Commenter	Comment number	Comment Location	Comment	Response	ISG adjustment
DOE	**1**		Technical Review Guidance section identifies "general requirements that should be included for a demonstration program for storage of HBF beyond 20 years to be applicable to support a license or certificate application." This could be interpreted as being inconsistent with the NRC position that the ISG docs not impose regulatory requirements and may constrain applicants from developing alternative approaches. Therefore we recommend editing the ISO to clarify that elements contained in the Technical Review Guidance section provide an applicant with one approach to demonstrate compliance with the applicable sections of I 0 CPR 72, but do not preclude an applicant from developing alternative approaches.	The last 2 sentences of the issue state: “This is not a regulatory requirement. Alternative approaches may be used to demonstrate safety and compliance as appropriately justified by the applicant”	No change

NEI	**L1**		The currently proposed ISG-24 does not provide guidance to NRC staff on how to use information obtained, or planned to be obtained, through a demonstration program in the NRC's review of dry storage license renewal applications, but rather states specific technical requirements that would apply to the conduct of the HBF demonstration program itself. An ISG is not an appropriate vehicle for establishing new regulatory requirements.	The NRC staff will not use the information from the demonstration. The applicant will use the information to support his analysis of the current and expected condition of the fuel. This ISG is to provide guidance to the NRC staff on the characteristics of a demonstration that should be present for the demonstration to be a valid provider of data that the applicant can use.	No change
	L1a		The requirements stated in the ISG are often overly prescriptive and would be problematic to implement.	NRC staff agrees however these are not requirements	Changes have been made to broaden the conditions a demonstration must meet to provide valid information for an applicant's use.
	L1b		The current proposal is both premature. We recommend that the NRC temporarily withdraw this proposed ISG until after staff has had the opportunity to comment on the draft HBF demonstration program test plan.	NRC staff does not agree- This ISG is not directed to the current DOE demonstration but rather to any demonstration that the industry or applicants choose to run.	No change.
	1	**Discussion Paragraph 3 p. 1**	The phrase "2) HBF could exhibit a ductile-to-brittle transition temperature (DBTI) due to the presence of radial hydrides" is awkward. A better way of stating the issue would be "the radial hydrides could raise the cladding ductile-to-brittle transition temperature (DBTT) enough to compromise the ability of the cladding to withstand stress without undergoing brittle failure."	NRC staff agrees	The statement in the ISG will be changed to the commenter's suggestion

	2	**Discussion Paragraph 3 p.1**	• The statement "Research performed in Japan and the United States indicated that: 1) hvdrides could reorient at a significantly lower stress than previously believed" is not well supported by Reference 4. In Reference 4, hydride reorientation and ring compression test (RCT) for high burn-up PWR Zry-4 (67 GWd/MTU) and Zirlo (70 GWd/MTU) were conducted at 140 and 110 MPa of hoop stress that is higher than the hoop stress of 90 MPa as specified in ISG-11 (see Table 5 in Reference 4 as attached in the first attachment). • In addition, at least within the knowledge of industry experts, RCT testing by Japanese researchers was conducted at room temperature, resulting more radial-hydride formation than that formed at relatively high temperature such as 150°C (see slide 13 of the Kamimura presentation attached as the second attachment). • High burn-up PWR Zyr-4 and Zirlo fuel cladding showed more brittle behavior when tested at room or low temperature for RCT as shown in Reference 4, Table 5. • However, actual cladding temperature of HBF will be higher than the room temperature during at least the initial 20 years and longer storage period. • The application of Japanese data (i.e., relatively low temperature and hoop stress for re-orientation and ductile- brittle transition) could be too conservative to apply for the actual scenario of expected storage conditions.	**Bullet #1** - Ref #4 by its placement wasn't intended to support the statement regarding the stress. No references were attached to the comments but NRC is familiar with both references **Bullet #2** – Radial hydrides do not form during the ring compression test (RCT). Kamimura did his RCT at room temperature but the hydride reorientation process was done as high as 400 C . Kamimura found increase reorientation with increased temperature and increased stress. Reorientation occurred as low as 16 MPa in HB Zircaloy-2. He found no reorientation below 100 MPa in HBF Zircaloy-4. Daum found a stress threshold of 75±12 MPa for HBF Zircaloy-4. The threshold is material dependent, which is not reflected in ISG-11 Rev 3. The point being made was that hydrides can reorient below the stress threshold in ISG-11 Rev-3. **Bullet #3** - NRC staff agrees that the cladding is less brittle at higher temperatures **Bullet #4** - NRC staff does not agree that fuel temperatures in parts of the cask may not reach near room temperature in the long term. The questions are how long will it take and will the rod parts that saw the higher temperature required for reorientation also see the lower temperatures. **Bullet #5** – NRC staff agrees, but the point of this paragraph is that the guidance in ISG-11 Rev 3 does not prevent hydride reorientation from occurring, and that to prevent hydride reorientation the allowable stress might have to be much lower than 90 MPa.	Japanese and US references supporting a lower stress will be added. K Kamimura, "Integrity Criteria of Spent Fuel for Dry Storage in Japan" Proc. International Seminar on Interim Storage of Spent Fuel, ISSF 2010, Tokyo Nov 2010, page VI3-1 RS Daum, S Majumbdar, Y Liu, and MC Billone, "Radial-hydride Embrittlement of High-burnup Zircaloy-4 Cladding", J Nucl. Sci. Tech, Vol 43, No 9 , p.1054, 2006

	3	**Discussion Paragraph 4 p.2**	The first sentence is awkward and difficult to follow. Suggested replacement: There is reasonable assurance that low burn-up fuel can be stored safely and then retrieved over time periods well in excess of 20 years. There is no evidence to suggest that HBF cannot similarly be stored safely and then retrieved for time periods beyond 20 years, but the supporting data is not as extensive as for low burn-up fuel. Therefore, confirmatory data or a commitment to obtain data on HBF ... .,	The 1st suggested sentence change is irrelevant to this ISG since this ISG only deals with HBF	The last phrase of the sentence in question has been removed because it is extraneous and confusing
	4	**Discussion Para 6 p.2**	The second item ("The condition of the fuel after 20 years of storage") is unclear and inconsistent with the other items. Item 2 should be restated "The condition of the fuel after 20 years of storage does not degrade."	NRC staff agrees	This condition will be changed to the suggested wording

	5	**TRG Paragraph 2, Item 1 p.3**	The guidance essentially sets a burn-up limit of no more than 4 GWD/MTU above the burn-up of fuel in the demonstration program with the same cladding type to define the applicability of the demonstration program. This is problematic for several reasons. • There is no stated basis for 4 GWD/MTU. • The point of the high burn-up demonstration program is verify there are no deleterious phenomena at work in dry storage, not to establish a specific burn-up limit based on one test program. • While there are a variety of cladding types and variations, all cladding currently in use is made from zirconium based alloys. Rather than setting strict and arbitrary limits, licensees should have the flexibility to demonstrate from available data, including high burn-up demonstration programs, separate effects tests and analyses, that there is reasonable assurance of fuel integrity. • A prototypical high burn-up fuel dry storage demonstration program is an expensive, long-lead time endeavor and there is no technical justification provided for the requirement inherent in Item 1.	NRC staff agrees	The reviewer should assure that the maximum burn-up of the fuel in the application is ≤ the burn-up of the fuel in the demonstration. If the burn-up is higher than that in the demonstration the applicant should provide evidence, based on characteristics of the fuel derived from reactor – use qualification testing or other separate effects tests (SET) that the added burn-up will not change the results determined by the demonstration. Similarly if there is a different cladding type the reviewer should determine if arguments based on comparison of composition and fabrication technique (SRA, RX) justify the use of the demonstration results.

	6	**TRG Paragraph 2, Item 2 p.3**	The requirement that fuel peak cladding temperatures (PCTs) of the high burn-up demonstration program bound the PCTs requested in the license application is problematic for a number of reasons. • The intent of the demonstration program is to provide representative data of typical conditions in one storage system, not to "bound" phenomena for all storage systems. • It is neither feasible nor necessary to run numerous high burn-up demonstration programs in order to bound all scenarios for all cladding types for all storage systems. • It is not clear that higher temperature is bounding for all phenomena. Nor is it even clear whether the NRC's use of the term bounding is meant to be applied to the high or low temperatures. • The ISG creates uncertainty with regard to how the program's results are to be characterized. The demonstration program must meet NRC regulatory limits. How can it meet those limits (with margin and allowance for uncertainty) and at the same time set limits?	**Bullet #1** - the system only serves as a vessel to hold the fuel. The fuel behavior will be set by the temperature and the atmosphere not the system that is holding the fuel. This is the argument that the results of the demonstration can be used for any system. **Bullet #2** – The NRC staff disagrees that multiple demonstrations can't be run. For example cleaver utilities may run demonstrations via monitoring a loaded cask. **Bullet #3** – Item 2 is about peak cladding temperature (PCT) ergo the upper bound **Bullet #4** – There are two ways that the applicants can use the data from the demonstration: a) use the data to show that the models used to determine performance have confirmed predictive capabilities and use those models for their own system, or b) use the performance of the rods in the demonstration directly to infer the behavior of the rods in their application. In the former case the need for bounding PCT is not necessary, in the later case it would be since the peak temperature affects the rod behavior.	This item will be modified to state that if the applicant uses direct observations of the rod behavior to imply the condition of the rods in his system then the temperatures in the demonstration must bound the temperatures in the application. If the applicant uses predictive tools that have been confirmed by the demonstration then the temperatures of the rods in the application do not have to be bound by the temperature of the rods in the demonstration.

	7	**TRG Paragraph 2, Item 2 p.3**	The requirement that thermal models used in licensing must benchmark the data from the high burn-up demonstration program is inappropriate. It is appropriate for the NRC to require that thermal models be appropriately justified for their application. It is likely that models used in licensing will be benchmarked against the high burn-up demonstration program data. However, it is inappropriate for the NRC to require validation to the demonstration program in all cases. Other sources may be (and have been) used to provide a perfectly adequate validation	As the commenter is well aware the temperature models currently used are conservative on the high side to their predictions may have no relationship to the actual temperatures of the rods. Transferring data from the demonstration to an actual application requires, since most of the degradation phenomena are temperature driven, that the relative temperatures in the demonstration and the application be known.	The item will be reworded to state that the temperature models used in the application should be benchmarked against the demonstration temperature data, or against actual measured rod temperature data in the same temperature range.

	8	**TRG Paragraph 2, Item 3 p.3**	The requirement that the interior of a helium-filled demonstration canister be monitored continuously for moisture, hydrogen oxygen, fission gas and fuel cladding axial temperature distribution is inappropriate. • Continuous monitoring is challenging from a technical perspective. Would this apply during transport from the pool to the pad? From the pad to an examination facility? • Continuous monitoring while on a storage pad provides a potential pathway for release of radioactivity to the environment. • Continuous monitoring is unnecessary. The storage system can be monitored for a period of time after loading and before being placed out on the pad-the time of greatest potential for damage-and monitored again at the end of the storage period.	NRC staff agrees with respect to gas monitoring but not temperature. Gas monitoring is not expected during movement of the canister. Due to the short duration temperature monitoring during transportation is not suggested as long as thermal equilibrium is reached. The duration and frequency of the gas monitoring should be determined by analysis. Gases should always be sampled prior to opening of the canister. If the applicant claims that no galvanic degradation is feasible then, if after drying, moisture is detected in the canister, moisture and H_2 should be monitored at a reasonable frequency to be determined by the applicant until the moisture disappears.	Changes will be made in item 3 to reflect the position described in the NRC staff response.
			As a side comment, current plans are to carry out a high burn-up demonstration program with a TN-32 bare fuel cask, not a canister-based system. The ISG incorrectly specifies a canister.	NRC staff agrees with the side comment.	Since this ISG does not apply only to the DOE demonstration but any demonstration that any applicant or organization chooses to run the item has been changed to read “canister or cask”

	9	**TRG Paragraph 2, Item 4 p.3**	This requirement requires examination of the fuel" at periodic intervals," implying multiple openings and fuel examinations. No basis is provided for needing multiple openings, and such a requirement is inconsistent with the program conducted at Idaho with lower burn-up fuel (only one of the six casks was opened, and only once). If multiple openings are a true requirement, the basis should be provided. That will assist in determining (i) the proper number of examinations and (ii) intervals between examinations that will satisfy the NRC	NRC staff agrees	The ISG will be modified to state that some fuel should be examined anytime the system is opened and fuel is accessible.
	10	**TRG Para 2, Item 6 p.3**	No basis is provided for the minimum duration of 10 years. Also, is it permissible to open the cask one or more times during the 10 year period, as may be required under Item 4? Flexibility should be preserved here.	The initial license period is 20 years and renewal periods are up to 40 years. A demonstration is to provide that there was satisfactory performance during the first 20 years and that the results could be extrapolated with a TLAA to support an additional 40 years. The staff agreed that anything ≤ 10 years storage duration was too short to support these goals	The ISG will clarify the basis for 10 years minimum and add a sentence allowing opening of the canister during the 10 year period if necessary

	11	**TRG Paragraph 2, Item 6 p.3**	The last sentence in Item 6 is confusing and should be clarified. The current wording is: The evaluation of the data from the monitoring and examination of individual rods shall be available prior to the end of the currently approved storage period. What is the intended meaning and application of "currently approved storage period?" For a high burn-up demonstration program with storage duration of at least 10 years, this requirement may not be possible to meet in all cases.	NRC staff agrees that it is confusing	The ISG will be modified to state that as a minimum the monitoring data from the demonstration must be available before the end of the current licensing period. If available, data from the examination of the rods should be cited in the applicant's analysis of the condition of the fuel.
	12	**TRG Last Para p.4**	This paragraph adds new requirements on aging management plans. It is not appropriate to levy such new requirements in an ISG.	An ISG is guidance not regulatory requirements	No change.