SAFETY EVALAUTION REPORT
Model No. TN-BGC1 Package
French Certificate of Approval No. F/313/B(U)F-96, Revision Iak
Docket No. 71-3034

SUMMARY

By letter dated February 20, 2009, the U.S. Department of Transportation (DOT) requested that the Nuclear Regulatory Commission (NRC) review the Model No. TN-BGC1 package, authorized by French Certificate of Approval No. F/313/B(U)F-96, Revision Iak. DOT requested that the NRC provide a recommendation concerning revalidation of the certificate for import and export which include air transport. DOT also requested that the review be limited to the transport of Content No. 11 (solid non-irradiated uranium-bearing materials contained within a TN-90 secondary conditioning container) and Content No. 26 (non irradiated TRIGA fuel elements). DOT provided copies of English translations of the Certificate of Approval and the Safety Analysis Report (160 EMBAL PFM DET 08000157A).

Based upon our review, the statements and representations in the documents described above, and for the reasons stated in this Safety Evaluation Report (SER), the staff finds that the TN-BGC1 package, as described in French Certificate of Approval No. F/313/B(U)F-96, Revision Iak, meets the requirements of paragraph 680 of International Atomic Energy Agency (IAEA) "Regulations for the Safe Transport of Radioactive Material," TS-R-1, 1996 Edition (Revised), for Content No. 11 and Content No. 26, as limited with the following conditions:

1. For Content No. 11, the maximum fissile mass is not to exceed 5 kilograms U-235 per package. The mass of water must not exceed 2000 grams per package in the form of moisture content of wood. No hydrogenous packaging materials are permitted within the package containment vessel.

2. For Content No. 26, the maximum number of TRIGA fuel elements per package is not to exceed 5 standard elements or 23 thin elements, where standard and thin elements are defined in F/313/B(U)F-96 26ak, Appendix 26, Content No. 26. The total mass of cardboard must not exceed 1200 grams, the moisture content of the wood components must not exceed 10 percent, and the total water content (including moisture content of the wood and water equivalent in the form of cardboard) must not exceed 2900 grams per package. No other hydrogenous packaging materials are permitted within the package containment vessel.

3. Uranium metallic powder and uranium tetrafluoride (UF4) are prohibited under Content No. 11.

EVALUATION

The TN-BGC1 package design was previously reviewed by NRC. The staff had performed a complete review of the design referenced in Revisions De and Df in 1998 and a review in 2007 focused only on criticality safety for air transport of the Hag version of the Certificate. The current request is to revalidate Revision Iak of the Certificate. Per DOT request, the staff limited its evaluation to Contents No. 11 and 26. Furthermore, the staff limited its review only to the changes made to the Certificate since its last review in 2007 and the changes to the Safety Analysis Report (SAR) since 1998. The changes made to the Certificate are:

- referencing International Atomic Energy Agency, Safety Standards Series, N “TS-R-1, 1996 edition (revised in 2005),” instead of “TS-R-1, 1996 edition,”
- removing Content No. 27, 28, 29, and 30,
- removing some of the references and adding some,
- the French certificate was renewed and the new expiration date is “31 August 2013.”

Appendix 0

- referencing the revised Safety Analysis Report (160 EMBAL PFM DET 0800157, dated February 28, 2008) in Section 1.0,
- deleted the requirement of transporting the package in a vertical position only when in a container in Section 1.5,
- the package operation and maintenance requirements have been removed from Sections 2.0 and 3.0 of the Certificate and are cited by referencing Section 4 of the SAR,
- Section 5 of the revised Safety Analysis Report is referenced for Quality Assurance.

Appendix 11

- adding the following statements:
    - “The content consists of uranium-bearing material in solid form.”
    - “The uranium is non-irradiated uranium and does not come from reprocessing.”
    - “The presence of hydrogenated material which hydrogen content is greater than that of water, is not authorized.”
- adding uranium tetrafluoride (UF4) as one of the acceptable chemical form of unirradiated uranium for transport in Section 1,
- the 3000A2 limit has been removed from Section 1,
- the addition of spacer E6 in internal arrangement for AA 204 container,
- revised Safety Analysis Report referenced in Sections 3 and 4.

Appendix 26

- the statement “The presence of hydrogenated material which hydrogen content is greater than that of water, is not authorized” has been added to Section 1,
- the conditions for “Internal Arrangement” have been deleted and Section 2.17.2 of the Safety Analysis Report, which include these conditions, have been referenced in the Certificate,
- the revised Safety Analysis Report has been referenced in Sections 3 and 4 of the Certificate,
- deletion of sentence “conditioning of fissile material must not contain plastic materials (polyethylene, …) which concentration in hydrogen is higher than the water one.” from the Certificate.

With respect to the changes to the SAR, the SAR has been completely reformatted and it appeared identifying all the changes were not possible. The staff requested and the applicant provided a list of major changes to the design, analyses, and assumptions for the TN-BGC1 package since the issuance of SAR 9990-Z, Rev. 10 (e-mail from Catherine Grandhomme, ML091380178). The major changes to the SAR are:

Contents

- addition of uranium tetrafluoride under Content 11,
- addition of content 26.

Structural

- additional drop tests (Attachment 3.1-1 to 3.1-3 of the SAR),
- calculations for additional drop tests (Attachments 3.1-4 to 3.1.5 of the SAR),
- addition of calculations for immersion test (Attachment 3.1-6 of the SAR),
- modification of calculations for stresses on the package during handling (Attachment 3.1-7 of the SAR),
- modification of calculational assumptions for tie downs (Attachment 3.1-8 of the SAR),
- new calculations for the packaging resistance to explosions caused by contents (Attachment 3.1-9 of the SAR),
- new calculations for modal analysis (Attachment 3.1-10 of the SAR),
- modification of calculations for internal containers (Attachment 3.2-1 of the SAR),
- new calculations for combustion of hydrogen in TN 90 container (Attachment 3.2-2 of the SAR).

Thermal

- modification of thermal analysis under Hypothetical Accident Conditions (Attachment 3.3-2 of the SAR).

Containment

no significant changes with respect to Contents No. 11 and No. 26.

Shielding

no changes due to Contents No. 11 and No. 26.

Criticality

- new calculations for uranyl nitrate considering aluminum fillers,
- new calculations for Content No. 26,
- new calculations for Content No. 26 with U-ZrH2 medium.

1.0 GENERAL INFORMATION

1.1 Packaging

The packaging consists of an outer rectangular cage constructed of aluminum tubes and an inner cylindrical body constructed of concentric stainless steel shells with a solid resin between the shells. The cage has outer dimensions of approximately 600 mm by 600 mm by 1821 mm in length. It is constructed of an assembly of aluminum tubes (30 mm by 30 mm with a 2-mm wall thickness) that are welded together. The top of the cage is open for removal of the main body. Perforated aluminum plates are incorporated into the cage to act as a personnel barrier.

The main body is composed of a stainless steel containment vessel surrounded by a solid borated resin thermal shield with a minimum thickness of 48 mm, which is enclosed in an outer stainless steel shell. The main body is connected to the outer cage by a series of attachment lugs. The resin acts as a neutron absorber and thermal insulator. The containment vessel shell is 6-mm thick and is welded to an 8-mm thick bottom plate. The outer stainless steel shell is 1.5-mm thick. The bottom end of the body incorporates a wood impact limiter within the outer stainless steel shell. The containment vessel cavity is 178 mm in diameter and 1475-mm long. The cavity is closed by a stainless steel lid that has leak testable, double O-ring seals. The top closure is equipped with a resin and wood top cover (impact limiter) that is attached to the main body. Contents are loaded and positioned within the containment vessel using a system of secondary containers and spacers. The maximum total weight of the package is approximately 400 kg.

1.2 Drawings

The packaging is shown on the following drawings:

Design and overall arrangement TN-9990-65 (C)
Cage TN-9990-118 (B)
Plug assembly TN-9990-117 (B)

1.3 Contents

The contents are described in French Certificate of Approval No. F/313/B(U)F-96, Rev. No. Iak. The following contents were considered in this evaluation:

• Content No. 11 (solid unirradiated uranium and uranium compounds), and
• Content No. 26 (unirradiated TRIGA fuel elements).

Uranium metallic powder and uranium tetrafluoride (UF4) in Content No. 11 are excluded from this review.

1.4 Criticality Safety Index

The Criticality Safety Index (CSI) for the package, as specified in French Certificate of Approval No. F/313/B(U)F-96, Rev. No. Iak, and U.S. Department of Transportation Competent Authority Certificate USA/0492/B(U)F-96, Revision 10, is as follows:

CSI for Content No. 11 1.0
CSI for Content No. 26 0.0

2.0 STRUCTURAL EVALUATION

The revised SAR provides an analysis update to continue to demonstrate structural performance of the TN-BGC1 package. Detailed structural evaluations as documented in Attachments to SAR Chapters 3.1 and 3.2 for the TN-BGC1 packaging and its packing containers, respectively, are reviewed as follows.

Strength of the TN-BGC1 Packaging

SAR Attachment 3.1-1 summarizes results for the four series of drop tests performed on the TN-BGC-1 package. Attachment 3.1-2 provides details of the 27 drop tests of the first two series considered in the July 2000 United States Nuclear Regulatory Commission (USNRC) SER. Attachment 3.1-3 presents the third and fourth series of drop tests conducted in December 2000 and January 2003, respectively, to supplement the previous two test series which involved as a packing container only in the dynamic crush test but not the 9-meter drop tests. The last two series, which use exclusively, include the dropping of a 500-kg plate from a height of 9 meters, the one-meter dropping of the package on to a sharp edge, and the 9-meter free dropping of the package. Therefore, the four test series, in aggregate, provide reasonable assurance that the TN-BGC1 package with its packing container has been subject to the tests associated with the most damaging drop configurations.

SAR Attachment 3.1-4 demonstrates, by analysis, that the package containment boundary will not suffer a loss of sealing in a vertical top-cover down drop at an ambient test temperature of -40°C. This is done by a transient dynamic impact analysis of a detailed finite element model of the packaging and its packing container representation. The analysis involves first to benchmark the model for the top-cover down drop test conducted at an ambient temperature of 20°C. The -40°C, cold-temperature, drop was then simulated by altering element properties of the wood to correspond to those at the cold temperature. To evaluate seal performance for the top-cover down, oblique drop, Attachment 3.1-5 continues to use the same finite element model to determine that at a drop angle of 10° out of the vertical, the package will undergo the most detrimental drop test in terms of plug detachment. The analysis also demonstrates that the seal will remain functional at the ambient temperatures of 20°C and -40°C.

SAR Attachment 3.1-6 adds calculations to demonstrate mechanical resistance of the containment vessel during immersion. Attachment 3.1-7 revises calculations for package handling devices. Multiple-package shipping configurations for transport by road, rail, and maritime conveyances are analyzed in Attachment 3.1-8, for the acceleration inertia force combinations, per IAEA Standard ST-1 (1996). The analysis assumes tie-down configurations and establishes that the single- and two-package units in vertical position meet the road and the maritime, but not the rail, transport acceptance criteria. It also determines that a single package tied down in horizontal position meets acceptance criteria for all three transportation modes and, when tied together in horizontal position, as many as three packages are acceptable for road transportation.

Strength of Packing Container and Behavior of Contents

SAR Attachment 3.2-1 analyzes three families of packing containers for mechanical resistance to normal and accident condition internal pressures. Using closed form solutions for idealized but conservative boundary conditions, the analysis demonstrates that the shell and plug of the packing container will behave satisfactorily to remain leak-tight.

Package Configuration for Criticality Control

On maintaining geometric configuration for package criticality control, SAR Chapter 3.2 states that the internal arrangements used to maintain contents within a defined volume are checked to ensure they are not loaded above the elastic limits of their constituent materials when subjected to internal pressure. For normal transportation condition, the SAR notes that the low loading levels assure adequate resistance of the internal arrangements, including the radial positioning of the material in the tertiary container by the E7 spacer. For accident conditions of transport, the SAR recognizes that the internal cavity of package TN-BGC1 is entirely preserved during various drop tests. By noting also that the leak rate of the arrangement remains satisfactory after the test sequences, the staff finds that the internal arrangements will not deform to affect the geometry assumptions used for demonstrating criticality safety of the package.

On the basis of the review above, the staff finds that the package meets the applicable structural requirements of the IAEA regulations.

3.0 MATERIAL EVALUATION

The only materials changes are the addition of TRIGA fuel rods, and UF_4 solid as approved content, and the air transport of the TRIGA fuel rods and Content No. 11 (non-irradiated solid uranium bearing material, including uranium metal and alloys, uranium oxides, carbides, and nitrides, including UF_4). There are no issues with the frame, containers, and shock absorbers of this system. They have not changed since previous approvals in 2000.

The unirradiated TRIGA fuel rods contain hollow or solid pellets of U-ZrHx-based material (with x between 0 & 2) contained in incoloy cladding. These rods are placed in protective cartons made of AG3 (6000 series) aluminum or stainless steel. These primary cases are placed in a container, which may contain water. Type TN 90, AA 204, and AA 203, all made of stainless steel (UNS J92500 austenitic), or AA 41, made of polymers, may be used as secondary packing containers. Various blocks made of AG3 (6000 series) or AU4G (ISO AlCuMgSi) aluminum, are included for heat transfer and positioning.

There is no galvanic couple when the TRIGA fuel rods are placed in stainless steel protective cartons. The incoloy of the rod cladding may set up a weak galvanic cell with an aluminum carton corroding the cladding and producing hydrogen. Similar interactions and consequences will develop if a stainless steel carton is placed in an aluminum alloy containment vessel. To eliminate any chance of galvanic generation of hydrogen, and meet IAEA TS-R-1 (2005 Edition) Regulation 507, the package must be dried prior to shipment.

If water had been allowed in the package, then compatibility of the fuel cladding with the packing carton and packing carton with the secondary container would have required that all stainless steel components be used.

Air transport has been requested for Content No. 11. UF_4 has been requested as an addition to the previously approved content in this category. The 2000 SER excluded metallic powder. The current CoC markup states: “In the event that metal powders are transported, the powder conditioning boxes, the secondary conditioning container used and the cavity of the TN-BGC 1 shall be inerted at bar 1 absolute pressure and leak tightness of $<6.65 \times 10^{-5}$ Pa/m^3/s.” This indicates that the applicant is requesting that the previous restriction on metallic powders be removed.

The stated controls on leak tightness, and pressure are insufficient to eliminate the potential for a pyrophoric reaction. Additional requirements on 1) purity (water content) of the cover gas must be specified, 2) the powder must not have been in contact with a moist atmosphere, and 3) procedures for loading and inerting this material must be provided. Unless these conditions are added to the CoC one can not rule out a pyrophoric event when the container is opened, and IAEA TS-R-1 (2005 Edition) Regulation 507 can not be met.

The potential interaction of the solid UF_4 with the packing materials has not been analyzed in the SAR. Without analysis of any potential interactions, IAEA TS-R-1 (2005 Edition) Regulation 507 can not be met and this material should not be allowed as an approved content.

The staff finds that air transport of Contents No. 26 and No. 11 meets all materials requirements of IAEA TS-R-1 (2005 Edition) only if the TRIGA fuel is shipped dry. However, the staff finds that metallic powder and UF_4 are not approved contents.

3.0 THERMAL EVALUATION

The thermal performance of the package was evaluated by a combination of physical tests and analyses. The maximum decay heat per package is 340 watts, as specified in the French Certificate of Approval. Staff review was limited to Content No. 11 (solid uranium-bearing materials) and Content No. 26 (bars of non-irradiated TRIGA fuel elements), which has negligible decay heat. For the analytical calculations, the vendor used the I-DEAS program, which is based on a finite element approach. The vendor developed finite element models to perform the thermal evaluation for normal conditions of transport and for hypothetical accident conditions. The developed finite element models include both two-dimensional and three-dimensional models. Thermal evaluations were performed for each content (including the addition of new contents), as defined in the application. Therefore, the thermal analysis has been modified to include the thermal evaluation of the new contents. However, the analysis approach (finite element method) remains unchanged. The applicant performed a steady-state thermal evaluation for normal conditions of transport. The applicant included the maximum amount of decay heat, corresponding to the plutonium contents, and exposed the package to solar insolation. The applicant determined that for normal conditions of transport all component temperatures, including the seals, remain within their maximum allowable temperatures. The applicant performed fire analyses to demonstrate the package performance under fire test conditions.

The applicant used the temperatures calculated for normal conditions of transport as the base temperatures for the accident conditions evaluation. The fire evaluation included exposing the package to an ambient temperature of 800°C for 30 minutes. The applicant also included solar radiation during the test. The maximum temperatures of all package components were within the allowable service temperatures. The maximum seal temperature during the fire test was 142°C, which is below the maximum steady state temperature for the seal material of 250°C.

Based on the statements and representations in the SAR, the staff finds that the thermal evaluation has been adequately described, and the thermal performance of the package meets the requirements of IAEA Safety Requirements, No. TS-R-1.

4.0 CONTAINMENT EVALUATION

The staff had evaluated the containment design of TN-BGC1 based on the maximum leakage rate measurement of 1×10^{-4} atm-cm^3/s prior to each shipment during the 2000 revalidation review. At that time, the staff had stated in its SER that a leak rate of 1×10^{-2} atm^3/s was adequate. However the A_2 value, according to IAEA, Safety Standards, 1985 Edition, as amended 1990, for contents with enrichment more than 20% was 0.02 curie. Under the IAEA, Safety Standard Series, TS-R-1, 1996 edition (revised in 2005), which the current TN-BGC1 French certificate references, the A_2 value for contents with uranium enrichment more than 20% needs to be calculated based on the isotopic mixture of the content. The smallest A_2 value is

0.027 curie which is associated with U-232 (slow lung absorption). The smallest A_2 value for both U-234 and U-236 is 0.16 curie associated with slow lung absorption. The leakage rate measurement prior to each shipment in the current TN-BGC1 SAR is 6.65 x 10^{-4} atm-cm^3/s.

Given the current A_2 values are approximately equal to or greater than the IAEA, Safety Series, 1985 Edition values, and the tertiary containers such as TN 90 providing another level of containment, the staff believes that current maximum allowable leakage rate of 6.65 x 10^{-4} atm-cm^3/s is adequate for Contents No. 11 and No. 26.

5.0 SHIELDING EVALUATION

Since the authorized contents, unirradiated solid uranium-bearing materials with up to 100% ^{235}U enrichment (Content No. 11) and unirradiated TRIGA fuel (Content No. 26), do not emit significant amount of radiation particles, i.e., neutron, gamma, or beta, the external surface dose rates of these packages are expected to be insignificant and meet the requirements of IAEA radioactive material transportation package TS-R-1, 1996 edition as amended in 2000.

6.0 CRITICALITY EVALUTION

For ground transport of fissile materials, the provisions of paragraphs 650 to 671, 673 to 679, 681, and 682 in IAEA TS-R-1 apply. Paragraphs 681 and 682 specify, in part, that an array of packages must be subcritical under conditions consistent with the Type B package tests, assuming reflection by at least 20 cm of water.

For air transport of fissile materials, the provisions of paragraphs 650 to 671, 673 to 679, and 680 in IAEA TS-R-1 apply. Paragraph 680 specifies, in part, that the package shall be subcritical under conditions consistent with the Type C package tests as specified in paragraph 734, assuming reflection by at least 20 cm of water.

6.1 Packages for Content No. 11

The applicant performed a criticality safety evaluation for the TN BGC-1 package with solid uranium-bearing materials, Content No. 11, for 5.5 kilograms of 100% enriched ^{235}U with various water contents in a TN 90 secondary container under both normal conditions of transport and hypothetical accident conditions. Under the hypothetical accident conditions, the package is assumed to retain the geometric shape and dimensions but have lost 15 mm of the 48 mm neutron poison resin layer and the outer cage. The applicant shows that these packages remain subcritical under both normal conditions of transport and hypothetical accident conditions. The applicant also evaluated an array of 144 damaged packages and found it is subcritical. Therefore, the Criticality Safety Index is determined as 1.0 for this package in accordance with TS-R-1, paragraph 682.

The applicant, however, provides no information regarding the benchmark of the criticality calculation codes APOLLO and MORET, which were used for criticality safety analysis. As a result, the staff was unable to assess the quality of the calculated results from these codes, i.e., determining the bias and uncertainties associated with these codes for these specific fissile material configurations. Based on the information provided in an email dated June 5, 2009, the applicant states that the estimated error of the APOLLO code for k_{eff} is 3.165% for a single benchmark experiment. This indicates that the code is highly unreliable. Further, the additional information provides no bias and trend analysis for the code. The one benchmark calculation provided in the same email provides little or no value to assessing the validity of the code.

In addition, the applicant did not provide information sufficient to support the assumption that the unburned resin layer, after an accident fire, will retain its geometry. The issue on whether it is possible for the remaining resin (after fire) to fall off to the bottom of canister was not discussed. Consequently, the staff was unable to assess the validity of the assumption that the unburned resin will stick to the outer surface of the inner shell of the packaging cavity as assumed. The safety analysis did not provide any discussion on the possibility that the unburned resin may fall off the wall and accumulate at the bottom of the space left by the burned resin in between the inner and outer cylinders.

For air transport of fissile material, the provisions of paragraph 680 in IAEA TS-R-1 apply. Paragraph 680 specifies, in part, that a single package must be subcritical under conditions consistent with the Type C package tests, assuming reflection by at least 20 cm of water but no water in-leakage. The applicant assumed that the package cannot survive the Type C tests, and provided a criticality assessment based on the most favorable geometry, i.e., spherical configuration of the fissile material and the moderating materials present in the packaging, assuming worst-case effects of the mechanical and thermal tests. This is consistent with guidance in IAEA "Advisory Material for the IAEA Regulations for the Safe Transport of Radioactive Material," Safety Guide No. TS-G-1.1.

For air transport, only a single package needs to be evaluated at both normal conditions of transport and hypothetical accident conditions. The applicant evaluated packages with a maximum fissile load of 5.5 kilograms of uranium, assumed to be 100 percent U-235. The hydrogenous packaging materials are estimated to be equivalent to 2000 grams of water plus 2500 grams of carbon. Other packaging materials that were considered in the analysis include stainless steel (which could act as a neutron reflector). Aluminum spacers and inner containers are not considered in the analysis. The applicant took no credit for the presence of the borated resin, which acts as a neutron absorber.

The applicant considered spherical geometry for the criticality analysis. Various ^{235}U and water ratios in the inner sphere were evaluated. In the models, the fissile material is modeled as a spherical geometry, surrounded by concentric shells. The most reactive cases assumed moderation of the fissile material by 2000 grams of water, with stainless steel closely surrounding the fissile material. The stainless steel thickness was varied to ensure full reflection. Heterogeneous and homogeneous fuel-water mixtures were considered. The applicant also demonstrated and the staff confirmed that the presence of carbon in the model does not increase the k_{eff} of the system.

Since the applicant provides no information on the criticality computer code benchmark and there is no supporting data in the analysis to demonstrate that the unburned resin will remain uniformly attached to the outside wall of the inner packaging container, the staff performed independent analyses employing both the MCNP 5 and SCALE 5.1 codes under the assumptions that all resin were lost during fire accident (Hypothetical Accident Conditions) but the fuel container diameter will retain its dimension, i.e., 12 cm in diameter, under normal conditions of transport or hypothetical accident conditions.

Based on these assumptions, the staff developed both MCNP 5, version 5 and SCALE 5.1 models for ground and air transport packages. The staff performed independent calculations for Content No. 11. Different from the applicant's evaluation, a fissile mass of 5.0 kilograms was assumed. The staff assumed a homogeneous mixture of ^{235}U and water, with a maximum water content of 2000 grams, consistent with the applicant. A stainless steel reflector of 17.80

centimeters (340 kg of stainless steel) surrounded by an additional 20 centimeters of water reflector was modeled. The results of staff's calculations confirmed that the maximum k_{eff} for this case was less than 0.95 considering statistical uncertainties. The results from the staff's independent analyses show that the package designs for Content No. 11 with maximum payload of 5.0 Kg of up to 100% enriched ^{235}U, with reasonable assurance, meet the regulatory requirements of TS-R-1 for ground/surface and air transport modes.

The staff finds that the package meets the requirements of paragraph 680 of TS-R-1 provided:

> For Content No. 11, the maximum fissile mass is not to exceed 5 kilograms U-235 per package. The mass of water must not exceed 2000 grams per package in the form of moisture content of wood. No hydrogenous packaging materials are permitted within the package containment vessel.

6.2 Content No. 26 – TRIGA Fuel

There is no new design change in the package for Content No. 26; the staff's evaluation of November 2007 remains valid. The restrictions and conditions remain applicable. Specifically, this restriction is:

> For Content No. 26, the maximum number of TRIGA fuel elements per package are not to exceed 5 standard elements or 23 thin elements, where standard and thin elements are defined in F/313/B(U)F-96, 26ak, Appendix 26, Content No. 26. The total mass of cardboard must not exceed 1200 grams, the moisture content of the wood components must not exceed 10 percent, and the total water content (including moisture content of the wood and water equivalent in the form of cardboard) must not exceed 2900 grams per package. No other hydrogenous packaging materials are permitted within the package containment vessel.

CONDITIONS

Based on the staff's review and independent analyses, the staff recommends that the following additional conditions be included in the U.S. DOT revalidation of French Certificate of Approval No. F/313/B(U)F-96, Revision Iak:

1. For Content No. 11, the maximum fissile mass is not to exceed 5 kilograms U-235 per package. The mass of water must not exceed 2000 grams per package in the form of moisture content of wood. No hydrogenous packaging materials are permitted within the package containment vessel.

2. For Content No. 26, the maximum number of TRIGA fuel elements per package is not to exceed 5 standard elements or 23 thin elements, where standard and thin elements are defined in F/313/B(U)F-96, 26ak, Appendix 26, Content No. 26. The total mass of cardboard must not exceed 1200 grams, the moisture content of the wood components must not exceed 10 percent, and the total water content (including moisture content of the wood and water equivalent in the form of cardboard) must not exceed 2900 grams per package. No other hydrogenous packaging materials are permitted within the package containment vessel.

3. Uranium metallic powder and uranium tetrafluoride (UF4) are prohibited under Content No. 11.

CONCLUSIONS

Based upon our review, the statements and representations in the documents described above, and for the reasons stated in this SER, the staff finds that the TN-BGC1 package, as described in French Certificate of Approval No. F/313/B(U)F-96, Revision Iak, meets the requirements of paragraph 680 of International Atomic Energy Agency (IAEA) “Regulations for the Safe Transport of Radioactive Material,” TS-R-1, 1996 Edition (Revised), for Content No. 11 and Content No. 26, as limited with the conditions listed above.

Issued with letter to R. Boyle, Department of Transportation, on 6/12/2009.