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May 17, 2000

MEMORANDUM TO: E. William Brach, Director
Spent Fuel Project Office, NMSS

THROUGH: James E. Lyons, Acting Deputy Director **/RA/**
Technical Review Directorate
Spent Fuel Project Office, NMSS

FROM: Lawrence E. Kokajko, Acting Chief /RA/
Technical Review Section B
Technical Review Directorate
Spent Fuel Project Office, NMSS

SUBJECT: APPROVAL OF INTERIM STAFF GUIDANCE MEMORANDUM NO. 13, REAL INDIVIDUAL, REVISION 0

Attached is the draft of Interim Staff Guidance (ISG) No. 13, "Real Individual," Revision 0, for your approval. This draft was prepared to: (1) provide guidance clarifying the meaning of "real Individual;" (2) specify how an applicant could perform off-site dose evaluations for both site-specific and general independent spent fuel storage installations; and (3) clarify standard review plan text regarding dose calculations outside the controlled area.

This draft has been reviewed by the Spent Fuel Project Office staff, the Technical Review section supervisors, and personnel in the Division of Industrial and Medical Nuclear Safety. All comments received have been satisfactorily dispositioned; therefore, we recommend that this ISG be approved.

Attachment: Draft ISG No. 13, Rev. 0

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Spent Fuel Project Office
Interim Staff Guidance - 13
Real Individual

Issue:

The purpose of this guidance is to, (1) clarify the meaning of a *real individual* as used in 10 CFR 72.104, (2) specify how the applicant may perform dose evaluations beyond the controlled area for site-specific and general Independent Spent Fuel Storage Installation (ISFSI) licenses, and (3) clarify standard review plan (SRP) text regarding dose calculations outside the controlled area.

Regulatory Basis:

- 10 CFR 72.104 specifies dose rate limits for normal operations to any *real individual* located at or beyond the controlled area of a **site-specific ISFSI**.
- 10 CFR 72.212(b)(2) requires the **general ISFSI licensee** to maintain written *real individual* dose evaluations which establish that the 72.104 requirements are met, prior to use of an approved cask.
- 10 CFR 72.236(d) requires the **application for a cask design** to show that the shielding and confinement features of the cask are sufficient to meet the requirements in 72.104.

Discussion:

The provisions of 10 CFR 72 call for two types of licenses for ISFSIs. The applicant can choose to apply for a site-specific license, or utilize the general license granted under 72.210. If a site-specific license is chosen, then the application must present site-specific analytical dose evaluations in accordance with 72.104 for *real individuals* located at or beyond the controlled area. If a general license is chosen, 72.212(b)(2) requires written *real individual* dose evaluations which establish that the 72.104 requirements are met, prior to use of an approved cask. Additionally, an application for a cask design is required by 72.236(d) to show that shielding and confinement features of the cask are sufficient to meet the requirements in 72.104.

The *real individual* is an individual at or beyond the controlled area, and dose to any real individual must not exceed the limits specified in 72.104 from both the storage facility and other surrounding fuel cycle activities. For example, a real individual may be anyone living, working, or recreating close to the facility for a significant portion of the year.

Technical Review:

The two types of licenses necessitate different methods for dose calculations outside the controlled area.

Site-specific ISFSI License Application (Subpart B). One approach to a site-specific ISFSI licence application may be to show that an individual's dose at the controlled area boundary with full-time occupancy, including contributions from other fuel cycle activities, will not exceed the limits specified in 10 CFR 72.104.

Another approach is to identify individuals within the geographical location of the ISFSI, and estimate their maximum radiological exposures. In this way, a maximally exposed *real individual* is identified. Calculations may involve site-specific information, such as, number of storage casks, cask array configuration, characteristics of actual fuel loaded, and surrounding topography features. Calculations may estimate the amount of time that a *real individual* spends near the facility, the distance the *real individual* is from the facility, and/or other factors that may mitigate radiological exposure to the *real individual*.

If this second approach is taken, then the applicant should establish measures in the radiological protection program, environmental monitoring program, and/or operating procedures to identify and reevaluate potential increases in exposure to the real individuals during the term of the license. Compliance with the dose limits in 72.104 will be verified by an environmental monitoring program using direct radiation measurements (such as TLDs) and/or effluent measurements, as appropriate.

Approval of a Spent Fuel Storage Cask (Subpart L). The spent fuel storage cask application should provide shielding and confinement calculations that; (1) demonstrate that the shielding and confinement features are sufficient to meet the requirements in 72.104 and 72.106, and (2) facilitate future site-specific evaluations for each general ISFSI licensee. The applicant should evaluate the shielding and confinement features of a single cask and a theoretical array of casks, assuming design basis source terms and full-time occupancy.

The single cask analysis should identify the minimum distance that is required to meet the dose rates in 72.104. Past applications have shown this distance to be typically within 200 meters of the cask. The applicant should include a dose rate versus distance curve for a single cask to facilitate a site-specific evaluation for general licensees. To satisfy section 72.106(b), dose evaluations should be determined at a minimum of 100 meters distance to the closest boundary of the controlled area. However, the applicant may use a longer distance, provided that the longer distance is made a condition of use.

The applicant should also include a dose rate versus distance curve for a theoretical cask array. The theoretical cask array should consist of at least 20 storage casks (2x10 array), and should account for self shielding among casks.

It is important to note that the general ISFSI licensee is permitted to use additional engineering features, such as berms, to mitigate doses to *real individual*s near the site. If such features are used in the cask SAR to show compliance with the regulations, they should be included in the cask conditions of use. In addition, the SAR should determine the degree to which the normal condition dose rates could change for the identified off-normal conditions.

General ISFSI License Requirements (Subpart K). As required by 72.212(b)(2), a general licensee must perform a written evaluation to demonstrate that the dose rate limits in 72.104 are met. An evaluation similar to that for a site-specific ISFSI should be performed. The licensee may use information provided in the cask SAR, as well as site specific information to perform the evaluation. Evaluations performed by the general ISFSI licensee are not reviewed for approval by NRC; however, they are subject to NRC inspection and must be recorded and maintained by the general licensee.

Applicability:

This ISG is applicable to 10 CFR 72 ISFSI facilities and:

1. NUREG-1536, *Standard Review Plan for Dry Cask Storage Systems*

2. NUREG-1567, *Standard Review Plan for Spent Fuel Dry Storage Facilities*

Recommendations:

Text in NUREG-1536 and NUREG-1567 should be edited to reflect the information in this ISG. Attachment A includes specific recommendations for changes to NUREG-1536. Attachment B includes specific recommendation for changes to NUREG-1567.

Approved M. Wayne Hodges for E. William Brach

E. William Brach **Date** 5/17/00

Attachment A
Spent Fuel Project Office, ISG - 13

This attachment includes recommendations for changes to NUREG-1536, *Standard Review Plan for Dry Cask Storage Systems*.

Replace Section 5.IV., "Acceptance Criteria," on Pages 5-1 and 5-2, as shown:

~~The task of identifying dose rate limits for direct radiation from storage casks is complicated by three considerations. First, 10 CFR Part 72 states regulatory dose limits in terms of total absorbed doses rather than dose rates. Second, dose analyses must include potential sources of radiation other than direct radiation from spent fuel in the cask. Third, the regulatory requirements (listed below) for acceptable cask use at an ISFSI are site-specific and must be separately evaluated on a case-by-case basis. That is, these evaluations are performed as required for a site-specific license application or as required by 10 CFR 72.212 for a utility using a cask under the general license.~~

In general, the DCSS shielding evaluation seeks to ensure that the proposed design fulfills the following acceptance criteria:

~~1. The minimum distance from each spent fuel handling and storage facility to the controlled area boundary must be at least 100 meters. The "controlled area" is defined in 10 CFR 72.3 as the area immediately surrounding an ISFSI or monitored retrievable storage (MRS) facility, for which the licensee exercises authority regarding its use and within which ISFSI operations are performed.~~

1 ~~2~~. The **application for a cask design** ~~cask vendor~~ must show that, during both normal operations and anticipated occurrences, the radiation shielding features of the proposed DCSS are sufficient to meet the radiation dose requirements in Sections 72.104(a). ~~Specifically, the vendor must demonstrate this capability for a typical array of casks in the most bounding site configuration. For example, the most bounding configuration might be located at the minimum distance (100 meters) to the controlled area boundary, without any shielding from other structures or topography.~~

2 ~~3~~. Dose rates from the cask must be consistent with a well-established "as low as reasonably achievable" (ALARA) program for activities in and around the storage site.

3 ~~4~~. ~~After a design-basis accident, an individual at the boundary or outside the controlled area shall not receive a dose greater than 5 rem to the whole body or any organ~~. **Radiation shielding and confinement features must be provided sufficient to meet the requirements in 72.106. Any individual located on or beyond the nearest boundary of the controlled area may not receive from any design basis accident the more limiting of a total effective dose equivalent of 0.05 Sv (5 rem), or the sum of the deep dose equivalent to and the committed dose equivalent to any individual organ or tissue (other**

than the lens of the eye) of 0.5 Sv (50 rem). The lens dose equivalent shall not exceed 0.15 SV (15 rem) and the shallow dose equivalent to skin or any extremity shall not exceed 0.5 Sv (50 rem).

4 ~~5~~. The proposed shielding features must ensure that the DCSS meets the regulatory requirements ~~for occupational and radiation dose limits for individual members of the public, as~~ prescribed in 10 CFR Part 20~~, Subparts C and D~~.

Replace the third, fourth and fifth paragraphs of Section 5.V.4.c., "Dose Rates," on Page 5-6, as shown:

~~Appropriately detailed calculations are necessary to show that the radiation shielding features are sufficient to meet the requirements of 10 CFR 72.104 and 72.106. These calculations will need to assume a typical storage arrangement for the casks. Later, when a particular site is selected, calculations will be needed to show ultimate compliance of the spent fuel system. Site configurations not enveloped by the typical site layout assumed in the SAR must be treated in the written evaluations required under 72.212(b)(2) and (3) before the cask system is used. In addition, the SAR should determine the degree to which the normal condition dose rates could change for the identified off-normal conditions. The need for additional calculations should be indicated in the SER and in the conditions set forth in the Certificate of Compliance~~.

~~The NRC has previously accepted a calculated dose rate of 0.25 mSv/yr (25 mrem/yr) at the ISFSI controlled area boundary as sufficient evidence that the limit for exposure of the public will not be exceeded under normal conditions. The applicant should provide a discussion that would help determine whether a potential ISFSI would be within the dose rate envelope. These could involve identifying the minimum controlled area dimensions to ensure that the 0.25 mSv/yr dose is not exceeded. Alternatively, the presentation could provide the maximum number of casks that could be stored in an ISFSI, with the minimum distance of 100 meters between the stored fuel and the controlled area boundary (10 CFR Part 72.106(b)), or a suggestion that the licensee install berms, to meet the criterion of 0.25 mSv/yr (25 mrem/yr).~~

~~To demonstrate applicant compliance with these requirements, the NRC staff has accepted calculations in the SAR showing a dose rate less than 0.25 mSv/yr (25 mrem/yr) from one cask (or a representative array of casks) at an assumed distance to the controlled area boundary. Such calculations, in practice, can give only a general assessment of the proposed cask system. In addition to unknown information about the ISFSI itself, the implied assumption that an individual would be at the controlled area boundary for 8760 hours (the entire year) is very conservative.~~

The application for a cask design is required by 72.236(d) to demonstrate that the shielding and confinement features of the cask are sufficient to meet the requirements in 72.104 for any real individual. The real individual is an individual at or beyond the controlled area, and the dose to any real individual must not exceed the limits specified in 72.104 from both the storage facility and other surrounding fuel cycle activities. For example, a real individual may be anyone

living, working, or recreating close to the facility for a significant portion of the year.

However, for approval of a cask design, the applicant should evaluate the shielding and confinement features of a single cask and a theoretical array of casks, assuming design basis source terms and full-time occupancy. The applicant should also provide analyses to facilitate future site-specific evaluations for each general ISFSI licensee.

The single cask analysis should identify the minimum distance that is required to meet the dose rates in 72.104. Past applications have shown this distance to be typically within 200 meters of the cask. The applicant should include a dose rate versus distance curve for a single cask to facilitate a site-specific evaluation for general licensees. To satisfy section 72.106(b), dose evaluations should be determined at a minimum of 100 meters distance to the closest boundary of the controlled area. However, the applicant may use a longer distance, provided that the longer distance is made a condition of use.

The applicant should also include a dose rate versus distance curve for a theoretical cask array. The theoretical cask array should consist of at least 20 storage casks (2x10 array), and should account for self shielding among casks.

It is important to note that the general ISFSI licensee is permitted to use additional engineering features, such as berms, to mitigate doses to real individuals near the site. If such features are used in the cask SAR to show compliance with the regulations, they should be included in the cask conditions of use. In addition, the SAR should determine the degree to which the normal condition dose rates could change for the identified off-normal conditions.

As required by 72.212(b)(2), a general licensee must perform a written evaluation to demonstrate that the dose rate limits in 72.104 are met. An evaluation similar to that for site-specific ISFSI should be performed. The licensee may use information provided in the cask SAR, as well as site specific information to perform the evaluation. Evaluations performed by the general ISFSI licensee are not reviewed for approval by NRC; however, they are subject to NRC inspection and must be recorded and maintained by the general licensee.

The general licensee should establish measures in the radiological protection program, environmental monitoring program, and/or operating procedures to identify and reevaluate potential increases in exposure to the real individuals. Compliance with the dose limits in 72.104 will be verified by the environmental monitoring program with direct radiation measurements and/or effluent measurements, as appropriate.

Replace Section 10.IV.3., "Public Exposures," on Page 10-2, as follows:

3. ~~Public~~ Exposures **At or Beyond the Controlled Area Boundary**

a. Normal Conditions:

whole body:	**0.25 mSv/yr** (25 mrem/yr)
thyroid:	**0.75 mSv/yr** (75 mrem/yr)
other organ:	**0.25 mSv/yr** (25 mrem/yr)

~~These doses include the cumulative effects of other nuclear fuel cycle facilities that may be at the same location as the storage system (i.e., the nuclear power plant) and apply to the limiting real individual of the general public residing at a permanent location nearest the facility~~.

b. Accident and Natural Phenomenon Events:

~~5 rem to the whole body or any organ of any individual located at or beyond the nearest boundary of the controlled area~~. **Radiation shielding and confinement features must be provided sufficient to meet the requirements in 72.106. Any individual located on or beyond the nearest boundary of the controlled area may not receive from any design basis accident the more limiting of a total effective dose equivalent of 0.05 Sv (5 rem), or the sum of the deep dose equivalent to and the committed dose equivalent to any individual organ or tissue (other than the lens of the eye) of 0.5 Sv (50 rem). The lens dose equivalent shall not exceed 0.15 SV (15 rem) and the shallow dose equivalent to skin or any extremity shall not exceed 0.5 Sv (50 rem).**

Replace the first paragraph of Section 10.V.3., "Public Exposures," on Page 10-3, as shown:

3. ~~Public~~ Exposures **At or Beyond the Controlled Area Boundary**

~~An SAR for an application seeking approval of a DCSS under 10 CFR Part 72, Subpart L, should include an analysis of potential public exposures that will facilitate a future site-specific suitability analysis required by a licensee prior to DCSS use. One approach is for the applicant to include a dose rate versus distance curve for a theoretical cask array. This curve would assist the reviewer in the determination of the cumulative exposure effects. As an alternative, the analyses documented in the SAR may presume that the public exposure occurs at a distance of 100 meters from the closest stored fuel, with the most severe concentration of casks, and a distance of at least 100 meters between the transfer path and the closest point of public access. 10 CFR 72.106(b) specifies 100 meters as the minimum distance to the closest boundary of the controlled area. These assumptions should be conservative relative to most actual site conditions.~~

As required by 72.236(d), the spent fuel storage cask application must; (1) demonstrate that the shielding and confinement features of the cask are sufficient

to meet the requirements for real individuals in 72.104, and for design basis accident conditions in 72.106, and (2) facilitate future site-specific evaluations for each general ISFSI licensee. The real individual is an individual at or beyond the controlled area, and dose to any real individual must not exceed the limits specified in 72.104 from both the storage facility and other surrounding fuel cycle activities. For example, a real individual may be anyone living, working, or recreating close to the facility for a significant portion of the year.

However, for approval of a cask design, the applicant should evaluate the shielding and confinement features of a single cask and a theoretical array of casks, assuming design basis source terms and full-time occupancy.

a. Normal Conditions

~~Review the information in SAR Section 5 regarding the direct dose rate at the controlled area boundary. For applications requesting approval of a cask system under 10 CFR Part 72, Subpart L, the dose for the public should be determined at a distance of 100 meters from the closest boundary of the controlled area, as specified in 10 CFR 72.106(b). However, the applicant may use a longer distance, provided that the longer distance is made a condition of use.~~

~~The sum of doses, including an additional margin to account for doses received from other fuel cycle (reactor) operations, must satisfy the requirements of 10 CFR 72.104(a). As discussed in Chapter 5 of this SRP, the direct dose at the controlled area boundary depends on many site-specific conditions, which the SAR may treat in a general manner. Verify that the SAR includes a requirement for site-specific dose analysis and monitoring by the ISFSI licensee, or that the applicant has presented sufficient bounding analyses. (The latter approach will generally require extensive calculations.)~~

The single cask analysis should identify the minimum distance that is required to meet the dose rates in 72.104. Past applications have shown this distance to be typically within 200 meters of the cask. The applicant should include a dose rate versus distance curve for a single cask to facilitate a site-specific evaluation for general licensees. To satisfy section 72.106(b), dose evaluations should be determined at a minimum of 100 meters distance to the closest boundary of the controlled area. However, the applicant may use a longer distance, provided that the longer distance is made a condition of use.

The applicant should also include a dose rate versus distance curve for a theoretical cask array. The theoretical cask array should consist of at least 20 storage casks (2x10 array), and should account for self shielding among casks.

It is important to note that the general ISFSI licensee is permitted to use additional engineering features, such as berms, to mitigate doses to real individuals near the site. If such features are used in the cask SAR to show compliance with the regulations, they should be included in the cask conditions

of use. In addition, the SAR should determine the degree to which the normal condition dose rates could change for the identified off-normal conditions.

As required by 72.212(b)(2), a general licensee must perform a written evaluation to demonstrate that the dose rate limits in 72.104 are met. An evaluation similar to that for site-specific ISFSI should be performed. The licensee may use information provided in the cask SAR, as well as site specific information to perform the evaluation. Evaluations performed by the general ISFSI licensee are not reviewed for approval by NRC; however, they are subject to NRC inspection and must be recorded and maintained by the general licensee.

The general licensee should establish measures in the radiological protection program, environmental monitoring program, and/or operating procedures to identify and reevaluate potential increases in exposure to the real individuals. Compliance with the dose limits in 72.104 will be verified by the environmental monitoring program with direct radiation measurements and/or effluent measurements, as appropriate.

Attachment B
Spent Fuel Project Office, ISG - 13

This attachment includes recommendation for changes to NUREG-1567, *Standard Review Plan for Spent Fuel Dry Storage Facilities*:

Replace the second paragraph of Section 11.4.3.2, "Offsite Doses," on Page 11-15, as follows:

> ~~The collective dose should be determined as the sum of the products of individual doses in each of 16 compass sectors about the installation and the number of population members in each sector. Sectors should be centered between the arcs having radii of 1.5, 3, 5, 6.5, and 8 km (about 1,2,3,4, and 5 miles).~~ **If radioactive effluents from the ISFSI are anticipated, the applicant should provide the estimated annual collective dose (in person-rem) related to the ISFSI. Details on estimated radioactive effluents and models and equations used to determine the dose should be presented.** The dose should be based on all important exposure pathways (direct radiation, airborne releases, etc.), and modes of exposure (external exposure, inhalation, etc.). The dose should be specified as whole-body or effective, and the organ receiving the highest dose should be identified. Dose calculations must consider direct radiation and discharges of radioactive material under both normal conditions and anticipated occurrences as well as contributions from **both the storage facility and other surrounding fuel cycle activities** ~~other uranium fuel-cycle facilities with the region~~. The methodology applied must be acceptable to NRC.