AUTORITÉ DE SÛRETÉ NUCLÉAIRE

TRANSPORT AND SOURCES DEPARTMENT

PERMISSIBLE PACKAGE DESIGN APPROVAL CERTIFICATE

F/366/B(U)F-96 (Ck)

The French Governing Authority,

With respect to the request submitted by TN International by letter CEX-15-00115358-098 dated 26 August 2015,

given the safety analysis reports ref DOS-07-00089301-000 Rev. 08 of 04 August 2015 and DOS-07-00089301 Rev. 06 of 31 October 2013,

Hereby certifies that the package design comprising packaging TN ® 81 option b hereafter described below in appendix 0 section k and:

- loaded with:
  - at most, 28 vitrified residue canisters (CSD-V) resulting from the processing of fuel produced by AREVA NC in a basket with 7 compartments (Content No.1), as described in appendix 1 version h;
  - at most, 14,000 kg of compacted waste canisters resulting from the processing of irradiated fuel, distributed in 5 of the 7 basket compartments, with a maximum permissible weight of 3000 kg per loaded compartment (Content No. 2), as described in appendix 2 version i;
  - or, at most, 28 vitrified residue canisters (CSD-B) produced by AREVA NC, mainly resulting from the rinsing of tanks following a definitive shut down process, in a basket with 7 compartments (Contents No. 5), as described in appendix 5 version k;
  - or, at most, a mixture of 28 canisters containing vitrified residues CSD-V & CSD-B, both produced by AREVA NC, in a basket with 7 compartments, (Content No. 6) as described in appendix 6 version k;
  - or, at most, a mixture of 20 canisters containing vitrified residue (CSD-B), produced by AREVA NC and compacted waste (CSD-C) from the processing of fuel, in 5 of the 7 basket compartments, with a maximum permissible weight of 3000 kg per loaded compartment (Content No. 7), as described in appendix 7 version k.
- when empty, contaminated or not, fitted with its interior fixtures or not, is compliant as a type B(U) package design,

  is compliant with the requirements of a type B(U)F package containing fissile material;

and with the instructions in the regulations, agreements or recommendations listed below:

- regulations for the safe transport of radioactive material, IAEA Safety Standards series, No. SSR6 2012 edition;
- European Agreement on the International Carriage of Dangerous Goods by Road (ADR);
- regulations governing International Rail Transportation of Dangerous Goods (RID);
- European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways (ADN);
- International maritime code for dangerous goods (IMDG code of the IMO);

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- decision of 29 May 2009 modified concerning the carriage of dangerous goods by terrestrial routes (TMD decision);
- order - 23 November 1987 (amended) concerning the Safety of Shipping, division 411 of the attached regulations (RSN Order);

This certificate does not relieve the consignor from compliance with any requirements drawn up by the government of any country through or towards which the package will be transported.

This certificate expires on: **30 June 2017**

Registration number: **CODEP-DTS-2016-008310**

Montrouge, **22 March 2016**

The Director of Industrial Activities and Transport
Vivien TRAN-THIEN

SUMMARY OF THE CERTIFICATE ISSUES

Produced	Expiry date	Type of issue and modifications made	Authority	Certificate ID	Modification Version									
					Body	t	0	1	2	3	4	5	6	7
03/06/2003	30/06/2007	New certificate	DGSNR	F/366/B(M)F	Aa	a	a	a						
16/03/2005	30/06/2007	Extension	DGSNR	F/366/B(M)F	Ab	b	b	b	-	-	-	-	-	-
17/11/2005	30/06/2007	Extension B(U)	DGSNR	F/366/B(U)F	Ac	-	c	c						
14/06/2007	30/06/2012	Prorogation B(U)	DGSNR	F/366/B(U)F	Bd	-	d	d						
13/02/2009	30/06/2012	Extension mainly to CSD-C B(U)	ASN	F/366/B(U)F	Be	-	e	e	e	-	-	-	-	-
21/12/2010	30/06/2012	Extension to content 3	ASN	F/366/B(U)F	Bf	-	f	-	-	f	-	-	-	-
18/06/2012	30/12/2014	Prorogation B(U)	ASN	F/366/B(U)F	Cg	-	g	g	g	g	-	-	-	-
25/11/2013	30/06/2017	Extension to CSD-U & CSD-B B(U)	ASN	F/366/B(U)F	Ch	-	h	h	h	h	h	h	h	h
02/12/2014	30/06/2017	Extension to content 2	ASN	F/366/B(U)F	Ci	-	h	-	i	-	-	-	-	-
18/05/2015	30/06/2017	Extension to content 4	ASN	F/366/B(U)F	q	-	i	-	-	-	)	-	-	-
22/03/2016	30/06/2017	Extension to contents 1, 2, 5, 6 and 7	ASN	F/366/B(U)F	Ck	-	k	h	i	-	-	k	k	k

APPENDIX 0

TN® 81 PACKAGING

1 PACKAGING DEFINITION

The package was designed, manufactured, inspected, tested, maintained and used in compliance with the TN International Safety Analysis Report DOS-07-00089301 rev. 08 dated 04 August 2015.

The packaging, of a generally cylindrical form, is presented in Figure 0.1.

The packaging concept drawings are TN International drawings:

- PLA-07-00083366-122 rev. 04 "TN®81/TN®85 PACKAGING – DESIGN DRAWING - OVERALL – TRANSPORT CONFIGURATION"
- PLA-07-00083366-123 rev. 03 "TN®81/TN®85 PACKAGING – DESIGN DRAWING - DETAILS – TRANSPORT CONFIGURATION"
- PLA-07-00083366-124 rev.02 "TN®81 PACKAGING – DESIGN DRAWING - DETAILS – TRANSPORT CONFIGURATION CSD-C"
- PLA-07-00083366-125 rev. 02 "TN®81 CASK – CONCEPT DRAWING – TWO PARTS SHIELDING PLUG FOR PRIMARY LID"

The overall external dimensions of the package are:

- length : 7,215 mm ;
- outer diameter : 2,750 mm.

The maximum allowable carriage weight of the loaded packaging is 113,700 kg for transport configuration T1 and 115,900 kg for transport configuration T2.

The packaging features the principal sub-assemblies described below:

1.1 Body

The principal part of the packaging comprises a forged solid steel shell with a forged solid steel base, either in one piece or welded together. The shell cannot be made of a welded assembly with several sections.

The external structure is made of radial aluminium sections screwed to the shell and containing lead and resin.

1.2 Closing system

Forged solid steel lids (primary or primary transport and secondary) delimit a cylindrical cavity with a diameter of 1,349 mm and an effective length of 5,178 mm.

The primary lid is held in place by a flange, attached to the shell by screws, which assure the recessed leaktightness of its gaskets (metal and elastomer) in their grooves. It is used for the transportation of vitrified residue canisters or compacted waste canisters, or a mixed load of vitrified residue and compacted waste canisters (Contents No. 1, 2, 3, 4, 5, 6 & 7)

The primary transport lid is held in place by the flange attached to the shell by screws, which assure the recessed elastomer gaskets are leaktight in their grooves. It is used only for shipping compacted waste canisters (Content No. 2) and for the shipping of a mixture of canisters containing vitrified residue CSD-B & compacted waste CSD-C) (Content No. 7).

In configuration T1, an aluminium flange replaces the secondary lid; it is attached under the front shock-absorbent cover by screws. An optional protective plate for the gasket surfaces of the secondary lid may be added.

In configuration T2, the secondary lid covers the primary lid. It is attached to the shell by screws that assure the leaktightness of the (metal and elastomer) gaskets in their grooves. Configuration T2 is used only for shipping vitrified residue canisters (Contents No. 1, 3, 4, 5 and 6).

An orifice in the primary lid gives access to the cavity and is mainly used to create a vacuum to the cavity and fill it with helium, and incidentally to adjust the internal pressure or take gas samples. This orifice is closed by a screw-fit plug, fitted with an elastomer O-ring, doubled by a cover fitted with a dual metallic gasket. The plug is fitted with a test orifice, giving access to the space between the gaskets. This orifice is capped by a test plug. The primary lid also includes a test orifice, giving access to the space between the gaskets. This orifice is capped by a test plug.

An orifice in the primary transport lid gives access to the cavity. This orifice is fitted with a quick-connect coupling and closed by a plug, fitted with elastomer gaskets. The primary transport lid and its cover each include at least one test orifice giving access to the space between the gaskets. These orifices are capped by a test plug.

The secondary lid (fitted only in transport configuration T2) includes an orifice at 0° giving access to the space between the lids. This orifice is capped by a cover fitted with a dual metal gasket. The secondary lid and its cover each include a test orifice giving access to the space between the gaskets. These orifices are capped by a test plug.

1.3 Shock absorbing systems

During carriage, impact protection is ensured.

- radially by two aluminium rings
- longitudinally in the upper and lower parts by shock-absorbent covers

The lid end cover is a stainless steel aluminium structure reinforced with brackets and shells which delimit the compartments filled with wood. The cover is a thermal insulator for the metal and/or elastomer gaskets of the lids in the event of a fire. It is screwed at the front end of the shell.

The base cover is a stainless steel aluminium structure reinforced with brackets and shells which delimit the compartments filled with wood. The cover is fitted to the base by a shell. The cover is screwed to the base.

Each aluminium ring is made of two half-rings assembled by two aluminium closing flats, each one fitted with bolts.

1.4 Handling and tie-down components

Two pairs of trunnions attached to the forged shell are used to handle, tip and moor the packaging.

1.5 Safety functions

The main safety functions and elements important to safety are:

- **the confinement** is provided by the packaging's containment system.
  The containment system may differ in accordance with transport configurations and the contents shipped (see figure 0.4).

  For vitrified residue canister contents (Contents No. 1, 3, 4, 5 and 6):

  In transport configuration T1, the containment system of the packaging comprises (see figure 0.2):

  - the forged shell with a forged base and welding (S1) if the base and the shell are welded together;
  - the primary lid and its metallic gasket;
  - the orifice cover, with its metallic gasket.

  In transport configuration T2, the containment system of the packaging comprises (see figure 0.3):

  - the forged shell with a forged base and welding (S1) if the base and the shell are welded together;
  - the secondary lid and its metallic gasket;
  - the coupling cover and its metallic gasket.

  For contents holding compacted waste canisters (Content No. 2) or for a mixture of vitrified residue

canisters (CSD-B) and compact waste canisters (CSD-C) (Content No. 7):

Only transport configuration T1 is used and the containment system of the packaging comprises (see figure 0.2):

- Either:
  - the forged shell with a forged base and welding (S1) if the base and the shell are welded together;
  - the primary transport lid and its internal elastomer gasket;
  - the orifice cover of the secondary lid and its internal elastomer gasket.
- Or:
  - the forged shell with a forged base and welding (S1) if the base and the shell are welded together;
  - the primary lid and its metallic gasket;
  - the orifice cover with its metallic gasket.

- **Radiological protection:**

  The thicknesses of the forged steel and lead shell provide the main gamma shielding.

  On the packaging, neutron shielding is provided by the resin radially surrounding the packaging. The resin is confined in painted aluminium sections on the outside.

  On the base and lid ends, the resin also provides neutron shielding. In the shock-absorbent covers, neutron shielding is provided by the wood, and also by the resin in the bottom cap. This is VYAL B resin.

- **Safety-criticality** provided by the confinement system which comprises the items described in the content definition appendix.
- **The dissipation of internal power** provided by the aluminium profiles, fitted with fins and in contact with the ambient air (two or three fins per profile).
- **Impact protection** provided radially by two aluminium rings and axially by the shock-absorbent covers at the top and bottom ends

2 MEASURES TO BE TAKEN BY THE CONSIGNOR PRIOR TO SHIPMENT OF THE PACKAGE

The package must be used in accordance with applicable procedures which conform to the instructions for use in chapter 6A of the Safety Analysis Report DOS-07-00089301-600 Rev. 06.

- The measurement uncertainties related to the materials and methods used to perform leaktightness tests must be taken into account during the tests in question.
- When shipping CSD-C waste, a thorough drying procedure, under conditions to be agreed upon with the appropriate safety authority, must be applied prior to shipping. Failing which, gas measurements must be taken after loading the packaging, to determine the amount of dihydrogen present.

3 MAINTENANCE PROGRAMME

Package maintenance procedures are described in chapter 7A of the Safety Analysis Report DOS-07-00089301-700 Rev. 03.

4 NOTIFICATION AND RECORDING OF SERIAL NUMBERS

The competent authorities must be kept informed of any packaging that is taken out of service or transferred to another owner. Accordingly, an owner transferring a packaging must provide the name of the new owner.

5 QUALITY ASSURANCE

The Quality Assurance principles applied during the design, manufacturing, inspection, testing, maintenance and use of the package must conform to those described in chapter 8A of the Safety Analysis Report DOS-07-00089301-800 Rev. 00.

6 ADDITIONAL REQUIREMENTS FOR CONFINED TRANSPORT

If packages are shipped inside a closed transport unit (covered vehicle, transport container, canopies, etc.), heat dissipation may be modified. The thermal power must then be such that, given the thermal power of the load and taking into account the regulatory atmospheric conditions after thermal equilibrium is reached for a given contents:

- CSD-V - produced by AREVA NC (Content No. 1),
- CSD-C - produced by AREVA NC (Content No. 2),
- CSD-V - produced by Sellafield Ltd. (Content No.3),
- CSD-U - produced by AREVA NC (Content No. 4),
- CSD-B - produced by AREVA NC (Content No. 5),
- A mixture of CSD-V & CSD-B, both produced by AREVA NC (Content No. 6),
- A mixture of CSD-C & CSD-B, produced by AREVA NC (Content No. 7):

The maximum temperature of the external surface would be less than or equal to 140°C.

In the event of carriage in France, justification of compliance with this criterion must be submitted to the Nuclear Safety Authority (ASN).

FIGURE 0.1

TN® 81 PACKAGE ARRANGEMENT DRAWING - CONFIGURATION T2
(PAGE 1/2)

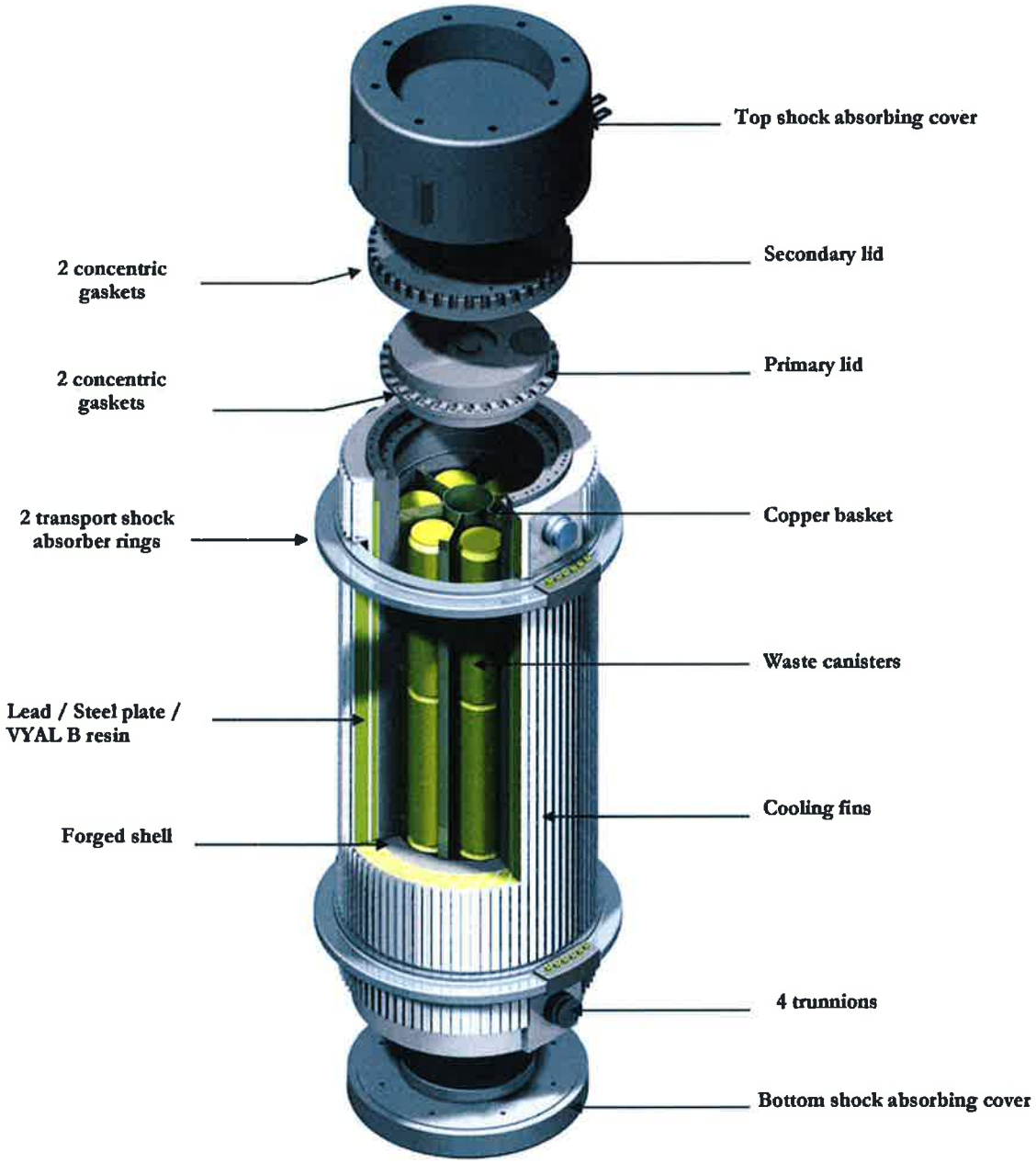


FIGURE 0.1

TN® 81 PACKAGE ARRANGEMENT DRAWING - CONFIGURATION T2
(PAGE 2/2)

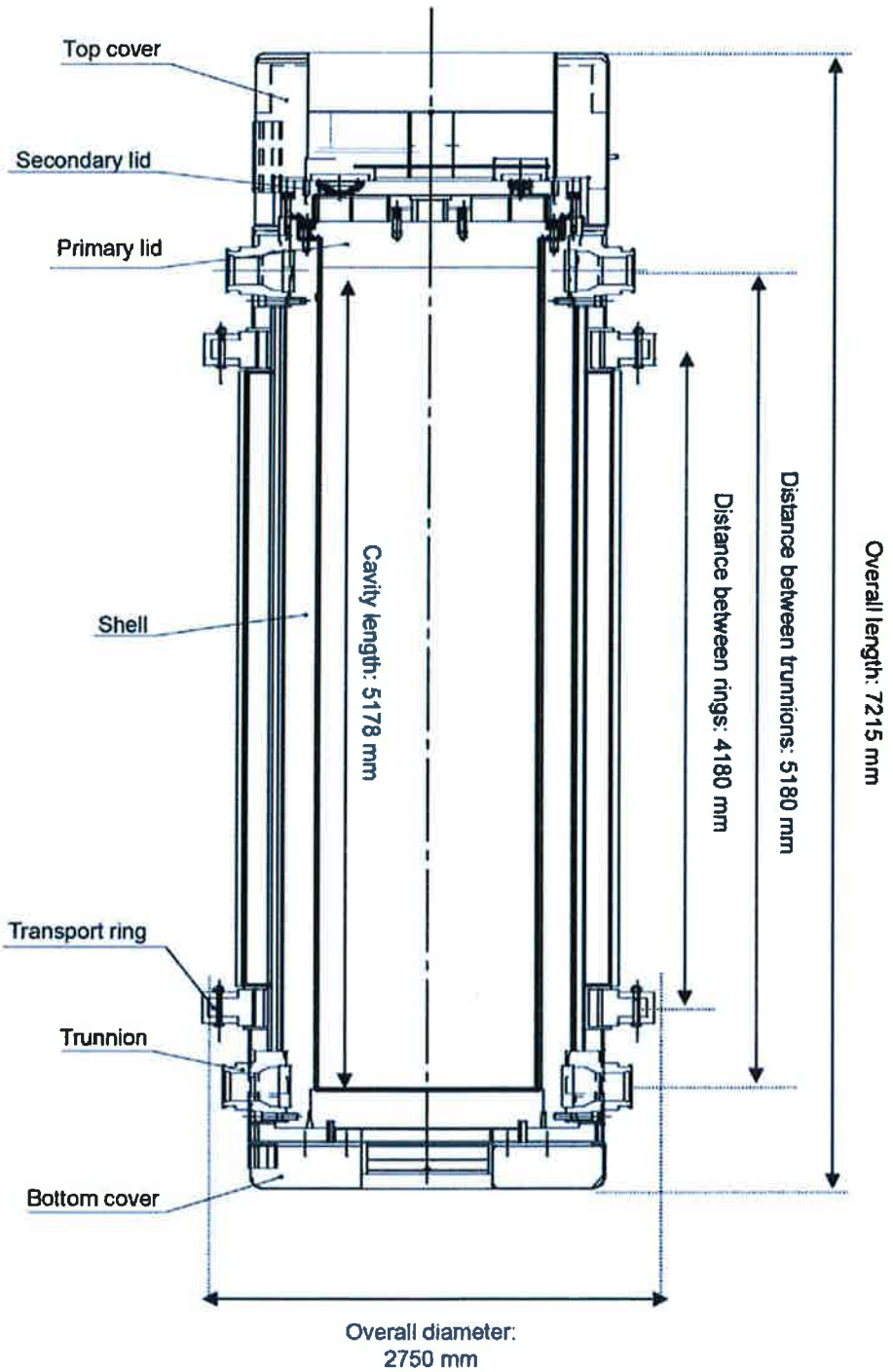


FIGURE 0.2

TRANSPORT CONFIGURATION T1
WITH CONTAINMENT VESSEL DRAWING

Primary lid or primary transport lid = leaktightness barrier

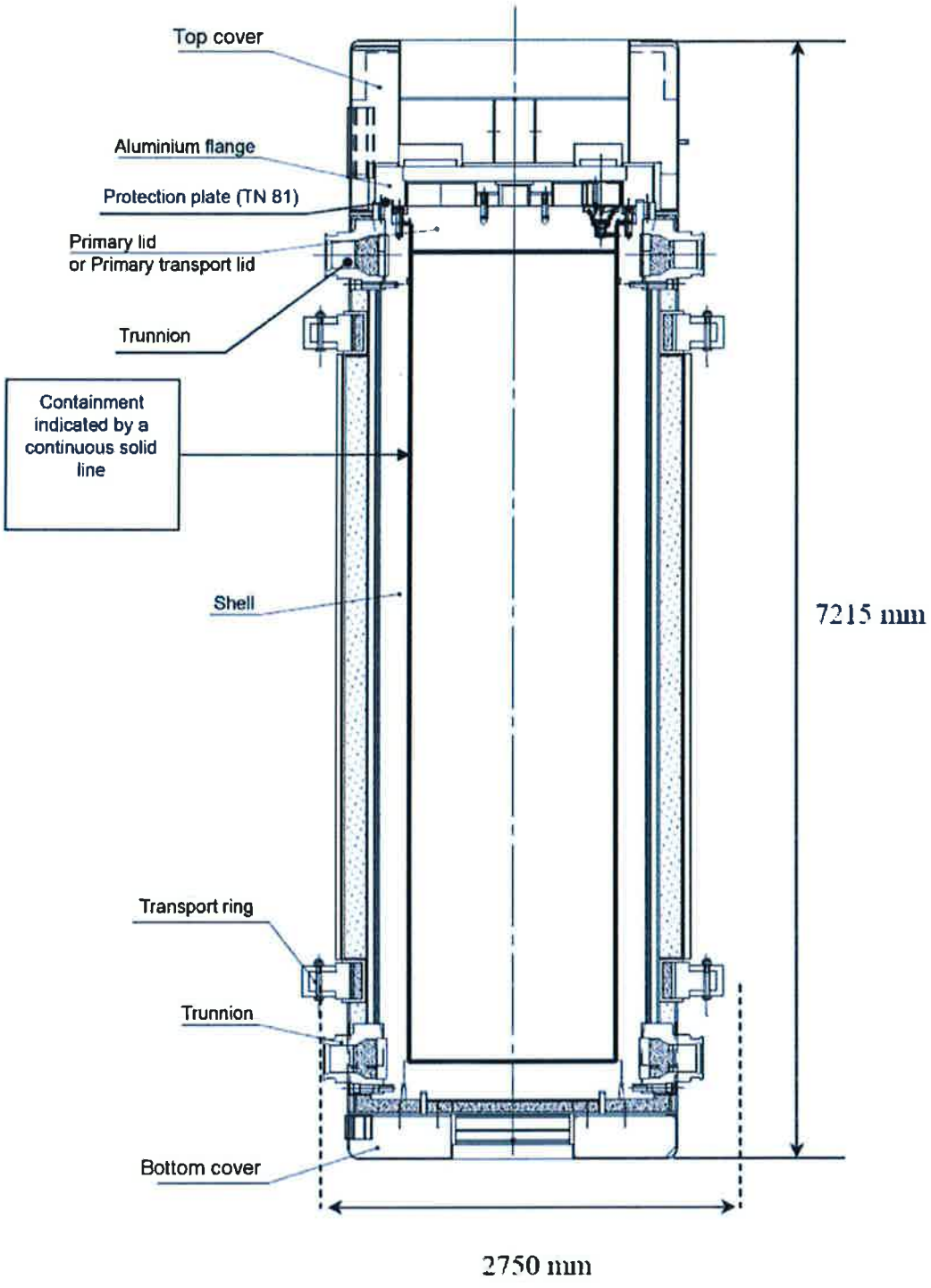


FIGURE 0.3

TRANSPORT CONFIGURATION T2
WITH CONTAINMENT VESSEL DRAWING

Secondary lid = leaktightness barrier

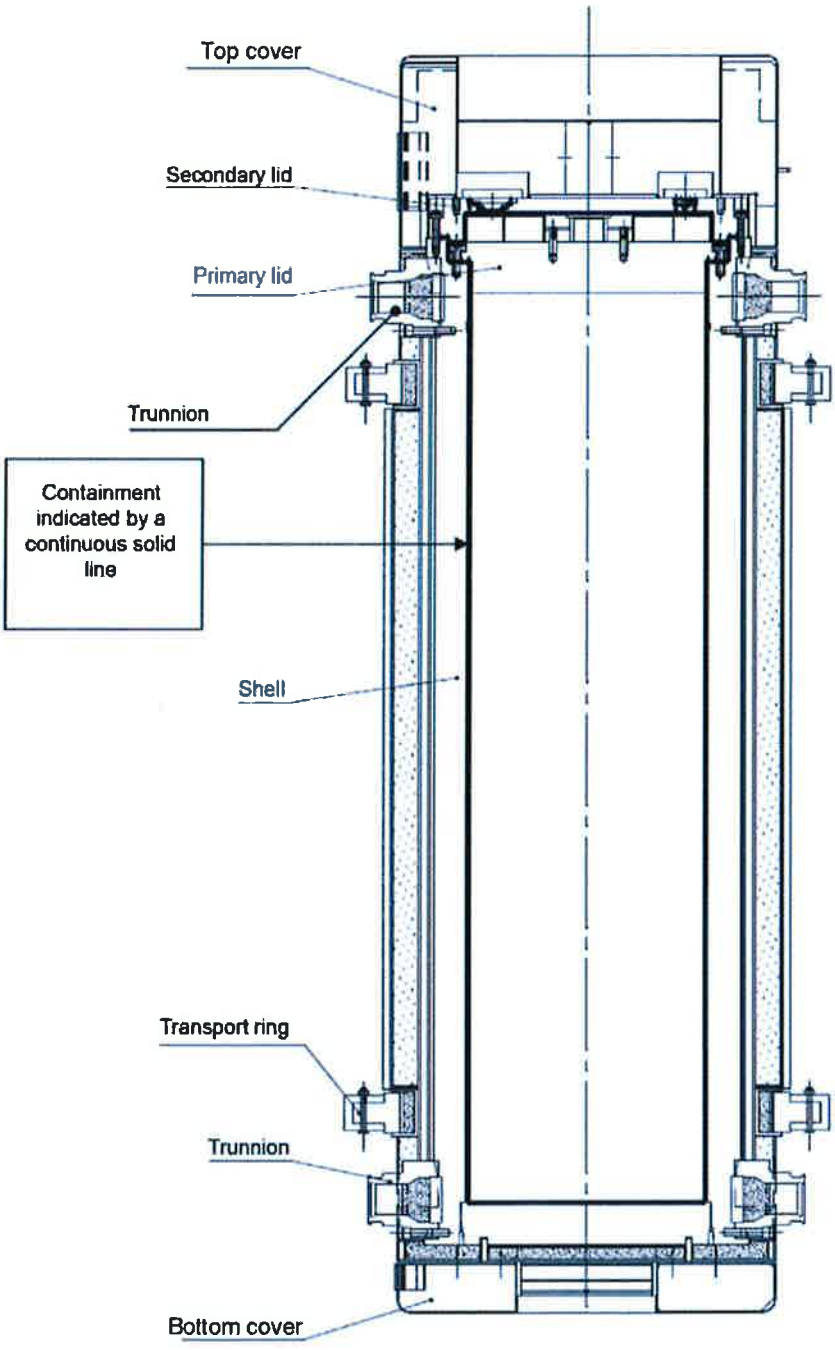
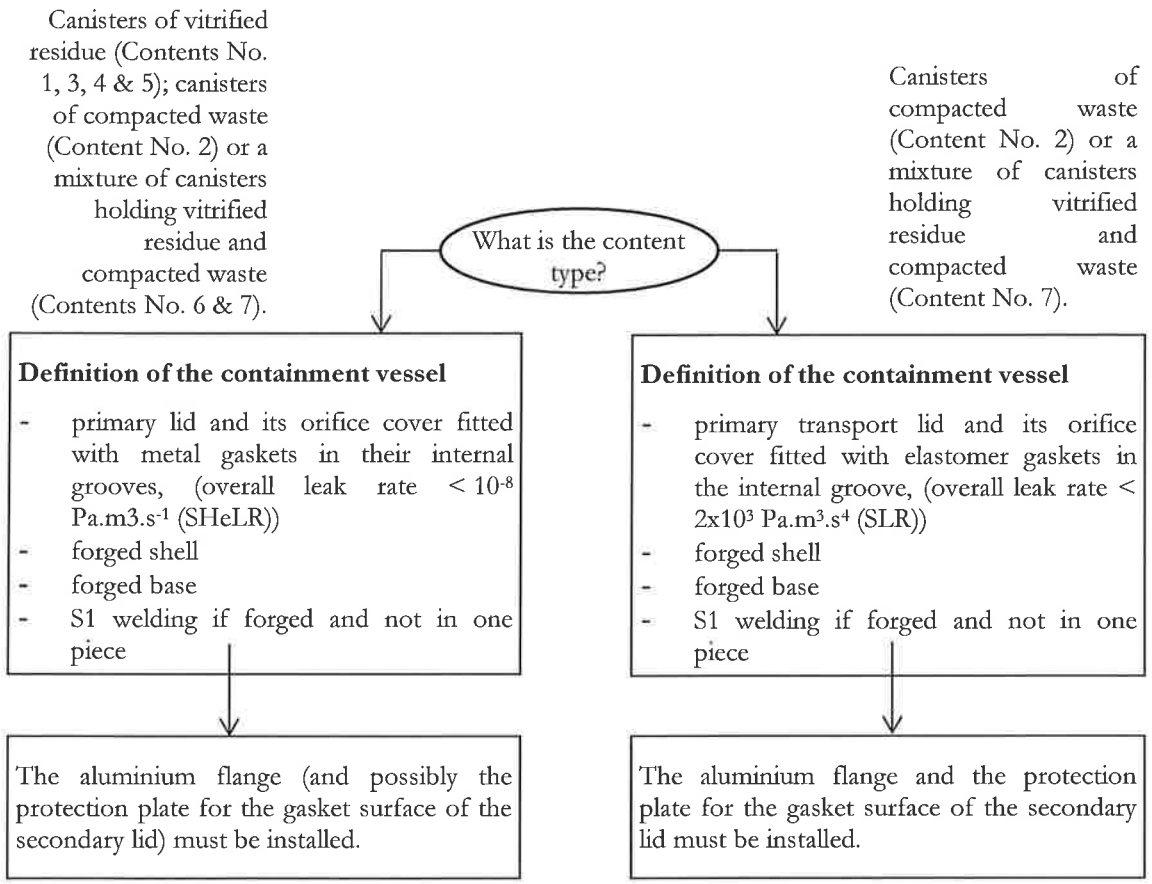


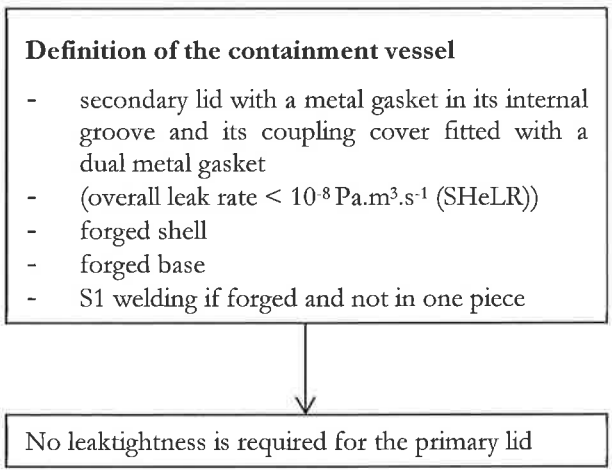
FIGURE 0.4

DEFINITION OF THE CONTAINMENT BY CONFIGURATION AND CONTENT TYPE

Configuration T1



Configuration T2 (for vitrified residue canisters only)



APPENDIX 1

CONTENT NO. 1

VITRIFIED RESIDUE CANISTERS (CSD-V) PRODUCED BY AREVA NC

The safety of these contents is demonstrated in the Safety Analysis Report DOS-07-00089301 Rev. 06 - dated 31 October 2013.

1 DEFINITION OF AUTHORISED CONTENT

At most, 14,000 kg of vitrified residue canisters, produced by AREVA NC, resulting from fuel processing, in the form of:

- at most 28 stainless steel canisters filled with a vitrified mixture whose characteristics, presented in chapter 0A (DOS-07-00089301-050 rev.03) of the safety analysis report, are listed below,
- and, in the event of a partial load of vitrified residue canisters, all basket compartments partially filled with vitrified residue canisters must be completed by steel dummy spacers, the characteristics of which are detailed in chapter 0A of the Safety Analysis Report (DOS-07-00089301-050 rev.03). Basket compartments may be left totally empty (in this case, they contain neither canisters nor dummy spacers).

The containment analysis does not impose any particular limitation concerning the total quantity or isotopic composition of the mixture of fission products, activation products, actinides and their oxides.

Maximum canister weight:

550 kg (with up to 14,000 kg for all the canisters loaded and possible shims).

Physical state and chemical form:

Mixture of oxides, vitrified.

Density: 2.75 (approximately).

Waste is distributed uniformly in glass, which has a uniform composition.

The minimum B_2O_3 weight equals 12.4 %.

Special form:

The material is not in any special form.

Maximum thermal power of canisters:

The maximum residual power authorised per canister is 2 kW.

Activity:

The activity of the content must be such that, given the nature and energy of the gamma radiation and neutrons emitted, the regulatory limits for dose-rates around the package are not exceeded.

For the radioelements contributing to the dose-rate, the activities must be limited so that the following transport inequation applies for each canister:

$$S = \sum_{i=1}^{8} \frac{A_{i\,max}}{A_{Gi}} \leq 0{,}95$$

Where:

- $A_{i\,max}$ the maximum real source (activity (A in TBq/canister) or weight (m in g/canister) accordingly) of the radioelement i, for all the loaded canisters:

$$A_{imax} = \max_j \left[A_{ij}\right] \text{ for j = 1 to 28 canisters maximum.}$$

- A_{Gi} the reference source term (activity (A in TBq/canister) or weight (m in g/canister) accordingly) for radioelement i, defined in the following table:

Radioelement or family	Reference gamma source term (TBq/canister)
$A_{Sr90+Y90}$	1,062E+06
$A_{Ru106+Rh106}$	1,978E+04
A_{Cs134}	2,541E+04
A_{Cs137}	2,552E+06
$A_{Ce144+Pr144}$	1,337E+04
A_{Eu154}	3,295E+03

Radioelement or family	Reference gamma source term (g/canister)
A_{Am241}	6,320E+03
A_{Cm244}	1,105E+02

Fissile material:

The quantity of fissile isotopes (U-233, U-235, Pu-239, Pu-241) must be less than 400 g of Pu-239 equivalent per canister. The following ratios may be used: 1 g of Pu-241 is equivalent to 2 g of Pu-239, 1 g of U-235 is equivalent to 0.65 g of Pu-239 and 1 g of U-233 is equivalent to 1 g of Pu-239.

Actinides other than uranium and plutonium are not subject to isotopic separation.

Conformance:

The vitrified residue canisters shipped conform to COGEMA 300 AQ 016 "Specifications of vitrified residues produced from reprocessing at UP2 or UP3-A La Hague Plants" (Second series, July 1986). Procedures defined by the consignor guarantee that the shipped content conforms to the performance of the package design as concerns the thermal power and dose-rate regulatory limits.

The steel shims conform to the drawing shown in figure 1.3.

2 INTERNAL FITTINGS

The internal fittings placed in the cavity include a storage basket with 7 compartments, a bottom plate and a set of 6 basket blocking parts made of carbon steel or stainless steel.

The basket (see figure 1.1) is made of copper sheets; each compartment can hold 4 stacked canisters (figure 1.2).

3 CRITICALITY STUDY

This is covered in chapter 5A (DOS-07-00089301-500 rev.01) of the safety analysis report.

The study accepts the presence of hydrogenated material and/or water penetration into the packaging, including in the containment.

The confinement system comprises the vitrified residue (glass matrix and fissile material).

Nuclear Criticality-Safety Index (CSI): 0 (number N - "infinite")

FIGURE 1.1

RADIAL CROSS-SECTION OF THE BASKET IN THE CAVITY

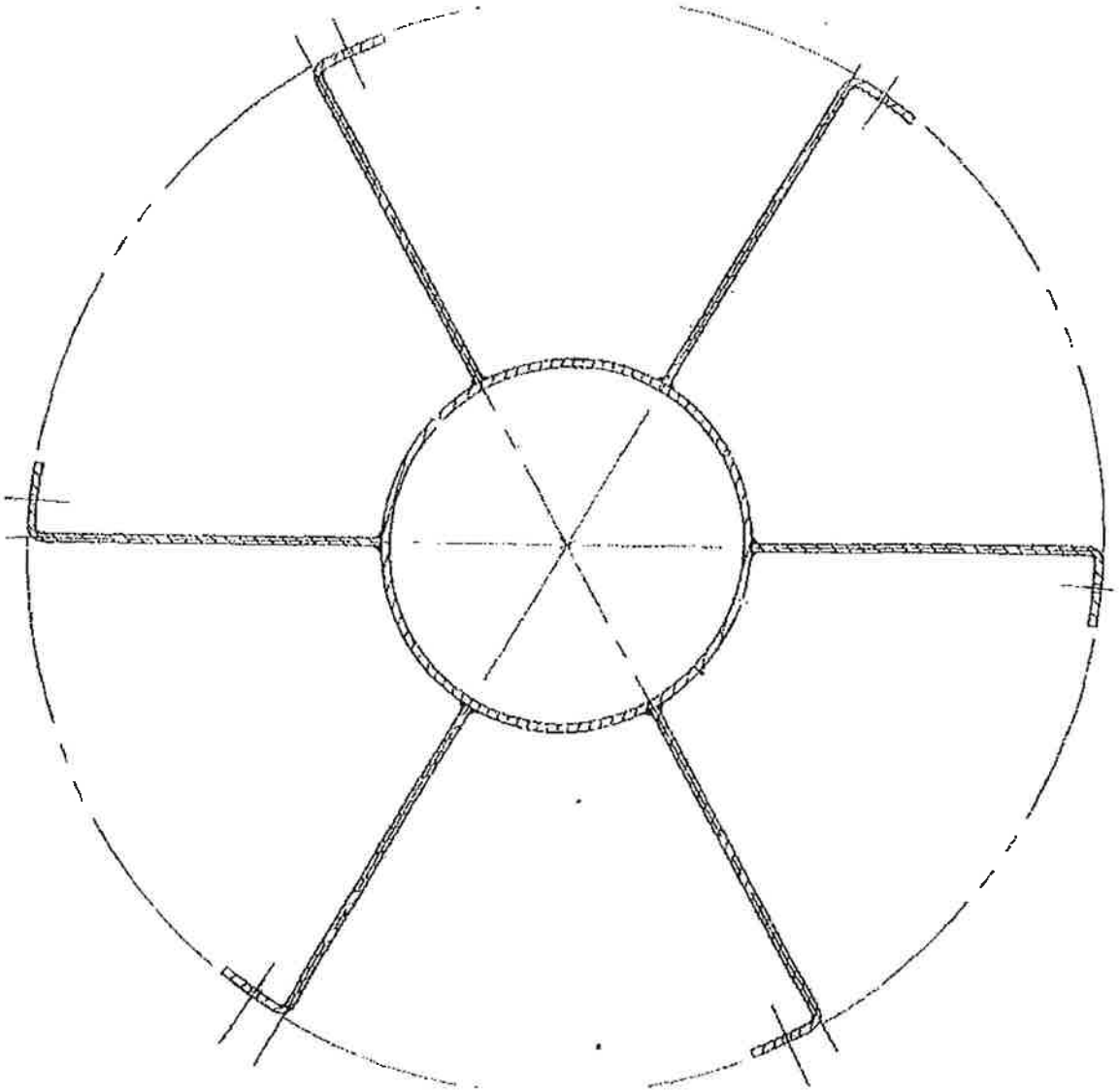


FIGURE 1.2

DRAWING OF A VITRIFIED WASTE CANISTER

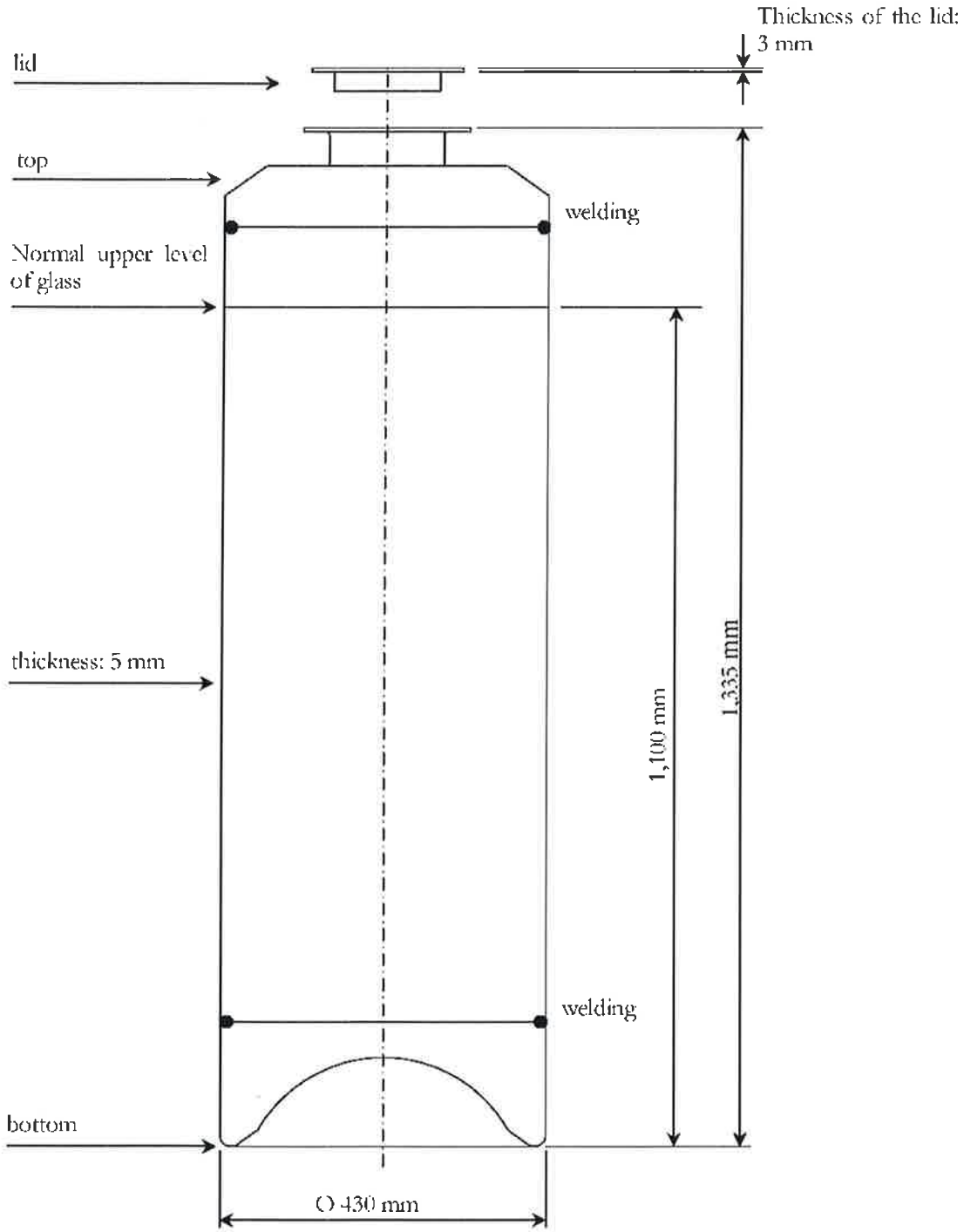
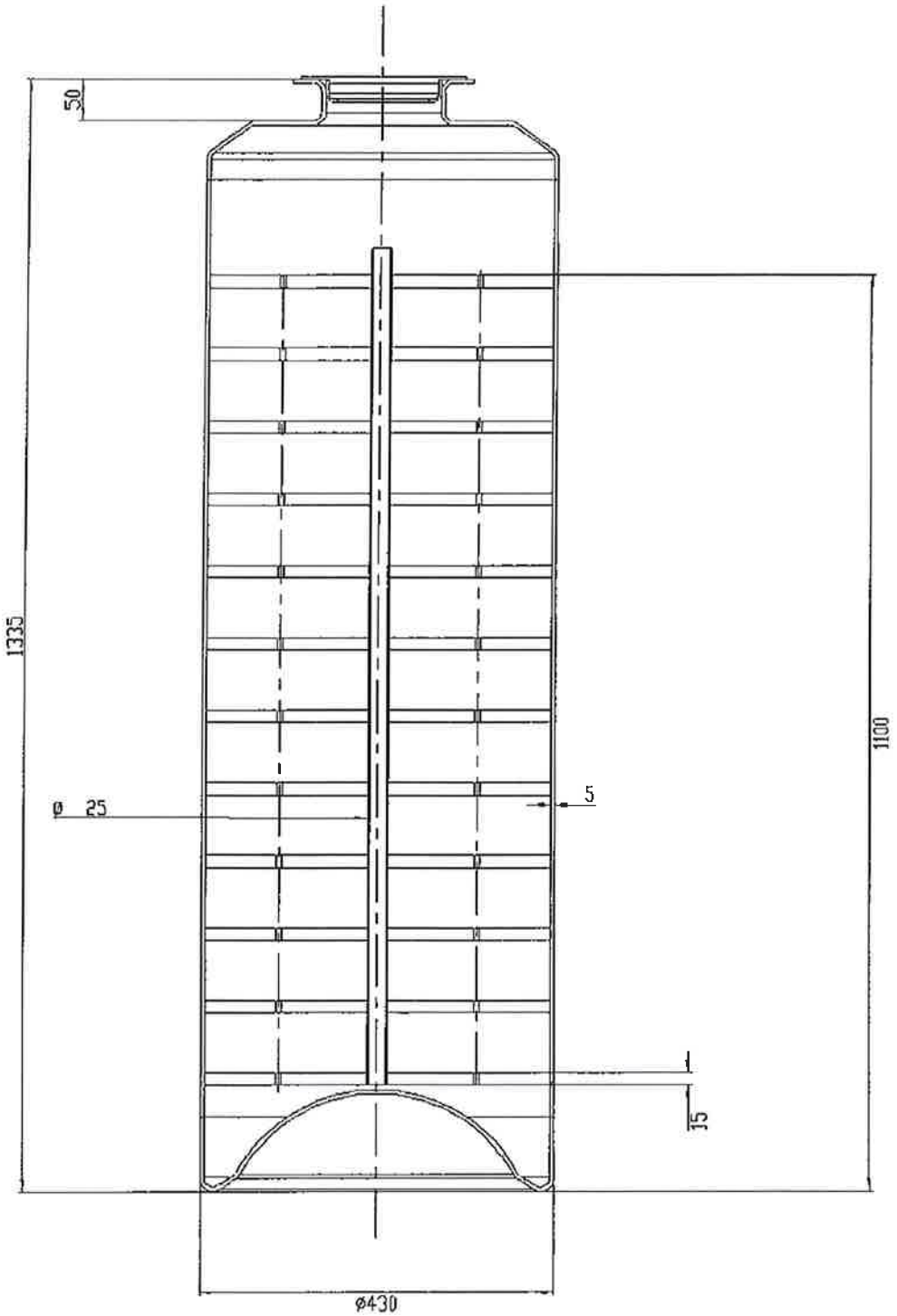


FIGURE 1.3

DRAWING OF A DUMMY SPACER



All dimensions are given in mm.

APPENDIX 2

CONTENTS N°2

COMPACTED WASTE CANISTERS (CSD-C)

1 DEFINITION OF AUTHORISED CONTENT

Definition of content

At most 14,000 kg of standard compacted waste packages (including possible dummy spacers) in the form of at most 20 canisters (CSD C) weighing at most 850 kg each, made of steel filled with structural elements and technological waste resulting from the reprocessing of irradiated fuel, arriving from the Shell and Cap Compacting Workshop (ACC) of the AREVA NC plant in La Hague, whose characteristics, described in chapter 0A of the Safety Analysis Report (DOS-07-00089301-051 rev.03), are listed below. The canisters (CSD C) are divided into a maximum of 5 basket compartments with a maximum permissible weight of 3000 kg per loaded compartment (see figure 2.3). Any compartment partially filled with CSD-C must include dummy spacers (see figure 2.4). Basket compartments may be left totally empty (in this case, they contain neither canisters nor dummy spacers).

Physical state and chemical form of the compacted residue

Mixture of metallic structural elements (hulls, end pieces and other elements constituting an assembly of a light water reactor), and possibly metal technological waste, compacted into disk wafers.

Special form

The material is not in a special form.

Maximum thermal power per canister:

90 W

Activity

The activity of the content must be such that, given the nature and energy of the gamma radiation and neutrons emitted, the regulatory limits for dose-rates around the package are not exceeded.

The maximum authorised activity is 746.2 TBq per canister.

Fissile material

The standard compacted waste packages permissible in the TN 81 packaging are those simultaneously meeting all the conditions below:

- permissible mass of fissile material (heavy metal) per CSD-C expressed in mass of 239Pu must be less than or equal to 215 g

AND

- permissible mass of fissile material (heavy metal) per CSD-C expressed in mass of 235U must be less than or equal to 380 g

The mass of fissile material, 239Pu or 235U respectively, is measured in the Shells and End-Piece Compacting Workshop, assimilating the fissile isotopes present in the waste to 239Pu (or 235U respectively).

Conformance

The compacted waste canisters (CSD-C) shipped conform to COGEMA 300 AQ 055 Rev. 03 – "Specification of standard package for compacted waste" dated 3 July 2001. Only CSD-C manufactured in the ACC workshop of the AREVA NC plant at The Hague are authorised.

The compacting process at the ACC workshop must ensure a nominal disk wafer diameter of 388 mm.

The CSD-C, containing shells and end-fittings as well as technological waste, must have at least 3,614 kg/l of structural metal for disk wafers containing shells & end-fittings.

The technological waste authorised is metallic and composed of steel, Inconel or zirconium, the other elements being present only in trace form.

The compacted waste should not contain graphite, beryllium nor solid pieces of lead or aluminium. Each CSD-C may contain up to 25 g of organic matter.

The canisters must not be capped: the Poral filter must not be blocked.

A maximum volume of 10 litres of loose debris is permitted for each CSD-C. Debris pot casings are authorised as long as they have been emptied prior to compacting.

Figure 2.2 shows a drawing of a compacted waste canister.

2 INTERNAL FITTINGS

The internal fittings placed within the cavity include a storage basket with 7 compartments, a bottom plate and a set of 6 basket blocking parts in carbon steel or stainless steel.

The basket (see figure 2.1) is made of copper sheets; each compartment can hold 4 stacked canisters.

3 CRITICALITY STUDY

This is covered in chapter 5A (DOS 07 00089301 502 rev.03) and chapter 5A-2 (DOS 07 00089301 503 rev.01) of the Safety Analysis Report.

The confinement system in question is provided by the compacted waste, the steel walls of the canisters and their spring, the steel body of the packaging, the primary transport lid, and finally the basket.

Nuclear Criticality-Safety Index (CSI): 0 (number N - "infinite")

FIGURE 2.1

RADIAL CROSS-SECTION OF THE BASKET IN THE CAVITY

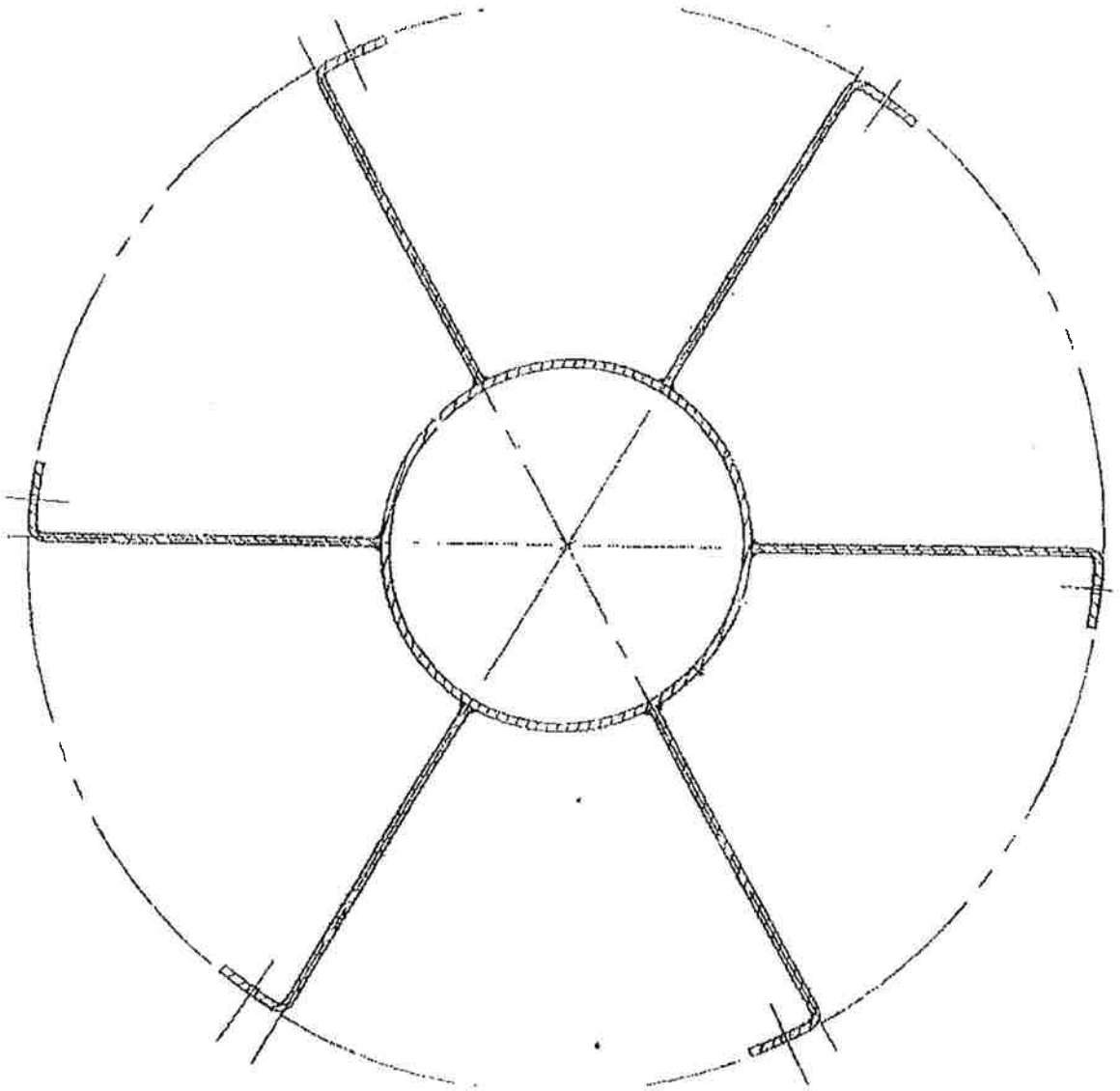
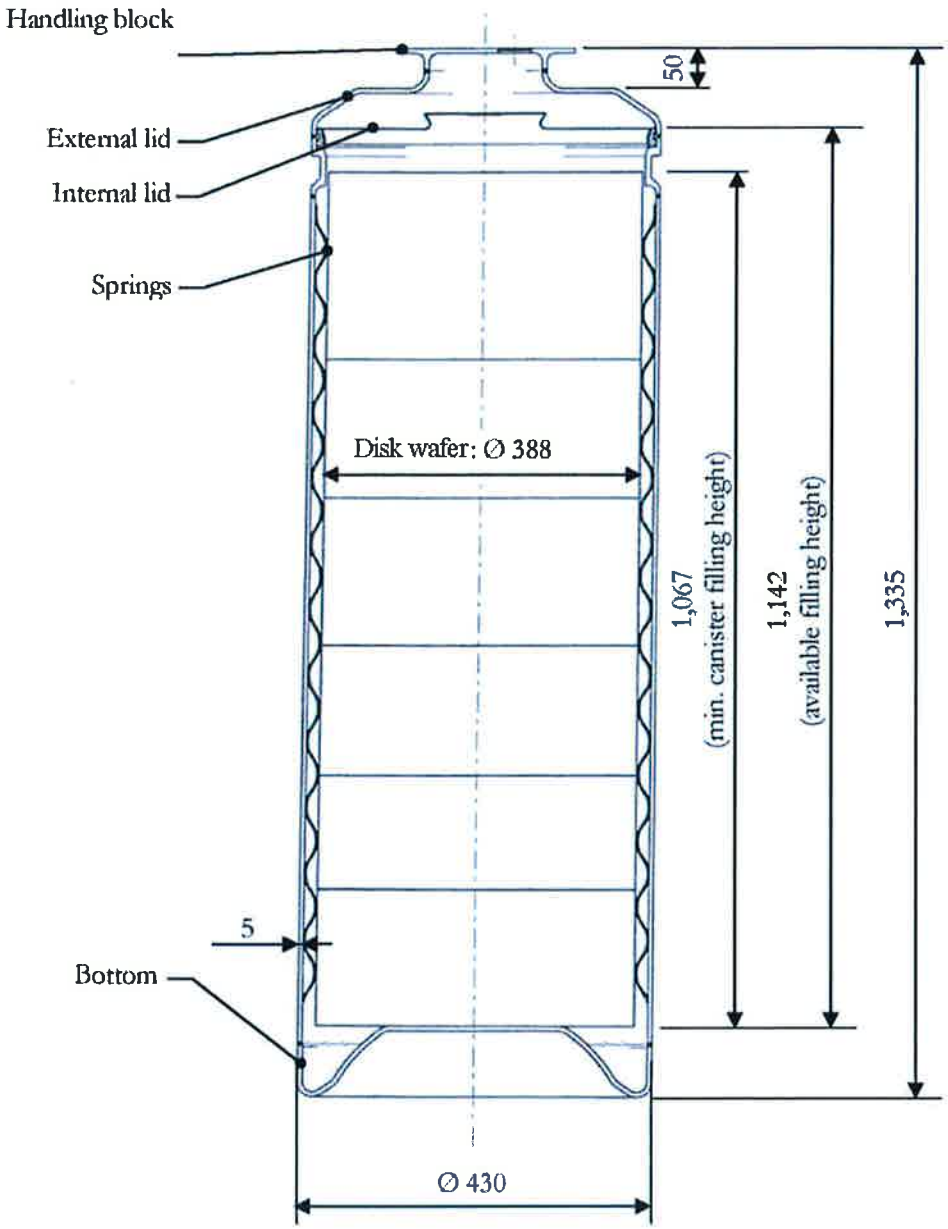


FIGURE 2.2

DRAWING OF A COMPACTED RESIDUE CANISTER



All dimensions are given in mm.

FIGURE 2.3

DEFINITION OF THE MAXIMUM PERMISSIBLE WEIGHT BY BASKET COMPARTMENT

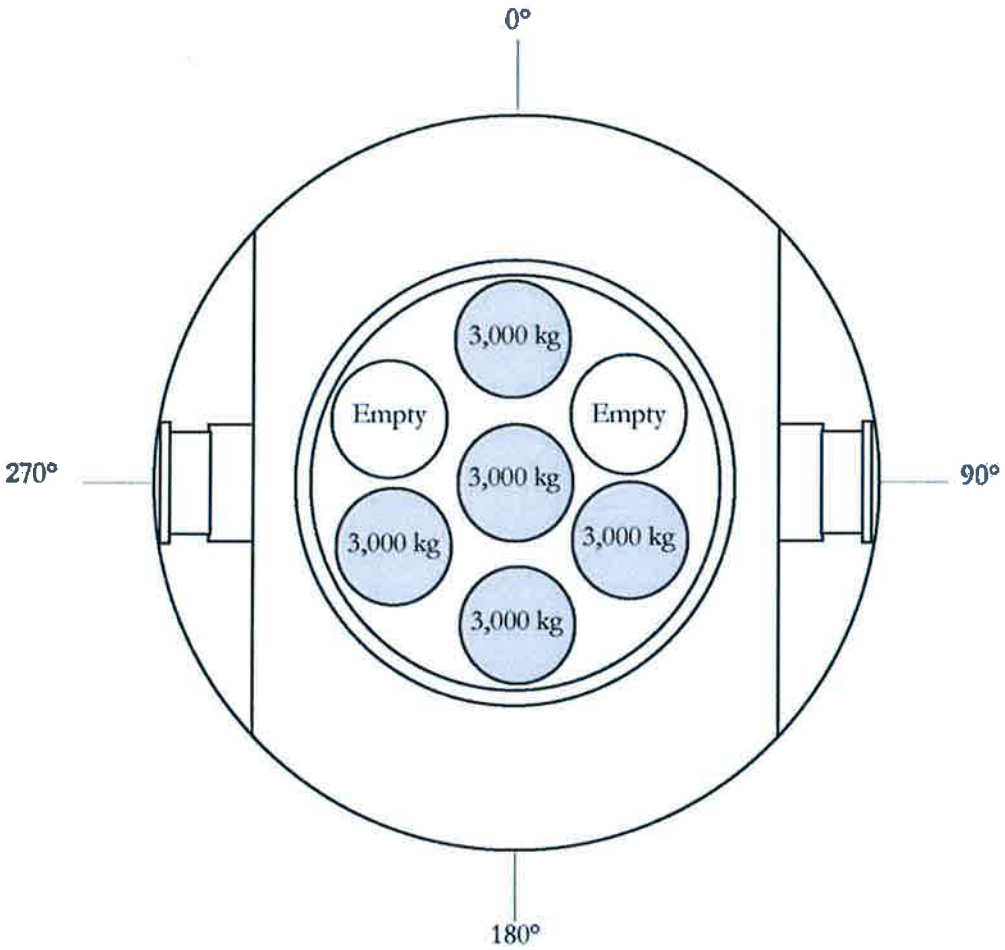
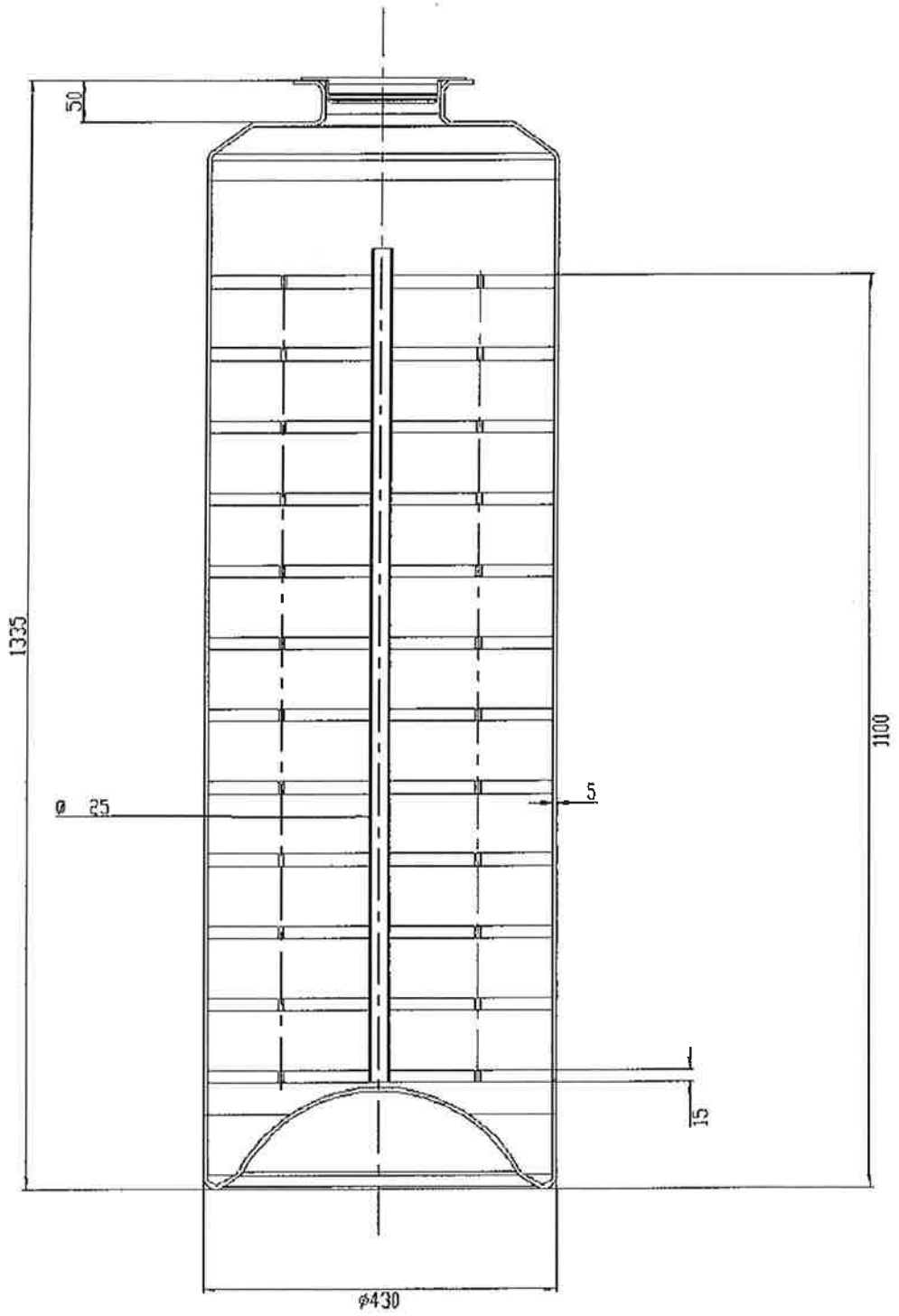


FIGURE 2.4

DRAWING OF A DUMMY SPACER



All dimensions are given in mm.

APPENDIX 5

CONTENT No.5

VITRIFIED RESIDUE CANISTERS (CSD-B) PRODUCED BY AREVA NC

1 DEFINITION OF AUTHORISED CONTENT

A maximum of 14,000 kg of Type CSD-B vitrified waste canisters as produced by AREVA NC, mainly from the rinsing of tanks following a definitive decommissioning, in the form of:

- at most 28 stainless steel canisters filled with a vitrified mixture whose characteristics, presented in chapter 0A (DOS-07-00089301-050 rev.03) of the safety analysis report, are listed below,
- and, in the event of a partial load of vitrified residue canisters, all basket compartments partially filled with vitrified residue canisters must be completed by steel dummy spacers, the characteristics of which are detailed in chapter 0A of the Safety Analysis Report (DOS-07-00089301-050 rev.05). Basket compartments may be left totally empty (in this case, they contain neither canisters nor dummy spacers).

Maximum canister weight:

550 kg (with up to 14,000 kg for all the canisters loaded and possible shims).

Physical state and chemical form:

Mixture of oxides, vitrified.

Density: 2.5 (approximately).

Waste is distributed uniformly in glass, which has a uniform composition.

The minimum B_2O_3 weight equals 12 %.

Special form:

The material is not in a special form.

Maximum thermal power of canisters:

The maximum residual power authorized per canister is 90 W.

Activity:

The activity of the content must be such that, given the nature and energy of the gamma radiation and neutrons emitted, the regulatory limits for dose-rates around the package are not exceeded.

The maximum authorised activity per canister is 746.2 TBq.

Fissile material:

For each vitrified residue canister, the following conditions must simultaneously be verified:

$$\frac{M^{239}Pu}{400\,g} \leq 1 \qquad \frac{M^{241}Pu}{25g} \leq 1 \qquad \frac{M^{233}U}{1{,}6\,g} \leq 1 \qquad \frac{M^{235}U}{158{,}4\,g} \leq 1$$

Actinides other than uranium and plutonium are not subject to isotopic separation.

Conformance:

The Type CSD-B vitrified residue canisters transported must conform to the AREVA NC specification 300 AQ 061 00 "Specifications for standard packages for CSD-B vitrified residue produced by La Hague" (September 2009). Procedures defined by the consignor guarantee that the shipped content conforms to the performance of the package design as concerns the thermal power and dose-rate regulatory limits.
The steel dummy spacers conform to the drawing shown in figure 5.3.

2 INTERNAL FITTINGS

The internal fittings placed within the cavity include a storage basket with 7 compartments, a bottom plate and a set of 6 basket blocking parts in carbon steel or stainless steel.

The basket (see figure 5.1) is made of copper sheets; each compartment can hold 4 stacked canisters (figure 5.2).

3 CRITICALITY STUDY

This is covered in chapter 5A-3 of the Safety Analysis Report (DOS-07-00089301-504 rev.00).

The study accepts the presence of hydrogenated material and/or water penetration into the packaging, including in the containment.

The confinement system comprises the vitrified residue (glass matrix and fissile material).

Nuclear Criticality-Safety Index (CSI): 0 (number N - "infinite")

FIGURE 5.1

RADIAL CROSS-SECTION OF THE BASKET IN THE CAVITY

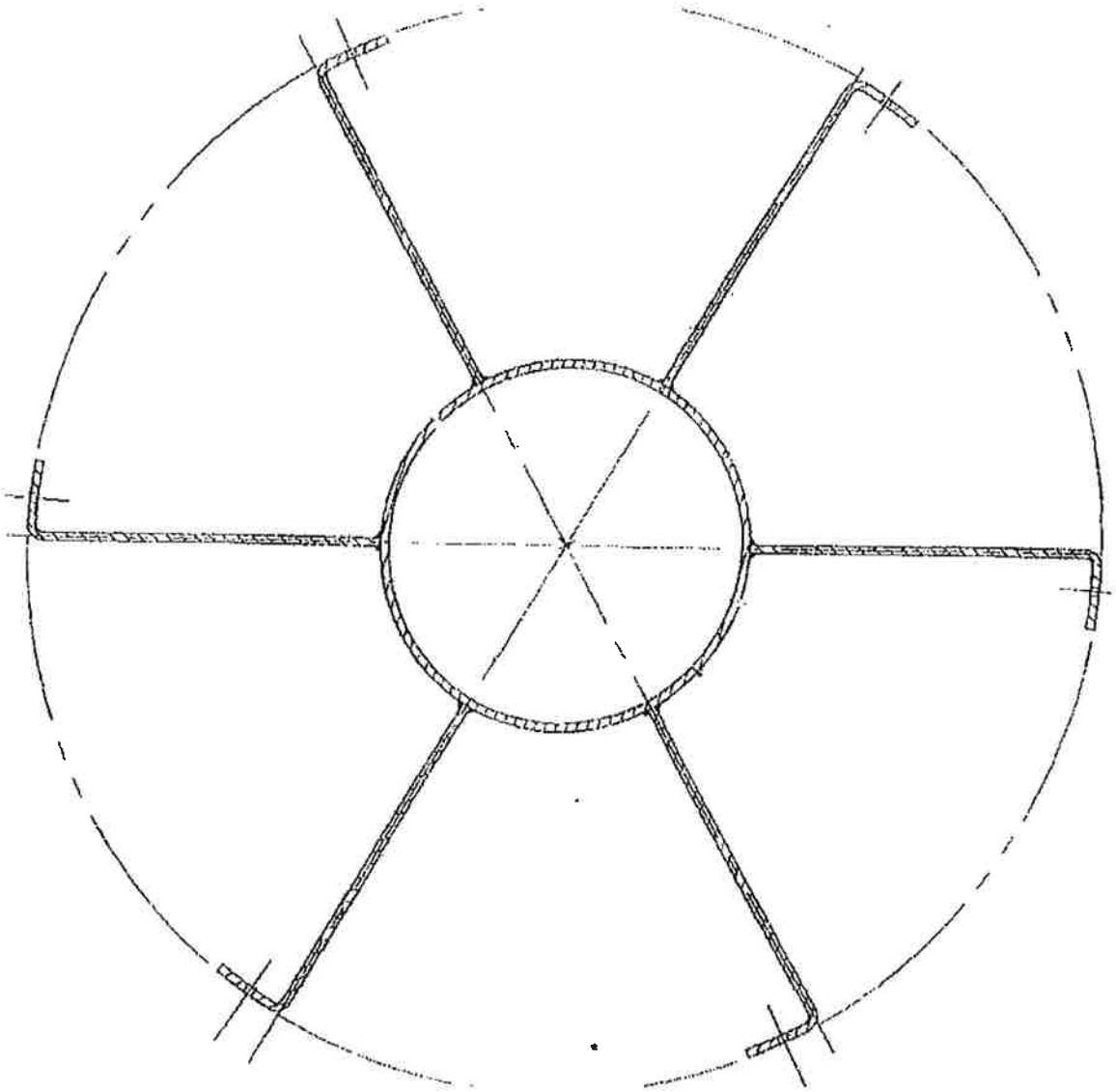


FIGURE 5.2

DRAWING OF A VITRIFIED WASTE CANISTER

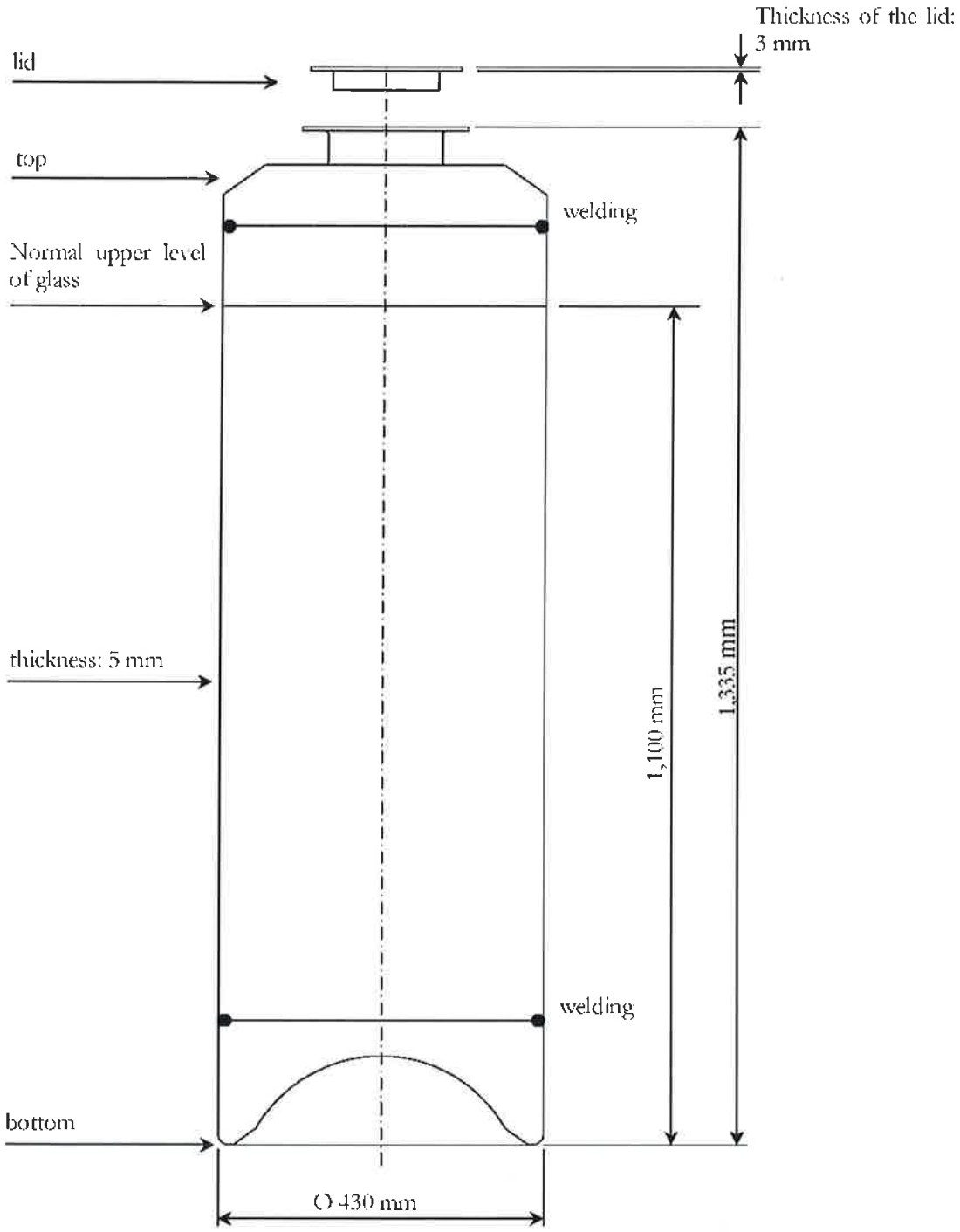
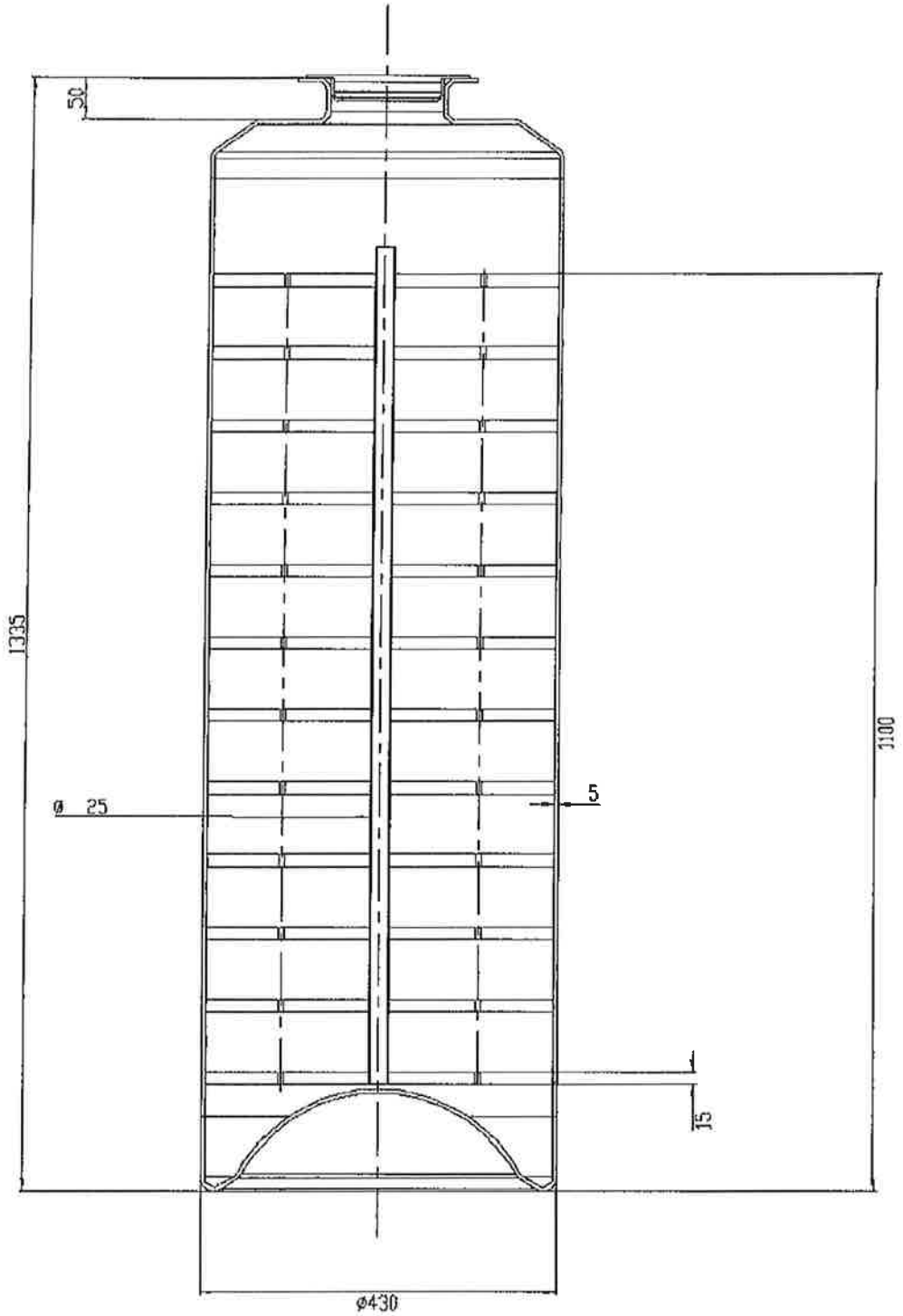


FIGURE 5.3

DRAWING OF A DUMMY SPACER



All dimensions are given in mm.

APPENDIX 6

CONTENTS No.6

MIXTURE OF VITRIFIED WASTE CANISTERS (TYPES CSD-V and CSD-B) - PRODUCED BY AREVA NC

1 DEFINITION OF AUTHORISED CONTENT

A maximum of 14,000 kg of vitrified residue canisters (types CSD-V & CSD-B) produced by AREVA NC, resulting from fuel processing, in the form of:

- at most 28 stainless steel canisters filled with a vitrified mixture whose characteristics, presented in chapter 0A (DOS-07-00089301-050 rev.03) of the safety analysis report, are listed below,
- the canisters are distributed across the 7 basket compartments as shown in Figure 6.4.
- and, in the event of a partial load of vitrified residue canisters, all basket compartments partially filled with vitrified residue canisters must be completed by steel dummy spacers, the characteristics of which are detailed in chapter 0A of the Safety Analysis Report (DOS-07-00089301-050 rev.05). Basket compartments may be left totally empty (in this case, they contain neither canisters nor dummy spacers).

Maximum canister weight:

550 kg (with up to 14,000 kg for all the canisters loaded and possible dummy spacers).

Physical state and chemical form:

Mixture of oxides, vitrified.

Waste is distributed uniformly in glass, which has a uniform composition.

For the CSD-V produced by AREVA NC:

Density: 2.75 (approximately).

The minimum B_2O_3 weight equals 12.4 %.

For the CSD-B:

Density: 2.5 (approximately).

The minimum B_2O_3 weight equals 12 %.

Special form:

The material is not in a special form.

Maximum thermal power of canisters:

The maximum residual power authorized per canister is 2,000 W for the CSD-V produced by AREVA NC & 90 W for the CSD-B, also produced by AREVA NC.

Activity:

The activity of the content must be such that, given the nature and energy of the gamma radiation and neutrons emitted, the regulatory limits for dose-rates around the package are not exceeded.

For the CSD-V produced by AREVA NC:

For the radioelements contributing to the dose-rate, the activities must be limited so that the following transport inequation applies for each canister:

$$S = \sum_{i=1}^{8} \frac{A_{i\,max}}{A_{Gi}} \leq 0{,}95$$

Where:

- $A_{i\,max}$ the maximum real source (activity (A in TBq/canister) or weight (m in g/canister) accordingly) of the radioelement i, for all the loaded canisters:
  $A_{imax} = \max_j \lfloor A_{ij} \rfloor$ for j $A_{imax} = \max_j \lfloor A_{ij} \rfloor$ pour j = 1 to 28 canisters maximum.
- A_{Gi} the reference source term (activity (A in TBq/canister) or mass (m in g/canister) accordingly) for the radioelement
- I, defined in the following table:

Radioelement or family	Reference gamma source term (TBq/canister)
$A_{Sr90+Y90}$	1,062E+06
$A_{Ru106+Rh106}$	1,978E+04
A_{Cs134}	2,541E+04
A_{Cs137}	1,276E+06
$A_{Ce144+Pr144}$	1,337E+04
A_{Eu154}	3,295E+03

Radioelement or family	Reference gamma source term (g/canister)
A_{Am241}	6,320E+03
A_{Cm244}	1,105E+02

For the CSD-B:

The maximum authorised activity per canister is 746.2 TBq.

Fissile material:

For each vitrified residue canister, the following conditions must simultaneously be verified:

$$\frac{M^{239}Pu}{400\,g} \leq 1 \qquad \frac{M^{241}Pu}{25\,g} \leq 1 \qquad \frac{M^{233}U}{1{,}6\,g} \leq 1 \qquad \frac{M^{235}U}{158{,}4\,g} \leq 1$$

Actinides other than uranium and plutonium are not subject to isotopic separation.

Conformance:

For the CSD-V produced by AREVA NC:

The vitrified residue canisters shipped conform to COGEMA 300 AQ 016 "Specifications of vitrified residues produced from reprocessing at UP2 or UP3-A La Hague Plants" (Second series, July 1986). Procedures defined by the consignor guarantee that the shipped content conforms to the performance of the package design in terms of the thermal power and dose-rate regulatory limits.

The steel dummy spacers conform to the drawing shown in figure 6.3.

For the CSD-B:

The Type CSD-B vitrified residue canisters transported must conform to the AREVA NC specification 300 AQ 061 00 "Specifications for standard packages for CSD-B vitrified residue produced by La Hague" (September 2009). Procedures defined by the consignor guarantee that the shipped content conforms to the performance of the package design concerning the thermal power and dose-rate regulatory limits.

The steel dummy spacers conform to the drawing shown in figure 6.3.

2 INTERNAL FITTINGS

The internal fittings placed within the cavity include a storage basket with 7 compartments, a bottom plate and a set of 6 basket blocking parts made of carbon steel or stainless steel.

The basket (see figure 6.1) is made of copper sheets; each compartment can hold 4 stacked canisters (figure 6.2).

3 CRITICALITY STUDY

This is covered in chapter 5A-3 of the Safety Analysis Report (DOS-07-00089301-504 rev.00).

The study accepts the presence of hydrogenated material and/or water penetration into the packaging, including in the containment.

The confinement system comprises the vitrified residue (glass matrix and fissile material).

Nuclear Criticality-Safety Index (CSI): 0 (number N - "infinite")

FIGURE 6.1

RADIAL CROSS-SECTION OF THE BASKET IN THE CAVITY

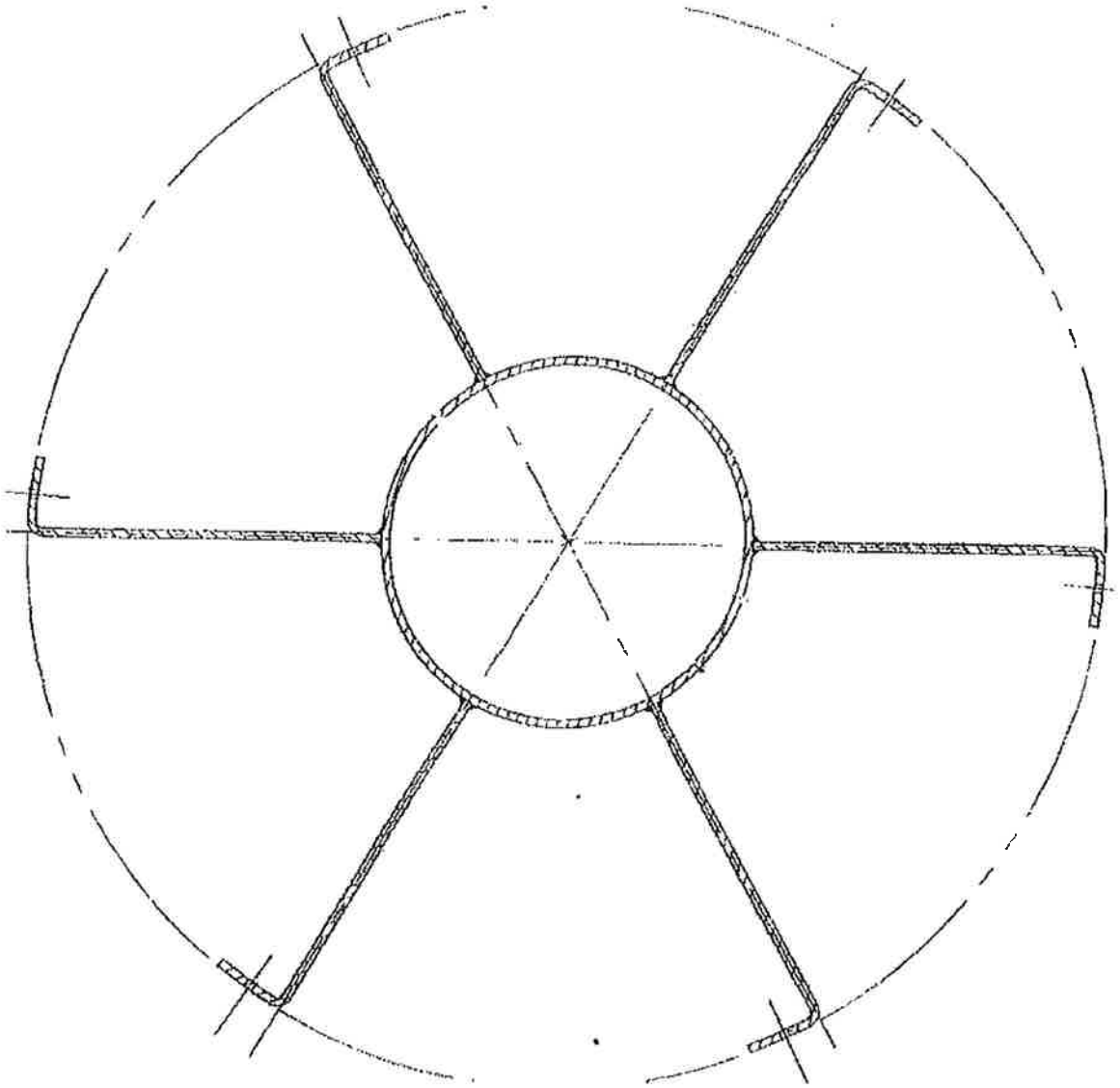


FIGURE 6.2

DRAWING OF A VITRIFIED RESIDUE CANISTER

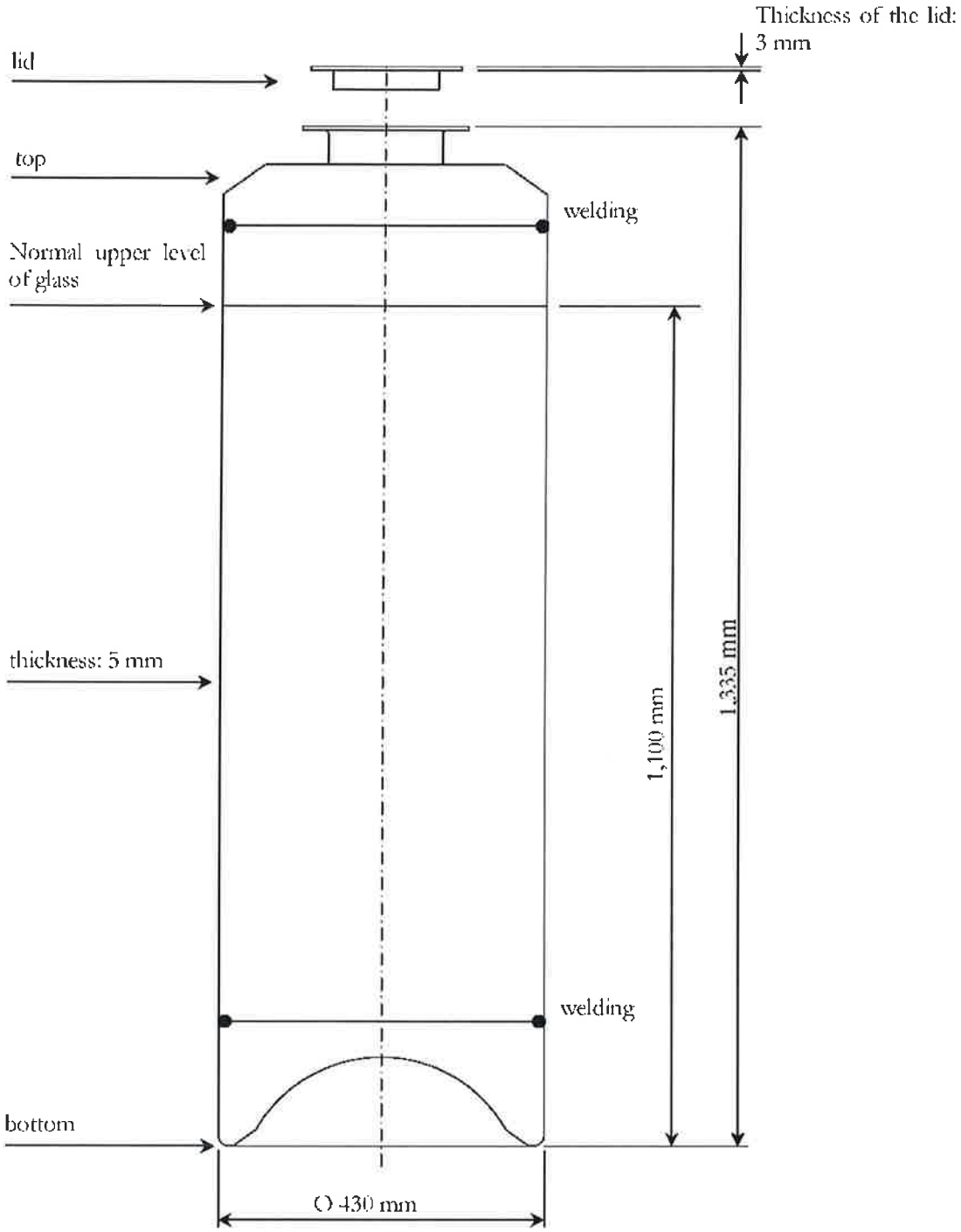
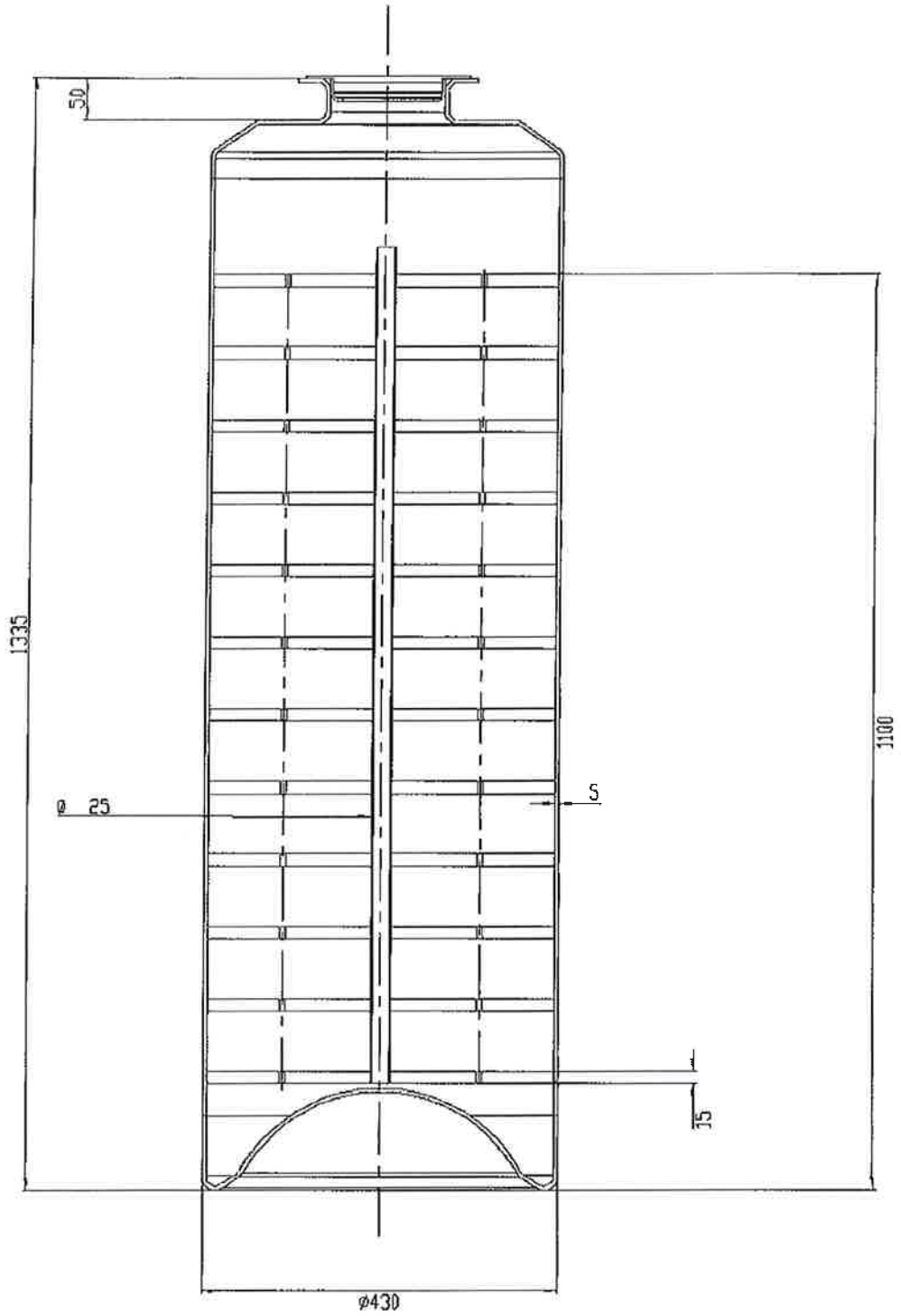


FIGURE 6.3

DRAWING OF A DUMMY SPACER



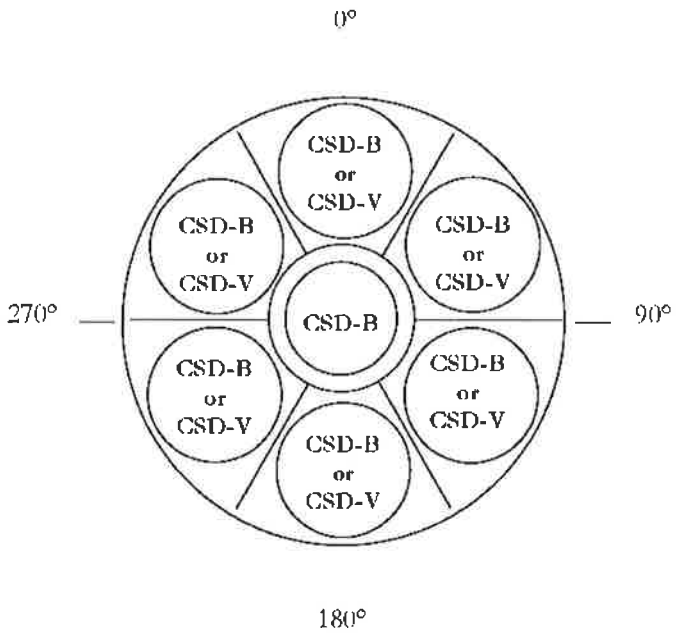
All dimensions are given in mm.

FIGURE 6.4

CANISTER DISTRIBUTION

The load must satisfy the following conditions:

- each compartment must contain canisters of the same type;
- the canisters are distributed as shown in the diagram below:



APPENDIX 7

CONTENT No. 7

MIXTURE OF COMPACTED WASTE (CSD-C) & VITRIFIED RESIDUE (CSD-B) CANISTERS

1 DEFINITION OF AUTHORISED CONTENT

A maximum of 14,000 kg of a mixture of compacted waste canisters (CSD-C) & vitrified residue canisters (CSD-B) in the form:

- of a maximum of 20 stainless steel canisters: CSD-C - in steel, filled with structural elements and technological waste from the reprocessing of irradiated fuels, coming from the shells and end-fittings compacting workshop in the AREVA NC plant at La Hague, the characteristics of which, detailed in Chapter 0A of the Safety Analysis Report (DOS-07-00089301-051 Rev.03), are summarised below; CSD-B, produced by AREVA NC and filled with a vitrified mixture whose characteristics, detailed in Chapter 0A of the Safety Analysis Report (DOS-07-00089301-050 Rev 05) are summarised below,
- The canisters are distributed into 5 of the 7 basket compartments, with a maximum admissible mass of 3,000 kg per loaded compartment (See Figure 7.5), in accordance with the distribution conditions shown in Figure 7.6.
- In the event of a partial load of canisters, all empty compartments in baskets partially filled with canisters must be filled using steel dummy spacers, the characteristics of which are detailed in chapter 0A of the Safety Analysis Report (DOS-07-00089301-050 rev.05). Basket compartments may be left totally empty (in this case, they contain neither canisters nor dummy spacers).

Maximum canister weight:

For the CSD-C:

850 kg (with up to 14,000 kg for all the canisters loaded and possible dummy spacers).

For the CSD-B:

550 kg (with up to 14,000 kg for all the canisters loaded and possible dummy spacers).

Physical state and chemical form:

For the CSD-C:

Mixture of metallic structural elements (hulls, end pieces and other elements constituting an assembly of a light water reactor), and possibly metal technological waste, compacted into disk wafers.

For the CSD-B:

Mixture of oxides, vitrified.

Waste is distributed uniformly in glass, which has a uniform composition.

Density: 2.5 (approximately).

The minimum B2O3 weight equals 12 %.

Special form:

The material is not in a special form.

Maximum thermal power of canisters:

The maximum residual power authorised per canister is 90 W for both CSD-C & CSD-B.

Activity:

The activity of the content must be such that, given the nature and energy of the gamma radiation and neutrons emitted, the regulatory limits for dose-rates around the package are not exceeded.

The maximum activity authorised per canister is 746.2 TBq for both CSD-C & CSD-B.

Fissile material:

For the CSD-C:

The standard CSD-C compacted waste canisters permissible in the TN 81 packaging are those simultaneously meeting all the conditions below:

- permissible mass of fissile material (heavy metal) per CSD-C expressed in mass of 239Pu must be less than or equal to 215 g

AND

- permissible mass of fissile material (heavy metal) per CSD-C expressed in mass of 235U must be less than or equal to 380 g

The mass of fissile material, 239Pu or 235U respectively, is measured in the Shells and End-Piece Compacting Workshop, assimilating the fissile isotopes present in the waste to 239Pu (or 235U respectively).

For the CSD-B:

For each vitrified residue canister, the following conditions must simultaneously be verified:

$$\frac{M^{239}Pu}{400\,g} \leq 1 \qquad \frac{M^{241}Pu}{25g} \leq 1 \qquad \frac{M^{233}U}{1{,}6\,g} \leq 1 \qquad \frac{M^{235}U}{158{,}4\,g} \leq 1$$

Actinides other than uranium and plutonium are not subject to isotopic separation.

Conformance:

For the CSD-C:

The compacted waste canisters (CSD-C) shipped, conform with COGEMA 300 AQ 055 Rev. 03 – "Specification of standard package for compacted waste" dated 3 July 2001. Only CSD-C manufactured in the ACC workshop of the AREVA NC plant at The Hague are authorised.

The compacting process at the ACC workshop must ensure a nominal disk wafer diameter of 388 mm.

The CSD-C, containing shells and end-fittings as well as technological waste, must have at least 3,614 kg/l of structural metal for disk wafer containing shells & end-fittings.

The technological waste authorised is metallic and composed of steel, Inconel or zirconium, the other elements being present only in trace form.

The compacted waste should not contain graphite, beryllium nor solid pieces of lead or aluminium. Each CSD-C may contain up to 25 g of organic matter.

The canisters must not be capped: the Poral filter must not be blocked.

A maximum volume of 10 litres of loose debris is permitted for each CSD-C. Debris pot casings are authorised as long as they have been emptied prior to compacting.

Figure 7.2 shows a drawing of a CSD-C compacted waste canister.

For the CSD-B:

The Type CSD-B vitrified residue canisters transported must conform to the AREVA NC specification 300 AQ 061 00 "Specifications for standard packages for CSD-B vitrified residue produced by La Hague" (September 2009). Procedures defined by the consignor guarantee that the shipped content conforms with the performance of the package design as concerns the thermal power and dose-rate regulatory limits.

The steel dummy spacers conform to the drawing shown in figure 7.4.

2 INTERNAL FITTINGS

The internal fittings placed within the cavity include a storage basket with 7 compartments, a bottom

plate and a set of 6 basket blocking parts made of carbon steel or stainless steel.

The basket (see figure 7.1) is made of copper sheets; each compartment can hold 4 stacked canisters.

3 CRITICALITY STUDY

This is covered in chapter 5A (DOS 07 00089301 502 rev.03), chapter 5A-2 (DOS 07 00089301 503 rev.01) and chapter 5A-3 (DOS 07 00089301 504 Rev. 00) of the Safety Analysis Report.

For the CSD-B, the confinement system is made up of the vitrified residue itself (fissile materials and glass).

For the CSD-C, the confinement system in question is made up of the compacted waste, the steel walls of the canisters and their spring, the steel body of the packaging, the primary transport lid, and finally the basket.

Nuclear Criticality-Safety Index (CSI): 0 (number N - "infinite")

FIGURE 7.1

RADIAL CROSS-SECTION OF THE BASKET IN THE CAVITY

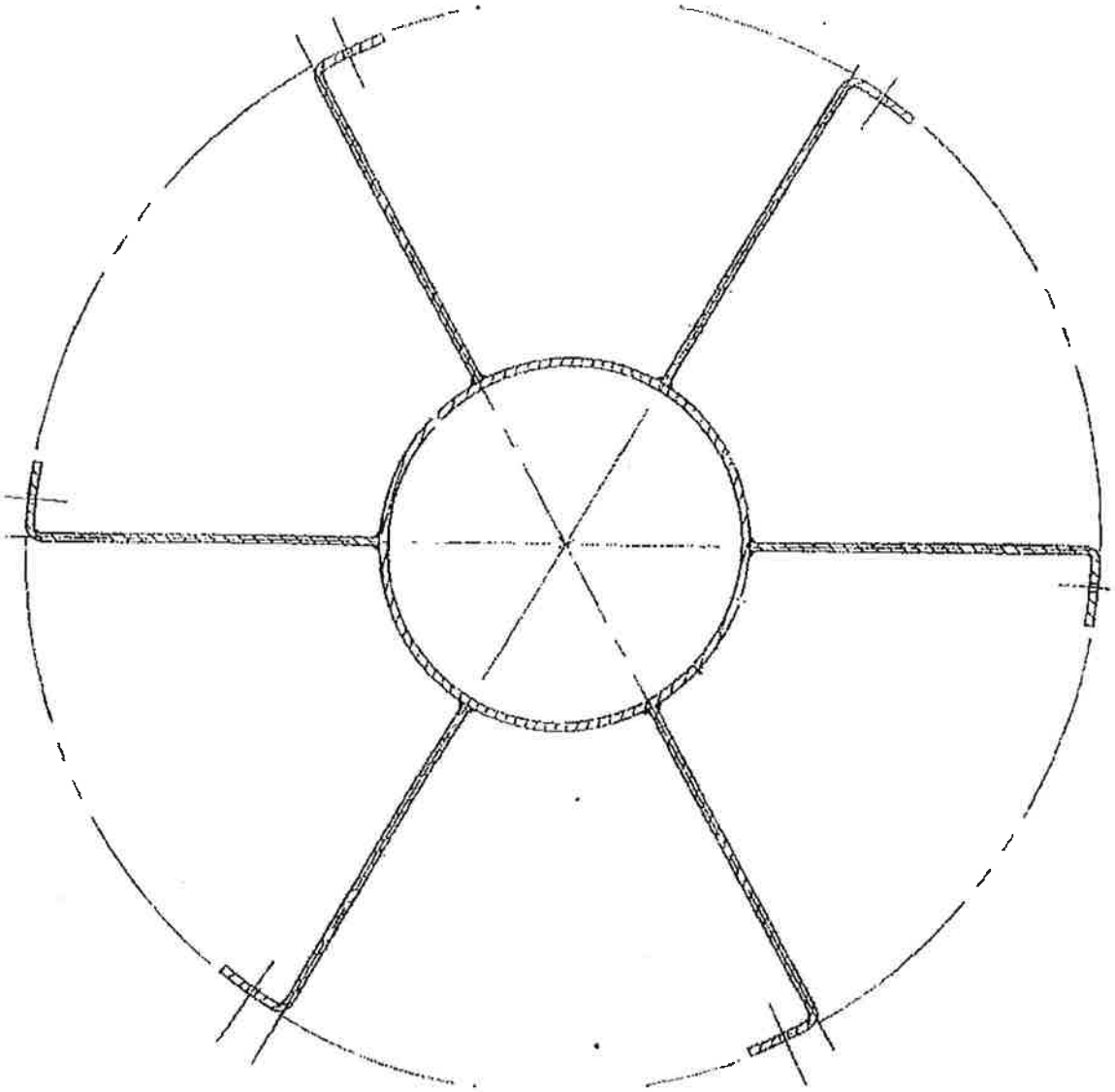


FIGURE 7.2

DRAWING OF A CSD-C COMPACTED RESIDUE CANISTER

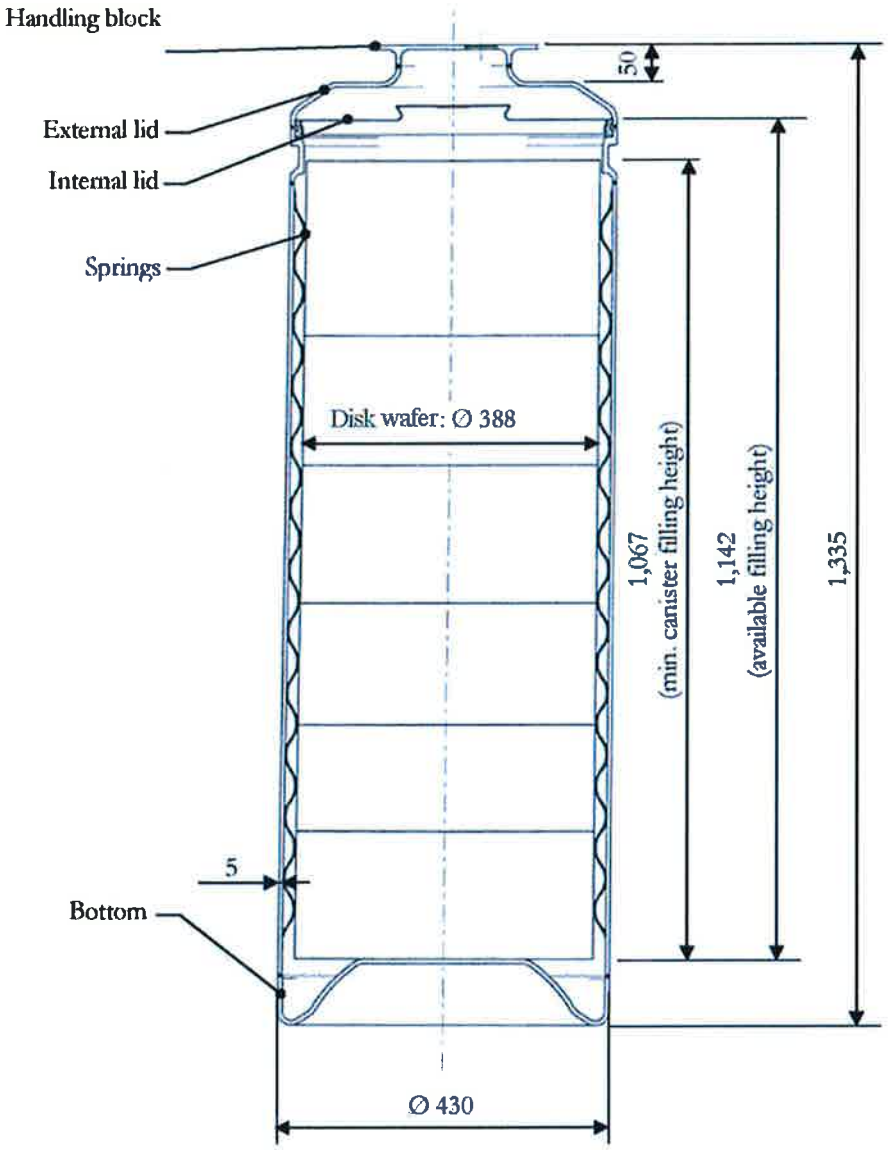


FIGURE 7.3

DRAWING OF A VITRIFIED RESIDUE CANISTER

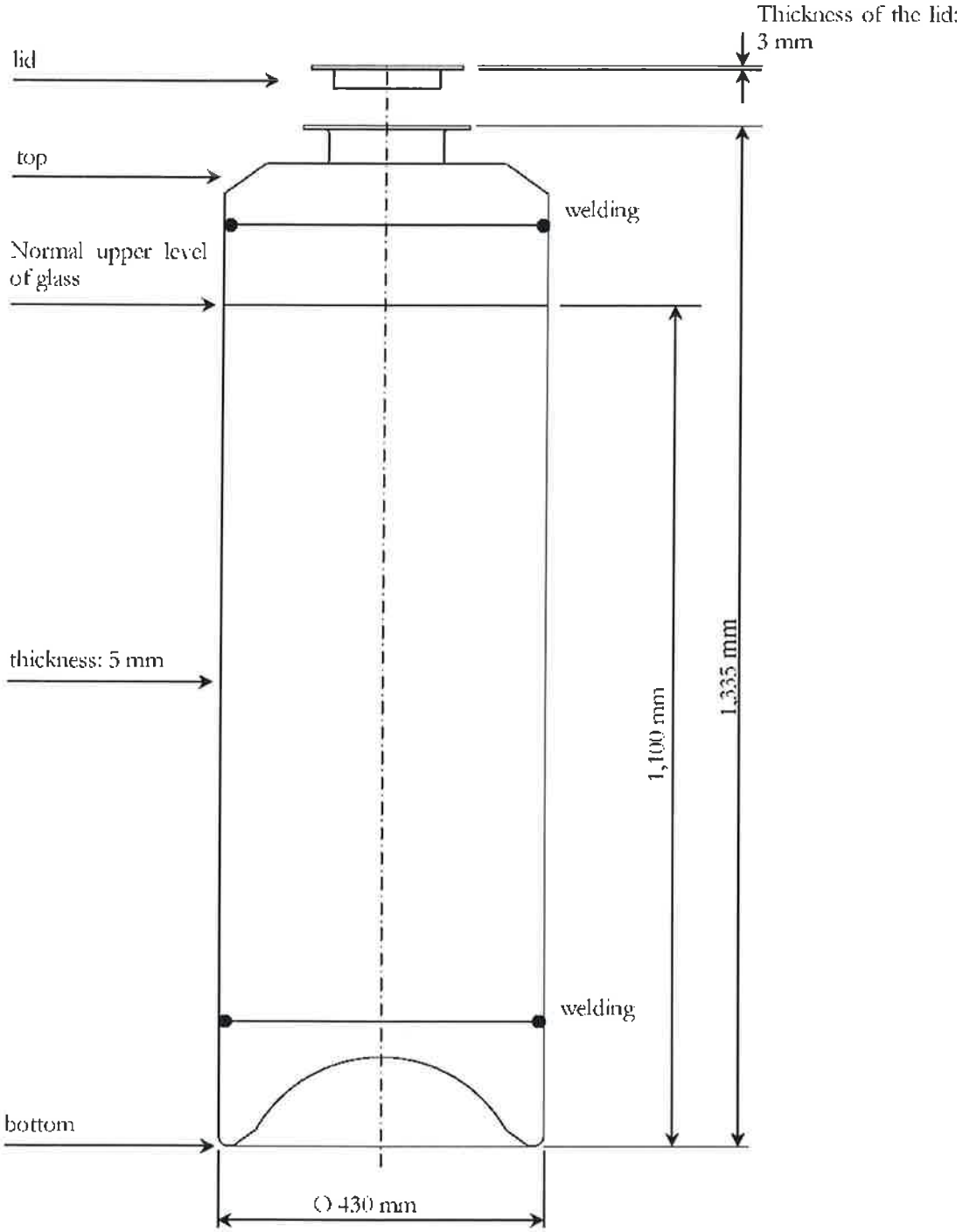


FIGURE 7.4

DRAWING OF A DUMMY SPACER

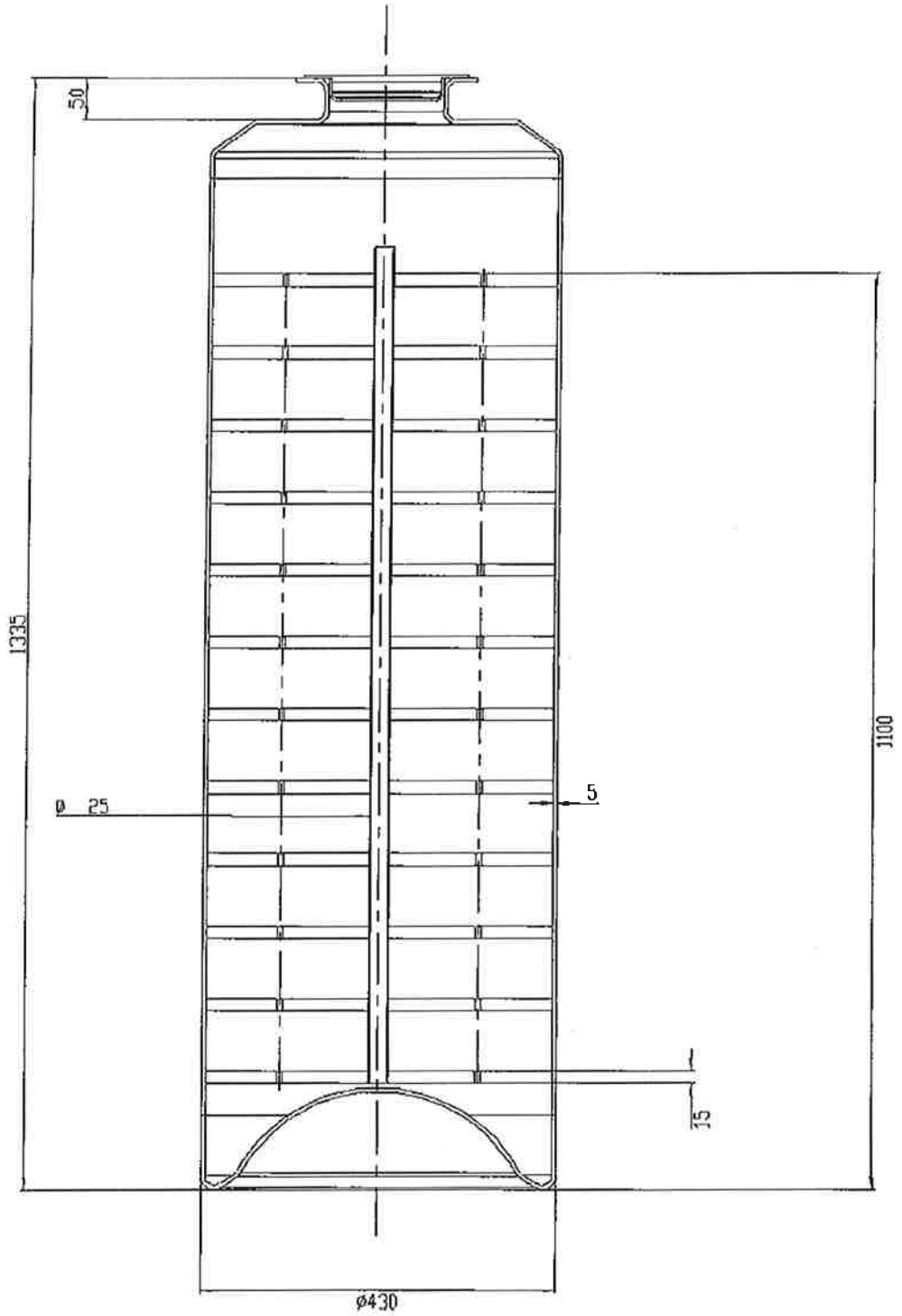


FIGURE 7.5

DEFINITION OF THE MAXIMUM PERMISSIBLE WEIGHT BY BASKET COMPARTMENT

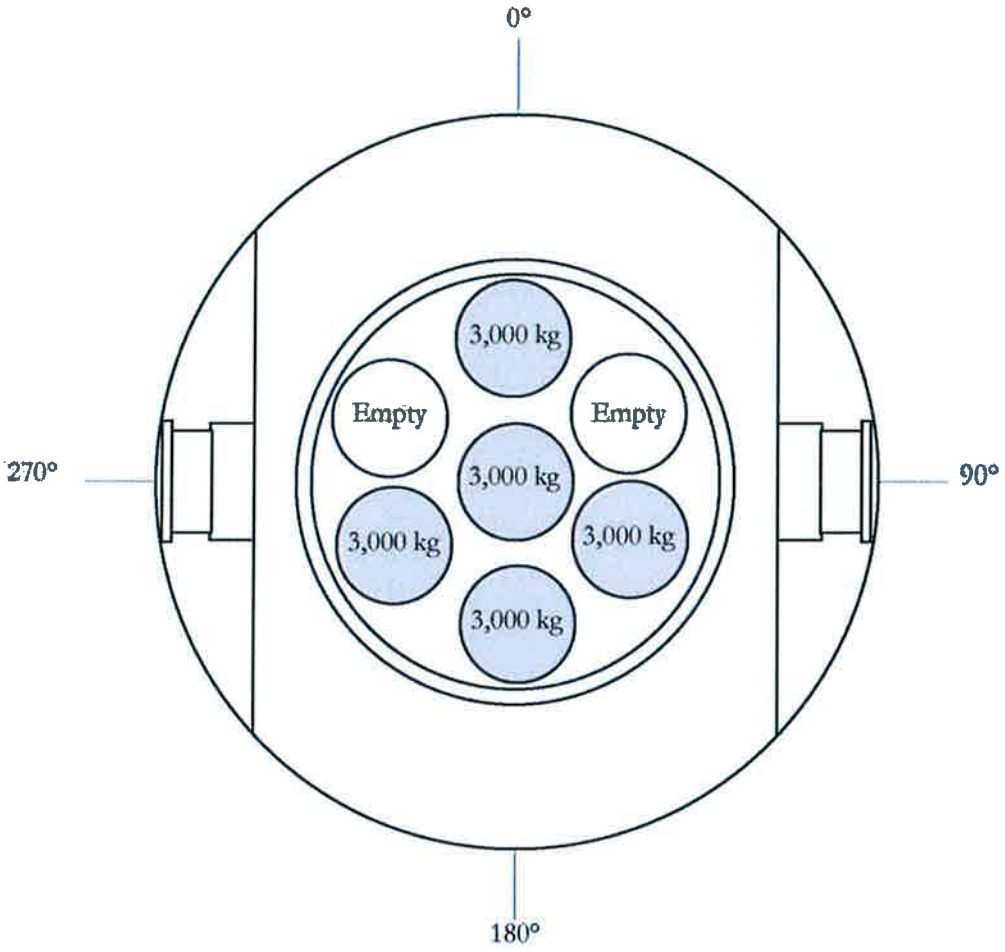


FIGURE 7.6

CANISTER DISTRIBUTION

The load must satisfy the following conditions:

- each compartment must contain canisters of the same type;
- the canisters are distributed as shown in the diagram below: