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U.S. Nuclear Regulatory Commission
11555 Rockville Pike
Rockville, MD 20852-2738

Attn: Mr. Doug Weaver
Director, Division of Spent Fuel Storage and Transportation (SFST)
Office of Nuclear Material Safety and Safeguards (NMSS)

Subject: REQUEST FOR CLARIFICATION OF AN APPARENT NEW OR CHANGING REGULATORY INTERPRETATION OF 10 CFR PART 71 PERTAINING TO HYPOTHETICAL ACCIDENT CONDITIONS OF FREE DROP AND "SECONDARY IMPACT" OF SPENT NUCLEAR FUEL WITHIN TYPE B PACKAGING

Docket No. 71-9356

Dear Mr. Weaver,

Further to conversations with you and the SFST staff on December 13, 2011, NAC International, Inc. (NAC) would like to present, as described in detail in the Attachment hereto, this informal request for clarification of an emerging issue (as indicated in the subject line above) that NAC anticipates it may be asked to address by SFST staff as part of the pending review and approval of NAC's MAGNATRAN application, dated January 19, 2011. NAC requests receiving a written response to allow NAC to adequately and efficiently respond to the NRC position on this issue.

As set forth in the Attachment, it appears that SFST may have adopted a new or changed regulatory requirement that "free drop" testing in accordance with Sections 71.71 and 71.73 of 10 CFR Part 71 requires the applicant to assume that transport cask contents are oriented in a position that is not an orientation that could be realistically expected to occur during the free drop ("secondary impact" assumption). The Attachment provides NAC's assessment of the issue. The assessment includes those references and logic NAC has used in laying out its preliminary conclusions. This was done to provide you and your staff insight into NAC's current position on the issue for NRC's consideration. In short, NAC has performed a detailed review and assessment but was unable to identify any support for applying the secondary impact assumption noted above as a regulatory requirement pursuant to 10 CFR Part 71.

As discussed in prior conversations, NAC is asking for this clarification in support of its pending MAGNATRAN application.

Most importantly, NAC is committed to nuclear safety. If the NRC concludes that the secondary impact assumption is a safety issue required by the regulations to be evaluated, NAC would be committed to addressing that safety issue. In order to adequately protect the public health and safety, NAC would expect the NRC to provide guidance to the industry in order to ensure the safety issue is addressed uniformly. This includes guidance for addressing the currently loaded storage canisters that have approved and active NRC licensed transportation casks which do not consider this secondary impact assumption.

If you have any comments or questions, please contact me on my direct line at 678-328-1274.

Sincerely,

Anthony L. Patko
Director, Licensing
Engineering

ATTACHMENT as stated

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ATTACHMENT

I. Statement of Issue for Clarification

With respect to 10 CFR Part 71 and the pending NRC review of NAC's MAGNATRAN application, is the following statement contained in Reference 2, (i) an existing regulatory requirement or (ii) a new regulatory requirement?

> *Excerpt from Reference 2, Section 2.6.1: "Staff has concluded that only relying on a typical test configuration wherein the package has an initial condition of base-down or bottom-up, which allows gravity to act on the contents and close the existing geometric gap, is unconservative and ignores the as-shipped conditions of the package."*

NAC seeks the following clarification in the NRC's response:

A. If "secondary impact" is an existing regulatory requirement, please provide a citation as to the NRC rule, regulation or order and any supporting NRC guidance.

B. If it is a new NRC position, i.e., it is not an existing regulatory requirement, please provide a citation as to why an applicant would need to comply with the "secondary impact" assumption.

II. Listing of Documents Reviewed by NAC

References:

1. 10 CFR Part 71.73, Hypothetical Accident Conditions (HAC)
2. Safety Evaluation Report (SER) for the Holtec HI-STAR 60 Cask, Revision 0, Holtec, May 2009
3. NUREG-0170, Final Environmental Statement on the Transportation of Radioactive Material by Air and Other Modes, December 1977
4. NUREG/CR-4829, Shipping Container Response to Severe Highway and Railway Accident Conditions, February 1987
5. SAND90-2406, A Method for Determining the Spent-Fuel Contribution to Transport Cask Containment Requirements, November 1992
6. 40 FR 23768, Packaging and Transportation by Air, June 2, 1975
7. 48 FR 35600, Rule To Achieve Compatibility With the Transport Regulations of the International Atomic Energy Agency (IAEA), August 5, 1983
8. 53 FR 21550, Transportation Regulations; Compatibility With the International Atomic Energy Agency (IAEA), June 8, 1988
9. 60 FR 50248, Compatibility With the International Atomic Energy Agency (IAEA), September 28, 1995
10. NUREG-1617, Standard Review Plan for Transportation Packages for Spent Nuclear Fuel, January 2000
11. Regulatory Guide 7.8, Load Combinations for the Structural Analysis of Shipping Casks for Radioactive Material, Revision 1, March 1989

III. NAC's Assessment -- Discussion

A. 10 CFR Part 71 Licensing for NAC Prior to MAGNATRAN

When licensing a Type B transport cask under 10 CFR Part 71, the regulations require the applicant to provide supporting justification that the package can survive, while remaining subcritical for both normal conditions of transport and Hypothetical Accident Conditions (HAC), without releasing its contents to the environment, sections 10 CFR 71.55, 71.71 and 71.73, respectively. This requires a free drop from 1 ft. for the normal conditions of transport and a 30 ft. free drop for the HAC.

In the past, NRC has approved and licensed NAC transport casks under 10 CFR Part 71, by evaluating these drops with the cask contents in a position consistent with the free drop orientation. For example, the end drop orientation results in all the cask contents resting on the bottom cask lid prior to releasing the cask for the drop test. Upon release of the cask, the cask and its contents would free fall together until impacting an essentially unyielding surface. Until now, this has been NAC's understanding of the regulatory requirements and is consistent with the requirements of 10 CFR 71.55(e).

NAC's understanding is based upon 10 CFR 71.73(c)(1), as follows:

> *"Free drop. A free drop of the specimen through a distance of 9 m (30 ft) onto a flat, essentially unyielding, horizontal surface, striking the surface in a position for which maximum damage is expected."*

NRC guidance for "position" is provided in Regulatory Guide 7.8 (Reference 11), page 7.8-4, which describes "position" to be synonymous with "orientation" of the cask at impact:

> *"In determining which position causes maximum damage, applicants should consider impact orientations in which the cask strikes the impact surface on its top end, top corner, side, bottom end, and bottom corner and the center of gravity of the cask is directly over the point of impact."*

This guidance indicates that "orientation" is with respect to the cask body and not the package, which would include both the cask and its contents. The guidance further indicates that the position of the cask at impact resulting in the most damage is one of many possible relative angular positions between the cask body and the unyielding horizontal surface at impact. Prior to the licensing activities with MAGNATRAN, NAC has applied this guidance as an acceptable means for meeting the HAC requirements by identifying what cask orientation is most damaging for various cask components as described in NUREG-1617 (Reference 10).

In addition to the previous quote, 40 FR 23768 (Reference 6), page 23769, also conveys the word "position" to be applicable to only the cask body by delineating "container" and "package" to mean the cask body vs. the cask body and contents, respectively. The following quote is from page 23769:

> *"Container designs required to meet accident conditions are evaluated under current regulations against the following accident test conditions in sequence:*

30-foot free drop of the container in the most damaging position onto a flat, essentially unyielding surface, 40-inch drop onto a steel bar to test the ability to withstand puncture, 30-minute fire test at 1475° F and 3-foot water immersion test for eight hours."

This section goes further to explain why these test conditions were chosen. The following is a continuation of the previous quote from page 23769:

"The puncture test and the drop test are engineering qualification tests. The test conditions were chosen to provide reproducible laboratory conditions representative of severe transportation accident environments."

A laboratory condition of the package would result in the cask's contents resting at the bottom of the transport cask. This regulatory basis conflicts with SFST's technical review staff's position quoted below from another 10 CFR Part 71 applicant's SER (Reference 2):

"Staff has concluded that only relying on a typical test configuration wherein the package has an initial condition of base-down or bottom-up, which allows gravity to act on the contents and close the existing geometric gap, is unconservative and ignores the as-shipped conditions of the package."

A laboratory condition of the package is consistent with the analysis NAC has performed in the past to evaluate the structural integrity of the cask and the credible fissile material configuration post HAC as required by 10 CFR 71.55(e). This regulatory provision requires the package to be subcritical for the credible fissile material configurations that result from ***only*** the HAC tests specified in 10 CFR 71.73. As described above, those 10 CFR 71.73 specified HAC tests result in the fuel resting on the bottom of the cask prior to the drop. Analyzing these drops in this manner does not result in any drop orientations that would create a secondary impact of the fuel within the cask package.

B. <u>10 CFR Part 71 Licensing After the Concept of Secondary Impact</u>

The concept of a secondary impact of fuel within the cask package, as understood by NAC, was first introduced into NRC licensing activities during the Reference 2 applicant's Type B transport package application. This package was officially licensed by the NRC on May 22, 2009 and incorporated special design features to handle the accident scenario quoted below, which NAC believes is already bounded by the evaluation conditions described in 10 CFR Part 71.

The accident scenario that the NRC described in Reference 2, which NAC anticipates could be applied to its pending application for MAGNATRAN, is as follows:

"With respect to longitudinal gaps, the staff's position is that when transported, the package is oriented in a horizontal position such that an accident event will tend to load the package in an axial direction without the benefit of having a completely closed geometric gap near the bolted lid due to the manner in which the package is loaded onto the conveyance. If the package is vertical, there exists a maximum geometric gap between the closure lid and the contents. As the

package is upended in preparation for transport, this gap will still exist as the direction of gravity does not change to allow for the contents to translate relative to the lid and close the gap. Staff has concluded that only relying on a typical test configuration wherein the package has an initial condition of base-down or bottom-down, which allows gravity to act on the contents and close the existing geometric gap, is unconservative and ignores the as-shipped conditions of the package. The same logical exercise can be performed for the C.G. Over Corner or Slapdown orientations to show that consideration of maximum gaps is conservative and appropriate."

The postulated configuration described in the Reference 2 quote requires the transport cask contents to be virtually suspended within the transport cask prior to the free drop, such that a maximum gap is created between the transport cask contents and the transport cask lower lid. This is not consistent with the prior licensing actions taken by the NRC for NAC's existing NRC licensed transport casks.

C. <u>10 CFR Part 71 Requirements and Secondary Impact</u>

The accident scenario described in Reference 2 is not specified as one of the accident scenarios required to be evaluated within 10 CFR Part 71.71 or 71.73. In NAC's view, it is important to recognize 10 CFR Part 71 does not purport to describe all possible as-shipped or accident configurations. 10 CFR Part 71's framework provides bounding accident conditions within, such that, extreme conservatism would exist within the accident analyses. Many studies over the years have proven this concept, such as NUREG-0170, NUREG/CR-4829 and SAND90-2406 (References 3, 4 & 5). The following quote is from NUREG/CR-4829 (Reference 4):

"By comparing the responses it is determined that most highway and railway accident conditions fall within the 10 CFR 71 hypothetical accident conditions."

Several conservatisms within the regulations that are applicable to and address the concern of the secondary impact of fuel within the transportation package include:

- *Cask drops from up to 30' onto an unyielding surface*

  The assumption that the transportation cask will impact an unyielding surface is highly conservative. In reality, transportation casks carry a significant amount of mass and therefore momentum while being transported. The lack of a real world body that will act as an essentially unyielding structure when impacted by such a massive package is a hypothetical assumption.

- *Criticality analysis to show sub-criticality of the package after the introduction of moderator*

  The regulations require the transportation package to be designed, such that, during a normal condition of transport or HAC, water intrusion into the cask cavity will not occur. However, the regulations also require an evaluation to demonstrate the contents will remain sub-critical even if water is introduced into the cask cavity. This is a hypothetical assumption that by design should not happen.

- *Sequential application of the free drop, crush, puncture and thermal hypothetical accidents onto a single transportation package*

  The regulations require a transportation package to be analyzed to demonstrate that the package's containment boundary will not be breached after successive application of the free drop, crush, puncture and thermal accident conditions. This is a hypothetical assumption that is highly unlikely to occur during a single transport accident.

These conservatisms are also described in the regulatory basis of 10 CFR Part 71. The following quote is from 40 FR 23768, page 23769 (Reference 6):

> *"For example, a 30-foot drop onto an unyielding surface produces impact of shock loads which are more severe than drops of several thousand feet onto targets such as land, water or even city streets which would tend to yield when struck by the package. Because of the conservatism of most designs, packages, when subjected to tests involving free fall from much greater heights than 30-feet, have either remained undamaged or continued to contain their contents. For example, a number of packages which pass NRC qualification tests have also been tested under extra severe conditions such as a 250-foot free fall onto an essentially unyielding surface."*

Sandia National Laboratories (SNL) documented a study performed to determine the spent fuel contribution to transport cask containment requirements, SAND90-2406 (Reference 5). This study concluded axial and lateral gaps between a fuel assembly and its support structures within the transportation cask can be a significant contributor to the structural loading seen by the fuel. The following Figure 1 is an excerpt from page 65 of Reference 5 and provides an excellent illustration of how the secondary impact of the fuel within the cask would not be consistent with a free drop test. That is the fuel would have to be suspended within the cask prior to initiation of the free drop test, such that, an initial gap would exist.

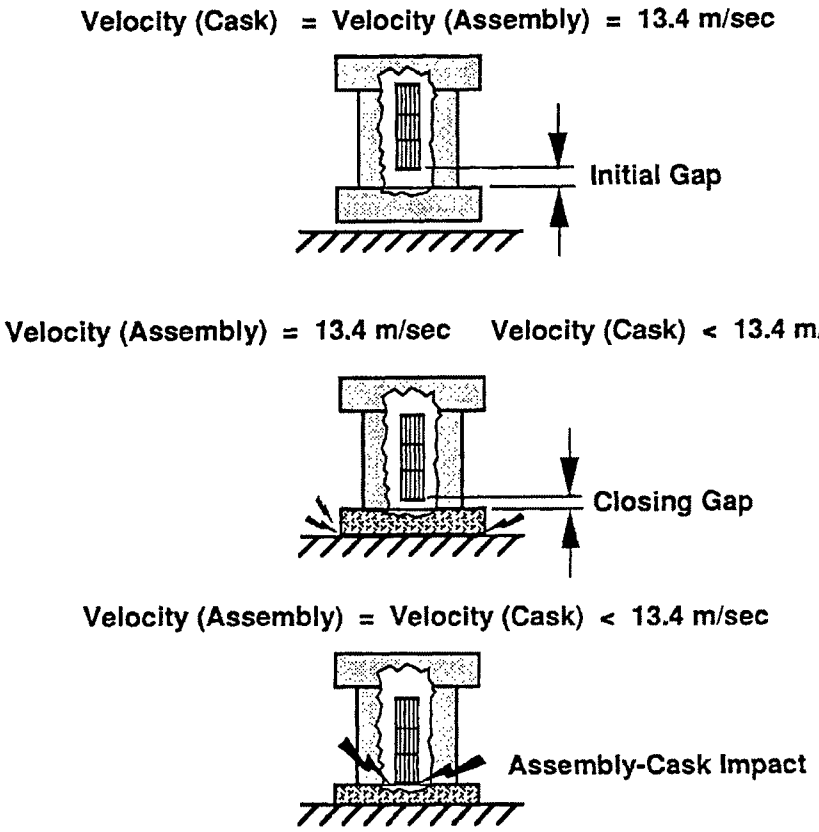

Figure 1
Illustration of End-Drop and Initial Velocity Loading
Courtesy of SNL SAND90-2406

IV. NAC's Assessment – Preliminary Conclusion

NAC's preliminary conclusion is the "secondary impact" assumption is not consistent with existing regulatory requirements. NAC also notes that there is a sound basis for the existing regulations to ensure safety. As this appears to be a new NRC position that is not necessary to ensure adequate protection, it is NAC's position that an assumption of secondary impact is not applicable to the pending NRC review and approval of the MAGNATRAN application.