Division of Spent Fuel Storage and Transportation,
Interim Staff Guidance – 26A
Shielding and Radiation Protection Review Effort and Licensing Conditions for 10 CFR Part 72 Applications

Issue:

This Interim Staff Guidance (ISG) addresses issues related to high dose-rate transfer casks and ensuring the appropriate prioritization of the staff's review procedures in the areas of shielding and radiation protection for spent fuel dry storage systems under 10 CFR Part 72. This ISG does this by (1) establishing a method to determine the appropriate priority levels for shielding and radiation protection review procedures; (2) providing guidance regarding the conditions the staff should include in certificates of compliance, licenses, and technical specifications; and (3) providing guidance regarding the analyses that the staff should verify are included by applicants in applications submitted under 10 CFR Part 72 and the staff's evaluation of those analyses.

Applicability:

This ISG applies to all dry storage system (DSS) Certificate of Compliance (CoC) and CoC amendment applications submitted in accordance with 10 CFR Part 72, Subpart L and reviewed in accordance with NUREG-1536, Revision 1, "Standard Review Plan for Spent Fuel Dry Storage Systems at a General License Facility" (NUREG-1536). Though focused on CoC and CoC amendment applications, the principles in this guidance also apply to specific-license Independent Spent Fuel Storage Installation (ISFSI) license and license amendment applications submitted in accordance with 10 CFR Part 72, Subpart B and reviewed in accordance with NUREG-1567, "Standard Review Plan for Spent Fuel Dry Storage Facilities" (NUREG-1567). However, the staff's application of the guidance to these specific-license ISFSI applications should be guided by the considerations discussed in Section 5 of Appendix A of this ISG. The ISG guidance regarding transfer casks (TC) applies to all system features used to perform the function of a TC (i.e., loading of spent fuel from the spent fuel pool for dry storage and preparation of that fuel for storage, including draining and drying of the canister/cask, cask/canister sealing operations, and leak testing operations). The guidance regarding the storage overpack applies to system features used to perform the overpack's function (i.e., storage of spent fuel at an ISFSI pad).

Introduction:

This ISG focuses on the following aspects of 10 CFR Part 72, Subpart L shielding and radiation protection reviews:

1. Priority levels of review procedures for spent nuclear fuel DSS CoC applications (including amendments),
2. CoC and Technical Specifications (TS) conditions, and
3. Safety Analysis Report (SAR) analyses in applications.

The guidance for these review aspects is based on criteria regarding DSS shielding characteristics, namely TC surface and overpack side surface dose rates.[1] The purpose of this guidance is to establish a method for adjusting the review procedure priority levels to levels that are appropriate for each application, to ensure the staff includes appropriate conditions in CoCs

[1] These dose rates exclude dose rates at streaming paths.

and TS, and to ensure SARs in applications include appropriate analyses. In so doing, the ISG ensures review guidance adequacy in light of recent DSS design developments, as discussed in Section 2 of Appendix A. The ISG also improves the efficiency, effectiveness, and consistency of staff's reviews. For example, review effort may decrease or increase depending on the DSS shielding characteristics. Appendix A describes the bases for this guidance, including the criteria selection. For reviews of 10 CFR Part 72 Subpart B applications, the term CoC becomes specific license.

Discussion:

In July 2010, the staff issued NUREG-1536 which includes generic priorities for the review procedures in every technical review area (structural, shielding, criticality, etc.). These priorities are labeled HIGH, MEDIUM, and LOW and are defined on pages 5 and 6 of NUREG-1536. These priorities provide guidance to the staff on the relative level of effort typically applied in implementing each review procedure. This ISG establishes a method for adjusting (either lowering or raising) the priorities for the shielding and radiation protection review procedures based on the TC surface and overpack side surface dose rates calculated in the application. This method gives added weight to the "consequences" aspect of the prioritization method in NUREG-1536 that established the generic review procedure priorities.

Various licensees and applicants face situations that pose operational challenges for implementing dry storage of spent nuclear fuel. Thus, DSS vendors have recently introduced designs, particularly TC designs, to address these challenges. These TC designs go beyond those envisioned in the development of the current shielding and radiation protection review guidance, raising significant, unanticipated radiation protection issues. To address these developments, this ISG enhances the review guidance to include descriptions of the types of analyses that should be included in the SAR and the conditions and requirements that should be included in the CoC and TS. This ISG describes the analyses and licensing conditions that are necessary for TCs and storage overpacks, adjusting them for TCs based on the TCs' surface dose rates.

Though the focus of the ISG is on CoC and CoC reviews, the principles of this guidance also apply to specific-license ISFSI license and license amendment reviews. However, in applying this guidance the reviewer should consider aspects of these applications that differ from those for CoCs and CoC amendments as discussed in Section 5 of Appendix A of this ISG. These aspects include information regarding the facility and its site. Consideration of these aspects and their impact on shielding and radiation protection should guide the reviewer in determining the appropriate application of the review effort and licensing condition guidance in this ISG.

Regulatory Criteria:

The regulatory criteria specified in Sections 6.3 and 11.3 of NUREG-1536 and Sections 7.3 and 11.3 of NUREG-1567 all apply to this ISG.

Technical Review Guidance:

Appendix A of this ISG includes detailed descriptions and explanations of the guidance provided in this section.

Review Prioritization (Level of Review)

From the application, determine the maximum TC surface dose rate, considering the side and top surfaces of the TC loaded with design-basis contents and the TC configuration resulting in maximum dose rates during normal operating conditions for each surface, and determine the maximum dose rate on the side surface(s) of the storage overpack. Use these dose rates, Table 1 and the following definitions of Elevated, Standard, and Reduced to adjust the generic priority levels of the review procedures. For example, for a DSS that has a TC with a maximum dose rate for the side and top of 1 rem/hr and an overpack with a maximum side dose rate of 200 mrem/hr, per Table 1, the review priority levels discussed in NUREG-1536 would each be reduced by one (i.e., all HIGH level procedures become MEDIUM level, and all MEDIUM level procedures become LOW level procedures, and all LOW level procedures remain at this priority level). The information in Table 1 should be viewed as a starting point for determining the level of review effort. The reviewer's judgment is still an important component of how the review is performed, and other factors may influence the level of review effort. These factors include those provided in Section 6.5.4.4 of NUREG-1536 and the potential use of analysis methods presented in the SAR to make subsequent design changes pursuant to 10 CFR 72.48.

Definitions:

Elevated – review procedure priority levels are raised to the next level higher than their generic priority level. Those procedures that are already HIGH priority will remain at this level. The level of review effort will increase accordingly.
Standard – review procedures remain at their generic priority levels. The level of review effort will also remain at the appropriate generic level.
Reduced – review procedure priority levels are lowered to the next level lower than their generic priority level. Those procedures that are already LOW priority will remain at this level. The level of review effort will decrease accordingly.

SAR analyses and CoC/TS conditions

Transfer cask(s)

From the application, determine the maximum TC surface dose rate, considering the side and top surfaces of the TC loaded with design-basis contents and the TC configuration resulting in maximum dose rates during normal operating conditions for each surface. Use this dose rate and Table 2 to determine the analyses that should be included in the SAR and the licensing conditions that should be included in the CoC and TS.

Storage overpack(s)

Use Table 3 to determine the analyses that should be included in the SAR and the licensing conditions that should be included in the CoC and TS.

Recommendation:

The staff recommends modifying NUREG-1536 to include the guidance in this ISG per Appendix B of this ISG. The staff also recommends modifying NUREG-1567 to incorporate the guidance in this ISG and its Appendix A.

Appendices:

Appendix A – Technical Basis and Guidance Details
Appendix B – Description of NUREG-1536 Changes to Implement ISG Guidance

Approved: _____________DRAFT________________**Date:** _________
DIRECTOR - SFST

Table 1. Level of Shielding and Radiation Protection Review Effort[1]

Maximum side[2] surface dose rate for the storage overpack	Dose Rate at TC Surface		
	TC Dose Rate ≤2 rem/hr	TC Dose Rate 2 – 5 rem/hr	TC Dose Rate > 5 rem/hr
≤ 300 mrem/hr	Reduced	Standard	Elevated
> 300 mrem/hr	Standard	Elevated	Elevated

Notes
1. For DSSs that have more than one TC and/or overpack, the TC and overpack in the application with the highest dose rates should be used to determine the level of review.
2. In cases where the overpack top surface is a significant contributor to doses, the reviewer should also use the maximum top surface dose rate.

Table 2. TRANSFER CASK – Licensing Conditions and Safety Analyses

	Level 1: TC[1] Dose Rate[2] ≤ 2 rem/hr	**Level 2: TC Dose Rate 2 – 5 rem/hr**	**Level 3: TC Dose Rate > 5 rem/hr[3]**
CoC Description	Weight of TC, materials of construction (including the geometric arrangement of the shielding layers – see pg. 2 of NUREG-1745[5] for an example)	Level 1 plus: design information for shielding that provides nominal specifications (for shielding thickness, density, etc.)	Level 2 plus: descriptions of supplemental shielding and any remote operations. Pre-operational training condition to address remote operations and off-normal operations in place of remote operations
Technical Specification Limiting Condition for Operation (TS LCO)	LCO: Dose rate limits for top and side TC surfaces based on licensee's 10 CFR 72.212 analysis for TC configuration(s)[2,4] specified in the LCO ACTION: • State the cask is placed in a safe condition and the cause for exceeding the limit is determined • Describe appropriate corrective actions Surveillance Requirement (SR): • State measurements are performed • Describe the measurement locations on TC surfaces and TC configuration(s)[4] for performing measurements • State that each measurement is compared with the appropriate limit LCO is not needed if TS Design Features Option B is selected (see below)	Same as Level 1	LCO (including ACTION and SR): Level 2 LCO and include SAR design-basis dose rate limits (values specified in the LCO) for the TC configuration(s) specified in the LCO
TS Design Features	A. Specify that TC design includes shielding that limits top and side TC surface dose rates to ≤ 2 rem/hr for the following conditions:	A. Specify that TC design includes shielding that limits top and side TC surface dose rates to the design-basis dose rates (values are specified in TS)	Specify the materials and thicknesses of the gamma and neutron shielding components (including properties of neutron shielding necessary to specify its effectiveness) integral to the TC

	Level 1: TC[1] Dose Rate[2] ≤ 2 rem/hr	Level 2: TC Dose Rate 2 – 5 rem/hr	Level 3: TC Dose Rate > 5 rem/hr[3]
	- TC configuration yielding maximum dose rates under normal operation conditions - TC containing design-basis contents - Analysis using method in the system FSAR **OR** B. Specify the materials and thicknesses of the gamma and neutron shielding components (including properties of neutron shielding necessary to specify its effectiveness) integral to the TC that represent the limiting shielding effectiveness	for the following conditions: - TC configuration yielding maximum dose rates under normal operation conditions - TC containing design-basis contents - Analysis using method in the system FSAR **OR** B. Specify the materials and thicknesses of the gamma and neutron shielding components (including properties of neutron shielding necessary to specify its effectiveness) integral to the TC that represent the limiting shielding effectiveness	that represent the limiting shielding effectiveness Also, specify the materials and minimum thicknesses of the gamma and neutron shielding components of any supplemental shielding as well as the operational requirements of any remote operating equipment
TS Radiation Protection Program	Specify that licensee update its 10 CFR Part 20 Radiation Protection Program (RPP) to (1) confirm use of TC design is compatible with as low as is reasonably achievable (ALARA) requirements; and (2) have program to detect gross misloads prior to loading into storage cask; description of program, including corrective actions, is provided in TS RPP	Level 1 plus: Specify licensee perform dose assessment and have in place approved, written recovery procedures for loading and handling malfunctions, including effects of elevated dose rates on plant operations	Level 2 plus: Specify that licensee confirm use of TC design is compatible with 10 CFR Part 72 and Part 20 dose limits (e.g., 10 CFR 20.1301(a)(2)), and that licensee have in place approved, written procedures to govern any remote operations

	Level 1: TC[1] Dose Rate[2] ≤ 2 rem/hr	Level 2: TC Dose Rate 2 – 5 rem/hr	Level 3: TC Dose Rate > 5 rem/hr[3]
SAR Shielding and Radiation Protection Information	Same as stated in the Standard Review Plan – includes worker dose assessment	Level 1 plus: at least one shielding calculation using minimum thicknesses and minimum neutron shield material properties and an analysis of worker dose for off-normal handling events (e.g., a crane hang-up)	Level 2 plus: general recovery procedures and dose assessment for both workers and members of the public for off-normal handling events Any use of remote operations should be described in these and other chapters of the SAR, as appropriate

Notes

1. For systems that do not use a TC, the same approach will be applied to the equipment used for removing fuel from the spent fuel pool and preparing it for dry storage. For DSSs that have multiple TC designs, this guidance should be applied to each TC design.
2. All discussion of dose rates refers to surface dose rates. The dose rate used to determine the level to which a system is assigned in this table is the maximum calculated design-basis surface dose rate, considering the side and top TC surfaces (excluding streaming paths), for normal operation conditions. This is typically the maximum TC radial surface dose rate assuming a bounding fuel load, a dry TC configuration, and no supplemental shielding. TS LCO dose rate limits may be for any TC configuration the applicant can justify as being appropriate.
3. Systems with TCs having design-basis dose rates in this range will require stringent review and special evaluation. Evaluation may, for significantly high design-basis dose rates, need to be done on a case-by-case (i.e., on a per licensee site) basis and may require interaction with licensees who may potentially use the TC to understand impacts on plant operations and may also require senior NRC management, including Commission, involvement. Consultation with the NRC regarding such proposed systems prior to submission of an application is strongly encouraged.
4. The configuration(s) set in the TS must be consistent with those for which dose rates were calculated in the application/SAR (e.g., flooded canister or dry canister) but are to be surface dose rates in either case.
5. U.S. NRC, NUREG-1745, “Standard Format and Content for Technical Specifications for 10 CFR Part 72 Cask Certificates of Compliance,” June 2001, (ML011940387).

Table 3. STORAGE OVERPACK[1] – Licensing Conditions and Safety Analyses

Item/Location	Expected Content
CoC Description	General Design Description: - materials - features: penetrations, unique/novel features - overall configuration of materials/construction - contents orientation
TS LCO	LCO: • Dose rate limits for appropriate overpack surfaces based on licensee's 10 CFR 72.212 analysis • LCO states dose rates shall not exceed the SAR design-basis calculations (the SAR values are included in the LCO) ACTION: • State the cask is placed in a safe condition and the cause for exceeding limit is determined • Describe appropriate corrective actions SR: • State measurements performed; • Specify the measurement locations on overpack surfaces and the overpack configuration when measurements are performed • State that each measurement is compared with the appropriate limit
TS Radiation Protection Program	Specify that licensee ensure its 10 CFR Part 20 RPP appropriately addresses dry storage operations involving the overpack and verify use of overpack design is compatible with 10 CFR Part 72, 10 CFR Part 20, and ALARA requirements
SAR Shielding and Radiation Protection Information	Same as stated in Standard Review Plan

Notes

1. For DSSs that have multiple overpack designs, this guidance should be applied to each overpack design.

Division of Spent Fuel Storage and Transportation
Interim Staff Guidance – 26A
Appendix A
Technical Basis and Guidance Details

1 Introduction

This document provides the supporting information for Interim Staff Guidance (ISG) – 26A. This information includes the background, history of, and need for this ISG. This information also includes the technical basis for the guidance, including the criteria used to determine the level of review and the information and conditions needed in the applicant's Safety Analysis Report (SAR) and the design licensing documents (Certificate of Compliance (CoC) and Technical Specifications (TS)). Lastly, further detail is provided to elaborate on the ISG guidance. This document frequently refers to NUREG-1536 as the standard review plan (SRP).

The focus of this appendix is on CoC and CoC amendment reviews. However, as stated in the ISG, the principles also apply to specific-license independent spent fuel storage installation (ISFSI) license and license amendment reviews. The staff should consider the discussion in Section 5 of this appendix in applying the guidance to these reviews. In applying this appendix to these reviews, where it is appropriate, the terms NUREG-1536, CoC and DSS become NUREG-1567, license and facility, respectively. Also, the term SRP will refer to NUREG-1567 where it is appropriate.

2 ISG Development Background/History

Spent fuel dry storage systems (DSS) employ large, heavy casks to remove spent nuclear fuel (or spent fuel) from a reactor's spent fuel pool and allow dry storage of that fuel at an ISFSI. The means for removing the fuel from the spent fuel pool may be the storage overpack itself or a separate transfer cask (TC), which holds an inner canister that is then transferred from the TC to the storage overpack. Both the overpack and the TC, for those systems employing TCs, weigh 100 or more tons when fully loaded. The heavy load cranes in the spent fuel pool buildings of the majority of nuclear reactor facilities are either currently capable of or can be modified to be capable of handling these kinds of loads. Some facilities, however, do not have such crane capacity and are unable to modify the crane to increase its capacity to allow for handling of these loads.

Thus, different approaches have been proposed to enable the removal of spent fuel from the pool using these lower capacity cranes. These approaches include consideration of the different regulatory options provided in 10 CFR Part 72 to implement changes in TC design or operations. These options include requests for exemptions under 10 CFR 72.7 and performing analyses of the changes to determine whether or not the changes can be implemented under 10 CFR 72.48. References [1 – 5] describe a notable example of these approaches and the end results. The staff developed this guidance to address these kinds of TC design developments given the significance of the design and operations modifications and the unusual, or extreme, nature of the operations. In addition, the staff is concerned about the high dose rates (even with the conditions imposed for the exemption) and the potential impacts on facility operations in cases such as this, particularly under off-normal conditions. References [6, 7, 8] illustrate other instances of CoC holders and licensees' attempts to reduce the loads associated with spent fuel operations so that lower capacity cranes can be used for these operations.

The guidance provided in NUREG-1536 [12] and NUREG-1567 [16], as applicable, does not adequately cover cases like those described above, in terms of both design and operations. The guidance may not cover future TC designs and operations that industry may consider to address future challenges utilities may face in conducting spent fuel dry storage operations. Thus, this ISG provides guidance that will enable the staff to perform appropriate reviews, including expending an appropriate level of effort and ensuring appropriate conditions are included in the CoC, or license, and TS commensurate with the TC design of a DSS or facility.

In addition, review practices, as embodied in the licensing documentation (e.g., CoC, license, TS), are not consistent across DSS designs. Thus, another objective of this ISG is to provide consistency in reviews and the conditions to be included in the CoC, or license, and TS and the information to be included in the SAR for both TCs and storage overpacks.

During the development of this ISG, interactions with industry stakeholders [9, 10, 11] led the staff to reconsider the nature of its shielding and radiation protection reviews of DSS applications. The objective was to ensure the staff expends the appropriate level of effort in these reviews, that the staff conducts reviews effectively and efficiently, and that the reviews do not result in unnecessary regulatory burden. At the time of these interactions, the staff was also revising NUREG-1536 to add generic priority levels (i.e. adjust the level of review effort in a way that generally applies to the staff's review of DSS CoC applications) for reviews of DSSs for all technical areas. NUREG-1536 states that these generic priority levels may be adjusted based on the characteristics of each specific application. As a result of the staff's interaction with industry stakeholders and review of the guidance in NUREG-1536, the staff found that some adjustments to the level of effort in shielding and radiation protection reviews would be appropriate. For DSSs with certain characteristics, the review effort may be reduced; for others, however, it may need to be increased. By establishing quantitative, measurable criteria, this ISG enhances the prioritization of the shielding and radiation protection review procedures that are in the latest revision of NUREG-1536. This ISG uses these criteria as part of its method for revising the generic prioritization in order to customize the priority levels of the review procedures in these two areas to each application. The ISG's method gives added weight to the "consequences" aspect of the generic prioritization method in NUREG-1536.

3 Technical Basis

The ISG establishes the specific information and analyses that should be provided in the application, particularly in the Radiation Protection and Shielding Chapters of the SAR. It also provides guidance on the conditions that should be included in the CoC and/or TS. For TCs, the types and level of detail of the SAR information as well as the CoC and TS conditions are dependent upon the TC surface dose rates.

Adjustment of the review prioritization and level of effort is based on two criteria (see ISG Table 1). These criteria are: (1) the maximum surface dose rate on the TC loaded with design-basis fuel in the highest dose-rate configuration(s) under normal conditions without supplemental shielding (i.e., shielding not integral to the TC) and (2) the maximum dose rate on the side surface(s) of the storage overpack. These two criteria provide a simple means for determining the shielding capabilities of the DSS. However, the criteria are not equally weighted. The TC dose rate criterion is given greater weight since, in the staff's judgment, due to the events discussed in Section 2, TC design has the greatest potential for shielding and radiation protection concerns. The dose rates used for the TC criterion are the same as those used to

determine the necessary SAR analyses and licensing conditions for TCs (see ISG Table 2). The bases for these criteria are discussed in the following sections.

The guidance regarding the necessary CoC and TS conditions and SAR analyses for storage overpacks (see ISG Table 3) does not follow a graded approach. The guidance for storage overpacks is to be applied consistently to all storage overpacks. Section 3.3 discusses the basis for this approach to the overpack guidance.

3.1 Dose Rate Criterion for the Transfer Cask

The TC surface dose rate is used for determining the needed TC licensing conditions and analyses and is the first criterion for determining the level of review. The reviewer should apply the dose rate ranges in ISG Tables 1 and 2 to the side and top surfaces of the TC. The radiation emitted from these surfaces is considered to be significant with respect to the occupational doses, doses to members of the public on-site, and doses at the controlled area boundary. While there may be operations where the TC is elevated (i.e. lifted by the crane) or is in a horizontal position such that individuals could be exposed to radiation from the TC base, the staff expects that other considerations besides radiation protection will ensure that risk due to exposure is minimized. For example, when the TC is elevated and the bottom is exposed, the potential physical hazards associated with being under a heavy load (e.g., dropping or uncontrollable lowering of the TC) are expected to preclude individuals from being under the TC. When a TC is being handled in a horizontal position, exposing the bottom, this is usually for transfer of the spent fuel to the overpack, or storage module and a minimal amount of operational activity is performed on or near the base of the TC. Still, the staff expects that licensees will properly consider 10 CFR Part 20 requirements (e.g., 10 CFR 20.1301(a) and (b)) and apply the necessary controls during this activity. The staff expects that personnel are not directly below or in line with the TC base but are off to the side. However, the reviewer should also consider the dose rates on the TC base in determining the appropriate TC level in ISG Tables 1 and 2 if a TC design requires significant operations involving the TC base or handling of the TC such that exposures to radiation from the TC base could be significant.

The dose rate criterion values for the three TC levels in ISG Tables 1 and 2 are based on the configuration(s) that results in maximum dose rates during normal operations for a TC loaded with design-basis contents. This configuration is typically a dry TC without supplemental shielding. The dose rates will usually be the highest for operations where the cask is dry (e.g., TC movement from the decontamination area to interface with a storage overpack or storage module, or draining the TC during removal from the spent fuel pool); thus, dose rates can be the most problematic for these operations. Any shielding that supplements the TC and is not an integral part of the TC is also not included since this kind of shielding does not necessarily move around with the TC (e.g., into or out of the spent fuel pool or from the decontamination area to the transfer device), may not be used in all stages of operations, and masks the TC's shielding performance. Thus, the reviewer should only consider the TC itself and the shielding features that are integral to the TC for determining the appropriate TC level in ISG Tables 1 and 2. Additionally, the SAR analysis should demonstrate the shielding performance for all the proposed DSS contents. This is done with calculations of dose rates for contents with characteristics that encompass the proposed contents with respect to radiological source term and shielding (i.e., design-basis contents).

The staff recognizes that for some systems, the system design and operations are such that another TC configuration may be appropriate to use for determining the appropriate TC level in

ISG Tables 1 and 2.[1] The staff also recognizes that the maximum dose rates for the TC top area and the TC radial surface may occur for different shielding configurations that exist during normal operations. Thus, the reviewer should consider the dose rates for all TC shielding configurations that will exist during normal operations in order to ensure that the maximum dose rates that occur for the TC top and radial surfaces at any time during normal operations are identified and used to determine the TC level.

It is also important to note that the maximum dose rates used to determine the TC category do not include dose rates at TC features that act as streaming paths, such as vent ports and drain ports that account for very small areas of the TC surface. Thus, streaming paths are localized areas of elevated dose rates that generally do not reflect the overall shielding performance of the TC and will not have an influence on public exposures arising from the TC use. The licensee should be able to easily minimize personnel exposures due to streaming paths through use of adequate procedures and readily available supplemental shielding such as lead blankets. Therefore, the reviewer does not generally need to consider streaming paths to determine the maximum TC surface dose rates. However, the reviewer may consider using dose rates associated with a feature on the TC surface if, in the reviewer's judgment, the nature of the dose rates so warrants (e.g. areas where the elevated dose rates are not truly localized and affect significant areas of the TC surface). In any case, the SAR should include (e.g., in the operations description) appropriate cautions that alert the licensees to the presence of and the dose rates at these features and indicate the need for licensees to establish procedures that keep personnel away from these features or otherwise reduce personnel dose from them.

The staff set the dose rate values differentiating the three TC levels in ISG Tables 1 and 2 based upon its judgment derived from experience with certifying DSSs as well as the implications of the dose rates for compliance with regulatory dose limits. The staff performed a review of all of the SARs from all current 10 CFR Part 72 CoCs, including all previously approved amendments, to determine the design-basis surface dose rates of the available TCs. This review included the side and top surface dose rates. Based on this review, the dominant determining factor of the TC level is the TC side surface dose rate. Yet, a significant portion of loading and unloading operations involve activities around the TC top. Therefore, the staff determined that the reviewer should also consider the maximum dose rates at the TC top in determining the TC level and the level of review. This review indicated that only a small number of approved systems (considering each amendment and each TC-canister combination for which dose rate analyses are provided as a separate system, about 24 of about 120) have canisters that result in TC design-basis dose rates that exceed 2 rem/hr. Of these systems, ten do not exceed 4 rem/hr. The other fourteen systems have dose rates that significantly exceed 4 rem/hr.

Staff reviewed the fourteen systems with dose rates significantly above 4 rem/hr in greater detail to understand the basis for the dose rates and how the system operations are described. This review indicated that these fourteen systems are for two TC-canister combinations that were approved in an amendment to their respective dry storage system CoCs and are included in

[1] Indian Point Energy Center has applied for an amendment to the Unit 2 and Unit 3 reactor licenses to use a Shielded Transfer Canister (STC) to perform a wet transfer of spent fuel from the Unit 3 spent fuel pool to the Unit 2 spent fuel pool. Though this is a 10 CFR Part 50 licensing action, the operations have many similarities to dry storage operations. So, the staff reviewed this action using applicable guidance for DSS reviews. For this particular case, the STC is always flooded. So the flooded condition would be used to determine the TC dose rate level. Per ISG Table 2, the STC would be in Level 2 [15].

subsequent CoC amendments that did not affect these TC-canister combinations. Additionally, there is evidence that the design-basis side surface dose rates for these systems are significantly over-predicted and that calculations with more state of the art methods for the same configurations, design-basis source terms, and relevant assumptions would result in design-basis dose rates that are less than 4 rem/hr on the TC side. Thus, the concerns described later in this section related to high dose-rate systems are in large part alleviated. The TC top surface dose rates, however, would still be significantly above 4 rem/hr with the state of the art methods. Yet, based on the SAR descriptions of the system operations, operations involving the TC top for the configuration with these high dose rates are limited like operations with other equipment having high dose rates, such as high integrity containers, discussed at the end of this section. Even in off-normal conditions, expectations regarding operations are that recovery operations can be done without excessive personnel exposures. Further, the TC orientation while in this configuration minimizes the contribution of the TC top to dose to the public in normal and off-normal conditions. Thus, the staff considers these TC systems to be like systems with design-basis dose rates that are less than 4 rem/hr.

Based on the foregoing reviews, the staff concluded that it has significant experience certifying, and the industry has significant experience using, systems with design-basis dose rates under 2 rem/hr. This experience establishes a level of confidence in the ability to appropriately handle and operate these systems from a shielding and radiation protection standpoint. Based on this conclusion and the staff's considerations described later in this section for dose rates under 2 rem/hr, the staff selected this value as the upper bound for the lowest dose rate range. Additionally, considering the approved systems having maximum dose rates that exceed 2 rem/hr as well as the implications of higher dose rates (described later in this section), the staff determined that 5 rem/hr is an appropriate upper bound value for the middle dose rate range.

Concerns with respect to personnel exposures and the potential for impact to public exposure increase with increasing TC dose rates, particularly as dose rates approach and exceed 2 rem/hr. For TCs that have dose rates that equal or exceed 2 rem/hr, an individual working at those surfaces would have a very limited time in which to perform necessary functions. Regulatory annual dose limits could be reached in 2.5 hours or less (1 hour at 5 rem/hr). The licensee's administrative limit could be reached much sooner. This time constraint is particularly relevant for those activities requiring personnel to spend significant time at the TC. Examples include welding and non-destructive examinations (NDE) of welds, which can mean a worker is at the TC for an hour or longer. If equipment failures or other delays occur, then personnel occupancy time may increase. Further, public exposure can be more noticeably impacted by operations with TCs having these dose rates, especially in the event of an off-normal situation (e.g., crane 'hang-up'). Doses from these operations, including off-normal conditions which are referred to in the regulations as anticipated occurrences, must be included in the licensee's demonstration of compliance with the appropriate regulatory limits (e.g., 10 CFR 72.104(a)).

In setting the dose rate thresholds at 2 and 5 rem/hr, the staff considered the distances personnel would need to be from the TC, the impact of supplemental shielding that can be employed for ALARA purposes, and licensees' experience with and capability of dealing with dose rates up to these levels, which are an occasional part of normal plant operations. 'Reasonable' distances of individuals from the TC along with supplemental shielding can significantly mitigate personnel exposures for operations with TCs having contact dose rates less than 2 rem/hr. These factors can also have a relatively significant impact for operations with TCs having contact dose rates up to 5 rem/hr, though this impact is less than for dose rates

below 2 rem/hr. For purposes of this ISG, the staff defines ‘reasonable’ distances as distances for which:

- personnel dose rates during normal and off-normal operations are the same
- the ability to detect problems is not limited or hindered in any way (e.g., not a location such that noises that may indicate crane problems cannot be heard), and
- personnel are able to work in areas where they would normally be expected to work (e.g., NDE personnel get close to the TC, crane operators operate the crane from the crane cab or with the device they usually use, other personnel directing TC movement are on the re-fueling floor in an appropriate proximity to the TC).

For TCs with surface dose rates greater than 5 rem/hr, it is not clear that the considerations stated in the preceding paragraph for normal operations will continue to be valid. Instead, licensees may need to take more significant actions. Additionally, off-normal conditions and recovery become even more important. For dose rates exceeding 5 rem/hr, there is limited staff and industry experience. This experience includes the approval of two CoC amendments[2], a recent exemption request [1], and a recent CoC amendment request that has a TC in this dose rate range and, as of April 2012, has been reviewed and is in the rulemaking process [6]. There are significant concerns when TCs reach surface dose rates that exceed 5 rem/hr. These concerns increase with increasing dose rates, especially when occupational staff cannot normally be in the vicinity of or in the same room with the TC safely. Crane hang-ups and other off-normal conditions become a greater concern since they may impact plant operations and require special actions to recover from these conditions. The ability to detect crane or other problems early may also be impaired, leading to an increased risk of problems. Even normal operations may require special actions or modifications to loading operations to handle the TC (e.g., modification of area radiation monitors’ alarm set points). Thus, unlike TCs with Level 1 or Level 2 dose rates, significant differences arise between normal operations exposures and off-normal conditions exposures. For example, a crane malfunction that requires personnel to manually operate the crane will result in these personnel being closer to the TC and therefore exposed to significantly higher radiation fields than for normal conditions that rely on remotely controlling the crane to keep personnel at distance. The ability of a licensee to comply with 10 CFR Part 20 limits, not only for occupational staff, but also for members of the public, becomes a more significant concern, with site characteristics becoming a more important factor. Operations with such TCs will also have a more significant impact on off-site doses and therefore affect a licensee’s ability to meet the 10 CFR 72.104 dose limits. Site characteristics will become more of a factor and/or the licensee may need to use supplemental shielding to ensure compliance with these limits for normal and off-normal conditions. It is expected that these high dose-rate TCs will be proposed and/or used for only uncommon or unusual circumstances where use of other, lower dose-rate TCs is shown to be impractical.

With increasing TC dose rates, especially when they exceed 5 rem/hr (as described below), the staff finds there is a need for additional information and conditions in the licensing documents and the SAR to maintain the system design within the bounds that the staff finds acceptable, to ensure ALARA principles are included in the design and operational controls, and to ensure adequate understanding of the design and its associated radiological conditions/hazards under different conditions. These added conditions and the added information are also necessary to ensure adequate analysis of the conditions (normal, off-normal, and accident) and preparation

[2] See the discussion earlier in this section regarding the fourteen systems with design-basis dose rates exceeding 4 rem/hr.

to appropriately handle the TC under those conditions. With increasing dose rates, changes to TC design or operations will have a greater radiological impact. The relative size of a change at higher dose rates (versus at lower dose rates) will translate into a larger actual change, which can then translate into a significantly reduced allowable time in work areas or increased occupational dose and potential concerns for 10 CFR Part 20 worker and public limits and 10 CFR Part 72 public limits. Also, with increasing dose rates, conditions that may be relatively benign at low dose rates (i.e., for TCs in Level 1) with respect to radiological hazard become less benign. Thus, added CoC and TS conditions and SAR information ensure proper definition and understanding of the hazards and adequate preparation for them. The doses to members of the public may also be non-negligible, and licensees should analyze them and verify they comply with 10 CFR Part 20 and 10 CFR Part 72 requirements. CoC holders should also consider these things in designing high dose-rate TCs, and the staff should consider these things in reviewing applications with high-dose rate TCs.

In developing this guidance, the staff considered other operations that occur at general licensees' facilities to determine the appropriateness of the dose rate levels and the information the guidance indicates should be included in the CoC, TS, and SAR and evaluated by the staff. The staff recognizes that licensees perform operations that involve equipment with high dose rates. These activities include operations with high integrity containers (HICs) and weld examinations on reactor vessel heads. The staff is also aware that these other activities may involve dose rates that are as high as or higher than the TC dose rates reported in this ISG and may receive a different level of regulatory scrutiny during licensing reviews. Thus, to determine the appropriateness of the dose rates used in this ISG as well as the guidance regarding the licensing conditions and analyses, the staff compared these other licensee operations with those performed in dry storage loading.

The staff considered the operational complexity, necessary operator actions, operator distances from the equipment, expected operator stay times, operations frequency, load weight versus crane capacity, and potential event consequences. Operations with TCs may, depending upon a licensee's remaining spent fuel pool capacity and spent fuel management strategy, occur several times in a year (i.e., a licensee may load several DSSs in a year). The other high dose-rate activities happen less frequently (e.g., once a year, once an outage, once every several outages). Thus, the significance of exposures for operations with TCs increases due to the potential frequency of the exposures. Dry storage loading operations involve a lengthy sequence of procedures, some of which may require relatively long (cumulative) stay times at or near the TC. In comparison, HIC operations involve less lengthy procedure sequences and minimal operator actions at or near the HIC. Dry storage loading operations involve use of more active systems too, which means a greater likelihood of anticipated occurrences and the need to diagnose and fix the causes of these occurrences or otherwise adjust operations in response to them. The weight of loaded TCs is near the maximum capacity of the cranes used to lift them; hence, the likelihood of crane malfunctions is increased versus lifts of other loads, such as HICs. In previous incidents, loaded TCs have been suspended from cranes for significant lengths of time while licensees diagnosed and remedied the crane problems. Additionally, some TC movements are with the TC loaded and the canister lid just resting in the canister and not otherwise physically restrained. Therefore, the consequences of a potential TC drop are significant in comparison to other loads. Based on these factors, in addition to those factors already described, the staff has determined that this ISG is appropriate to provide assurance of adequate radiation protection for workers and the public.

3.2 Dose Rate Criterion for the Storage Overpack

The maximum dose rate on the side surface(s) of the storage overpack is the second criterion for determining the level of review. The staff considered using the overpack surface dose rates or the distance from the ISFSI storage pad to the controlled area boundary needed for a single overpack to meet the 10 CFR 72.104(a) annual dose limits and determined that using the surface dose rates, in particular the maximum dose rates on the side surface(s) of the overpack, was the best criterion. Several factors provide the basis for this determination. One factor is that the dose rates on the overpack surface are readily and easily measured. Second, while calculations for surface dose rates involve various assumptions and the difficulty of transporting radiation through thick shields, they do not involve the difficulties and assumptions that are part of calculations of dose at significant distances from the overpack. An example of these assumptions is the occupancy time and the appropriate justification for the assumed occupancy time. Since a DSS is intended to be used by multiple 10 CFR Part 50 and Part 52 licensees, CoC holders and applicants have used a bounding assumption of full-time occupancy without supplemental shielding (e.g., berms). Another factor is that dose from an overpack has an occupational as well as off-site impact. Also, surface dose rates can provide some indication of the distances needed to meet the annual dose limits in 10 CFR 72.104(a).

The staff recognizes that there are various factors that influence the actual requirements for an ISFSI to meet the 10 CFR 72.104(a) limits. These factors include the use of supplemental shielding at the site, the ISFSI array size and configuration, geography, and locations of residences, recreational areas and workplaces. The staff, however, notes that these factors have different effects on the distance needed for an ISFSI to meet the regulatory dose limits; some would result in the need for a greater distance while others could result in a shorter distance being sufficient. An ISFSI will have many loaded storage overpacks (a factor that increases distance with increasing numbers of overpacks), but may be located such that occupancy times near the facility will be low (a factor for reduced distance). Thus, while not a strong predictor of the actual distance required for actual ISFSIs, the staff finds that the surface dose rate criterion is one that can provide a sense for the distances that may be required and is a straightforward and reasonable criterion to use to determine the level of review.

Based on the operations with the overpack and the surfaces that contribute the most to off-site dose, the staff decided to limit the criterion to the maximum dose rate on the side surface(s) of the overpack and not include the dose rates from the overpack top surface. Furthermore, dose rates on the overpack side(s) usually are higher than those on the overpack top surface. However, in cases where the overpack top surface is a significant contributor to doses, the reviewer should include the maximum top surface dose rate in determining the maximum overpack surface dose rate to compare with the criterion value in ISG Table 1. As with the TC surface dose rate, the maximum overpack dose rate used to determine the level of review does not include the dose rates at streaming paths (e.g., inlet and outlet vents). The same logic discussed in Section 3.1 for not considering streaming paths for TC dose rates applies to the streaming paths for overpack dose rates. Additionally, streaming paths should not significantly influence off-site doses. As with the TCs, the reviewer may consider the dose rates from streaming paths if in his or her judgment this is warranted.

In determining the overpack criterion value to use in ISG Table 1, the staff considered the overpack surface dose rates for all current Part 72 CoCs, including approved amendments. Additionally, the staff gave some consideration to the distances needed for a single overpack under the assumptions of full-time occupancy and no supplemental shielding to meet the 10

CFR 72.104(a) limits and the potential implications with regard to an array of storage overpacks. The staff also considered the degree to which ALARA is incorporated into the design. ALARA principles should be incorporated into the DSS design as well as the system operations and procedures.

The staff performed a review of the SARs from all current Part 72 CoCs, including all previously approved amendments, and found that none of the currently approved storage overpack designs have surface dose rates that exceed 300 mrem/hr on the overpack side(s). Additionally, none of these designs require a distance greater than 350 meters in order to meet the regulatory dose limits for design-basis contents of a single overpack.[3] Only a few systems have overpack dose rates that are even close to this value or that even require this distance, including very recent designs with contents having characteristics that result in high radiation source terms. Given the characteristics of the currently approved overpack designs, the characteristics of the contents for which they have been approved, and the staff's judgment as discussed in the following paragraphs, reviewers should exert a greater level of effort in reviews of storage overpack designs that have side surface dose rates that exceed 300 mrem/hr to determine reasonable assurance of compliance with the regulatory requirements for shielding and radiation protection.

For any particular licensee, the maximum overpack surface dose rates and hence the minimum distance to meet the annual dose limits in 10 CFR 72.104(a) may be less than that determined in the cask design SAR. This is due to factors such as the characteristics of the actual spent fuel contents to be loaded into the cask at the licensee's site. The staff's judgment is that an overpack that has side surface dose rates less than 300 mrem/hr based on the design-basis analysis represents a system design that the staff should be able to relatively easily find adequately incorporates ALARA principles. The staff also expects that such an overpack does not require, in the majority of cases, more than reasonable adjustments of the licensee's site or reliance upon assumptions or conditions regarding the licensee's site and its surroundings in order for a licensee to operate an ISFSI containing an array of that design in compliance with the regulatory dose limits. In other words, the staff may be able to relatively easily determine that the DSS's overpack design provides radiation shielding sufficient to meet the requirements of 10 CFR 72.104 (see 10 CFR 72.236(d)).

For overpack designs that have increasing surface dose rates, the adequacy of implementation of ALARA into the design is not as easily determined. Additionally, the design may increase the burden of regulatory compliance on the licensee. For example, the licensee may need to modify its site and use supplemental features for shielding, or it may need to rely more on assumptions and conditions regarding the site and its surroundings and the spent fuel contents to be loaded into dry storage. In other words, it is less clear that the overpack design provides radiation shielding sufficient to meet the requirements of 10 CFR 72.104 (see 10 CFR 72.236(d)).

As noted previously, there are occupational dose impacts from the storage overpacks. The overpack dose rates give an indication of the kinds of impacts to be expected from the use of a DSS. Licensees will need to modify their facility's radiation protection program (RPP) to

[3] There are some DSS designs that use a storage cask without an inner canister for confinement. Thus, the DSS has a storage cask and not an overpack. However, the term overpack applies to the DSS component used to store the spent fuel at the ISFSI pad and so applies to the storage cask for these DSSs.

address dry storage at the facility, including ensuring that occupational doses due to dry storage operations (whether from operations directly related to dry storage operations or from other personnel activities near the ISFSI but not necessarily associated with its operation) are ALARA. The staff expects that incorporation of the impacts of dry storage operations into the facility's RPP should not require significant modifications to that program when the dry storage operations use overpacks with dose rates less than 300 mrem/hr. It is not clear that the same is true for dry storage operations with overpacks that have higher surface dose rates. As already noted, ALARA should be part of the DSS design. These considerations contribute to the staff's judgment expressed above that greater review effort is necessary to determine the adequacy of ALARA implementation in overpack designs that have surface dose rates greater than 300 mrem/hr on the side surface(s).

3.3 Storage Overpack Licensing Conditions and Analyses

With respect to the amount and type of information that should be in the CoC and/or TS for the storage overpacks, the staff determined that a graded approach, similar to the guidance for TCs, is not needed at this time. This determination is based upon the regulations, particularly 10 CFR 72.104, the staff's expectations regarding licensees' implementation of dry storage, and the design and contents specifications for currently approved DSSs. The doses from an ISFSI must be such that the limits in 10 CFR 72.104(a) are met by any licensee using dry storage. While this regulation covers all operations associated with dry storage, due to the duration of storage operations versus loading and unloading operations, it is the storage operations that are most affected by these limits. Also, there are many factors for each licensee's site that influence a licensee's ultimate compliance with 10 CFR 72.104(a). There have been no DSS designs to date that include overpacks that have very high dose rates with respect to off-site dose analyses, including very recent designs intended to store contents that represent the high end of radiation source terms.

An objective of this ISG is to ensure that the overpack design remains within the condition bounds for which the staff finds reasonable assurance that the requirements of 10 CFR 72.236(d) are met, with some consideration for impacts to occupational exposures. The level of review required to reach that finding for a particular overpack design, however, may vary as previously noted. Therefore, considering the foregoing, the staff has determined that a graded approach to the licensing documentation for storage overpacks is not necessary at this time. However, reviewer judgment may dictate that in some cases additional CoC or TS conditions may be necessary.

4 Detailed Technical Review Guidance

Some DSSs have multiple TC designs and/or multiple overpack designs. The guidance in the following sections applies to the TC designs and the overpack designs for a DSS as specified in the notes for ISG Tables 1, 2, and 3.

4.1 Level of Review Effort

The SRP prioritization defines three priority levels (HIGH, MEDIUM and LOW) and categorizes the review procedures for each SRP chapter as one of these three priority levels. This ISG provides a method for adjusting the priority levels for the shielding and radiation protection review procedures that are in the SRP to appropriate levels for each DSS application. Differences in the priority levels will affect the overall level of review effort in the shielding and

radiation protection reviews. An application that needs an “Elevated” review effort means that each review procedure’s priority level is raised to the next higher level. For example, an “Elevated” review would change the priority level of SRP Section 11.5.3, “Exposures at or Beyond the Controlled Area Boundary” from MEDIUM (stated in the SRP) to HIGH. If the generic priority level in the SRP is already at the HIGH level, it remains HIGH. An application that needs a “Reduced” review effort means that each review procedure’s priority level is decreased to the next lower level. If the generic priority level in the SRP is already at the LOW level, it remains LOW. An application that needs a “Standard” review effort means that each review procedure’s priority level remains at the generic levels that are in the SRP. Thus, the priority levels are shifted in one direction or another, resulting in different levels of effort being expended in the shielding and radiation protection reviews as needed.

These levels of review effort are applicable when appropriate conditions (that are consistent with the applicant’s analysis results) are included in the TS and CoC to properly define the system design and establish necessary operational conditions (see Section 4.2). Regardless of the level of review, the reviewer should check to see that all shielding and radiation protection areas are addressed in the SAR. If errors or questionable methods are found during the review, the reviewer should conduct a more extensive review to resolve the discrepancies and gain sufficient assurance that additional deficiencies do not exist.

The reviewer’s judgment is still an important component of how the review is performed. For instance, the review procedure priorities may follow those of a “Reduced” review based on the TC and storage overpack dose rates, but the definition of the allowable contents and the supporting analyses may employ a new, complex, one-of-a-kind method that in the reviewer’s judgment warrants a more detailed review than a “Reduced” review. In another instance, an amendment may request changes to the TC design and minor changes to the allowable contents and the overpack that result in the TC surface dose rates exceeding 5 rem/hr, but the maximum side surface dose rate for the overpack remains less than 300 mrem/hr. This would result in an “Elevated” review. However, the reviewer may use his or her judgment and perform a less rigorous review of amendment aspects related only to the overpack.

Some applications may involve changes that only impact the TC or the overpack but not both. In such cases, the review would not include the unaffected part of the DSS. If an application contains changes that only affect the TC, the reviewer may simply use the first row of ISG Table 1 to determine the level of review effort. The reviewer will have to use judgment, considering the overpack dose rates relative to the dose rate used in ISG Table 1, to determine the level of review when performing a review of an application containing changes that only affect the overpack. Similar considerations would apply for those DSSs that have multiple TC designs or multiple overpack designs.

In determining the appropriate level of review, the reviewer should consider other factors such as those provided in Section 6.5.4.4 of NUREG-1536 and the potential for CoC holders and licensees to use the analysis methods presented in the SAR when making design changes pursuant to 10 CFR 72.48. The reviewer may need to consider whether or not a CoC or TS condition is necessary to limit this use of any of the SAR methods to ensure the methods are used within the conditions that the staff finds acceptable (see Condition 9 of reference [13] for an example)[4].

[4] See also page 2 of [12] and the definition of design given in 10 CFR 72.48(a)(4).

4.2 Licensing Documentation

4.2.1 Transfer Cask

The reviewer should verify that the CoC includes a description of the TC that provides a general understanding of the TC's design and shielding/radiation protection features. Detail should be sufficient to provide a clear understanding of and capture the major properties and performance of the TC design (as proposed in the application) while allowing the CoC holder to make minor modifications to the TC as needed and as permitted under 10 CFR 72.48 (e.g. to address licensee-specific needs and/or to maintain or improve TC performance). ISG Table 2 provides a summary of the information that should be included in the CoC and the associated TS and Radiation Protection Program (RPP) based on the dose rates at the TC surface. The dose rate cutoff values in the table are based on maximum calculated TC surface dose rates for normal operation conditions for the bounding fuel load for which the DSS is certified. The table also provides guidance on the content of the analyses in the Radiation Protection and Shielding Chapters of the SAR. The content is based on the TC surface dose rate level (TC level). As the surface dose rate gets progressively higher, the table calls for additional specifications in the CoC and TS (including the TS RPP) and additional information in the radiation protection and shielding analyses.

4.2.1.1 Certificate of Compliance

The basic features of the TC should be provided in the general description section of the CoC. This is the starting point for listing the key features of the TC that provide the safety performance of the TC. At a minimum, this description should include the weight and materials of construction and the geometric/physical arrangement of the shielding of the TC (similar to the example in NUREG-1745 [14]). In conjunction with a TS dose rate LCO or TS Design Features specification, this description provides adequate information to ensure that the safety function of the TC is being met. Additional information has not historically been required. However, for systems with a higher estimated surface dose rate, as described in ISG Table 2, progressively more detail, such as nominal shielding thicknesses, should be added. At the highest level, operations practices or conditions (such as use of supplemental shielding and remote operations) found to be necessary should also be described. These practices or conditions are those that are needed due to the TC design not allowing workers to operate within the vicinity of the TC safely without such practices, or are necessary to meet occupational radiation protection standards (i.e., not operational options intended for ALARA considerations alone). The term "remote operations," as used in this guidance, refers to any of these practices or conditions. In cases where supplemental shielding is used, it should be described in the CoC to the level of detail that is used to describe the shielding that is integral to the TC in the CoC. Additionally, for the higher dose rate TCs, particularly those in TC Level 3 of ISG Table 2, the CoC condition for pre-operational testing and training exercises should include dry run training exercises for performing the remote operations as well as operations that would be necessary during off-normal conditions (e.g., manual crane operations, crane repair) and other operation activities the reviewer deems necessary given the nature of the TC dose rates.

4.2.1.2 Technical Specifications - Limiting Conditions for Operation and Design Features

It is important to provide appropriate specifications to assure the TC fulfills its intended function. Therefore, applications for DSS CoCs, both new certificates and amendments, should include one or more appropriate mechanisms (or measures) to provide this assurance together with the

bases and justification as to how these mechanisms fill this role. The mechanisms will be incorporated in the TS, and their bases and justification should be captured in the operating controls (TS bases) chapter of the SAR. As described in ISG Table 2, these measures may be in one of two forms. One form is limits on the surface dose rates of a loaded TC as a Limiting Condition for Operation (LCO) in the TS and an appropriate dose rate-based TS Design Feature specification. Alternatively, the measures may be in the form of a specification of the materials and thicknesses of the gamma and neutron shielding components in the TS Design Features.

Dose rate limits and their associated measurements, as part of a TS LCO, provide an immediate and direct indication that a loaded TC fulfills several aspects of its intended function. These aspects include: guiding ALARA planning, providing confidence that public dose limits will not be exceeded, and detecting any unexpected problems with the cask fabrication and contents. Furthermore, including surface dose rates in the TS together with a TS Design Feature specification based on the maximum design-basis dose rates ensures the fundamental shielding characteristics of the approved design will be maintained without unduly restricting minor changes that may be made under 10 CFR 72.48. The option of specifying the TC shielding features in the Design Features of the TS provides a direct indication regarding most of these aspects; however, it relies upon an appropriate fabrication acceptance testing program and the assumption of the loaded contents meeting the contents specifications. ALARA planning and detection of unexpected problems with the contents would be left to the TS RPP.

When the TS includes surface dose rate limits to assure the TC's shielding function is achieved, the TS must include a provision for the licensee to take measurements, compare them against the limits, and take corrective action(s) if those limits are exceeded. Taking dose rate measurements at the TC surface typically can be done shortly after the TC is removed from the pool, and remotely if necessary. This allows for early confirmation of predicted dose rates on the TC and provides confidence in the predicted dose rates at distance since the limits are derived from the licensee's analyses for compliance with regulatory dose limits. The measurements also can confirm the licensee's 10 CFR Part 20 ALARA planning is appropriate and personnel protection is adequate.

To be effective, the TS LCO should require the licensee to perform measurements with the TC in the same configuration (e.g., flooded vs. dry, fuel load) as in the analysis that provides the basis for the LCO limit. The TC configuration should be specified in the TS LCO. Consideration should be given to any advantage or preference for using a particular TC configuration in the TS LCO (e.g., TC configuration prior to canister closure). Additionally, the quantity and location of measurements should be sufficient to provide reasonable assurance that the purposes of the measurements are met. The TS bases should provide justification of the proposed measurement scheme, including the number and locations of measurements and why certain features are not measured, if applicable. The TS LCO dose rate limits should include limits for the TC top and side surfaces. Each measurement should be compared against the appropriate limit; averaging of measurements is not considered an acceptable practice because it can result in a problem remaining undetected since averaging can mask higher measured dose rates in one area with lower measured dose rates in another area of the TC. The reviewer should note that while this ISG indicates the TC dose rate TS should be incorporated as an LCO, it may be located in the administrative programs section of the TS instead, as long as the same result is obtained (see Section 5.1.2 of NUREG-1745).

As indicated in ISG Table 2, the TS include a dose rate limit LCO and a dose rate-based TS Design Feature limiting the TC design to ensure the TC fundamental shielding characteristics

are maintained. This is done by specifying the design includes shielding to ensure design-basis dose rates do not exceed the appropriate limit(s) (see Table 2).

An alternative option is to specify the materials and thicknesses of the gamma and neutron shielding components in the TS Design Features in a manner that represents the limiting shielding effectiveness. This means that the specification will include tolerances on the component dimensions and the materials specifications. For example, the specifications of a borated polymer neutron shield would include items such as the minimum material density and the minimum hydrogen and boron content of the shield material. These specifications provide the control over the design necessary to ensure the TC retains its fundamental shielding characteristics. Compliance with these specifications would be ensured by appropriate acceptance tests at TC fabrication, which should be described in the acceptance testing and maintenance program chapter of the SAR. For some items, primarily the steel components, the inspections (material, dimensional, etc.) set in the respective codes is sufficient. For other items, such as lead shielding and (borated) polymer-based materials, other tests are needed. These tests may include scans over the entire accessible TC surface in the region(s) of these shielding features with an appropriately sized grid pattern (e.g., the staff has accepted 6 in x 6 in grid patterns) and a known gamma or neutron source, then comparing the measured dose rates versus the expected dose rates as determined by calculation or other appropriate means to demonstrate shield effectiveness. For polymer-based materials, the SAR may also need to include descriptions of tests for ensuring proper material composition. Though focused on transportation containers, NUREG/CR-3854 [17] provides useful guidance on acceptance testing.

When the surface dose rates are high (i.e., TC Level 3), both surface dose rate limits and shielding materials and thicknesses need to be specified per ISG Table 2. Additionally, for the highest TC level in the table, specific information on any supplemental shielding or remote operating equipment needed for safe operation of the system should be included in the TS Design Features. This information would include the minimum material and dimensional properties of the supplemental shielding and a description of the remote operating equipment, to include the controls used for ensuring that equipment's reliability and operability. The SAR should also include a detailed description and analysis of the remote operations.

The guidance for TS LCO dose rate limits and the TS Design Features design-basis dose rate-based specification provides flexibility for the TC design, particularly for TCs that are in TC Level 1. For these TCs, the licensee defines cask-specific (or loading campaign-specific) dose rate limits for the TC derived from its 10 CFR 72.212 analyses. Further, the dose rate limit values are not included in the TS. However, this flexibility is limited such that modifications that cause the TC to no longer remain in TC Level 1 would necessitate an amendment to ensure the licensing conditions appropriate to the TC's new dose rate level are put in place for that TC. This limitation is imposed by the TS Design Features specification that the TC shielding must be such that the design-basis dose rates do not exceed the dose rate limit of 2 rem/hr. The staff finds that such flexibility is acceptable and does not present an undue risk to the health and safety of members of the public or the occupational staff involved in the dry storage operations with the TC. For TCs with the higher dose rates of TC Level 2, this flexibility is more limited by having the TS Design Feature specification use the design-basis dose rates calculated in the SAR as the limits with these values specified in the TS. This guidance is based on the design-basis dose rates in the SAR being calculated so that they are reasonably bounding for the contents that may be stored in the DSS. If in the staff's judgment the contents are "representative" and hence not deemed reasonably bounding to the extent that it is likely that

dose rates for actual content loadings could exceed SAR design-basis values, the staff may modify the TS LCO so that dose rate limits are based on the 10 CFR 72.212 analysis but do not exceed the design-basis dose rates in the SAR.

The TS LCO should establish appropriate actions. The expected actions should include those stated in ISG Table 2, with appropriate corrective actions when limits are exceeded. These actions would include activities such as removal of misloaded contents or development of written justification for allowing misloaded contents to remain in the canister.[5] For example, an action may be to perform an analysis to show that 10 CFR 72.104 limits can still be met with the contents placed at the ISFSI. Additional appropriate actions include the development of a corrective action plan to prevent recurrence of misloads and completion of operations with supplemental shielding and subsequent repair of the TC prior to its next use. A corrective action similar to this last example would assume, or include, the stipulation that the licensee analysis shows the supplemental shielding will bring the dose rates to within the LCO limits. If this assumption or stipulation cannot be met, the TC would be unloaded and repair and maintenance would be performed prior to further TC use. Licensees should verify their analyses and limits are based upon the TC version they are using. The actions should address the potential causes for exceeding the limits.

4.2.1.3 TS Radiation Protection Program

The reviewer should verify that the RPP description in the TS contains a sufficient level of information and includes a specification of the confirmations, programs, and procedures that the site licensee must have in writing, update, and follow. While the details of the site licensee information are subject to inspection, the nature of the information should be specified in the RPP description in the TS. ISG Table 2 provides guidance on some specific elements of the RPP, especially those that may change as the TC dose rates increase.

At the lowest dose rate level (TC Level 1), the TS RPP should indicate that a licensee implementing the system at its site needs to update its Part 20 RPP to confirm that the use of the TC design (along with the rest of the system) is compatible with the site's ALARA requirements. Also, the site needs to have a program to prevent and detect misloads of spent fuel. The TS RPP should describe the needed elements of such a program. One aspect of this program could be the use of dose rate measurements to assist in detecting misloads or in confirming the success of the program prior to loading the canister into the storage overpack. The TS RPP should also indicate the kinds of corrective actions to be implemented in the event of a misload. These actions would include those considered for misloads for TS LCO Actions (e.g., removal of misloaded contents, analysis of whether or not 10 CFR 72.104 can still be met with the misloaded contents stored at the ISFSI) and modification of the TC operations as necessary per ALARA requirements.

At the second dose rate level (TC Level 2), in addition to the above, an element should be included in the RPP that directs the user to perform a site-specific dose assessment and have approved, written recovery procedures in place for loading and handling malfunctions. These procedures should address the effects of elevated TC dose rates on plant operations. Examples of operations that may be impacted by higher dose rate TC activities include operator actions required by the 10 CFR Part 50 or Part 52 (license) TSs, security guard actions, responses to alarms set off by the loaded TC, required plant technician activities, and

[5] Depending on the misload, an exemption may be required for this option.

administrative staff activities. The description of the user assessment in the TS RPP should indicate the scope of plant operations that should be considered for potential impacts due to use of a TC with these dose rates.

At the highest dose rate level in ISG Table 2 (TC Level 3), two more stipulations are added to the RPP. The first of these is that the licensee needs to confirm that the use of the high-dose-rate TC design will not result in any 10 CFR Part 20 or 10 CFR Part 72 dose limits being exceeded. The second is that the licensee must have in place approved written procedures to govern any remote operations.

4.2.1.4 SAR Shielding and Radiation Protection Information

The reviewer should verify that the radiation protection analyses are appropriate for the dose-rate levels expected. For the lowest level of TC dose rates, the worker dose assessment as currently described in the SRP is appropriate and sufficient. For the middle TC dose rate level, at least one shielding calculation should use the minimum shielding properties (i.e., minimum thicknesses and, for neutron shielding, the minimum material specifications, such as minimum density and minimum hydrogen and boron content) to determine the dose rates so that the potential effect of material tolerance is quantified. In addition, worker dose should be analyzed for potential off-normal events such as a crane hang-up. If a system has TC dose rates in the highest TC level in ISG Table 2, all of the foregoing analyses in this section should be included. In addition, there are two more areas that should be addressed for these high dose-rate designs. First, general recovery procedures and dose assessments should be provided for off-normal events. Second, any use of remote operations should be described and analyzed in the appropriate SAR chapters.

4.2.2 Storage Overpack

The reviewer should verify that the description of the storage overpack in the CoC provides a general understanding of the overpack's design and its shielding and radiation protection features. Detail should be sufficient to provide a clear understanding of and capture the major properties and performance of the overpack design (as proposed in the application) while allowing for minor modifications to the overpack by the CoC holder as needed (to address licensee-specific needs and/or maintain or improve overpack performance), as allowed by 10 CFR 72.48. ISG Table 3 provides a summary of the information that should be included in the CoC and the associated TS.

4.2.2.1 Certificate of Compliance Description

The description of the overpack in the CoC should include the types of materials that comprise the overpack. For example, the overpack is made of carbon steel and plain/un-reinforced concrete. Features important to shielding and radiation protection should also be included in the CoC. These features include penetrations like inlet and outlet vents/ducts or any unique or novel features that are either relied on for shielding or may present significant radiation streaming paths.

The CoC should include the overall configuration. For example, a standalone vertical cylinder may be a cylindrical steel and concrete vessel with its side walls such that the concrete is enclosed between the inner and outer steel shells or a steel reinforced concrete cylindrical

vessel. For a bunker-type storage system, the description may be a reinforced concrete unit with a spent fuel canister support structure that is a structural steel frame with rails.

The CoC description should also include the contents' orientation during storage (i.e., vertical or horizontal).

4.2.2.2 Technical Specification – Limiting Condition for Operation

The reviewer should ensure that limits on the dose rates around a loaded storage overpack are included in the TS. As with the TC, overpack dose rate limits and measurements provide a direct indication that the overpack fulfills its intended function (as described in Section 4.2.1.2). Typically, the TS should specify that the licensee must perform a 10 CFR 72.212 analysis to establish site-specific dose rate limits for the overpack. As an additional specification, there should be an overall limit on the overpack dose rates based on the design-basis analyses in the SAR. Not all of the licensee-set limits may need to be capped by a design-basis limit. For example, the TS may require the licensee to set limits for the inlet and outlet vents of the overpack but the TS may not set a design-basis maximum limit for the vents. A surveillance requirement for measurements and checks against the applicable limits should be included as well as actions to take when limits are exceeded.

There can be some flexibility as far as the locations and the number of measurements. However, the reviewer should ensure that the proposed measurement scheme for any overpack design has the following attributes:

- The locations are on features of the overpack surface that contribute significantly to public and/or occupational dose
- The locations are highly indicative of overpack shielding effectiveness
- The locations are on features of the overpack for which occupational and/or public dose may be sensitive to design changes or fabrication deviations
- Each measurement on an overpack feature is compared to the appropriate limit. Averaging of measurements is not typically considered an acceptable practice because it can result in a problem remaining undetected since averaging can mask higher measured dose rates in one area with lower measured dose rates in another area of the overpack. An application seeking to use averages of measured dose rates for dose rate limit compliance should justify the effectiveness of this method to detect problems and not mask a problem with either the shielding or the contents.
- A sufficient number of measurements are made for the same feature to provide reasonable assurance that the dose rates from the overpack feature have been characterized. For example, for a vertical cylinder overpack, measurements of the vertical surface should be made around the periphery at 90-degree intervals at the mid-plane and at an appropriate distance above and below the mid-plane for 12 measurements of the vertical surface. The overpack lid also should have multiple measurement locations.

The following is an example of a sequence of actions licensees should take if the measured dose rates exceed the applicable limits:

a. Verify the overpack/storage unit is correctly closed and the canister is properly positioned in the unit.
b. Verify the correct contents are loaded in the correct storage cell/basket locations.
c. Perform a written analysis to verify whether the as-loaded canister and overpack will result in 10 CFR 72.104 and/or 10 CFR Part 20 limits being exceeded.
d. Perform a written analysis within 30 days to determine why surface limits were exceeded.
e. If the analysis in c. shows 10 CFR 72.104 (and/or 10 CFR Part 20) limits will be exceeded, remove the overpack or its inner container (i.e., spent fuel canister) from storage or take other effective, timely measures (e.g., installation of temporary supplemental shielding) until appropriate permanent corrective action is completed to ensure dose limits are not exceeded.

As with the TC dose rate TS, the reviewer should note that while this ISG indicates the overpack dose rate TS should be incorporated as an LCO, it may be located in the administrative programs section of the TS, as long as the same result is obtained. For example, some currently approved cask systems have incorporated dose rate limits and LCO-like specifications in their TS Radiation Protection Program.

4.2.2.3 Technical Specification Radiation Protection Program

The reviewer should verify that the TS RPP specifies that each system user will ensure that its 10 CFR Part 20 RPP appropriately addresses DSS loading and unloading, as well as ISFSI operations, including transport of the loaded overpack outside of facilities governed by 10 CFR Part 50 or Part 52 (as applicable). As stated in Section 4.2.1.3, the 10 CFR Part 20 RPP is not reviewed as part of a 10 CFR Part 72 CoC or CoC amendment application and the details of the site licensee information are subject to inspection. However, the nature of the information to be included in the licensee's 10 CFR Part 20 RPP should to be specified in the RPP description in the TS. The TS should describe the elements that need to be included in the 10 CFR Part 20 RPP, with the level of detail warranted for each element (e.g., dose rate limits, measurement scheme, and corrective actions for a TS RPP that establishes dose rate limits instead of a TS LCO that sets dose rate limits). The RPP should include appropriate controls for direct radiation and contamination, ensuring compliance with applicable regulations, and implement actions to maintain occupational exposures ALARA. While the loading and unloading may be mostly operations with the TC, TS definitions of loading and unloading may also capture some operations that involve the overpack.

It is important to also consider the acceptance testing and maintenance programs for the shielding features. For example, some DSS CoC holders and licensees rely, at least in part, on the TS dose rate limits and measurements to demonstrate shielding effectiveness. Thus, the needed level of rigor of the TS LCO and/or RPP may be influenced by the degree to which the applicant proposes to rely on the TS dose rate limits and measurements to demonstrate that the as-fabricated overpack will perform as designed.

5 Guidance Implementation

The guidance should be applied to reviews of all 10 CFR Part 72 CoC and CoC amendment applications affecting shielding and radiation protection aspects of the DSS design and/or

operations. In the case of an application that affects the TC, but not the overpack, only the guidance regarding the TC should be applied. In the case of an application that affects the overpack but not the TC, only the guidance regarding the overpack should be applied.

The principles of this guidance should also be applied to reviews of all specific-license ISFSI license and license amendment applications that affect shielding and radiation protection aspects of the facility design and/or operations. Unlike CoC and CoC amendment applications, these applications include information regarding the facility and the site. Also, the RPP is part of the application review. Additionally, the facility may be more than just a storage pad; it may include other structures and systems for handling and storing spent fuel. The application may also include storage of reactor-related greater than Class C (GTCC) waste. Thus, the reviewer should consider this information in applying the guidance principles in this ISG to reviews of these license and license amendment applications. For example, the distance from the facility's structures and systems to the controlled area boundary is part of the application. This is also true of the total amount of spent fuel and reactor-related GTCC waste to be stored at the facility. These considerations may allow for, or necessitate use of, different licensing conditions, which may be less restrictive in some cases.

6 References

1. Letter from William Ruland (U.S. NRC) to Mr. R. T. Ridenoure (OPPD), "Exemption from 10 CFR 72.48, 10 CFR 72.212 and 72.214 for Dry Spent Fuel Storage Activities – Fort Calhoun (TAC No. L23984)," dated July 19, 2006. (ML062000153)
2. NRC Regulatory Issue Summary 2006-22, "Lessons Learned from Recent 10 CFR Part 72 Dry Cask Storage Campaign," U.S. NRC, November 15, 2006. (ML062930034)
3. SRM, COMGBJ-06-0005, "Use of Unshielded Transfer Casks in Spent Fuel Movement," U.S. NRC, August 31, 2006. (ML062220396)
4. Letter from D. Blair Spitzberg (U.S. NRC) to Mr. R. T. Ridenoure (OPPD), "Inspection Report 050-00285/06-013; 072-00054/06-002," dated July 19, 2006.(ML062000421)
5. Letter from Robert Lewis (U.S. NRC) to Ms. Tara Neider (Transnuclear, Inc.), "NRC Inspection Report No. 72-1004/2006-204 and Notice of Violation," dated November 9, 2006. (ML063130354)
6. Letter from Tara Neider (Transnuclear, Inc.) to U.S. NRC, "Application for Amendment 11 of the NUHOMS Certificate of Compliance No. 1004 for Spent Fuel Storage Casks, Revision 0," dated April 10, 2007. (ML071240088)
7. Memorandum from Christopher Regan (NRC) to William Ruland (NRC), "Summary of December 11, 2006, Meeting with Holtec International Regarding the HI-TRAC 100D-75 Light Weight Transfer Cask," dated December 14, 2006. (ML063520142)
8. Letter from J.E. Pollock (Entergy) to U.S. NRC, "Indian Point Nuclear Power Plant Units 2 and 3: Application for Unit 2 Operating License Condition Change and Units 2 and 3 Technical Specification Changes to Add Inter-Unit Spent Fuel Transfer Requirements," dated July 8, 2009. (ML091940177)
9. Memorandum from Pierre Saverot (NRC) to Nader Mamish (NRC), "Summary of November 21, 2008, Meeting with NEI and Industry on Shielding and Radiation Protection," dated November 26, 2008.(ML083330406)
10. Letter from Steven Kraft (NEI) to E. William Brach (U.S. NRC), "NRC/Industry Meeting of November 21, 2008," dated March 4, 2009. (ML090690784 & ML090690785)
11. Letter to Steven Kraft (NEI) from Raymond Lorson (U.S. NRC), "Response to NEI's Follow-up Comments on the NRC/Industry Meeting of November 21, 2008," dated July 2, 2009. (ML091880263)

12. U.S. NRC, NUREG-1536, Revision 1, “Standard Review Plan for Spent Fuel Dry Storage Systems at a General License Facility,” July 2010. Pg. 1-2 and 5-6 define the priority levels and acknowledge the potential need for adjusting the SRP prioritization depending upon the specific application’s characteristics.(ML101040620)
13. U.S. NRC, “Certificate of Compliance No. 1030 for NUHOMS HD System,” dated January, 10, 2007. (ML070160072).
14. U.S. NRC, NUREG-1745, “Standard Format and Content for Technical Specifications for 10 CFR Part 72 Cask Certificates of Compliance,” June 2001.(ML011940387)
15. Letter from J.E. Pollock (Entergy) to U.S. NRC, “Indian Point Nuclear Power Plant Units 2 and 3: Response to Request for Additional Information Regarding the Inter-Unit Spent Fuel Transfer License Amendment Request (TAC Nos. ME1671, ME1672, and L24299),” dated July 28, 2011. (ML11220A079)
16. U.S. NRC, NUREG-1567, “Standard Review Plan for Spent Fuel Dry Storage Facilities,” March 2000.(ML003686776)
17. L. E. Fischer and W. Lai, “Fabrication Criteria for Shipping Containers,” NUREG/CR-3854 (UCRL-53544), U.S. NRC, Lawrence Livermore National Laboratory, March 1985. (http://rampac.energy.gov/NRCinfo/NUREG_3854.pdf)

Division of Spent Fuel Storage and Transportation
Interim Staff Guidance – 26A
Appendix B
Description of NUREG-1536 Changes to Implement ISG Guidance

This appendix provides the changes to NUREG-1536 that are necessary in order to incorporate this ISG. Deletions are shown in bold and strikeout, and insertions/additions are shown in bold and italics where changes involve only minor portions of text.

Replace the 7th paragraph of Section 2.5.2.2 as shown:

For normal, off-normal, and accident-level conditions, reviewers should verify that the applicant has defined appropriate operating and accident scenarios. For these scenarios, the reviewer should verify the applicant includes in the SAR a comprehensive evaluation of the effects of such scenarios on the SSCs important to safety. ***Normal and off-normal conditions analyses of worker dose/occupational impacts should also be addressed to a level appropriate for the system dose rates (see Table 6-3).*** The analyses of such events are addressed in individual chapters of the SRP. For example, the analyses of an earthquake on the DSS structural components are addressed in SRP Chapter 3, "Structural Evaluation." The applicant's evaluations should demonstrate that the requirements of 10 CFR 72.104 and 72.106 as well as 10 CFR Part 20 have been met.

Replace the 1st paragraph of Section 6.3 as shown:

10 CFR Part 72 requires that spent fuel storage and handling systems be designed with adequate shielding to provide sufficient radiation protection under normal, off-normal, and accident-level conditions. The DSS application should describe the design principle and functional features of the shielding structures, systems, and components (SSCs) important to safety in sufficient detail to allow the U.S. Nuclear Regulatory Commission (NRC) staff to thoroughly evaluate their effectiveness. It is the responsibility of the vendor and the facility owner to analyze such SSCs with the objective of assessing the impact of direct radiation doses and effluent releases to the environment on public health and safety. The reviewers should verify the applicant's evaluations through review of the applicant's model, or confirmatory analyses or independent modeling analysis. ***The extent and depth of this verification should follow the guidance given in Section 6.5 on level of review effort.*** In addition, SSCs important to safety should be designed to withstand the effects of both credible accidents and severe natural phenomena without impairing their capability to perform their safety functions.

Replace the paragraph in Section 6.4.3 as shown:

The application should include information in the SAR relative to materials and arrangements of all SSCs important to safety. ***These materials and arrangements include equipment, such as supplemental shielding, needed for safe operation of the system.***

Replace the 1st paragraph of Section 6.4.3.1 as shown:

The SAR should describe the geometric arrangement of shielding and include illustrations that identify the spatial relationships among sources, shielding, and design dose rate locations. The SAR should clearly indicate the physical dimensions***, including tolerances,*** of sources and shielding materials. The SAR should also identify penetrations, voids, or irregular geometries that provide potential paths for gamma or neutron streaming. These potential streaming paths

should be clearly identifiable on submitted drawings. The SAR should describe design features used to minimize streaming through these penetrations.

Replace the paragraph in Section 6.4.3.2 as shown:

The shielding reviewer should consult with the materials reviewer to assure that the SAR adequately describes the composition and geometry of the shielding materials***, including material and dimensional tolerances.***

Replace the 2nd paragraph of Section 6.4.4.3 as shown:

The SAR should clearly indicate the physical locations on and around the casks ***and the cask conditions/configuration (e.g. flooded or dry cask)*** for which dose rate calculations have been performed. These locations should include points on or in the immediate vicinity of cask surfaces where workers will perform operations during loading, retrieval, handling, and any projected maintenance and surveillance. For storage casks with internal labyrinthine air flow passages, the SAR should include dose rate estimates for the air inlets and air outlets using a computer code appropriate for streaming calculations. The SAR should identify points that have the highest calculated dose rates.

Modify Section 6.5 as described:

A. **After the current paragraph, add the “Technical Review Guidance” text for “Review Prioritization (Level of Review)” in the ISG, with the following modifications:**
    a. **Add the following sentence to the beginning of the paragraph:** The reviewer’s overall level of effort for performing a review and evaluation of the Shielding and Radiation Protection Chapters of the SAR should be informed by the system properties, as described here.
    b. **Insert the following in the first sentence of the paragraph after “maximum TC surface dose rate”:** (excluding dose rates at streaming paths)
    c. **Change “Table 1” to “Table 6-2”.**
    d. **Delete the last two sentences of the paragraph.**
B. **Add Table 1 of the ISG and label it as Table 6-2.**
C. **Add the 2nd, 3rd, 4th, and 5th paragraphs of Section 4.1, “Level of Review Effort” of Appendix A to the ISG, with the following modifications:**
    a. **Change “(see Section 4.2)” to “(see Section 6.7)”.**
    b. **Change “ISG Table 1” to “Table 6-2” in the first paragraph.**
    c. **Delete “of NUREG-1536” and “(see Condition 9 of reference [13] for an example)[4]” and the accompanying footnote from the last paragraph.**

Modify Figure 6-1 as described:

A. **In Chapter 6 box, add a new column with the heading “Additional Considerations:” and the following bullet items: “Level of Review Effort”, “Transfer Cask” and “Storage Overpack”.**
B. **In Chapter 9 box, add a bullet item “General Recovery Procedures, If Needed”.**
C. **In Chapter 11 box, add a bullet item “Level of Review”.**
D. **In Chapter 13 box at the bottom of the figure, delete “Optional”.**

Replace the 2nd paragraph of Section 6.5.1.1 as shown:

The shielding reviewer should coordinate with the review of SRP Chapter 2, “Principal Design Criteria Evaluation,” as well as review any additional shielding-related criteria. The reviewer should also refer to SRP Chapter 9, “Operating Procedures Evaluation,” to consider any expected operating procedures that would require close proximity to the cask such as cask equipment that should be monitored or serviced frequently. However, the evaluated dose rates at the side of the same cask should be reviewed to ensure that the ALARA principles are either engineered into the design or evoked by specific operating procedures in Chapter 9, “Operating Procedures Evaluation” of the SAR. ***The reviewer should evaluate the adequacy of any expected operations procedures (e.g., remote operations) needed during normal conditions due to the system design not allowing workers to operate safely in the vicinity of the system component without them or the procedures are needed to meet occupational radiation protection standards. The adequacy of procedures to address off-normal events (e.g., crane hang-up) should also be evaluated.***

Add the following as a 2nd paragraph in Section 6.5.1.2:

The reviewer should coordinate with the SRP Chapter 8, “Materials Evaluation,” reviewer and the Chapter 13, “Technical Specifications and Operating Controls and Limits Evaluation,” reviewer(s) to ensure the appropriate system features, analyses and conditions of use are incorporated in the SAR, CoC, and TS (See Section 6.7).

Replace the 2nd paragraph of Section 6.5.4.3 as shown:

For normal and off-normal conditions, the applicant should indicate the dose rate at all locations accessible to occupational personnel during cask loading, transport to the ISFSI, and maintenance and surveillance operations***, keeping in mind the locations which may be needed for development and support of dose rate limits in the Technical Specifications (see Section 6.7)***. Generally, these locations include points at or near various cask components and in the immediate vicinity of the cask. Example of locations include vent areas, trunnion areas, peak side of the cask, peak top of the cask, the canister-gap region, and the bottom of the transfer cask. The applicant should also calculate the dose rates at a distance of 1m from these locations because they typically contribute to occupational exposures.

Replace the 9th paragraph in Section 6.5.4.3 as shown:

The reviewer should review ***Section 6.7 and*** the technical specifications of Chapter 13 of this SRP to ensure appropriate requirements are addressed in the technical specifications of the cask. In addition, the degree to which the normal condition dose rates could change for the identified off-normal conditions should be verified. The need for additional calculations should be indicated in the Safety Evaluation Report (SER) and in the conditions set forth in the CoC.

Replace the 1st paragraph in Section 6.5.4.4 as shown:

The reviewer should independently evaluate the dose rates in the vicinity of the cask for normal, off-normal, and accident-level conditions. In determining **~~the level of effort appropriate for these calculations~~** ***the appropriate level of effort***, the reviewer should consider ***the discussion in Section 6.5 and*** the following factors:

- the degree of sophistication in the SAR analysis***/analyses***;

- a comparison of SAR dose rates with those of similar casks that have previously been reviewed, if applicable;

- the typical variation in dose rates expected between different computer codes and cross-section sets;

- the fact that actual dose rates will be monitored and doses limited by the requirements of 10 CFR Part 20;

- the ***conditions and*** restrictions to be placed on the ***DSS design and operations (see the guidance in Section 6.7), such as dose rate limits,*** ~~**on the DSS operations or the limits to be placed on dose rates,**~~ as documented in the CoC and/or technical specifications;

- the guidance provided in Section 6.7 regarding the content of the CoC, TS, and SAR;

- the applicant's experience in using the methods and computer codes in previous submittals;

- the use of new, or previously reviewed, computational methods or computer codes ***or analysis methods***; and,

- the inclusion in the design of any significant departures from previous cask system designs (e.g., unusual shield geometry, new types of materials, ~~or~~ different source terms***, or methods for defining allowable contents***).

Replace the 3rd paragraph in Section 6.5.4.4 as shown:

If a more detailed review is required (e.g., a new and not previously reviewed shielding computer code), the reviewer should independently confirm the dose rates to ensure that the SAR results are reasonable and conservative. As previously noted, the use of a simple computer code for neutron calculations often does not provide results with sufficient accuracy and confidence. An extensive and more detailed evaluation may be necessary if large uncertainties are suspected ***or new, or previously unreviewed, computational methods or computer codes are used***. To the degree possible, the use of a different shielding computer code with a different analytical technique and cross-section set from that used in the SAR analysis will usually provide a more independent evaluation.

Add a new Section 6.7 as described with the title shown here:

6.7 Supplement: Guidance for Inclusion of Information in the Certificate of Compliance, Technical Specifications, and Safety Analysis Report

A. Add the following text after the title:

This supplement includes additional guidance to assure that appropriate provisions are included in the approval documents for dry storage systems based upon the characteristics of the dry storage system design, as informed by recent activities under 10 CFR Part 72. These

provisions include conditions to be placed in the CoC and TS and analyses to be included in the SAR.

B. Add Subsection 6.7.1, "Introduction." The subsection text is the 2nd paragraph of the ISG "Discussion" Section with the text "this ISG" replaced with "this supplement".

C. Add Subsection 6.7.2, "Guidance." Following the heading, include the following paragraph:

It is recognized that not all storage systems use a transfer cask. For those systems, the storage overpack may perform the function of the transfer cask in addition to its storage function. Thus, the guidance related to transfer casks will apply to all devices while they are used to perform the function of a transfer cask (i.e., loading of spent fuel from the spent fuel pool and preparation of that fuel for dry storage, including canister/cask draining and drying, cask/canister sealing operations, and leak testing operations), including the storage overpack. For systems that do not use a storage overpack (e.g., the design does not have an inner canister for confinement of the spent fuel but uses a storage cask), the guidance related to overpacks will apply to devices used to store the spent fuel at the ISFSI pad.

D. Add the subsections from ISG, Appendix A, Section 4.2, "Licensing Documentation" as part of the new Subsection 6.7.2, "Guidance" for the SRP. The text subsection headings are numbered appropriately (e.g., 6.7.2.1 Transfer Cask). ISG Tables 2 and 3 are also included at appropriate locations within this subsection of the supplement and renumbered as Table 6-3 and Table 6-4, respectively. All references to ISG Tables 2 and 3 in the text should be changed to refer to Tables 6-3 and 6-4. References to ISG guidance and the SRP guidance should be appropriately modified to reflect that this text is part of the SRP (e.g., "the ISG guidance" may be changed to something like "this guidance" or "this supplement").

Replace the paragraph in Section 11.5 as shown:

The interrelationship of the radiation protection review with the other disciplines is shown in Figure 11-1. ***The reviewer should also refer to Section 6.5 for guidance on determining the level of review and Section 6.7 for supplemental guidance related to the SAR analyses and the CoC and TS conditions that the applicant should address and the reviewer should evaluate as part of the radiation protection review described in this chapter.***

Modify Figure 11-1 as described:

A. In Chapter 6 box, add a bullet item "Level of Review"

B. Add a new box to the lowest row of boxes in the figure, with an arrow pointing from the Chapter 11 box to the new box. The heading of the new box is "Chapter 13 – Technical Specifications and Operating Controls and Limits Evaluation". The box has the following items as bullets: "Dose Rate Limits", "Design Features" and "Radiation Protection Program Content".

Replace the paragraph in Section 13.4 as shown:

The reviewer should verify that the applicant identifies proposed technical specifications necessary to maintain subcriticality, confinement, shielding, heat removal, and structural integrity under normal, off-normal, and accident-level conditions***, keeping in mind additional***

guidance for TS content provided in specific discipline chapters (e.g., Section 6.7). In addition, the reviewer should ensure that the applicant identifies the basis for each of the proposed technical specifications by reference to the analysis in the SAR. The NRC staff can use NUREG-1745, "Standard Format and Content for Technical Specifications for 10 CFR Part 72 Cask Certificates of Compliance," as an appropriate template in the review of the technical specifications. However, the staff may impose alternative technical specifications to NUREG-1745 guidance, based on operational experience, and the Office of General Counsel legal interpretations that have been made since issuance of NUREG-1745.