melt-through occurs when the concrete basemat is penetrated because of CCI. This may happen if CCI is not terminated either because there is no water in the reactor cavity or because the core debris is not coolable even if water is available. Since the basemats of some PWR containments have considerable thickness, eventual