# RESPONSE TO STAKEHOLDER COMMENTS

The purpose of this attachment is to list all the public comments received on Interim Staff Guidance (ISG)-2, Revision 2, "Fuel Retrievability in Spent Fuel Storage Applications." The NRC issued this document (ML15239A683) in 80FR63843 for public comment on October 21, 2015, for a 30 day period and received comments from the following sources:

- Kristopher Cummings (Nuclear Energy Institute (NEI)), dated November 16, 2015 (ML15337A082),
- Diane D'Arrigo (Nuclear Information and Resource Service (NIRS)), dated November 20, 2015 (ML15337A011),
- Patricia Borchmann, dated November 20, 2015 (ML15337A010),
- Donna Gilmore (San Onofre Safety), dated November 20, 2015 (ML15337A007),
- Robert Einziger, dated November 13, 2015 (ML15324A253),
- Marv Lewis, dated November 21, 2015 (ML15337A009) and November 26, 2015 (ML15337A012),
- Yankee Atomic Electric Company, dated November 17, 2015 (ML15337A083),
- Connecticut Yankee Atomic Power Company, dated November 17, 2015 (ML15337A083),
- Maine Yankee Atomic Power Company, dated November 17, 2015 (ML15337A083),
- Richard Morgal, dated November 20, 2015 (ML15337A084 and ML15337A008).

The staff's resolution and any associated changes to the ISG are listed for each comment.

**Comment 1. Kristopher Cummings (NEI)**: Conforming changes should be identified and implemented in other NRC documents that currently rely on the fuel-based definition of retrievability such as, but not limited to Inspection Procedures IP-60854 and IP-60855. The NRC should reevaluate ISG-1, Revision 2 "Classifying the Condition of Spent Fuel for Interim Storage and Transportation Based on Function" in light of ready retrieval being defined on a canister/cask basis.

*Response:* The staff agrees with this comment. As stated in the draft ISG-2, Rev. 2, "the staff recommends the definitions for ready retrieval be incorporated into NUREG-1536, NUREG-1567, and NUREG-1927." Because ISGs are intended to be interim, as the NUREGs are updated the information in other ISGs will also be incorporated into the NUREGs. Subsequently, Inspection Procedures that are impacted by these revisions will be re-evaluated. No changes have been made to the draft ISG as a result of this comment.

**Comment 2. Kristopher Cummings (NEI)**: How would this change be implemented in loaded spent fuel storage casks? Would certificate of compliance (CoC) holders need to request an amendment to the CoC, and general licensees need to then process the paperwork to certify that existing canister/casks meet the new Amendment requirements? Please clarify how the revised definition of ready retrieval could be implemented for the over 2,200 loaded dry storage systems.

*Response:* The staff agrees that the revised ISG should clarify how the revised definition of retrievability may be implemented and has added clarifying text on the requirements for CoC holders. Clarifying language was added to the ISG on page 3 (ML16019A128).

To provide additional clarification in response to the comment, the staff notes that, although not required to meet 72.122(l) retrievability requirements, CoC holders could incorporate this revised ISG in applications for new systems, or in applications for amendments to systems. If such an amendment were approved by the NRC, consistent with Part 72 regulations, GLs could apply the changes authorized by an amended CoC to a cask loaded under the initial CoC or an earlier amended CoC, if the necessary requirements are met. Additionally, a CoC holder could request a revision to an initial CoC or amended CoC and, if approved, the revision would supersede the initial or amended CoC being revised. If such a revision were approved, GLs would be required to perform the necessary steps to update to the revised CoC. Because revisions supersede the existing CoC and require action on the part of GLs that possess the impacted systems, NRC review of revision applications are subject to a backfit review.

**Comment 3. Kristopher Cummings (NEI)**: Clarify what is meant by "operational safety problems" in the new definition of ready retrieval. 10 CFR 72.122(h) includes the use of similar language with regard to degradation of the enclosed fuel assemblies, but it is unclear how this applies to a dry storage cask/canister that is in compliance with its Technical Specification.

*Response:* The staff disagrees that additional clarification regarding "operational safety problems" is needed in the revised ISG. As stated in NUREG-1567, the term "operational safety problems" is based on operational radiation exposure and preventing release of radioactive materials to the environment in excess of 10 CFR Part 20 limits, maintaining ALARA, and the criticality safety requirements. The use of this term is consistent with the language in 10 CFR 72.122(h)(1) and 72.122(h)(5). No changes have been made to the draft ISG as a result of this comment.

However, in discussions with the Advisory Committee on Reactor Safeguards Subcommittee on Metallurgy and Reactor Fuels during the public meeting on March 23, 2016, the staff determined this phrase, "operational safety problems," is unnecessary. The staff has deleted this phrase.

**Comment 4. Kristopher Cummings (NEI)**: The last sentence in this paragraph discusses inclusion of Technical Specifications (TSs) for structures, systems and components (SSCs) relied upon for ready retrieval. The current paradigm of ready retrieval on a fuel assembly basis already requires maintenance of SSCs associated with the canister/cask. Adding additional TS requirements for ready retrieval is not consistent with PRM 72-7, which requests TS requirements to be focused on safety criteria. We recommend deleting this sentence.

*Response:* The staff disagrees with the recommendation to delete the sentence regarding TSs for SSCs relied upon for ready retrieval. This sentence is not intended to suggest that additional technical specifications would be necessary. The guidance is only intended to relay to reviewers that the review they currently perform on TS should assure that the technical specifications proposed to maintain retrievability are sufficient. Therefore, no changes have been made to the ISG as a result of this comment.

**Comment 5. Kristopher Cummings (NEI)**: This paragraph uses terminology that is not consistent with ISG-1, Revision 2, "Classifying the Condition of Spent Nuclear Fuel for Interim Storage and Transportation Based on Function", such as "structurally-unsound." We recommend revising this paragraph to be consistent with ISG-1, Revision 2 to avoid confusion.

*Response:* The staff agrees with this comment. The ISG has been edited to be consistent with ISG-1, Rev. 2. The changes were made to the ISG on page 2 (ML16019A128).

**Comment 6. Kristopher Cummings (NEI)**: These paragraphs only refer to the independent spent fuel storage installation (ISFSI) licensee or applicant. While it is understood that the ISFSI licensee will be responsible for demonstrating the ability to achieve ready retrievability from an operational perspective, it would be useful to also recognize the role of the Certificate of Compliance (CoC) holder to describe in a CoC application or license amendment request how ready retrieval can be achieved based on the new definition. This would make the ISG consistent with the approach CoC holders have taken to address the current fuel-assembly-based retrievability definition in approved CoCs.

*Response:* The staff agrees that this revised ISG was written to assure compliance with 10 CFR 72.122(l), which does not apply to CoC holders. This revised ISG does not limit the ability of CoC holders to continue to provide information on retrievability in their safety analysis report and application. As to the process used by various entities to achieve this change in definition, see the response to Comment 2 and the clarified language in the ISG. No additional changes have been made to the ISG as a result of this comment.

**Comment 7. Kristopher Cummings (NEI)**: The last sentence in the 6th paragraph states that one possible approach for demonstrating ready retrieval is to "implement a program designed to identify, monitor and mitigate possible degradation…" It should be clarified that this program would only be after the initial period of operation (i.e., the initial license term). The current design and licensing basis of dry storage systems is that there are no degradation mechanisms that would lead to a loss of intended function in the first license period. The NRC should evaluate this requirement as a backfit to the existing loaded canisters that already require retrievability of the canister/cask under the current definition.

At a minimum it should be clarified what this program entails and how it differs from the aging management programs associated with license renewal to avoid confusion amongst licensees, certificate of compliance holders and dry storage system users.

*Response:* The staff agrees that the ISG merits clarification.

In the initial period of operation, an applicant needs to demonstrate that the structures, systems, and components (SSCs) for ready retrieval/retrievability are maintained and reflected in the Technical Specifications in the same way an applicant must do so for all technical specifications. The program referenced in the revised ISG is not an early aging management program, but is offered as one way an applicant may choose to demonstrate that the SSCs for ready retrieval/retrievability are maintained.

The ISG provides interim guidance to the staff on additional options by which an applicant may choose to demonstrate retrievability. The options outlined in the revised ISG and available to applicants are voluntary for applicants. Moreover, applicants are not protected under the backfitting provisions in 10 CFR Parts 50 or 72, or the issue finality provisions of Part 52 (80FR63843).

Clarifying edits have been made to the revised ISG in response to this comment. The changes were made to the ISG on page 3 (ML16019A128).

**Comment 8. Kristopher Cummings (NEI)**: Since NUREG-1927, Revision 1 is currently in draft form, the update to the definition of ready retrievability should be incorporated into the final version of NUREG-1927, Revision 1.

*Response:* The staff disagrees that the update to NUREG-1927 should incorporate this definition of ready retrieval. Due to timing, it is not feasible to integrate this ISG into NUREG-1927, Revision 1. It will be integrated into future revisions to Standard Review Plans which would include NUREG-1927. No changes have been made to the ISG as a result of this comment.

**Comment 9. Diane D'Arrigo (NIRS)**: NIRS supports retaining the requirement for retrievability in irradiated fuel storage systems.

*Response:* The staff agrees with this comment. This revision of ISG-2 retains the requirement for retrievability. No changes have been made to the ISG as a result of this comment.

**Comment 10. Diane D'Arrigo (NIRS)**: NIRS endorse the comments of San Onofre Safety submitted by Donna Gilmore sanonofresafetry.org.

*Response*: Staff's responses to comments received from San Onofre Safety are identified elsewhere in this document.

**Comment 11. Patricia Borchmann**: Based on NRC docs contained in Docket NRC 2015-0241, and "Draft ISG-2, Revision 2 on Fuel Retrievability", it appears far more technical work, actual testing and operational experience is necessary to justify the scope, and scale of changes proposed by NRC staff, to reduce, modify or eliminate current regulations. Stakeholders do not wish to reduce safety margins contained in current regulations, which require spent fuel storage casks be 'readily retrievable', and having capability to be transported offsite for further processing, or disposal.

*Response:* The staff disagrees with the comment. This ISG revision does not remove the regulatory requirements for retrievability, but rather the ISG provides options for complying with the retrievability requirement. Any option chosen by the licensee must comply with both the design basis of the system and with applicable NRC regulations. Therefore, ISG-2, Rev. 2 continues to assure that current safety margins for a system are maintained. There is no change to this ISG revision as a result of this comment.

**Comment 12. Patricia Borchmann**: Stakeholders note the Draft ISG-2, Revision 2 was developed to apply to storage Certificate of Compliance (CoC), using ambiguous metrics:

"To the extent practicable in design of storage casks, consideration should be given to compatibility with removal of stored spent fuel from reactor site, transportation, and ultimate disposition by Department of Energy".

*Response:* The staff disagrees with the comment. The requirements in 10 CFR 72.236(m), which applies to certificate holders only, is intended to ensure that certificate holders consider offsite transportation in the design of their storage systems. It is also intended to give cask vendors flexibility in designing storage systems without being prescriptive. Since licensees have the authority from the NRC to possess the spent fuel, the licensees are responsible for ensuring that any storage system they choose will meet all the regulations, including the

retrievability regulations in 10 CFR 72.122(l). There are no changes to this ISG revision as a result of this comment.

**Comment 13. Patricia Borchmann**: Stakeholders observe how all regulatory parameters propose a series of flexible options from which licensees are allowed to select certain options, which would define further submittals, and processing requirements. During the evolution of Internal Staff Guidance documents, stakeholders observed how the regulatory agency NRC consistently applied little, or defined no independent engineering performance criteria, and instead typically only applied a deferential concurrence with specific findings, values, and patterns self-defined or projected by ongoing agency, and industry research, or forecasts of simulated conditions, based on computer modeling, but not based on actual testing outcomes, or evidence derived from actual operational experience, which fully examined all aspects of projected cask aging degradation causes.

*Response:* While this revised ISG provides options for demonstrating compliance with the retrievability requirement, the option chosen by the licensee must comply with the design basis of the system. Any changes to the approved design bases of the system are required to be reviewed and approved by the NRC.

Additionally, the NRC does not always require actual performance or compliance testing that is intended to demonstrate, by test alone, the compliance of the cask with the regulation. Instead, the NRC allows computer modeling software to be benchmarked against actual physical tests that are intended to validate the analysis method to include the software and the modeling technique. Once the software is adequately benchmarked, the applicant is free to use the software to model the behavior of a cask and its compliance with the regulations without further testing.

No changes have been made to the ISG as a result of this comment.

**Comment 14. Patricia Borchmann**: Stakeholders observe how, as regulations become more difficult to define until a more substantial basis of operational experience is developed, and specific spent fuel behavior patterns become known (especially with high burn-up fuel), many technical uncertainties or technological gaps will still remain technically unresolved, and little more than sophisticated industry 'guesswork' is supposed to provide stakeholders, and investors with confidence that performance will match forecast projections. So far, industry projections or forecasts on many technical service life estimates for expensive replacements of major infrastructure components have recently been found surprising deficient, and major infrastructure components in reactor design service life are found incapable to withstand readily foreseeable events, due to findings such as 'premature embrittlement', stress corrosion cracking, alkali-silica reaction, concrete degradation, metal fatigue, stress, mechanical fatigue, or performance failures which reflect unexpected departures from forecast service life projections. Stakeholders often have credible solid reasons to have become skeptical of industry rhetoric over decades, or routine cavalier assurances of defense in depth, system robustness, and redundancy of emergency safety systems, performance capabilities.

*Response:* This comment appears to raise concerns with aging management programs and is, therefore, outside the scope of the draft ISG-2, Rev. 2. This revised ISG pertains solely to the demonstration of retrievability for spent fuel storage applicants.

Although this comment is outside the scope of this ISG, the staff is taking this opportunity to offer additional information on aging management programs. Dry storage spent fuel systems

are designed and constructed to require a minimal amount of maintenance. However, when a licensee or a Certificate of Compliance (CoC) holder applies for a renewed site specific license or CoC, the licensee or CoC holder must also conduct an Aging Management Review. Based on the results of the Aging Management Review, the site specific licensee and/or CoC holder must provide Time-Limited Aging Analysis or Aging Management Programs for important to safety structures systems and components that may be subject to aging during the period of extended operation. The NRC staff reviews the Time-Limited Aging Analyses and Aging Management Programs provided by Licensees and CoC holders. Moreover, the NRC conducts inspections of licensed of Independent Spent Fuel Storage Installations to determine compliance with NRC regulations.

No changes have been made to the ISG as a result of this comment.

**Comment 15. Patricia Borchmann**: Without storage cask designs with mechanical instrumentation capabilities to define actual internal fuel conditions during fuel storage duration, an unintended consequence of cask design simplicity is uncertainty of fuel condition, or internal depths of cask wall penetrations. Until more sophisticated internal cask condition assessment capabilities are developed, tested, refined, retested and proven, little more than crude guesswork capabilities remain only as an inferior substitute for actual proven testing, and evidence driven results. Therefore, stakeholders consider it extremely premature, and grossly inappropriate for the type of conclusive statements, and the undisputable level of conclusion findings which already appear in certain section currently contained in Docket NRC 2015-0241.

*Response:* The staff disagrees with this comment. This revised ISG provides options for demonstrating compliance with the retrievability requirement. Whichever option is chosen by the licensee, that option must comply with the storage system's design basis, or receive additional review and approval by the NRC to assure the regulatory requirements are met. No changes have been made to the ISG as a result of this comment.

**Comment 16. Patricia Borchmann**: For example, in paragraph 1 of the Foreword (page v), second sentence: "Based on the current knowledge of material properties and mechanical performance of fuel cladding, the Nuclear Regulatory Commission (NRC) has reasonable assurance that spent nuclear fuel, including high burnup fuel (burnup >45 GWd/MTU), is safe for storage and transport under normal, off normal, and hypothetical accident conditions as prescribed in 10 CFR Part 72, and Part 71 for all the storage systems and transportation packages approved to date". As a stakeholder who has read the technical body of work contained in the 68-page document published September 2015 **"A Quantitative Impact Assessment of Hypothetical Spent Fuel Reconfiguration in spent Fuel Storage Casks and Transportation Packages",** I take extreme exception to conclusive findings contained in Foreword, as only one example.

Another extreme example, can be found one page 42;

"For configurations where all of the assemblies are represented as debris piles, which remain inside their respective basket cells, large impacts on the predicted internal cask temperatures could result in the package not meeting the thermal requirements for such systems. For the vertical orientation, the maximum temperature of the basket stainless steel walls and neutron absorber material increased by over 79 degrees C, compared to the nominal intact configuration case as shown in Figure 24. The assembly debris is assumed to block the basket cell channels causing a reduction in the convective heat transfer within the canister. In addition, the release of the fission product gases results in a decrease in gas thermal conductivity, resulting in lower

heat conduction and heat transfer through the gas space. Both effects -- lower convection and lower gas thermal conductivity - result in the large increase in internal temperatures. Increasing the packing fraction of the debris caused a greater increase in the maximum basket wall temperature. This is expected as the debris, generating the same amount of heat, has less ....."

Rod assembly deformation results: (page 49):

For the vertical orientation, both increasing and decreasing the fuel lattice pitch caused a decrease in maximum cladding, basket wall, and neutron absorber temperature as shown in Table 21. The heat transport within the canister relies on complex parallel and intersection paths of conduction, convection and thermal radiation. Decreasing the lattice pitch resulted in a higher predicted recirculating mass flow rate within the canister as shown in Figure 30, thereby increasing convective heat transport. However, the flow loss coefficients for spacer grids and entrance/exit losses may be impacted. Increasing the lattice pitch increases the cladding to basket wall view factors, thereby increasing thermal radiation heat transport. Of the cases analyzed, the nominal intact configuration case resulted in highest temperatures.

*Response*: This comment refers to information in NUREG/CR-7203 and is outside the scope of ISG-2, Rev. 2.

Nonetheless, the staff is taking this opportunity to provide a brief explanation regarding the statements referenced. The statement in NUREG/CR-7203 referenced in the comment is based upon tests performed on high burnup spent fuel samples, as described in NUREG/CR-7198, “Mechanical Fatigue Testing of High-Burnup Fuel for Transportation Applications.” However, in NUREG/CR-7203, the purpose was to quantify the consequences of all fuel reconfiguration scenarios, no matter how low and unlikely they are, such as fuel debris piles. Even under these extremely unlikely scenarios, typically there are adequate temperature margins to cover the temperature increases discussed on Page 42.

With regard to thermal impact of rod/assembly deformation discussed in Page 49 of NUREG/CR-7203, “the nominal intact configuration case resulted in the highest temperatures,” which is how the design analyses are normally performed.

No changes have been made to the ISG as a result of this comment.

**Comment 17. Patricia Borchmann**: In southern California, reactor communities in San Diego and Orange County have many stakeholders (8.4 million within 50 miles of San Onofre SONGS 2 & 3), who are still skeptical of the broad assurances, and agency rhetoric about system robustness, defense in depth, performance capabilities, and safety redundancy systems, and many stakeholder do not share the same high confidence levels that are shared by most agency regulators, and industry insiders, contractors, vendors, utility advocates. For instance, many of the most basic underlying premises applied to Decommissioning Reactors seems as agency/industry calculations are typically a gross underestimation of a credible, foreseeable risk events, or examples where nuclear regulatory agency, and industry advocates grossly exaggerate, or overestimate performance capabilities. For instance, on page 2 [in 80 FR 72358], Under II. Background section A: Regulatory Actions Related to Decommissioning Power Reactors: paragraph 3:

"During reactor decommissioning, the principal radiological risks are associated with storage of spent fuel onsite. Generally a few months after reactor has been permanently shut down, there

are no possible design-basis events that could result in a radiological release exceeding limits established by EPA early-phase Protective Action Guidance of 1 roentgen equivalent at the exclusion area boundary. The only accident that might lead to a significant radiological release at a decommissioning reactor is a zirconium fire. The zirconium fire scenario is postulated, but highly unlikely, beyond-design-basis accident scenario that involves a major loss of water inventory from spent fuel pool (SFP), resulting in a heatup scenario that might result in a zirconium fire are related to decay heat of irradiated fuel stored in SFP. Therefore, probability of zirconium fire scenario continues to decrease as a function of time that decommissioning reactor has been permanently shut down". I think that entire paragraph is unsupported by evidence, and needs to be reexamined as a fundamental underlying assumption on Decommissioning.

*Response:* This comment which discusses a general lack of confidence in the NRC, as well as a more specific comment regarding language regarding decommissioning, is outside the scope of this ISG. This revised ISG is limited to issues of retrievability. The agency's activities in all respects – whether developing regulations or guidance – strives to ultimately assure the protection of public health and safety. No changes have been made to the ISG as a result of this comment.

**Comment 18. Patricia Borchmann**: Since most recent Community Engagement Panel (CEP) Meeting in late September provided updated permit sequencing phases projected by SCE Edison, stakeholders are finding out that spent fuel stored in Spent Fuel Pools will remain in cooling ponds, much longer than initially projected. Therefore, stakeholders assert that the regulatory agency's forecast for the most unlikely event of a potential breach of spent fuel pool, loss of coolant accident , or other potential accident scenario are NOT as remote, or as unlikely as forecast by NRC, or industry advocates. Therefore, stakeholders still assert that credible foreseeable risks have been grossly underestimated, and performance capabilities during a most unlikely accident scenario are grossly overestimated, by having trained onsite crews available, to bring in offsite water distribution sources, to perform replacement of cooling water in spent fuel pools before cooling water loss causes criticality, or potential explosion, or other hazard.

*Response:* This comment is outside the scope of the draft ISG-2, Rev. 2. This ISG pertains to retrievability as it applies to spent fuel storage applications under Part 72. Thus, this ISG applies to applications for storage of spent fuel at an independent spent fuel storage installation, and does not apply to storage of spent fuel in a spent fuel pool at a nuclear power reactor. The spent fuel pool in use at a nuclear power reactor is licensed and maintained under Part 50, and the spent fuel would be stored in the spent fuel pool per the regulations in Part 50. No changes have been made to the ISG as a result of this comment.

**Comment 19. Donna Gilmore (San Onofre Safety)**: Thin canister critical problems: Cannot be inspected, repaired or maintained; May have through-wall cracks in as little as 20 years, resulting in radiation leaks; Have no early-warning system and no continuous radiation monitoring system; Have no mitigation plan for canister replacement or failure; Lack an adequate design for fuel retrievability; Are not transportable with partial cracks.

*Response:* The staff disagrees with this comment. The NRC is not aware of any deficiencies in its current regulations that would challenge the continued safe storage of spent fuel in spent fuel pools or dry cask systems. If the NRC identifies a concern with the safe storage of spent fuel, the NRC will evaluate the issue and take action to change its regulatory program necessary to

protect public health and safety. No changes have been made to the ISG as a result of this comment.

**Comment 19(a)** Cannot be inspected, repaired or maintained

*Response:* Nondestructive examination (NDE) methods for the inspection of canisters already exist and have been used in the nuclear industry for decades. Methods to apply existing NDE techniques to welded stainless steel canisters have been developed and currently are being tested by both the Electrical Power Research Institute (EPRI) and dry storage system manufacturers.

Aging management programs are required for site specific and certificate of compliance (CoC) renewals and the NRC has required site specific licensees and CoC holders that use welded austenitic stainless steel canisters to address localized corrosion and stress corrosion cracking using an aging management program. NRC reviews the aging management programs and the NRC can and has issued renewals with conditions that require inspections to be conducted in accordance with the approved aging management programs. If the licensee or CoC holder identifies that proposed inspections cannot be performed in accordance with conditions of the license or CoC renewal, then the licensee or CoC holder is out of compliance with the renewed license. In such cases, the licensee or CoC holder would be required to propose alternatives that demonstrate the safety functions of the structure system or component that is potentially subject to aging will be maintained for period of extended operation.

Possible mitigation and repair options for welded stainless steel dry storage canisters are expected to be similar to those that have actually been used on components. Application of these methods or alternate methods to dry storage canisters requires demonstration and compliance with the quality assurance program in 10 CFR Part 72 Subpart G or 10 CFR Part 50 Appendix B.

**Comment 19(b)** May have through-wall cracks in as little as 20 years, resulting in radiation leaks

*Response:* The time necessary for through wall cracks has been evaluated by EPRI. In hot humid environments close to coastal locations with high concentrations of sea salt aerosols, studies were conducted by the Electrical Power Research Institute (EPRI) ("Flaw Growth and Flaw Tolerance Assessment for Dry Cask Storage Canisters," EPRI, Palo Alto, CA, 2014. 3002002785.) The EPRI analysis shows that when conditions for stress corrosion cracking are possible, through wall flaws may occur in 26.5 to more than 80 years, depending on environmental conditions at the ISFSI. The EPRI work considered multiple years of site specific weather data that is made available by the National Oceanic and Atmospheric Administration (NOAA). A summary of the results is tabulated in the referenced report in Table 3-3 on page 3-13. See the EPRI report here:
http://www.epri.com/abstracts/Pages/ProductAbstract.aspx?productId=000000003002002785

The NRC staff also evaluated conditions for cracking of dry storage canisters and found with conservative assumptions (i.e., conditions favorable to stress corrosion cracking initiation and propagation) the fastest crack growth rates would not result in the penetration of a dry storage canister until at least 30 years based on site specific NOAA data for 2014. The NRC assessment considered operational experience with chloride induced stress corrosion cracking. More information can be found in Information Notice 2012-10.
(http://pbadupws.nrc.gov/docs/ML1231/ML12319A440.pdf)

The NRC discussed stress corrosion cracking in the April 21, 2015, Public Meeting with the Nuclear Energy Institute on the Chloride Induced Stress Corrosion Cracking Regulatory Issue Resolution Protocol. The meeting summary is available on ADAMS (Accession Number ML15146A090) http://pbadupws.nrc.gov/docs/ML1514/ML15146A090.pdf and the presentation materials are available (Accession Number ML15146A115) http://pbadupws.nrc.gov/docs/ML1514/ML15146A115.pdf

Although there are differences between the EPRI and the NRC analyses, such as the parameters used to determine crack growth rates, it is important to note that both the EPRI report and the NRC independent analyses reached similar conclusions on the range of possible crack growth rates and the important influence of site specific conditions. Based on these results of operating experience and both the EPRI and NRC independent analyses, the NRC staff find there is no basis to support the commenter's assertion that canisters may have through wall cracks in as little as 20 years.

The NRC staff have been actively involved in addressing the potential for stress corrosion cracking of welded stainless steel canisters for more than 10 years. The NRC staff will continue to collect and review relevant operational experience on atmospheric exposure and stress corrosion cracking of austenitic stainless steels.

If, at some time in the future, the NRC were to identify a concern with the safe storage of spent fuel, the NRC would evaluate the issue and take actions necessary to protect public health and safety.

**Comment 19(c)** Have no early-warning system and no continuous radiation monitoring system

*Response:* Aging Management Programs (AMP) that are based on inspections and monitoring are necessary when aging effects are possible on structures systems and components that are important to safety. The inspections that will be conducted as part of the aging management program are relied upon to detect aging effects such as the potential aging of welded stainless steel canisters by localized corrosion and stress corrosion cracking. As indicated in section 3.6 of NUREG-1927, Revision 1: An effective AMP prevents, mitigates, or detects the aging effects and provides for the prediction of the extent of the aging and timely corrective actions before there is a loss of intended function.

The NRC is addressing potential storage canister cracking in the renewal period of licensed operation by requiring periodic inspections of certain canisters to provide for the early detection of cracks well before they can grow through a canister wall, with associated mitigation if necessary to maintain the system's important to safety functions.

Radiation monitoring is not relied on for an early warning system for canister failure, nor would it be appropriate to do so, because with radiation monitoring, radiation is detected only after the confinement barrier is breached. However, site specific and generally licensed ISFSIs must be in compliance with NRC regulations including specific dose limits for an individual located beyond the independent spent fuel storage installation (ISFSI) controlled boundary. These limits are defined in 10 CFR 72.104 for normal operations and anticipated occurrences and 10 CFR 72.106 for a design basis accident. Typically, an ISFSI boundary fence is equipped with multiple thermoluminescent dosimeters (TLDs). These TLDs are regularly monitored. The results of the monitoring program are one of many items, procedures, and operations reviewed by NRC inspectors. The NRC inspection reports are typically made publically available. The

NRC public web page has guidance on accessing these inspection reports
http://www.nrc.gov/waste/spent-fuel-storage/oversight.html

**Comment 19(d)** Have no mitigation plan for canister replacement or failure

*Response:* See the response to Comment 19(a).

**Comment 19(e)** Lack an adequate design for fuel retrievability

*Response:* Even if a canister is breached by stress corrosion cracking (SCC), the extent of cracking will not impede the retrievability of the canister from any of the currently NRC licensed systems. The extent of potential cracking is limited by the area of the canister where through wall tensile stresses exist. Analysis of existing canister designs and confirmatory testing of residual stresses in welded stainless steel canisters have shown that the area of the canister where through wall SCC may occur is very limited. The studies indicate that the extent of cracking is small and limited to regions a short distance from fabrication welds used to construct the canister. Even under aggressive environments the extent of cracking will be small compared to the critical flaw size (i.e., the size of a SCC crack will be much smaller than the size of a crack that would affect the structural integrity of the canister and potentially impair canister movement). An assessment of the critical flaw size for normal and accident conditions is included in the Flaw Growth and Flaw Tolerance Assessment for Dry Cask Storage Canisters. EPRI, Palo Alto, CA: 2014. 3002002785. The EPRI report is publically available and may be obtained here:
http://www.epri.com/abstracts/Pages/ProductAbstract.aspx?productId=000000003002002785

As stated in response to Comment 19(a), procedures for removing fuel from welded stainless steel canisters are included in operational procedures of licensed designs.

**Comment 19(f)** Are not transportable with partial cracks.

*Response:* Transportation and package certification is covered under the regulations in 10 CFR Part 71, and this ISG does not impact applications under Part 71. The NRC has certified multiple systems for the transportation of nuclear materials including spent nuclear fuel from commercial power reactors. For example, the NRC recently approved the AREVA TN MP197HB transportation package. The Certificate of Compliance (ML14114A099) http://pbadupws.nrc.gov/docs/ML1411/ML14114A099.pdf includes condition 9(b):

"For any DSC that has been used in storage, the condition of the DSC must be evaluated, prior to transportation, to verify that the integrity of the canister is maintained. The verification shall follow the instructions outlined in Chapter A.7, Section A.7.1.3, and step 5 of the application. The effectiveness of the inspection and verification techniques, outlined in Chapter A.7, Section A.7.1.3, step 5, shall be demonstrated on mockups or working systems, prior to transportation."

This condition requires that prior to transportation, a dry storage canister (DSC) or NUHOMS canister in storage must be inspected to verify its integrity and assure that the contents meet the description in the transportation certificate of compliance. This condition is included because the intact DSC is relied on for moderator exclusion. The certificate holder is developing the required inspection system to meet the requirements for transporting DSCs that have been in storage. As stated in Certificate of Compliance condition 9(b) the effectiveness of the inspection system must be verified prior to transportation of the DSCs. Verification of inspection system

performance will follow well established practices that have been used for many years in the nuclear industry and must meet the requirements in 10 CFR 71.119.

**Comment 20. Donna Gilmore (San Onofre Safety)**: If you find yourself in a hole, stop digging. The fact the NRC has approved thin-walled welded canister systems that have critical flaws is no reason to dig another hole by eliminating needed requirement for fuel assembly retrievability. Instead, the NRC should increase minimum standards for dry cask storage and transport systems so existing ISG-2 can be met.

*Response:* To the extent this comment raises questions regarding the current 10 CFR Part 72 regulatory structure for certificate of compliance systems, this comment is outside the scope of this revised ISG. To the extent this comment is concerned that this revision decreases minimum standards, the staff disagrees. This ISG revision does not decrease the regulatory requirements for retrievability, but instead, the ISG provides options for complying with the retrievability requirement. Any option chosen by the licensee would, however, need to comply with both the design basis of the system, as well as with applicable NRC regulations. Therefore, ISG-2, Rev. 2 continues to assure that the current safety margins for a system are maintained. No changes have been made to this ISG as a result of this comment.

**Comment 21. Donna Gilmore (San Onofre Safety)**: NRC Regulation 10 CFR § 71.85 does not allow transport with even partially cracked canisters. NRC Regulation 10 CFR § 71.85 Packaging and Transportation of Radioactive Materials. Preliminary determinations. Before the first use of any packaging for the shipment of licensed material — (a) The certificate holder shall ascertain that there are no cracks, pinholes, uncontrolled voids, or other defects that could significantly reduce the effectiveness of the packaging.

*Response:* This comment is outside the scope of the draft ISG-2, Rev. 2. The ISG pertains only to retrievability issues in spent fuel storage applications and does not apply to applicants under Part 71.

For any canister/cask that has been used in storage, the condition of the canister/cask and its contents must be evaluated, prior to transportation, to verify that the integrity of the canister is maintained and that the canister/cask and contents meet the conditions of the transportation certificate of compliance. In the event that a canister/cask or contents do not meet the conditions in the transport certificate of compliance, the canister/cask or contents will need to be remediated to comply with the transportation certificate. If remediation is not feasible, the transportation certificate will need to be revised to authorize transport of the canister/cask/contents, and the applicant will be required to show that it meets the transportation regulations in 10 CFR Part 71.

It is also important to note that the requirement in 10 CFR 71.85 does not allow defects that could significantly reduce the effectiveness of the packaging. Thus, packagings may have defects, but the defects would have to be evaluated to assure they do not reduce the effectiveness prior to transportation. No changes have been made to this ISG as a result of this comment.

**Comment 22. Donna Gilmore (San Onofre Safety)**: NRC transport cask certificates require verification of the integrity of the canister prior to transportation. However, there is no current method to inspect them for cracks or repair cracks. NRC Certificate of Compliance NUHOMS-MP197HB, Certificate 9302, April 23, 2014 (ML14114A099), [High burnup fuel transport cask] Page 17, “For any DSC [Dry Storage Canister] that has been used in storage, the condition of

the DSC must be evaluated, prior to transportation, to verify that the integrity of the canister is maintained."

*Response:* This comment is outside the scope of the draft ISG-2, Rev. 2. The ISG pertains only to retrievability in spent fuel storage applications and does not apply to applications under Part 71.

In addition, see the response to 19(a), 19(f), and 21.

No changes have been made to the ISG as a result of this comment.

**Comment 23. Donna Gilmore (San Onofre Safety)**: The NRC approves destruction of empty spent fuel pools yet has no other specific mitigation plans identified for failed spent fuel canisters that could be implemented now.

*Response:* This comment is outside the scope of the draft ISG-2, Rev. 2, which is limited to the issue of retrievability in spent fuel storage applications. The staff notes that, if there was a failed spent fuel canister, the licensee would need to evaluate this in the corrective action program and remediate the failed fuel canister.

**Comment 24. Donna Gilmore (San Onofre Safety)**: The Department of Energy (DOE) Standard Contract requires fuel assembly retrievability in order to place the fuel assemblies in a DOE approved cask and to aid in ensuring flexibility for safer storage in a permanent repository. Even though this is not within the NRC's "required" scope, the NRC Commissioners directed the NRC to consider transportation issues (COMDEK-09-0001). They also directed staff to encourage the adoption of state of the art technology for storage and transportation, internationally. Adopting state of the art technology available internationally should be pursued as directed by the Commissioners. This ISG-2 revision does the opposite.

The Commissioners stated: "The staff should undertake a thorough review of the regulatory programs for spent fuel storage and transportation to evaluate their adequacy for ensuring safe and secure storage and transportation of spent nuclear fuel for extended periods beyond the 120 year timeframe considered up to this point. This review should include the standards, regulations, guidance, review processes, and inspection and enforcement procedures. The staff should also undertake research to bolster the technical basis of the NRC's regulatory framework to support extended periods. The review should identify risk-informed, performance-based enhancements that will bring increased predictability and efficiency to the regulatory processes, and should investigate ways to incentivize these processes to encourage the adoption of state of the art technology for storage and transportation in a risk-informed, performance-based manner. The review should be conducted in a transparent, participatory, and collaborative manner with our stakeholders. The review should also benefit from experience gained through the Multi-National Design Evaluation Process (MDEP) for reactors and consider opportunities for comparing and, where appropriate, harmonizing, international standards for transport packages and storage casks. The staff should develop a project plan for Commission approval, including objectives, plans, potential policy issues, projected schedules, performance measures, and projected resource requirements. Such a plan should leverage, as appropriate, improvement initiatives that the staff already has underway." Staff Requirements – COMDEK-09-0001 – Revisiting the Paradigm for Spent Fuel Storage and Transportation Regulatory Programs, February 18, 2010
http://pbadupws.nrc.gov/docs/ML1004/ML100491511.pdf

*Response:* This comment is outside the scope of the draft ISG-2, Rev. 2, which is limited to the issue of retrievability in spent fuel storage applications.

This ISG does not prevent the use of state of the art technology. Instead, this revised ISG provides options for applicants in meeting retrievability in a manner that continues to meet the storage regulations and maintains safety and security. No changes have been made to this ISG as a result of this comment.

**Comment 25. Donna Gilmore (San Onofre Safety)**: ISG-2 Rev 2 Page 6 attempts to justify the elimination of the retrievability requirement by referencing COMSECY-10-0007: "Consistent with the staff's ongoing work conducting a review of the regulatory framework for spent fuel storage and transportation (see COMSECY-10-0007, Ref. 16), the staff began exploring alternatives to the guidance on the application of ready retrieval. The staff's review has centered on redefining the first part of the guidance on ready retrieval (i.e., the ability of the fuel assemblies to be removed from a canister or cask by normal means), but maintaining the second part (i.e., the ability of the canister or cask to be removed from the storage location). By redefining the first part of the guidance (i.e., the ability to remove the individual spent fuel assemblies or canned assemblies by normal means) and providing alternatives, the spent fuel would still be retrieved safely and be readied for transportation consistent with the law and regulations. This way, the spent fuel dry storage confinement continues to be maintained without the potential negative impacts associated with opening the storage system."

*Response:* The draft ISG-2, Rev. 2 does not eliminate the requirement for retrievability, but instead provides options to meet the requirement. No changes have been made to the ISG as a result of this comment.

**Comment 26. Donna Gilmore (San Onofre Safety)**: However, in COMSECY-10-0007 it states the NRC staff has not identified timeframes for such things such as needed replacement of cask components to assure continued safer storage and transportability. It also states need to conduct potential risk and environmental assessments.

Commissioners directed NRC staff "to develop a project plan to conduct a thorough review of the regulatory programs for spent nuclear fuel (SNF) storage and transportation, and to evaluate their adequacy for ensuring safe and secure storage of SNF for extended periods beyond 120 years. The Commission also directed the staff to undertake research to bolster the technical bases of the regulatory framework in support of extended periods, and to leverage ongoing improvement initiatives."

"The staff notes that one significant outcome of the various research studies may be identification of timeframes that require significant mitigation actions (e.g., replacement of cask components) to assure continued safe storage and transportability. The staff has not yet identified any such timeframes, and has preliminarily selected an analytical timeframe of 300 years for the scope of the extended storage and transportation regulatory program review elements, such as extrapolating research data, conducting potential risk and environmental assessments, and developing aging management and design performance guidelines." U.S. Nuclear Regulatory Commission. 2010. COMSECY-10-0007 Project Plan for the Regulatory Program Review to Support Extended Storage and Transportation of Spent Nuclear Fuel. ADAMS Accession No. ML101390216.
http://pbadupws.nrc.gov/docs/ML1013/ML101390216.html

The NRC needs to complete the tasks identified in NRC Project Plan for the Regulatory Program Review to Support Extended Storage and Transportation of Spent Nuclear Fuel (COMSECY-10-0007) prior to revising ISG-2 Rev 2. ISG-2 (page 6) states it is consistent with staff's ongoing work in this project. However, part of that project is addressing the lifespan of the dry storage system. The assumption is being made in the ISG-2 revision that the thin 0.50" thick stainless steel canisters will have a sufficient lifespan and will not need replacing and can be used for long-term interim and final disposal. However, this part of the NRC Project Plan has not been completed. In fact, the current work completed raises serious concerns about the lifespan, maintainability and transportability of these thin canisters. The NRC should not base ISG-2 on hope of future solutions for these problems. We cannot afford to continue digging this hole with inferior dry storage technology. Better solutions are available if the NRC would simply require a dry cask solution that can be inspected, repaired, maintained, adequately monitored, doesn't crack and meets current fuel retrievability requirement.

*Response:* This comment is outside the scope of the draft ISG-2, Rev. 2, which is limited to the issue of retrievability in spent fuel storage applications.

Nonetheless, the staff is providing some information on activities associated with this COMSECY. COMSECY-10-0007 (http://www.nrc.gov/reading-rm/doc-collections/commission/comm-secy/2010/2010-0007comscy.pdf) includes a Project Plan for the Extended Storage and Transportation Regulatory Program Review

Work completed to enhance the technical and regulatory basis of the existing regulatory framework to support extended storage and transportation (EST) includes:

(1) Identification and Prioritization of the Technical Information and Prioritization of the Technical Information Needs Affecting Potential Regulation of Extended Storage and Transportation of Spent Nuclear Fuel. http://pbadupws.nrc.gov/docs/ML1404/ML14043A402.html,

(2) NUREG/CR-7170, "Assessment of Stress Corrosion Cracking Susceptibility for Austenitic Stainless Steels Exposed to Atmospheric Chloride and Non-Chloride Salts," http://pbadupws.nrc.gov/docs/ML1405/ML14051A417.pdf,

(3) Available Methods for Functional Monitoring of Dry Cask Storage Systems (ML14323A067) http://pbadupws.nrc.gov/docs/ML1432/ML14323A067.pdf

(4) NDE to Manage Atmospheric SCC in Canisters for Dry Storage of Spent Fuel: An Assessment (ML13276A196) http://pbadupws.nrc.gov/docs/ML1327/ML13276A196.pdf

(5) Extended Storage and Transportation: Evaluation of Drying Adequacy (ML13169A039) http://pbadupws.nrc.gov/docs/ML1316/ML13169A039.pdf

See also SECY-15-0076: Annual Status Report Activities Related to Extended Storage and Transportation Regulatory Program Review (ML15098A650) http://pbadupws.nrc.gov/docs/ML1509/ML15098A650.html

In addition, near term regulatory improvements in process include the development of NUREG-1927, Revision 1, "Standard Review Plan for Renewal of Specific Licenses and Certificates of Compliance for Dry Storage of Spent Nuclear Fuel - Draft Report for Comment," http://pbadupws.nrc.gov/docs/ML1518/ML15180A011.pdf. See Comment 19 response on inspection and repair of dry storage systems.

No changes have been made to the ISG as a result of this comment.

**Comment 27. Donna Gilmore (San Onofre Safety)**: Stainless steel thin canisters are subject to chloride-induced stress corrosion cracking and can crack through the wall of the canisters 16 years after crack initiation.

Summary of August 5, 2014, Public Meeting with the Nuclear Energy Institute on Chloride Induced Stress Corrosion Cracking Regulatory Issue Resolution Protocol, September 9, 2014 http://pbadupws.nrc.gov/docs/ML1425/ML14258A081.pdf

*Response:* This comment is outside the scope of the draft ISG-2, Rev. 2, which is limited to the issue of retrievability in spent fuel storage applications.

See the response to Comment 19(b)

No changes have been made to the ISG as a result of this comment.

**Comment 28. Donna Gilmore (San Onofre Safety)**: The Koeberg nuclear plant in South Africa had a similar component leak from through-wall cracks of 0.61" deep in 17 years. The majority of U.S. thin canisters are only 0.50" thick.

Chloride-Induced Stress Corrosion Cracking Tests and Example Aging Management Program, Darrell S. Dunn, NRC/NMSS/SFST, August 5, 2014, http://pbadupws.nrc.gov/docs/ML1425/ML14258A082.pdf

*Response:* This comment is outside the scope of the draft ISG-2, Rev. 2, which is limited to the issue of retrievability in spent fuel storage applications.

See the response to Comment 19(b).

Additionally, in an effort to be responsive to the comment, the NRC staff are very familiar with the operational experience at the Koeberg plant in South Africa. See NRC Information Notice 2012-20: Potential Chloride-Induced Stress Corrosion Cracking of Austenitic Stainless Steel and Maintenance of Dry Cask Storage System Canisters. (Accession Number ML12319A440) http://pbadupws.nrc.gov/docs/ML1231/ML12319A440.pdf.

No changes have been made to the ISG as a result of this comment.

**Comment 29. Donna Gilmore (San Onofre Safety)**: An EPRI evaluation of a Diablo Canyon spent fuel canister provides evidence of a two-year old canister having all the conditions for cracking after only two years of service. It had a low enough canister temperature for magnesium chloride salts to dissolve (deliquesce) on the canister which can initiate stress corrosion cracking.

Diablo Canyon: conditions for stress corrosion cracking in 2 years, D. Gilmore, October 23, 2014 https://sanonofresafety.files.wordpress.com/2011/11/diablocanyonscc- 2014-10-23.pdf

*Response:* This comment is outside the scope of the draft ISG-2, Rev. 2, which is limited to the issue of retrievability in spent fuel storage applications.

Moreover, it appears that the basis for this comment is, in part, incorrect information. The conditions necessary for stress corrosion cracking (SCC) to occur have been thoroughly tested, analyzed, reviewed, and documented. A NRC staff presentation on the subject is included in the April 21, 2015, Public Meeting with the Nuclear Energy Institute on the Chloride Induced Stress Corrosion Cracking Regulatory Issue Resolution Protocol. The meeting summary is available on ADAMS (Accession Number ML15146A090) http://pbadupws.nrc.gov/docs/ML1514/ML15146A090.pdf and the presentation materials are available (Accession Number ML15146A115) http://pbadupws.nrc.gov/docs/ML1514/ML15146A115.pdf

The commenter's reference is dependent on a 40-45 g/m$^3$ absolute humidity value in reaching conclusions regarding the temperature at which deliquescence can occur. However, the staff believes this is an unrealistic absolute humidity value, as described below, and use of this value leads to improbable assumptions regarding when deliquescence can occur, and thus improbable assumptions for crack initiation and crack growth rate. Work conducted by the NRC to assess the conditions necessary for SCC included actual records of atmospheric conditions that are available from National Oceanic and Atmospheric Administration (NOAA). In reviewing the available data from NOAA, the staff found that measured dew points above 29°C [84°F] (absolute humidity of 28.8 g/m$^3$) are rare. According to the available records, the highest recorded dew point of 32°C [90°F] was in Appleton, Wisconsin on July 13, 1995 corresponding to an absolute humidity of 33.7 g/m$^3$. The staff noted that while absolute humidity values are usually below 30 g/m$^3$, the conservative assessment conducted by the NRC in Accession Number ML15146A115 used actual available "real-life" atmospheric data along with numerous conservative assumptions. The staff used these conservative assessments in formulating the inspection criteria for canisters.

The NRC staff noted that the actual assessment of the conditions on the Diablo Canyon and Hope Creek canisters is described in SANDIA REPORT SAND2014-16383, "Analysis of Dust Samples Collected from Spent Nuclear Fuel Interim Storage Containers at Hope Creek, Delaware, and Diablo Canyon, California," Charles R. Bryan and David G. Enos, July 2014. (http://prod.sandia.gov/techlib/access-control.cgi/2014/1416383.pdf).

The conclusion explains the limitations of the sample collection and analyses. No changes have been made to this ISG as a result of this comment.

**Comment 30. Donna Gilmore (San Onofre Safety)**: No technology and tools exist to inspect canisters for cracks.

Summary of August 5, 2014 Public Meeting with the Nuclear Energy Institute on Chloride Induced Stress Corrosion Cracking Regulatory Issue Resolution Protocol, September 9, 2014, http://pbadupws.nrc.gov/docs/ML1425/ML14258A081.pdf
Mark Lombard, October 6, 2015 https://youtu.be/QtFs9u5Z2CA

*Response*: See the response to Comment 19(a).

**Comment 31. Donna Gilmore (San Onofre Safety)**: No feasible method to repair cracks in canisters filled with spent nuclear fuel.

Dr. Kris Singh, Holtec President, manufacturer of Holtec canisters), October 14, 2014
https://youtu.be/euaFZt0YPi4

A Framework to Develop Flaw Acceptance Criteria for Structural Integrity Assessment of Multipurpose Canisters for Extended Storage of Used Nuclear Fuel, ASME 2014 Pressure Vessels & Piping Division Conference, PVP2014, July 20-24, 2014, PVP2014- 28990, Savannah River National Lab (SRNL), Poh-Sang Lam, et. al. http://sti.srs.gov/fulltext/SRNL-STI-2014-00151.pdf

*Response:* See the response to Comment 19(a).

**Comment 32. Donna Gilmore (San Onofre Safety)**: The NRC has not prioritized investigating other conditions that could cause these thin canisters to prematurely fail, such as corrosive particles in air pollution (e.g., sulfides). At NRC REG CON 2015 on November 19, Mark Lombard and EPRI stated they do not have plans to investigate any other factors that may cause the thin canisters to fail, even though the NRC Project Plan COMSECY-10-0007 states otherwise:

"the Commission directed the staff to develop a project plan to conduct a thorough review of the regulatory programs for spent nuclear fuel (SNF) storage and transportation, and to evaluate their adequacy for ensuring safe and secure storage of SNF for extended periods beyond 120 years. The Commission also directed the staff to undertake research to bolster the technical bases of the regulatory framework in support of extended periods, and to leverage ongoing improvement initiatives."

"The staff notes that one significant outcome of the various research studies may be identification of timeframes that require significant mitigation actions (e.g., replacement of cask components) to ensure continued safe storage and transportability. The staff has not yet identified any such timeframes, and has preliminarily selected an analytical timeframe of 300 years for the scope of the extended storage and transportation regulatory program review elements, such as extrapolating research data, conducting potential risk and environmental assessments, and developing aging management and design performance guidelines."

*Response:* The staff disagrees with this comment. The NRC has evaluated and tested the effects of pollutants and other possible atmospheric deposits. The results of this work are documented in NUREG/CR-7170, "Assessment of Stress Corrosion Cracking Susceptibility for Austenitic Stainless Steels Exposed to Atmospheric Chloride and Non-Chloride Salts," http://pbadupws.nrc.gov/docs/ML1405/ML14051A417.pdf.

Moreover, the agency continues to improve its understanding of long term storage. If, at some time in the future, the NRC were to identify a concern with the safe storage of spent fuel, the NRC would evaluate the issue and take actions necessary to protect public health and safety. No changes have been made to this ISG as a result of this comment.

**Comment 33. Donna Gilmore (San Onofre Safety)**: Numerous incidences of improper loading of canisters outside of Certificate of Compliance (CoC) requirements has occurred bringing into question the current basis for assumptions of safe storage. Current basis for safe storage assume improper loading will never happen. Proper loading is critical to integrity of both the canisters and fuel. If licensees cannot be trusted to load fuel properly, even with numerous checks and balances, the need for fuel retrievability becomes even more important. The NRC has not addressed this issue.

NUREG-1864 A Pilot Probabilistic Risk Assessment Of a Dry Cask Storage System At a Nuclear Power Plant, March 2007, A. Malliakos, NRC Project Manager ML071340012 http://pbadupws.nrc.gov/docs/ML0713/ML071340012.pdf

Page 13 Executive Summary

The pilot PRA assesses the risk to the public and identifies the dominant contributors to risk associated with dry cask storage involving a single cask at a specific boiling water reactor site. Among the items that were beyond the scope of the study were subsequent versions of the specific cask studied in this report, unloading of the cask, offsite transportation, repository storage, uncertainty analysis, worker risk, human reliability, fabrication errors, mis-loading of spent nuclear fuel, aging effects, and combinations of factors that could impact the probability of MPC failure.

Examples of incorrect loading. Since fuel assemblies cannot be inspected, it is unknown whether fuel damage occurred from this misloading.

Diablo Canyon: Misloaded all but two Holtec canisters through multiple loading cycles. They were loaded in incorrect zones for their cooling period. Both PG&E and Holtec vendor were responsible. Diablo Canyon Event Number 51134, June 6, 2015. http://www.nrc.gov/reading-rm/doc-collections/event-status/event/2015/20150610en.html

North Anna: The applicant inadvertently reversed the upper and lower zones while preparing the DSC loading maps. This resulted in twelve fuel assemblies being loaded into seven DSCs with decay heat greater than specified in the CoC. Currently, the twelve affected fuel assemblies have been in storage for a minimum of 1.3 years and have decayed to meet the required decay heat limits of the CoC. However, this should never have happened. Federal Register Volume 77, Number 65, April 4, 2012, Pages 20438-20440, FR Doc No: 2012-8114, NRC Docket Nos. 72-1030, 72-56; 50-338 and 50-339: NRC-2012-0084, Independent Spent Fuel Storage Installation, Virginia Electric and Power Company: North Anna Power Station Units 1 and 2 http://www.gpo.gov/fdsys/pkg/FR-2012-04-04/html/2012-8114.htm

*Response:* This comment is outside the scope of the draft ISG-2, Rev. 2, which is limited to the issue of retrievability in spent fuel storage applications.

Nonetheless, in an effort to be responsive to the comment, the staff notes that the current design bases do not assume improper loading will never happen, but rather show that the storage cask can safely store spent fuel when loaded in accordance with the certificate or license, including the technical specifications. Every CoC system contains technical specifications (TS) that detail the requirements for loading, and licensees are required to follow these TS. If a licensee fails to follow the TS that apply to loading, then they must report the incident, evaluate the misload, and their planned corrective actions to address the issue to the NRC before moving forward. In each of the instances referenced by the comment, the action taken by the licensees to address the issue was evaluated by the NRC and determined to be protective of public health and safety.

No changes have been made to this ISG as a result of this comment.

**Comment 34. Donna Gilmore (San Onofre Safety)**: The NRC should complete an evaluation of the impact of canister leaks, particularly with high burnup fuel.

*Response:* This comment is outside the scope of the draft ISG-2, Rev. 2, which is limited to the issue of retrievability in spent fuel storage applications.

Nonetheless, in an effort to be responsive to the comment, the NRC notes that risk assessments for spent fuel storage and transportation have been conducted by the NRC and industry and are publically available. NRC risk assessments are published in NUREG-1140 (NRC ADAMS ML062020791), NUREG-1864 (ML071340012) and NUREG-2125 (ML14031A323). NUREG-1140 analyzed a postulated accident involving the removal of the lid of a storage cask in which all the fuel rods have been damaged. The analysis found that the resultant doses were below the Environmental Protection Agency's protective action guidelines for taking protective action after an accident.

No changes have been made to this ISG as a result of this comment.

**Comment 35. Donna Gilmore (San Onofre Safety)**: The Advisory Committee on Reactor Safeguards stated their concerns in a 2000 letter to the NRC regarding ignition and fire risks in pools. Similar unanswered questions exist for dry storage. Please provide any documents that address impact of a canister leak with high burnup fuel, taking these factors into consideration.

"…there were issues associated with the formation of zirconium-hydride precipitates in the cladding of fuel especially when that fuel has been taken to high burnups. Many metal hydrides are spontaneously combustible in air. Spontaneous combustion of zirconium-hydrides would render moot the issue of "ignition" temperature that is the focus of the staff analysis of air interactions with exposed cladding. The staff has neglected the issue of hydrides and suggested that uncertainties in the critical decay heat times and the critical temperatures can be found by sensitivity analyses. Sensitivity analyses with models lacking essential physics and chemistry would be of little use in determining the real uncertainties." The staff analysis of the interaction of air with cladding has relied on relatively geriatric work. Much more is known now about air interactions with cladding. This greater knowledge has come in no small part from studies being performed as part of a cooperative international.

ACRS letter to NRC Chairman regarding Draft Final Technical Study of Spent Fuel Accident Risk at Decommissioning Nuclear Power Plants, Dana A. Powers, ACRS Chairman, ACRS-1885 April 13, 2000 http://pbadupws.nrc.gov/docs/ML0037/ML003704532.pdf

Argonne scientists reported high burn-up fuels may result in fuel rods becoming more brittle over time. The U.S. Nuclear Waste Technical Review Board (NWTRB) December 2010 report, "Evaluation of Technical Basis for Extended Dry Storage and Transportation of Used Nuclear Fuel", states insufficient information is available on high burnup fuels to allow reliable predictions of degradation processes during extended dry storage. https://sanonofresafety.files.wordpress.com/2013/06/usnwtrb-evaloftechbasisforextendeddrystorageandtransportofusednuclearfuel2010-dec- eds_rpt.pdf

"Only limited references were found on the inspection and characterization of fuel in dry storage, and they all were performed on low-burnup fuel after only 15 years or less of dry storage [using the CASTOR V/21 cask, which has very difference specifications than the stainless steel canisters commonly used in the U.S. today (maximum 21 PWR fuel assemblies, maximum initial U-235 enrichment 2.2% – 2.3%, maximum burnup 35 GWd/MTU, maximum fuel assembly heat generation 1kW, side-wall thickness 14.9″, two stainless steel bolted lids (11.4" and 3.5" thick) and no damaged fuel assemblies allowed.] Insufficient information is available on high-burnup fuels to allow reliable predictions of degradation processes during extended dry storage, and no

information was found on inspections conducted on high-burnup fuels to confirm the predictions that have been made. The introduction of new cladding materials for use with high-burnup fuels has been studied primarily with respect to their reactor performance, and little information is available on the degradation of these materials that will occur during extended dry storage. The NWTRB also states [page 11]: These [degradation] mechanisms and their interactions are not well understood. New research suggests that the effects of hydrogen absorption and migration, hydride precipitation and reorientation, and delayed hydride cracking may degrade the fuel cladding over long periods at low temperatures, affecting its ductility, strength, and fracture toughness. High-burnup fuels tend to swell and close the pellet-cladding gap, which increases the cladding stresses and can lead to creep and stress corrosion cracking of cladding in extended storage. Fuel temperatures will decrease in extended storage, and cladding can become brittle at low temperatures."

Data from high burnup fuel rods shows increased oxide thickness with increased burnup. Page 55 and 60 of NWTRB report states: "Hydride precipitation can be evenly distributed or dominate in certain areas. Both cladding hydrogen content and effective wall-thickness are correlated to the amount of oxidation that occurs on the outer surface of the cladding. Plotting more than 4,400 measurements from commercial fuel-rods taken from reactors around the world, Figure 20 shows the maximum outer-surface oxide-layer thickness data in low-Sn Zircaloy-4 cladding plotted as a function of burnup.

Taking these oxide thickness measurements, the maximum wall thickness average (MWTA) hydrogen content can be calculated using a hydrogen evolution model. Figure 21 plots the wall-average hydrogen content in low-Sn Zircaloy-4 cladding as a function of burnup from both measured and model-calculated data. For a discharge burnup in the range of 60-65 GWd/MTU, the maximum oxide thickness is 100 μm and the average hydrogen concentration is 800 ppm, which corresponds to a metal loss of 70 μm using conservative assumptions."

*Response:* This comment is outside the scope of ISG-2, Rev. 2 which is limited to the issue of retrievability in spent fuel storage applications. The changes in ISG-2 provide the flexibility to assure spent fuel retrievability.

Nonetheless, in an effort to be responsive to the comment, the NRC notes that the spent fuel assemblies, including those containing high burnup fuel, placed in dry storage have cooled enough that they do not need an active cooling system using water. Therefore, loss of cooling water which was the scenario assumed in the Spent Fuel Pool Study does not apply here.

In dry storage, the fuel (high burnup fuel or low burnup fuel) has been cooled sufficiently to the point that the cooling system is based on natural conduction and convection with helium inside the cask/canister and air circulation outside the cask/canister. In addition, analyses are performed under off-normal conditions which include blockage of canister over-pack air inlet for vented systems, to provide assurance that spent fuel cladding does not exceed the design-basis peak clad temperature before corrective actions are taken.

Since 2010, the NRC has developed draft Regulatory Issue Summary, "Considerations in Licensing High Burnup Spent Fuel in Dry Storage and Transportation," (ML14175A203) to communicate the staff position on high burnup fuel. Additionally, the NRC has reviewed and considered recent examples of research completed on high burnup fuel: NUREG/CR-7198, "Mechanical Fatigue Testing of High-Burnup Fuel for Transportation Applications," published in May 2015 (ADAMS Accession No. ML15139A389) and NUREG\CR-7203, "A Quantitative Impact Assessment of Hypothetical Spent Fuel Reconfiguration in Spent Fuel Storage Casks

and Transportation Packages," published in September 2015 (ADAMS Accession No. ML15266A413).

Moreover, the NRC continues to improve its understanding of long term dry storage issues and, as part of this effort, the NRC is closely following Department of Energy and industry efforts to study the effects of storing high burn-up spent fuel in casks. As information becomes available, the NRC will analyze the information to determine if additional or different actions are necessary. If necessary, the NRC will issue orders or enhance its regulatory requirements for storage of spent fuel, as appropriate, to continue providing adequate protection of public health and safety and the common defense and security.

No changes have been made to this ISG as a result of this comment.

**Comment 36. Donna Gilmore (San Onofre Safety)**: The below NRC recommended changes to ISG-2 Rev 2 NRC should be rejected for the reasons stated in Comments 19-35.

This ISG recommends the following definition to be used by staff when evaluating Part 72 applications:

Ready retrieval: The ability to safely remove, with no operational safety problems, the spent fuel from storage for further processing or disposal. Acceptable means for removing the spent fuel from storage includes the ability to do one or a combination of the following:
A. remove individual or canned spent fuel assemblies from wet or dry storage,
B. remove a canister loaded with spent fuel assemblies from a storage cask/overpack,
C. remove a cask loaded with spent fuel assemblies from the storage location.

The staff recommends the definitions for ready retrieval be incorporated into NUREG- 1536, NUREG-1567, and NUREG-1927. These definitions do not necessitate any actions for currently approved storage systems.

If an applicant for an initial ISFSI license or an applicant for an ISFSI license amendment relies upon Option B or Option C to demonstrate ready retrieval, the applicant should also address the storage system's continued ability to ensure ready retrieval. One possible approach would be for the applicant to implement a program designed to identify, monitor, and mitigate possible degradation that could impact the intended function of the dry storage system's SSCs and subcomponents that are relied upon for compliance with the retrievability requirements.
For applicants for renewal of an ISFSI license, in order to verify that the 10 CFR 72.122(l) retrievability requirement is met, the reviewer should ensure that the approved design bases for the item being relied upon in the option(s) chosen (fuel assembly, cask, or canister) to demonstrate ready retrieval, including any programs implemented, has not been altered. Additionally, the reviewer should ensure that the AMPs and TLAAs provide reasonable assurance that the approved design bases will be maintained during the period of extended operation. This includes reviewing operating experience for incident-free storage, including inspections and analyses performed during the initial storage period for ensuring SSCs relied upon for ready retrieval were maintained. The reviewer should refer to Draft NUREG-1927, Rev. 1 (Ref. 8) for additional guidance.

*Response:* As explained in responses to the individual Comments 19-35, the staff disagrees with this comment.

No changes have been made to this ISG as a result of this comment.

**Comment 37. Robert Einziger**: Why isn't 10 CFR 72.122(h) (1) given as part of the regulatory basis? This section states "The spent fuel cladding must be protected during storage against degradation that leads to gross ruptures or the fuel must be otherwise confined such that degradation of the fuel during storage will not pose operational safety problems with respect to its removal from storage. This may be accomplished by canning of consolidated fuel rods or unconsolidated assemblies or other means as appropriate". If the applicant makes the safety case in the application that the canister is safe to use as the retrievable method then clearly there will be no operational safety issues hence the fuel no longer has to be prevented from having gross degradation.

*Response:* The staff disagrees with this comment. While an applicant providing information to comply with 10 CFR 72.122(h) (1) may rely upon information provided to demonstrate compliance with 10 CFR 72.122(l), it is 10 CFR 72.122(l), that specifically requires a demonstration of retrievability. Thus, it is 10 CFR 72.122(l) which is cited as part of the regulatory basis.

No changes have been made to this ISG as a result of this comment.

**Comment 38. Robert Einziger**: Why isn't 10 CFR 72.236(m) given as part of the regulatory basis? This section states "To the extent practicable in the design of spent fuel storage casks, consideration should be given to compatibility with removal of the stored spent fuel from a reactor site, transportation, and ultimate disposition by the Department of Energy." Clearly this clause is directly related to retrievability to the extent that you can interpret "compatibility with removal of the stored spent fuel from a reactor site" as retrievability.

*Response:* The staff agrees with this comment and has included language in the ISG to add 10 CFR 72.236(m) to the regulatory basis discussion. The changes were made to the ISG on page 1 (ML16019A128).

**Comment 39. Robert Einziger**: Page 3, 2nd paragraph - Are you implying that for either Option B, or C that an aging management program for either the canister (option B) or fuel (option C) would have to be in place for the initial storage period. Otherwise how do you guarantee that they will monitor potential degradations that could affect the retrievability?

*Response:* See response to Comment 7. Additionally, the ISG was edited to add clarifying text. The changes were made to the ISG on page 3 (ML16019A128).

**Comment 40. Robert Einziger**: Page 6, 2nd paragraph - Everything in this paragraph is true, which is the reason that the demonstration project was started by Department of Energy (DOE) and ISG-24 was developed and incorporated into NUREG- 1927 Rev 2. The performance of the fuel in the demonstration would be monitored and related to the fuel in storage so that the cask or canister would not have to be opened. If this change is made why is DOE going to such lengths to do the demonstration?

*Response:* The demonstration project is outside the scope of the draft ISG-2, Rev. 2, which is limited to the issue of retrievability in spent fuel storage applications. Moreover, the demonstration project is under the purview of the DOE; the NRC is not commenting on this DOE project in this document, other than to indicate that the NRC is closely monitoring industry and DOE efforts in this regard.

No changes have been made to this ISG as a result of this comment.

**Comment 41. Robert Einziger**: Page 7 top paragraph - says that this guidance is consistent with the current International Atomic Energy Agency (IAEA) safety Guide SSG-15 position on retrievability. The regulatory basis in this ISG revision says the retrievability requirements are only applicable to normal and off-normal conditions and does not apply to accident conditions. Nowhere, in Part 72, is this exclusion to the retrievability clause stated. IAEA guide SSG-15 Section 6.1 states that "requirements were established in Ref (9) to maintain ... and to ensure retrievability of the spent fuel. These safety functions should be maintained during all operational states and accident conditions." Clearly there is an inconsistency between this revision and the IAEA guidance.

*Response:* The staff agrees that in 10 CFR Part 72, there is no exclusionary clause for retrievability after an accident. The interpretation of the applicability of retrievability can be found in ISG-3. The staff has edited the ISG to clarify the difference of the NRC interpretation of the applicability of retrievability and the IAEA interpretation. The changes were made to the ISG on page 7 (ML16019A128).

**Comment 42. Robert Einziger**: If the canister is the retrieval basis then 10 CFR 72.122(h)(l) [See item 37 above] can be meet even if the fuel assembly is grossly degraded during extended storage provided all other safety considerations such as thermal, containment and criticality regulations can be met in the degraded state. A recent NUREG/CR from Oak Ridge supports the position that these regulatory requirements can be met with grossly degrade fuel. Hence there is no regulatory basis for the NRC to require that steps be taken to prevent gross rupture of the fuel rods. Applicant would no longer have to limit the maximum cladding temperature, dry the fuel other than removing gross water, or maintain internal atmosphere conditions suggested in ISG-1 Rev 3 to prevent gross rupture. As higher burnup fuel is loaded into casks or shorter cooling times are legislated to clear the reactor storage pools, the current suggested temperature limits may be approached or exceeded. The ultimate consequences is that the utilities may have storage systems from which the fuel cannot be removed on an assembly basis and repackaged if a standard canister is deemed necessary, or may not be acceptable by the Department of Energy by the terms of the standard contract. The bottom line is that while the change to the retrievability guidance may be acceptable for storage it does not take into account the ramifications for the full back-end of the fuel cycle and thus violate 10 CFR 72.236(m)

*Response:* The staff disagrees with this comment. Regardless of the method chosen for demonstrating retrievability, an applicant must demonstrate compliance with all applicable NRC regulations.

A licensee may choose to comply with retrievability on only a canister/cask basis, but this does not mean that the fuel is assumed to be degraded. Whether or not the design of the system accounts for the fuel to be degraded in the cask/canister would need to be determined and evaluated by the licensee. NUREG/CR-7203 includes all possible fuel degradation scenarios some of which could have significant impact. If an applicant chooses to use degraded fuel assumption for demonstrating safety compliance, there are a set of stringent requirements with respect to confinement, criticality safety, and radiation protection. Moreover, certificate of compliance holders must continue to comply with 72.236(m).

No changes have been made to this ISG as a result of this comment.

**Comment 43. Marv Lewis**: There is no justification for taking away a safety such as retrievability of spent fuel from the public. This action assumes that we know all the variables about High burn up, new cladding alloys, transportation accidents and multitudinous unknown and future variables.

*Response:* The staff disagrees with this comment. The draft ISG-2, Rev. 2 does not eliminate the requirement for retrievability. It provides some options to meet the requirement. No changes have been made to this ISG as a result of this comment.

**Comment 44. Marv Lewis**: We have not looked at many happenings going on right now. Bachen crude in 100 plus tank cars sharing track with spent fuel canisters, broken spent fuel boxes failing to meet staff's testing and RAI needs. It goes on.

*Response:* This comment is outside the scope of the draft ISG-2, Rev. 2, which is limited to the issue of retrievability in spent fuel storage applications.

Moreover, the NRC is not aware of any deficiencies in its current regulations that would challenge the continued safe storage of spent fuel in spent fuel pools or dry cask systems. If, at some time in the future, the NRC were to identify a concern with the safe storage of spent fuel, the NRC would evaluate the issue and take action to change its regulatory program necessary to protect public health and safety. The NRC will continue to monitor the ongoing research into spent fuel storage.

No changes have been made to this ISG as a result of this comment.

**Comment 45. Marv Lewis**: Lack of retrievability can impact future needs. The USA may be embroiled in future wars where Pu in spent fuel is a necessity for defense. I pray this never happens.

*Response:* The staff disagrees with this comment. The draft ISG-2, Rev. 2 does not eliminate the requirement for retrievability. Instead, it provides options to meet the requirement. No changes have been made to this ISG as a result of this comment.

**Comment 46. Marv Lewis**: This rulemaking proceeded with little publicity. This omission is unfair to a public which must pay all the future costs.

*Response:* The staff disagrees with this comment. Draft ISG-2, Rev. 2, is not a rulemaking, but is instead, guidance to the staff.

Moreover, the staff has continued to engage the public in this discussion including hosting public meetings (e.g., July 29, 2015 public meeting, ML15216A272, and October 29, 2015, ML151317A259) and requesting comment in the *Federal Register* (80FR63843).

No changes have been made to this ISG as a result of this comment.

**Comment 47. Yankee Atomic Electric Company**: YAEC believes that Draft ISG 2, Revision 2 is consistent with a risk-informed, performance based regulatory approach. We support the Draft ISG's position that fuel retrievability should include removal of a canister loaded with spent fuel assemblies from a storage cask/overpack, as well as removal of a cask loaded with spent fuel assemblies from the storage location.

*Response:* No changes have been made to this ISG as a result of this comment.

**Comment 48. Yankee Atomic Electric Company**: YAEC has previously commented to the NRC (letter dated March 18, 2013, BYR 2013-016, NRC Docket ID 2013-0004) that retrievability can and should be canister based and that any retrieval of spent fuel assemblies stored at sites such as our is best performed at a future consolidated storage, reprocessing, or repository facility. Spent fuel assembly retrieval at sites designed for these tasks is preferable, because stand-alone Independent Spent Fuel Storage Installations, such as YAEC, no longer possess the capability to retrieve spent fuel assemblies from a dry storage canister.

*Response:* No changes have been made to this ISG as a result of this comment.

**Comment 49. Yankee Atomic Electric Company**: YAEC also agrees with the Draft ISG position that in order to verify that the 10 CFR 72.122 retrievability requirements are met by applicants for renewal of an ISFSI license, the NRC staff can rely on the Aging Management Programs and Time-Limited Aging Analyses established under NRC and NEI guidance documents. Industry and site specific operating experience, inspections, and analysis performed during the storage period provide further assurance that the approved design bases will be maintained during the period of extended operation and that fuel retrieval is maintained.

*Response:* No changes have been made to this ISG as a result of this comment.

**Comment 50. Yankee Atomic Electric Company**: In conclusion, YAEC supports the comments submitted on the Draft ISG 2, Revision 2 by the Nuclear Energy Institute.

*Response:* No changes have been made to this ISG as a result of this comment.

**Comment 51. Connecticut Yankee Atomic Power Company**: CYAPCO believes that Draft ISG 2, Revision 2 is consistent with a risk-informed, performance based regulatory approach. We support the Draft ISG's position that fuel retrievability should include removal of a canister loaded with spent fuel assemblies from a storage cask/overpack, as well as removal of a cask loaded with spent fuel assemblies from the storage location.

*Response:* No changes have been made to this ISG as a result of this comment.

**Comment 52 Connecticut Yankee Atomic Power Company**: CYAPCO has previously commented to the NRC (letter dated March 18, 2013, CY-13-019, NRC Docket ID 2013-0004) that retrievability can and should be canister based and that any retrieval of spent fuel assemblies stored at sites such as our is best performed at a future consolidated storage, reprocessing, or repository facility. Spent fuel assembly retrieval at sites designed for these tasks is preferable, because stand-alone Independent Spent Fuel Storage Installations, such as CYAPCO, no longer possess the capability to retrieve spent fuel assemblies from a dry storage canister.

*Response:* No changes have been made to this ISG as a result of this comment.

**Comment 53. Connecticut Yankee Atomic Power Company**: CYAPCO also agrees with the Draft ISG position that in order to verify that the 10 CFR 72.122 retrievability requirements are met by applicants for renewal of an ISFSI license, the NRC staff can rely on the Aging Management Programs and Time-Limited Aging Analyses established under NRC and NEI guidance documents. Industry and site specific operating experience, inspections, and analysis

performed during the storage period provide further assurance that the approved design bases will be maintained during the period of extended operation and that fuel retrieval is maintained.

*Response:* No changes have been made to this ISG as a result of this comment.

**Comment 54. Connecticut Yankee Atomic Power Company**: In conclusion, CYAPCO support the comments submitted on the Draft ISG 2, Revision 2 by the Nuclear Energy Institute.

*Response:* No changes have been made to this ISG as a result of this comment.

**Comment 55. Maine Yankee Atomic Power Company**: Maine Yankee believes that Draft ISG 2, Revision 2 is consistent with a risk-informed, performance based regulatory approach. We support the Draft ISG's position that fuel retrievability should include removal of a canister loaded with spent fuel assemblies from a storage cask/overpack, as well as removal of a cask loaded with spent fuel assemblies from the storage location.

*Response:* No changes have been made to this ISG as a result of this comment.

**Comment 56 Maine Yankee Atomic Power Company**: Maine Yankee has previously commented to the NRC (letter dated March 18, 2013, OMY-13-025, NRC Docket ID 2013-0004) that retrievability can and should be canister based and that any retrieval of spent fuel assemblies stored at sites such as our is best performed at a future consolidated storage, reprocessing, or repository facility. Spent fuel assembly retrieval at sites designed for these tasks is preferable, because stand-alone Independent Spent Fuel Storage Installations, such as Maine Yankee, no longer possess the capability to retrieve spent fuel assemblies from a dry storage canister.

*Response:* No changes have been made to this ISG as a result of this comment.

**Comment 57. Maine Yankee Atomic Power Company**: Maine Yankee also agrees with the Draft ISG position that in order to verify that the 10 CFR 72.122 retrievability requirements are met by applicants for renewal of an ISFSI license, the NRC staff can rely on the Aging Management Programs and Time-Limited Aging Analyses established under NRC and NEI guidance documents. Industry and site specific operating experience, inspections, and analysis performed during the storage period provide further assurance that the approved design bases will be maintained during the period of extended operation and that fuel retrieval is maintained.

*Response:* No changes have been made to this ISG as a result of this comment.

**Comment 58. Maine Yankee Atomic Power Company**: In conclusion, Maine Yankee support the comments submitted on the Draft ISG 2, Revision 2 by the Nuclear Energy Institute.

*Response:* No changes have been made to this ISG as a result of this comment.

**Comment 59. Richard Morgal**: The DOE has stated that large canisters (such as the 37 assembly Holtec Hi-Storm UMAX) are not suitable for disposal at a Department of Energy (DOE) permanent repository.

If the NRC allows these large canisters to be loaded and then stored on-site with no plan for retrievability of the assemblies, it would appear that the NRC is essentially stranding these canisters on-site permanently. Because the DOE will not take them due to their excessive size.

This is a very realistic, non-safety related, problem with current NRC regulations to allow spent nuclear fuel to be stored in dry storage technology with no documented/proven means of re-configuring the spent nuclear fuel into canisters the DOE sees as compatible with a permanent repository.

Given this conflict between the NRC allowing huge canisters to store spent nuclear fuel and its incompatibility with DOE permanent storage of the spent fuel, it is likely the canisters will be stranded on-site for many decades.

*Response:* This comment is outside the scope of the draft ISG-2, Rev. 2, which is limited to the issue of retrievability in spent fuel storage applications.

No changes have been made to this ISG as a result of this comment.

**Comment 60. Richard Morgal**: For cooling purposes these huge stainless steel canisters will be exposed to ambient air. At marine influenced sites, the ambient air is rich with Magnesium salts known to cause Chloride Induced Stress Corrosion Cracking (CISCC) to the canisters.

During the decades of storage, it is quite likely that CISCC will degrade the canisters to a point where they are not capable of containing spent nuclear fuel during transport and will require being re-packaged before being relocated.

During the decades of storage, it is quite likely that CISCC will degrade these canisters to a point where they will lose their ability to remain air-tight, allowing radioactive Krypton 85 to, be released into the immediate environment.

*Response:* See the response to Comment 19 and 34.

**Comment 61. Richard Morgal**: During the decades of storage, these breached canisters will "breathe" in the ambient air, allowing both oxygen and water to reach the spent fuel rods, creating, opportunities for the zirconium cladding to oxidize...

*Response:* This comment is outside the scope of the draft ISG-2, Rev. 2, which is limited to the issue of retrievability in spent fuel storage applications.

In addition, this concern has been evaluated and documented in PNL-6365 “Evaluation of Cover Gas Impurities and Their Effects on the Dry Storage of LWR Spent Fuel,” R. W. Knoll and E.R. Gilbert, November 1987. http://www.osti.gov/scitech/servlets/purl/5599035

The oxidation rate of zirconium cladding is strongly temperature dependent. Knoll and Gilbert (1987) state that although the Zircaloy cladding is thermodynamically capable of reacting with the inventory of oxidizing gases, the oxidation kinetics are slowed by the relatively low cladding temperatures in storage and by the pre-existing oxide scale on the spent fuel cladding. Based on the conservative oxidation rate equation published by Knoll and Gilbert (1987) over the temperature range of 260 to 400 °C, the loss of Zircaloy cladding thickness in 1 year at 330 °C would be approximately 0.075 percent of the cladding wall thickness. As cladding temperatures decrease, the oxidation rate also decreases. At a temperature of 275 °C, loss of 1 percent of the Zircaloy cladding wall thickness would take more than 100 years. Thus, after decades in storage, the cladding temperatures will be too low for significant loss of Zircaloy cladding thickness by oxidation.

No changes have been made to this ISG as a result of this comment.

**Comment 62. Richard Morgal**: During the decades of storage, the people who benefited from the use of the electric power generated by the spent-nuclear fuel will have passed on, leaving a new generation to address the mess that the NRC and the Department of Energy has left behind. With no benefit derived from the waste we are leaving them.

Have our ancestors left us a legacy as toxic or dangerous as the legacy we are leaving our descendants inside of these dry canisters? I can't think of any.

*Response:* This comment is outside the scope of the draft ISG-2, Rev. 2, which is limited to the issue of retrievability in spent fuel storage applications.

It is not within the purview of the NRC's regulatory role to determine whether nuclear power is part of the U.S. energy solution, but only to ensure that, as long as nuclear power is a part of our energy portfolio, that it is conducted in such a manner that the public health and safety, and common defense and security is protected. No changes have been made to this ISG as a result of this comment.

**Comment 63. Richard Morgal**: With no documented means of retrieving the material safely available now, how can the NRC force later generations to solve this problem?

*Response:* The staff disagrees with this comment. There are means to retrieve individual fuel assemblies from a canister that have been proven in industry with operating experience. While technologies addressing retrievability are likely to improve, this is not a technology that would have to be developed. However, that is not what the ISG is addressing. The ISG provides flexibility and options for complying with the retrievability requirement. The option chosen by the licensee would need to comply with design basis of the system and the regulations. No changes have been made to this ISG as a result of this comment.

**Comment 64. Richard Morgal**: Ethically, the NRC must specify and PROVE a safe means of retrieving the spent nuclear fuel assemblies onsite from these huge stainless steel canisters BEFORE these canisters are allowed to be stored on-site for countless decades.

Since these canisters are already deployed on-site of most nuclear power plant sites, this document should NOT reach the conclusion that there is no need for the spent nuclear fuel to be retrievable.

*Response:* The staff disagrees with this comment. The NRC currently requires applicants to demonstrate the retrievability of fuel from the system. This ISG does not change this requirement, but instead, provides options for complying with the retrievability requirement in future applications. The safety margins would not be reduced by changing the guidance on retrievability. The option chosen by the licensee would need to comply with the design basis of the system and the applicable regulations.

See also the response to Comments 14 and 19(a).

No changes have been made to this ISG as a result of this comment.

**Comment 65. Richard Morgal**: The spent nuclear fuel must be retrievable as one of the basic tenants of the storage technology being implemented so that it can be repackaged into Department of Energy certified canisters suitable for permanent disposal.

*Response:* See response to Comment 59.

**Comment 66. Richard Morgal**: The spent nuclear fuel must be retrievable to allow the material to be repackaged before being relocated to a different location after years of being deployed in a CISCC prone environment.

The spent nuclear fuel must be retrievable to allow the material to be repackaged after the canister has suffered from CISCC sufficiently to breach the canister allowing the ingress of oxygen and water into the canister. Leaving behind an even larger threat to future generations.

*Response:* See the response to Comments 19, 61, and 63.

**Comment 67. Richard Morgal**: The spent nuclear fuel must be retrievable, with specifications in place that document proven methods and procedures relating to how one goes about safely getting the fuel out of the canisters the NRC is allowing to be deposited across our country.

*Response:* See response to Comment 63.

**Comment 68. Richard Morgal**: Our nation prides itself as a nuclear nation, our policies and procedures for the handling of our spent nuclear fuel need to be exemplary to the rest of the world. What is being proposed in this document is a disgrace.

Its our mess, lets keep it clean and tidy rather than leaky and volatile. Future generations are relying upon the NRC to do the right thing and plan for all foreseeable situations that could arise in the future.

*Response:* This comment is outside the scope of the draft ISG-2, Rev. 2, which is limited to the issue of retrievability in spent fuel storage applications. No changes have been made to this ISG as a result of this comment.

**Comment 69. Richard Morgal**: The problems I point out in the NRC's approach to retrievability of our spent nuclear fuel are not far fetched and are foreseeable situations that are likely to occur. Please include in the Fuel Retrievability document solutions to the three scenarios listed above.

Those being:

Incompatibility with Department of Energy permanent repository canister requirements.

Need to repackage the spent fuel before transport following decades of storage in salt rich environments;

Need to repackage the spent fuel following a breached canister that has been stored for decades.

*Response:* See response to Comments 19(a) and 59.

**Comment 70. Richard Morgal**: Since almost all our nation's spent nuclear fuel is being stored on-site at the nuclear facility where it was used, the method used to retrieve the spent nuclear fuel from a canister must be on-site.

Given the possibility that the spent fuel may not be transportable due to damage of the stainless steel canister, the ability to retrieve spent fuel from a canister must be deployable to all sites that currently store spent nuclear fuel in dry canisters or plan on storing the fuel on-site in dry canisters.

If on-site retrieval is not included in the planning process to get the fuel out of a canister, there will be no means to relocate fuel from a damaged canister off-site, regardless of the cause of the canister damage. These are 100 ton radioactive canisters, surely the NRC believes there needs to be a means of retrieving their contents, if the canister becomes damaged.

The process of developing a plan to retrieve the spent fuel from a dry canister should include a list of installed on-site infrastructure features at the ISFSI that will facilitate the retrieval of the spent fuel.

Features such as a cooling pool or hot swap tower, 150 ton gantry crane, air handling equipment, filtering equipment... All proven and developed, not left for a future generation to figure out and pay for.

If these requirements are placed upon decommissioning nuclear power plants that plan on implementing an ISFSI, it would be possible to reuse hundreds of millions of dollars of installed plant infrastructure to perform retrieval. Rather than having to rebuild the infrastructure later due to poor planning or wishful thinking.

It is incorrect to state "we don't know what will be needed to retrieve the fuel so we can't specify the infrastructure", that's leaving the problem to the next generation. This problem is our problem and we need to document how it is to be handled with current technology that is PROVEN.

The NRC needs to determine a method of retrieving the fuel from dry canisters and list the site infrastructure required to implement a PROVEN technique for ON-SITE retrieval of spent nuclear fuel from dry storage canisters.

With such a plan in place and list of infrastructure requirements to perform on-site retrieval, the public can then believe that the NRC is considering a most likely situation that might occur during the indeterminate period of time that the dry storage of spent nuclear fuel will reside on site.

*Response:* See response to Comments 19(f), 21, 23, 63, and 19(e).

No changes have been made to this ISG as a result of this comment.