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 B(U)F FISSILE RADIOACTIVE MATERIALS PACKAGE DESIGN CERTIFICATE USA/0762/B(U)F-96, REVISION 0

REVALIDATION OF GERMAN COMPETENT AUTHORITY CERTIFICATE D/4347/B(U)F-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 - NCS 45.

2. Package Description and Authorized Radioactive Contents - as described in Germany Certificate of Competent Authority D/4347/B(U)F-96, Revision 0 (attached). Contents are restricted as shown in Special Condition 5.d.

3. Criticality - The minimum criticality safety index is 0. There is no restriction on the number of packages per conveyance.

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.

   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.

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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.

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. Special Conditions -

a. The package shall be transported under exclusive use.

b. The package shall not be used for air transport.

c. Each package must be pressurized with pure Helium 4.6 (purity 99.996 or better) to mitigate the potential for cladding oxidation.

d. Contents are restricted as follows:
(1) Irradiated intact PWR rods, full length fuel rods with cladding failures (damaged fuel rods) provided that the damaged rods are enclosed in sealed cans, or solid irradiated structural materials (for example top nozzles, fuel rod tubes, contaminated parts from hot cells, etc.). In all cases, the combined payload shall not exceed 75 kg per package;
(2) The allowable burnup and enrichment combination shall satisfy the limits as specified in Table 1 (attached);
(3) The allowable burnup and cooling times shall satisfy the limits specified in Table 2 (attached);
(4) Each fuel rod with an average burnup greater than 45 GWd/MTU must be placed in a sealed can (fuel above 45 GWd/MTU should be treated as damaged fuel due to the unknown property of high burnup fuel);
(5) Graphite and beryllium in any form are prohibited in the package;
(6) Content 1 is limited to a maximum number of fuel rods of 29, fuel rod diameters must be within the range of 0.6 to 1.2 cm, and maximum active fuel rod length is limited to a maximum of 390 cm; and
(7) Contents 1.2 and 1.3 are limited to a maximum fissile material distribution of 17.0 g/cm.

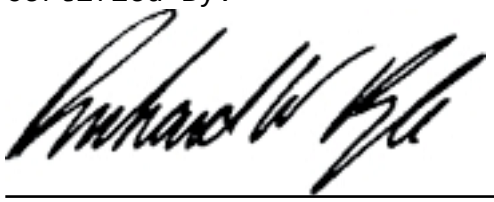
6. Marking and Labeling - The package shall bear the marking USA/0762/B(U)F-96 in addition to other required markings and labeling.

7. Expiration Date - This certificate expires on December 04, 2013.

CERTIFICATE USA/0762/B(U)F-96, REVISION 0

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 December 08, 2008 petition by Nuclear Cargo and Services, GmbH, Hanau, Germany, , and in consideration of other information on file in this Office.

Certified By:



Jan 22 2010

Dr. Magdy El-Sibaie (DATE)
Acting Associate Administrator for Hazardous Materials Safety

Revision 0 - Issued to endorse German Certificate of Approval No. D/4347/B(U)F-96, Revision 0.

Table 1 – Allowable enrichment/burnup combination for contents of NCS 45 irradiated fuel package

Enrichment (wt.% U-235)	Average Burnup (GWd/MgU)
1.0	10
1.7	20
2.4	30
3.1	40
3.7	50
4.5	60
5.3	80
5.3	100
5.3	120

Table 2 – Allowable payload of NCS 45 irradiated intact PWR fuel rod package (kg)

	Minimum Cooling time (days)					
Maximum Burn-up GWd/MgU	**120**	**180**	**365**	**730**	**1825**	**3650**
10	75.0	75.0	75.0	75.0	75.0	75.0
20	75.0	75.0	75.0	75.0	75.0	75.0
30	75.0	75.0	75.0	75.0	75.0	75.0
40	64.0	70.0	75.0	75.0	75.0	75.0
50	40.0	46.0	53.0	63.0	75.0	75.0
60	30.0	32.0	37.5	44.0	53.0	65.0
80	15.3	16.3	17.7	19.8	23.4	28.5
100	6.7	6.9	7.5	8.3	10.2	13.2
120	2.7	2.8	3.1	3.5	4.9	6.9

Translation

Federal Office for Radiation Protection

Certificate of Approval

D/4347/B(U)F-96 (Rev. 0)

for a package design of type B(U) for fissile radioactive materials

Pursuant to the application filed by Nuclear Cargo + Service GmbH, Hanau, on August 02, 2001 (Ref.: hil) amended by letter dated July 079 2007 the package with the manufacturer's designation **NCS 45** is approved as a type B(U) package design for fissile radioactive materials according to the following regulations for transports by road, rail, sea and inland waterways:

Regulations for the Safe Transport of Radioactive Material, 2005 Edition, International Atomic Energy Agency (IAEA), No. TS-R-1,

European Agreement for International Transports of Dangerous Goods by Road (ADR) of 30 September 1957 (BGBl. 1969 II p. 1489), last amended by the 18th ADR-Amendment Order dated 08 September 2006 (BGBl. 2006 II p. 826), Appendices A and B

Regulations for International Transports of Dangerous Goods by Rail (RID) - Enclosure I of Appendix B of the Agreement concerning International Railway Traffic (COTIF Agreement) of 9 May 1980 (BGBl. 1985 II, p. 130), last amended by the 13th RID-Amendment Order dated 17 October 2006 (BGBl. 2006 II p. 953) ,

International Maritime Dangerous Goods Code (IMDG-Code). Amendment 33-06,

Regulations for the Transport of Dangerous Goods on the Rhine (ADNR) and the Regulations for the Transport of Dangerous Goods on the Moselle dated 12 July 2003 (BGBl. II p. 648), last amended by the 7th ADNR-Amendment-Order dated 21 December 2006 (BGBl. II p.1378),

Regulations for the Domestic and International Transport of Dangerous Goods by Road and Rail (Dangerous Goods Regulations Road and Rail - GGVSE) dated 24 November 2006 (BGBl. I p. 2683),

Regulations for the Transport of Dangerous Goods with Sea Going Vessels (Dangerous Goods Regulations Sea - GGVSee) dated 3 December 2007 (BGBl. I p. 2816),

Regulations Concerning the Transport of Dangerous Goods over Inland Waterways (Dangerous Goods Regulations Inland Navigation - GGVBinSch) of 31 January 2004 (BGBl. I p. 136) last amended by the Seventh Order for the Amendment of Dangerous Goods Regulations Inland Navigation dated 26 June 2007 (BGBl. I p. 1222),

related to the Guidelines of the Federal Minister for Transport, Building and Urban Affairs (BMVBS) of November 17, 2004 (VkBl. Volume 23, p. 594, 2004) and February 20, 1991 (VkBl Volume 4, p. 231, 1991).

It is certified that the Federal Office for Radiation Protection, Salzgitter, is the Competent Authority authorized by the Federal Minister for Transport, Building and Urban Affairs (BMVBS) according to Section 7.9 of the IMDG Code.

Holder of the Certificate: Nuclear Cargo + Service GmbH
Rodenbacher Chaussee 6
63457 Hanau

Documents:

1. Application of company Nuclear Cargo + Service GmbH of August 02, 2001 (Az.: hil) with enclosures
2. Safety report of company Nuclear Cargo + Service GmbH no. NCS 0017 Rev. 5 dated 30.10.2008
3. Design examination certificate of the Federal Institute for Materials Research and Testing (BAM) Berlin, dated June 13, 2008 (Az.: III.3/20837) in connection with letters of BAM dated November 7, 2008 and December 3, 2008

As far as the verification of criticality safety is concerned, special reference is made to the report NCS 0017 "Criticality", Rev. 3 dated February 27, 2008 contained in the safety report

Manufacturer designation: **Transport packaging NCS 45**

Identification of the package: **D/4347/B(U)F-96**

Validity of approval: **until December 04, 2013, included**

Criticality safety index (CSI): **0**

Allowable contents:

Content 1: Uranium oxide in the form of fuel rods, fuel rod sections, pellets as well as pellet scrap according to the general specification fixed in attachment 1, table 1. Based on the variation of parameters for the five fuel specifications of content 1 following specific data must be observed:

Content 1.1: Uranium oxide according to the data in attachment 1, table 1.1

Content 1.2: Uranium oxide according to the data in attachment 1, table 1.2

Content 1.3: Uranium oxide according to the data in attachment 1, table 1.3

Content 1.4: Uranium oxide according to the data in attachment 1, table 1.4

Content 1.5: Uranium oxide according to the data in attachment 1, table 1.5

For burn-up values of more than 62 GWd/t_U the content must be enclosed in tightly welded cans. Additionally, dose rate measurements with extended measurement scope according to collateral clause no. 9 have to be carried out.

Content 5: Fissile excepted materials according to the general and specific data fixed in attachment 1, table 5 and table 5.1.

For all contents applies:

- A mixed loading of the fuel specifications of content 1 among each other as well as with content 5 is not admissible.
- For securing the radiological safety the contents mentioned above must be limited so that the following conditions are met:

$$\dot{D}_{OF} = S_\gamma \cdot w_{\gamma,OF} \cdot f_{\gamma,OF} + S_n \cdot w_{n,OF} \cdot f_{n,OF} \leq 2000\,\mu Sv/h$$

$$\dot{D}_{2m} = S_\gamma \cdot w_{\gamma,2m} \cdot f_{\gamma,2m} + S_n \cdot w_{n,2m} \cdot f_{n,2m} \leq 100\,\mu Sv/h$$

In this formulas are

$\dot{D}_{OF/2m}$ Dose rate in µSv/h at the surface (OF) of the package or in 2 m distance from the vehicle, respectively

$S_{\gamma/n}$ Source intensity in s^{-1} for gamma and neutron radiation, respectively.

The total source intensity of the gamma radiation S_γ is calculated according to following rule:

$$S_\gamma = \sum_{i=1}^{12} Q_\gamma^i \cdot s_i$$

In this the calculated gamma group source intensities s_i in s^{-1} for the energy groups i are groupwise multiplied with the factors Q_γ^i (dimensionless) from table 1 and added up.

The neutron source intensity S_n is taken directly from the output file of the calculation.

For the calculation of the source terms $S_{\gamma/n}$ the program system SCALE from version 5 up to version 5.1 is to be used (see collateral clause no. 10).

$f_{\gamma/n(OF/2m)}$ Correction factors (dimensionless) for gamma and neutron radiation, respectively, referring to the axial extension of the source in the packaging according to table 2 for the surface (OF) of the package and in 2 m distance from the transport vehicle.

$w_{\gamma/n(OF/2m)}$ Dose rate contribution in µSv/h s for gamma and neutron radiation according to table 3 for the surface (OF) of the package and in 2 m distance from the transport vehicle.

Table 1: Weighing factors for S_γ

Energy group i	Energy range	Q_γ^i
1	8 – 10 MeV	2.18
2	6.5 – 8 MeV	2.87
3	5 – 6.5 MeV	3.18
4	4 – 5 MeV	3.16
5	3 – 4 MeV	2.83
6	2.5 – 3 MeV	1.82
7	2 – 2.5 MeV	1
8	1.66 – 2 MeV	0.38
9	1.33 – 1.66 MeV	0.11
10	1 – 1.33 MeV	0.011
11	0.8 – 1 MeV	0.00033
12	0.6 – 0.8 MeV	0.000012

Table 2: Correction factors for the axial extension of the source

Place	Correction factor* with respect to	
	Gamma radiation	Neutron radiation
Surface of the package	$f_{\gamma,OF}(h) = 1.0 + 18 \cdot e^{-0.015 \cdot h}$	$f_{n,OF}(h) = 1.0 + 9 \cdot e^{-0.01 \cdot h}$
2 m distance from the transport vehicle	$f_{\gamma,2m}(h) = 1.8 - 0.0018 \cdot h$	$f_{n,2m}(h) = 1.32 - 0.0005 \cdot h$

*The factors $f_{\gamma/n(OF/2m)}$ refer always to the maximal source extension of 443.5 cm.
Extension h from 20 cm to 443.5 cm

Table 3: Dose rate contribution for each source particle

Place	Dose rate contribution with respect to	
	Gamma radiation [µSv/h s]	Neutron radiation [µSv/h s]
Surface of the package	$w_{\gamma,OF} = 1.31 \cdot 10^{-11}$	$w_{n,OF} = 1.37 \cdot 10^{-5}$
2 m distance from the transport vehicle	$w_{\gamma,2m} = 1.15 \cdot 10^{-12}$	$w_{n,2m} = 7.66 \cdot 10^{-7}$

Design of the packaging:

The design transport packaging NCS 45 fulfills with respect to the mechanical and thermal properties according to the above mentioned design examination certificate of BAM in connection with letter of BAM, Berlin dated 07.11.2008 and 03.12.2008, and with respect to criticality safety and radiation shielding according to the examination of BfS the requirements towards a type B(U) package for fissile radioactive material (IAEA-Regulations para. 671).

For the proof of criticality safety the inleakage of water into all voids of the packaging was assumed.

Description of the packaging:

The package design consists of the subassemblies packaging main body, lid plug, bottom plug, trunnions, shock absorbers and interior components. The packaging main body is a cylindrical austenitic welded design. The open ends of the packaging main body are closed with the lid and bottom plug with bolted flange connections.

The cylindrical inner cavity with a maximal length of 4625 mm (special design) and a diameter of 220 mm is designed for the accommodation of fuel rods, fuel rod sections, pellets, pellet scrap and powder in the inner components foreseen for this purpose.

At the outer mantle side of the packaging at each of the lid and bottom side two by 180° turned trunnions are fixed by bolts in welded trunnion support plates.

Both of the cylindrical shock absorbers filled with spruce and balsa wood are fixed to the ends of the packaging main body with 6 cylinder head screws each.

Schematic representations of the package in normal and special design (drawing no. 150-151-00, Rev. h and 150-151-01, Rev. f) are attached as attachment 3.

The "Containment" is constituted of following parts and elements, respectively:

- Inner tube, head piece and foot piece of the packaging main body as well as the connecting welding seams
- Flange of the lid plug with belonging inner gasket and bolts
- Rotary lock lid with belonging inner gasket and bolts
- Coupling lid with belonging inner gasket and bolts
- Rotary lock drive lid with belonging inner gasket and bolts
- Flange of the bottom plug with belonging inner gasket and bolts
- Push plug lid with belonging inner gasket and bolts

The "Confinement System" is constituted of the following parts and elements, respectively:

The "Confinement System" consists of the parts and elements of the "Containment". Depending on the content the following centering frames and the respectively belonging fissile material arrangements are to be added:

- Centering frame ZG-BSK-NA or ZG-BSK-SA; drawing no: 0-090-108-00-00
- Centering frame ZG-BS-NA or ZG-BS-SA; drawing no: 0-090-112-00-00
- Centering frame ZG-ZRS-NA or ZG-ZRS-SA; drawing no: 1-090-111-00-00

Main dimensions of the transport packaging NCS 45:

Diameter with shock absorbers:	approx. 1630 mm
Diameter without shock absorbers:	approx. 730 mm
Height with shock absorbers:	approx. 6247 mm
Height without shock absorbers:	approx. 5307 mm
Maximal mass, packaging (tare):	approx. 19650 kg
Maximal mass, package (gross):	approx. 22660 kg

For the time being the packagings designated by the respective parts lists revisions in attachment 4 comply with the certificate of package approval at hand (see also collateral clause no. 7).

Collateral Clauses and Directives:

1. All quality assurance measures taken during planning, accompanying controls and operation must be in agreement with the standards of the Technical Guideline concerning Quality Assurance Measures (QM) and Monitoring (QÜ) for Packages used for the Transport of Radioactive Materials (TRV 006) of BMVBW (VkBl. Brochure 4, p. 233, 1991).

2. The manufacture of new packagings is only allowed according to the parts list 150-151 with the highest revision index in attachment 4 including the changes according to collateral clause no. 7.

3. This certificate of package approval is only valid together with the belonging final acceptance certificate which must be sent to BAM and BfS without previous request. Deviations tolerated by BAM according to TRV 006 as well as changes according to collateral clause no. 7 are to be documented in this final acceptance certificate. For serial packagings manufactured already the deviations tolerated by BAM and the changes according to collateral clause no. 7 must be documented in the documentation book.

4. It must be assured that every user of the packaging will register with BfS before using it for the first time, and that he proves reception of and compliance with the documentation book, which in particular contains the approval certificate, the handling and maintenance instruction and the instructions concerning periodical inspections. In this respect, the following must be specially mentioned:

   - Handling Instructions No. HA-02-06 Rev. 2
     "Handling of the Packaging NCS 45"

   - Inspection Instruction No. WP-02-02, Rev. 1
     "Periodic Inspections of the Packaging NCS 45"

   The use of documents with a higher revision index as specified in the safety analysis report is in connection with this certificate of package approval only allowed after release of BAM and approval of BfS. These therewith become integral part of the present certificate of package approval.

5. Each serial packaging must be submitted to periodic inspections in due time. For serial packagings which are only used outside the Federal Republic of Germany the periodic inspections may be performed and certified by inspection personnel which is authorized by the competent authority of the respective country. The certificates for the performed periodic inspections must be sent to BAM and BfS without previous request.

6. Each serial packaging must be durably marked with the above mentioned identification as well as with the date (month, year) of the next periodic inspection.

7. Modifications concerning parts lists and the therein mentioned drawings and material data sheets on which the certificate of package approval is based, require after release by BAM the approval by BfS in form of an agreement to the modification certificate or an extended type list (according to attachment 4). With this they become part of the present certificate of package approval.

8. The package has to be transported under exclusive use.

9. Before each transport of the package of the design NCS 45 with burn-up values of more than 62 GWd/t_U dose rate measurements with an extended measurement program with respect to test procedure no. PA-02-10 have to be carried out. Additionally, information about the used fuel and the irradiation history must be documented. The extended measurement program must be agreed with by BfS before beginning of the measurements. Based on the evaluation of the measurement results the revocation of this measurement program can be applied for at BfS.

10. Other versions of the program SCALE from version 5 to 5.1 as well as other programs may only be used after approval by BfS.

11. This approval does not exempt the consigner from the necessity to observe any regulations of the government of a country into or through which the package is transported.

Costs:

1. According to § 12 Section 1 and 2 of the Law for the Transport of Dangerous Goods (Gefahrgutbeförderungsgesetz – GGBefG) in the version dated September 29, 1998 (BGBl. I p. 3114), amended for the last time by article 294 of the ninth Jurisdiction Adaptation Order dated 31 October 2006 (BGBl. I p. 2407) in connection with Article 1 and Attachment (to Article 1), I. Part, Fee number 007 of the Directive concerning Costs for Measures to be taken during the Transport of Dangerous Goods (GGVKostV) of November 13, 1990 (BGBl. I p. 2490), last amended by the Third Order for the Amendment of Dangerous Goods Regulations dated December 17, 2004 (BGBl. I p. 3711), costs arising from this certificate - fees and expenses – will be charged.

2. According to § 12 Section 1 of the GGBefG related to § 13 Section 1 No. 1 of the Law concerning Administration Costs (VwKostG) of June 23, 1970 (BGBl. p. 821), amended for the last time through the Law of August 29, 2008 (BGBl. I p. 718), the company Nuclear Cargo + Service GmbH must carry the costs.

3. The determination of costs will be communicated separately.

Statement of rights of appeal:

Objections against this certificate may be filed within one month after its issuing. Objections must be filed with the Federal Agency for Radiation Protection, Willy-Brandt-Straße 5, 38226 Salzgitter, either in written form, or to be written down.

Salzgitter, December 04 , 2008

In representation

Thiele

Attachments

Appendix

Attachment 1: Specification for contents 1 and 5
Attachment 2: Interior components
Attachment 3: Data sheets transport packaging NCS 45, drawing nos. 150-151-00, Rev. h (normal design), 150-151-01, Rev. f (special design)
Attachment 4: Type list

- Appendix to Certificate of Approval D/4347/B(U)F-96 (Rev. 0) -

Rev. No.	Date of publication	Period of validity	Reason for revision
0	04.12.2008	04.12.2013	First publication

Content 1

Table 1: general specification for content 1

Property	Specification	
Chemical composition of the active zone	- Uranium oxide - Gadolinium as Gd_2O_3 is acceptable	
Fuel composition before irradiation	Enriched natural Uranium or enriched Uranium from reprocessing	
Fuel composition after irradiation	Actinides, fission and activation products from irradiation in the reactor. The material can be irradiated or un-irradiated.	
Geometry of pellets	arbitrary	
Geometry of fuel rods	arbitrary	
Geometry of fuel assemblies	arbitrary	
Loading of non fissile materials	Loading of non fissile materials in solid form is acceptable	
Cladding tube material	Stainless steel, Zirconium alloys, Aluminium	
Not acceptable materials	Graphite or Beryllium are not allowed in the inner cask volume	
Thermal power	Flooding of the inner cavity with Helium and transport without a closed container	max. 3000 W max. 730 W / m max. 380 W / 0.5 m
	Flooding of the inner cavity with Helium and transport in a closed container	max. 2500 W max. 730 W / m max. 380 W / 0.5 m
	Flooding of the inner cavity with air and transport with or without a closed container	max. 750 W max. 580 W / m max. 290 W / 0.5 m

Table 1.1: Specification for content 1.1

Property	Specification
Physical form	- Undamaged fuel rods - Fuel rods in welded cans - Fuel rod sections, pellets and pellet scraps in welded cans
Fuel composition before irradiation	Uranium oxide with enrichment of max. 5.3 wt. % of U-235 in Uranium
Hydrogen density in the fuel	Atom ratio H/U-235 ≤ 1
Burn-up	max. 120 GWd/Mg_U
Cooling time	min. 120 d, see Table 1.1a
Inner components	drawing 0-090-108-00-00: payload max. 100 kg drawing 0-090-112-00-00: payload max. 100 kg
Heavy metal mass before irradiation	see Table 1.1a
Thermal power for each guide tube	Inner components according to drawing nos. 0-090-108-00-00 and 0-090-112-00-00, see Table 1.1b
Activity inventory	max. $2 \cdot 10^4$ TBq, max. $2 \cdot 10^5$ A_2
Fissile material cross section	max. 380 cm^2 (equivalent diameter 22 cm = cavity diameter)
Fissile material height	max. cavity length
Mass of fissile material before irradiation	max. 16.4 g U-235 / cm length of the fissile material zone max. 4.0 kg U-235 total

Table 1.1a: Permissible heavy metal mass

Burn-up	GWd/Mg_U max.	33			62			120[3]		
Cooling time	days min.	120	730	3650	120	730	3650	120	730	3650
PWR-fuel rods	kg	75	75	75	75	75	75	35	46	59
BWR-fuel rods[1]	kg	75	75	75	75	75	75	35	46	59
BWR-fuel rods[2]	kg	47	53	54	26	28	29	12	13	13.8

[1] for a proven compliance of a surface contamination of $\leq 5.2 \cdot 10^6$ Bq/cm^2 (33 GWd/Mg_U), $\leq 9.8 \cdot 10^6$ Bq/cm^2 (62 GWd/Mg_U), $\leq 1.9 \cdot 10^7$ Bq/cm^2 (120 GWd/Mg_U)

[2] surface contamination not measured or surface contamination limits according to footnote [1] not met

[3] for enclosure of the fuel in welded cans

Table 1.1b: Permissible thermal power for each guide tube for the inner components according to drawings 0-090-108-00-00 and 0-090-112-00-00

Specification	Filled with	
	Helium	Air
maximal thermal power for each guide tube for max. 7 guide tubes, W	100	100
maximal thermal power for each guide tube for all other guide tubes, W	75	18.75
maximal thermal power for each guide tube for max. 7 guide tubes for each 500 mm loading length, W	30	30
maximal thermal power for each guide tube for all other guide tubes for each 500 mm loading length, W	9	7

Table 1.2: Specification for content 1.2

Property	Specification
Physical form	- Undamaged fuel rods - Fuel rods in welded cans - Fuel rod sections, pellets and pellet scraps in welded cans
Fuel composition before irradiation	Uranium oxide with enrichment of max. 5.3 wt. % of U-235 in Uranium
Hydrogen density in the fuel	Atom ratio H/U-235 ≤ 1
Burn-up	max. 120 GWd/Mg_U
Cooling time	min. 120 d, see Table 1.2a
Inner components	drawing 1-090-111-00-00 (18 cm diameter): payload max. 95 kg
Heavy metal mass before irradiation	see Table 1.2a
Activity inventory	max. $2 \cdot 10^4$ TBq, max. $2 \cdot 10^5$ A_2
Fissile material cross section	max. 254 cm^2 (equivalent diameter maximal 18 cm)
Height of fissile material	max. cavity length
Mass of fissile material before irradiation	max. 4.0 kg U-235 total

Table 1.2a: Permissible heavy metal mass

Burn-up	GWd/Mg_U max.	33			62			120[3]		
Cooling time	days min.	120	730	3650	120	730	3650	120	730	3650
PWR-fuel rods	kg	75	75	75	75	75	75	35	46	59
BWR-fuel rods[1]	kg	75	75	75	75	75	75	35	46	59
BWR-fuel rods[2]	kg	47	53	54	26	28	29	12	13	13.8

[1] for a proven compliance of a surface contamination of $\leq 5.2 \cdot 10^6$ Bq/cm^2 (33 GWd/Mg_U), $\leq 9.8 \cdot 10^6$ Bq/cm^2 (62 GWd/Mg_U), $\leq 1.9 \cdot 10^7$ Bq/cm^2 (120 GWd/Mg_U)

[2] surface contamination not measured or surface contamination limits according to footnote [1] not met

[3] for enclosure of the fuel in welded cans

Table 1.3: Specification for content 1.3

Property	Specification
Physical form	- Damaged or undamaged fuel rods - Fuel rods in welded cans - Fuel rod sections, pellets and pellet scraps in welded cans - Not welded fuel rod sections - Pellets und pellet scraps in not welded cans
Fuel composition before irradiation	Uranium oxide with enrichment of max. 5.3 wt. % of U-235 in Uranium
Hydrogen density in the fuel	Atom ratio H/U-235 $\leq$ 100
Burn-up	max. 120 GWd/Mg_U
Cooling time	min. 120 d, see Table 1.3a and 1.3b
Inner components	Drawing 0-090-108-00-00: payload max. 100 kg Drawing 1-090-109-00-00: payload max. 95 kg Drawing 1-090-110-00-00: payload max. 100 kg Drawing 1-090-111-00-00: payload max. 95 kg Drawing 0-090-112-00-00: payload max. 100 kg
Heavy metal mass before irradiation	see Table 1.3a and 1.3b
Thermal power for each guide tube	Inner components according to drawing nos. 0-090-108-00-00, 1-090-110-00-00 and 0-090-112-00-00 see Table 1.3c
Activity inventory	max. $2 \cdot 10^4$ TBq, max. $2 \cdot 10^5$ A_2
Fissile material cross section	max. 380 cm^2 (equivalent diameter 22 cm = cavity diameter)
Height of fissile material	max. cavity length
Mass of fissile material before irradiation	max. 1380 g U-235 total

Table 1.3a: Permissible heavy metal mass for undamaged fuel rods and canned fuel

Burn-up	GWd/Mg_U max.	33			62			120[3]		
Cooling time	days min.	120	730	3650	120	730	3650	120	730	3650
PWR fuel rods[1]	kg	75	75	75	75	75	75	35	46	59
BWR fuel rods[1]	kg	75	75	75	75	75	75	35	46	59
BWR-fuel rods[2]	kg	47	53	54	26	28	29	12	13	13.8

[1] for a proven compliance of a surface contamination of $\leq 5.2 \cdot 10^6$ Bq/cm^2 (33 GWd/Mg_U), $\leq 9.8 \cdot 10^6$ Bq/cm^2 (62 GWd/Mg_U), $\leq 1.9 \cdot 10^7$ Bq/cm^2 (120 GWd/Mg_U)

[2] surface contamination not measured or surface contamination limits according to footnote [1] not met

[3] for enclosure of the fuel in welded cans

Table 1.3b: Permissible heavy metal mass for damaged fuel rods and non canned fuel

Burn-up	GWd/Mg_U max.	33			62		
Cooling time	days min.	120	730	3650	120	730	3650
PWR and BWR fuel rods	kg	6.5	12.4	17.1	4.1	6.5	8.7

Table 1.3c: Permissible thermal power for each guide tube for the inner components according to drawings 0-090-108-00-00, 0-090-110-00-00 (component part according to section C-C) and 0-090-112-00-00

Specification	Filled with	
	Helium	Air
maximal thermal power for each guide tube for max. 7 guide tubes, W	100	100
maximal thermal power for each guide tube for all other guide tubes, W	75	18.75
maximal thermal power for each guide tube for max. 7 guide tubes for each 500 mm loading length, W	30	30
maximal thermal power for each guide tube for all other guide tubes for each 500 mm loading length, W	9	7

Table 1.4: Specification for content 1.4

Property	Specification
Physical form	- Undamaged fuel assemblies - Undamaged fuel rods - Fuel rods in welded cans - Fuel rod sections, pellets und pellet scraps in welded cans
Fuel composition before irradiation	Uranium oxide with enrichment of max. 3.4 wt. % of U-235 in Uranium
Hydrogen density in the fuel	Atom ratio H/U-235 ≤ 1
Burn-up	max. 62 GWd/Mg_U
Cooling time	min. 120 d, see Table 1.4a and 1.4b
Inner components	without inner components: payload max. 350 kg Drawing 0-090-108-00-00: payload max. 100 kg Drawing 1-090-109-00-00: payload max. 95 kg Drawing 1-090-110-00-00: payload max. 100 kg Drawing 1-090-111-00-00: payload max. 95 kg Drawing 0-090-112-00-00: payload max. 100 kg
Heavy metal mass before irradiation	see Table 1.4a and 1.4b
Thermal power for each guide tube	Inner components according to drawing nos. 0-090-108-00-00, 1-090-110-00-00 and 0-090-112-00-00 see Table 1.4c
Activity inventory	max. $3 \cdot 10^4$ TBq, max. $2 \cdot 10^5$ A_2
Fissile material cross section	max. 380 cm^2 (equivalent diameter 22 cm = cavity diameter)
Height of fissile material	max. cavity length
Mass of fissile material before irradiation	max. 6.5 kg U-235 total

Table 1.4a: Permissible heavy metal mass **in case** of use of inner components

Burn-up	GWd/Mg_U max.	33			62		
Cooling time	days min.	120	730	3650	120	730	3650
PWR fuel rods	kg	75	75	75	75	75	75
SWR fuel rods[1)]	kg	75	75	75	75	75	75
SWR-Fuel rods[2)]	kg	47	53	54	26	28	29

Table 1.4b: Permissible heavy metal mass **without** use of inner components

Burn-up	GWd/Mg_U max.	33			62		
Cooling time	days min.	120	730	3650	120	730	3650
PWR fuel rods	kg	167	260	275	100	137	164
SWR fuel rods[1)]	kg	167	260	275	100	137	164
SWR-Fuel rods[2)]	kg	47	53	54	26	28	29

[1)] for a proven compliance of a surface contamination of $\leq 5.2 \cdot 10^6$ Bq/cm^2 (33 GWd/Mg_U), $\leq 9.8 \cdot 10^6$ Bq/cm^2 (62 GWd/Mg_U)

[2)] surface contamination not measured or surface contamination limits according to footnote [1)] not met

Table 1.4c: Permissible thermal power for each guide tube for the inner components according to drawings 0-090-108-00-00, 1-090-110-00-00 (component part according to section C-C) and 0-090-112-00-00

Specification	Filled with	
	Helium	Air
maximal thermal power for each guide tube for max. 7 guide tubes, W	100	100
maximal thermal power for each guide tube for all other guide tubes, W	75	18.75
maximal thermal power for each guide tube for max. 7 guide tubes for each 500 mm loading length, W	30	30
maximal thermal power for each guide tube for all other guide tubes for each 500 mm loading length, W	9	7

Table 1.5: Specification for content 1.5

Property	Specification
Physical form	- Undamaged fuel rods - Fuel rods in welded cans - Fuel rod sections, pellets and pellet scraps in welded cans
Fuel composition before irradiation	Uranium oxide with enrichment of max. 7 wt. % of U-235 in Uranium
Hydrogen density in the fuel	Atom ratio H/U-235 ≤ 1
Burn-up	max. 120 GWd/Mg_U
Cooling time	min. 120 d, see Table 1.5a
Inner components	Drawing 0-090-112-00-00: payload max. 100 kg
Heavy metal mass before irradiation	see Table 1.5a
Thermal power for each guide tube	Inner components according to drawing no. 0-090-112-00-00 see Table 1.5b
Activity inventory	max. $2 \cdot 10^4$ TBq, max. $2 \cdot 10^5$ A_2
Fissile material cross section	max. 380 cm^2 (equivalent diameter 22 cm = cavity diameter)
Height of fissile material	max. cavity length
Mass of fissile material before irradiation	max. 5.25 kg U-235 total

Table 1.5a: Permissible heavy metal mass

Burn-up	GWd/Mg_U max.	33			62			120[3]		
Cooling time	days min.	120	730	3650	120	730	3650	120	730	3650
PWR fuel rods	kg	75	75	75	75	75	75	35	46	59
SWR fuel rods[1]	kg	75	75	75	75	75	75	35	46	59
SWR-Fuel rods[2]	kg	47	53	54	26	28	29	12	13	13.8

[1] for a proven compliance of a surface contamination of $\leq 5.2 \cdot 10^6$ Bq/cm^2 (33 GWd/Mg_U), $\leq 9.8 \cdot 10^6$ Bq/cm^2 (62 GWd/Mg_U), $\leq 1.9 \cdot 10^7$ Bq/cm^2 (120 GWd/Mg_U)

[2] surface contamination not measured or surface contamination limits according to footnote [1] not met

[3] for enclosure of the fuel in welded cans

Table 1.5b: Permissible thermal power for each guide tube for the inner components according to drawing 0-090-112-00-00

Specification	Filled with	
	Helium	Air
maximal thermal power for each guide tube for max. 7 guide tubes, W	100	100
maximal thermal power for each guide tube for all other guide tubes, W	75	18.75
maximal thermal power for each guide tube for max. 7 guide tubes for each 500 mm loading length, W	30	30
maximal thermal power for each guide tube for all other guide tubes for each 500 mm loading length, W	9	7

Content 5

Table 5: general specification for content 5

Property	Specification	
Chemical composition of the active zone	arbitrary The content must not have other dangerous properties.	
Physical form	solid	
Thermal power	Flooding of the inner cavity with Helium and transport without a closed container	max. 3000 W max. 730 W / m max. 380 W / 0.5 m
	Flooding of the inner cavity with Helium and transport in a closed container	max. 2500 W max. 730 W / m max. 380 W / 0.5 m
	Flooding of the inner cavity with air and transport with or without a closed container	max. 750 W max. 580 W / m max. 290 W / 0.5 m
Fissile mass	$m_{U\text{-}233} + m_{U\text{-}235} + m_{Pu\text{-}239} + m_{Pu\text{-}241} \leq 15$ g	

Table 5.1: Specification for content 5.1

Property	Specification
Physical form	- structural materials and cladding tubes of fuel assemblies - surface contaminated parts from hot cells
Fuel composition before irradiation	Uranium oxide with an enrichment of max. 7.0 wt% of U-235 in Uranium
Hydrogen density in the fuel	Atom ratio H/U-235 ≤ 1
Burnup	max. 120 GWd/Mg_U
Cooling time	min. 120 days
Inner components	without inner components: payload max. 350 kg drawing 0-090-108-00-00: payload max. 100 kg drawing 1-090-109-00-00: payload max. 95 kg drawing 1-090-110-00-00: payload max. 100 kg drawing 1-090-111-00-00: payload max. 95 kg drawing 0-090-112-00-00: payload max. 100 kg
Mass of structural material	see Table 5.1a
Mass of heavy metal before irradiation	see Table 5.1b
Activity inventory	max. 3000 A_2 (fission products and actinides)

Table 5.1a: Permissible mass of structural materials

Burnup	GWd/Mg_U max.	33			62			120[3]		
cooling time	days min.	120	730	3650	120	730	3650	120	730	3650
PWR fuel rods	kg	126	138	140	54	63	66	7.0	13.5	19
BWR fuel rods[1]	kg	126	138	140	54	63	66	7.0	13.5	19
BWR fuel rods[2]	kg	14	15	15.5	6.0	7.0	7.3	0.8	1.5	2.1

[1] for a proven compliance of a surface contamination of $\leq 5.2 \cdot 10^6$ Bq/cm^2 (33 GWd/Mg_U), $\leq 9.8 \cdot 10^6$ Bq/cm^2 (62 GWd/Mg_U), $\leq 1.9 \cdot 10^7$ Bq/cm^2 (120 GWd/Mg_U)

[2] surface contamination not measured or surface contamination limits according to footnote [1] not met

[3] for enclosure of the fuel in welded cans

Table 5.1b: Permissible heavy metal mass before irradiation

Burnup	U-235	U-total
GWd/Mg_U	g	g
33	15	468
62	15	333
120	15	210

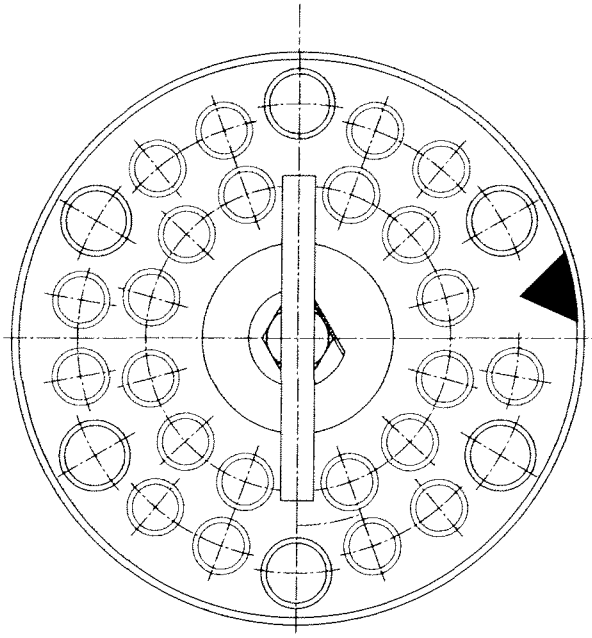


Fig. 1: Centering frame ZG-BSK-NA/SA
Drawing no. 0-090-108-00-00

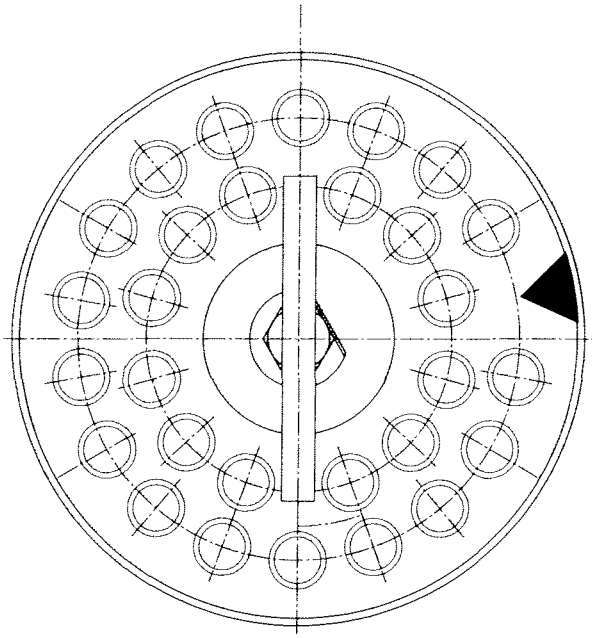
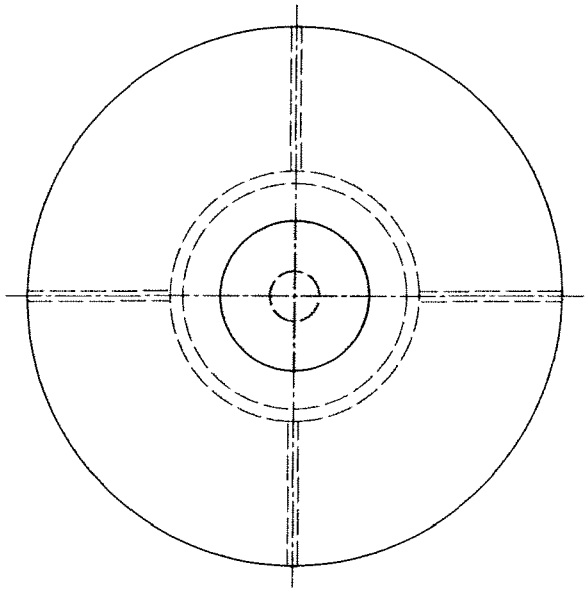


Fig. 2: Centering frame ZG-BS-NA/SA
Drawing no. 0-090-112-00-00

Design I



Design II
For outer diameter of Pos. 8 equal or greater 200 mm Pos. 4 is not used

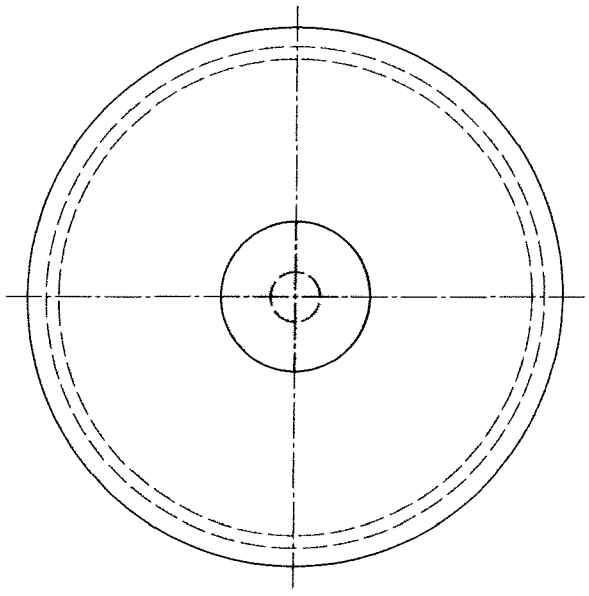


Fig. 3 and 4: Centering frame ZG-ZR-NA/SA (2 designs)
Drawing no. 1-090-109-00-00

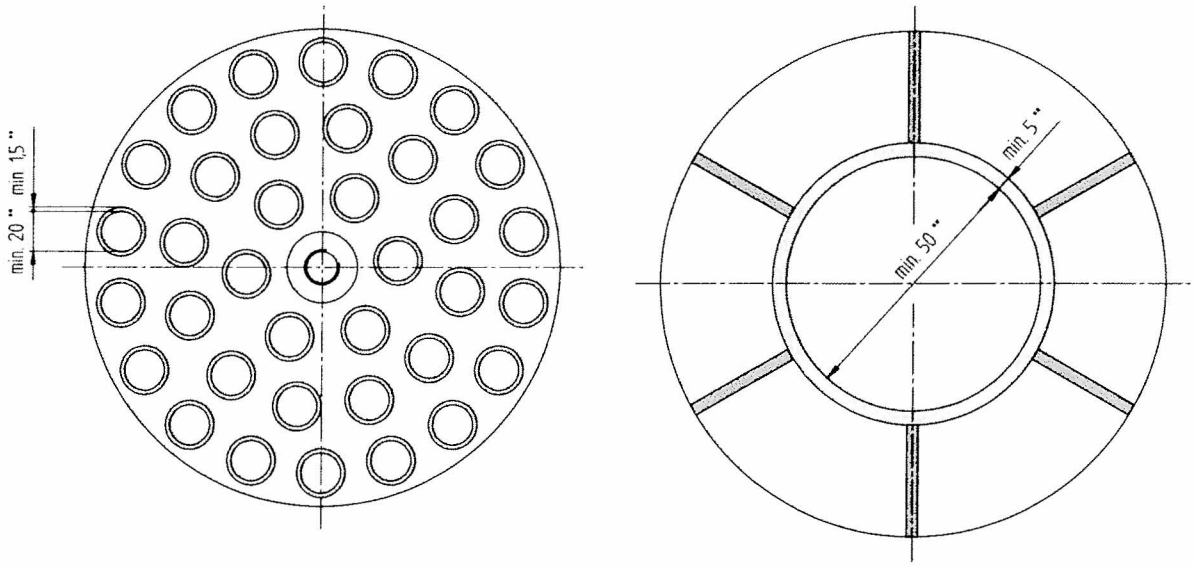


Fig. 5 and 6: Centering frame ZG-OA-NA/SA (different cross sections)
Drawing no. 1-090-110-00-00

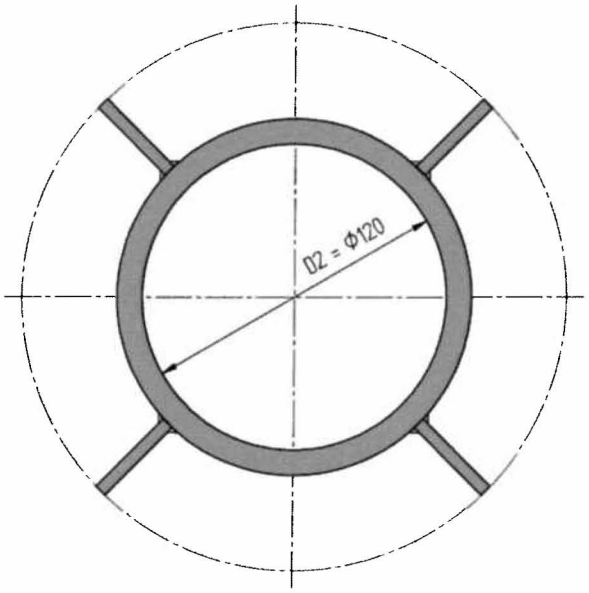
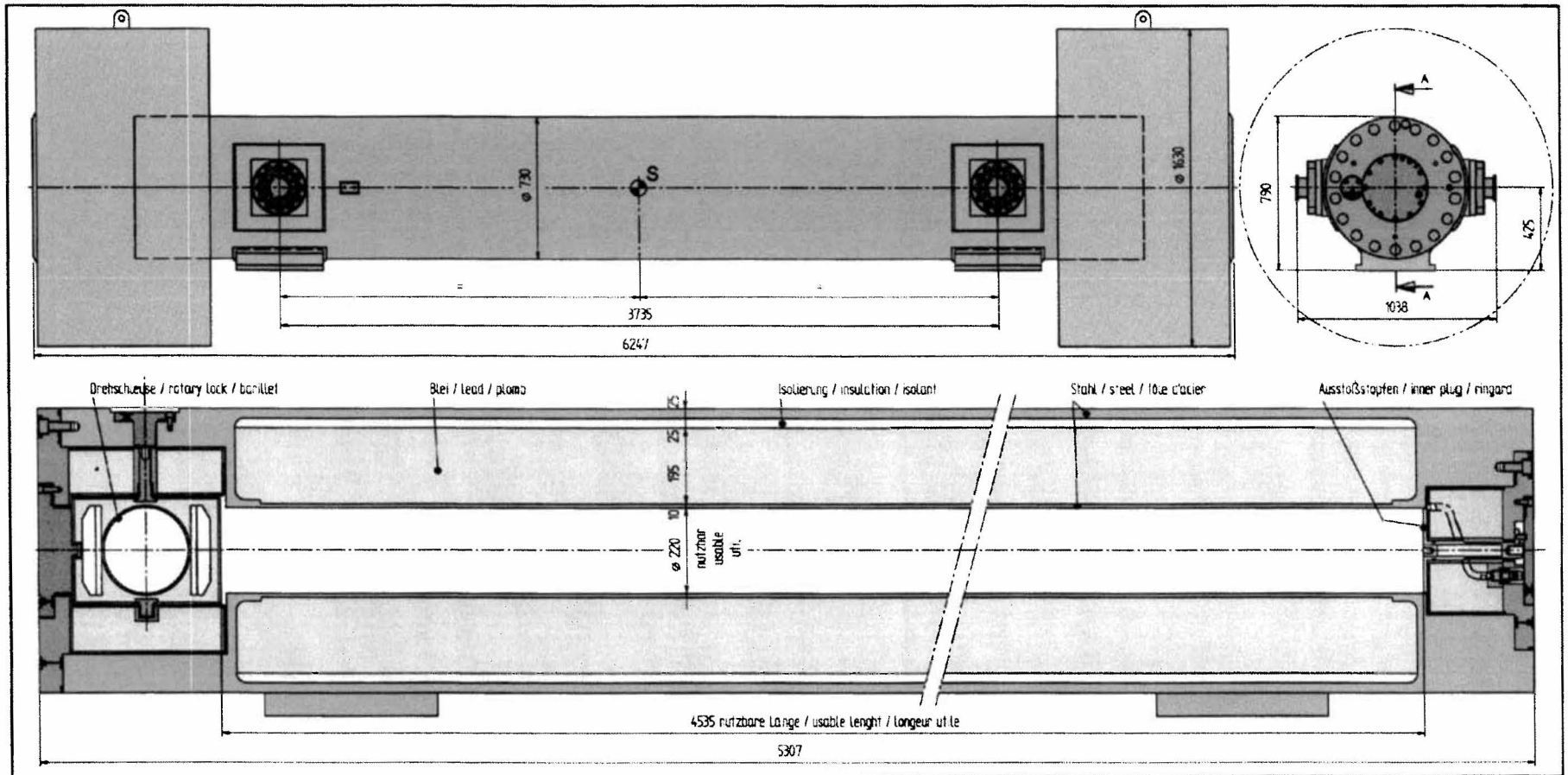


Fig. 7: Centering frame ZG-ZRS-NA/SA (diameter (D2) variable, maximal 18 cm)
Drawing no. 1-090-111-00-00

NUR ZUR INFORMATION ! / ONLY FOR INFORMATION ! / POUR INFORMATION !



SCHNITT A - A
Section A - A
Coupe A - A

Massen / mass / Masse:

Behälter / body / Corps	19.650 kg
Deckelstoßdämpfer / lid shock absorber / Capot avant	1330 kg
Bodenstoßdämpfer / bottom shock absorber / Capot arrière	1330 kg
Tara / tare / Tare	22.310 kg
max. Zuladung / max. pay load / Charge utile max.	350 kg
max. Brutto / max. gross / Poids brut max.	22.660 kg

NUCLEAR CARGO + SERVICE GMBH

DATENBLATT
DATASHEET

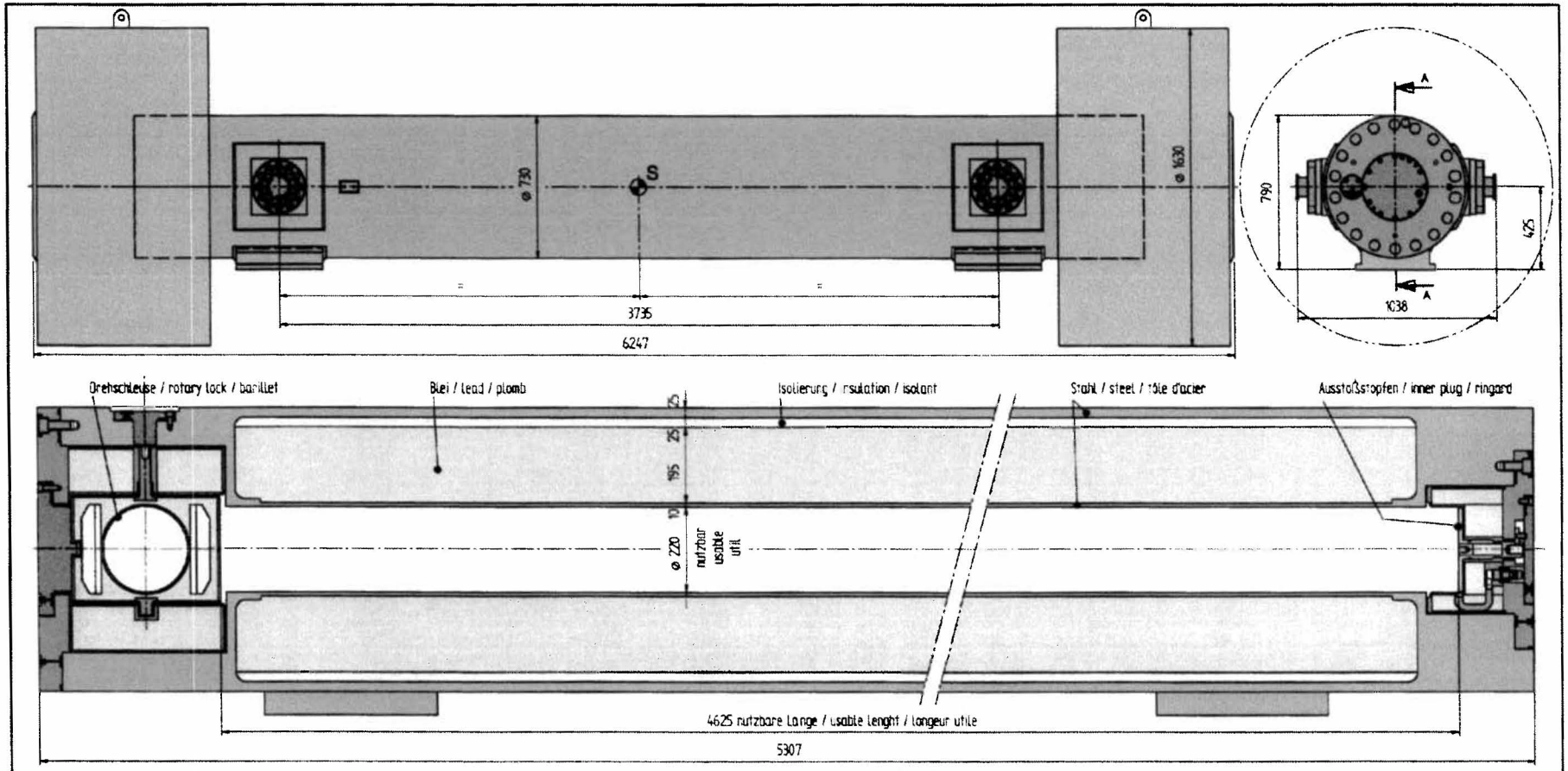
Nr. / no
150-151-00

Benennung / title
Behälter NCS 45 / Container NCS 45 / Emballage NCS 45
Normalausführung / standard design / version normale

				2001	Datum	Name	Projekt / project: Behälter NCS 45
				Gezeichnet	31.07.	Korn	
							Maßstab / scale 1:20 / 1:10
h	Nr. 080201	20.02.08	Korn	Geprüft	31.07.	Hilbert	
Index	Revision	Datum	Name	Urheberrecht nach DIN ISO 16016 / Copyright acc. to DIN ISO 16016			

Translation

NUR ZUR INFORMATION ! / ONLY FOR INFORMATION ! / POUR INFORMATION !



SCHNITT A - A
Section A - A
Coupe A - A

Massen / mass / Masse:

Behälter / body / Corps	19.650 kg
Deckelstoßdämpfer / lid shock absorber / Capot avant	1330 kg
Bodenstoßdämpfer / bottom shock absorber / Capot arrière	1330 kg
Tara / tare / Tare	22.310 kg
max. Zuladung / max. pay load / Charge utile max.	350 kg
max. Brutto / max. gross / Poids brut max.	22.660 kg

NCS NUCLEAR CARGO + SERVICE GMBH

DATENBLATT
DATASHEET

Nr / no
150-151-01

Benennung / title
Behälter NCS 45 / Container NCS 45 / Emballage NCS 45
Sonderausführung / special design / version spéciale

Index	Revision	Datum	Name
f	Nr. 080201	20.02.08	Korn

	Datum	Name
2003		
Gezeichnet	30.04.	Korn
Geprüft	30.04.	Hilbert

Projekt / project: **Behälter NCS 45**

Maßstab / scale 1:20 / 1:10

Translation

Type List

for the transport packaging NCS 45

Packagings of type NCS 45 which were or are manufactured according to the parts lists listed in the following comply with the design certified in this certificate of package approval (see also collateral clauses 2, 3 and 7).

Parts list, Revision	**Release by BAM**
150-151, Rev. t	Design examination certificate of BAM of June 13, 2008 (Ref.: III.3/20837)

Salzgitter, December 04, 2008

In representation

Thiele

U.S. Department
of Transportation

**Pipeline and
Hazardous Materials
Safety Administration**

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

CERTIFICATE NUMBER: USA/0762/B(U)F-96, Revision 0

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