



U.S. Department
of Transportation

Pipeline and
Hazardous Materials
Safety Administration

COMPETENT AUTHORITY CERTIFICATION FOR A
TYPE FISSILE
RADIOACTIVE MATERIALS PACKAGE DESIGN
CERTIFICATE USA/0653/AF-96, REVISION 12
REVALIDATION OF FRENCH COMPETENT AUTHORITY
CERTIFICATE F/381/AF-96

East Building, PHH-23
1200 New Jersey Ave, SE
Washington, D.C. 20590

The Competent Authority of the United States certifies that the radioactive material package design described in this certificate satisfies the regulatory requirements for a Type AF package as prescribed in the regulations of the International Atomic Energy Agency¹ and the United States of America².

1. Package Identification - TNF-XI.
2. Package Description and Authorized Radioactive Contents - as described in French Certificate of Competent Authority F/381/AF-96 (Dk) dated April 9, 2018 (attached), limited to contents as described in Appendix 8 (attached). Contents are also authorized as described in French Certificate of Competent Authority F/381/AF-96 (Di) dated September 6, 2016 (attached), limited to contents as described in Appendices 2 and 7 (attached), and subject to the following restrictions:
 - a. Type and Form of Material: Uranium oxide pellets, powder and scrap as described below. In Tables 1, 2 and 3, "Homogeneous UO₂ powder" refers to powders, such as fine powder, when those materials have not been subjected to any treatment that would lead to agglomeration; in Tables 1 and 2, "Heterogeneous UO₂ material" refers to heterogeneous materials, such as coarse powder, granulated powders, pellets, and scrap, when those materials do not meet the definition of homogeneous powders. In case of a mix of several forms of fissile material, the mix shall be considered heterogeneous material.

¹ "Regulations for the Safe Transport of Radioactive Material, 2012 Edition, No. SSR-6" published by the International Atomic Energy Agency (IAEA), Vienna, Austria.

² Title 49, Code of Federal Regulations, Parts 100-199, United States of America.

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b. Maximum quantity of material:

- i) Uranium oxide pellets, powder, and scrap which meets the requirements of Enriched Commercial Grade Uranium, as defined in ASTM C996-10. U_3O_8 or $UO_{x, x>2}$ are authorized provided that the equivalent UO_2 mass is less than the limits specified in Table 1. For these contents there shall be no more than 25 kg of contents per pail and no more than 300 kg of contents per package. Presence of hydrogenated materials (with a hydrogen concentration less than hydrogen concentration in water) or water inside cavities and pails is allowed. The auto-ignition temperature of the hydrogenated materials (with a hydrogen concentration less than hydrogen concentration in water) shall be greater than $140^{\circ}C$ ($284^{\circ}F$). The presence of materials containing more hydrogen than water is not allowed in the package.

- ii) Uranium oxide pellets, powder, and scrap which meets the requirements of Enriched Commercial Grade Uranium, as defined in ASTM C996-10. U_3O_8 or $UO_{x, x>2}$ are authorized provided that the equivalent UO_2 mass is less than the limits specified in Table 2. For these contents, there shall be no more than 25 kg of contents per pail and no more than 300 kg of contents per package. In each pail, the contents can be put in a polyethylene bag (CH_2) or in a bag made of a material with a hydrogen concentration less than that of polyethylene. The maximum hydrogen content of the bags within each cavity is a mass of 56 g H, which is equivalent to a maximum mass of 390 g polyethylene, considering all sources of hydrogenous material within each cavity. The auto-ignition temperature of the bag material shall be greater than $140^{\circ}C$ ($284^{\circ}F$). The presence of materials containing more hydrogen than polyethylene is not allowed in the package.

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iii) Uranium oxide powder scrap, which may contain impurities, and meets the requirements of Enriched Commercial Grade Uranium, as defined in ASTM C996-10. The impurities aluminum and carbon shall not exceed 5,000 ppm and 10,000 ppm, respectively. U_3O_8 or $UO_{x,x>2}$ are authorized provided that the equivalent UO_2 mass is less than the limits specified in Table 3. For these contents there shall be no more than 25 kg of uranium oxide powder scrap contents per pail and no more than 300 kg of uranium oxide powder scrap contents per package. In each pail, the contents can be put in a polyethylene bag (CH_2) or in a bag made of a material with a hydrogen concentration less than that of polyethylene. The maximum hydrogen content of the bags within each cavity is a mass of 56 g H, which is equivalent to a maximum mass of 390 g polyethylene, considering all sources of hydrogenous material within each cavity. The auto-ignition temperature of the bag material shall be greater than $140^{\circ}C$ ($284^{\circ}F$). The presence of materials containing more hydrogen than polyethylene is not allowed in the package.

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iv) Uranium oxides in the form of powder and scraps, enriched up to a maximum of 5.0 wt.% U-235, may be mixed with residues consisting of incinerator ashes or earth, sand and residues from dissolution, as described in Appendix 7. U_3O_8 or $UO_{x,x>2}$, non-irradiated, are authorized when the uranium mass is less than 5 kg per well (each well containing three pails), or equivalent UO_2 mass less than 5.68 kg per well (each well containing three pails). For these contents there shall be no more than 75 kg of uranium oxide powder and scraps mixed with residues, consisting of incinerator ashes or earth, sand and residues from dissolution, contents per well. No more than 300 kg uranium oxide powder and scraps mixed with residues, consisting of incinerator ashes or earth, sand and residues from dissolution, contents per package. The incinerator ashes consist of mainly silica, alumina, alumina-silicates, metal oxides, phosphates, aluminum metal, charred wood, and charred plastic. The earth, sand and dissolved residues consist of mainly silica, alumina, titanium, iron oxide and alumina-silicate. Other organic or inorganic compounds may be present in the form of trace amounts. The residues are chemically stable and contain no liquid. The radioactive material may be placed in plastic bags made of a material with a hydrogen concentration less than that of polyethylene. The auto-ignition temperature of the bag material shall be greater than $140^{\circ}C$ ($284^{\circ}F$). The presence of material containing more hydrogen than polyethylene is not allowed in the package. The presence of material containing beryllium is not allowed in the package.

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Table 1

Max ²³⁵ U Enrichment (weight %)	Homogeneous UO ₂ Powder Maximum Loading (kg)	Heterogeneous UO ₂ Material (Pellet and Scrap) Maximum Loading (kg)
≤ 4.05	300	300
4.1	300	293
4.15	300	287
4.25	300	271
4.35	300	259
4.45	300	247
4.55	294	238
4.65	281	228
4.75	265	219
4.85	255	208
4.95	244	202
5.0	239	197

Table 2

Max ²³⁵ U Enrichment (weight %)	Homogeneous UO ₂ Powder Maximum Loading (kg)	Heterogeneous UO ₂ Material (Pellet and Scrap) Maximum Loading (kg)
≤ 4.05	300	300
4.15	300	284
4.25	300	271
4.35	300	256
4.45	300	247
4.55	286	236
4.65	271	224
4.75	259	216
4.85	248	208
4.95	238	202
5.0	232	196

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Table 3

Max ²³⁵ U Enrichment (weight %)	Homogenous UO ₂ Powder Maximum Loading (kg)
≤ 4.05	300
4.15	300
4.25	300
4.35	300
4.45	300
4.55	286
4.65	271
4.75	259
4.85	248
4.95	238
5.0	232

3. Criticality - The minimum criticality safety index is 0.5 for contents described in Appendix 2 and listed above in 2.b.(i), 2.b.(ii), and 2.b.(iii). The minimum criticality safety index is 0.0 for contents described in Appendix 7 and listed above in 2.b.(iv). The minimum criticality safety index is 0.0 for contents described in Appendix 8. The maximum number of packages per conveyance is determined in accordance with Table 11 of the IAEA regulations cited in this certificate.

4. General Conditions -

a. Each user of this certificate must have in his possession a copy of this certificate and all documents necessary to properly prepare the package for transportation. The user shall prepare the package for shipment in accordance with the documentation and applicable regulations.

b. Each user of this certificate, other than the original petitioner, shall register his identity in writing to the Office of Engineering and Research, (PHH-23), Pipeline and Hazardous Materials Safety Administration, U.S. Department of Transportation, Washington D.C. 20590-0001.

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- c. This certificate does not relieve any consignor or carrier from compliance with any requirement of the Government of any country through or into which the package is to be transported.
- d. Records of Management System activities required by Paragraph 306 of the IAEA regulations¹ shall be maintained and made available to the authorized officials for at least three years after the last shipment authorized by this certificate. Consignors in the United States exporting shipments under this certificate shall satisfy the applicable requirements of Subpart H of 10 CFR 71.

5. Special Conditions -

- a. The package design must be in agreement with Chapter 0, "Description of the TNF-XI Packaging Model," Document No. DOS-06-00037028-004, Revision 5.
- b. The package must be prepared for shipment and operated in accordance with Chapter 6A, "Operating Instructions of the Packaging," Document No. DOS-06-00037028-600, Revision 5; and Chapter 7A, "Acceptance Test and Maintenance Program," Document No. DOS-06-0037028-700, Revision 0;
- c. The package must be maintained and operated in accordance with Chapter 8A, "Quality Assurance Applicable to TNF-XI Package Model," Document No. DOS-06-0037028-800, Revision 1, of the application.
- d. The package must be fabricated in accordance with Design Drawing No. 12986-001, Revision K.
- e. The minimum thermal conductivity of the stainless-steel material (i.e., entry X2 Cr Ni 18-9 in Table 0.2, Chapter 0, "Description of the TNF-XI Packaging Model," Document No. DOS-06-00037028-004, Revision 5) shall be $14.8 \text{ W} \cdot \text{m}^{-1} \cdot \text{K}^{-1}$ at 20°C.
- f. Transport by air is not authorized.

6. Marking and Labeling - The package shall bear the marking USA/0653/AF-96 in addition to other required markings and labeling.

7. Expiration Date - This certificate expires on December 31, 2021.

CERTIFICATE USA/0653/AF-96, REVISION 12


This certificate is issued in accordance with paragraph(s) 816 of the IAEA Regulations and Section 173.472 and 173.473 of Title 49 of the Code of Federal Regulations, in response to the June 7, 2018 petition by TN Americas LLC, Columbia, MD, and in consideration of other information on file in this Office.

Certified By:



August 20, 2019

(DATE)

 William Schoonover
Associate Administrator for Hazardous
Materials Safety

Revision 12 - Issued to revalidate French Certificate of Approval No. F/381/AF-96, Revision Dk, dated April 9, 2018 with contents as described in Appendix 8 and to continue authorization of contents as previously described in Revision 11 of this certificate based on French Certificate of Approval No. F/381/AF-96, Revision Di.



DIRECTION DU TRANSPORT ET DES SOURCES

**CERTIFICATE OF APPROVAL
OF A PACKAGE MODEL****F/381/AF- 96 (Dk)
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The French Competent Authority,

Given the application submitted by the TN International company in the letter CEX-17-00186360-032 dated March 29th, 2017,

Given the TN International Safety Analysis Report DOS-06-00037028-000 Rev. 9 of June 1st, 2017, and the technical note NTE-18-005200-000 Ind. 2.0,

certifies that the package design called "TNF-XI", as described in appendix 0 revision k and loaded with uranium in uranium oxides form, uranyl nitrate form, sodium diuranates form or ammonium diuranate form, enriched to a maximum of 20% of ²³⁵U as described in appendix 8 revision k, (content n°8) ;

complies, as a Type A package containing fissile materials, to the requirements of the regulations, agreements or recommendations listed below:

- Safety Standards Series– Regulations for the Safe Transport of Radioactive Materials – International Atomic Energy Agency n° SSR-6, 2012 Edition ;
- European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR) ;
- Regulations concerning the International carriage of Dangerous goods by Rail (RID) ;
- European Agreement concerning the International Carriage of Dangerous goods by inland waterways (ADN) ;
- International Maritime Dangerous Goods Code (IMDG Code from IMO) ;
- Order of May 29th, 2009 concerning the carriage of dangerous goods by terrestrial ways (TMD Order) ;
- Order of November 23th, 1987 modified concerning the Ship Safety, section 411, attached (RSN Order).

This certificate does not relieve the consignor from compliance with any requirement of the government of any country through or into which the package will be transported.

This certificate expires on **31/12/2021**.

Registration number: **CODEP-DTS-2018-013769**

Montrouge, **9th April 2018**

APPENDIX 0

TNF-XI PACKAGING

1. DESCRIPTION OF THE PACKAGING

The packaging is designed, manufactured, inspected, tested, maintained and used in compliance with the Safety Analysis Report TN International DOS-06-00037028-000 Rev. 9 of June 1st, 2017.

The TNF-XI packaging, of a generally rectangular shape, is presented in Figure 0.1.

The design drawing of the packaging is the drawing COGEMA LOGISTICS 12986-01 Rev. K.

The outer overall dimensions of the packaging are:

- Nominal height of body: 940 mm,
- Maximal nominal height of packaging: 1040 mm,
- Cross section of body: 1100 × 1100 mm (overall nominal dimensions).

The maximal mass of empty packaging (± 10 kg) is 660 kg.

The maximal mass of loaded packaging allowable in transport is 1050 kg.

The packaging comprises the main components described below.

1.1 Body

The body of the packaging consists of a steel external casing of rectangular shape, and four cylindrical internal enclosures, also made of steel, separated by a layer of shock-absorbing and thermally insulating material.

Each internal enclosure consists of two steel shells separated by a filling of neutron shielding material and of a flat stainless steel bottom welded to these enclosures.

Each internal enclosure is intended to receive three pails, each pail containing the radioactive material.

1.2 Closing device

Each internal enclosure is closed by a primary lid equipped with an elastomer gasket. A “bayonet system” located on the inner face of the primary lid allows closure of the inner enclosure onto the flange.

The primary lid is protected by an upper plug formed by a stack of discs surrounded by a thin steel casing. A “bayonet system” located on the upper face of the plug allows closure of this one onto the flange of the packaging body. Leaktightness between the plug and the body is guaranteed by a seal.

1.3 Handling and storage components

The lower face of the packaging is equipped with steel forklift paths.

1.4 Safety functions

The main safety functions and the most important elements for safety are:

- **the containment** of the packaging which is provided by:
 - the four stainless steel cylindrical inner enclosures;
 - the four primary lids and their seal;

- **the radiological shielding** mainly provided by:
 - the resin contained between the shells of each inner enclosure;
 - the foam in the packaging body;
 - the steel sheets, borated if appropriate, especially those in the primary lids, the inner enclosures, the upper plugs, and the packaging body;
- **the protection against criticality** provided by the confinement system constituted of the elements described in chapter 5A of the safety analysis report ;
- **the protection against shock** is mainly provided by the shock absorber material contained in the body of the packaging ;
- **the protection against fire** mainly provided by insulating material.

2. MEASURES TO BE TAKEN BY CONSIGNOR BEFORE SHIPMENT

The package must be used in compliance with the operating instructions described in chapter DOS-06-00037028-600 Rev. 5 (Chapter 6A) of the Safety Analysis Report.

The correct closing of the pails used for the packaging of the contents must be checked by a visual inspection before loading in the cavity of the package.

3. MAINTENANCE PROGRAM

The maintenance program of the packaging is described in chapter DOS-06-00037028-700 Rev. 0 (Chapter 7A) of the Safety Analysis Report.

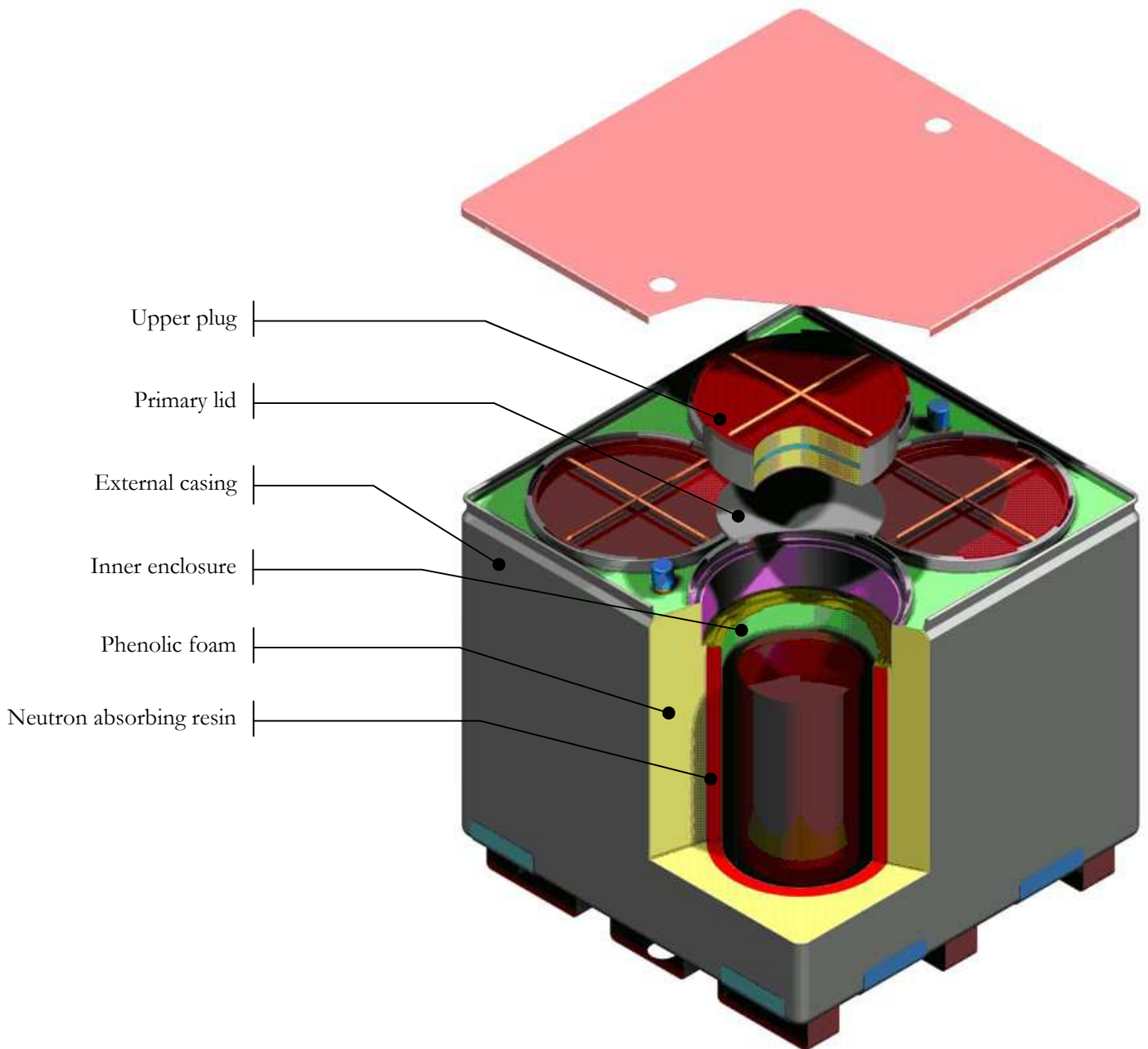
4. NOTIFICATION AND REGISTRATION OF SERIAL NUMBERS

Should a packaging be disposed of or change ownership, this must be notified to the competent authorities. Accordingly, the party relinquishing ownership of a packaging shall forward the name of the new owner.

5. QUALITY ASSURANCE

The applicable quality assurance principles for the packaging design, manufacture, inspection, tests, maintenance and use must be compliant with these described in chapter DOS-06-00037028-800 Rev. 1 (Chapter 8A) of the Safety Analysis Report.

FIGURE 0.1
SKETCH OF THE TNF-XI PACKAGE



APPENDIX 8

CONTENTS N° 8: URANIUM IN URANIUM OXIDES FORM, URANYL NITRATE FORM, SODIUM DIURANATES FORM OR AMMONIUM DIURANATE FORM, MIXED WITH RESIDUES

1. AUTHORIZED CONTENT DEFINITION

1.1 Physical form

The radioactive content is constituted of uranium in of uranium oxides form, uranyl nitrate form, sodium diuranates form or ammonium diuranate form. These uranium complexes, in solid form, may be mixed with residues that are:

- either inorganic residues: metallic oxides and precipitates, glass or mineral complexes in solid form. These residues are mainly composed of:
 - Either calcined filter aid (silicon dioxide, aluminium oxides, calcined aluminosilicate), with small amount of iron oxides and gadolinium oxides,
 - or calcium and aluminium fluorides,
 - or sodium nitrates and gadolinium (hydr)oxides,
 - or glass,
 - or glass wool or rock wool,
 - or concrete and cement,
 - or gypsum,
 - or aluminium oxides and brick.
- or organic residues in solid form mainly composed of:
 - either polyethylene resin with or without carbon black,
 - or polyvinyl chloride laden or not with carbon black,
 - or rubber (natural and synthetic),

Other organic compounds may be present in form of traces.

- or organic and inorganic residues mainly composed of aluminium in form of thin sheet, kraft paper and composite fibres (synthetic fibres or glass fibres).

The shipment of dangerous good other than class 7 is only allowed for aluminium fluoride (ONU n°: 1759) and Sodium Nitrate (ONU n°: 1498). The quantity per cavity of these compounds is limited to the limited quantities required in the ADR, RIS and IMDG code, that is to say:

- in the limit of 1 kg for aluminium fluoride classified in the group II and 5 kg for the one classified in the group III,
- in the limit of 5 kg for Sodium Nitrate.

Aluminium is not under pulverulent form.

In order not to damage the pails, the radioactive content shall not present any peak or sharp edge made of material at least as hard as the material of the material of the pails.

1.2 Isotopic composition and maximal allowable weight

Only unirradiated uranium may be present in the packaging.

The maximal allowable mass of uranium, under every possible listed forms listed in the paragraph 1.1, is limited per inner enclosure to:

- 5 kg for a mass enrichment in ^{235}U lower or equal to 5%;
- 0.5 kg for a mass enrichment in ^{235}U higher to 5% and lower or equal to 20%;

The maximal allowable mass of uranium and residues is limited to 75 kg per inner enclosure.
The thermal power of the content is below 0.5 mW per inner enclosure.

In case of a mix of both enrichments in one packaging, the most restrictive allowable mass of fissile material applies.

For a temperature lower or equal to 100°C, the content must:

- be chemically stable,
- contain no liquid,
- be compatible with the material of the plastic bags, the pails, the inner enclosure and the seal of the primary lid,

1.3 Maximal activity

The content being unirradiated uranium, the allowable A2 activity is infinite.

1.4 Maximal weight of powder

The content, before to be loaded in the inner enclosure, has a total mass not exceeding 300 kg, cumulative value of the four inner enclosures.

2. CONDITIONING

Inner primary containers: pails

The radioactive material may be packed in bags constituted of material more hydrogenated than water. Packed (or not) radioactive material is placed in pails.

Each inner enclosure must always contain three pails equipped with their ring made of steel or borated steel. These pails, in stainless steel and placed in vertical position, have a nominal diameter of 287.4 mm, an empty mass of approximately 7 kg and a lid in stainless steel with a closing system.

The ring in steel or borated steel has a minimal height of 180 mm, a thickness of 2 mm and an external diameter between 280 mm and 285 mm. This ring may have a longitudinal weld.

The material of the plastic bags must withstand a temperature at least equal to 100°C.

Before loading of the content, a visual check must be done in order to ensure absence of salient parts that could damage the pails.

3. CRITICALITY ANALYSIS

It is subject of chapters DOS-06-00037028-500 Rev.6 (chapter 5A), DOS-06-00037028-506 Rev.0 (chapter 5A-6) the Safety Analysis Report.

Confinement system considered is described in the chapter DOS-06-00037028-500 Rev.6 (chapter 5A) of the Safety Analysis Report.

Criticality Safety Index (CSI): 0.



DIRECTION DU TRANSPORT ET DES SOURCES

**CERTIFICATE OF APPROVAL
OF A PACKAGE MODEL****F/381/AF- 96 (Di)
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The French competent authority,

Given the application submitted by the TN International company in the letter CEX-15-00115358-121 dated December 14th, 2015,

Given the TN International Safety Analysis Report DOS-06-00037028-000 Rev.6 of December 14th, 2015,

certifies that the package design called "TNF-XI", as described in appendix 0 index i and:

- loaded with oxides of uranium, unirradiated, enriched to a maximum of 5 % in ²³⁵U as described in appendix 2i, (content n°2) ;
- loaded with oxides of uranium, unirradiated, enriched to a maximum of 5 % in ²³⁵U as described in appendix 7i, (content n°7) ;

complies, as a Type A package containing fissile materials,

with the requirements of the regulations, agreements or recommendations listed below:

- Safety Standards Series– Regulations for the Safe Transport of Radioactive Materials – International Atomic Energy Agency n° SSR-6, 2012 Edition ;
- European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR) ;
- Regulations concerning the International carriage of Dangerous goods by Rail (RID) ;
- European Agreement concerning the International Carriage of Dangerous goods by inland waterways (ADN) ;
- International Maritime Dangerous Goods Code (IMDG Code from IMO) ;
- Order of May 29th, 2009 concerning the carriage of dangerous goods by terrestrial ways (TMD Order) ;
- Order of November 23th, 1987 modified concerning the Ship Safety, section 411, attached (RSN Order).

This certificate does not relieve the consignor from compliance with any requirement of the government of any country through or into which the package will be transported.

This certificate expires on **31/12/2021**.

Registration number: **CODEP-DTS-2016-033417**

Montrouge, **6th September 2016**

SUMMARY OF CERTIFICATE ISSUES

Issue	Expiration	Type of issue and modifications	Authority	Type of certificate	Revision index									
						t	0	1	2	3	4	5	6	7
05.08.2002	05.08.2007	First issue type A and type IP-2 package	DGSNR	AF-96	Aa	-	a	a	a	a	a	-	-	-
31.10.2002	05.08.2007	Extension type A and type IP-2 package	DGSNR	AF-96	Ab	-	b	b	b	b	b	-	-	-
04.07.2007	31.12.2011	Prorogation type A package	ASN	AF-96	Bc	-	c	c	c	-	-	-	-	-
04.07.2007	31.12.2011	Prorogation type IP-2 package	ASN	IF-96	Bd	-	d	-	-	d	d	-	-	-
25.11.2010	31.12.2011	Extension type A package	ASN	AF-96	Be	-	e	-	-	-	-	e	-	-
10.10.2011	31.12.2016	Prorogation type A package	ASN	AF-96	Cf	-	f	f	f	-	-	-	-	-
10.10.2011	31.12.2016	Prorogation type IP-2 package	ASN	IF-96	Cg	-	g	-	-	g	g	-	-	-
11.08.2014	31.12.2016	Extension type A package	ASN	AF-96	Ch	-	h	-	-	-	-	-	h	-
06.09.2016	31.12.2021	Prorogation and extension type A package	ASN	AF-96	Di	-	i	-	i	-	-	-	-	i

APPENDIX 0

TNF-XI PACKAGING

1. DESCRIPTION OF THE PACKAGING

The packaging is designed, manufactured, inspected, tested, maintained and used in compliance with the Safety Analysis Report TN International DOS-06-00037028-000 Rev. 6 of December 14th, 2015.

The TNF-XI packaging, of a generally rectangular shape, is presented in Figure 0.1.

The design drawing of the packaging is the drawing COGEMA LOGISTICS 12986-01 Rev. K.

The outer overall dimensions of the packaging are:

- Nominal height of body: 940 mm,
- Maximal nominal height of packaging: 1040 mm,
- Cross section of body: 1100 × 1100 mm (overall nominal dimensions).

The maximal weight of empty packaging (± 10 kg) is 660 kg.

The maximal weight of loaded packaging allowable in transport is 1050 kg.

The packaging comprises the main components described below.

1.1 Body

The body of the packaging consists of a steel external casing of rectangular shape, and four cylindrical internal wells, also made of steel, separated by a layer of shock-absorbing and thermally insulating material.

Each well consists of two steel shells separated by a filling of neutron shielding material. The natural boron concentration of this material is compliant with the value specified in chapter 0 of Safety Analysis Report.

1.2 Closing device

Each well is closed by a primary lid equipped with an elastomer gasket. The internal face is equipped with four steel teeth enabling the closing on the well flange by a "bayonet system".

The primary lid is protected by an upper plug formed by the superimposing of discs. This assembly is surrounded by a thin steel covering. The upper face comprises six steel teeth enabling closing on the body flange by a "bayonet system". Leaktightness between the plug and the body is provided by a seal.

1.3 Handling and storage components

The lower face of the packaging is equipped with steel forklift paths.

1.4 Safety functions

The main safety functions and the most important elements for safety are:

- **the containment** provided by the containment system constituted of:
 - the four stainless steel cylindrical inner shells;
 - the four flat stainless steel bottoms welded to the cylindrical inner shells;
 - the four primary lids and their seals;

- **the radiological shielding** mainly provided by:
 - the resin contained between the cylindrical inner and outer shells;
 - the foam in the packaging body;
 - the steel sheets contained in the primary lids, the inner shells, the four cylindrical inner and outer shells;
 - the borated steel sheets;
 - the discs near the upper plugs;
- **the safety criticality** provided the confinement system constituted of the elements described in chapter 0 of the safety analysis report ;
- **the protection against shock** is mainly provided by the shock absorber material contained in the body of the packaging ;
- **the protection against fire** mainly provided by insulating material.

2. MEASURES TO BE TAKEN BY CONSIGNOR BEFORE SHIPMENT

The package must be used in compliance with the operating instructions described in chapter DOS-06-00037028-600 Rev. 3 (Chapter 6A) of the Safety Analysis Report.

The correct closing of the pails used for the packaging of the contents must be subject to a visual inspection before loading in the cavity of the package.

3. MAINTENANCE PROGRAM

The maintenance program of the packaging is described in chapter DOS-06-00037028-700 Rev. 0 (Chapter 7A) of the Safety Analysis Report.

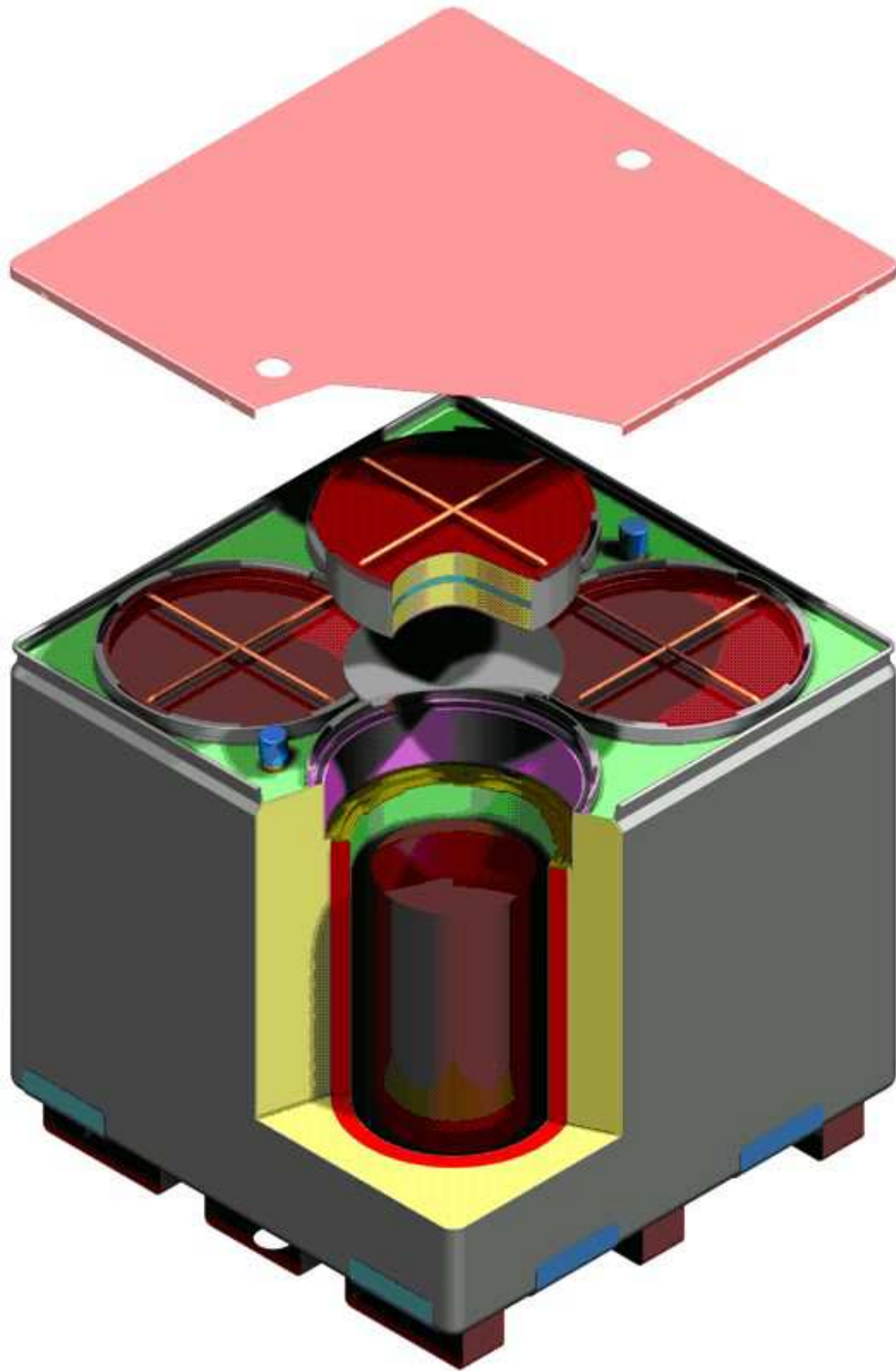
4. NOTIFICATION AND REGISTRATION OF SERIAL NUMBERS

Should a packaging be disposed of or change ownership, this must be notified to the competent authorities. Accordingly, the party relinquishing ownership of a packaging shall forward the name of the new owner.

5. QUALITY ASSURANCE

The applicable quality assurance principles for the packaging design, manufacture, inspection, tests, maintenance and use must be compliant with these described in chapter DOS-06-00037028-800 Rev. 1 (Chapter 8A) of the Safety Analysis Report.

FIGURE 0.1
SKETCH OF THE TNF-XI PACKAGE



APPENDIX 2

CONTENTS N° 2: URANIUM OXIDES (UO₂, UO₃, OR U₃O₈)

1. AUTHORIZED CONTENT DEFINITION

1.1 Physical form

The radioactive content is constituted of uranium oxides (UO₂, UO₃, or U₃O₈) in the form of powder, pellets or scraps of pellets.

1.2 Isotopic composition and maximal allowable weight

The maximal allowable weight of uranium oxide in each cavity (shared out in three pails) of the package is limited to the values defined in function of the maximum content enrichment in ²³⁵U, as follows:

Mass enrichment (e = ²³⁵ U/U _{tot})	UO ₂ , UO ₃ , U ₃ O ₈ (powder, pellets or scraps of pellets)
≤ 4.15%	75.0 kg
≤ 4.45%	64.5 kg
≤ 4.65%	58.5 kg
≤ 4.85%	53.5 kg
≤ 4.95%	51.5 kg
≤ 5%	50.0 kg
Density	≤ 10.96 g/cm ³

The powder of uranium oxide may contain impurities. The Aluminium and Carbon impurities shall not exceed the limit specified hereafter:

Elements	Maximum concentration (ppm)
Al	≤ 5,000
C	≤ 10,000

1.3 Maximal activity

The radioactive contents must comply with the “unirradiated Uranium” definition of the applicable regulation.

1.4 Maximal weight of powder

The total maximal weight of this content is 300 kg.

2. PACKAGING

Inner primary containers: pails

The uranium oxide may be placed in bags constituted of material more hydrogenated than water. Packed (or not) uranium oxide is placed in pails (three for each cavity) in stainless steel compliant with the following characteristics:

- Placed in vertical position,
- Material : stainless steel,
- Nominal diameter: 287.4 mm,
- Lid in stainless steel with closure ring,
- Empty weight: approximately 7 kg,
- The thickness of the pails is at least equal to 1 mm,
- Presence of a borated steel ring in the pails that must comply with the following characteristics: minimal height: 180 mm, minimal thickness: 2 mm, external diameter between 280 mm and 285 mm, natural boron mass content: greater than 1%, which represents a concentration in ^{10}B of $C \geq 8.7 \cdot 10^{20}$ at/cm³. The borated ring may have a longitudinal weld.

Each cavity must always contain the three pails stacked in vertical position with their borated ring.

The maximal authorised mass of plastic material more hydrogenated than water is limited to 390 g per cavity. The operating temperature of the plastic bag must be equal or greater than 100°C.

3. CRITICALITY ANALYSIS

It is subject of chapters DOS-06-00037028-500 Rev.5 (chapter 5A), DOS-06-00037028-503 Rev.3 (chapter 5A-3) and DOS-06-00037028-504 Rev.0 (chapter 5A-4) of the Safety Analysis Report.

Confinement system considered is described in the chapter DOS-06-00037028-500 Rev.5 (chapter 5A) of the Safety Analysis Report.

Criticality Safety Index (CSI): 0.

APPENDIX 7 CONTENTS N° 7: URANIUM OXIDES (UO₂, UO₃, OR U₃O₈)

1. AUTHORIZED CONTENTS DEFINITION

1.1 Physical form

The radioactive content is constituted of uranium oxides (UO₂, UO₃, or U₃O₈) in the form of powder, pellets or scraps of pellets mixed with residues consisting in incinerator ashes or earth, sand and residues from dissolution.

1.2 Isotopic composition and maximal allowable weight

The maximal allowable weight of uranium in each cavity (shared out in three pails) of the package is limited to 5 kg of uranium under form of uranium oxides. The maximum mass enrichment “e” in ²³⁵U is limited to 5% ($e = \frac{^{235}\text{U}}{U_{\text{tot}}}$).

The residues incinerator ashes consist of mainly silica, alumina, aluminosilicates, metal oxides, phosphates, aluminium metal, charred wood and charred plastic in undefined part.

The earth, sand and dissolved residues consist of mainly silica, alumina, titania, iron oxide and aluminosilicate in undefined part. Other organic or inorganic compounds may be present in the form of traces.

The residues are chemically stable, contain no liquid.

The authorised quantity of uranium oxides and residues is limited to 75 kg per cavity.

1.4 Maximal activity

The radioactive contents must comply with the “unirradiated Uranium” definition of the applicable regulation.

1.5 Maximal weight of powder

The total maximal weight of this content is 300 kg.

2. PACKAGING

Inner primary containers: pails

The uranium oxide can be placed in bags constituted of material more hydrogenated than water. Packed (or not) uranium oxide is placed in pails (three for each cavity) in stainless steel compliant with the following characteristics:

- Placed in vertical position,
- Material : stainless steel,
- Nominal diameter: 287.4 mm,
- Lid in stainless steel with closure ring,
- Empty weight: approximately 7 kg,
- Presence of a steel ring (that can be borated) in the pails that must comply with the following characteristics: minimal height: 180 mm, minimal thickness: 2 mm, external diameter between 280 mm and 285 mm. The borated ring may have a longitudinal weld.

Each cavity must always contain the three pails stacked in vertical position with their borated ring.

The operating temperature of the plastic bag must be equal or greater than 100°C.

3. CRITICALITY ANALYSIS

It is subject of chapters DOS-06-00037028-500 Rev.5 (chapter 5A) and DOS-06-00037028-505 Rev.0 (chapter 5A-5) of the Safety Analysis Report.

Confinement system considered is described in the chapter DOS-06-00037028-500 Rev.5 (chapter 5A) of the Safety Analysis Report.

Criticality Safety Index (CSI): 0.



U.S. Department of
Transportation

**Pipeline and
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