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April 27, 2007

Jill S. Caverly
Project Manager, Licensing Branch
Division of Spent Fuel Storage and Transportation
U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555-0001

Subject: Response to NRC's RAI for NPC Shipping Package dated 1/26/07

Reference: (1) NRC CoC No. 9294, Docket 71-9294 (TAC L24033)
(2) Letter, S.P. Murray to Director, SFPO, 10/3/06
(3) Letter, S.P. Murray to Director, DSFST, 2/26/07

Dear Ms. Caverly:

Global Nuclear Fuel - Americas, LLC (GNF-A) facility in Wilmington, N.C. has reviewed the NRC request for additional information dated 1/26/07.

In Reference 2, Global Nuclear Fuel-Americas, LLC (GNF-A) requested an update to the Certificate of Compliance USA/9294/AF-85 to provide resolution and clarification of certain issues of understanding identified during international validation. In addition, we requested an update of the certificate to IAEA 1996 status.

On March 15 2007, GNF-A met with the NRC-DSFST to discuss your request for additional information. As discussed at that meeting, additional testing was planned to augment the NPC thermal evaluation analysis. The results of these additional tests along with our responses to your request are attached.

The following is a description of the Attachments to this letter.

Attachment 1 contains the questions and GNF-A's Response to NRC Request for Additional Information (RAI) dated January 26, 2007.

Attachment 2 contains the pages and drawing that have changed in the SAR as described in Attachment 1. They should be inserted as replacement pages/drawing in the SAR documents you have. Based upon the polybottle melting test results, the maximum loading per ICCA (as indicated in Section 1.2.3 of the SAR) will not need to be modified as requested in our October 3, 2006 request. The maximum loading table remains unchanged from CoC No. 9294, Revision 4 (dated 11/21/2005).

Attachment 3 is Drawing Number SK105E4037, Sheet 2, Revision 1.

Please contact me on (910) 675-5950 or Phil Ollis on (910) 675-6301, if you have any questions or would like to discuss this matter further.

Sincerely,

Scott P. Murray, Manager
Licensing & Liabilities COE

cc: SPM 07-024

GNF-A NPC Responses

Attachment 1

Request for Additional Information:

Chapter 1.0

1.1 Submit a revised drawing of the NPC Powder Container. Drawing SK105E4037, sheets 1 through 3, Revision 1, appears to contain information not appropriate for inclusion within a (CoC). Also, confirm that the NPC Powder Container depicted in this revised drawing will be the "plastic receptacle" noted in CoC No. 9294, Revision 4, Condition 5.(a)(3)(b), footnote No. 4. If so, the SAR should be revised to reflect this.

A CoC is a regulatory instrument to control the design of a package used for transportation of radioactive material. See 10 CFR 71.4. While the bottle and lid appear to be components associated with Model No. NPC packaging, the NPC skid base and NPC skid lid do not appear to be packaging components.

This information is being requested in accordance with the provisions of 10 CFR 71.33 which requires an application to include a description in sufficient detail to identify the package accurately and provide sufficient basis for evaluation of the package.

GNF-A Response:

Drawing SK105E4037 sheet 1 and sheet 3 were submitted in error. Drawing SK105E4037, sheets 1 and 3 are not packaging components and will be deleted as references in the SAR Chapter 1.3 Appendix.

Drawing SK105E4037 sheet 2 is submitted with this response.

The SAR Chapter 1 (Section 1.3) has been revised to reflect this change and is submitted with this response.

1.2 Submit a drawing of the NPC "metal receptacle" noted in CoC No. 9294, Revision 4, Condition 5.(a)(3)(b), footnote No. 4. This drawing should contain sufficient information inclusion in CoC No. 9294. In the alternative, revise the SAR to remove the "metal receptacle" as a packaging component.

This information is being requested in accordance with the provisions of 10 CFR 71.33 which requires an application to include a description in sufficient detail to identify the package accurately and provide sufficient basis for evaluation of the package.

GNF-A Response:

There currently is no "metal receptacle" being used as noted in CoC No. 9294, revision 4, Condition 5.(a)(3)(b), footnote 4. The "metal receptacle" was listed as a possible future option in the original submittal, but has never been used or developed.

The SAR Chapter 1 (Section 1.2.3) has been revised to remove the reference to the "metal receptacle" and is submitted with this response.

Also, CoC No. 9294, Revision 4, Condition 5.(a)(3)(b), footnote No. 4. should be revised to delete the reference to the "metal receptacle".

1.3 *Submit a drawing of the NPC "dunnage," if appropriate, based on response to question 2-1. This drawing should contain sufficient information for inclusion in CoC No. 9294.*

This information is being requested in accordance with the provisions of 10 CFR 71.33 which requires an application to include a description in sufficient detail to identify the package accurately and provide sufficient basis for evaluation of the package.

GNF-A Response:

The current payload configuration of the ICCAs includes three polyethylene receptacles/bottles stacked on top of each other. Each ICCA will be shipped with three polyethylene bottles (e.g. if there are only two filled polyethylene bottles there will be one empty polyethylene bottle placed into the ICCA). The total mass inside the ICCA will be less than 60 kgs. including any empty polyethylene bottles. There is no other "dunnage" used during normal transport.

As shown in Exhibit 2-1a, the bottles are tightly packed into the ICCA to limit the movement of the payload. The radial gap between the bottle wall and ICCA wall is 0.08 inches, and the approximate gap between the top bottle lid and ICCA lid is 0.15 inches in the axial direction.

Chapter 2.0

2-1. *Confirm by test or analysis or both that the ICCAs with contents in either plastic or metal receptacles the containment barrier will not be adversely affected as a result of the hypothetical accident condition (HAC).*

The internal arrangement/layout may influence the structural performance and containment function of the ICCA. Therefore, results of either a test or an analysis, or both, are needed to demonstrate that for a given layout, the ability of the ICCA to retain fissile material under the HAC will not be impaired as a result of the impact by the receptacles.

This information is being requested to enable the staff to determine compliance with the requirements of 10 CFR 71.43 and 71.55.

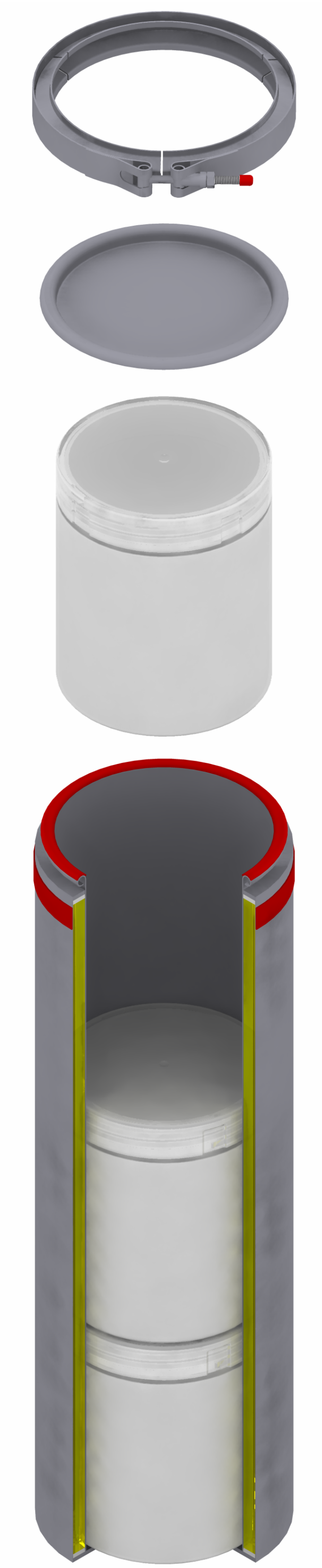
Response:

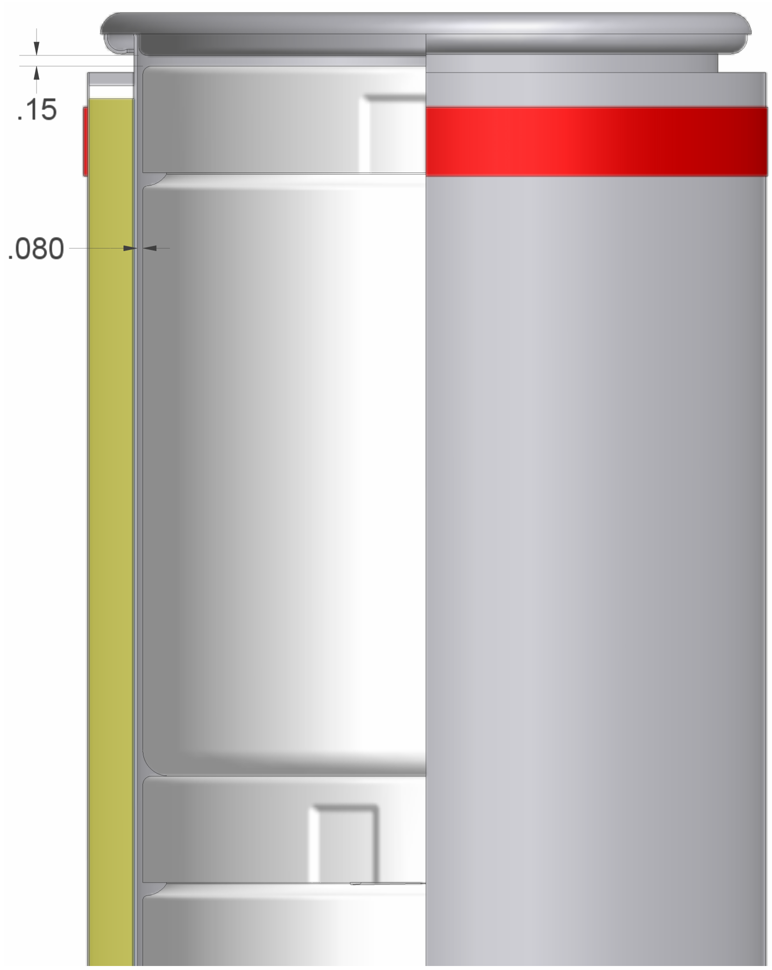
The current payload configuration of the ICCAs includes three polyethylene receptacles/bottles stacked on top of each other. As shown in Exhibit 2-1a, the bottles are tightly packed into the ICCA to limit the movement of the payload. The radial gap between the bottle wall and ICCA wall is 0.08 inches, and the approximate gap between the top bottle lid and ICCA lid is 0.15 inches in the axial direction.

During the design and analysis process of the NPC, the decision was made to evaluate the container using the worst-case payload configuration. For the drop test sequence documented in Appendix 2.10.1 of the SAR, a bounding payload was chosen. Prior to free drop, puncture, and thermal testing, the nine ICCAs of each certified test unit (CTU) were loaded with lose sand and bagged lead shot to simulate the maximum payload of 132 pounds (60 kg) of uranium oxide powder. Justification for the use of loose payload and ignoring the inner packing is:

- This loose payload configuration was considered conservative since the maximum payload is applied to the closure region of the ICCA. Additional packaging was considered an enhancement to the confinement capabilities of the ICCA and limits dispersal of the contents.
- Loose materials were considered a better test of the sealing surface of the ICCA. In reality, the polyethylene bottles limit the total movement of the contents and potential damage to the ICCA imposed by the contents.
- The polyethylene bottles were considered to provide little structural support during the accident sequence since the bottles are fabricated from material that is soft in relation to the steel inner shell of the ICCA. Therefore, additional loading or damage to the ICCA was not anticipated because of using the polyethylene bottles.
- During normal production, the bottles are nearly filled with material. The total mass of the three ICCAs and contents is less than the 60kg design limit. Therefore, loading of the ICCA during the HAC drop sequence is bounded by the CTU payload. The CTU maximized the available kinetic energy and bounds the deformation expected during the drop sequence.

Exhibit 2-1a – ICCA Packing Details





Chapter 3.0

3-1. Provide the results of an evaluation of the effect of the HAC fire on the "plastic receptacles" within the ICCAs.

This information is being requested to enable the staff to determine compliance with the requirements of 10 CFR 71.73.

GNF-A Response:

To determine the thermal performance of the ICCAs and plastic receptacles, i.e. polyethylene bottles, during the HAC fire, an axisymmetric finite element model was first developed using ANSYS. The model includes the ICCA, three polyethylene bottles, and UO_2 contents. For consistency, the model uses the same material properties provided in Chapter 3 of the SAR. Exhibit 3-1a shows the ANSYS model.

The analysis was solved by applying an initial ambient temperature of 132°F and the maximum-recorded ICCA temperature of 365°F to the outer edges of the model [NPC SAR Appendix 2.10.1, *Certification Tests*]. This analysis conservatively assumes that the ICCA wall is instantaneously exposed to the maximum temperature achieved during the fire test and remains at this temperature for one full hour. The results show that after on hour, a maximum polyethylene bottle temperature of 338°F is achieved. Exhibit 3-1b shows the sidewall temperature time history of each polyethylene bottle.

Based on the thermal analysis results, a thermal test of the polyethylene bottles was performed to determine the performance of the bottles in the predicted temperature range. The thermal test involved six polyethylene bottles. Three bottles were tested empty and three contained sand inside of a polyethylene bag.

Except for the case where the melting temperature is reached, a load of 40 kg was applied to each empty bottle during the test to represent two loaded poly bottles stacked on top. Exhibits 3-1c through 3-1e show the empty poly bottle at the various stages during the melting process. As the figures show, once the temperature of the empty poly bottle exceeds 324°F the bottle looses structural integrity and is unable to support the 40 kg weight. The empty bottle melts and collapses under its own weight once the temperature exceeds 340°F. For all lids and bottles, the weight variation was within 1gram. The following table is the summary of results during the thermal testing of the empty poly bottles.

Results for Empty Polyethylene Bottles and Lids

	Softening Point	Loss of Structural Integrity	Melting Point	Flow Temperature[1]
Time in oven (Min.)	20	30	30	30
Test Temperature Range (°F)	270 – 280	306 – 324	340 – 371	—
Average Temperature (°F)	274	315	354	374

1. Manufactures data sheet: A. Schulman PE LP 477-01, Polyethylene, High Density.

For the three bottles filled with sand, the affects of elevated temperatures were less pronounced than the empty bottle cases. Exhibit 3-1f through 3-1h show the poly bottles with sand inside of a polyethylene bag. As Exhibit 3-1f shows, when exposed to temperatures expected during the fire, the bottle maintains its shape through out the test and as the temperature is increased, only the air gap regions of the bottle not in contact with the sand are greatly affected by the increased heat. As Exhibits 3-1g and 3-1h show, the test results for temperatures ranging between 330°F and 370°F are essentially the same. It was noted that at the maximum temperature, the lid material began to melt (see Figure 3-1g). The following table is the summary of results during the thermal testing of the poly bottles filled with sand.

Results for Polyethylene Bottles and Lids Filled with Sand

	Softening Point	Loss of Structural Integrity	Melting Point
Time in oven (Min.)	30	30	30
Test Temperature Range (°F)	270 – 280	330 – 358	344 – 370
Average Temperature (°F)	274	338	354

For the loss of structural integrity case, the weight of the bottle increases. During this test, the polyethylene bag melted at one location and adhered to the side of the bottle. A small amount of sand "dusting" also adhered to the bag contributing to the increase in weight. The total increase in weight was 14.8 grams.

Conclusions:

The following conclusions are made for the NPC polyethylene bottle thermal evaluation:

1. The thermal test confirms that the polyethylene bottles melt at approximately 350°F, which is consistent with the melting temperature given Section 3.3 of the Safety Analysis Report.
2. There was no evidence of material flow in the tested temperature range up to 370°F.
3. When sand or other contents fill the bottle, the only melting that occurs is in the air gap region between the contents and the lid.
4. Because only a 0.08-inch radial gap exists between the polyethylene bottle and the ICCA inner shell, the bottles will be supported circumferentially as the bottles deform in the axial direction. Therefore, the bottles are expected to deform less and more uniformly than what was observed during this test series.
5. The sand and polyethylene never mixed during the test. However, the higher temperature tests, a small amount of sand stuck to the polyethylene bag that bonded with the bottle. Therefore, melting of the plastic bag inside the polyethylene bottle is considered credible during the HAC fire event.

Exhibit 3-1a – ICCA ANSYS Axisymmetric Thermal Model

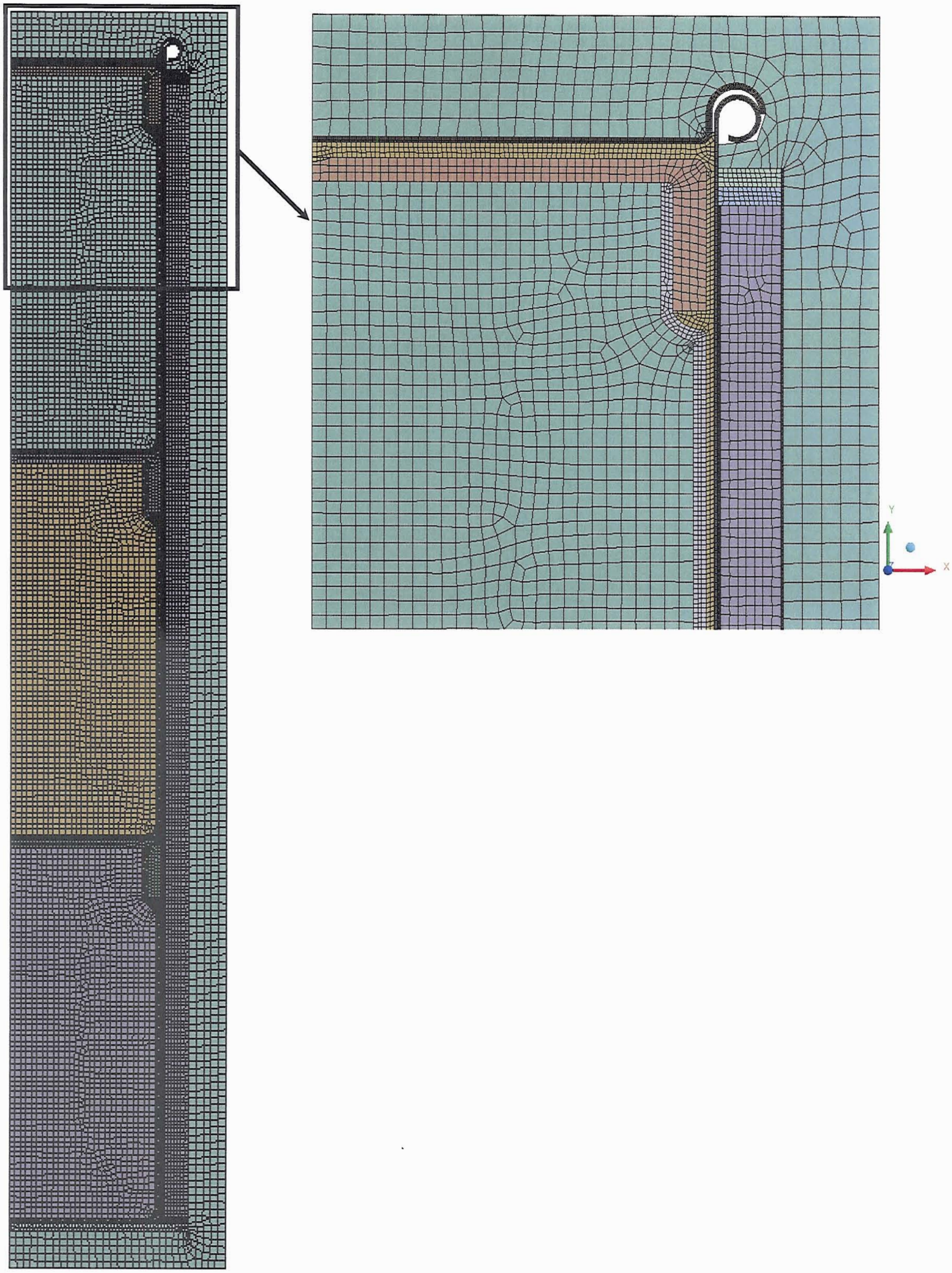
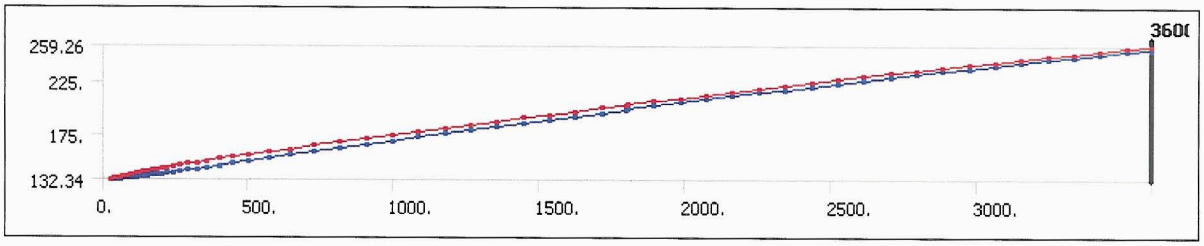
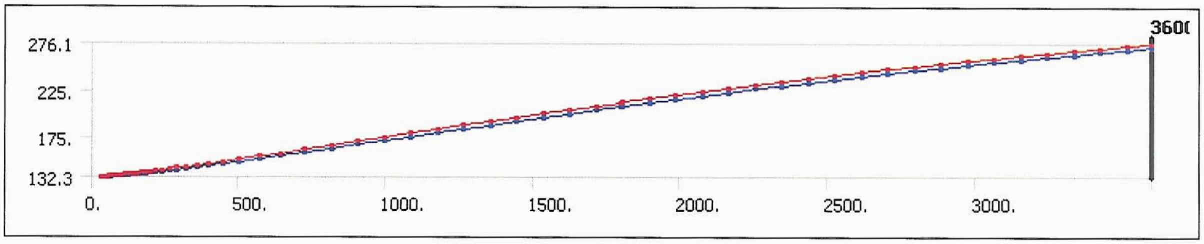


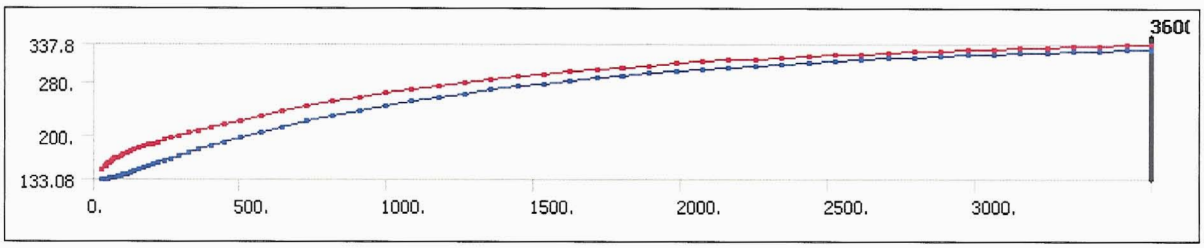
Exhibit 3-1b – The maximum (red) and minimum (blue) temperatures of the polyethylene containers outer wall surface over the full hour at 365°F (Y Axis = °F, X Axis = Seconds).



(a) Top Polyethylene Bottle Wall



(b) Middle Polyethylene Bottle Wall

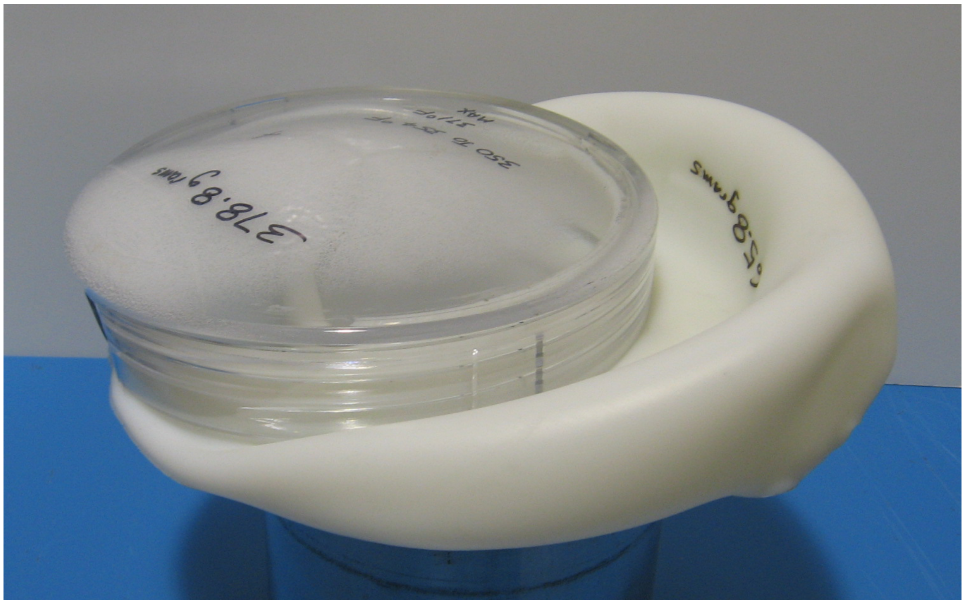


(c) Bottom Polyethylene Bottle Wall

Exhibit 3-1c – Empty Bottle, 270°F to 280°F, 20 Minutes

Exhibit 3-1d – Empty Bottle, 306°F to 324°F, 30 Minutes

Exhibit 3-1e – Empty Bottle, 340°F to 371°F, 30 Minutes



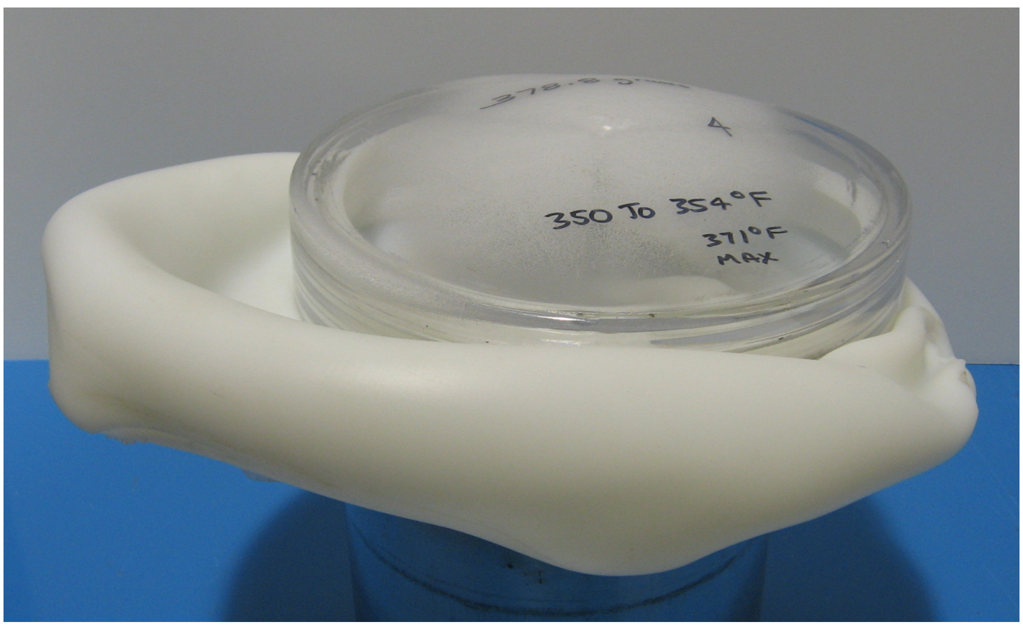

350 To 354°F
371°F
MAX
4

Exhibit 3-1f – Bottle with Sand Media, 270°F to 280.4°F, 30 Minutes

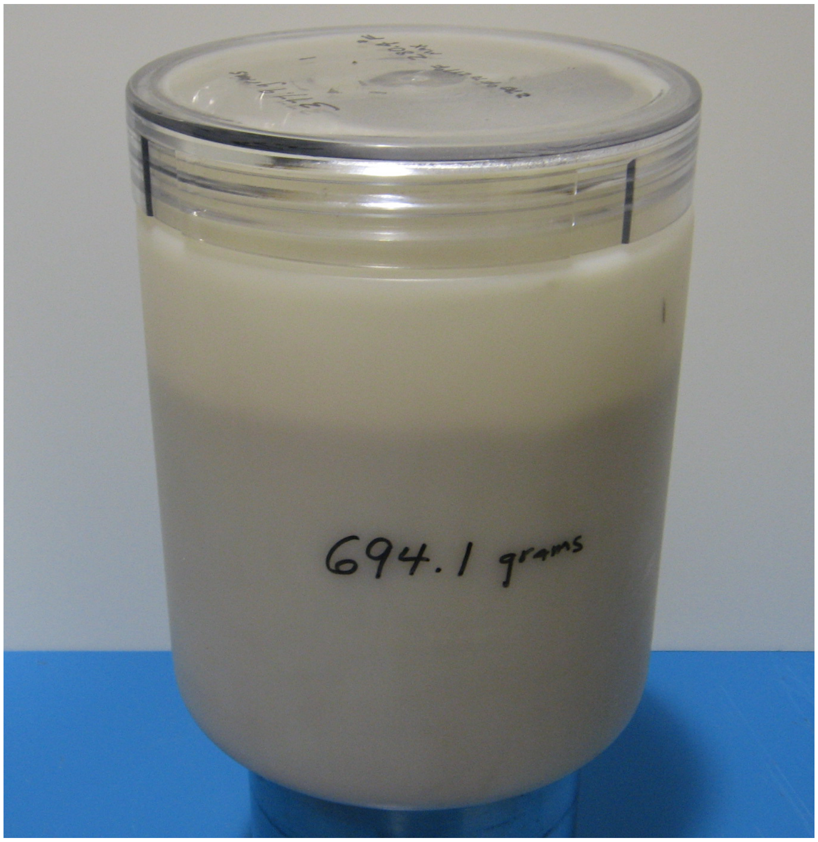


Exhibit 3-1g – Bottle with Sand Media, 330°F to 358°F, 30 Minutes

Exhibit 3-1h – Bottle with Sand Media, 346°F to 370°F, 30 Minutes

Attachment 2

GNF-A SAR Pages
and Drawing Changes

Proposed Word Changes to NRC Certificate of Compliance (COC) 9294

1. 1 (b) Revision Number should be changed from 4 to 5

2. 1 (d) Package Identification Number should be changed from USA/9294/AF-85 to USA/9294/AF-96

3. Condition 5.(a)(3) should be revised to include drawing number SK105E4037, Sheet 2, Revision 1:

   "177D4970, Sheet 1, Revision 0"
   "177D4970, Sheet 2, Revision 0"
   "177D4970, Sheet 3, Revision 0"
   "177D4970, Sheet 4, Revision 0"
   "177D4970, Sheet 5, Revision 0"
   "177D4970, Sheet 6, Revision 0"
   "177D4970, Sheet 7, Revision 0"
   "177D4970, Sheet 8, Revision 0"

   "SK105E4037, Sheet 2, Revision 1"

4. Condition 5.(b) table and revised footnotes should be inserted.

Type, Form, and Maximum Quantity of Material Per Package

Material Forms[1] (<5.00 wt.% U-235)	**Particle Size Restriction Minimum OD (inches)**	**Max. loading per ICCA (kgs)**		**Max. loading per NPC (kgs)**	
		Net[4]	U	Net[4]	U
Homogeneous Uranium Oxide Compounds[2]	N/A	60.0	52.89	540.0	476.1
Heterogeneous UO_2 Pellets (BWR)	0.342	60.0	48.48	540.0	436.3
Heterogeneous UO_2 Pellets (PWR)	0.300	60.0	46.71	540.0	420.4
Heterogeneous Uranium Compounds[3]	Unrestricted Particle Size	60.0	40.54	540.0	364.8

[1] No solutions or liquids are authorized and there shall be no free liquid present. The Material Form within any NPC must be the same.
[2] Homogeneous compounds limited to UO_2, U_3O_8, $UO_{2\ x>2}$, dried calcium-containing sludges, $UO_2(NO_3)_2\ 6H_2O$, and uranium oxide bearing ash.
[3] Heterogeneous compounds limited to UO_2, U_3O_8, $UO_{2\ x>2.}$
[4] Maximum content weight of any ICCA including plastic receptacles (e.g., bags, bottles, etc.).

1.2.3 Contents of Packaging

The NPC packaging is designed to transport a maximum of 1,190 pounds (540 kg) of uranium bearing payload, including receptacles and packing material in the ICCA in accordance with the table below. The radionuclide content is Type A quantities of uranium.

Type, Form, and Maximum Quantity of Material Per Package

Material Forms[1] (<5.00 wt.% U-235)	**Particle Size Restriction Minimum OD (inches)**	**Max. loading per ICCA (kgs)**		**Max. loading per NPC (kgs)**	
		Net[4]	U	Net[4]	U
Homogeneous Uranium Oxide Compounds[2]	N/A	60.0	52.89	540.0	476.1
Heterogeneous UO_2 Pellets (BWR)	0.342	60.0	48.48	540.0	436.3
Heterogeneous UO_2 Pellets (PWR)	0.300	60.0	46.71	540.0	420.4
Heterogeneous Uranium Compounds[3]	Unrestricted Particle Size	60.0	40.54	540.0	364.8

[1] No solutions or liquids are authorized and there shall be no free liquid present. The Material Form within any NPC must be the same.
[2] Homogeneous compounds limited to UO_2, U_3O_8, $UO_{2\ x>2}$, dried calcium-containing sludges, $UO_2(NO_3)_2\ 6H_2O$, and uranium oxide bearing ash.
[3] Heterogeneous compounds limited to UO_2, U_3O_8, $UO_{2\ x>2}$.
[4] Maximum content weight of any ICCA including plastic receptacles (e.g., bags, bottles,etc.).

The payload within an NPC may be distributed in any ratio within the nine Inner Containment Canister Assemblies (ICCAs), provided that the content of any one ICCA never exceeds 132.2 pounds (60 kg), and the maximum uranium payload of Table 6.1 are met. Within an ICCA, the payload is enclosed in plastic receptacles (e.g. bags, bottles, etc.).

1.3 Appendix

1.3.3 Packaging General Arrangement Drawings

This section contains the following GNF NPC packaging general arrangement drawings[1].

Drawing Number 177D4970, Sheet 1, Revision 0

Drawing Number 177D4970, Sheet 2, Revision 0

Drawing Number 177D4970, Sheet 3, Revision 0

Drawing Number 177D4970, Sheet 4, Revision 0

Drawing Number 177D4970, Sheet 5, Revision 0

Drawing Number 177D4970, Sheet 6, Revision 0

Drawing Number 177D4970, Sheet 7, Revision 0

Drawing Number 177D4970, Sheet 8, Revision 0

Drawing Number SK105E4037, Sheet 2, Revision 1

[1] The NPC packaging general arrangement drawings utilize the uniform standard practice of ASME Y14.5M, *Dimensioning and Tolerancing* American National Standards Institute, Inc. (ANSI).

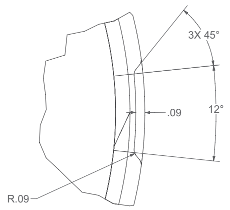
Attachment 3

GNF-A Drawing Number:
SK105E4037, Sheet 2, Revision 1

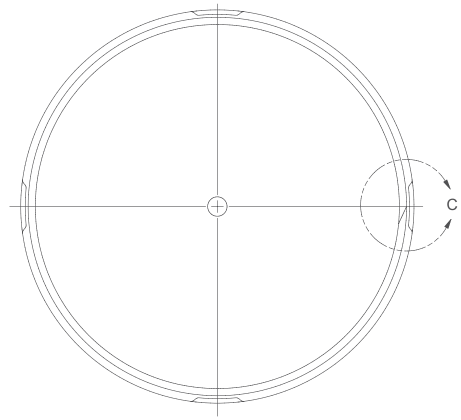
SK105E4037	SH NO 2

REVISIONS		
1	13 DEC 2005 RB JAMES	MTK

RMCN07280



DETAIL C
4X



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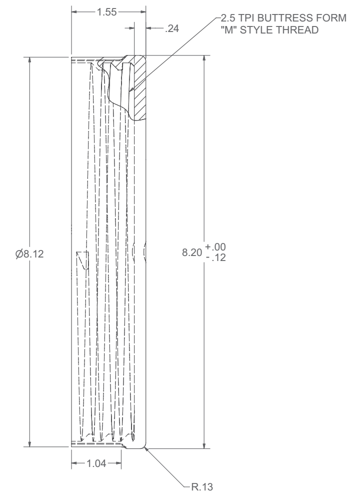
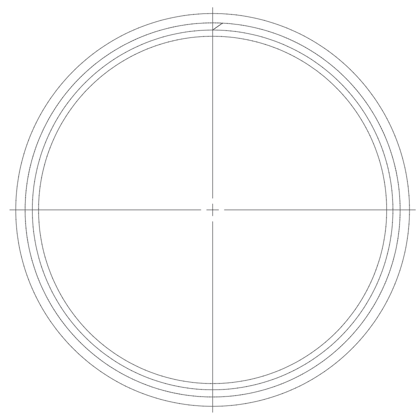
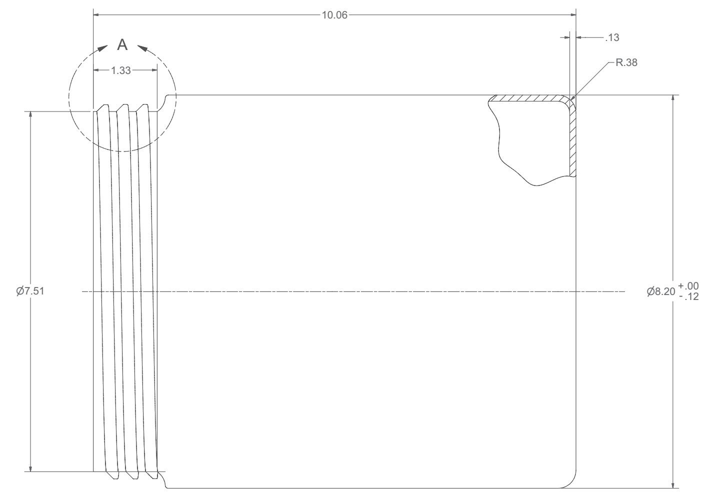


(2) MATERIAL: POLYETHYLENE - TEREPHTHALATE (PET)
COLOR: TRANSPARENT
MATERIAL VOLUME: 18.9in^3 = 309.7cc
MATERIAL DENSITY: 1.38g/cc

[1]

(3) MATERIAL: LEXAN
COLOR: TRANSPARENT
MATERIAL VOLUME: 18.9in^3 = 309.7cc
MATERIAL DENSITY: 1.52g/cc





POLY BOTTLE

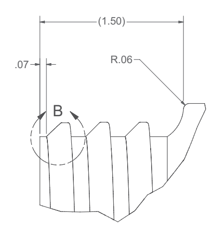
(4) MATERIAL: HIGH DENSITY POLYETHYLENE (HDPE)
COLOR: MILK WHITE

MATERIAL VOLUME: 40.9in^3 = 670.2cc

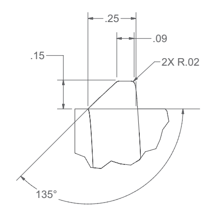
BOTTLE EMPTY VOLUME: 478.9in^3 =7847.8cc

MATERIAL DENSITY: 0.96g/cc

[1]



DETAIL A



DETAIL B

GNF Global Nuclear Fuel	DATE	DWG NO SK105E4037	REV 1
DRAWN CW CLARK	Feb-25-2005		
CHECKED AK LANGSTON	Mar-01-2005	SH NO 2	CONT ON 3