4.3. Implications for Regulatory Requirements Related to Emergency Preparedness, Security and Insurance

The industry and other stakeholders have expressed interest in knowing the relevance of the results of this study to decisions regarding specific regulatory requirements. These decisions could be made in response to plant-specific exemption requests, or as part of the integrated rulemaking for decommissioning plants. Such decisions can be facilitated by a risk-informed examination of both the deterministic and probabilistic aspects of decommissioning. Three examples of such regulatory decisions are presented in this section.

4.3.1 Emergency Preparedness

The requirements for emergency preparedness are contained in 10CFR 50.47 [Ref. 3] and Appendix E to 10 CFR Part 50 [Ref. 4]. Further guidance on the basis for EP requirements is contained in NUREG-0396 [Ref. 5], and NUREG-0654/FEMA-REP-1 [Ref 6]. The overall objective of EP is to provide dose savings (and in some cases immediate life saving) from accidents.

In the past, the NRC staff has typically granted exemptions from off-site emergency planning requirements for decommissioning plants that could demonstrate that they were beyond the period in which a zirconium fire could occur. The rationale for those decisions was that, in the absence of a zirconium fire, a decommissioning plant had no appreciable scenarios for which the consequences justify the imposition of an off-site EP requirement. The results of this technical study confirm that position for both the scenarios resulting in a potential zirconium fire as well as credible pool criticality events.

In some cases, emergency preparedness exemptions have also been granted to plants which were still in the window of vulnerability for zirconium fire. In these cases, the justification was that enough time had elapsed since shutdown that the evolution of a zirconium fire accident would be slow enough that the staff had confidence that mitigative measures and, if necessary, off-site protective actions could be implemented without preplanning. The staff believes that the technical analysis discussed in Section 3 and the decision criteria laid out in Section 2 have direct bearing on how such exemption requests should be viewed in the future. In addition, this information has bearing on the need for, and the extent of, emergency preparedness requirements in the integrated rulemaking.

The consequence analysis presented in Appendix 4 demonstrates that the off-site consequences of a zirconium fire are comparable to those from operating reactor postulated severe accidents. Further, the analysis demonstrates that timely evacuation can significantly reduce the number of early fatalities due to a zirconium fire. The thermal-hydraulic analysis presented in Appendix 1 confirms our earlier conclusion that zirconium fire events evolve slowly, even for initiating events that result in a catastrophic loss of fuel pool coolant. The results in Section 3 also show that the frequency of zirconium fires is low when compared with the risk guidelines derived from RG 1.174. Thus the risk associated with early fatalities from these scenarios is low which provides some basis to support reductions in EP requirements for decommissioning plants. With respect to the potential for pool criticality, the staff's assessment discussed in Section 3 and Appendix 3 demonstrates that credible scenarios for criticality are highly unlikely and are further precluded by the assumptions of Boraflex monitoring programs. Additionally, even if some criticality event was to occur, it would not be expected to have off-site

consequences. Therefore, the conclusions regarding possible reductions in EP program requirements are not affected.

One important safety principle of RG 1.174 is consistency with the defense-in-depth philosophy. Defense-in-depth is included in a plant design to account for uncertainties in the analysis or operational data. The spent fuel pools at operating reactors and decommissioning facilities do not exhibit the defense-in-depth accorded to the reactor. As discussed in Section 1, this difference is justified in light of the considerably greater margin of safety of the SFP compared with reactors. For SFPs at operating reactors, defense-in-depth consists mainly of the mitigating effect of emergency preparedness.

The risk assessments contained in this report indicate that the safety principles of RG 1.174 can be applied to assess whether changes to emergency preparedness requirements are appropriate. The risk of a release from a spent fuel accident is very low. Notwithstanding this low risk, the safety principles in RG 1.174 dictate that defense-in-depth be considered and, as discussed previously, emergency preparedness provides defense-in-depth. However, because of the considerable time available to initiate and implement protective actions, there does not appear to be a need for formal emergency plans for rapid initiation and implementation of protective actions. The principle aspects of emergency planning which is needed for SFP events is the means for identification of the event and for notification of State and local emergency response officials. It should be noted that there will continue to be a need for on-site emergency preparedness for response to the more likely accidents which only have on-site consequences. This study indicates that a one year period provides adequate decay time necessary to reduce the pool heat load to a level that would provide sufficient human response time for anticipated transients, and minimize any potential gap release. This is also the decay time that would result in a 10-12 hour delay from fuel uncovery to zirconium fire, even for very improbable severe seismic events or heavy load drop causing total loss of pool inventory.

Any future reduction of the one year decay time would be contingent on plant specific thermal hydraulic response, scenario timing, human reliability results and system mitigation and recovery capabilities. That is, any licensee wishing to gain relief from regulatory requirements prior to the one year post-shutdown, would need to demonstrate that plant specific vulnerability to a zirconium fire satisfies the risk informed decision process, risk insights and recommended criteria described in Sections 2 and 3.

4.3.2 Security

Currently licensees that have permanently shutdown reactor operations and have offloaded the spent fuel into the SFP are still required to meet all the security requirements for operating reactors in 10 CFR 73.55 [Ref 7]. This level of security would require a site with a permanently shutdown reactor to provide security protection at the same level as that for an operating reactor site. The industry has asked the NRC to consider whether the risk of radiological release from decommissioning plants due to sabotage is low enough to justify modification of safeguards requirements for SFPs at decommissioning plants.

In the past, decommissioning licensees have requested exemptions from specific regulations in 10 CFR 73.55, justifying their requests on the basis of a reduction in the number of target sets susceptible to sabotage attacks, and the consequent reduced hazard to public health and safety. Limited exemptions based on these assertions have been granted. The risk analysis in

this report does not take exception to the reduced target set argument; however, the analysis does not support the assertion of a lesser hazard to public health and safety, given the consequences that can occur from a sabotage induced uncovery of fuel in the SFP when a zirconium fire potential exists. Further, the risk analysis in this report did not evaluate the potential consequences of a sabotage event that could directly cause off-site fission product dispersion, for example from a vehicle bomb that was driven into or otherwise significantly damaged the SFP, even if a zirconium fire was no longer possible. However, this report would support a regulatory framework that relieves licensees from selected requirements in 10 CFR 73.55 on the basis of target set reduction when all fuel has been placed in the SFP.

The risk estimates contained in this report are based on accidents initiated by random equipment failures, human errors or external events. PRA practitioners have developed and used dependable methods for estimating the frequency of such random events. By contrast, this analysis, and PRA analyses in general, do not include events due to sabotage. No established method exists for estimating the likelihood of a sabotage event. Nor is there a method for analyzing the effect of security provisions on that likelihood. Security regulations are based on a zero tolerance for sabotage involving special nuclear material - which includes spent fuel. The regulations are designed and structured to remove sabotage from design basis threats at a commercial nuclear power plant, regardless of the probability or consequences.

The technical information contained in this report shows that the consequences of a zirconium fire would be high enough to justify provisions to prevent sabotage. Moreover, the risk analysis could be used effectively to assist in determining priorities for, and details of, the security capability at a plant. However, there is no information in the analysis that bears on the level of security necessary to limit the risk from sabotage events. Those decisions will continue to be made based on a deterministic assessment of the level of threat and the difficulty of protecting a specific facility.

10 CFR 72 [Ref. 8] allows facilities not associated with an operating power reactor to store spent fuel at an independent spent fuel storage installation (ISFSI). 10 CFR 73.51 did not consider the risk posed by vehicle-borne bombs at facilities where potential criticality and fuel heat-up were still issues. The staff also noted that the applicability of 10 CFR 26 [Ref 9] has not been thoroughly evaluated for decommissioning reactors once the fuel has been removed from the reactor vessel and placed in the SFP, and specifically does not apply to ISFSIs licensed under 10 CFR 72. Given the importance of a vehicle bomb threat to the integrity of SFP, and the significance of HRA to the conclusions reached in the SFP risk analysis, the staff recommends that for coherency in the regulations, both of these subjects be revisited during the overall integration of rules for decommissioning reactors.

4.3.3 Insurance

In accordance with 10 CFR 140 [Ref.10], each 10 CFR 50 licensee is required to maintain public liability coverage in the form of primary and secondary financial protection. This coverage is required to be in place from the time unirradiated fuel is brought onto the facility site until all of the radioactive material has been removed from the site, unless the Commission terminates the Part 50 license or otherwise modifies the financial protection requirements under Part 140. On March 17, 1999, the staff proposed to the Commission that insurance indemnity requirements for permanently shutdown reactors be developed in an integrated, risk-informed effort along with requirements for emergency preparedness and security. In the past, licensees have been

granted exemptions from financial protection requirements on the basis of deterministic analyses that indicate that a zirconium fire could no longer occur. The analysis in this report supports continuation of this practice, and would support a revised regulatory framework for decommissioning plants that reduces the level of insurance protection when a generic or plant-specific thermal-hydraulic analysis demonstrates that a zirconium fire can no longer occur.

In the staff requirements memorandum (SRM) for SECY-93-127 [Ref. 11], the Commission suggested that withdrawal for secondary financial protection insurance coverage is allowed after the requisite minimum spent fuel cooling period has elapsed. Further, the Commission directed the staff to determine more precisely the appropriate spent fuel cooling period after plant shutdown, and to determine the need for primary financial protection for independent spent fuel storage installations (ISFSIs). Spent reactor fuel aged for one year can be stored in an ISFSI. The NRC staff has considered whether the risk analysis in this report justifies relief from this requirement for a decommissioning plant during the period when it is vulnerable to zirconium fires. As part of this effort, the staff recognizes the structural similarities between a SFP at a decommissioning plant and a wet (as opposed to dry) ISFSI that could be considered under 10 CFR 72; ISFSIs are generally dry. Indemnification is not required for a separately-licensed ISFSI. The risk analysis in this report indicates high consequences of a zirconium fire, identifies a generic window of vulnerability up to a period of about 5 years after shutdown, and concludes that the predicted frequency of such an accident is within the acceptance guidelines of RG 1.174 after one year, provided that certain constraints are met.

Since the postulated consequences are high, the frequency of a zirconium fire occurring in a decommissioning plant SFP would have to be low to justify a reduction in indemnification protection. The zirconium fire frequencies presented in Section 3 for a decommissioning plant SFP are comparable to the large early releases frequencies (LERF) from some operating reactors, and are within the LERF guidelines of RG 1.174. A zirconium fire frequency criterion to justify reduction of the insurance requirement while a vulnerability to zirconium fires exists has not been established. The potential for a zirconium fire occurring at a decommissioning plant SFP has been described in this risk study to meet the LERF guidelines in RG 1.174 after a decay time of one year, provided that certain conditions are met. On a deterministic basis, the possibility exists that the 5-year window of vulnerability could be reduced with more refined thermal-hydraulic analysis or some other constraints on other parameters such as fuel configuration.