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CRITICALITY CONCERNS

The assumption is made that all the pool water is lost and some regions may contain burned fuel that is hot enough to cause a zirconium fire. From a criticality standpoint, the highest reactivity would probably be achieved if the fuel remained fairly well intact rather than relocating (melting) to the bottom of the pool since, in this configuration, a reintroduction of water would cause the most optimum moderation condition. Without moderation, fuel at current enrichment levels (no greater than 5 wt% U-235) cannot achieve criticality.

The only types of pools in which recriticality may be of concern are those which initially contain neutron absorber material for reactivity holddown, such as boral or boraflex, and only if the absorber material can subsequently be lost. All other pools are analyzed to maintain a subcritical margin when moderated by pure water.

Complete reflooding by full density pure water of these types of pools (with the loss of neutron absorber) could cause a criticality concern. However, one must consider the different fuel conditions in the large pool volume. While some of the more recently discharged fuel may have significant decay heat, the older fuel from previous cycles would be relatively cold. This would determine the rate and level of reflooding. Since there are instances where a peak in reactivity could occur at low-density (optimum moderation) conditions, consideration should be given to the possibility of criticality at low-density conditions

If fire-fighting foam is used to quench fuel, a peak in reactivity may occur at low moderator density (optimum moderation condition). Therefore, consideration should be given to the use of high-expansion foam for fire-fighting to prevent a low-density optimum moderation condition.

If sufficient coolant were eventually added to the pool to make recriticality a concern, the approach to criticality would probably be extremely slow and would not produce a large power burst. Therefore, further fuel and pool structural damage would not be expected. Because of the negative reactivity feedback, the most probable scenario is that introduction of water back into the voided pool would cause a chugging effect and would not generate an appreciable amount of power. However, because of the difficulty in predicting failure mechanisms and reflood rates, we recommend that any makeup water used for reflooding should be borated.

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