6E Additional Bypass Leakage Considerations

6E.1 Bypass Mechanism through ACS Interconnection

In accordance with the ABWR design, the ACS is provided to establish and maintain an inert atmosphere within the primary containment during all plant operating modes, except during shutdown for refueling or equipment maintenance or access for inspection at low reactor power. The ACS also maintains a slightly positive inert gas pressure in the primary containment during normal, abnormal and accident conditions to prevent air (oxygen) leakage into the inerted volumes from the secondary containment.

Isolation valves F040 and F041 (see Figure 6.2-39), which are normally open, make a direct flow path connection between drywell and the wetwell air space. Therefore, in the event of a pipe break inside the drywell, this direct flow path will become an additional steam bypass leakage path. However, this additional bypass leakage path will close in a few seconds, because of automatic closure of these valves upon receipt of a LOCA signal. These isolation valves are designed to close automatically within 15 seconds after receiving a high drywell pressure (13.83 kPa) signal.

Failure of the above two isolation valves to close, which may result in a continuous bypass pathway, is highly unlikely. Division II is the power source for these two valves, and they are fail-to-close safe. Four independent sensors (one in each electrical division) detect high pressure in the drywell. Isolation system uses reverse logic (i.e., valve in open position with a low drywell pressure signal), and the signal uses two-out-of-four logic. A loss of signal will de-energize the solenoid resulting in valve closure.

6E.2 Other Bypass Pathways

All containment systems which communicate with the drywell and/or wetwell air space were examined for any potential steam bypass pathways during LOCA events. A careful review of their P&IDs revealed no additional bypass pathways.

6E.3 Effect on Existing Bypass Analyses

The ACS interconnection, as described above, will become a bypass pathway during LOCA. This pathway will introduce steam bypass leakage area, in addition to the bypass leakage area considered and analyzed in the existing bypass analyses (Subsections 6.2.1.1.5.3 and 6.2.1.1.5.4). Simple engineering analyses were performed to assess effect of this additional bypass leakage area on these two existing bypass analyses.

6E.3.1 Estimate of Effective Bypass Leakage Area (A/K)

The flow area, A, through the ACS interconnection is determined by the 50A piping of Sch 80, which is about .00186m^2. In determining the total loss coefficient, only flow losses were

considered. Pipe friction losses were ignored for conservatism. A total flow loss coefficient of 11.5 was determined, which comprises of the following:

a.	Standard entrance loss coefficient:	0.5
b.	Flow loss coefficient for two standard globe valves in series:	8.0
c.	Flow loss coefficient for two standard elbows in series:	2.0
d.	Standard exit loss coefficient:	1.0

The effective bypass leakage area, $A/\sqrt{K}$, is approximately $5.57x10^{-4}m^2$.

6E.3.2 Duration of Bypass Flow

Bypass flow through this additional bypass pathway will terminate upon closure of the isolation valves. As noted above, these valves will close within 15 seconds after receiving a high drywell pressure 13.83 kPaG signal. It was determined that the drywell pressure for a small(.00186m^2) steam break LOCA will reach to 13.83 kPaG in about 20 seconds after LOCA. Allowing for the 15 seconds of valve closure time, this additional bypass pathway will be active for the first 35 seconds only. For assessment purposes, a continuous effective flow area of $5.57x10^{-4}m^2$ during the first 35 seconds was assumed. Decrease in flow area during the valve closure period was ignored for conservatism.

6E.3.3 Effect on Existing Bypass Analyses

(a) Bypass Capability Without Sprays and Heat Sinks (Subsection 6.2.1.1.5.3)

This analysis, which assumes continuous steam bypass leakage over 6-h period, determined an acceptable effective flow area of 5 cm^2. In this analysis, a stratified atmosphere model, which assumed steam only flow through the leakage path, was assumed to ensure conservative results.

It was estimated that this additional bypass leakage area of $5.57x10^{-4}m^2$ will result in a total flow of about 4.54 kg of steam over the 35-s period. This additional flow of 4.54 kg of steam is about 0.1% (which is almost negligible) of the total flow of steam over the 6-h period in the existing analysis.

Given inherent conservatism in the analysis assumption, it is concluded that this ACS interconnection bypass pathway will have a negligible effect on the existing analysis results.

(b) Bypass Capability with Sprays and Heat Sinks

This analysis, which takes credit for heat sinks as well as manual actuation of sprays 30 minutes after the wetwell airspace pressure reaches 103.7 kPaG, determined an acceptable effective bypass leakage area of 50 cm^2.

Given manual actuation of sprays as defined above, it is concluded that this ACS interconnection bypass pathway should have no impact on this bypass capability analysis.

6E.4 Conclusion

In view of the above results, it is concluded that the suppression pool bypass mechanism through interconnection in the atmospheric control system (ACS) will have no effect on the existing bypass leakage analyses in Subsections 6.2.1.1.5.3 and 6.2.1.1.5.4.