FUNCTIONAL FAILURE SUMMARY INFORMATION FROM NORTH ANNA IPE

The next several events involve faults of a 4160 V or 480 V bus. Both 4160 V buses, the 480 V buses, and several MCC's are represented. These events appear in virtually all the sequences at lower frequencies. Note that the 1H buses characteristically have a higher risk achievement worth than comparable 1J buses, again due to the greater dependence of ESGR cooling components upon the 1H buses.

3.4.1.2 Functional Failures Leading to Core Damage

In order to evaluate the relative contribution of the failure of various systems or functions, other than the initiating events, to the overall core damage frequency it is possible to group the core damage sequences by functional failure. The percentage contribution for the following functional failures are shown in Table 3.4.1-8.

- Failure of Emergency Switchgear Room cooling (T8, Hv)
- High Head/Low Head Recirculation (H1, H2)
- Recovery of offsite power (B)
- Auxiliary Feedwater (L, Lt)
- RC Pump Seal LOCA (T4, Slc)
- Operator cooldown and depressurization (O, Y)
- Failure of Safety Injection (D1, D2, D3)
- Failure of Bleed and Feed (P)

The sum of these events is greater than 100% as a number of the sequences contribute to more than one category of functional failure. For example some sequences consist of failure of Auxiliary Feedwater and failure of feed and bleed.

Failure of Safety Injection (HHSI-D1, Accumulators-D2 or LHSI-D3) contributes 42% to the core damage frequency and is dominated by D1. These sequences fall into three major groups: 1) failure of required injection during a LOCA (e.g., S2D1D3, S1D1Y or AD2), 2) failure during transient after AFW (L) fault (e.g., T1LD1 or T2LD1), and 3) failure in Hv Transfer event (e.g. T1Tr) following failure of operator cooldown (O) but following recovery of ESGR cooling (e.g., T1TrOD1, T3TrOD1 and T2ATrOD1).

Failure of operator cooldown and depressurization contributes 36% and involves three basic groups. For medium and small LOCAs and SGTR, when HHSI (D1) is available, O represents normal operator cooldown. If HHSI is not available, Y represents operator cooldown without HHSI. In these cases, failure to cooldown will prevent the use of Low Head Safety Injection pumps to maintain Reactor Coolant System inventory. Finally, for events with imminent loss of emergency power (T6, T8, and the initiators with consequential loss of ESGR cooling sequences, T1Hv, T2Hv, etc.), operator cooldown O is needed to avoid RC pump seal LOCA since RC pump seal cooling will also be lost with loss of emergency power.

Loss of Emergency Switchgear Room cooling contributes to 34% of the core damage frequency, through the T8 initiator and through the consequential loss and coincidental loss of ESGR cooling for several initiators. These latter events are the initial event in the T1Tr, T2Tr, T2ATr, T3Tr, T9ATr and T9BTr event trees. Since loss of ESGR cooling results in a loss of emergency power, core damage will occur through an RC pump seal LOCA if there is no cooldown, or through loss of core heat removal capability when the turbine driven AFW pump eventually fails (including SG overfill).

Sequences involving loss of Auxiliary Feedwater contribute 24% to the overall core damage frequency. One of the reasons for this is that six of the top seven initiating events require the operation of Auxiliary Feedwater following the initiator.

Failure of recirculation contributes 13% and failure of bleed and feed following loss of Auxiliary Feedwater contributes 1%.

As station blackout is only a 10% contributor to the overall core damage frequency, failure to recover offsite power only contributes 10%. The contribution from seal LOCAs is less than 1%.

3.4.1.3 Dominant Accident Sequences

The top 22 dominant accident sequences (core damage frequency greater than 1.0E-6/yr) are discussed in detail in this section. A complete list of the sequences and a list of the dominant cut sets for those sequences with frequency greater than 1.0E-7/yr are given in Appendix B. The sequences discussed in this section contribute approximately 75% of the core damage frequency and the sequences in the Appendix with frequency greater than 1.0E-7/yr contribute 96% of the core damage frequency.

Sequence S2D1D3

Frequency: 5.15E-6 Contribution: 7.6%

This sequence is initiated by a small break LOCA. The high head safety injection system fails to provide coolant make-up to the reactor. As blowdown through the break continues, the subcooling decreases and the core starts to heatup and eventually uncover. When the core outlet thermocouples reach 1200F, the operators are directed into functional restoration procedure 1-FR-C.1, which will direct the operators to perform core cooling recovery. In this sequence, the LHSI pumps fail to provide adequate flow to re-establish core cooling. All containment systems function during the core damage process, resulting in plant damage state #21. Dominant contributors to this sequence involve plugging of the RWST discharge isolation valve (1QSMV--PG-10S38) and common cause failure of the check valves on the cold legs SI injection lines

TABLE 3.4.1-8
CONTRIBUTION TO CORE DAMAGE FREQUENCY OF FUNCTIONAL FAILURES

Function	Contribution to CDF
Failure of Injection (D1,D2,D3)	42%
Failure to Cooldown and Depressurize (O,Y)	36%
Failure of Emergency Switchgear Room Cooling (T8,HV)	34%
Failure of Auxiliary Feedwater (L,Lt)	24%
Failure of Recirculation (H1,H2)	13%
Failure to Recover Offsite Power (B)	12%
Failure of Feed and Bleed (P)	1%
Seal LOCA (T4,Slc)	<1