4.0 Implications of Spent Fuel Pool Risk For Regulatory Requirements

An important motivation for performing the risk analysis contained in this report is to provide insight into the risk implications of potential changes to regulatory requirements for decommissioning plants. Section 4.1 presents a brief summary of the potential regulatory changes in the areas of emergency preparedness, safeguards, and insurance indemnification. Section 4.2 describes the safety principles of RG 1.174 as they apply to a SFP, and examines the design, operational, and regulatory elements that are important in ensuring that the risk from a SFP continues to meet these principles. Both the Industry Decommissioning Commitments (IDCs) and Staff Decommissioning Assumptions (SDAs) are essential in achieving the levels of safety presented in this analysis, and are discussed. Section 4.3 examines the implications of the technical results for those specific regulatory decisions, and how future regulatory activity would properly reflect such commitments and assumptions.

4.1 Potential Regulatory Changes for Decommissioning Plants

Potential changes to regulatory requirements for decommissioning plants are described in SECY-00-0145, "Integrated Rulemaking Plan for Nuclear Power Plant Decommissioning." This rulemaking plan would amend EP regulations for licensees who have permanently ceased operations and have permanently removed the fuel from the reactor vessel. The approach described therein would allow a significant reduction in the level of EP when decay heat levels and fuel heatup rates are substantially reduced, and additional EP reductions at some later time when the fuel will not be susceptible to a zirconium fire. Relaxations in requirements related to insurance, safeguards, staffing and training, and backfit would also be made on the bases of reduced decay heat levels and susceptibility of the fuel to a zirconium fire.

The following regulatory changes would be considered for implementation:

- With regard to EP, licensees would no longer be required to: have a formalized emergency planning zone (EPZ); coordinate with state and local organizations within the EPZ as to specific responsibilities and actions; have an offsite Emergency Operations Facility, onsite Technical Support Center, and onsite Operations Support Center; promptly notify the public using such things as the siren system, tone alert radios, or National Weather radios; and conduct biennial full participation exercises. However, the decommissioning licensee would still be required to promptly notify offsite authorities, characterize the releases, and make protective action recommendations, have a means of promptly notifying offsite organizations and communicating with the public, and hold onsite biennial exercises and semiannual drills.

- With regard to insurance, ...

- With regard to safeguards, ...

This report provides the technical basis and decision making logic for assessing the merit of regulatory changes for decommissioning plants. The thrust of the technical assessment is on changes in EP requirements, but the same technical information also provides the underpinnings for decisions related to changes in insurance, safeguards, staffing and training,

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backfit, and other requirements.

4.2 Risk Informed Decision Making

In 1995, the NRC published its PRA Policy Statement [Ref 1], which stated that the use of PRA technology should be increased in all regulatory matters to the extent supported by the state-of-the-art of the methods. Subsequent to issuance of the PRA Policy Statement, the agency published RG 1.174, which contained general guidance for application of PRA insights to the regulation of nuclear reactors. The regulatory framework proposed in this report for decommissioning plants is based on the risk-informed decision making process described in RG 1.174 [Ref 2]. Although the focus of RG 1.174 is decision making regarding changes to the licensing basis of an operating plant, the same risk-informed philosophy can be applied generically to evaluate the acceptability of potential exemptions or changes to current regulatory requirements for decommissioning plants.

RG 1.174 articulates the following safety principles which should be applied in evaluating regulatory changes for decommissioning plants:

- "The proposed change meets the current regulations unless it is explicitly related to a requested exemption or rule change, i.e., a "specific exemption" under 10 CFR 50.12 or a "petition for rulemaking" under 10 CFR 2.802.

- When proposed changes result in an increase in core damage frequency and/or risk, the increases should be small and consistent with the intent of the Commission's Safety Goal Policy Statement

- The proposed change is consistent with the defense-in-depth philosophy.

- The proposed change maintains sufficient safety margins.

- The impact of the proposed change should be monitored using performance measurement strategies."

A discussion of each of these safety principles and how they would continue to be satisfied at a decommissioning plant is provided in the sections that follow. Since the application of this study specifically relates to exemptions to a rule or a rule change for decommissioning plants, a discussion of the first principle regarding current regulations is not necessary nor is it provided.

4.2.1 Increases in Risk

RG 1.174 states that when proposed changes result in an increase in core damage frequency and/or risk, the increases should be small and consistent with the intent of the Commission's Safety Goal Policy Statement.

The staff has evaluated the risks associated with SFP accidents and the impacts of potential changes to regulatory requirements for decommissioning plants relative to applicable regulatory guidance. Guidance on acceptable levels of (total) risk to the public from nuclear power plant operation is provided in the Commission's Safety Goal Policy Statement [Ref 3]. Additional guidance on the acceptable levels of risk increase from a change to the plant licensing basis is provided in RG 1.174. The guidance contained in these documents is summarized below and used in this report to evaluate the risks associated with SFP accidents and the impacts of potential changes to regulatory requirements for decommissioning plants.

SFP Risk Relative to the Safety Goal Policy Statement

The "Policy Statement on Safety Goals for the Operation of Nuclear Power Plants," issued in 1986, establishes goals that broadly define an acceptable level of radiological risk that might be imposed on the public as a result of nuclear power plant operation. These goals are used in a generic sense to assess the adequacy of current requirements and potential changes to the requirements. The Commission established two qualitative safety goals that are supported by two quantitative objectives for use in the regulatory decision making process. The qualitative safety goals stipulate that:

- Individual members of the public should be provided a level of protection from the consequences of nuclear power plant operation such that individuals bear no significant additional risk to life and health

- Societal risks to life and health from nuclear power plant operation should be comparable to or less than the risks of generating electricity by viable competing technologies and should not be a significant addition to other societal risks.

The following quantitative health objectives (QHOs) are used in determining achievement of the safety goals:

- The risk to an average individual in the vicinity of a nuclear power plant of prompt fatalities that might result from reactor accidents should not exceed one-tenth of one percent (0.1 percent) of the sum of prompt fatality risks resulting from other accidents to which members of the U.S. population are generally exposed.

- The risk to the population in the area near a nuclear power plant of cancer fatalities that might result from nuclear power plant operation should not exceed one-tenth of one percent (0.1 percent) of the sum of cancer fatality risks resulting from all other causes.

These QHOs have been translated into two numerical objectives as follows:

- The individual risk of a prompt fatality from all "other accidents to which members of the U.S. population are generally exposed," such as fatal automobile accidents, is about 5E-4 per year. One-tenth of one percent of this figure implies that the individual risk of prompt fatality from a reactor accident should be less than 5E-7 per reactor year.

- "The sum of cancer fatality risks resulting from all other causes" for an individual is taken to be the cancer fatality rate in the U.S. which is about 1 in 500 or 2E-3 per year. One-tenth of one percent of this implies that the risk of cancer to the population in the area near a nuclear power plant due to its operation should be limited to 2E-6 per reactor year.

Although the Policy Statement and related numerical objectives were developed to address the risk associated with power operation, it is reasonable to require that these objectives continue to be met for as long as nuclear materials remain on the plant site. Accordingly, the staff has compared the estimated risks associated with SFP accidents to the QHOs.

The risks associated with SFP accidents compare favorably with the QHOs. The comparisons, presented in Section 3.6.3, show that a typical site that conforms with the IDCs, and SDAs, would meet the QHOs by about one to two orders of magnitude one year after shutdown, and greater margins at later times. The risk comparisons provided in Appendix 4C show that SFP facilities maintained at or below the recommended PPG of 1E-5 per year, would continue to meet the QHO even the most severe SFP source term.

Risk Increases Relative to Regulatory Guide 1.174

The guidelines in RG 1.174 pertain to the frequency of core damage accidents (CDF) and large early releases (LERF). For both CDF and LERF, RG 1.174 contains guidance on acceptable values for the changes that can be allowed due to regulatory decisions as a function of the baseline frequencies. For example, if the baseline CDF for a plant is below 1E-4 per year, plant changes can be approved that increase CDF by up to 1E-5 per year. If the baseline LERF is less than 1E-5 per year, plant changes can be approved which increase LERF by up to 1E-6 per year.

For decommissioning plants, the risk is primarily due to the possibility of a zirconium fire associated with the spent fuel cladding. The consequences of such an event do not equate directly to either a core damage accident or a large early release as modeled for an operating reactor. Zirconium fires in spent fuel pools potentially have more long term consequences than an operating reactor core damage accident because there may be multiple cores involved; the relevant clad/fuel degradation mechanisms could lead to increased releases of certain isotopes (e.g., short-lived isotopes such as iodine will have decayed, but the release of longer-lived isotopes such as ruthenium could be increased due to air-fuel reactions); and there is no containment surrounding the SFP to mitigate the consequences. On the other hand, they are different from a large early release because the postulated accidents progress more slowly, allowing time for protective actions to be taken to significantly reduce early fatalities (and to a lesser extent latent fatalities). In effect, a spent fuel pool fire would result in a "large" release, but this release would not generally be considered "early" due to the significant time delay before fission products are released.

Even though the event progresses more slowly than an operating reactor large early release event and the isotopic make-up is somewhat different, the consequence calculations performed by the staff and discussed in Section 3.6 show that spent fuel pool fires could have significant health effects on par with those for a severe reactor accident. These calculations considered the effects of different source terms and evacuation assumptions on offsite consequences. Since an SFP fire scenario would involve a direct release to the environment with significant consequences, the staff has decided that the RG 1.174 guidance concerning LERF can be applied to the issue of SFP risks for decommissioning plants.

The LERF guidance is applied in two ways in this report:

1. Because the changes in EP requirements do not impact the frequency of events involving a large early release (i.e., the SFP fire frequency) but instead affect the consequences of these releases, the allowable increase in LERF in RG 1.174 is translated into an allowable increase in key risk measures. The estimated risk increases associated with changes in EP requirements are then compared to the allowable increases inferred from RG 1.174. These comparisons are presented in Appendix 4D.

2. The RG 1.174 guidance is used to establish a Pool Performance Guideline (PPG). The PPG provides a threshold for controlling the risk from a decommissioning SFP. By maintaining the frequency of events leading to uncovery of the spent fuel at a value less than the recommended PPG value of 1E-5 per year, zirconium fires will remain highly unlikely, the risk will continue to meet the Commission's QHOs, and changes to the plant (SFP) licensing basis that result in very small increase in risk may be permitted consistent with the logic in RG 1.174. A licensee would need to assure that the frequency of events leading to uncovery of the spent fuel would be less than the PPG in order to implement the risk-informed changes in the revised rule for decommissioning plants. This assurance could be provided by conforming with the IDCs and SDAs listed in Tables 4.2-1 and -2. The rationale for the PPG is presented in Appendix 4C.

The risk increases associated with relaxations in EP requirements compare favorably with the guidance contained in RG 1.174 (see Table 4 of Appendix 4D). Relaxation of EP requirements would result in an increase of about 1.5E-5 early fatalities and 2 person-rem per year, which is about a factor of 15 and five below the allowable increase inferred from the RG 1.174 LERF criteria. The increase in the risk measures related to the QHO are also substantially lower than the allowables from RG 1.174. Since the SFP fire frequency assumed in these comparisons is about a factor of four lower than the PPG of 1E-5 per year, a SFP facility operating nominally at the PPG would have a smaller margin to the allowable risk limits for the reference plant but would still be at or below the limits under the above assumptions.

The above results assume that emergency preparedness is of marginal value in large earthquakes because of its impairment by offsite damage. However, as described in Appendix 4D, even under the most optimistic assumptions regarding the value of emergency preparedness in seismic events (i.e., assuming full and relaxed EP results in early and late evacuation, respectively, and using the LLNL seismic hazard frequency and high ruthenium source term) the change in risk is small and the QHOs continue to be met with margin.

Measures to Assure Risk Increases Remain Small

The analysis in Section 3 explicitly examines the risk impact of specific design and operational characteristics. This analysis credits the industry decommissioning commitments (IDCs) proposed by NEI in a letter to the NRC dated November 12, 1999 (see Appendix 6), and several additional staff decommissioning assumptions (SDAs) identified through the staff's risk assessment and the staff's evaluation of the RG1.174 safety principles for decommissioning plants. The IDCs and SDAs are summarized in Tables 4.2-1 and -2.

The low numerical risk results shown in Section 3 and Appendix 2 are predicated on the IDCs and SDAs being fulfilled. Specifically,

* IDC #5 and SDAs #1 and #2 provide assurance of timely operator response for a broad range of operational events,
* The low likelihood of pool failure due to heavy load drop is dependent on design and procedural controls for handling of heavy loads (IDC #1 and #9, and SDA #3),
* The low baseline frequency for seismically-initiated zirconium fire is predicated upon implementation of the seismic checklist shown in Appendix 5 (SDA #4),
* The low likelihood of loss of cooling is dependent upon procedures and training (IDC #2) and instrumentation (IDC #5 and SDA #2).
* The low likelihood of loss of inventory is dependent upon design provisions (IDC #6) and procedures/controls (IDC #7) to limit leakage.
* The high probability of the operators identifying and recovering from a loss of cooling or loss of inventory event is dependent upon procedures and training for effective use of on-site and offsite resources (IDC #2 through #4, IDC #8, and SDA #2) and SFP instrumentation (IDC #5 and SDA #2).
* The low likelihood criticality issues is dependent on continuation of programs to assess the condition of Boraflex absorber material (SDA #5)
* Applicability of the staff's generic risk assessment to a specific facility is assured by SDA #6.

The staff concludes the following with regard to SFP risks, and risk increases associated with EP relaxations:

- A SFP facility that conforms with the IDCs, and SDAs would meet the QHOs by about one to two orders of magnitude shortly after shutdown, and with greater margins at later times.
- The risk increase associated with relaxations in EP requirements is very small, even under the most optimistic assumptions regarding the value of emergency preparedness in seismic events, and the QHOs continue to be met with margin.
- Continued conformance with IDCs and SDAs provides reasonable assurance that the SFP risk and risk increases associated with regulatory changes would remain small.

4.2.2. Defense-in-Depth

RG 1.174 states that the proposed change should be consistent with the defense-in-depth philosophy.

In accordance with the Commission White Paper on Risk-Informed Regulation (March 11, 1999), "Defense-in-depth is an element of the NRC's Safety Philosophy that employs successive compensatory measures to prevent accidents or mitigate damage if a malfunction, accident, or naturally caused event occurs at a nuclear facility. The defense-in-depth philosophy ensures that safety will not be wholly dependent on any single element of the design, construction, maintenance, or operation of a nuclear facility. The net effect of incorporating defense-in-depth into design, construction, maintenance and operation is that the facility or system in question tends to be more tolerant of failures and external challenges." Therefore, application of defense-in-depth could mean in part that there is more than one source of cooling water or that pump make-up can be provided by both electric as well as direct-drive diesel pumps. Additionally, defense-in-depth can mean that even if a serious outcome (such as fuel damage) occurs, there is further protection such as containment to prevent radionuclide releases to the environment, and emergency response measures to provide dose savings to the public.

The defense-in-depth philosophy applies to the operation of the spent fuel pool, whether at an operating plant or in a decommissioning plant. The philosophy also applies to the potential regulatory changes contemplated for decommissioning plants. Implementation of defense-in-depth for SFPs is different from that applied to nuclear reactors because of the different nature of the hazards. The robust structural design of a fuel pool, coupled with the simple nature of the pool support systems, goes far toward preventing accidents associated with loss of water inventory or pool heat removal. Additionally, because the essentially quiescent (low temperature, low pressure) initial state of the spent fuel pool and the long time available for taking corrective action associated with most release scenarios provide significant safety margin, a containment structure is not considered necessary as an additional barrier to provide an adequate level of protection to the public. Likewise, the slow evolution of most SFP accident scenarios allows for reasonable human recovery actions to respond to system failures, and provides sufficient time to allow for the implementation of protective actions without the full compliment of regulatory requirements associated with operating reactors.

The staff's risk assessment demonstrates that the risk from a decommissioning plant SFP accident is small if industry design commitments (IDCs) and additional staff decommissioning assumptions (SDAs) are implemented as assumed in the risk study. Due to the different nature of a SFP accident versus an accident in an operating reactor, with respect to system design capability needs and event timing, the defense-in-depth function of reactor containment is not required. However, the staff has identified that defense-in-depth in the form of accident prevention measures and an appropriate level of emergency planning can limit risk and provide dose savings for as long as a zirconium fire is possible.

Defense-in-depth for accident prevention and mitigation is provided by licensee conformance with the IDCs and SDAs, as discussed previously. Defense-in-depth for consequence mitigation is provided by the remaining requirements for on-site EP (such as those envisioned in the rulemaking plan), combined with the capability for timely implementation of offsite protective measures on an ad hoc basis. The latter capabilities are viable in SFP accidents due to the substantial amount of time available prior to fission product release in these events.

As a result of potential changes to EP requirements, licensees may no longer be required to: have a formalized EPZ; coordinate with state and local organizations within those EPZs as to specific responsibilities and actions; have an offsite EOF, onsite TSC, and onsite OSC; promptly notify the public using such things as the siren system, tone alert radios, or National Weather radios; and conduct biennial full participation exercises. However, the decommissioning licensee would still be required to promptly notify offsite authorities, characterize the releases, and make protective action recommendations; have a means of promptly notifying offsite organizations and communicating with the public; and hold onsite biennial exercises and semiannual drills. These remaining onsite capabilities provide reasonable assurance that offsite authorities, including NRC, will notified of an SFP event in a timely manner.

The assessments conducted for this study show that in all but the most severe events, recovery and mitigation times of more than 100 hours are available from onset of the loss of cooling to the time of release. These times would be sufficient to permit offsite protective actions to be implemented on an ad hoc basis, if necessary, without the full compliment of regulatory requirements associated with operating reactors. In reaching this judgement the staff recognizes that relaxation of EP requirements for decommissioning plants would not result in an immediate lapse of all offsite emergency response capabilities following final shutdown, but would more likely result in early elimination of some capabilities (e.g., sirens) and more gradual deterioration of certain other capabilities (e.g., communications), with a transition towards longer ad hoc response times over a period of several years due to such factors as attrition of experienced personnel. Within the first year, when SFP heatup rates and risks are greatest, response capabilities are expected to be largely intact, and comparable to those for full EP. These capabilities could be expected to diminish over time, resulting in longer ad hoc response times. However, continued fission product decay in the spent fuel will simultaneously result in longer times to release, providing additional time during which emergency response measures could be implemented.

Only in the most unlikely events, such as severe seismic events and heavy load drops failing the pool floor, might the accident progress so rapidly that emergency response measures might not be implemented in a timely manner. The staff's risk study indicates that such events are very unlikely (a frequency of less than 2.4E-6 per year) and dominated by large earthquakes with a magnitude several times the SSE. However, as discussed in Section 3.6.2, for ground motion levels that correspond to SFP failure, emergency planning would have marginal benefit because of extensive collateral damage to infrastructure (e.g., power, communications, buildings, roads, and bridges). Emergency response action would likely be implemented on an ad hoc basis in these events. As such, relaxations in EP requirements are not expected to substantially reduce the existing level of protection for the dominant contributor.

The next largest contribution is from cask drop sequences. The frequency of such events is extremely small in the staff's risk study (2E-7 per year) due to implementation of IDCs and SDAs concerning movement of heavy loads. Relaxations in EP requirements could result in some increase in the risk associated with these events for a limited time window following shutdown (1 to 5 years in the staff's analysis). However, the increase is very small and represents only a small fraction of the total risk from SFPs, as shown in Section 3.6. For the remaining SFP accidents that lead to SFP fires, either current emergency planning would also be ineffective (e.g., boil down sequences due to organizational failures) or the accident frequencies would be at least an order of magnitude lower than that for the cask drop accident (e.g., aircraft impact). As such, mitigation of these events would not be risk significant.

The staff concludes the following with regard to defense-in-depth:

- Remaining EP requirements, together with the substantial amount of time available for emergency response will provide a sufficient level of defense-in-depth for SFP accidents.
- In the large seismic events that dominant SFP risk, current EP would be of marginal value due to extensive collateral damage offsite. Accordingly, relaxations in EP requirements are not expected to substantially alter the existing level of protection.
- In those sequences in which current EP would be effective, a comparable level of protection should continue to be provided though remaining requirements for on-site EP and the capability to implement offsite protective actions on an ad hoc basis.
- There can be a trade off between the formality with which the elements of emergency planning (procedures, training, performance of exercises) are treated and the increasing safety margin as the fuel ages and the time for response gets longer.

4.2.3 Safety Margins

RG 1.174 states that the proposed change should maintain sufficient safety margins.

As discussed in Section 2, the safety margins associated with fuel in the spent fuel pool are much greater than those associated with an operating reactor due to the low heat removal requirements and long time frames available for recovery from off normal events. Due to these larger margins the staff judges that the skid mounted and other dedicated SFP cooling and inventory systems in place provide adequate margins for accident prevention. Additionally, the monitoring programs that verify Boraflex condition provide assurance of margin with respect to shutdown reactivity.

The risk results provided in Section 3.6.3 show that a typical site that conforms with the IDCs, and SDAs would meet the Commission's QHOs by about one to two orders of magnitude depending on assumptions regarding the SFP source term and seismic hazard frequency. The risk comparisons provided in Appendix 4C show that SFP facilities maintained at or below the recommended PPG of 1E-5 per year, would continue to meet the QHOs for even the most severe source term.

The estimated risk increases associated with the EP relaxations are also well below the allowable increases inferred from the RG 1.174 LERF criteria. As discussed in Section 4.2.1 and Appendix 4D, the increases in risk from the EP relaxation would be about a factor of 10 below the maximum allowable increases inferred from RG 1.174. Since the SFP fire frequency assumed in these comparisons is about a factor of four lower than the PPG of 1E-5 per year, a plant operating nominally at the PPG would have a smaller margin to the allowable risk limits for the reference plant but would still be at or below the limits.

The results of a sensitivity case in Appendix 4D indicates that even under the most optimistic assumptions regarding the value of EP in seismic events, the change in risk associated with relaxation of the requirements for radiological preplanning is still relatively small. The increases in early fatalities and individual early fatality risk remain below the maximum allowable for each risk measure. Population dose and individual latent cancer fatality risk are about a factor of two higher than the allowable value inferred from RG 1.174. This increase in individual latent cancer risk represents about nine percent of the QHO, thus, considerable margin to the QHO would still remain.

The evacuation effectiveness assumed for "Full EP" in the sensitivity case is unrealistic for high g earthquakes, and the risk increase associated with the EP relaxations would be closer to the baseline value. Also, the risk reduction estimates are based on the LLNL seismic hazard frequencies and the high ruthenium source term, and would be substantially lower if either the EPRI seismic hazard frequencies or the low ruthenium source term were used. Finally, the above comparisons are based on the risk levels one year after shutdown. Use of either the EPRI seismic hazard frequencies or the low ruthenium source term would reduce each of the risk measures by about a factor of 10, to values which are well below the RG 1.174 allowables and the QHOs. The risk impact will decrease even further in later years due to reduced consequences as fission products decay.

The staff concludes that large margins of safety in SFP accidents will remain even with substantial relaxations of EP requirements, and that conformance with the IDCs and SDAs provides reasonable assurance that sufficient margins to the Safety Goals will be maintained.

4.2.4. Implementation and Monitoring Program

RG 1.174 states that the impact of the proposed change should be monitored using performance measurement strategies. RG 1.174 further states that an implementation and monitoring plan should be developed to ensure that the engineering evaluation conducted to examine the impact of the proposed changes continues to reflect the actual reliability and availability of SSCs that have been evaluated. This will ensure that the conclusions that have been drawn will remain valid.

Applying this guideline for the SFP risk evaluation results in identification of four primary areas for performance monitoring: 1) the performance and reliability of SFP cooling and associated power and inventory make-up systems, 2) the Boraflex condition for high density fuel racks, 3) crane operation and load path control for cask movements, and 4) onsite emergency response capabilities. The following

- Performance and reliability monitoring of the SFP systems, heat removal, AC power and inventory should be carried out similar to the provisions of the maintenance rule (10 CFR 50.65)

- The current monitoring programs identified in licensee's responses to Generic Letter 96-04 [Ref. 2] with respect to monitoring of the Boraflex absorber material should be maintained by decommissioning plants until all fuel is removed from the SFP. This staff assumption is stated in SDA #5 (see Table 4.2-2)

- Heavy load activities and load paths should be monitored and controlled by the licensee in accordance with IDC # 1 (see Table 4.2-1)

- Licensees should continue to provide a level of onsite capabilities to assure prompt notification of offsite authorities, characterization of potential releases, development of protective action recommendations and communication with the public. These capabilities should be monitored by holding periodic onsite exercises and drills.

The staff concludes that continued compliance with the maintenance rule, the IDCs, and the SDAs, together with remaining requirements related to onsite EP provides a reasonable level of monitoring of SFP safety.

Table 4.2-1 Industry Decommissioning Commitments (IDC)

IDC number	Industry commitments
1	Cask drop analyses will be performed or single failure proof cranes will be in use for handling of heavy loads (i.e., phase II of NUREG-0612 will be implemented).
2	Procedures and training of personnel will be in place to ensure that on-site and offsite resources can be brought to bear during an event.
3	Procedures will be in place to establish communication between on-site and offsite organizations during severe weather and seismic events.
4	An offsite resource plan will be developed which will include access to portable pumps and emergency power to supplement on-site resources. The plan would principally identify organizations or suppliers where offsite resources could be obtained in a timely manner.
5	Spent fuel pool instrumentation will include readouts and alarms in the control room (or where personnel are stationed) for spent fuel pool temperature, water level, and area radiation levels.
6	Spent fuel pool seals that could cause leakage leading to fuel uncovery in the event of seal failure shall be self limiting to leakage or otherwise engineered so that drainage cannot occur.
7	Procedures or administrative controls to reduce the likelihood of rapid drain down events will include (1) prohibitions on the use of pumps that lack adequate siphon protection or (2) controls for pump suction and discharge points. The functionality of anti-siphon devices will be periodically verified.
8	An on-site restoration plan will be in place to provide repair of the spent fuel pool cooling systems or to provide access for make-up water to the spent fuel pool. The plan will provide for remote alignment of the make-up source to the spent fuel pool without requiring entry to the refuel floor.
9	Procedures will be in place to control spent fuel pool operations that have the potential to rapidly decrease spent fuel pool inventory. These administrative controls may require additional operations or management review, management physical presence for designated operations or administrative limitations such as restrictions on heavy load movements
10	Routine testing of the alternative fuel pool make-up system components will be performed and administrative controls for equipment out of service will be implemented to provide added assurance that the components would be available, if needed.

Table 4.2-2 Staff Decommissioning Assumptions (SDAs)

SDA number	Staff Assumptions
1	Walk-downs of SFP systems will be performed at least once per shift by the operators. Procedures will be developed for and employed by the operators to provide guidance on the capability and availability of on-site and offsite inventory make-up sources and time available to initiate these sources for various loss of cooling or inventory events.
2	Control room instrumentation that monitors spent fuel pool temperature and water level will directly measure the parameters involved. Level instrumentation will provide alarms at levels associated with calling in offsite resources and with declaring a general emergency.
3	Load Drop consequence analyses will be performed for facilities with non-single failure proof systems. The analyses and any mitigative actions necessary to preclude catastrophic damage to the spent fuel pool that would lead to a rapid pool draining would be sufficient to demonstrate that there is high confidence in the facilities ability to withstand a heavy load drop.
4	Each decommissioning plant will successfully complete the seismic checklist provided in Appendix 5 to this report. If the checklist cannot be successfully completed, the decommissioning plant will perform a plant specific seismic risk assessment of the SFP and demonstrate that SFP seismically induced structural failure and rapid loss of inventory is less than the generic bounding estimates provided in this study ($<3x10^{-6}$ per year).
5	Licensees will maintain a program to provide surveillance and monitoring of Boraflex in high density spent fuel racks until such time as spent fuel is no longer stored in these high-density racks.
6	Licensee's spent fuel pool cooling design will be at least as capable as that assumed in the risk assessment, including instrumentation. Licensees will have at least one motor-driven and one diesel-driven fire pump capable of delivering inventory to the spent fuel pool.