Should the dose limits for acts of radiological sabotage (if any are established under Policy Issue 1) be the same as the dose limits for design-basis accidents? (Policy Issue 2)

Summary

In the current regulations, the dose limit for security scenarios for non-collocated, specific-license independent spent fuel storage installations (ISFSIs) is consistent with the design-basis accidents (DBAs) (i.e., 0.05-Sv (5-rem) dose limit).[1] As discussed in the statements of consideration accompanying the final rule promulgating the initial regulations for 10 CFR Part 72,[2] this dose limit was derived from protective actions recommended by the U.S. Environmental Protection Agency (EPA) for projected doses to populations for planning purposes. Additionally, under a 1995 ISFSI emergency planning final rule the Commission concluded that a release exceeding the EPA Protective Action Guidelines (PAGs) would not occur;[3] consequently, no verification was required that doses would be less than 0.01 Sv (1 rem) at the site area boundary. If the Commission determines, under Policy Issue 1 (see Enclosure 1 to this paper),[4] that a radiological acceptance criterion for acts of radiological sabotage should be applied to all ISFSI licensees, is a 0.05-Sv (5-rem) dose limit criteria still the appropriate limit? The staff has identified four options for Policy Issue 2:

1. Keep the dose limit for radiological sabotage consistent with the dose limit for ISFSI DBAs (i.e., a 0.05-Sv (5-rem) dose limit at the controlled area boundary).

2. Keep the dose limit for radiological sabotage consistent with the dose limit for DBAs (i.e., a 0.05-Sv (5-rem) dose limit at the controlled area boundary); and also meet a 0.01-Sv (1-rem) dose limit for both safety and security events at the site area boundary.

3. Keep the dose limit for radiological sabotage consistent with the dose limit for ISFSI DBAs (i.e., 0.05 Sv (5 rem)), but apply it at the site area boundary instead of at the controlled area boundary. (Changes to ISFSI emergency planning requirements —i.e.,

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[1] The dose criteria in Title 10 of the *Code of Federal Regulations* (CFR) 72.106, "Controlled Area of an ISFSI or MRS," (0.05 Sievert (Sv) [5 rem] total effective dose equivalent; 0.15 Sv [15 rem] to the lens of the eye; 0.5 Sv [50 rem] as either the sum of the deep dose equivalent and any organ dose, or the shallow dose equivalent to the skin or any extremity) are hereinafter referred to as the 0.05-Sv (5-rem) dose limit.

[2] Final rule - 10 CFR Part 72, "Licensing Requirements for the Storage of Spent Fuel In an Independent Spent Fuel Storage Installation." Published in the *Federal Register* (45 FR 74693) on November 12, 1980. See public comment Issues 20 and 21 (at 45 FR 74696 and 74697).

[3] Final rule - 10 CFR Part 72, "Emergency Planning Licensing Requirements for Independent Spent Fuel Storage Facilities (ISFSI) and Monitored Retrievable Storage Facilities (MRS)." Published in the Federal Register (60 FR 32430) on June 22, 1995. See public comment Issues 17 and 25 (at 60 FR 32434 and 32435).

[4] Enclosure 1, "Should a Radiological Acceptance Criterion for Security Scenarios be Applied Consistently to All ISFSIs? (Policy Issue 1)."

the potential to classify events to a "general emergency" level—would likely be required.) or

4. Increase the dose limit for radiological sabotage consistent with the dose limit for reactor DBAs (i.e., 0.25 Sv (25 rem) at the site area boundary). (Changes to ISFSI emergency planning requirements—i.e., the potential to classify events to a "general emergency" level—would be required.)

The staff recommends Option 2. This option provides consistency between the dose limits for ISFSI DBAs and acts of radiological sabotage. Since this paper contemplates ISFSI licensees potentially extending their controlled area boundary outward (to meet a radiological sabotage dose limit), the staff would propose adding a new requirement for licensees to verify doses are also less than 0.01 Sv (1 rem) at the site area boundary. The term "site boundary" is defined in 10 CFR 20.1003 ("Definitions");[5] however, it is not defined in 10 CFR Part 72 or Part 73. Given the differences in the physical location of an ISFSI at the various reactor sites, as well as the presence of ISFSIs located away from any reactor, the staff would seek stakeholder input (as discussed in the Commitments section of the main Commission paper) on applying existing or developing new definitions (and criteria) for defining the term "site boundary" for ISFSIs.

While the staff would apply this verification to both safety and security events, no impacts would be expected for safety events. For security events, certain licensees may have challenges due to the short distance to their controlled area boundary. The options in this paper would provide ISFSI licensees sufficient flexibility to address these challenges. Potential options would include changes to the design of the ISFSI, the use of engineered security features to protect the ISFSI, changes to the ISFSI protective strategy, or changes to the ISFSI emergency planning program. Furthermore, this option would not impact the public health and safety objectives currently contained within the ISFSI's emergency planning program requirements and would continue to support the staff's assumptions that underlie the NRC's 1995 ISFSI emergency planning final rule.

Options 3 and 4 would require reassessment and expansion of the ISFSI emergency planning program requirements, since a foundational assumption from the 1995 ISFSI emergency planning final rule may no longer be valid (i.e., the dose at the site area boundary could exceed the EPA PAGs' dose limit of 0.01 Sv (1 rem)). Should the Commission conclude that Options 3 or 4 are preferable to Option 2, the staff would need to evaluate several safety, legal, policy, and technical issues, including whether a collocated or a non collocated ISFSI's emergency planning program, capable of classifying events at a "general emergency" level, should contain the same elements as a power reactor's emergency planning program to ensure adequate protection of public health and safety. This would include discussions with the U.S. Federal Emergency Management Agency (FEMA) on the applicability of FEMA's regulations to ISFSIs and whether conforming changes to FEMA's offsite emergency planning regulations would also

[5] 10 CFR 20.1003, "*Site boundary* means that line beyond which the land or property is not owned, leased, or controlled by the licensee."

be necessary. The FEMA regulations, which apply to State and local entities, appear to address only "commercial nuclear power facilities."[6]

Background

As discussed in the statements of consideration accompanying the 1980 final rule that initially promulgated 10 CFR Part 72, the current 0.05-Sv (5-rem) dose limit in 10 CFR 72.106(b) was derived from protective actions recommended by the EPA for projected doses to populations for planning purposes. Additionally, under a 1995 ISFSI emergency planning final rule the NRC addressed the issue of security events exceeding the EPA's PAGs. In public comment Issue 25, a commenter had proposed that "… the accident classification system should include the general emergency. This might be necessary in cases of radiological sabotage." The NRC's response stated:

> An essential element of a General Emergency is that "A release can be reasonably expected to exceed EPA Protective Action Guidelines exposure levels off site for more than the immediate site area." As previously discussed, NRC studies have concluded that the maximum offsite dose [from an ISFSI event] would be less than 1 rem [0.01 Sv] which is less than the EPA Protective Action Guidelines.

Although not fully articulated in the statements of considerations accompanying these previous rulemakings, the staff's assumption is that the NRC's establishment of a regulatory structure using a 0.05-Sv (5-rem) dose limit at the controlled area boundary (with a minimum distance of 100 meters), instead of a structure employing a standard using a 0.01-Sv (1-rem) dose limit at the site area boundary (i.e., the owner controlled area boundary), was intended to provide defense in depth or a "margin of prudency" to preventing a "release [that] can be reasonably expected to exceed the EPA Protective Action Guidelines exposure levels off site" of greater than 0.01 Sv (1 rem). Absent this approach, ISFSI licensees would have potentially been required to classify accidents up to the "general-emergency" level. Requiring certain ISFSI licensees to classify accidents to the "general-emergency" level (i.e., non-collocated, specific-license ISFSIs or ISFSIs collocated with decommissioning power reactors) would significantly increase the cost and complexity of the ISFSI licensee's emergency planning program. Moreover, a licensee choosing to make their controlled area boundary contiguous with their site area boundary—to address the radiological sabotage issues discussed in this paper—would also imply that the Commission should also require a licensee to verify that the EPA PAGs' dose limit of 0.01 Sv (1 rem) is met at the site area boundary (i.e., a contiguous controlled area boundary and site area boundary would necessitate the same dose limit).

[6] 44 CFR 350.4, "Exclusions," states, in part, "The regulation in this part applies only to State and local planning and preparedness with respect to emergencies at commercial nuclear power facilities and does not apply to other facilities which may be licensed by NRC ...."

Under 10 CFR 72.32(a), "Emergency plans," non-collocated, specific-license ISFSI emergency plans are required to classify accidents up to the “alert” level. Collocated ISFSIs at operating power reactors are able to address emergencies up to the "general-emergency" level, since the operating power reactor licensee is required to incorporate the ISFSI into the existing collocated power reactor's emergency plan (see 10 CFR 72.212(b)(6)). However, the staff notes that most power reactors undergoing decommissioning promptly seek exemption from the Commission’s power reactor emergency planning regulations. Thus the decommissioning reactor licensee, along with the associated, collocated ISFSI licensee, would only be required to classify emergencies up to the "alert" level.

For spent fuel stored in a dry storage cask—as opposed to spent fuel in an operating reactor's reactor vessel or spent-fuel storage pool—most of the short-lived nuclides have decayed away before the spent fuel is placed in the storage cask. Current approved storage cask designs typically require a minimum decay/cooling time of 5 years before the spent fuel can be stored in the cask. While the staff was mindful of this difference when originally selecting the 0.05-Sv (5-rem) dose limit in 10 CFR 72.106(b) for ISFSIs, the staff was focused on safety scenarios involving direct radiation exposure from the spent fuel, rather than on security scenarios that may involve the release and subsequent uptake of aerosolized spent fuel. The ISFSI security assessments from SECY-06-0045[7] (discussed in Policy Issues 1 and 6) completed by the staff indicated that certain security scenarios may challenge the 0.05-Sv (5-rem) dose limit, mostly due to [redacted] radioactive materials released from a spent fuel dry storage cask. The staff notes that, due to the relative lack of short-lived nuclides, the committed dose accrued from inhalation or ingestion of [redacted] radioactive material after a release from a dry-storage cask is likely to be delivered over a longer period of time (than would be expected from a release from an operating reactor) and is based largely upon the relatively larger presence of transuranic and longer-lived fission-product particulate matter.

<u>Discussion</u>

Any sabotage-related release from an ISFSI would most likely be a prompt event, where any release occurs essentially immediately after the incident, and little (if any) time would exist for the licensee to recommend and then for State officials to initiate offsite protective action recommendations relative to the plume exposure (e.g., sheltering or evacuating). The dose to offsite personnel from the plume exposure would likely occur within a few minutes of a release from the ISFSI and would also terminate within a short time thereafter. This is in contrast to a reactor event, where a release may continue for a significant period of time. Effectively, an ISFSI security event could be considered a "puff" release. Because the bulk of the accrued dose from an ISFSI event would arise largely from inhalation and ingestion of the respirable particles, and not from the direct exposure to particles once they have fallen out of suspension and contaminated the ground, protective action recommendations such as sheltering in place or

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[7] SECY-06-0045, “Results of Implementation of the Decisionmaking Framework for Materials and Research and Test Reactor Security Assessments,” ADAMS No. ML060340452, dated March 1, 2006. [Non-public]

evacuating would likely only limit a small portion of the total dose received from most security events analyzed by the staff in the ISFSI security assessments.

To minimize risk to public health and safety, a higher dose limit would likely necessitate more robust emergency planning. Choosing a higher dose limit (e.g., the current 0.25-Sv (25-rem) dose limit currently utilized by a power reactor under 10 CFR 50.34(a)(1)(ii)(D)(*1*), "Contents of applications; Technical information,") would clearly require further development of the technical bases and, potentially, a backfit analysis, to be performed during the development of the proposed rule. Additionally, choosing a dose limit at the site area boundary higher than the current NRC assumptions stated in the 1995 ISFSI emergency planning final rule (0.01-Sv (1-rem)) would likely require licensees to be able to classify and respond to emergencies up to the "general-emergency" level.[8]

The staff desires Commission direction on whether to (1) keep an ISFSI 0.05-Sv (5-rem) dose limit for both security events and for safety-related DBAs or (2) to increase the dose limits for security-related events or (3) to apply the dose limits at a different boundary. Increasing the dose limit for terrorist attacks above the dose limit for design-basis accidents represents a shift in Commission policy away from a consistent dose limit for ISFSIs, regardless of the initiating event. Additionally, the staff desires direction on whether licensee verification of a 0.01-Sv (1-rem) dose limit at the site area boundary due to both security events and safety-related DBAs is also appropriate.

Issue 2 Options

1. *Keep the dose limit for radiological sabotage consistent with the dose limit for DBAs (i.e., a 0.05-Sv (5-rem) dose limit at the controlled area boundary)*.

   The main advantage to this option is that the 0.05-Sv (5-rem) dose limit is already specified in the regulations as a dose limit for both DBAs for all ISFSIs and for security-related events for non-collocated, specific-license ISFSIs only. Under this option, the cause of the dose is not considered when determining which dose limit must be met; the dose limit is the same regardless of the initiating event. This option also has the advantage of holding all ISFSI licensees to the same dose criteria for security events, regardless of the level of emergency planning at the site. Under Policy Issue 1, all ISFSI licensees would be required to meet the same dose limits.

   However, it is likely that most ISFSIs currently meet the dose requirements at the controlled area boundary for security events—largely because existing ISFSIs are currently loading older, colder fuel (i.e., the licensees are not loading the spent fuel to the design basis limit), and because the distance to their controlled area boundaries are greater than the regulatory minimum of 100 meters (328 feet). Some ISFSI licensees

[8] See *Federal Register* notice 60 FR 32430, public comment Issues 17, 25, 35, and 37 (at 60 FR 32434, 32435, 32436, and 32437).

may need to expend additional resources to meet the 0.05-Sv (5-rem) dose limit by increasing the current distances from their ISFSI to the controlled area boundary, or through implementation of other security measures.

The main disadvantage of this option is the potential cost to some ISFSI licensees who have not been subject to the dose limit for security scenarios, and whether or not such a change could be justified for any ISFSI licensee under the backfit rule. [redacted] (see Enclosure 6 to this paper),[9] the staff cannot say, [redacted], whether all ISFSI licensees would also meet a 0.05-Sv (5-rem) dose limit controlled area boundary. The staff notes that some licensees may have limited ability to expand the distance between their ISFSI and the controlled area boundary because of natural, site, or public features.

Since this paper contemplates ISFSI licensees potentially moving their controlled area boundary outward (as an option to meet the security assessments contemplated by this paper under Policy Issue 1), an additional significant disadvantage is whether a licensee would also meet the EPA PAGs of 0.01 Sv (1 rem) at the site area boundary (an underlying assumption from the Commission's 1995 ISFSI emergency planning final rule). The staff has not evaluated whether any ISFSI licensees can meet the 0.01-Sv (1-rem) dose limit at the site area boundary for either DBAs or radiological sabotage events. However, the staff would not expect any impacts for safety-related DBAs. The staff notes that licensees would be provided sufficient flexibility to evaluate the tradeoffs of increased security costs versus increased emergency planning costs in meeting security requirements by setting the distance to the controlled area boundary and thus meeting the 0.05-Sv (5-rem) dose limit.

2. *Keep the dose limit for radiological sabotage consistent with the dose limit for DBAs (i.e., a 0.05-Sv (5-rem) dose limit at the controlled area boundary; and also meet a 0.01-Sv (1-rem) dose limit for both safety and security events at the site area boundary.*

The advantages of Option 2 are the same as Option 1, that is the application of a single 0.05-Sv (5-rem) dose limit that is already specified in the regulations as a dose limit for both DBAs for all ISFSIs and for security-related events for non-collocated, specific-license ISFSIs only. As with Option 1, the cause of the dose is not considered when determining which dose limit must be met; the dose limit is the same regardless of the initiating event. An additional advantage is that licensee verification of a 0.01-Sv (1-rem) dose limit at the site area boundary would confirm the Commission's underlying assumption in the 1995 ISFSI emergency planning final rule. This option would reduce emergency planning uncertainties if an ISFSI licensee moved their controlled area boundary outward to meet a radiological sabotage dose limit. Accordingly, the staff

[9] Enclosure 6, "Response to ISFSI Security Questions." [Non-public]

would add a requirement for a licensee to also verify that the dose at the site area boundary is less than the EPA PAGs of 0.01 Sv (1 rem).

As with Option 1, the staff also notes that some licensees may have limited ability to expand the distance between their ISFSI and the controlled area boundary because of natural, site, or public features. Therefore, licensees would be provided sufficient flexibility to evaluate the tradeoffs of increased security costs versus increased emergency planning costs in setting the distance to the controlled area boundary and thus meeting the 0.05-Sv (5-rem) and 0.01-Sv (1-rem) dose limits.

The main disadvantages of this option are the same as Option 1, i.e., the potential cost to some ISFSI licensees who have not been subject to the dose limit for security scenarios, and whether or not such a change could be justified for any ISFSI licensee under the backfit rule. Another disadvantage of this option is that it imposes a verification of the dose at the site area boundary due to DBAs (i.e., a licensee verification that doses are less than 0.01 Sv (1 rem)). However, the staff's expectation is that all ISFSI licensees currently meet this dose limit for DBAs. Additionally, whereas an uncertainty on whether an ISFSI licensee can meet the 0.01-Sv (1-rem) dose limit at the site area boundary would be considered a disadvantage under Option 1, the certainty of meeting the EPA PAGs at the site area boundary and consistency with the Commission's assumptions stated in the 1995 ISFSI emergency planning final rule are considered a significant advantage.

The staff notes that while the term "site boundary" is defined in 10 CFR Part 20 (see § 20.1003), it is not defined in 10 CFR Part 72 or Part 73. Given the differences in the physical location of an ISFSI at the various reactor sites, as well as the presence of ISFSIs located away from any reactor, the staff would seek stakeholder input (as discussed in the Commitments section of the main Commission paper) on applying existing or developing new definitions (and criteria) for defining the term "site boundary" for ISFSIs. This would address the potential range of ISFSIs, e.g., ISFSIs located at an operating reactor, at a decommissioning reactor, or away from any reactors.

3. *Keep the dose limit for radiological sabotage consistent with the dose limit for ISFSI DBAs (i.e., 0.05 Sv (5 rem)), but apply it at the site area boundary instead of at the controlled area boundary. (Changes to ISFSI emergency planning requirements —i.e., the potential to classify events to a "general emergency" level—would likely be required.)*

The main advantage to this option is that the onsite dose limit for both ISFSI safety and security events would remain at 0.05 Sv (5 rem). Additionally, licensees would have more flexibility in meeting the radiological sabotage performance objective by permitting the controlled area boundary to be extended to the site area boundary (i.e., the two boundaries could be contiguous). However, because the dose beyond the site boundary would then be greater than the EPA PAGs of 0.01 Sv (1-rem), licensees would

be required to classify accidents up to the "general emergency" level to ensure that public health and safety are adequately protected.

As discussed in the background section above, most off-site protective action recommendations would serve to limit only the direct dose and the dose from exposure to contaminated ground, not from the dose accrued from plume exposure (i.e., inhalation of respirable radioactive material). This is different from the planning assumptions for protective actions from a radioactive release at an operating power reactor, where the potential for a release to continue for several days must be considered. Consequently, further staff evaluation would be required to identify the scope of the emergency planning program requirements that would be appropriate to this class of licensee and class of events. For example, would an offsite emergency operations facility, a 10-mile emergency planning zone, and a joint information center, etc. be necessary? The staff would need to initiate discussions with FEMA on the applicability of FEMA's regulations to ISFSIs and whether conforming changes to FEMA's offsite emergency planning regulations would also be necessary. The FEMA regulations, which apply to State and local entities, appear to address only "commercial nuclear power facilities," which may not include ISFSIs.

For general-license ISFSIs or collocated, specific-license ISFSIs located at an operating power reactor, an increase in ISFSI emergency planning requirements would likely be enveloped by existing power reactor emergency planning requirements. For non-collocated, specific-license ISFSIs and for ISFSIs located at decommissioning power reactors, increased emergency planning requirements would arise or would be reinstated, respectively (i.e., many decommissioning power reactor licensees seek exemption from the full emergency planning requirements soon after they permanently cease operations, e.g., only requiring the classification of accidents to the "alert" level).

Accordingly, the main disadvantages from this option would be increased potential dose to the public as a result of a terrorist attack at an ISFSI. To mitigate the increased potential dose to the public, non-collocated, specific-license ISFSIs and ISFSIs located at decommissioning power reactors would need to increase their emergency planning requirements. This would create a new or renewed cost, respectively, for these licensees. Rescinding a previously approved exemption for a power reactor licensee (e.g., a decommissioned reactor who had reduced the classification level of their emergency plan upon decommissioning) would likely involve a backfit assessment.

4. *Increase the dose limit for radiological sabotage consistent with the dose limit for reactor DBAs (i.e., 0.25 Sv (25 rem) at the site area boundary). (Changes to ISFSI emergency planning requirements—i.e., the potential to classify events to a "general emergency" level—would be required.)*

This option has the advantage of crediting general-license ISFSIs and collocated, specific-license ISFSIs at operating power reactors for having more robust emergency

planning in place. Additionally, this option has the advantage of allowing ISFSI licensees greater flexibility than Option 1, 2, or 3 for security-related events. For example, this option would not have as much potential for forcing a licensee to extend their controlled area boundaries up to the site area boundary or to implement significantly increased security measures. This would have the effect of reducing the likelihood of a backfit for some licensees.

This option shares many of the disadvantages of Option 3, with respect to a need for increased emergency planning requirements for some ISFSI licensees and discussions with FEMA. Another disadvantage associated with this option is that raising the dose limit for security scenarios above that for DBAs which may have a negative impact on public confidence regarding ISFSIs. Specifically, the public may have difficulty in understanding why a higher dose limit is allowed for a security event, since the health consequences of a given dose are the same, regardless of whether the initiating event is a safety event or a security event.

Additionally, a disadvantage of this option would be the expenditure of significant staff resources to evaluate the legal, regulatory, and technical implications associated with increasing the dose limit for security scenarios. Raising the dose limit criteria for security scenarios above 0.01 Sv (1 rem) at the site area boundary would likely require a higher level of emergency planning than what currently exists at some ISFSIs (e.g., the ability to classify accidents to the "general-emergency" level). Many of the resource impacts under this option are similar to the resource impacts under Option 1, 2, and 3.

Issue 2 Recommendation

The staff recommends Option 2: “Keep the dose limit for security-related events consistent with the dose limit for DBAs (i.e., the 0.05-Sv (5-rem) dose limit); and also meet a 0.01-Sv (1-rem) dose limit for both safety and security events at the site area boundary.” This option would not pose a potential for increased risk to public health and safety, and would therefore not impact the ISFSI's basis for emergency planning, including protective actions' planning. However, this option would provide greater certainty that ISFSI licensees are meetings the EPA PAGs. Additionally, this option provides consistency between dose limits for ISFSI safety-related DBAs and for security-related events, which is consistent with the approach the Commission has taken toward emergency planning at nuclear power reactors.