The analysis below is given to demonstrate that the MNRC spent fuel storage pits will remain subcritical by an acceptable margin (k_{eff}<0.90) under any condition or fuel loading. This analysis will need to be incorporated into section 9.1.3 of the SAR.

Criticality Safety Analysis for MNRC's Fuel Storage Pit:

An MCNP model is used to simulate a single fuel storage pit based on the known geometry and composition of the MNRC fuel pits. The analysis simulates a fuel storage pit having 2 tiers of 19 fuel elements each in a hexagonal arrangement, for a total of 38 fuel elements. The inner diameter of the fuel storage pit is 10". There is a 6" distance from the bottom of lower-rack fuel elements to the bottom of the fuel storage pit. The distance between the bottom of higher-rack fuel elements and the top of lower-rack fuel elements is 3.3". The concrete surrounding the fuel pits was simulated as well because the hydrogen in the concrete will likely act as a reflector.

In order to be conservative for this analysis only fresh 8.5/20, 20/20, and 30/20 TRIGA fuel elements are modeled. The k_{eff} factors under each condition are summarized in the following table. In each case, the MCNP models were run long enough for the relative statistical error of k_{eff} to be less than 1%.

k_{eff} Factor	38 8.5/20 Fresh FEs	38 20/20 Fresh FEs	38 30/20 Fresh FEs
Dry Condition	0.493	0.559	0.565
Flooded Condition	0.747	0.824	0.821

The worst-case scenario is that 38 fresh 20/20 TRIGA fuel elements are placed in a water-flooded fuel storage pit, resulting in a k_{eff} equal to 0.824. This result was not statistically different than the flooded condition with 38 fresh 30/20 fuel elements. The results in all cases are significantly lower than a k_{eff} of 0.900. A more realistic scenario is that 8.5, 20, and 30 wt% elements of different (non-zero) burnups will be placed in the fuel storage pits. As fuel burnup increases the k_{eff} will decrease slightly, thus increasing the safety margin. It should be noted once again MNRC has no plans to flood any of the MNRC spent fuel storage pits.