POLICY ISSUE
(Notation Vote)

June 4, 2001 SECY-01-0100

FOR: The Commissioners

FROM: William D. Travers
Executive Director for Operations

SUBJECT: POLICY ISSUES RELATED TO SAFEGUARDS, INSURANCE, AND EMERGENCY PREPAREDNESS REGULATIONS AT DECOMMISSIONING NUCLEAR POWER PLANTS STORING FUEL IN SPENT FUEL POOLS (WITS 200000126)

PURPOSE:

To present the Commission with policy issues and options related to regulatory decision-making in the areas of insurance, emergency preparedness (EP), and safeguards for decommissioning nuclear power plants and to request Commission approval of staff recommendations.

BACKGROUND:

In the early 1990s, the staff initiated an effort to revise the regulatory requirements for decommissioning nuclear power plants. The decommissioning regulatory improvement effort has focused on revisions to requirements in the areas of insurance, EP, and safeguards because existing regulations present a significant burden to decommissioning licensees without apparent commensurate safety benefits. The technical basis needed to support the decommissioning regulatory improvement effort has been difficult to develop. This has been partly due to an incomplete understanding of the zirconium fire risk associated with decommissioning plants.

In March 1999, the NRC staff briefed the Commission about ongoing efforts to improve decommissioning regulations. The staff proposed to consider a risk-informed approach on decommissioning plant issues and to use the risk insights derived from this review to guide the

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development of new regulations and for reviewing decommissioning exemption requests. Details of this effort are discussed in SECY-99-168, “Improving Decommissioning Regulations for Nuclear Power Plants,” dated June 30, 1999. As part of this effort, the staff completed a study of accidents at decommissioning plant SFPs, “Technical Study of Spent Fuel Pool Accident Risk at Decommissioning Nuclear Power Plants,” NUREG-1738. The study was publicly issued in January 2001.

In a December 20, 2000, memorandum forwarding NUREG-1738 to the Commission, it was noted that the study has implications related to previous policy on decommissioning exemptions for insurance, EP, and safeguards and so the staff committed to provide a policy options paper for Commission consideration. This paper, combined with information regarding previously issued exemptions provided in a separate paper to the Commission, fulfills that commitment.

DISCUSSION:

As discussed in NUREG-1738, the only postulated scenario at a decommissioning plant that could result in a significant offsite radiological release is a beyond-design-basis event commonly referred to as a zirconium fire. An event sequence resulting in a zirconium fire begins with a substantial loss of water from the spent fuel pool (SFP), uncovering the spent fuel. Uncovering the spent fuel could result in a heatup to the point where the fuel’s zirconium cladding might begin to oxidize in a rapid, exothermic, self-sustaining reaction. The plume from such a zirconium fire could have significant offsite radiological consequences.

In NUREG-1738, the staff concluded that the risk from an SFP zirconium fire at decommissioning plants is very low and well below the Commission’s safety goals for operating reactors. The study found that the event sequences most important to the zirconium fire risk at decommissioning plants are large (catastrophic) earthquakes and spent fuel cask drop events. These findings are contingent on the implementation of certain SFP design, operational, and administrative features assumed by the staff or committed to by the industry that are documented in the study. NUREG-1738 did not explicitly compare the risk from nuclear power plant operation to the risk of spent fuel storage at a decommissioning plant SFP. However, the likelihood of a large offsite radiological release that could impact public health and safety from a decommissioning plant is considerably lower than the likelihood of such a release from an operating reactor when including initiating events associated with normal and abnormal operations, design basis accidents, and beyond design basis accidents.

NUREG-1738 also presented thermal-hydraulic analyses of the stored spent fuel when SFP cooling is lost or the spent fuel is uncovered. The staff found that a generic decay heat level (and, therefore, decay time) beyond which a zirconium fire is physically impossible cannot be defined. This is because the geometry of the spent fuel assemblies, the associated air cooling flow paths, and the resultant heat transfer rates are not predictable following a major dynamic event (such as a very severe earthquake), which could rupture and rapidly drain the SFP. As a result, the study concluded that the possibility of a zirconium fire cannot be dismissed even many years after final reactor shutdown.

This finding is important because it differs from previous positions on exempting decommissioning plants from certain insurance, EP, and safeguards requirements as described

in SECY-93-127, “Financial Protection Required of Licensees of Large Nuclear Power Plants During Decommissioning,” dated July 13, 1993. The previous position was based on demonstrating by thermal-hydraulic analysis that spent fuel stored in the SFP would air cool sufficiently and not reach the zirconium fire ignition temperature. The position did not consider blockage or obstructions to natural circulation air flow through the fuel assemblies since such sequences were considered strictly hypothetical. In NUREG-1738, the staff observed that it is not feasible, without numerous constraints, to define a generic decay heat level beyond which a zirconium fire is not physically possible. Stated in this manner, the zirconium fire cannot be considered strictly hypothetical. However, the staff notes that the sequences in which a zirconium fire comes about are very low likelihood sequences. In this light, the sufficiency of previous exemptions that ruled out a zirconium fire based on air cooling calculations assuming normal SFP assembly configurations and geometries has been reconsidered. The previous policy established in SECY-93-127 for reducing certain insurance, EP, and safeguards requirements at decommissioning plants has been revisited by this paper. Potential implications of the finding of NUREG-1738 and the policy recommendation of this paper on previously issued exemptions at currently decommissioning plants will be provided in a separate paper to the Commission.

The risk from a zirconium fire was examined in NUREG-1738 for a “generic” decommissioning plant. The study quantified the initiating event frequencies (i.e., events that can lead to spent fuel uncovery). The initiating event frequencies were determined to be very low and dominated by the frequency of severe earthquakes. The frequency of such events leading to a zirconium fire is less than 3E-6 per year at most decommissioning plant sites. These conclusions apply to decommissioning facilities that have certain design, operational, and administrative characteristics that were assumed in the risk study. Such characteristics are identified in NUREG-1738 as industry decommissioning commitments (IDCs) and staff decommissioning assumptions (SDAs). Zirconium fire probabilities may be higher for facilities that do not satisfy these staff assumptions or industry commitments, and may be lower for facilities that have different seismic characteristics. The likelihood of a zirconium fire at a facility that does not implement all the IDCs and SDAs cannot be determined from NUREG-1738. If it were necessary to determine the likelihood of a zirconium fire at such a facility, a plant-specific assessment would be required. The NUREG-1738 study also included zirconium fire consequence assessments. The results demonstrate that as long as the fuel uncovery frequency is less than 1E-5 per year, the zirconium fire risk is low and within the Commission’s Quantitative Health Objectives (QHOs). In addition, the study developed an approach similar to Regulatory Guide (RG) 1.174, “An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis,” to assist decommissioning plant regulatory decision making.

In general, the NUREG-1738 risk assessments, insights, and methodologies represent a technically sound basis for risk-informing decommissioning plant regulatory decision making. However, there are some limitations and additional considerations in applying the information in NUREG-1738 as noted below:

- No information in the report bears on the level of safeguards necessary to limit the risk from sabotage events. The risk analysis in NUREG-1738, like PRA analyses in general, does not include events due to sabotage. No established method exists for quantitatively

estimating the likelihood of a sabotage event at a nuclear facility.

- NUREG-1738 determined that relaxation of offsite EP a few months after shutdown resulted in only a small change in consequences from a zirconium fire. The change in consequences due to relaxation of offsite EP is small because the overall risk is low and offsite EP was judged to have marginal impact on the evacuation effectiveness under a severe earthquake. Notwithstanding the low likelihood of an SFP zirconium fire, the safety principles of RG 1.174 dictate that defense-in-depth be considered. Onsite mitigative actions and offsite protective actions provide defense-in-depth. Therefore, any reduction in offsite EP needs to be balanced with maintaining an appropriate level of defense-in-depth. The timing and extent of offsite EP reductions would require considerations beyond the risk insights in NUREG-1738. Public confidence is also a consideration.

- NUREG-1738 noted uncertainties concerning the seismic hazard estimates and the release fractions for ruthenium and fuel fines. However, regardless of which of the two recognized seismic hazard estimates are assumed for the initiating event frequency, and assuming any release fraction considered in the source term sensitivity study, the risk from a zirconium fire still meets the Commission safety goals for operating reactors.

Despite the limitations for quantitatively assessing the likelihood of sabotage at a nuclear facility, the staff believes the findings and methodologies developed in NUREG-1738 can be used to define an appropriate, risk-informed, level of offsite EP and insurance coverage for permanently shut down reactors. Regulatory changes for insurance or offsite EP would be premised on the assumption that the level of safeguards maintained at a decommissioning plant would provide high assurance that the likelihood of a zirconium fire due to sabotage is very low.

The staff's intent to pursue a risk-informed approach for insurance and EP for decommissioning plants is consistent with Commission guidance in the Policy Statement on Use of Probabilistic Risk Assessment Methods in Nuclear Regulatory Activities (60 FR 42622, August 16, 1995). The Commission stated therein that the use of PRA technology should be increased in all regulatory matters to the extent supported by the state-of-the-art in PRA methods and data, and in a manner that complements the NRC's deterministic approach and supports the NRC's traditional defense-in-depth philosophy. The technical study of spent fuel pool accident risk represents an important advancement by establishing the level of risk associated with decommissioning plants, and identifying the design and operational features necessary to ensure that risks to the public from these shutdown facilities are sufficiently small. The staff considers the risk insights from this study to be generically valid and sufficiently robust that they may be used as the basis for a regulatory framework applicable to decommissioning plants, even considering the large uncertainties inherent in estimating seismic hazards and fission product source terms.

The staff has defined several policy issues and recommended options which, with Commission approval, will enable the staff to move forward with decommissioning rulemaking in the areas of safeguards, EP, and insurance.

POLICY ISSUES:

The attachment to this paper provides a detailed discussion of the policy issues, options for addressing the issues, and staff recommendations that support regulatory decision-making in the areas of insurance, EP, and safeguards for decommissioning plants. A summary of the policy issues and the associated staff recommendations are presented below.

1. Should the Safety Goals for Operating Nuclear Power Plants be Applied to Decommissioning Plants?

The Commission Safety Goal policy statement applies only to operating nuclear power plants. The policy statement does not apply to fuel cycle facilities and does not address decommissioning nuclear power plants. Even though a zirconium fire is different from a core damage accident, a zirconium fire event can have public health and safety consequences similar to a severe core damage accident with a large offsite release; therefore, the safety goals applied to operating plants appear appropriate for decommissioning plants with spent fuel in an SFP.

The Commission's policy statement on PRA encourages the greater use of PRA techniques to improve safety, regulatory decision making, and efficiency, and directs the staff to expand PRA usage to the extent possible. The Commission has also requested that the staff consider risk-informing decommissioning regulations. To support the use of risk-informed decision making for decommissioning, NUREG-1738 relied on PRA techniques that demonstrate the risk from a zirconium fire at a decommissioning plant is low and meets Commission safety goals for operating nuclear power plants.

For these reasons, the staff recommends that the safety goals for operating nuclear power plants be applied to decommissioning plants while spent fuel is being stored in the SFP.

2. Should the Commission develop an approach using probabilistic risk assessments for quantifying the likelihood of sabotage that would permit greater risk-informed regulatory decision making in the area of safeguards?

As stated previously, the Commission has directed the staff to expand the use of PRA technology for regulatory decision making and to risk-inform regulatory activities to the extent practical. However, the Commission's intent regarding risk-informing safeguards is unclear since methods and data for quantifying the likelihood of a sabotage event have not been identified. As the Commission is aware, the staff qualitatively considers the relative likelihood and extent of the threat to licensee facilities and materials based on a comprehensive assessment of the domestic and international threat environment. There is information available through the federal national security agencies that assess the national terrorist threat which calls into question the feasibility of developing a quantitative risk assessment methodology for sabotage.

The staff, as a result of its ongoing work with the Federal national security agencies, has determined that the ability to quantify the likelihood of sabotage events at nuclear power plants is not currently supported by the state-of-the-art in PRA methods and data. The staff also believes that both the NRC and the other government stakeholders would need to conduct additional research and expend significant time and resources before it could even attempt to quantify the likelihood of sabotage events. In addition, the national security agencies, Intelligence Community, and Law Enforcement Agencies do not currently quantitatively assess the likelihood of terrorist, criminal, or other malevolent acts. To risk-inform NRC's assessment of the likelihood of threat in a quantitative manner, NRC would have to not only develop the tools and data to quantitatively estimate the threat, but would also have to convince Law Enforcement Agencies, Intelligence Community, and national security agencies that quantitative assessment of threat was possible, reasonable, and feasible and that they should change their business practices to provide NRC with the necessary information to support quantitative analysis.

NMSS has developed a process for identifying regulatory applications for risk-informed approaches and has also developed screening criteria for such applications. These criteria have been applied to the issue of risk-informing safeguards by consideration of the likelihood of an adversary attack. Based on the discussion above, the staff has concluded that several of the criteria would cause the topic to be "screened-out" from further consideration. Detailed information about the application of these screening criteria is provided in the attachment.

The staff recommends that the new regulatory requirements for safeguards at decommissioning plants be based on deterministic and performance-based criteria such as proposed in Policy Issue 3 and the current draft version of proposed revisions to the physical protection requirements for power reactors in 10 CFR 73.55. This approach supports the development of risk-informed rulemaking for insurance and EP regulations at decommissioning plants premised on the assumption that the level of safeguards maintained at a decommissioning plant will provide high assurance that the likelihood of a zirconium fire due to sabotage is very low. While the staff is not recommending the development of a risk-informed approach for quantifying the likelihood of sabotage, the staff will, through its ongoing interactions with the Federal national security agencies, continue to look for opportunities to increase the use of PRA technology in the safeguards area. If in the future, the staff determines that a methodology to quantify the probability of sabotage might be feasible, the Commission's direction will be sought.

3. How should the Commission define the safeguards protection goal to be applied to SFPs at decommissioning plants ?

The staff recommends a safeguards protection goal for decommissioning nuclear power plant SFPs that consists of a design criterion of protecting against radiological sabotage by the design basis threat and a performance standard of preventing spent fuel sabotage that could cause radiation exposure to an individual at the nearest controlled area boundary from exceeding the dose specified in 10 CFR 72.106 (5 rem at a minimum of 100 meters). This would apply the same protection goal to decommissioning plant SFPs as proposed in a performance-based revision to 10 CFR 73.55 which is being developed for Commission consideration in a separate paper. The staff notes that this recommendation may result in the need to backfit safeguards plans at some decommissioning plants that have been exempted from some of the current requirements in 10 CFR 73.55.

4. What level of insurance is appropriate for licensees of decommissioning plants given the low likelihood of a large onsite and offsite radiological release from a zirconium fire accident involving the spent fuel stored in the SFP?

The staff has considered a risk-informed approach in establishing new regulations for decommissioning plants in the area of insurance. The risk insights from the technical study of SFP risks, NUREG-1738, would form the underpinnings of the new regulations. The technical study shows the risk of a zirconium fire at decommissioning plants that implement the design, operational, and administrative characteristics that were assumed in the risk study (IDCs and SDAs) to be very low generically, and well within the Commission's safety goals. The risk is low because of the very low likelihood of a zirconium fire, even though the consequences from a zirconium fire could be serious. The risk from radiological sabotage will be maintained low by protecting the spent fuel against the design basis threat as recommended in Policy Issue 3. Therefore, the staff recommends that insurance requirements be substantially reduced shortly after a reactor permanently shuts down and enters into decommissioning. These licensees would not be required to participate in the secondary retrospective rating pool and primary insurance coverage would be reduced to about $100 million. In addition, onsite property damage insurance would not be required 60 days after permanent shutdown. Reasonable assurance of the very low frequency of a zirconium fire event would be established by a new rule requiring decommissioning plant licensees to implement the design, operational, and administrative characteristics that were assumed in the risk study (IDCs and SDAs) before insurance is reduced. Since insurance provides no direct protection of public health and safety, it appears that neither the cost-benefit provision nor the adequate protection provision of the backfit rule would suggest that this policy recommendation would result in backfit implications for currently decommissioning plants with insurance exemptions.

5. What level of offsite emergency preparedness is appropriate for decommissioning plants given the low likelihood of a radiological release large enough to exceed protective action guides offsite?

The staff recommends that offsite EP be incrementally reduced and eventually eliminated after a reactor permanently shuts down. In addition to deterministic and defense-in-depth considerations, insights of NUREG-1738 can be used to risk-inform reductions in offsite EP. The reduction and eventual elimination of offsite EP would be based on ensuring that there is a reasonable length of time for protective and mitigative actions between the initiation of SFP drainage and fuel heat-up to the point of a large offsite radiological release (i.e., zirconium fire). The Commission's defense-in-depth philosophy would be maintained based on the expectation that there would be reasonable assurance of implementing onsite mitigative actions and offsite protective actions given the slow developing nature of the spent fuel zirconium fire. Criteria for the initial reduction and eventual elimination of offsite EP regulations would be determined during the rulemaking process. Reasonable assurance of the very low frequency of a zirconium fire event would be established in the new rule by requiring decommissioning plant licensees to implement the design, operational, and administrative characteristics that were assumed in the

risk study (IDCs and SDAs) before offsite EP is reduced. The staff notes that this recommendation may have backfit-like implications for decommissioning plants with offsite EP exemptions. The staff will evaluate the need to adopt the IDCs and SDAs for these plants. In addition, the staff also will consider the need to backfit changes to the emergency action level classifications at currently decommissioning plants.

EXISTING EXEMPTIONS:

In the staff requirements memorandum to SECY-98-253, "Applicability of Plant-Specific Backfit Requirements to Plants Undergoing Decommissioning," dated February 12, 1999, the Commission directed the staff to apply the current backfit rule, 10 CFR 50.109, to plants undergoing decommissioning until a backfit rulemaking applicable to plants undergoing decommissioning is codified. The staff anticipates that new decommissioning rules would be developed to implement Commission policy direction in response to this paper. Therefore, the staff will consider the backfit rule as part of any rulemaking implementing the policies recommended in this paper. The staff would need to perform backfit analyses and make backfit determinations in conjunction with the rulemaking process relative to previously granted exemptions at plants currently undergoing decommissioning.

The appropriateness of exemptions granted to plants currently decommissioning has been questioned because these exemptions were granted, in part, on the belief that a zirconium fire was not possible. Despite the NUREG-1738 conclusion that a zirconium fire cannot be dismissed even many years after shutdown, it is the staff's judgment that previously granted exemptions for EP and insurance at currently decommissioning plants do not present an undue risk to the public health and safety given the long time periods available to support implementation of protective or mitigative measures on an ad hoc basis for SFP accidents. Specifically, because of the long spent fuel decay times at currently decommissioning plants, a zirconium fire cannot occur for an extended period of time (at least 20 hours), if it could occur at all, even under the worst-case adiabatic heatup assumptions (no heat transfer of any kind from the fuel assemblies). The time available to take ad hoc mitigative and protective actions provides reasonable assurance that there are no immediate public health or safety concerns with past exemptions issued to currently decommissioning plants.

Based on a review of existing exemptions, the staff has identified some potential regulatory actions that the staff may need to pursue for EP exemptions as part of the backfit process associated with future rulemaking. The staff does not anticipate any backfit implications for insurance exemptions. For existing safeguards exemptions, the implications of the risk study present new concerns that will require a more extensive review. Since discussion of the potential vulnerabilities of SFPs to radiological sabotage is Safeguards Information (SGI), this material will be provided to the Commission in a separate correspondence that will also provide additional information on the implications of the policy recommendations on existing insurance and EP exemptions.

RESOURCES:

The staff has estimated the resources required to develop new regulations and regulatory guidance in the area of decommissioning plant safeguards, insurance, and EP, consistent with the policy recommendations in this paper. Estimates to complete backfit analyses of these recommendations for currently decommissioning plants is also provided.

If the Commission approves the staff's recommendations, the staff estimates the following resources will needed over the next several years:

Decommissioning Rulemaking and Regulatory Guidance for Safeguards, Insurance, EP and Project Management are estimated to be:

FY01	FY02	FY03	FY04
1.3 FTE	5.0 FTE	4.0 FTE	1.4 FTE

Backfit Analyses of Currently Decommissioning Plants for Safeguards and EP are estimated to be:

FY01	FY02	FY03	FY04
0.5 FTE	2.3 FTE	1.0 FTE	0.3 FTE

If the Commission approves the staff's recommendations in this paper, unbudgeted resources estimated at 10.5 FTE (10 FTE for NRR and 0.5 FTE for NMSS) will be reprogrammed using the Planning, Budgeting, and Performance Management process.

COORDINATION:

The Office of the General Counsel has reviewed this paper and has no legal objections to its contents. The Office of the Chief Financial Officer has reviewed this paper for resource implications and has no objections to its contents.

RECOMMENDATIONS:

That the Commission:

1. Approve the staff recommendations related to the policy issues presented in the attachment and summarized above.

2. Make this SECY publicly available within 10 days of its date.

3. Note that if the Commission approves the staff recommendations, a schedule for an integrated decommissioning rulemaking plan addressing insurance, EP and safeguards, as well as a schedule for developing a long-term plan for broad-scope decommissioning regulatory improvements will be provided to the Commission within 60 days of receiving the Commission response to this paper.

/RA/

William D. Travers
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for Operations

Attachment: Decommissioning Policy Issues and Options

Decommissioning Policy Issues and Options

The staff's decommissioning plant spent fuel pool (SFP) risk study, NUREG-1738, concluded that the risk from an SFP zirconium fire at decommissioning plants is very low and well below the Commission's safety goals for operating reactors. The study found that the event sequences most important to the zirconium fire risk at decommissioning plants are large (catastrophic) earthquakes and spent fuel cask drop events. NUREG-1738 did not explicitly compare the risk from nuclear power plant operation to the risk of spent fuel storage at a decommissioning plant SFP. However, the likelihood of a large offsite radiological release that could impact public health and safety from a decommissioning plant is considerably lower than the likelihood of such a release from an operating reactor when including initiating events associated with normal and abnormal operations, design basis accidents, and beyond design basis accidents.

NUREG-1738 also presented thermal-hydraulic analyses of the stored spent fuel when SFP cooling is lost or the spent fuel is uncovered. The staff found that a generic decay heat level (and, therefore, decay time) beyond which a zirconium fire is physically impossible cannot be defined. This is because the geometry of the spent fuel assemblies, the associated air cooling flow paths, and the resultant heat transfer rates are not predictable following a major dynamic event (such as a very severe earthquake), which could rupture and rapidly drain the SFP. As a result, the study concluded that the possibility of a zirconium fire cannot be dismissed even many years after final reactor shutdown.

This finding is important because it differs from previous Commission policy for exempting decommissioning plants from certain insurance, EP, and safeguards requirements. The previous policy originated in SECY-93-127, "Financial Protection Required of Licensees of Large Nuclear Power Plants During Decommissioning," dated July 13, 1993, and was based on demonstrating by thermal-hydraulic analysis that spent fuel stored in the SFP would air cool sufficiently and not reach the zirconium fire ignition temperature. The position did not consider blockage or obstructions to natural circulation air flows through the fuel assemblies since such sequences were considered strictly hypothetical. The staff documented in NUREG-1738 that SFP accident sequences associated with the dominant scenarios, even though very low in likelihood, could easily lead to SFP drainage with significant collateral damage of the spent fuel assemblies or surrounding structures involving air cooling flow blockage. Therefore, obstructions to natural circulation airflow associated with the dominant sequences may no longer be strictly hypothetical. Accordingly, the sufficiency of previous exemptions that ruled out a zirconium fire based on air cooling calculations assuming normal SFP assembly configurations and geometries has been reconsidered. Previous Commission policy established by SECY-93-127 for reducing certain insurance, EP, and safeguards requirements at decommissioning plants has been revisited by this paper. Potential implications of the finding of NUREG-1738 and the policy recommendation of this paper on previously issued exemptions at currently decommissioning plants will be provided to the Commission in a separate correspondence.

The risk from a zirconium fire was examined in NUREG-1738 for a "generic" decommissioning plant. The study quantified the initiating event frequencies (i.e., events that can lead to spent fuel uncovery). The initiating event frequencies were determined to be very low and dominated

by the frequency of severe earthquakes. The frequency of such events leading to a zirconium fire is less than 3E-6 per year at most decommissioning plant sites. These conclusions apply to decommissioning facilities that have certain design, operational, and administrative characteristics that were assumed in the risk study. Such characteristics are identified in NUREG-1738 as industry decommissioning commitments (IDCs) and staff decommissioning assumptions (SDAs). Zirconium fire probabilities may be higher for facilities that do not satisfy these staff assumptions or industry commitments, and may be lower for facilities that have different seismic characteristics. The likelihood of a zirconium fire at a facility that does not implement all the IDCs and SDAs cannot be determined from NUREG-1738. If it were necessary to determine the likelihood of a zirconium fire at such a facility, a plant-specific assessment would be required. The study also included zirconium fire consequence assessments. The results demonstrate that as long as the fuel uncovery frequency is less than 1E-5 per year, the zirconium fire risk is low and within the Commission's Quantitative Health Objectives (QHOs). In addition, the study developed an approach similar to Regulatory Guide (RG) 1.174, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis," to assist decommissioning plant regulatory decision making.

In general, the NUREG-1738 risk assessments, insights, and methodologies represent a technically sound basis for risk-informing decommissioning plant regulatory decision making. However, there are some limitations and additional considerations in applying the information in NUREG-1738 as noted below:

- No information in the report bears on the level of safeguards necessary to limit the risk from sabotage events. The risk analysis in NUREG-1738, like PRA analyses in general, does not include events due to sabotage. No established quantitative method exists for estimating the likelihood of a sabotage event at a nuclear facility.

- NUREG-1738 determined that relaxation of offsite EP a few months after shutdown resulted in only a small change in consequences from a zirconium fire. The change in consequences due to relaxation of offsite EP is small because the overall risk is low and offsite EP was judged to have marginal impact on the evacuation effectiveness under a severe earthquake. Notwithstanding the low likelihood of an SFP zirconium fire, the safety principles of RG 1.174 dictate that defense-in-depth be considered. Onsite mitigative actions and offsite protective actions provide defense-in-depth. Therefore, any reduction in offsite EP needs to be balanced with maintaining an appropriate level of defense-in-depth. The timing and extent of offsite EP reductions would require considerations beyond the risk insights in NUREG-1738. Public confidence is also a consideration.

- NUREG-1738 noted considerable uncertainties concerning the seismic hazard estimates and the ruthenium and fuel fines release fractions. However, regardless of which of the two recognized seismic hazard estimates are assumed for the initiating event frequency, and assuming any release fraction considered in the source term sensitivity study, the risk from a zirconium fire still meets the Commission safety goals for operating reactors.

Despite the limitations for quantitatively assessing the likelihood of sabotage at a nuclear facility, the staff believes the findings and methodologies developed in NUREG-1738 can be used to define an appropriate, risk-informed, level of offsite EP and insurance coverage for permanently shut down reactors. Regulatory changes for insurance or offsite EP would be premised on the assumption that the level of safeguards maintained at a decommissioning plant would provide high assurance that the likelihood of an SFP zirconium fire due to sabotage is very low.

The staff's intent to pursue a risk-informed approach for insurance and EP for decommissioning plants is consistent with Commission guidance in the Policy Statement on Use of Probabilistic Risk Assessment Methods in Nuclear Regulatory Activities (60 FR 42622, August 16, 1995). The Commission stated therein that the use of PRA technology should be increased in all regulatory matters to the extent supported by the state-of-the-art in PRA methods and data, and in a manner that complements the NRC's deterministic approach and supports the NRC's traditional defense-in-depth philosophy. The technical study of spent fuel pool accident risk represents an important advancement by establishing the level of risk associated with decommissioning plants, and identifying the design and operational features necessary to ensure that risks to the public from these shutdown facilities are sufficiently small. The staff considers the risk insights from this study to be valid generically and sufficiently robust that they may be used as the basis for a regulatory framework applicable to decommissioning plants, even considering the large uncertainties inherent in estimating seismic hazards and fission product source terms.

The staff has defined several policy issues and recommended options which, with Commission approval, will enable the staff to move forward with decommissioning rulemaking in the areas of safeguards, EP, and insurance.

POLICY ISSUES

1. Should the Safety Goals for Operating Nuclear Power Plants be Applied to Decommissioning Plants?

Discussion

For operating nuclear power plants, the Commission has decided to adopt qualitative safety goals that are supported by quantitative health effects objectives for use in the regulatory decision-making process. The Commission's first qualitative safety goal is that the risk from nuclear power plant operation should not be a significant contributor to a person's risk of accidental death or injury. The intent is to require such a level of safety that individuals living or working near nuclear power plants should be able to go about their daily lives without special concern by virtue of their proximity to these plants. Thus, the Commission's first safety goal is--

> *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.*

Even though protection of individual members of the public inherently provides substantial

societal protection, the Commission also decided that a limit should be placed on the societal risks posed by nuclear power plant operation. The Commission also believes that the risks of nuclear power plant operation should be comparable to or less than the risks from other viable means of generating the same quantity of electrical energy. Thus, the Commission's second safety goal is--

> *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.*

Severe core damage accidents can have the potential for life-threatening offsite release of radiation, for evacuation of members of the public and for contamination of public property. Apart from their health and safety consequences, severe core damage accidents can erode public confidence in the safety of nuclear power and can lead to further instability and unpredictability for the industry. To avoid these adverse consequences, the Commission has pursued a regulatory program that has as its objective providing reasonable assurance, while giving appropriate consideration to the uncertainties involved, that a severe core-damage accident will not occur at a U.S. nuclear power plant.

This policy statement focuses on the risks to the public from nuclear power plant operation. These risks include release of radioactive materials from the reactor to the environment from normal operations as well as from accidents. The risks from the nuclear fuel cycle are not included in the safety goals.

The fuel cycle risks to the public have been considered in their own right and determined to be quite small. They will continue to receive careful consideration. The possible effects of sabotage or diversion of nuclear material are also not presently included in the safety goals. At present there is no basis on which to provide a quantitative measure of risk on these matters. It is the Commission's intention that everything that is needed will be done to keep these types of safeguards risks at their present very low level; the Commission's expectation is that efforts on this point will continue to be successful. With these exceptions, the Commission's intent is that the risks from all the various initiating mechanisms be taken into account to the best of the capability of current evaluation techniques.

The Commission Safety Goal policy statement applies to operating nuclear power plants but not to fuel cycle facilities as noted above; nor to decommissioning nuclear power plants with spent fuel stored in an SFP. Consequences of an SFP zirconium fire do not directly equate to either a core damage accident or a large early release as modeled for operating reactors. This is because an SFP zirconium fire could involve multiple cores worth of spent fuel and SFPs typically do not have a containment; thus, the radiological release from a zirconium fire could be large. However, the radiological release would not likely be early due to the time between the loss of cooling and fission product release. In addition, the source terms from a core damage accident and a zirconium fire are different. Even though a zirconium fire is different from a core damage accident, the consequences from an SFP zirconium fire are similar to the consequences from a large early release event at an operating reactor. Therefore, the safety goals applied to operating nuclear power plants appear appropriate for decommissioning plants with spent fuel stored in the SFP.

The Commission's policy statement on PRA encourages the use of this analysis technique to improve safety decision making and regulatory efficiency. The policy statement requests the staff to expand PRA usage to the extent possible. The Commission also requested the staff to consider risk-informing decommissioning regulations. To support the use of risk-informed decision making for decommissioning, NUREG-1738 relied on PRA techniques that demonstrate the risk from a zirconium fire at a decommissioning plant is low and meets the Commission safety goals.

The staff, therefore, requests Commission direction on the application of operating nuclear power plant safety goals to decommissioning plants.

Option 1 Apply the safety goal policy statement to decommissioning plants with spent fuel stored in the spent fuel pool.

Pros
a. Consistent with application of safety goals to operating plants.
b. Consistent with Commission's PRA policy statement.
c. Would support the use of PRA techniques similar to those developed for operating reactors.
d. Would permit the findings from NUREG-1738 to be considered in regulatory decision-making for decommissioning.
e. Would support the Commission's SRM on risk-informing decommissioning.

Con
With the exception of the risk posed by spent fuel storage in an SFP, a decommissioning plant is more like a fuel cycle facility than an operating nuclear power plant.

Option 2 Do not apply the safety goal policy statement to decommissioning plants with spent fuel stored in the spent fuel pool.

Pros
a. The Commission may determine that decommissioning plants are more closely related to fuel cycle facilities than operating reactors.
b. The Commission may wish to withhold a decision on the application of operating reactor safety goals to decommissioning plants due to the current lack of alternative safety goal options.

Cons
a. The recommendations in NUREG-1738 are based, in part, on zirconium fire risk meeting the operating reactor safety goals. The findings of NUREG-1738 could not be put in context if the safety goal criteria cannot be applied.

b. Risk-informing decommissioning regulations may not be possible without establishing high level safety goal criteria.

Staff Analysis:

The Commission Safety Goal policy statement applies only to operating nuclear power plants. The policy statement does not address decommissioning nuclear power plants. The only postulated event scenario at a decommissioning plant storing spent fuel in an SFP that could result in a significant offsite radiological release is a zirconium fire. Even though a zirconium fire is different from a core damage accident, the consequences from an SFP zirconium fire are similar to the consequences from a large early release event at an operating reactor. Therefore, the safety goals applied to operating nuclear power plants appear appropriate for decommissioning plants with spent fuel in an SFP.

The Commission's policy statement on PRA encourages the greater use of PRA techniques to improve safety, regulatory decision making, and efficiency, and directs the staff to expand PRA usage to the extent possible. The Commission has also requested that the staff consider risk-informing decommissioning regulations. To support the use of risk-informed decision making for decommissioning, NUREG-1738 relied on PRA techniques that demonstrate the risk from a zirconium fire at a decommissioning plant is low and meets the Commission safety goals for operating nuclear power plants.

Recommendation:

The staff recommends the Option 1 position that the safety goals for operating nuclear power plants be applied to decommissioning plants while spent fuel is being stored in the spent fuel pool.

2. Should the Commission develop an approach using probabilistic risk assessments for quantifying the likelihood of sabotage that would permit greater risk-informed regulatory decision making in the area of safeguards?

Discussion:

NUREG-1738 did not assess the likelihood of radiological sabotage. Ideally, the probability of radiological sabotage should be included in the overall zirconium fire initiating event frequency. Risk studies do not consider sabotage because there is no established method for quantifying the likelihood of sabotage. The relative likelihood and extent of the sabotage threat to licensee facilities and materials is qualitatively evaluated based on a comprehensive assessment of the domestic and international threat environment. Expert judgment is then used in developing deterministic criteria and attributes of physical protection systems that maintain a high assurance that the risk from radiological sabotage will be low. In the absence of a quantitative assessment of the likelihood of sabotage, there will also be uncertainties in using the risk quantifications of NUREG-1738 for making regulatory decisions in areas besides safeguards.

The Commission, in the "Policy Statement on Safety Goals for the Operation of Nuclear Power Plants," published on March 14, 1983 (48 FR 10772), stated:

> The possible effects of sabotage or diversion of nuclear materials is not presently included in the safety goal. At present there is no basis on which to provide a measure of the risk of these matters. It is the Commission's intention that everything that is needed shall be done to keep such risks at their present, very low, level; and it is our expectation that efforts on this point will continue to be successful. With these exceptions, it is our intent that the risk from all various initiating mechanisms be taken into account to the best of the capability of the current evaluation techniques.

More recently, the Commission, in a *Federal Register* notice (59 FR 38891), dated August 1, 1994, issuing the rule for protection against malevolent use of vehicles at nuclear power plants, stated that:

> The NRC does not agree that quantifying the probability of an actual attack is necessary to a judgement of a substantial increase in overall protection of the public health and safety (a less stringent test of the justification for the rule change). Inherent in the NRC's current regulation is a policy decision that the threat, although not quantified, is likely in a range that warrants protection against a violent external assault as a matter of prudence.

The Commission, in an August 16, 1995, *Federal Register* notice (60 FR 42622), concerning the use of probabilistic risk assessment (PRA) methods in nuclear regulatory activities, provided the staff guidance to expand the use of risk-informed activities in the regulatory decision-making processes. This policy statement does not explicitly address safeguards considerations.

In the effort to address the use of PRA information, the staff issued Regulatory Guide (RG) 1.174, "An Approach for Using Probabilistic Risk Assessment in Risk-informed Decisions on Plant-Specific Changes to the Licensing Basis," in July 1998. This guide describes an acceptable approach for assessing the nature and impact of proposed licensing basis changes by considering engineering issues and applying risk insights. The regulatory guide permits only small increases in risk, and then only when it is reasonably assured that sufficient defense in depth and sufficient margins are maintained. Application for risk-informing safeguards was not specifically addressed in this guide.

In SECY-99-100, "Framework for Risk-Informed Regulations in the Office of Nuclear Material Safety and Safeguards," dated March 31, 1999, the staff identified a process for identifying regulatory applications for risk-informed approaches. In response to the staff requirements memorandum for SECY-99-100, the staff developed screening criteria for specific applications to determine the suitability for risk-informed approaches. These screening criteria are presented below.

(1) Would a risk-informed regulatory approach help to resolve a question with respect to maintaining or improving the activity's safety?

(2) Could a risk-informed regulatory approach improve the efficiency or the effectiveness of the NRC regulatory process?

(3) Could a risk-informed regulatory approach reduce unnecessary regulatory burden for the applicant or licensee?

(4) Would a risk-informed approach help to effectively communicate a regulatory decision or situation?

(If the answer to any of the above is yes, proceed to additional criteria; if not, the activity is considered to be screened out.)

(5) Do information (data) and analytical models exist that are of sufficient quality or could they be reasonably developed to support risk-informing a regulatory activity?

(If the answer to criterion 5 is yes, proceed to additional criteria; if not, the activity is considered to be screened out.)

(6) Can startup and implementation of a risk-informed approach be realized at a reasonable cost to the NRC, applicant or licensee, and/or the public, and provide a net benefit?

(If the answer to criterion 6 is yes, proceed to additional criteria; if not, the activity is considered to be screened out.)

(7) Do other factors exist (e.g., legislative, judicial, adverse stakeholder reaction) which would preclude changing the regulatory approach in an area, and therefore, limit the utility of implementing a risk-informed approach?

(If the answer to criterion 7 is no, a risk-informed approach may be implemented; if the answer is yes, the activity may be given additional consideration or be screened out.)

The above criteria are currently included in the Risk-Informed Regulation Implementation Plan.

When applying these screening criteria to risk-informing safeguards by consideration of the likelihood of an adversary attack, Criteria 2 (increase efficiency or effectiveness), and 3 (reduce unnecessary regulatory burden), appear to be met. However, the staff believes that the initiative fails against Criteria 5, 6 and 7.

With respect to Criterion 5, the staff, as a result of its ongoing work with the Federal national security agencies, has determined that the ability to quantify the likelihood of sabotage events at nuclear power plants is not currently supported by the state-of-the-art in PRA methods and data. With respect to Criterion 6, the staff believes that both the NRC and the other government stakeholders would need to conduct additional research and expend significant time and resources before it could even attempt to quantify the likelihood of sabotage events. With respect to Criterion 7, the national security agencies, Intelligence Community, and Law Enforcement Agencies do not currently quantitatively assess the likelihood of terrorist, criminal,

or other malevolent acts. To risk-inform NRC's assessment of the likelihood of threat in a quantitative manner, NRC would have to not only develop the tools and data to quantitatively estimate the threat, but would also have to convince law enforcement agencies, the Intelligence Community, and national security agencies (e.g., defense) that quantitative assessment of threat was possible, reasonable, and feasible and that they should change their business practices to provide the NRC with the necessary information to support quantitative analysis. Consequently, the staff would screen out quantitative analysis of threat as a risk-informed activity by using the current screening criteria.

During a safeguards symposium in Rockville, Maryland on May 10-11, 2000, sponsored by the staff, risk-informing safeguards regulations was specifically discussed. Representatives from Federal agencies, national laboratories, and other organizations that deal with national sabotage threat attended the symposium, and they discussed predicting and protecting against radiological sabotage at nuclear facilities. These attendees included experts on sabotage threat and risk assessment. At the conclusion of their discussions, the experts concurred that predicting the likelihood of radiological sabotage was not plausible using current state-of-the-art risk methodologies.

Most recently, the staff issued SECY-01-0015, "Process for Formulation and Disposition of Adversary Characteristics," on February 1, 2001. The paper describes a process for screening adversary characteristics to determine whether they should be included in the NRC safeguards programs, and to seek Commission approval of the process. This process and other processes that use expert judgment in developing deterministic criteria and attributes of physical protection systems are used to maintain a high assurance that the risk from radiological sabotage will be low at nuclear power plants.

Bearing in mind the above discussion related to risk-informing safeguards, the staff considered the following policy options:

Option 1 Commit resources to begin development of a PRA methodology that can be used to assess likelihood of sabotage so that safeguards regulations for decommissioning facilities can be more risk-informed.

Pros:
a. Responsive to the Commission's PRA policy statement.

b. Would eventually permit quantitative estimates of the risk of sabotage in existing PRAs.

Cons:
a. Expert consensus is that using PRA to assess the likelihood of radiological sabotage is beyond the state of current knowledge and technology.

b. Insufficient information available currently to estimate the resources to develop methods and technology to conduct assessment.

c. Large uncertainty as to whether this effort could be successfully accomplished given unlimited resources.

d. Unclear if risk-informing safeguards will result in a significant burden reduction for licensees or improvements in regulatory efficiency and effectiveness.

Option 2 Evaluate and document the current state-of-the-art PRA methodologies to assess sabotage and risk-inform safeguards regulations to determine if further developmental effort is warranted.

Pros: a. Responsive to the Commission's PRA policy statement.

b. Would provide documentation on the current feasibility and state-of-the-art application of PRA methodologies to assess the likelihood of sabotage.

c. Would avoid ineffective commitment of resources.

Cons: a. Would not benefit near-term efforts for risk informing safeguards regulations for decommissioning facilities.

b. The national security agencies, Intelligence Community, and Law-Enforcement Agencies do not currently assess the likelihood of terrorist, criminal or other malevolent acts.

c. Conducting a feasibility study would put the NRC in the lead ahead of other agencies that have a higher level of expertise on this subject. Other agencies may not support or may not be willing to divert resources to assist NRC in this effort.

Option 3 Continue to assess likelihood of sabotage in a qualitative manner using expert judgment. Deterministic and performance criteria will continue to be used to provide high assurance that the sabotage risks are kept at a very low level. Quantitative methods to assess the likelihood of sabotage will be considered, when appropriate, during periodic interactions with internal agency stakeholders, other Federal safeguards organizations, and other interested external stakeholders.

Pros: a. Consistent with the Commission's PRA policy statement when application of PRA methodologies is not practical or within the bounds of the state-of-the-art.

b. Maintains a high assurance that likelihood of sabotage is low at decommissioning nuclear power plants.

c. Enables insights from NUREG-1738 to be utilized for risk informing insurance and EP decisions during decommissioning without considering the uncertainties due to risk of sabotage.

d. There is no evidence that risk informing safeguards will change the level of protection required at nuclear facilities because of the need to maintain a prudent level of protection.

Con: Does not identify potential reductions in regulatory burden that could possibly be achieved assuming the risk of sabotage could be accurately characterized.

Staff Analysis:

As stated previously, the Commission has directed the staff to expand the use of PRA technology for regulatory decision making and to risk-inform regulatory activities to the extent practical. However, the application of this guidance to risk-informing safeguards is unclear since methods and data for quantifying the likelihood of a sabotage event have not been identified. Information available from other Federal national security agencies, which assess the national terrorist threat, calls into question the feasibility of developing a quantitative risk assessment methodology for sabotage. The staff, as a result of its ongoing work with these agencies, has determined that the ability to quantify the likelihood of sabotage events at nuclear power plants is not currently supported by the state-of-the-art in PRA methods and data. Both the NRC and other government agencies would need to conduct additional research and expend significant time and resources before it could consider quantifying the likelihood of sabotage. Moreover, it would be difficult to convince other Federal agencies to divert resources and support activities attempting to quantify the likelihood of sabotage.

Recommendation:

The staff recommends Option 3. New regulatory requirements for safeguards at decommissioning plants would be based on deterministic and performance-based criteria such as proposed in Policy Issue 3 and the proposed revisions to 10 CFR 73.55 concerning the physical protection requirements for power reactors. This approach supports the development of risk-informed rulemaking for insurance and EP regulations at decommissioning plants premised on the assumption that the level of safeguards maintained at a decommissioning plant will provide high assurance that the likelihood of a zirconium fire due to sabotage is very low. While the staff is not recommending the development of a risk-informed approach for quantifying the likelihood of sabotage, the staff will, through its ongoing interactions with the Federal national security agencies, continue to look for opportunities to increase the use of PRA technology in threat assessment. If in the future, the staff determines that a methodology to quantify the probability of sabotage might be feasible, the Commission's direction will be sought.

Safeguards

3. How should the Commission define the safeguards protection goal to be applied to SFPs at decommissioning plants?

Discussion:

In the "Policy Statement on Safety Goals for the Operation of Nuclear Power Plants," published on March 14, 1983 (44 FR 10772), the Commission stated:

> The possible effects of sabotage or diversion of nuclear materials is not presently included in the safety goal. At present there is no basis on which to provide a measure of the risk of these matters. It is the Commission's intent that everything that is needed shall be done to keep such risks at their present, very low, levels.

The safeguards requirements provide high assurance that activities involving special nuclear material are not inimical to the common defense and security and do not constitute an unreasonable risk to the public health and safety. An August 1, 1994, *Federal Register* notice (59 FR 38889), on protection against malevolent use of vehicles at nuclear power plants states:

> Inherent in the NRC's current regulations is a policy decision that the threat, although not quantified, is likely in a range that warrants protection against a violent external assault as a matter of prudence.

The safeguards requirements for operating reactor and decommissioning plant licensees are specified in 10 CFR 73.55, "Requirements for physical protection of licensed activities in nuclear power reactors against radiological sabotage." The protection goal of these requirements is to design a physical protection program to protect against the design basis threat (DBT) of radiological sabotage. The attributes of the DBT of radiological sabotage are specified in §73.1(a)(1), "Radiological sabotage." To achieve the protection goal, physical protection systems must meet the specific requirements for a safeguards organization, physical barriers, access controls, communications, testing and maintenance programs, and a response plan. The staff currently uses the performance standard of no core damage during Operational Safeguards Response Evaluations (OSREs) of physical protection programs at operating reactors.

The staff has created a proposed framework for developing and modifying an adversary characteristic document for the DBT of radiological sabotage. The proposed framework was developed over a 2 year period in conjunction with other Federal agencies that are involved in assessing terrorist threats. The staff plans to use the framework to formalize the adversary characteristic list that licensees presently use to develop OSRE force-on-force exercises.

Decommissioning plant licensees have requested exemptions for specific §73.55 safeguards requirements pursuant to 10 CFR 73.5, "Specific exemptions." The staff approved these exemptions, believing that there was no credible radiological sabotage event that would adversely affect public health and safety or result in offsite consequences. The staff's belief that there was no possibility of a zirconium fire in an SFP from sabotage is documented in a July 18,

1990, *Federal Register* Notice (55 FR 28181) stating that "a fire in a spent storage pool is not credible."

The staff has developed a proposed performance-based revision to §73.55. The revision includes the following proposed definition for spent fuel sabotage and includes the §72.106 standard for radiation exposure:

> Spent Fuel Sabotage. For the purpose of designing the security program at nuclear power reactors, spent fuel sabotage occurs when the integrity of the fuel can no longer be reasonably assured due to an act of sabotage that results in the potential for causing radiation doses in excess of the dose limits in 10 CFR 72.106. Physical protection of spent fuel in dry casks is described in 10 CFR 73.51.

The §72.106 limits apply to any individual on or beyond the nearest boundary of the controlled area. The limits include a total effective dose equivalent of 0.05 Sv (5 rem). The new definition of spent fuel sabotage would apply a performance standard of offsite dose to SFPs. The protection goal in the proposed revision to §73.55 would allow decommissioning plant licensees to modify their physical protection plans pursuant to §50.54(p)(2) without prior Commission approval if the changes did not decrease the safeguards effectiveness of the plans.

Another safeguards protection goal is specified in 10 CFR 73.51, "Requirements for the physical protection of stored spent nuclear fuel and high-level radioactive waste." This rule specifies the physical protection requirements for spent fuel in specifically licensed ISFSIs utilizing spent fuel pools or dry storage modules operated by other than Part 50 licensees. The revised 73.55 requirements will also apply the rule to ISFSIs utilizing dry casks which are associated with a power reactor. The protection goal is to design a physical protection system to protect against loss of control of the facility that could be sufficient to cause a radiation exposure exceeding the dose as described in §72.106. The staff is evaluating §73.51 to clarify the design criterion of "loss of control" of a facility.

Until recently, the staff believed that the DBT of radiological sabotage could not cause a zirconium fire. However, NUREG-1738 does not support the assertion of a lesser hazard to the public health and safety, given the possible consequences of sabotage-induced uncovery of the fuel in the SFP when a zirconium-fire potential exists.

The staff is conducting detailed analyses of the effects of the DBT of radiological sabotage on SFPs. The staff will use the results of these analyses to determine, on a plant-specific basis, whether radiological sabotage can result in the conditions which could lead to zirconium fires at a decommissioning plant. Information related to the potential vulnerabilities of SFPs to radiological sabotage is categorized as "Safeguards Information" and will be provided to the Commission in a separate correspondence.

It is incumbent on the staff to determine, based on Commission guidance, what protection goal should be used to develop safeguards requirements for decommissioning plants. The staff has examined the options and believes that the approach to this rulemaking is a policy matter. The following policy options were evaluated by the staff.

Option 1 The Commission may apply a safeguards protection goal that includes a design criterion of protecting against radiological sabotage by the DBT.

Pros:
a. Would require decommissioning plants to maintain a level of security commensurate to that of an operating reactor, including a response force (maintains safety and enhances public confidence).

b. Would not require any rulemaking changes (improves efficiency).

Cons:
a. Would require future decommissioning plant licensees to submit exemption requests to reduce their decommissioning plant physical protection plans below that of the level of operating reactors (increases regulatory burden).

b. Does not clearly articulate a performance standard.

c. Would require analyses of the approved exemptions to decommissioning plant physical security plans and could require the staff to perform backfit determinations even if licensees demonstrate, on a plant-specific basis, that SFP design and mitigative and safeguards protective measures preclude zirconium fires initiated by radiological sabotage (reduces efficiency).

Option 2 The Commission may apply a protection goal that includes a design criterion of protecting against radiological sabotage by the DBT and a performance standard of preventing spent fuel sabotage exceeding the limits specified in §72.106.

Pros:
a. Would be consistent with a proposed revision to §73.55 (increases efficiency and maintains safety).

b. Would allow future decommissioning licensees to modify their physical protection plans without Commission approval when the changes do not affect safeguards effectiveness (reduces regulatory burden).

c. Would apply a consistent performance standard to wet and dry spent fuel storage facilities (increases efficiency).

d. Would allow present decommissioning plant licensees to retain physical protection plan exemptions by demonstrating, on a plant-specific basis, that SFP design and mitigative and safeguards protective measures preclude zirconium fires initiated by radiological sabotage (maintains safety and increases efficiency).

Cons:
a. Would require development of associated regulatory guidance for implementing the revised rule and analyzing offsite dose (increases regulatory burden).

b. Would require review of approved exemptions to decommissioning plant physical security plans and could require backfit determinations (increases regulatory burden).

Option 3 The Commission may apply the physical protection goal for independent spent fuel storage installations as described in §73.51(a)(3), including a design criterion to protect against loss of control of the facility and a performance standard of preventing spent fuel sabotage exceeding the limits specified in §72.106.

Pro: a. Would apply a consistent protection goal to wet and dry spent fuel storage (maintains safety and improves efficiency).

b. Would permit decommissioning plant licensees to develop less costly physical protection plans than are required for operating reactors.

c. Would permit reduction in the number of exemptions required for compliance with the physical protection regulations.

Cons: a. May not provide an adequate level of protection if adversary possesses characteristics up to and including the DBT for radiological sabotage.

b. Would require decommissioning plant licensees to develop physical protection plans that are separate and distinct from operating reactor physical protection plans (increases regulatory burden).

c. Would require development of associated regulatory guidance for implementing the revised rule and analyzing offsite dose (increases regulatory burden and decreases efficiency).

d. Would require review of approved exemptions to decommissioning plant physical security plans (increases regulatory burden).

Staff Analysis:

Option 1 applies the existing safeguards protection goal for operating reactors to decommissioning plant SFPs. This protection goal consists of a design criterion of protecting against the DBT of radiological sabotage, thus maintaining a low likelihood of radiological sabotage initiating a zirconium fire. To meet this protection goal, licensees maintain physical barriers, access controls, communications, and a response plan which requires a minimum of five armed guards immediately available at the facility to interdict the DBT. Application of this protection goal to decommissioning plant SFPs would require an equivalent physical protection plan. As a result, many of the exemptions approved for decommissioning plant physical protection plans may need to be rescinded. In order to rescind the existing exemptions, the staff would have to evaluate the backfit implications of applying the operating reactor protection goal. Future decommissioning plants would have to request exemptions in order to reduce safeguards plans below operating reactor requirements.

Option 2 applies the protection goal in a proposed performance-based revision to §73.55 which is being developed in advance of this paper for presentation to the Commission. This protection goal consists of a design criterion of protecting against the DBT and a performance standard of no spent fuel sabotage that would result in exceeding the dose limits in 10 CFR 72.106. Application of this protection goal to decommissioning plants would permit a reduction in the level of protection required by Option 1 if licensees could demonstrate, on a plant-specific basis, that SFP design and mitigative and safeguards protective measures preclude a zirconium fire initiated by radiological sabotage. A plant-specific evaluation might consist of specific design features of the SFP, thermal-hydraulic analyses, or mitigating actions taken after the radiological sabotage event occurs such as pre-planned measures provided by the local law enforcement agency (LLEA) within the period before which a zirconium fire could occur.

If a licensee cannot preclude a zirconium fire initiated by radiological sabotage, then its physical protection plan would have to be revised to protect the SFP from the DBT. This might necessitate rescinding previously issued exemptions to the plant physical protection plan. In order to rescind the existing physical protection plan exemptions, the staff would have to complete a backfit analysis using the §72.106 offsite dose limits. The staff would have to codify the Option 2 protection goal through the rulemaking process and develop the associated regulatory guides and parameters for the thermal-hydraulic analysis.

Option 3 applies the existing protection goal for independent spent fuel storage installations (ISFSIs) to decommissioning plants. This protection goal consists of the design criterion of protecting against loss of control of the facility and the performance standard of no spent fuel sabotage that would result in exceeding the dose limits in 10 CFR 72.106(b). Application of this protection goal to decommissioning plants would require a level of protection roughly equivalent to that of Option 2 and similar to that applied to both collocated and away from rector specifically licensed ISFSIs. In order to rescind the existing physical protection plan exemptions, the staff would have to complete a backfit analysis using §72.106 offsite dose limits as the acceptable level of safety. Future decommissioning plant licensees would have to create physical protection plans that are different and distinct from the operating reactor plans, but which might not be different from the existing physical security plan for their collocated dry cask storage area. The staff would have to review and approve the new physical protection plans. The staff would have to codify the Option 3 protection goal through the rulemaking process and develop the associated regulatory guides. The staff would also have to clarify the adversary characteristics and the design criterion “loss of control of the facility.”

Recommendation:

The staff recommends Option 2. This protection goal combines the operating reactor physical protection plan design criterion of protecting against the DBT and the ISFSI performance standard of §72.106 offsite dose limits. The staff believes this protection goal requires an appropriate level of physical protection for decommissioning plant SFPs, since it provides a transition between protecting fuel in an operating reactor and protecting spent fuel stored in dry casks at ISFSIs. Under this option, the licensee would retain the physical protection level of an operating reactor until such time that a plant-specific evaluation and pre-planned safeguards

measures would preclude a zirconium fire initiated by radiological sabotage. Prior exemptions would remain in force if licensees are able to demonstrate, on a plant-specific basis, that SFP design and mitigative and safeguards protective measures preclude zirconium fires initiated by radiological sabotage. The staff is developing, in advance, a proposed change to §73.55 and related regulatory guides to include this rulemaking option.

Insurance

4. What level of insurance is appropriate for licensees of decommissioning plants given the low likelihood of a large onsite and offsite radiological release from a zirconium fire accident involving the spent fuel stored in the SFP?

Discussion

The Price-Anderson Act, which was enacted in 1957 (Sec. 170 of the Atomic Energy Act of l954, as amended), provides a system to pay funds for claims by members of the public for offsite personal injury and property damage resulting from a nuclear incident. It requires holders of licenses of large commercial nuclear power plants (reactors designed for producing substantial amounts of electricity and having rated capacities of 100,000 electrical kilowatts or more) to provide proof to the Commission that they have private nuclear liability insurance or some other form of what is called "financial protection" equal to the maximum amount of liability insurance available from private sources. For these licensees it establishes a two-layer insurance system for liability payments. The first layer consists of primary nuclear liability insurance available in the private market whereby licensees pay a premium each year for a fixed amount of liability coverage, currently $200 million. This primary insurance is supplemented by the second layer of the Price-Anderson system. In the event of a nuclear incident causing damages exceeding $200 million, the licensee of each of these plants would be assessed an equal share of the damages in excess of the primary insurance coverage. This secondary "deferred premium" currently may be up to $83.9 million per reactor per accident. With 106 reactors currently under this secondary system, insurance coverage available is approximately $9 billion. This "limit of liability" increases or decreases as new large commercial power reactors are licensed to operate or are removed from participation in the secondary layer. Whenever a licensee is required to maintain financial protection, Price-Anderson requires that the licensee execute an indemnity agreement that extends for the life of the license. The indemnity agreement specifies the Government's obligation with respect to its licensees.

In SECY-93-127 the staff examined a number of legal and technical issues associated with Price-Anderson insurance for licensees of decommissioning plants. The Commission approved the staff's SECY-93-127 recommendation that after a sufficient spent fuel cooling period had elapsed so that a zirconium fire was no longer possible in an SFP drained of all water, financial protection could be reduced by allowing these licensees to withdraw from participation in the secondary financial protection layer and reduce the primary level coverage from $200 million to $100 million through the exemption process. Based on this Commission policy, licensees of many decommissioning plants have been exempted from the secondary financial protection layer and are presently providing $100 million in primary insurance.

The current requirement in 10 CFR 50.54(w) for onsite property damage insurance is that each nuclear power plant licensee must have coverage of $1.06 billion or the amount of coverage generally available from private sources, whichever is less. The insurance levels have been set to assure that there are sufficient funds to stabilize and decontaminate the reactor and site after an accident. In the event of an incident, these funds are used to provide reasonable assurance that the nuclear power plant is maintained in a safe and stable condition so as to prevent any significant offsite risk to the public. There are no provisions in NRC regulations to reduce this coverage after an operating reactor shuts down permanently and begins decommissioning. As with Price-Anderson insurance, licensees of many decommissioning plants have requested exemptions to reduce the levels of onsite property damage insurance from $1.06 billion to approximately $25 to $50 million. All these requests explicitly or implicitly assumed that a zirconium fire was no longer possible.

As discussed above, the previous position on offsite and onsite insurance allowed substantial reductions in insurance coverage only after spent fuel had decayed to the point that a zirconium fire was no longer possible. However, as noted elsewhere in this paper, the decommissioning SFP risk study, NUREG-1738, states that the absolute assurance implied in the criterion of "sufficient cooling to preclude a fire" cannot be demonstrated analytically without numerous constraints on the conditions assumed in the analyses. This clearly conflicts with past NRC insurance policy and compels the staff to propose a new policy on decommissioning plant insurance.

The following rulemaking policy options have been evaluated by the staff:

Option 1 Maintain insurance at operating reactor levels until all spent fuel is removed from the SFP.

Pros: a. This level of insurance would provide the full level of coverage specified by the Price-Anderson Act so that there would be essentially no chance of accident consequences exceeding insurance coverage and no credible need for Federal Government indemnity. Likewise, there is essentially no chance that an accident could cause onsite property damage that exceeds the licensee's onsite insurance coverage (increases public confidence).

b. Insurance requirements would be predictable (maintains efficiency).

c. This option would not establish new requirements for decommissioning plants not currently required for operating reactors; i.e. implementing the SDAs and IDCs would not be required (increases efficiency and effectiveness; reduces licensee burden).

Con: Requiring full operating reactor levels of insurance coverage appears to be unnecessarily costly to decommissioning plant licensees whose overall likelihood of offsite radiological releases to the public is lower than that at operating reactors (does not reduce regulatory burden).

Option 2 Maintain insurance at operating reactor levels until a plant-specific thermal-hydraulic heatup analysis demonstrates that the uncovered spent fuel would not reach the zirconium ignition temperature. Analyses to determine this condition would take into account certain spent fuel geometry changes and associated reductions in cooling air flow that could be caused by an accident severe enough to drain a spent fuel pool.

Pros: a. This option would allow plant-specific heatup analyses to be performed to justify a reduction in insurance coverage without relying on generic analyses which were determined to be inconclusive in NUREG-1738 .

b. This option would not establish new requirements for decommissioning plants not currently required for operating reactors; i.e. implementing the SDAs and IDCs would not be required (increases efficiency and effectiveness; reduces licensee burden).

Cons: a. This option would require the expenditure of resources by licensees in performing zirconium fire thermal-hydraulic analyses and by the NRC in developing analytical guidance and reviewing analyses performed and submitted by licensees (does not improve efficiency).

b. This option would not ensure a highly predictable outcome for licensees since they would not know how long they must retain full insurance coverage until after they perform a technical analysis that is subject to NRC review and approval. Since the NRC must review and accept the licensee's analysis, the licensee and the NRC could disagree on analytical assumptions, conditions, etc. which could further negatively impact regulatory predictability (does not improve efficiency or effectiveness).

c. Although the likelihood of a zirconium fire would be very low, if such a fire occurred at a facility no longer fully insured, offsite consequences could result in Federal government indemnity for damages exceeding the level of primary insurance[1] coverage up to the statutory limit of $500 million. Damages in excess of $500 million would be uninsured. Onsite property damage could exceed both the licensee's insurance coverage and the licensee's corporate resources, causing bankruptcy and delaying decontamination and decommissioning (does not increase public confidence).

Option 3 Discontinue or substantially reduce insurance requirements after a generic fixed period of time based upon a qualitative policy judgment that zirconium fires, although still possible, are no longer "reasonably conceivable."

Pros: a. This option would be predictable since licensees would know well in

[1]The level of primary insurance would be determined by rulemaking, but is expected to be about $100 million.

advance when they could reduce insurance requirements (improves efficiency and effectiveness).

b. There would be no analytical burden on the licensee or the NRC and no delay associated with NRC review and approval of any analyses (reduces unnecessary regulatory burden).

c. This option would not establish new requirements for decommissioning plants not currently required for operating reactors; i.e. implementing the SDAs and IDCs would not be required (increases efficiency and effectiveness; reduces licensee burden).

Cons: a. It would be difficult to develop a sound basis for determining the proper decay time (does not increase public confidence).

b. This option would likely result in maintaining full insurance coverage for a longer period of time than would be likely if a plant-specific thermal-hydraulic analysis were performed (does not reduce unnecessary regulatory burden).

c. Although the likelihood of a zirconium fire would be very low, if such a fire occurred at a facility no longer fully insured, offsite consequences could result in Federal government indemnity for damages exceeding the level of primary insurance coverage up to the statutory limit of $500 million. Damages in excess of $500 million would be uninsured. Onsite property damage could exceed both the licensee's insurance coverage and the licensee's corporate resources, causing bankruptcy and delaying decontamination and decommissioning (does not increase public confidence).

Option 4 Substantially reduce offsite and onsite insurance shortly after permanent shutdown. Since the generic frequency of events which could possibly lead to a zirconium fire is very low (less that 3E-6 per year) at plants which have implemented the design and operational controls specified in the SDAs and IDCs, the Commission could decide that the likelihood of such fires is sufficiently low that a decommissioning plant is safe enough to permit insurance to be substantially reduced shortly after permanent shutdown. This finding would be generically based on the initiating event frequencies in NUREG-1738 and the premise that the level of safeguards maintained at a decommissioning plant will provide high assurance that the likelihood of a zirconium fire due to sabotage is very low.

Pros: a. This option would reduce costs to licensees (reduces regulatory burden).

b. This option would be predictable since licensees would know well in advance when they could reduce insurance requirements (improves efficiency).

c. Using the generic event frequencies in NUREG-1738 eliminates the need for licensees who implement the SDAs and IDCs to perform or for the NRC to review any plant-specific probability analyses (reduces licensee burden, improves efficiency and effectiveness).

d. Since the presence or absence of insurance has no effect on the probability of a zirconium fire, reducing insurance does not increase the radiological risk to the public (maintains safety).

Cons: a. This option would establish new requirements for decommissioning plants not currently required for operating reactors (i.e. implementing the SDAs and IDCs). Plants which cannot use the seismic checklist IDC, would have to perform site-specific seismic risk analyses for their spent fuel pools to determine if the NUREG-1738 event frequencies were applicable to their sites (does not increase efficiency and effectiveness; does not reduce licensee burden).

b. Although the likelihood of a zirconium fire would be very low, if such a fire occurred at a facility no longer fully insured, offsite consequences could result in Federal government indemnity for damages exceeding the level of primary insurance coverage up to the statutory limit of $500 million. Damages in excess of $500 million would be uninsured. Onsite property damage could exceed both the licensee's insurance coverage and the licensee's corporate resources, causing bankruptcy and delaying decontamination and decommissioning (does not increase public confidence).

c. This option might be viewed as a risk-based approach rather than a risk-informed approach as endorsed by the Commission.

Staff Analysis:

Since the presence or absence of insurance has no effect on the probability or consequences of a zirconium fire, reducing insurance does not increase the radiological risk to the public. The initiating event frequencies in NUREG-1738 show that the probability of a zirconium fire is very low (less than 3E-6 per year). After evaluating the options, the staff has concluded that onsite and offsite insurance coverage should be substantially reduced shortly after a facility permanently shuts down. The staff recommends a waiting period of 60 days after shutdown so that radioactive iodine in the spent fuel will have decayed away.

Recommendation:

The staff recommends Option 4; insurance will be substantially reduced at decommissioning plants based on the generic initiating event frequencies in NUREG-1738 for all facilities that implement the Industry Decommissioning Commitments and the Staff Decommissioning Assumptions. Licensees will not be required to participate in the secondary retrospective rating pool and primary insurance will be reduced to about $100 million. Onsite property damage insurance will not be required 60 days after permanent shutdown.

Emergency Preparedness

5. What level of offsite emergency preparedness is appropriate for decommissioning plants given the low likelihood of a radiological release large enough to exceed protective action guides offsite?

Discussion

The SFP risk study, NUREG-1738, concluded that the risk of zirconium fire at decommissioning plants was well below the Commission's Quantitative Health Objectives. Another conclusion was that a few months after shutdown, the contribution of offsite emergency planning (EP) to reducing overall risk was small for the accident sequences analyzed and that the risk change resultant from relaxing EP was within the guidelines of Regulatory Guide (RG) 1.174, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis." Given the Agency's effort to risk-inform regulatory decisions, the risk study provides reasonable bases for considering incremental reduction and eventual elimination of NRC requirements for offsite EP.

While the Commission recognizes risk analyses as important for risk-informing the regulatory process, it has also articulated the need for defense-in-depth. Essentially, defense-in-depth adds safety margin with regard to protection of the public health and safety in the unlikely event of a serious accident. EP is cited as an aspect of defense-in-depth. The Commission Policy Statement "Safety Goals for the Operation of Nuclear Power Plants," states:

> The Commission recognizes the importance of mitigating the consequences of a core-melt accident and continues to emphasize features such as containment, siting in less populated areas, and emergency planning as integral parts of the defense-in-depth concept associated with its accident prevention and mitigation philosophy.

The Policy goes on to state:

> To provide adequate protection of the public health and safety, current NRC regulations require conservatism in design, construction, testing, operation and maintenance of nuclear power plants. A defense-in-depth approach has been mandated in order to prevent accidents from happening and to mitigate their consequences. Siting in less populated areas is emphasized. Furthermore, emergency response capabilities are mandated to provide additional defense-in-depth protection to the surrounding population.

In addition, SECY-93-087, "Policy, Technical, and Licensing Issues Pertaining to Evolutionary and Advanced Light-water Reactor (ALWR) Designs," states:

> Moreover, the issue (EP) is complicated by the fact that the promulgation of emergency planning requirements following the TMI-2 accident was not premised on any specific assumptions about severe accident probability values. Hence, as

> a policy matter, it may be that even very low calculated probability values should not be considered a sufficient basis for changes to emergency planning requirements.

The tension between the appropriate use of NUREG-1738 risk insights and the need to maintain defense-in-depth at decommissioning plants is framed by the EP policy issue before the Commission in this SECY.

The technical and planning basis for EP was established in NUREG-0396, "Planning Basis for the Development of State and Local Government Radiological Emergency Response Plans in Support of Light Water Nuclear Power Plants," and NUREG-0654/FEMA-REP-1, “Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants.” NUREG-0396 recommended that the objective of EP should be to produce dose savings for a wide spectrum of accidents that could potentially lead to offsite doses in excess of the EPA protective action guidelines (PAGs). The PAGs are radiation doses that warrant the implementation of protective actions for the public. Most exemptions from offsite EP at decommissioning plants have been based on dose calculations that showed PAGs cannot be exceeded offsite, based on the information available at the time.

NUREG-0654 provides guidance intended to provide reasonable assurance that the licensee is capable of implementing adequate measures to protect the public health and safety in the event of a radiological emergency. These protective measures are designed to save public dose (and in some extreme accident scenarios immediately save lives) for a spectrum of accidents that could produce offsite doses in excess of the EPA PAGs. This basis stipulates that no single accident sequence be isolated as the one for which to plan because each accident could have different consequences, both in nature and degree. Rather, planning should be based upon the potential consequences, timing, and release characteristics of a spectrum of accidents.

In summary, the rationale for EP is based upon a spectrum of consequences from accidents (including severe accidents, even though they may be unlikely), tempered by probability considerations. This rationale was chosen over others (i.e., risk, probability and cost/benefit) because consequences could be used to help identify adequate planning standards and establish bounds for planning efforts. The reason for not choosing risk, probability, or cost/benefit was, in part, due to the difficulty in defining the appropriate levels of these criteria. NUREG-0396 states:

> Emergency planning is not based upon quantified probabilities of incidents or accidents...but on public perceptions of the problem and what could be done to protect health and safety. In essence, it is a matter of prudence rather than necessity.

In the past, the staff has typically granted exemptions from offsite EP requirements for decommissioning plants when it could be demonstrated (based on what was then the current understanding of zirconium fires) that they were beyond the critical decay time for spent fuel and that a zirconium fire was no longer possible. The rationale for those decisions was that in the absence of a zirconium fire, there were no decommissioning plant accident scenarios which could release enough radioactive material to exceed EPA PAGs offsite. Hence, offsite EP was not necessary to protect public health and safety. A finding from NUREG-1738 is that a generic critical decay time after which a zirconium fire is physically impossible cannot be established.

Therefore, the staff can no longer rely on thermal-hydraulic analyses to categorically rule out the possibility of a zirconium fire and large offsite radiological releases.

However, there is some precedent for reducing or eliminating EP requirements on the basis of alternate considerations such as indirect risk measures informed by thermal-hydraulic calculations. Specifically, some offsite EP exemptions were granted to plants which had not demonstrated that spent fuel was beyond the critical decay time. In these cases, the staff concluded that the exemptions were acceptable because the fuel had decayed to the extent that there was sufficient time for ad hoc actions to mitigate the accident and for ad hoc protective actions for public health and safety. The time was based on thermal-hydraulic calculations of how long it would take to heat the fuel cladding to the zirconium ignition temperature following an event that would prevent cooling of the fuel assemblies.

Since there is no definitive analytical basis for reducing offsite EP requirements, the staff will consider contributing factors such as the physics of the zirconium fire, the efficacy of protective measures implemented by local government agencies, the Commission's defense-in-depth concept and the very low risk of a zirconium fire at a decommissioning plant that has implemented IDCs and SDAs. The staff has examined the options and believes that the approach to this rulemaking is a policy matter. The following policy options were evaluated by the staff:

Option 1 Substantially reduce or eliminate offsite EP shortly after permanent shutdown. Since the generic frequency of events which could possibly lead to a zirconium fire is very low at plants which have implemented the design and operational controls specified in the SDAs and IDCs (less that 3E-6), the Commission may decide that the likelihood of a zirconium fire is low enough and decommissioning plants are sufficiently safe to permit offsite emergency preparedness to be substantially reduced or discontinued shortly after permanent shutdown. This finding would be generically based on the initiating event frequencies in NUREG-1738. The pros and cons of this risk-based approach to EP are provided below.

Pros:

a. Would reduce costs to licensees (reduce regulatory burden).

b. Would reduce costs to offsite authorities (reduce regulatory burden).

c. There would be no backfit concerns (improve efficiency).

Cons:

a. Might slightly increase risk to the public (may not maintain safety).

b. Would create a public perception problem given the (small) potential for an accident and the challenge in communicating the risk basis for elimination of EP (does not improve public confidence.)

c. Would raise the issue of consistency with previous Commission policy regarding the need for EP as a defense-in-depth measure rather than as a strictly risk-based measure (does not improve effectiveness, does not improve public confidence, may not maintain safety).

Option 2 Maintain offsite EP at the same level as during operations. The Commission may determine that offsite emergency preparedness should be at the same level as at operating reactors until the fuel is placed in storage casks or removed from the site.

Pros:
a. Would maintain an adequate level of protection of the public health and safety (maintain safety).

b. Would provide clear requirements without rulemaking or exemptions (improve efficiency).

c. Would be consistent with previous Commission policy regarding the need for EP as a defense-in-depth measure (improves public confidence).

Cons:
a. Would maximize costs without a commensurate benefit to the public health and safety (does not improve effectiveness, efficiency or realism, does not reduce unnecessary regulatory burden).

b. Would create a public perception problem by suggesting that the threat to the public health and safety does not decrease when nuclear operations cease (does not improve public confidence).

c. Would create backfit issues (does not improve effectiveness, efficiency or realism).

Option 3 Modify the level of offsite EP. The Commission may determine that it is acceptable to reduce and eventually eliminate offsite EP when spent fuel has decayed sufficiently so that there is time to take ad hoc mitigative and protective actions before a large release can begin.

Pros:
a. Would allow the cost of offsite EP to reflect the risk of impacting the public health and safety (maintains safety).

b. Would allow rulemaking that would require regulations commensurate with the risk of impacting the public health and safety (reduce unnecessary regulatory burden and improves effectiveness and realism).

c. Would deliver a consistent message to the public by requiring a level of EP commensurate with the threat to the public health and safety (improves public confidence).

d. Would be consistent with previous Commission policy regarding EP as a defense-in-depth measure rather than as a strictly risk-based measure (improves effectiveness and public confidence, maintains safety).

e. Could utilize the analytical assessment of NUREG-1738 to frame the physics of the zirconium fire versus spent fuel decay to risk-inform offsite

EP regulations. (improves effectiveness and realism, maintains safety).

Cons: a. Would require rulemaking to determine the appropriate offsite EP regulations versus fuel decay. (does not improve efficiency).

b. Might require extensive discussions with stakeholders on the appropriate level of offsite EP requirements versus fuel decay (does not improve efficiency).

c. Would require review of previously granted exemptions to ensure consistency with Commission policy (does not improve efficiency).

d. Might require a backfit analysis for previously granted exemptions (does not improve efficiency).

Staff Analysis:

In evaluating the options for an adequate level of offsite EP at decommissioning plants, the staff considered three questions: (1) What is the risk level, if any, below which accidents (e.g., a zirconium fire) need not be considered for EP? (2) Should risk arguments be used for reducing the requirements of a program that is mandated by the Commission's defense-in-depth philosophy? (3) Can the staff justify risk-based reductions in offsite EP to the public and the Federal Emergency Management Agency (FEMA) when neither has embraced a risk-based approach and the historical rationale for EP is clearly not risk-based?

The Commission's risk policy mandates defense-in-depth as a complement to risk analyses in the protection of the public health and safety. In concert with this policy, the staff's judgment on this policy issue is that risk measures alone cannot be used for reducing or eliminating offsite EP. Although the risk of a zirconium fire is low, the staff is not prepared to say it is low enough to remove the defense-in-depth layer that offsite EP provides to protect the public health and safety. In addition, the staff notes that the risk study does not analyze risk from radiological sabotage. Although the risk of sabotage is not considered in any standard reactor risk analyses, the staff cannot rule out sabotage (which is not quantifiable) as an insignificant risk contributor relative to other zirconium fire initiators. An argument can be made that the defense-in-depth provided by EP addresses the uncertainties of sabotage risk. A zirconium fire initiated by a sabotage event is no different from one created by other initiators.

The staff believes that Option 3 is appropriate, that is, full-scope offsite EP is appropriate for an initial period while fuel decays. This exact period would be decided in rulemaking, but is expected to be less than 1 year. After this period, aspects of offsite (and onsite) EP requirements could be phased down commensurate with the threat to the public health and safety. When fuel is sufficiently decayed, offsite EP could be reduced to a level similar to that required for a monitored retrievable storage installation (MRS) by 10 CFR 72.32(b). Again, the exact period would be decided in rulemaking, but the fuel would have to have decayed enough to allow 10 to 24 hours before a zirconium fire could begin, regardless of fuel configuration. The determination of this time period would rely on NUREG-1738 estimates. The level of offsite EP required by 10 CFR 72.32 is minimal, but not nonexistent (e.g., offsite agencies are invited to

participate in training and exercises but not required and there is no oversight by FEMA).

A working group has been established by NRC and FEMA staff responsible for EP and a consensus was rapidly reached on Option 3 above. There is a potential for differences of opinion on when requirements for offsite EP may be reduced and what the appropriate reductions would be. These details will be discussed fully in the rulemaking process if the Commission directs that rulemaking proceed to reduce offsite EP requirements for decommissioning plants. If rulemaking proceeds, public meetings will be held to solicit input from FEMA, the public, governmental stakeholders, and the industry.
It should be noted for completeness that the FEMA staff responsible for EP would not support Option 1, to substantially reduce or eliminate offsite EP shortly after permanent shutdown. FEMA would not object to Option 2, to continue a full offsite EP program until fuel is removed or placed in an ISFSI.

The staff proposes to maintain a level of offsite EP consistent with the Commission's defense-in-depth philosophy while utilizing risk insights of NUREG-1738. Reductions in offsite EP regulations would be based on:

- The length of time available for protective actions before a zirconium fire can begin,
- the length of time available for and relative simplicity of mitigative actions,
- the effectiveness of protective measures implemented by trained public agencies, and
- the very low frequency of initiating events that can cause a zirconium fire when IDCs and SDAs are implemented.

A reduction of offsite EP requirements is expected to be possible within the first year after shutdown.
The elimination of NRC requirements for offsite EP (i.e., a level of offsite EP requirements similar to that required by 10 CFR 72.32) would be based on different criteria and is expected to consider the point when spent fuel is decayed sufficiently to allow time for ad hoc protective actions by offsite agencies before a zirconium fire can develop. The elimination of offsite EP requirements is expected to be appropriate within five years of shutdown.

The specifics of offsite EP reduction and elimination would be developed in rulemaking if the Commission decides the staff proposal is appropriate. Criteria will be developed and public input solicited, to determine which regulations can be relaxed at what time post-shutdown and when offsite EP regulations can be eliminated. However, while offsite EP requirements may be eventually eliminated, requirements for an onsite EP program will not. It is expected that requirements for onsite EP programs will be similar to those for an MRS as dictated by 10 CFR 72.32(b), which require the licensee to maintain interface with offsite agencies and to offer drill and training opportunities.

The premise that relatively simple mitigative actions can be taken by the licensee to cool the spent fuel is important to the staff analysis. It is understood that makeup water can be easily added to the SFP to provide sufficient spent fuel cooling. This action could be implemented by using fire water systems powered by onsite diesels or water pumping trucks (e.g., fire trucks).

The effectiveness of public evacuations implemented by local officials is also important to the staff analysis. A search of the literature indicates that large scale evacuations (>1000 people) take place about every 2 weeks in the U.S.A. These efforts are largely successful and sufficient for the protection of public health and safety without the benefit of NRC requirements for offsite EP (see NUMARC/NESP-004, "Identification and Analysis of Factors Affecting Emergency Evacuations"). Many of these evacuations are accomplished with no time to prepare before the threat is upon the public. The physics of the zirconium fire result in a delay of at least some number of hours before a release can begin. It is reasonable to allow reduction in offsite EP requirements based on the premise of timely mitigative and protective measures.

Recommendation:

The staff recommends approval of Option 3 to permit incremental reduction and eventual elimination of offsite EP when the spent fuel has decayed sufficiently so that there is time to take ad hoc mitigative and protective actions before a large release can begin. The reduction and elimination would be based on a risk-informed review of SFP zirconium fires and the application of a commensurate level of offsite EP. This recommendation is informed by the reasonable assurance of very low zirconium fire frequency when the licensee has implemented the design, operational, and administrative characteristics that were assumed in NUREG-1738 (IDCs and SDAs). Protection from radiological sabotage is also assumed.

Note: 1. A working group established with FEMA would be used to gather stakeholder input in support of rulemaking for changing EP requirements for decommissioning plants.

2. A review of exemptions granted to EP regulations for decommissioning plants would be conducted to ensure consistency with this policy. In particular, the SFP risk values used to inform modification of offsite EP regulations are based on licensee implementation of the IDCs and SDAs. The status of IDC and SDA implementation at current decommissioning plants would have to be reviewed. If the staff determined that existing exemptions do not comply, the staff would pursue reinstatement of offsite EP requirements or implementation of the IDCs and SDAs, as justified, via the backfit process during rulemaking.