U.S. Department
of Transportation
Pipeline and
Hazardous Materials
Safety Administration

East Building, PHH-23
1200 New Jersey Avenue Southeast
Washington, D.C. 20590

**COMPETENT AUTHORITY CERTIFICATION
FOR A TYPE FISSILE
RADIOACTIVE MATERIALS PACKAGE DESIGN
CERTIFICATE USA/0776/AF-96, REVISION 0**

**REVALIDATION OF FRENCH COMPETENT AUTHORITY
CERTIFICATE F/347/AF-96**

This certifies that the radioactive material package design described is hereby approved for use within the United States for import and export shipments only. Shipments must be made in accordance with the applicable regulations of the International Atomic Energy Agency[1] and the United States of America[2].

1. Package Identification - FCC-3 Transport Package.

2. Package Description and Authorized Radioactive Contents - as described in France Certificate of Competent Authority F/347/AF-96, Revision Ci (attached). Contents are restricted to those listed in Appendices 1, 5 and 9 of French Certificate of Approval No. F/347/AF-96, Revision Ci.

3. Criticality - The minimum criticality safety index is as assigned in French Certificate of Approval. The maximum number of packages per conveyance is determined in accordance with Table X 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 Hazardous Materials Technology, (PHH-23), Pipeline and Hazardous Materials Safety Administration, U.S. Department of Transportation, Washington D.C. 20590-0001.

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[1] "Regulations for the Safe Transport of Radioactive Material, 1996 Edition (Revised), No. TS-R-1 (ST-1, Revised)," 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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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.

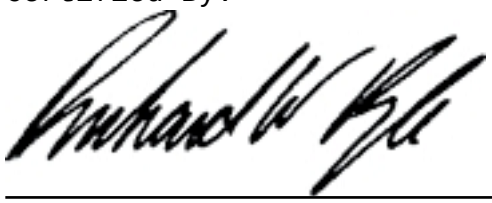
d. Records of Quality Assurance activities required by Paragraph 310 of the IAEA regulations[1] shall be maintained and made available to the authorized officials for at least three years after the last shipment authorized by this certificate. Consignors in the United States exporting shipments under this certificate shall satisfy the applicable requirements of Subpart H of 10 CFR 71.

5. Marking and Labeling - The package shall bear the marking USA/0776/AF-96 in addition to other required markings and labeling.

6. Expiration Date - This certificate expires on December 31, 2010.

This certificate is issued in accordance with paragraph 814 of the IAEA Regulations and Section 173.472 and 173.473 of Title 49 of the Code of Federal Regulations, in response to the October 20, 2009 petition by Areva - TN Inc, Columbia, MD, and in consideration of other information on file in this Office.

Certified By:



Dr. Magdy El-Sibaie
Associate Administrator for Hazardous Materials Safety

Sep 24 2010
(DATE)

Revision 0 - Issued to revalidate French Certificate of Approval No. F/347/AF-96, Revision Ci.

The Competent French Authority,

in view of the application submitted by **AREVA NP** by letter D-FDE-09-01452, Dated July 17th 2009 ;

in view of the safety file TFX/DC/2159 Rev D, completed by AREVA NP report FFDC03125 revision A dated August 23th 2006 and AREVA NP report FFDC03077 revision B dated August 23th 2006;

hereby certifies that the package design consisting of by the FCC-3 cask described in appendix 0 in revision a and loaded with:

:

- a maximum 2 PWR 17 x 17 12 ft fresh fuel assemblies, in version 1 of the cask, as described in appendix 1a ;
- or a maximum of 2 boxes containing PWR 17 x 17 12 ft fresh unassembled fuel rods, in version 1 of the cask, as described in appendix 5a ;
- or a maximum 2 PWR 17 x 17 12 ft fresh fuel assemblies, in version 1 of the cask, as described in appendix 9a ;
- or a maximum of 2 boxes containing PWR 17 x 17 12 ft fresh unassembled fuel rods, in version 1 of the cask, as described in appendix 11a ;

is compliant as a **type A Industrial package design containing fissile materials** with the regulations, agreements or recommendations hereafter:

- Regulations for the safe transport of radioactive material of International Agency of Energy Atomic; Safety requirements No. TS-R-1 (1996 edition revised);
- European Agreement on the International Carriage of Dangerous Goods by Road (ADR);
- regulation concerning international rail transportation of dangerous goods (RID);
- regulation for the transportation of dangerous goods on the Rhine (ADNR);
- International Maritime Code for dangerous goods of the international Maritime Organisation (IMDG IMO's code);
- order of June 1st 2001 amended concerning the shipping of dangerous goods by road (ADR order);
- order of June 5th 2001 amended concerning the shipping of dangerous goods by rail (RID order);
- order of December 5th 2002 (ADNR order) amended concerning the shipping of dangerous goods by internal waterway;
- order of November 23rd 1987 amended concerning the safety of ships (RSN order), division 411.

This certificate does not exempt the shipper from observing the requirements established by the authorities of the countries through or towards the territory of which the package will be transported.

This certificate cancels and replaces since the 11th September 2009 the certificate F/347/AF-96 (Ch) dated from the 31st August 2010.

The validity of this certificate expires on: **December 31st 2010**.

Registration Nr: **ASN/DIT/0542/2009**

PARIS, on the 11th September 2009

for the Minister of the Economy, Finances and Industry, and for delegation,

J .L. LACHAUME

for the Minister of Ecology and Sustainable Development, and for delegation,

J.L. LACHAUME

SUMMARY OF THE ISSUES OF THE CERTIFICATE

Issue	Expiration date	**Purpose of issue and modifications**	Authority	**Ref. of the certificate**	**Revision**						
					corps	t	0	1	2	3	4	5
31/01/00	31/01/05	First agreement	DGSNR	F/347/IF-85	Aa	-	a	a	a	a	a	-
27/11/02	31/01/05	Extension	DGSNR	F/347/IF-85	Ab	-	b	-	-	b	b	-
12/02/04	31/01/05	Extension	DGSNR	F/347/IF-85	Ac	-	b	c	c	c	c	-
30/12/04	31/01/10	Prorogation	DGSNR	F/347/IF-96	Bd	-	d	d	d	d	d	d
20/07/05	31/01/10	Extension	DGSNR	F/347/IF-96	Be	-	e	e	e	e	e	e
02/10/06	31/01/10	Extension	DGSNR	F/347/IF-96	Bf	-	e	e	e	e	e	e
15/07/09	31/12/10	Administrative prorogation	ASN	F/347/IF-96	Cg	-	e	g	g	g	g	g
31/08/09	31/12/10	Extension	ASN	F/347/AF-96	Ch	-	e	g	g	g	g	g
11/09/09	31/12/10	Extension	ASN	F/347/AF-96	Ci	-	f	h	h	h	h	h

Revision							
corps	6	7	8	9	10	11	12
Aa	-	-	-				
Ab	-	-	-				
Ac	-	-	-				
Bd	d	d	d				
Be	e	e	e				
Bf	e	e	e	f	f	f	f
Cg	g	g	g	g	g	g	g
Ch	g	g	g	g	g	g	g
Ci	h	h	h	h	h	h	h

APPENDIX 0

FCC3 PACKAGE

1. DESCRIPTION OF THE PACKAGING

The packaging is designed, inspected, maintained, tested and used in accordance with safety file TFX/DC/2159 rev D.

The packaging, in cylindrical shape, is shown in figure 0.1.

The concept drawing is 229K0100 or 229K0200 for version 1 and 229K0300 for version 2.

The overall nominal outside dimensions are:
- length: 4923 + - 8 mm
- outside diameter: 1048 +/- 4 mm.

The maximum permissible mass of the loaded container during transportation is 4385 kg.

The container consists of the following main sub-assemblies.

1.1 Body

The FCC3 packaging is composed of a cylindrical horizontally aligned enclosure made up of two linked half-shells comprising:
- a steel cradle made up of two stringers and suspended, by means of shock mountings, from the lower shell;
- an internal device resting on the cradle and designed to accommodate one of the contents.

This internal device is made up of:
- a support frame whose rigid reverse "T"-shaped structure is intended to accommodate the consignment. The fabricated portion of the frame contains neutron-absorbing resin. On the bottom plate, a swing bolt authorises the vertical positioning of the support frame for loading or unloading the assemblies;
- two "L"-shaped doors containing neutron-absorbing resin are fixed to the support frame and seal off the contents;
- a bottom plate supporting the fuel assemblies at the time of the loadings and unloading with the support frame in vertical position;
- a top plate in two parts for sealing off the cavities and wedging the fuel assemblies at the other end.

1.2 Closing system

The two half-shells are linked by flanges; a special angle bar on the lower shell enables the fitting of 30 bolts which link up the two cylinders.
The doors and top plates are joined to the frame by ball pins. The bottom plate is screwed to the frame.

1.3 **Damping system**

Two axial shock absorbers are fixed to the end of the upper shell. They are made up of two metal boxes containing a balsa wood block.

1.4 **Handling and lashing features**

Handling can be performed in normal safety conditions by standard lifting machinery, with the aid of slings and levers or hooks. Three lifting modes are possible:

- by the 4 lifting lugs, welded to the top shell, for handling the empty or loaded package and the lid on its own during the opening operations; these lifting boxes are made up of a bent plate with a port for passing a hook through;
- by sockets for fork lift trucks, under the lower shell.

The packaging is designed to be suitably lashed during transportation by means of lifting lugs.

1.5 **Safety functions**

The confinement system is made up of the features described in the appendices and, for the container portion, of the container structure featuring the following items:

- the internal device: it is formed of the frame, the doors and end plates, together with the radial and axial wedging system for the rod boxes, together forming two neutronic cavities
- the neutron-poisoning resin contained in the doors and frame
- the lower and upper shells which protect the internals in NTC and ATC.

- the shock protection provided by the two half-shells and by the internal device

- the fire protection afforded by the two half-shells, the internals and the resin in the doors and frame.

2. MEASURES WHICH THE SHIPPER MUST TAKE BEFORE DISPATCHING THE PACKAGE

The container must be used by following the procedures in accordance with the instructions in chapters 4 and 8 of the safety file.

Before each shipment, the shipper must ensure that the following checks have been made, according to a list drawn up on the basis of the service conditions described in chapter 4.2 of the safety file, that the results of these checks meet the specified criteria and that the list has been regularly signed:

- check that the package has been maintained as per section 3;
- check the compliance of the content with this certificate;
- check the compatibility of the contents with the packaging version;
- check the torques of the bolts joining together the two half-shells: 5 +/- 1 mdaN;
- check the presence of all the pins needed to tightly close the container;
- check the contamination of the outer surfaces of the package;
- check the maximum radiation intensity around the package, in contact and at 1 m;
- check the tamper-proof seals are in place preventing access to the ports;

- check the presence of the labels and markings (the package identification is " « F/347/AF-96 » and the packaging identification is « TYPE A »);
- check that the transportation is for exclusive use;
- check in case of river transport that the total number of A2, of the contents in the packages arranged in the same hold or another compartment is less than 100;
- the package must be lashed in horizontal position on its means of transport

3. MAINTENANCE PROGRAMME

Maintenance is described in chapter 8 of the safety file.

In particular, no less than every 50 cycles or every 5 years, whichever is most limiting:

- the good overall condition of the packaging will be checked and any non-compliant component will be replaced,
- liquid penetrant examination of the gripping zones for lifting will be performed.

Any packaging not meeting the criteria specified in the maintenance programme must be taken out of service until the appropriate corrective action has been taken.

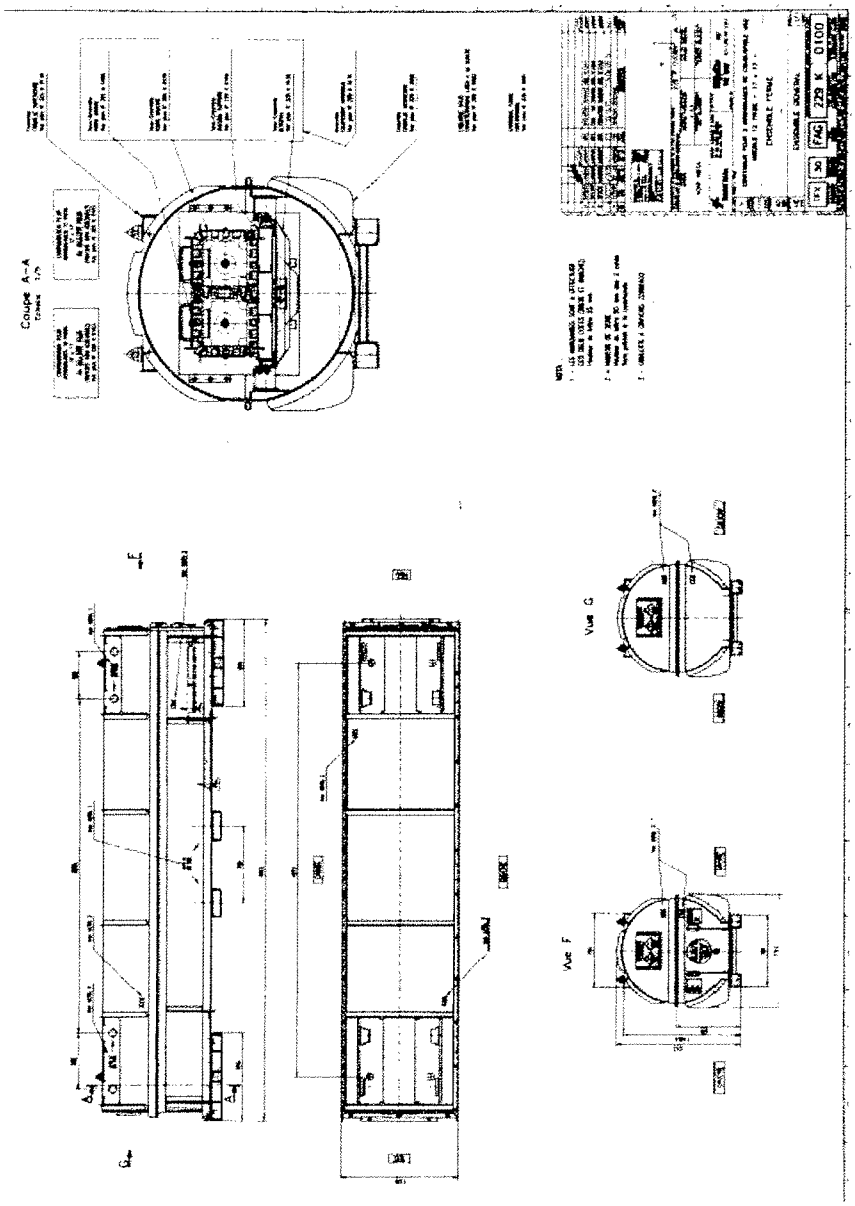
4. NOTIFICATION AND RECORDING OF SERIAL NUMBERS

Any taking out of use or change of owner of a packaging shall be made known to the competent authorities. To this effect, the owner relinquishing a packaging shall transmit the name of its purchaser.

5. QUALITY ASSURANCE

The QA principles to be applied during the design, fabrication, inspection, testing, maintenance and use of the packaging shall conform to those described in chapter 7 of the safety file.

FIGURE 0.1
CONTAINER DIAGRAM



APPENDIX 1

FRESH PWR FUEL ASSEMBLIES

The safety file justifying this content is TFX/DC/2159 rev. D.

This content must be loaded into an FCC 3 version 1 container

1. DEFINITION OF THE AUTHORIZED RADIOACTIVE CONTENT

1.1 Fuel assembly characteristics

The authorized radioactive content, as described in chapter 2.2 of the safety file, is made up of no more than two fresh fuel assemblies, destined for PWR, as described below:

Fuel assembly characteristics before irradiation:	**17x17 12 ft**
type of array	17x17
Nominal pitch of array (mm)	12,6
Max totale mass of the assembly with or without control component (kg)	751
Max mass of heavy metal per assembly (kg)	521
Nominal active length (mm)	3658
Max number of fuel rods	288(1)
Fuel rod characteristics before irradiation:	
Cladding material	Zirconium alloy
– Min thickness (mm)	0,52
– Min Outside Diameter (mm)	9,46
Pellets:	UNE
– Max diameter (mm)	8,20
– Max oxide density (97.5 % of theoretical density)	10,69
– Max initial enrichment $^{235}U/U_{total}$ (%)	5
– Max mass ratio $^{232}U/U_{total}$ (%)	5.10^{-8}
– Max mass ratio $^{234}U/U_{total}$ (%)	0,055
– Max mass ratio $^{236}U/U_{total}$ (%)	0,05
Max absolute internal pressure at 20 °C (bars)	32,7

(1) This number of rods corresponds to the maximum number of rods liable to be inserted into a structure (skeleton or canister), including the guide thimbles.

The mechanical strength properties of the cladding materials must meet either of the following criteria:

	1	2	3	4	5
$R_{p0.2}$ (MPa) ≥	520	455	350	250	290
R_m (MPa) ≥	710	590	480	400	440
A_t (%)≥	12	12	15	25	20

1.2 Consignment conditions

All the assemblies in a consignment must meet the conditions below.

type of assembly	max number of assemblies authorized per consignment	max initial enrichment per rod of each assembly in the consignment $^{235}U/U_{total}$ (%)	min number of rods in each assembly of the consignment (1)
17x17	2	5	264

(1) Incomplete assemblies may be equipped with solid steel (or Zy) bars possibly containing a neutron poison. The term « number of rods per assembly » means the total number of fuel rods and steel (Zy) bars.

All the assemblies in the consignment, except one, may be replaced by assembly skeletons.

The presence of materials more hydrogen-containing than water in the packaging is forbidden.

Max activity per packaging: The maximum activity of the content must be lower than 1 A2.
Physical state: Fuel rod assemblies consisting of sintered pellets placed in a Zirconium alloy cladding meeting either of the criteria given in paragraph 1.1 of this appendix.
Chemical form: Uranium oxide pellets (UO_2) and/or fuel pellets composed of a UO_2 blend whose enrichment in U235 is no more than 5% and of a substance acting as neutron poison with a blend density of no more than 10,69 g/cm^3.
Special form: Transported materials are not in special form.

2. CRITTICITY STUDY

It is described in report FFDC00817, given in appendix 12 of the safety file.
The hypotheses taken into account are as follows:
- Failure to comply with the geometrical integrity of the assemblies;
- Partial flooding;
- Waterlogging of all empty spaces.

Criticality Safety Index (CSI): 0,63 (Number N=80)
Special precautions when loading into reactor: None

Special precautions in transportation: None
The confinement system is made up of the features described in appendix 0 and, for the content section, of the following features:

- The Fuel Assembly characteristics as described in the table in paragraph 1.1;
- The cladding tubes which guarantee the containment of the fissile material in accident condition;
- The Fuel Assembly structure (grids, nozzles);
- The completeness of the assembly: any missing fuel rods are replaced by inert rods.

APPENDIX 5
FRESH PWR FUEL RODS

The safety file justifying this content is TFX/DC/2159 rev. D.

This content must be loaded into an FCC 3 version 1 container.

1. DÉFINITION OF THE AUTHORIZED RADIOACTIVE CONTENT

1.1 Fuel rod characteristics

The authorized radioactive content, as described in chapter 2.3 of the safety file, is made up of fresh fuel rods, destined for PWRs, as described below:

Fuel rod characteristics before irradiation:	**17x17 12 ft**
Max total mass per cavity (kg)	751
Max total mass of rods per box (kg)	665
Max mass of heavy metal per box (kg)	483(1)
Nominal active length (mm)	3658
Max number of fuel rods per box	267
Cladding material	Zirconium alloy
– Min thickness (mm)	0,52
– Min Outside Diameter (mm)	9,46
Pellets	UNE
– Max diameter (mm)	8,20
– Max oxide density (97.5 % theoretical density)	10,69
– Max initial enrichment $235U/U_{total}$ (%)	5
– Max mass ratio $^{232}U/U_{total}$ (%)	5.10^{-8}
– Max mass ratio $^{234}U/U_{total}$ (%)	0,055
– Max mass ratio $^{236}U/U_{total}$ (%)	0,05
– Min gadolinium oxide content by weight of gadolinia rods (%)	2
Max absolute internal pressure at 20 °C (bars)	32,7

(1) This maximum mass only covers contents with wedging and gadolinia contents.

The mechanical strength properties of the cladding materials must meet either of the following criteria:

	1	**2**	**3**	**4**	**5**
$R_{p0.2}$ (MPa) ≥	520	455	350	250	290
R_m (MPa) ≥	710	590	480	400	440
A_t (%)≥	12	12	15	25	20

1.2 Consignment Conditions

All the assemblies in a consignment must meet the conditions below.

Type of assembly	Max number of rods authorized per consignment	Max initial enrichment of each rod in the consignment ($^{235}U/U_{total}$)	Min number of rods in the consignment (1)
17x17	267	5	Full row of fuel or inert rods

(1) Incomplete fuel rod rows may be equipped with solid steel (or Zy) bars possibly containing a neutron poison. The term « number of rods per box » means the total number of fuel rods and steel (Zy) bars.

The presence of materials more hydrogen-containing than water in the packaging is forbidden.

Max activity per packaging: The maximum activity of the content must be lower than 1 A2.

Physical state: Fuel rod assemblies consisting of sintered pellets placed in a Zirconium alloy cladding meeting either of the criteria given in paragraph 1.1 of this appendix.

Chemical form: Uranium oxide pellets (UO_2) and/or fuel pellets composed of a UO_2 blend whose enrichment in U235 is no more than 5% and of a substance acting as neutron poison with a blend density of no more than 10,69 g/cm^3.

Special form: Transported materials are not in special form

2. INTERNAL LAYOUT

The internal layout consists of a rod box, as described in chapter 2.3 of the safety file.

2.1 Rod boxes

Non-assembled rods are grouped in rod boxes versions FCC3 which are inserted in place of the assemblies inside the FCC3 version 1.

The box consists of a U-shaped plate, closed at the ends and strengthened by two stringers welded to the upper part of the plate. It forms a square housing of section 214 x 214 mm^2.

An axial and radial wedging system makes it possible to adapt to the length of the rods and to hold them in place. A schematic is given in figure 5.1. A detailed description accompanied by drawings is supplied in appendix 1 of the safety file (note FFDC01038).

2.2 Wedges

A set of 2 wedges provides longitudinal restraint of the box in the cavity (a top wedge and a bottom wedge). A detailed description accompanied by drawings is supplied in appendix 1 of the safety file (note FFDC01038).

3. CRITICALITY STUDY

It is described in report FFDC01046, given in appendix 12 of the safety file.
The hypotheses taken into account are as follows:
- Partial flooding;
- Waterlogging of all empty spaces.

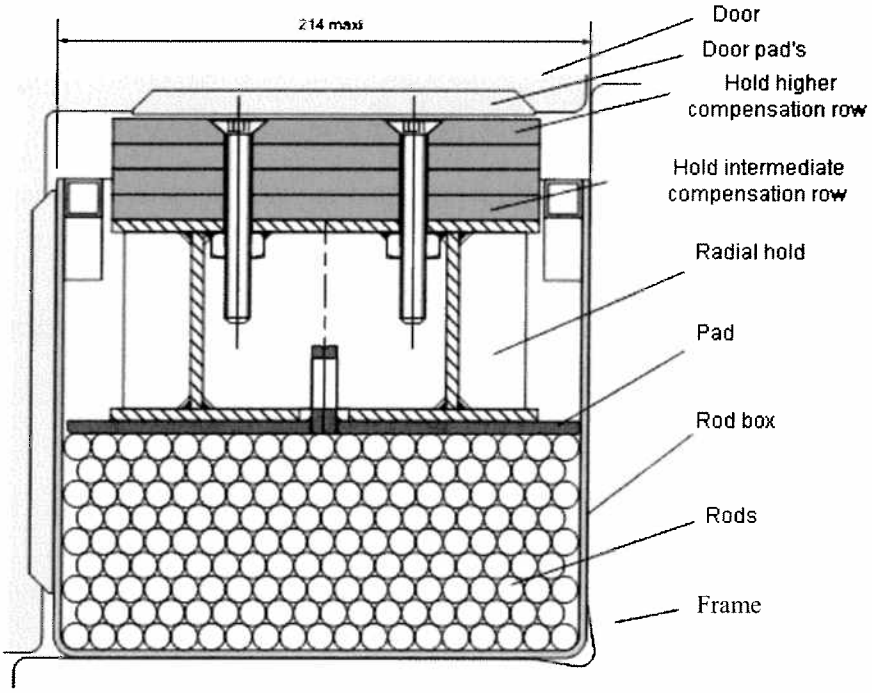
Criticality Safety Index (CSI):
- case of shipment of UO_2 rods with radial and axial wedging:
  - Criticality safety index: 0 (Number N infinite)
  - Special precautions when loading into reactor: None

- case of shipment of UO_2-Gd_2O_2 rods with or without radial and axial wedging:
  - Criticality safety index: 0 (Number N infinite)
  - Special precautions when loading into reactor: None

- case of shipment of UO_2 rods in small numbers, with or without radial and axial wedging
  - Criticality safety index: 50 (Number N = 1)
  - Special precautions when loading into reactor: respect a maximum UO_2 mass of 20 kg per package.

The confinement system is made up of the features described in appendix 0 and, for the content section, of the following features:
- The Fuel rod characteristics as described in the table in paragraph 1.1;
- The cladding tubes which guarantee the containment of the fissile material in accident condition.

FIGURE 5.1
ROD BOX DIAGRAM



APPENDIX 9
FRESH PWR FUEL ASSEMBLIES

The safety file justifying this content is TFX/DC/2159 rev. D.

This content must be loaded into an FCC 3 version 1 container.

1. DEFINITION OF THE AUTHORIZED RADIOACTIVE CONTENT

1.1 Fuel assembly characteristics

The authorized radioactive content, as described in chapter 2.2 of the safety file, is made up of two fresh fuel rods, destined for PWRs, as described below:

Fuel assembly characteristics before irradiation:	**17x17 12 ft**
Type of array	17x17
Nominal pitch of array (mm)	12,6
Max total mass of the assembly with or without control component (kg)	751
Max mass of heavy metal per assembly (kg)	521
Nominal active length (mm)	3658
Max number of fuel rods	288(1)
Fuel rod characteristics before irradiation:	
Cladding material	Zirconium alloy
- Min thickness (mm)	0,52
- Min outside diameter (mm)	9,40
Pellets:	UNE
- Max diameter (mm)	8,30
- Max oxide density (97.5 % theoretical density)	10,69
- Max initial enrichment $^{235}U/U_{total}$ (%)	4,9
- Max mass ratio $^{232}U/U_{total}$ (%)	5.10^{-8}
- Max mass ratio $^{234}U/U_{total}$ (%)	0,055
- Max mass ratio $^{236}U/U_{total}$ (%)	0,05
Max absolute internal pressure at 20 °C (bars)	32,7

(1) This number of rods corresponds to the maximum number of rods liable to be inserted into a structure (skeleton or canister), including the guide thimbles..

The mechanical strength properties of the cladding materials must meet either of the following criteria:

	1	2	3	4	5
$R_{p0.2}$ (MPa) ≥	520	455	350	250	290
R_m (MPa) ≥	710	590	480	400	440
A_t (%)≥	12	12	15	25	20

1.2 Consignment conditions

All the assemblies in a consignment must meet the conditions below.

type of assembly	max number of assemblies authorized per consignment	max initial enrichment per rod of each assembly in the consignment $^{235}U/U_{total}$ (%)	min number of rods in each assembly of the consignment (1)
17x17	2	4,9	264

(1) Incomplete assemblies may be equipped with solid steel (or Zy) bars possibly containing a neutron poison. The term « number of rods per assembly » means the total number of fuel rods and steel (Zy) bars.

All the assemblies in the consignment, except one, may be replaced by assembly skeletons.

The presence of materials more hydrogen-containing than water in the packaging is forbidden.

Max activity per packaging: The maximum activity of the content must be lower than 1 A2.

Physical state: Fuel rod assemblies consisting of sintered pellets placed in a Zirconium alloy cladding meeting either of the criteria given in paragraph 1.1 of this appendix.

Chemical form: Uranium oxide pellets (UO_2) and/or fuel pellets composed of a UO_2 blend whose enrichment in U235 is no more than 4,9% and of a substance acting as neutron poison with a blend density of no more than 10,69 g/cm^3.

Special form: Transported materials are not in special form.

2. CRITICALITY STUDY

It is described in report FFDC00817, given in appendix 12 of the safety file and in report FFDC03125.

The hypotheses taken into account are as follows:

- Failure to comply with the geometrical integrity of the assemblies in accidental condition of transport;

- Partial flooding;
- Waterlogging of all empty spaces.

Criticality Safety Index (CSI): 0,63 (Number N=80)
Special precautions when loading into reactor: None
Special precautions in transportation: None
The confinement system is made up of the features described in appendix 0 and, for the content section, of the following features:

- The Fuel Assembly characteristics as described in the table in paragraph 1.1;
- The cladding tubes which guarantee the containment of the fissile material in accident condition;
- The Fuel Assembly structure (grids, nozzles);
- The completeness of the assembly: any missing fuel rods are replaced by inert rods.

APPENDIX 11
FRESH PWR FUEL RODS

The safety file justifying this content is TFX/DC/2159 rev. D.

This content must be loaded into an FCC 3 version 1 container.

1. DEFINITION OF THE AUTHORIZED RADIOACTIVE CONTENT

1.1. Fuel rod characteristics

The authorized radioactive content, as described in chapter 2.3 of the safety file, is made up of fresh fuel rods, destined for PWRs, as described below:

Fuel rod characteristics before irradiation:	**17x17 12 ft**
Max total mass per cavity (kg)	751
Max total mass of rods per box (kg)	665
Max mass of heavy metal per box (kg)	483(1)
Nominal active length (mm)	3658
Max number of fuel rods per box	267
Cladding material	Zirconium alloy
- Min thickness (mm)	0,52
- Min outside diameter (mm)	9,40
Pellets:	UNE
- Max diameter (mm)	8,30
- Max oxide density (97.5 % theoretical density)	10,69
- Max initial enrichment $235U/U_{total}$ (%)	4,9
- Max mass ratio $^{232}U/U_{total}$ (%)	5.10^{-8}
- Max mass ratio $^{234}U/U_{total}$ (%)	0,055
- Max mass ratio $^{236}U/U_{total}$ (%)	0,05
- Min gadolinium oxide content by weight of gadolinia rods (%)	2
Max absolute internal pressure at 20 °C (bars)	32,7

(1) This maximum mass only covers contents with wedging and gadolinia contents..

The mechanical strength properties of the cladding materials must meet either of the following criteria:

	1	**2**	**3**	**4**	**5**
$R_{p0.2}$ (MPa) ≥	520	455	350	250	290
R_m (MPa) ≥	710	590	480	400	440
A_t (%)≥	12	12	15	25	20

1.2 Consignment conditions

All the assemblies in a consignment must meet the conditions below.

Type of assembly	Max number of rods authorized per consignment	Max initial enrichment of each rod in the consignment ($^{235}U/U_{total}$)	Min number of rods in the consignment (1)
17x17	267	4,9	Full row of fuel or inert rods

(1) Incomplete fuel rod rows may be equipped with solid steel (or Zy) bars possibly containing a neutron poison. The term « number of rods per box » means the total number of fuel rods and steel (Zy) bars.

The presence of materials more hydrogen-containing than water in the packaging is forbidden.

Max activity per packaging: The maximum activity of the content must be lower than 1 A2.

Physical state: Fuel rod assemblies consisting of sintered pellets placed in a Zirconium alloy cladding meeting either of the criteria given in paragraph 1.1 of this appendix.

Chemical form: Uranium oxide pellets (UO_2) and/or fuel pellets composed of a UO_2 blend whose enrichment in U235 is no more than 4,9% and of a substance acting as neutron poison with a blend density of no more than 10,69 g/cm^3.

Special form: Transported materials are not in special form.

2. INTERNAL LAYOUT

The internal layout consists of a rod box, as described in chapter 2.3 of the safety file.

2.1 Rod boxes

Non-assembled rods are grouped in rod boxes versions FCC3 which are inserted in place of the assemblies inside the FCC3 version 1.

The box consists of a U-shaped plate, closed at the ends and strengthened by two stringers welded to the upper part of the plate. It forms a square housing of section 214 x 214 mm^2.

An axial and radial wedging system makes it possible to adapt to the length of the rods and to hold them in place. A schematic is given in figure 5.1. A detailed description accompanied by drawings is supplied in appendix 1 of the safety file (note FFDC01038).

2.2 Wedges

A set of 2 wedges provides longitudinal restraint of the box in the cavity (a top wedge and a bottom wedge). A detailed description accompanied by drawings is supplied in appendix 1 of the safety file (note FFDC01038).

3. CRITICALITY STUDY

It is described in report FFDC01046, given in appendix 12 of the safety file and in report FFDC03125.

The hypotheses taken into account are as follows:

- Partial flooding;
- Waterlogging of all empty spaces.

Criticality Safety Index (CSI):

- case of shipment of UO_2 rods with radial and axial wedging:
  - Criticality safety index: 0 (Number N infinite)
  - Special precautions when loading into reactor: None

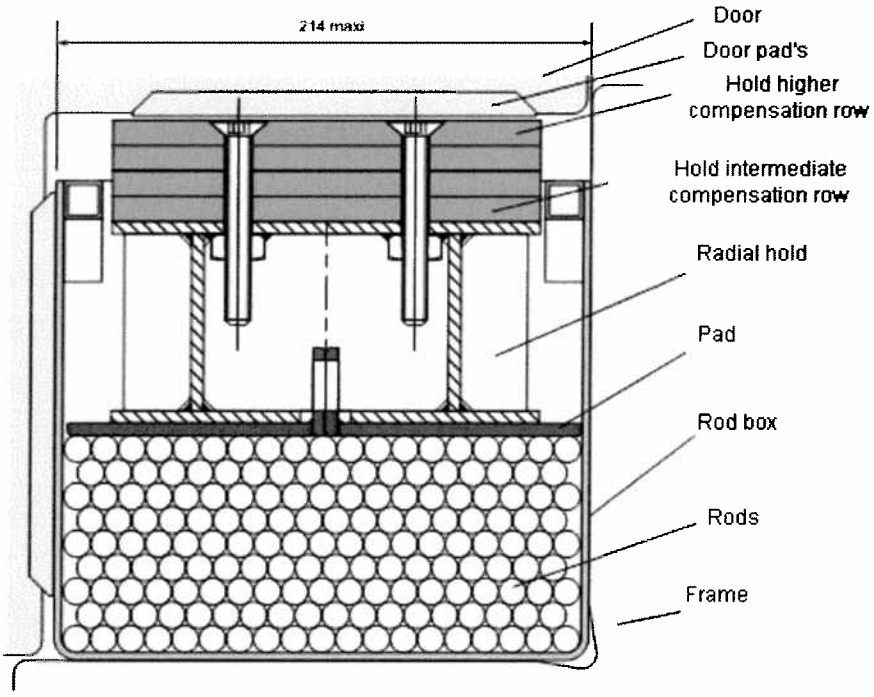
- case of shipment of UO_2-Gd_2O_2 rods with or without radial and axial wedging:
  - Criticality safety index: 0 (Number N infinite)
  - Special precautions when loading into reactor: None

- case of shipment of UO_2 rods in small numbers, with or without radial and axial wedging
  - Criticality safety index: 50 (Number N = 1)
  - Special precautions when loading into reactor: respect a maximum UO_2 mass of 20 kg per package.

The confinement system is made up of the features described in appendix 0 and, for the content section, of the following features:

- The Fuel rod characteristics as described in the table in paragraph 1.1;
- The cladding tubes which guarantee the containment of the fissile material in accident condition.

FIGURE 11.1
ROD BOX DIAGRAM



U.S. Department
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**Pipeline and
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