Region II Independent Spent Fuel Storage Installation (ISFSI) Inspection Program Position Paper

Quantitative Risk-Informed ISFSI Program

Region II believes that the program should be risk-informed. From the Executive Summary of NUREG/CR - 6642, Vol.1, Page xxvii, risk-informed is defined as "formulated in light of insights obtained from risk analysis." Also, from Executive Summary of NUREG/CR - 6642, "Risk Analysis and Evaluation of Regulatory Options for Nuclear Byproduct Materials Systems," Vol.1, Page xxxi, "risk … is the sum of the products of frequency (in events per year) and consequences (in mrem per event) for possible states of the system." The risk analysis of NUREG-1864, "A Pilot Probabilistic Risk Assessment of a Dry Cask Storage System at a Nuclear Power Plant," and Electric Power Research Institute (EPRI) Technical Report 1009691, "Probabilistic Risk Assessment of Bolted Casks: Updated Quantification and Analysis Report," determined the annual individual risk of a latent cancer fatality to be 1.8E-12 for the first year that a canister is loaded and placed on the ISFSI and is less in subsequent years. Subject matter expertise (Donald Chung, PhD, Nuclear Material Safety and Safeguards (NMSS)) confirms these results. These values are 6 orders of magnitude or more below the Commission Safety Goal Level of 2E-06 per year and indicate that the risk to the public from spent fuel dry storage is extremely low, even accounting for large uncertainties. From Government Accounting Office (GAO)-03-426, "Spent Nuclear Fuel Options Exist to Further Enhance Security," "The likelihood of widespread harm from … a severe accident involving commercial spent nuclear fuel is low." Largely because spent fuel is a ceramic material and hard to disperse and is stored in protective containers, these studies found that most accident scenarios would cause little or no release of spent fuel, with little harm to human health.

Note that additional probabilistic risk assessment (PRA) work on dry cask storage (DCS) is currently being conducted within the Agency. Felix Gonzalez and Brian Wagner are currently working with NMSS (Donald Chung, Meraj Rahimi and Travis Tate) to develop a risk matrix, criteria, and/or tools that can be used to risk-inform dry cask storage licensing and operations.

Region II believes that the ISFSI inspection program should be structured such that the inspection effort is commensurate with the ISFSI-related risk to provide reasonable assurance that the health and safety of the public is protected. This would be an efficient use of limited Agency resources and would help transition the Agency toward the desired modern risk-informed regulator.

Inspection Resources

Due the very low risk profile associated with ISFSI-related activities (as borne out by several NRC and industry studies), inspection resources could be leveraged by allowing the Resident Inspectors to conduct ISFSI inspections of routine loading campaigns. The training offered by the newly developed technical training center (TTC) F-220 ISFSI training course is divided into 18 relevant modules of sufficient detail to illustrate the major ISFSI campaign issues to be reviewed. Also, note that Region-based Inservice Inspectors using Inspection Procedure 71111 Attachment 08, Inservice Inspection Activities, may review the documented welding or non-

destructive examination (NDE) activity if the actual activity is not directly observed. A Region-based qualified in-service inspection (ISI) inspector or Region-based qualified ISFSI inspector could review the ISFSI-related documentation (welding package or NDE report) in the event that the Resident Inspector had any questions about the ISFSI welding or NDE. This would maximize the inspection effort without requiring the Resident Inspectors to become fully qualified ISFSI inspectors and would provide reasonable assurance that the health and safety of the public is protected. This would be an efficient use of limited Agency resources as the Agency transforms into a modern risk-informed regulator.

Resident Inspector Training for ISFSI Inspections

Inspection Manual Chapter 1245, "General Overview of the Inspector Training and Qualification Program," designed its inspector training and qualification program to ensure the development of competency in four general areas: (1) legal basis and regulatory processes; (2) technical expertise; (3) regulatory practices; and (4) personal and interpersonal effectiveness. The program is organized into three levels: Basic-Level Program; Proficiency-Level Program; and Specialized and Advanced Training and Qualification. Note that in most cases, the qualification program does not require specialized and advanced training. This is the training and qualification program required for all Resident Inspectors.

Because ISFSI activities originated in NMSS, ISFSI inspectors have traditionally been qualified to Manual Chapter 1246, "Formal Qualification Programs in the Nuclear Material Safety and Safeguards Program Area," to ensure that NMSS program area staff members have the necessary knowledge and skill to successfully implement the NMSS program, and to define a standardized methodology for determining that NMSS staff members have met the established qualification requirements.

The specific qualifications for ISFSI Inspectors are identified in IMC 1246, Appendix B3, "Training Requirements and Qualification Journal for Independent Spent Fuel Storage Installation Inspector," and are organized similarly to those of Inspection Manual Chapter 1245 in that a Basic Level and a Technical Proficiency Level are identified. The Basic Level of IMC 1246, Appendix B3, is very similar to that of IMC 1245 and specifically includes one item which is not included in IMC 1245, e.g., an overview of 10 CFR Part 72, "Licensing Requirements for the Independent Storage of Spent Nuclear Fuel, High-Level Radioactive Waste, and Reactor-Related Greater Than Class C Waste," (due to the nature of the unique subject being inspected). The Technical Proficiency Level identifies 11 Individual Study Activities (ISAs). (See following matrix.) One ISA is to review the ISFSI Inspection Procedures. Two of the ISAs are common to those of IMC 1245. The other eight ISAs may be learned from a new on-line ISFSI course being developed by the TTC. The course (F-220) is expected to be ready by mid-October 2019 and addresses 18 ISFSI-related areas, including the eight areas identified in the Technical Proficiency areas. Specifically, see the following comparison matrix:

1246 Appendix B3 Technical Proficiency Training	1245 Appendix B Subject Matter	F-220 Course Subject Matter
(ISA-Technical-1) ISFSI Inspection Procedures		

(ISA-Technical-2) Quality Assurance Program	ISA-General-1, Quality Assurance Program	
(ISA-Technical-3) Problem Identification and Resolution	ISA-General-2, Corrective Action Program	
(ISA-Technical-4) ISFSI Licensing		Module 3: ISFSI Regulations and Licensing
(ISA-Technical-5) ISFSI Control of Heavy Loads		Module 15: Heavy Loads
(ISA-Technical-6) ISFSI Canister Processing		Module 10: Canister Processing
(ISA-Technical-7) ISFSI Pad Construction and Design		Module 12: ISFSI Pad Construction and Design
(ISA-Technical-8) Radiation Protection		Module 17: Radiation Protection
(ISA-Technical-9) ISFSI Canister Sealing		Module 11: Canister Sealing
(ISA-Technical-10) ISFSI Fuel Selection		Module 9: Fuel Selection and Qualification
(ISA-Technical-11) 10 CFR 72.48		Module 8: 72.48 Evaluations

A review of the matrix indicates that the IMC 1246 areas of Technical Proficiency are covered by the IMC 1245 training program or will be available via the new F-220 course being developed by the TTC. Resident Inspectors could study the appropriate F-220 module prior to a routine ISFSI loading campaign and perform an inspection commensurate with the ISFSI-related risk to provide reasonable assurance that the health and safety of the public is protected. This would be an efficient use of limited Agency resources.

Performance of Routine ISFSI Campaigns

In late 2010 and early 2011, the Office of the Inspector General conducted a review of the NRC's ISFSI inspection program which resulted in OIG-11-A-12, "An Audit of NRC's Oversight of Independent Spent Fuel Storage Installations Safety", dated May 19, 2011. The audit made two recommendations to the Executive Director for Operations:

1. Develop and implement a formalized agency-wide ISFSI safety inspector training program.

2. Modify inspection guidance to include a minimum inspection frequency for conducting routine ISFSI safety inspections.

Due to the very low risk profile of routine ISFSI loading and storage, Region II determined that reasonable assurance for ISFSI safety could be achieved by including ISFSI activity inspection as a responsibility of the Resident Inspector staff after the licensee had demonstrated its ability to successfully load and transport a canister to the ISFSI pad for onsite storage. The radiological risks are reviewed by Region-based Health Physics Inspectors as the ISFSI is always included as one of the samples inspected during the routine HP inspection.

Prior to "going live" with the initial ISFSI loading campaign, the fully qualified Region II ISFSI Inspector led an inspection team to inspect a licensee's ISFSI program. The team would typically include four to five Headquarters inspectors/experts and would typically review a licensee's ISFSI "dry run" activities including: heavy loads and rigging/special lifting devices; welding and NDE; radiation protection; fire protection; emergency planning; fuel selection and verification; training; general license conditions and 72.212 report; quality assurance; safety reviews; etc. The fully qualified Region II inspector would also observe the licensee's initial loading to be assured that the licensee could safely conduct ISFSI loading activities. Note that the initial loading was often done with the assistance of a Headquarters ISFSI staff inspector, working around the clock until the loaded canister was placed on the ISFSI pad. Once the licensee completed the initial loading, all future ISFSI activity inspections were conducted by the Resident Inspectors and the fully qualified Region II inspector was available for consultation should a question or issue arise.

Therefore, Region II provided reasonable assurance that a licensee's ISFSI activities were conducted in a safe manner to prevent radiation-related deaths and illnesses and protect the environment. By using this technique, the ISFSI inspection program is conducted in a cost-effective manner consistent with the risk profile of the activities.

Region II recommends the continued use of Resident Inspectors for inspecting ISFSI loading campaigns.

Additional Information on Types and Levels of Risk Associated with ISFSI Activities

The risk associated with DCS has been explored by various entities over the years. In the case of in NUREG-1864, "A Pilot Probabilistic Risk Assessment of a Dry Cask Storage System at a Nuclear Power Plant," a comprehensive list of initiating events was developed, and the risk associated with each initiating event was evaluated. Analyses were performed to determine the cask's response to the mechanical and thermal loads imposed by the initiating events. The annual risk to the public from handling, transfer, and storage of a single cask was estimated. The risk measures are the individual probabilities of a prompt fatality within 1.6 km (1.0 mi) and a latent cancer fatality within 16 km (10 mi) of the site.

The values needed to assess risk are: the frequencies of the initiating events, the probability of multi-purpose canister failure, the fractions of fuel rods that fail, the probability that the secondary containment will fail to isolate, and the consequences. These five values are combined to calculate the risk to the public.

NUREG-1864, Table 19, shows the risk for the first year of service and the annual risk for subsequent years. The risk during the first year consists of the risk from the handling and transfer phases and part of the storage phase. The risk of subsequent years consists only of the annual risk of storage on the ISFSI, which is lower.

The risk measure in Table 19 is the annual individual risk of a latent cancer fatality. (Note: Because all offsite releases result in doses to individuals that are below the threshold for prompt fatalities, no prompt fatalities are expected.) The scenarios listed in the table indicate that the worst case is the first-year risk, e.g., the first year that a canister is loaded and placed on the ISFSI. The risk is 1.8E-12. All other listed risks are even less. Therefore, even allowing for the large uncertainties associated with these events, it appears that scarce Agency resources can be focused on areas with higher risk profiles.

Furthermore, for EPRI Technical Report 1009691, "Probabilistic Risk Assessment of Bolted Casks: Updated Quantification and Analysis Report," a cross-functional team comprised of both cask experts and PRA experts was assembled to analyze the radiological risks of a bolted cask design and it arrived at similar conclusions.

Note that these values are 6 orders of magnitude or more below the Commission Safety Goal Level of 2E-06 per year. These PRA results indicate that the risk to the public from spent fuel dry storage is very low.

From Government Accounting Office (GAO)-03-426, "Spent Nuclear Fuel Options Exist to Further Enhance Security," "The likelihood of widespread harm from a … severe accident involving commercial spent nuclear fuel is low, according to studies conducted by DOE and NRC." Largely because spent fuel is hard to disperse and is stored in protective containers, these studies found that most … accident scenarios would cause little or no release of spent fuel, with little harm to human health." Furthermore, "Spent fuel is a heavy, ceramic material that is neither explosive nor volatile and resists easy dispersal."

Additional PRA work on DCS is currently being conducted within the Agency. Felix Gonzalez and Brian Wagner are currently working with NMSS (Donald Chung, Meraj Rahimi and Travis

Tate) to develop a risk matrix, criteria, and/or tools that can be used to risk-inform dry cask storage licensing and operations.

With this information in mind and with the current effort to transform the Agency into a modern, risk-informed regulator, we are told that this transformation will be done by accepting some risk. Considering the low risk presented by dry cask storage activities, this is a good program for accepting some risk. The method used in Region II to satisfy the current inspection requirements is by having one fully qualified ISFSI inspector based in the Region available to consult with the Resident Inspectors who conduct the actual inspections of routine loading campaigns in the event of any issues/questions. The Resident Inspectors are generalists who inspect numerous plant activities over the course of carrying out their duties and responsibilities. Dry cask storage loading campaigns are just one more plant evolution to review. The radiation protection piece of the ISFSI activities is inspected by Region-based Radiation Protection Inspectors who always use the ISFSI as one of the inspection samples when the licensee's Radiation Protection Program is inspected.