5.0 Summary of Results

The results of this analysis provide insight into the risks associated with storage of spent nuclear fuel in fuel pools at decommissioned nuclear power plants. The five accident initiators that were analyzed consist of: 1) internal fires, 2) loss of cooling, 3) loss of inventory, 4) plant/grid centered losses of off-site power, and 5) severe weather induced losses of off-site power. The total frequency for the endstate is estimated to be 1.8E-7/year. Table 5.1 summarizes the fuel uncovery frequency for each initiator.

This frequency is to be compared with the pool performance guideline (PPG). This guideline has been established by analogy with the acceptance guidelines in RG. 1.174. In RG 1.174 it was determined that the mean value of the distribution characterizing uncertainty is the appropriate value to compare the guideline. However, it was determined that it is also necessary to investigate whether there are modeling uncertainties that could affect the decision made with respect to whether the guidelines have been met. This is the approach that has been followed here.

5.1 Characterization of Uncertainty

The frequencies are point estimates, based on the use of point estimates for the input parameters. The input parameter values were taken from a variety of sources, and in many cases were presented as point estimates with no characterization of uncertainty. In some cases, such as the initiating event frequencies derived from NUREG/CR 5496, and the HEPs derived from THERP, an uncertainty characterization was given, and the point estimates chosen corresponded to the mean values of the distributions characterizing uncertainty. For all other parameters, it was assumed that the values would be the mean values of distributions characterizing the uncertainty of the parameter value. In the case of SPAR HEPs, the authors consider their estimates as mean values based on the fact that the numbers were established on the basis of considering several different sources, most of which specified mean values. Consequently, the results of this analysis are interpreted as being mean values. A propagation of parameter uncertainty through the model was not performed, nor was it considered necessary. With the exception of the spent fuel pool cooling system itself, the systems relied on are single train systems. The dominant failure contributions for the spent fuel pool cooling system are assumed to be common cause failures. Thus there are no dominant cutsets in the solutions that involved multiple repetitions of the same parameter, and under these conditions, use of mean values as input parameters produces a very close approximation to mean values of sequence frequencies. Since typical uncertainty characterization for the input parameters is a lognormal distribution with error factors of 3 or 10, the 95th percentile of the output distribution will be no more than a factor of three higher than the mean value. This is not significant to change the conclusion of the analysis.

The numerical results are a function of the assumptions made and in particular, the model used to evaluate the human error probabilities. The results represent a reasonable assessment of the levels of risk that are achievable, given an appropriate level of attention to managing the facility with a view to ensuring the health and safety of the public. Alternate HRA models could result in frequencies that differ by an order of magnitude. However, given the time scales involved, and the simplicity of the systems, we believe that the conclusions of this study, namely that the risks are low, and that the NEI commitments play an important role in determining that low level, are robust.

Certain assumptions may be identified as having the potential for significantly influencing the results. For example, the calculated time windows associated with the loss of inventory event tree are sensitive to the assumptions about the leak size. The SPAR HRA method is, however, not highly sensitive to the time windows assumed, primarily making a distinction between time windows that represent an inadequate time, barely adequate, nominal, extra time, and expansive time. The precise definitions of these terms can be found in Reference 9. Consequently, the assumption of the large leak rate as 60 gpm is not critical. For the loss of inventory event tree, the assumption that the leak is self-limiting after a drop in level of 15 feet, may be a more significant assumption that, on a site specific basis may be non-conservative. The assumption that the preparation time of several days is adequate to bring off-site sources to bear may be questioned in the case of extreme conditions. However, the very conservative assumption that this is guaranteed to fail would change the corresponding event sequences by about an order of magnitude.

5.2 Conclusions

The analysis shows that, based on the assumptions made, the frequency of fuel uncovery from the loss of cooling, loss of inventory, loss of off-site power and fire initiating events is very low. The assumptions that have been made include that the licensee has adhered to NEI commitments 2, 4, 5, 8 and 10. In order to take full credit for these commitments, additional assumptions concerning how these commitments will be implemented have been made. These include: procedures and/or training are explicit in giving guidance on the capability of the fuel pool make-up system, and when it becomes essential to supplement with alternate higher volume sources; procedures and training are sufficiently clear in giving guidance on early preparation for using the alternate make-up sources; walk-downs are performed on a regular, (once per shift) basis. The latter is important to compensate for potential failures to the instrumentation monitoring the status of the pool.

NEI commitment 3, related to establishing communication between on-site and off-site organizations during severe weather, is also important, though its importance is somewhat obscured in the analysis by the assumption that there is some degree of dependence between the decision to implement supplemental make-up to the spent fuel pool from on-site sources such as fire water pumps, and that from off-site sources. However, if no such provision were made, the availability of off-site resources could become more limiting.

NEI commitments 6, 7 and 9 have been credited with lowering the initiating event frequency for the loss of inventory events from its historical levels.

This analysis has, demonstrated to the staff that, given an appropriate implementation of the NEI commitments, the risk is indeed low, and would warrant consideration of granting exemptions. Without credit for these commitments, the risk will be more than an order of magnitude higher.

Table 5.1 Summary of Results

Initiating Event	**Fuel Uncovery Frequency (per year)**
Internal Fires	2.3E-08
Loss of Cooling	1.4E-08
Loss of Inventory	3.0E-09
Loss of Off-site Power (plant centered & grid-related events)	2.9E-8
Loss of Off-site Power (severe weather events)	1.1E-7
TOTAL =	1.8E-07