

INDUSTRY WHITE PAPER ON STORAGE CASK/TRANSPORTATION PACKAGE CONTENTS

1.0 BACKGROUND

Industry is currently working to help inform NRC's decision pertaining to the resolution of RIRP¹ Issue I-10-01, "PWR Fuel Top Nozzle Stress Corrosion Cracking." Certain licensees are choosing to modify the structure of some of the assemblies susceptible to stress corrosion cracking of the top nozzle bulge joints as a means of ensuring safe handling, storage, and transportation. One decision that is needed early in the resolution process is whether Part 72 license/CoC amendments and Part 71 CoC amendments are necessary for licensees to store and/or transport these modified fuel assemblies.

This white paper addresses the specific question of whether the additional hardware used in the structural modifications to some of these assemblies must be identified and licensed as "contents" per 10 CFR Part 72 and 10 CFR Part 71 in the storage system and/or transportation package, irrespective of the technical aspects and safety analysis impact of the modifications.

The two types of hardware used to structurally reinforce SCC-susceptible fuel assemblies are:

1. Guide tube anchors (or similar devices) that are inserted into several of the fuel assembly guide tubes to transfer the lifting load from the top nozzle to the guide tubes, bypassing the bulge joints.
2. Instrument Tube Tie Rods (ITTRs) (or similar devices) that are inserted through the length of the fuel assembly via the center instrument tube and tie the fuel assembly bottom nozzle to the top nozzle to remove the lifting load from the bulge joint area.

The objective of this white paper is to provide industry's position on, and basis as to whether guide tube anchors, ITTRs or similar devices necessarily need to be classified as storage cask or transportation package contents, based on the regulations in 10 CFR 72 and 10 CFR 71.

2.0 THE REGULATIONS

2.1 10 CFR 72 - ISFSI Storage

The regulations in 10 CFR 72 do not provide a specific definition of what is considered cask contents. The regulations broadly refer to spent fuel, high-level radioactive waste (HLW), and Greater than Class C (GTCC) waste. Each of these terms is defined in §72.3:

Spent Nuclear Fuel or Spent Fuel means fuel that has been withdrawn from a nuclear reactor following irradiation, has undergone at least one year's decay since being used as a source of energy in a power reactor, and has not been chemically separated into its constituent elements by reprocessing. Spent fuel includes the special nuclear material, byproduct material, source material, and other radioactive materials associated with fuel assemblies.

¹ RIRP is the NEI Spent Fuel Storage and Transportation Regulatory Issue Resolution Protocol, described in NEI 10-03.

High-level radioactive waste or HLW means (1) the highly radioactive material resulting from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid material derived from such liquid waste that contains fission products in sufficient concentrations; and (2) other highly radioactive material that the Commission, consistent with existing law, determines by rule requires permanent isolation.

Greater than Class C waste or GTCC waste means low-level radioactive waste that exceeds the concentration limits of radionuclides established for Class C waste in § 61.55 of this chapter.

10 CFR 72.3 also provides a definition of “design capacity” that refers to contents:

Design capacity means the quantity of spent fuel, high-level radioactive waste, or reactor-related GTCC waste, the maximum burn up of the spent fuel in MWD/MTU, the terabequerel (curie) content of the waste, and the total heat generation in Watts (btu/hour) that the storage installation is designed to accommodate.

2.2 10 CFR 71 - Transportation

10 CFR 71.0 defines the purpose and scope of the regulations in Part 71, which include

(1) Requirements for packaging, preparation for shipment, and transportation of **licensed material**; and

(2) Procedures and standards for NRC approval of packaging and shipping procedures **for fissile material and for a quantity of other licensed material in excess of a Type A quantity**.

“Licensed material” is defined in 10 CFR 71.4 as follows:

Licensed material means byproduct, source, or special nuclear material received, possessed, used, or transferred under a general or specific license issued by the Commission pursuant to the regulations in this chapter.

10 CFR 71.33(b) provides requirements for package contents:

(b) With respect to the contents of the package:

- (1) Identification and maximum radioactivity of radioactive constituents;
- (2) Identification and maximum quantities of fissile constituents;
- (3) Chemical and physical form;
- (4) Extent of reflection, the amount and identity of nonfissile materials used as neutron absorbers or moderators, and the atomic ratio of moderator to fissile constituents;
- (5) Maximum normal operating pressure;
- (6) Maximum weight;
- (7) Maximum amount of decay heat; and
- (8) Identification and volumes of any coolants.

3.0 DISCUSSION

Licensees are required to comply with their 10 CFR 72 CoC or specific license and 10 CFR 71 CoC for all aspects of spent nuclear fuel storage at an ISFSI and transportation of that spent fuel. The licenses and CoCs include requirements on the contents of the storage cask and transportation package. Consideration of contents was, for many years, focused on the spent fuel assemblies themselves. Over time, however, licensees recognized the need to store and ultimately transport other hardware integral to the fuel assemblies, such as BWR fuel channels and PWR thimble plug devices (TPDs), control rod assemblies (CRAs), and burnable poison rod assemblies (BPRAs).

In the late 1990s a licensee loaded PWR fuel assemblies containing BPRAs and TPDs into a spent fuel storage cask without those devices being included in the license as cask contents. The NRC cited the licensee for violating the terms of their NRC license and subsequently issued Information Notice (IN) 99-29 to inform the industry of the event. The IN goes on to state:

“To store materials that are not explicitly permitted for storage in their site-specific license, or the applicable cask CoC, the licensee must seek a license or CoC amendment in accordance with the regulations.”

The IN does not provide additional clarification of the regulations, nor does it provide the regulatory basis for the above statement. As such, items integral to, but not part of the fuel assembly when burned in the reactor could be construed as contents in a narrow interpretation of the IN. It is the Part 72 and 71 regulations themselves that provide the ultimate basis to determine whether the guide tube anchors, ITTRs, and similar devices should be considered cask or package contents.

4.0 INDUSTRY POSITION

4.1 10 CFR 72 – ISFSI Storage

The salient parts of the Part 72 definitions listed in Section 2.1 above that address storage cask contents are listed below. The Part 72 definition with which each item is associated is shown in parentheses after the item. Following the list is industry’s evaluation of whether guide tube anchors and ITTRs meet any of these Part 72 requirements for being classified as contents.

1. It is irradiated in the reactor (definition of spent fuel)
2. It has not been reprocessed (definition of spent fuel)
3. It includes the special nuclear material, byproduct material, source material, and other radioactive materials associated with fuel assemblies (definition of spent fuel)
4. It is produced as a result of spent fuel reprocessing (definition of HLW)
5. It is other highly radioactive material requiring permanent isolation (definition of HLW)
6. It is GTCC waste (definition of GTCC waste)
7. It can be defined in terms of burnup, curie content, and heat generation (definition of design capacity)

Industry’s position is that guide tube anchors, ITTRs, and similar devices are not spent fuel by definition. They are not installed in the fuel assemblies when they are in the reactor, nor can spent fuel assemblies outfitted with either hardware be subsequently used in the reactor in a later

operating cycle. Guide tube anchors prevent the installation and use of thimble plugs or control rods and would disrupt coolant flow through the guide tubes. ITTRs prevent in-core instruments from being inserted into the assembly. Therefore, they are not subject to neutron activation and cannot become sources of radiation to be accounted for in the cask or package design.

Guide tube anchors, ITTRs and other similar devices are not a result of spent fuel reprocessing and, because they are not activated, do not constitute “other highly radioactive material requiring permanent isolation” or GTCC waste. Lastly, because guide tube anchors, ITTRs and other similar devices are not installed in fuel assemblies while they are being burned in the reactor and are not spent fuel themselves, they cannot be defined in terms of burnup, curie content, or heat generation.

The effects of the presence of this hardware on the technical aspects of the storage cask design, including structural, thermal, shielding, criticality, and confinement will be evaluated by the CoC holder or licensee and reviewed under the provisions of 10 CFR 72.48 to determine if prior NRC review and approval is required for storage.

Therefore, it can be concluded that neither guide tube anchors, nor ITTRs, nor similar devices with the same design function (and limitations on use) are contents required to be specifically licensed in a Part 72 license or CoC. These components should be evaluated when loaded into the storage casks, and supported by an appropriate technical analysis or evaluation to ensure they comply with the applicable license or CoC.

4.2 10 CFR 71 – Transportation

Guide tube anchors, ITTRs and other similar devices are not “licensed material” as defined in 10 CFR 71.4 because they are not byproduct, source, or special nuclear material. Each of the criteria for defining contents in 10 CFR 71.33(b) is addressed below as it applies to the subject hardware. The Part 71.33(b) requirements are listed individually below with industry’s evaluation following.

(1) Identification and maximum radioactivity of radioactive constituents

Guide tube anchors, ITTRs and other similar devices are not radioactive constituents.

(2) Identification and maximum quantities of fissile constituents

Guide tube anchors, ITTRs and other similar devices are not fissile constituents.

(3) Chemical and physical form

The chemical and physical form of the guide tube anchors, ITTRs and other similar devices is well understood and has a minimal impact on safe transportation of the licensed material because of the small volume displacement of water/gas by the hardware. Licensees will perform the necessary evaluations to transport this material under the existing Part 71 CoC with assistance from the CoC holder, as necessary.

- (4) Extent of reflection, the amount and identity of nonfissile materials used as neutron absorbers or moderators, and the atomic ratio of moderator to fissile constituents

Guide tube anchors, ITTRs and other similar devices are nonfissile materials. Which are not credited in the package criticality analysis as neutron absorbers and have an insignificant moderator effect. The effect of the presence of the hardware on the reactivity of the package is expected to be minimal because of the small volume displacement of water/gas by the hardware. Licensees will perform the necessary evaluations to transport this material under the existing Part 71 CoC with assistance from the CoC holder, as necessary.

- (5) Maximum normal operating pressure

Guide tube anchors, ITTRs and other similar devices displace open space within the fuel assembly that would otherwise be occupied by water moderator (during loading and unloading operations in a fuel pool) or an inert gas (after package preparation and during transportation). The effect of the presence of the hardware on the maximum normal operating pressure is expected to be minimal because of the small volume displacement of water/gas by the hardware. Licensees will perform the necessary evaluations to transport this material under the existing Part 71 CoC with assistance from the CoC holder, as necessary.

- (6) Maximum weight

Guide tube anchors, ITTRs and other similar devices displace open space within the fuel assembly that would otherwise be occupied by water (during loading and unloading operations in a fuel pool) or an inert gas (after package preparation and during transportation). The effect of the presence of the hardware on the maximum weight of the package is expected to be minimal because of the small volume displacement of water/gas by the hardware. Licensees will perform the necessary evaluations to transport this material under the existing Part 71 CoC with assistance from the CoC holder, as necessary.

- (7) Maximum amount of decay heat

Guide tube anchors, ITTRs and other similar devices are not activated materials and do not otherwise emit decay heat.

- (8) Identification and volumes of any coolants

Guide tube anchors, ITTRs and other similar devices are not themselves coolants and displace open space within the fuel assembly that would otherwise be occupied by water (during loading and unloading operations in a fuel pool) or an inert gas (after package preparation and during transportation). The effect of the presence of the hardware on the volume of these coolants and the heat removal function of the transportation package is expected to be minimal because of the small volume displacement of water/gas by the hardware. Licensees will perform the necessary evaluations to transport this material under the existing Part 71 CoC with assistance from the CoC holder, as necessary.

In summary, the effects of the presence of this hardware on the technical aspects of the transportation package design, including structural, thermal, shielding, criticality, and containment will be evaluated by the licensee with assistance from the CoC holder, as necessary, to determine if prior NRC review and approval is required for transportation.

Therefore, it can be concluded that neither guide tube anchors, nor ITTRs, nor similar devices with the same design function (and limitations on use) are contents required to be specifically licensed in a Part 71 CoC. These components should be evaluated when loaded into the transportation package, and supported by an appropriate technical analysis or evaluation to ensure they comply with the applicable CoC. We recognize that other regulatory requirements may direct these materials to require NRC approval for transportation.

4.3 Part 50 Considerations

Licensees that modify SCC-susceptible spent fuel assemblies with guide tube anchors, ITTRs, or similar devices must ensure the modified spent fuel assemblies are acceptable for wet rack storage in the spent fuel pool. Because this level of detail for wet pool storage is not included in the operating plant technical specifications, authorization to store these modified fuel assemblies is granted via 10 CFR 50.59. The licensees address the thermal, structural, criticality, handling, and accident analysis impact of storing these modified fuel assemblies in the spent fuel pool racks. If the 50.59 review is successful, the fuel assemblies are modified and placed in their wet storage location.

5.0 CONCLUSION

Industry's position is that guide tube anchors, ITTRs, and other similar devices with the same design functions (and limitations on use) are not contents as defined in the 10 CFR 72 or 71 regulations. Thus, this hardware does not require a Part 72 license or CoC amendment or a 10 CFR 71 CoC amendment to add this hardware as contents in the license/CoC. This hardware should be evaluated for storage and transportation in accordance with the applicable license/CoC and regulatory process(es). We recognize that license/CoC amendments could be required as a result of other regulatory processes (e.g., 10 CFR 72.48).