Recommendations for Enhancement of the
Independent Spent Fuel Storage Installation Inspection Program

A. Risk Insights for Independent Spent Fuel Storage Installation Activities

The Independent Spent Fuel Storage Installation (ISFSI) inspection program, as many aspects of nuclear reactor safety, is implemented as a matter of prudence rather than in sole response to a quantitative analysis of accident probabilities. When the Nuclear Regulatory Commission (NRC) "risk-informs" its processes, we attempt to quantitatively examine both the probability of an event and its possible consequences to understand its importance (risk). In other words, we ask ourselves the questions of what can go wrong, how likely it is, and what its consequences might be. The current quantitative ISFSI models only evaluate latent cancer fatality to a member of the public as the only “consequence” factor. The developers of the current models warned against using these results to make program decisions. The caution is due to large model uncertainties involving limited data sources, industry wide practices not being reflected in the model, and assuming all design factors are met at all times. While the enhancement team acknowledged the latent cancer fatality to the public is very low due to the decay time of spent fuel, it is not the only risk consequence.

Risk informing a program utilizes inputs beyond probabilistic models, including defense in depth considerations and subject matter expertise. Risk informing a program also requires consideration of consequences beyond latent cancer fatalities to a member of the public. The enhancement team recognized that a substantial occupational worker radiological hazard exists. The enhancement team also recognized that performance deficiencies could cause fuel damage and/or a loss of confinement, either of which would challenge the reasonable assurance of adequate protection for spent fuel storage. As experienced with recent spent fuel handling concerns with licensees, failures that challenge reasonable assurance also create losses in public confidence and increased scrutiny from external stakeholders.

In the area of risk insights, the team developed two options.

Option 1: Risk-informed, Performance-based ISFSI Program

Preferred option by majority of the enhancement team. Consistent with agency policy, the ISFSI program should be a risk-informed program that considers information from all available sources. This includes numerical estimates from probabilistic models, subject matter expertise, operating experience, and use of applicable data from other program areas. Performance deficiencies with a potential to cause fuel damage or canister damage are deterministically risk important as they involve radiological boundary failures and an unanalyzed fuel storage condition. As such, five safety focus areas (risk significant areas) were identified for inclusion in the inspection oversight program. The Safety Focus Areas are: Occupational Exposure, Public Exposure, Fuel Damage, Confinement/Canister Integrity and Impact to Plant Operation. These areas are further defined in the draft ISFSI Inspection Program Technical Basis (Enclosure 5).

Under the new ISFSI program our goal is to verify reasonable assurance for adequate protection of an ISFSI by evaluating licensee activities as they relate to the five safety focus areas. The ISFSI draft inspection procedures (IPs) have been written to focus on the more risk-significant aspects of the program. These items, which are related to the five safety focus areas were ranked based on relative risk, subject matter expertise, previous operating experience, information from NUREG/CR 1864, “A Pilot Probabilistic Risk Assessment of a Dry Cask

Storage System At a Nuclear Power Plant," and information from NUREG/CR 6642, "Risk Analysis and Evaluation of Regulatory Options for Nuclear Byproduct Material Systems."

Option 2: Probability of Latent Cancer Fatality (Quantitative Risk-Based) ISFSI program

One region believed that the ISFSI inspection program should primarily consider the very low latent cancer probability to a member of the public discussed in NUREG-1864. Without more adverse quantitative probabilistic results, the scope of the program requirements for inspection of the five safety focus areas would be significantly reduced. Enclosure 4, "Region II Independent Spent Fuel Storage Installation Inspection Program Position Paper," provides further explanation of the dissenting region's option in this area.

B. Independent Spent Fuel Storage Installation Inspection Program Resources

The origins for the resources (inspection hours) currently allocated to the different ISFSI inspection efforts can be traced back to NRC memorandum dated February 20, 2002, "Response to Regional Input on ISFSI Resources," (ADAMS Accession No. ML020520561). This memorandum contained the Office of Nuclear Reactor Regulation (NRR)/Nuclear Material Safety and Safeguards (NMSS) proposed inspections and estimated resources to implement the program at that time. The inspection hours were transferred to the different IPs used by ISFSI inspectors. Over the past 15 years the staff noted that the Full Time Equivalent (FTE) resources used for ISFSI inspections varied significantly between the regions. The actual FTE used disparity has been discussed on several occasions by ISFSI inspectors and managers during counterpart meetings and division director calls. The primary reason for the disparity is one region's belief that the very low latent cancer failure probability discussed in NUREG 1864 warrants the utilization of minimal inspection effort by resident inspectors that are not specifically qualified as ISFSI inspectors. No other region supports the use of resident inspectors, who are not trained or qualified in ISFSI operations, to implement the range of ISFSI inspection program requirements.

In keeping with the team's approach of developing a transformative program , the team identified all of the risk important ISFSI activities. The team then determined the amount of time, on average, to inspect the activity. The team strived to eliminate inspection activities already assessed under a different inspection program ((Radiation Protection, Security and Safeguards and Emergency Preparedness). The enclosed draft IPs reflect this effort, which is intended to be performed by ISFSI qualified inspection staff.

In the area inspection resources, the team developed two options.

Option 1: Inspection Resources – Risk Informed/Performance Based Approach

Preferred option by majority of the enhancement team. Aligns with Risk Option 1. All but one region agreed on the use of qualified ISFSI inspectors with an allowance of 96 hours per site every triennial cycle for licensees performing loading campaigns. For monitoring-only operations, all team members agreed on 24 hours per site every triennial cycle. As discussed above, the team decided on a risk-informed graded approach for ISFSI inspections. To this end, the team developed a risk prioritization tool to help the inspectors identify the most risk significant items to be inspected, and identified a set of minimum inspection requirements to be performed during the loading campaign inspections. If the inspector concludes that licensee performance is satisfactory for a focus area, the inspection effort reviewing that focus area will be complete. If the inspector determines that the licensee does not meet the performance expectation for a given

focus area, the inspector should conduct a more thorough review of that aspect of the licensee's program to determine the reasons for the performance deficiencies. The increased inspection effort may include additional sampling of selected activities and documents. Information on the proposed inspection resources are described in the draft inspection program documents.

For monitoring operations in-office, including follow-up on nonconforming licensee ISFSI activities between onsite inspections, all team members agreed the level of effort is 10 hours per site every triennial cycle.

For Away From Reactor (AFR) ISFSIs the entire team agreed to an estimated resource of 24 hours per site every triennial cycle. The team recognized that as aging management information becomes available and inspection experience is obtained, the NRC may consider a change to the inspection frequency for AFR ISFSI sites.

Performance based review beyond the prescribed level of effort will require regional management approval and licensee notification. The resources described above do not include time expended for preparation, documentation, and escalated enforcement.

Option 2: Inspection Resources – Risk Based Approach

One region believed a quantitative risk-informed approach using the latent cancer probabilities from NUREG-1864, should be used to assign inspection resources. If adopted, ISFSI inspection program resources would be reduced to an estimated 20 hours per site per triennial period and the activity would be performed by resident inspector staff. Given the low risk, no additional training requirements would be needed to observe ISFSI activities. Enclosure 4 provides further explanation of the dissenting region's option in this area.

C. Training for Independent Spent Fuel Storage Installation Inspectors

In April 2011, The Office of the Inspector General (OIG) performed an audit of NRC's oversight of Independent Spent Fuel Storage Installation Safety. This audit identified opportunities for improvement within the ISFSI safety inspection program in two areas. One of these areas was the ISFSI safety inspector training. As documented in audit report OIG-11-A-12 dated May 19, 2011 (ADAMS Accession No. ML111390338), NRC conducts ISFSI safety inspections with regional, resident, and HQ based inspectors. The training requirements for these inspectors vary. Further, when ISFSI safety inspectors do not have a consistent understanding of agency inspection requirements, oversight can be compromised. Specifically, there is an increased potential for inadequate inspections to occur, which could result in an increased risk to public health and safety.

Inconsistency in inspectors' training is another area that was discussed, prior to this ISFSI enhancement effort, by regional and headquarters staff during counterpart meetings and management phone calls. NRC Regions I, III and IV have a similar approach to inspector training and Region II uses the resident inspectors at the sites to perform the ISFSI reloading campaign inspection activities. As Region II does not have any Away-from-Reactors (AFR) ISFSIs, the inspection activities can be covered by the resident inspectors at ISFSIs co-located with operating sites. The team members all agreed that the focus on this area should be on training requirements for the inspectors and not on the individual doing the inspection.

In the area of inspector training, the team developed two options to be considered.

Option 1: Formal Qualification Program Specific for ISFSI Inspectors

Preferred option by majority of the enhancement team. All but one region recommends continued use of the formal qualification process currently established and defined in Inspection Manual Chapter (IMC) 1246, Appendix B3, "Training Requirements and Qualification Journal for Independent Spent Fuel Storage Installation Inspector," with some minor changes. ISFSI inspections must be performed by staff that have completed the ISFSI qualification program.

As with all inspector qualifications, regional management has the responsibility to identify equivalent training from other qualification efforts and credit completion in new qualification areas. The additional staff qualification requirements for IMC 1245 qualified staff are described in detail in the draft IMC 2690, Appendix C (Enclosure 6). The draft IMC 2690 provides the training requirements an IMC 1245, Appendix C1/C2 qualified inspector must complete for interim and full ISFSI qualifications.

Option 2: Basic Inspector Qualification

One region believed the risk, as described in NUREG 1864, was sufficiently low to warrant the use of resident inspectors not specifically ISFSI qualified to perform these inspections. Hence subsequent ISFSI loading campaign inspections are the responsibility of the Resident Inspector staff, with radiological risks reviewed by Region-based Health Physics Inspectors.

For initial loadings, a fully qualified Region II ISFSI Inspector leads an inspection team to inspect a licensee's ISFSI program. Once the licensee completed the initial loading, all future ISFSI activity inspections are conducted by the Resident Inspectors and the fully qualified Region II inspector is available for consultation should a question or issue arise. Enclosure 4 provides further explanation of the dissenting region's option in this area.

D. Frequency of Independent Spent Fuel Storage Installation Inspections

The Frequency of ISFSI inspections is another area where the staff identified inconsistencies among the regions prior to the beginning of the ISFSI Enhancement efforts. Additionally, this is the other area where the OIG found opportunities for improvement within the ISFSI safety inspection program during the audit mentioned above. As a response to this audit's recommendation regarding inspection frequency the staff in NMSS assigned a frequency of every two years (not to exceed three years) for ISFSI inspections. Even with this established frequency, inconsistencies among the regions are still found today when it comes to frequency of inspections. As mentioned above, the entire team recommends inspections for loading campaigns at ISFSIs co-located with operating reactors and AFRs be performed on a triennial cycle. The team recognized that as aging management information becomes available and inspection experience is obtained, the NRC may consider a change to the inspection frequency for AFR ISFSI sites. Additional information on inspection frequency is discussed in the draft ISFSI Inspection Program Technical Basis (Enclosure 5).

E. Funding for the Independent Spent Fuel Storage Installation Inspection Program

Under the current Agency budget structure, the ISFSI inspection program is funded by NRR and NMSS. This structure is described in the above-mentioned memo, "Response to Regional Input on ISFSI Resources," dated February 20, 2002. According to this memo NRR would fund ISFSI inspections for pre-operations tests, operations, and partially for review of 72.212(b) (General licensee only) at operating reactor sites at three Full Time Equivalents (FTE) for initial

inspections. In turn, NMSS would fund design, fabrication, on-site fabrication (vaults, pads, roads, etc.) and partially for review of 72.212(b) (General licensee only) for initial inspections. For repeat loading campaign inspections NRR solely would fund operations and security inspections.

The team recommends an update to the current budget structure to have the ISFSI inspection program solely funded by NMSS. It is the team's understanding that this is a function of the NRC's internal budget structure outside of the Agency's Fee Rules (10 CFR Part 170 and Part 171). As such the team recommends the removal of the ISFSI-related inspections performed under the IMC for Light -Water Reactor Inspection Program – Operations Phase, Appendix C, "Special and Infrequently Performed Inspections". Concurrent with this recommendation the team recommends the deletion of IPs 60854.1, "Preoperational Testing of ISFSIs at Operating Plants", 60855.1, "Operation of an ISFSI at Operating Plants," and 60856.1, "Review of 10 CFR 72.212(b) Evaluations at Operating Plants," currently used as a tool to manage and budget the ISFSI inspection program by NRR. Only one IP should be use for each ISFSI related activity and the budget and resources necessary for implementation of the ISFSI program activities should be managed entirely by NMSS. As such, the team recommends the development of a Memorandum of Understanding (MOU) or an Interoffice Support Request between NRR and NMSS in preparation for budget formulation activities for Fiscal Year (FY) 2022. ISFSI inspection program resources management, starting no later than FY 2022, should come from NMSS; from budget formulation to execution.

F. Additional Areas for Consideration

During the team's assessment of the ISFSI inspection program the team recognized that other areas of the ISFSI program will be impacted by the recommendations documented in this memo or/and that other efficiencies could be gained from an assessment to these other areas. However, the team could not complete a thorough assessment of these areas due to the already ambitious scope and aggressive schedule established for the team's efforts.

The team recommends the development of new efforts to assess and provide recommendations for enhancement in the areas of inspection readiness for transportation of spent nuclear fuel; and inspection guidance and inspection resources for Consolidated Interim Storage Facilities (CISF). While not evaluated by the team, efficiency gains related to the creation of a Center of Expertise (COE) for ISFSI activities may be possible. A potential exists to improve the consistency, management and effectiveness of the ISFSI inspection program with a COE. Further, with the potential of two new CISF facilities and the expected decline in new construction ISFSI activities, a COE for ISFSI activities should be considered by the agency.

Another area for consideration is the development of a self-assessment process for the ISFSI inspection program. The goal for this self-assessment activity should be to ensure consistency of the implementation of the ISFSI inspection program across all regions; recognize when an issue has generic implications and triggers the appropriate generic process for resolution and assessment of any Agency metrics that may be attached to the ISFSI inspection program.

Resource Estimate for Recurring Inspections Resource Options

Estimates for recurring inspection resources were derived after reviewing NRC correspondence and inspection procedures. Different resource estimates and scope of inspection are documented in the NRC document, "Response to Regional Input on ISFSI Resources," dated February 20, 2002, and the inspection procedures. Additionally, differences in regional practices on how to charge hours and the scope of inspection review did not provide reliable data. The recurring inspection table below used the hours from the listed inspection procedures.

Procedure	Current (hours) (Annualized) [3]	Option 1	Option 2	FTE delta [1,2] Option 1	FTE delta Option 2
60855	3840	2261	427	1.053	2.28
60857	444	0	0	0.296	0.296
60858	120	80	80	0.03	0.03
Total	4404	2341	507	1.379	2.606

Resources for New ISFSI Construction Activities

Historically, the regions expended approximately 30 percent more resources than allocated by the NRC memorandum dated February 20, 2002, to complete the suite of new ISFSI inspection procedures. After risk informing the procedures, the allocated resources increased for new ISFSI construction. The total FTE to support new ISFSIs is expected to continue to decline as nearly all operating reactor licensees have an operational ISFSI. New construction inspection activities will be performed if a licensee chooses to change to a different Dry Cask Storage System.

Procedure	Current Hours	Actual Estimate (+30%)	Proposed Hours
60853	120	160	120
60854	120	160	200
60856	120	160	160
60857	60	0	16
Total	420	480	496
FTE Total for construction and initial loading activities	0.28	0.32	0.33

[1] There are currently 64 licensees performing active loading campaigns and 10 away from reactor sites. Currently, 18 commercial power reactors are in decommissioning, and several more will transition to this process over the next few years. As fuel is completely transferred to the ISFSIs, the inspection resources needed to complete the program will also decrease. All but two operational sites have an existing ISFSI. Inspection resources to perform construction and initial loading inspections are expected to taper in the future.
[2] 1FTE=1500hours
[3] If hours from IP 60855.1 and the February 20, 2002, memorandum are used, the current hours decrease from 4404 to 3572.