AREVA

ADVANCED NUCLEAR FUELS GmbH

Prüfung und Freigabe von Übersetzungen / *Examination and release of translations*

Titel/Title:

Approval certificate

D/4343/IF-96 (Rev. 6)

for a package design of the type IP-2 for fissile radioactive material

Übersetzung geprüft/ Translation verified:	D. Steinigeweg **D. Steinigeweg**	04. Juni 2017 **Datum/Date**
Übersetzung freigegeben/ Translation approved:	i. V. **J. Rakers**	07.06.2017 **Datum/Date**

Approval certificate

D/4343/IF-96 (Rev. 6)

for a package design of the type IP-2 for fissile radioactive material

In response to the application submitted by Advanced Nuclear Fuels GmbH, Lingen, of 27 May 2016 (Ref: 703/16/BfS/DST), last amended by the letter dated 16 May 2017 (Ref: 725/17/BfE/DST), the container with manufacturer's designation "Fuel assembly shipping cask type ANF-18" as package design of the type IP2 for fissile radioactive material is approved for road, rail and sea modes of transport according to the following regulations:

Regulations for the Safe Transport of Radioactive Material, 2012 Edition, International Atomic Energy Agency (IAEA), No. SSR-6,

European Agreement concerning the International Carriage of Dangerous Goods by Road dated 30 September 1957 (ADR) (BGBl. 1969 II p. 1489), Annexes A and B in the version published on 17 April 2015 (BGBl. 2015 II p. 504, 2016 II p. 50), last amended by the 25th ADR amending regulations dated 25 October 2016 (BGBl. 2016 II p. 1203),

Regulations Concerning the International Carriage of Dangerous Goods by Rail (RID) – Annex C of the Convention concerning International Carriage by Rail (COTIF) dated 9 May 1980 (BGBl. 1985 II p. 130) in the version published on 16 May 2008 (BGBl. 2008 II p. 475, 899; 2009 II p. 1188, 1189; 2010 II p. 1273; 2012 II p. 168, 169, 1338; 2013 II p. 562, 2014 II p. 890, 2015 II p. 1143,1144), last amended by the 20th RID amending regulations dated 11 November 2016 (BGBl. 2016 II p. 1258),

International Maritime Dangerous Goods Code (IMDG Code), Amendment 37 14, in the official German translation of 13 November 2014 (VkBl. 2014 p. 810),

Verordnung über die innerstaatliche und grenzüberschreitende Beförderung gefährlicher Güter auf der Straße, mit Eisenbahnen und auf Binnengewässern (Gefahrgutverordnung Straße, Eisenbahn und Binnenschifffahrt - GGVSEB) (German regulations on the domestic and cross-border carriage of dangerous goods by road, rail and on inland waterways) in the version published on 30 March 2017 (BGBl. 2017 I p. 711),

Verordnung über die Beförderung gefährlicher Güter mit Seeschiffen (Gefahrgutverordnung See – GGVSee) (German regulations concerning the carriage of dangerous goods by sea) of 9 February 2016 (BGBl. 2016 I p. 182), last amended by Article 14 of the Act dated 26 July 2016 (BGBl. 2016 I p. 1843)

in conjunction with the Richtlinie für das Verfahren der Bauart-Zulassung von Versandstücken zur Beförderung radioaktiver Stoffe, von radioaktiven Stoffen in besonderer Form, von gering dispergierbaren radioaktiven Stoffen und freigestellten spaltbaren Stoffen (R003) (German Guidelines for the Type Approval Procedure for Packages for the Carriage of Radioactive Material, of Radioactive Material in Special Form, of Low Dispersible Radioactive Material and Exempted Fissile Material) in the version published on 09 June 2016 (VkBl. 2016 p. 430) and the BAM Gefahrgutregel über Maßnahmen zur Qualitätssicherung von Verpackungen zulassungspflichtiger Bauarten für Versandstücke zur Beförderung radioaktiver Stoffe (BAM-GGR 011) (Dangerous Goods Rule on Quality Assurance Measures for Package Types for the Carriage of Radioactive Material Requiring Approval) Rev. 0 of 25 June 2010 (Amts- und Mitteilungsblatt of the BAM 2011 p. 323), implemented by the announcement of 1 July 2010 (VkBl. 2010 p. 282).

It is confirmed that the Bundesamt für kerntechnische Entsorgungssicherheit (German Federal Office for the Safety of Nuclear Waste Management) is the authority authorised by the Bundesministerium für Verkehr und digitale Infrastruktur (Federal Ministry of Transport and Digitial Infrastructure) in accordance with Chapter 7.9 of the IMDG Code.

Approval holder: ADVANCED NUCLEAR FUELS GmbH
Am Seitenkanal 1
49811 Lingen

Documents:

1. Application submitted by Advanced Nuclear Fuels GmbH (ANF), Lingen, dated 27 May 2016 (Ref.: 703/16/BfS/DST) with appendices and amendment of the application dated 16 May 2017 (Ref.: 725/17/BfE/DST) with appendices
2. Safety report of ANF No. ANFG11.105 (03), Rev. 26, dated 15.05.2017
3. Test certificate issued by the Bundesanstalt für Materialforschung und -prüfung (BAM - German Federal Institute of Material Research and Testing), Berlin, dated 27.05.2002 (Ref.:III.3/20711) with BAM letter dated 26.06.2002 (Ref.: III.3/20711), 04.07.2002 (Ref.: III.3/20711), 09.07.2002 (Ref.: III.3/20711), 28.10.2002 (Ref.: III.3/20711), 07.01.2003 (Ref.: III.3/20711), 19.02.2003 (Ref.: III.3/20711), 24.02.2003 (Ref.: III.3/20711), 02.12.2003 (Ref.: III.3/20991), 22.11.2004 (Ref.: III.3/21094), 22.11.2006 (Ref.: III.3/21167), 04.02.2009 (Ref.: III.3/21305), 11.02.2009 (Ref.: III.3/21305), 30.07.2009 (Ref.: III.3/21326), 12.10.2009 (Ref.: III.3/21326), 23.11.2009 (Ref.: III.3/21326), 08.02.2010 (Ref.: III.3/21326), 21.02.2012 (Ref.: 3.3/21410), 18.01.2017 (Ref.: Ma, BAM order No.: 16026346) and 19.05.2017 (Ref.: Ma, BAM order No.: 16026346)

Regarding the demonstration of criticality safety, reference is made to the work reports ANFG-5.060 (065) Rev. 004 dated 16.05.2017, ANFG-5.060 (066) Rev. 004 dated 15.05.2017, ANFG-5.060 (067) Rev. 004 dated 16.05.2017 and ANFG-5.060 (068) Rev. 001 dated 19.01.2012 contained in the safety report.

Manufacturer's name: Fuel assembly shipping cask type ANF-18

Identification of the package: D/4343/IF-96

Validity of the approval: up to and including 30 June 2022

Criticality safety index (CSI): 1

Allowable contents:

1. A maximum of two fuel assemblies (FA) for pressurised water reactors of the type 14∗14-(16+1), 15∗15-20, 15∗15-(20+1), 16∗16-20, 17∗17-24, 17∗17-(24+1), 18∗18-24, containing uranium oxide pellets or gadolinium oxide / uranium oxide pellets, whereby the pellets are enclosed by cladding tubes made of zirconium alloys (Zircaloy). The FA correspond to the data specified in the following Tables 1 and 2. The uranium contained in a fuel assembly can also exist in the form of reprocessed uranium (WAU) or rather enriched reprocessed uranium (ERU), whereby the parameters listed in Table 3 regarding the composition of the fuel shall be complied with.

   The allowable fuel assembly designs are specified in Figures 1 to 7.

   Each FA can contain one control element.

2. A maximum of two fuel rod bundles for PWR fuel assemblies of the type 16∗16-20 (each up to a maximum of 236 fuel rods in one fuel rod carrier), containing uranium oxide pellets or gadolinium oxide / uranium oxide pellets, whereby the pellets are enclosed by cladding tubes made of zirconium alloys. The uranium contained in the fuel rods can also exist in the form of reprocessed uranium (WAU) or rather enriched reprocessed uranium (ERU), whereby the parameters listed in Table 3 regarding the composition of the fuel shall be complied with. The maximum pellet diameter is 9.2 mm, the maximum cladding tube inside diameter is 9.35 mm and the minimum cladding tube outside diameter is 10.65 mm. The fuel rod bundles are transported in the fuel rod carrier, which is designed as a fuel rod box (completely made of steel).

   During fuel rod transport (one bundle in each fuel rod carrier), fuel rods can be replaced by solid rods made of austenitic material or zirconium alloys, whose diameter is the same as the specified fuel rod diameter and whose length is the same as the specified fuel rod length.

Table 1: Geometric data of the fuel assemblies

No.	FA type (lattice arrangement)	Number of fuel rods	Distance between fuel rod centres	Active length of the UO_2 fuel rods	Diameter of the UO_2 pellets	Cladding tube outside diameter
			[mm]	maximum [mm]	maximum [mm]	minimum [mm]
1	14∗14-(16+1)	179	14.12	2425	9.7	10.65
2	14∗14-(16+1)	179	14.12	3062	9.7	10.65
3	15∗15-20	205	14.3	2662	9.7	10.65
4	15∗15-20	205	14.3	2997	9.7	10.65
5	15∗15-20	205	14.3	3562	9.7	10.65
6	15∗15-(20+1)	204	14.3	3671	9.7	10.65
7	16∗16-20	236	14.3	3412	9.2	10.70
8	16∗16-20	236	14.3	3912	9.2	10.70
9	17∗17-24	265	12.6	4215	8.6	9.4
10	17∗17-(24+1)	264	12.6	3670	8.6	9.4
11	18∗18-24	300	12.7	3912	8.1	9.45

- Instead of a fuel rod, a fissile material-free solid rod made of zirconium alloy, stainless steel, tungsten, tungsten carbide or bismuth, a cladding tube with fissile material-free pellets, which have the same diameter as the UO_2 pellets, or a modular rod can be inserted on a fuel rod position. A module rod contains one longitudinal section of fissile material and another longitudinal section with no fissile material. The fissile material-free area of the rod is made as a solid rod or cladding tube, filled with fissile material-free pellets with the same diameter as the UO_2 pellets. Both the solid rods and the modular rods have the same outside diameter and the same length as the fuel rods.
- Guide tubes made of zirconium alloy (Zircaloy) can be replaced by:
    - o austenitic guide tubes with the same cross-section,
    - o guide tubes made of zirconium alloy with larger cross-section,
    - o guide tubes made of zirconium alloy with polygonal outside contour and a larger cross-section,
    - o austenitic solid tubes or solid tubes made of zirconium alloy with the same outside diameter.
- The guide tubes can be made of zirconium alloy, stainless steel, tungsten, tungsten carbide or bismuth and have a cylindrical or polygonal ring cross-section. Solid rods with any cross-section made of the same materials can also be used on the positions of the guide tubes. In addition, it is also possible to push absorber rods with neutron poison into the guide tubes.
- Instrumentation tubes made of zirconium alloy can be replaced by tubes made of the same material but with a larger cross-section.

Table 2: Fuel data of the fuel assemblies (FA)

No.	FA type (lattice arrangement)	Total mass per FA including structural material[1)]	Total mass of uranium per FA	Enrichment (mass fraction) of U235	Polyethylene and/or Plastic[2)]
		maximum [kg]	maximum [kg]	maximum [%]	maximum [kg/FA]
1	14∗14-(16+1)	415	300	5.00	6.00
2	14∗14-(16+1)	510	355	5.00	6.00
3	15∗15-20	540	350	5.35	6.00
4	15∗15-20	600	400	5.35	6.00
5	15∗15-20	700	480	5.35	6.00
6	15∗15-(20+1)	700	485	5.35	6.00
7	16∗16-20	780	500	5.00	4.00
8	16∗16-20	890	580	5.00	4.00
9	17∗17-24	810	580	5.35	6.00
10	17∗17-(24+1)	715	500	5.35	6.00
11	18∗18-24	880	580	5.00	4.00

1) The maximum total mass per FA can increase by up to 85 kg, if the Zircaloy guide tubes are replaced by solid austenitic rods or solid rods made of Zircaloy and subject to the condition that the maximum gross mass of the package of 4700 kg is not exceeded.

2) Max. hydrogen content ≤ 7.3 % by mass, max. carbon content ≤ 62.6 % by mass

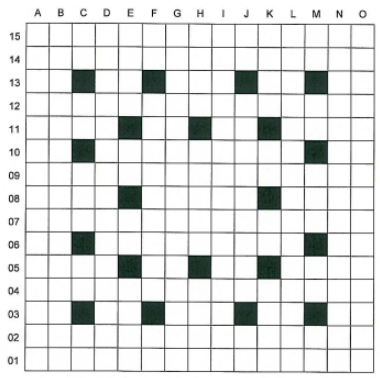
Table 3: Characterisation of the fuel made of ERU or uranium, maximum pellet density: 10.75 g/cm^3

Nuclide	Mass content maximum [%]	Activity per gram of uranium maximum [Bq]	Gamma output per gram of uranium maximum [MeV ∗ Bq]
U-232	5.00E-06[1)]	4.14E+04	
Th-228		4.13E+04	
U-234	2.00E-01	4.60E+05	
U-235	5.35E+00	4.28E+03	
U-236	2.50E+00	5.98E+04	
U-238	100E+00	1.24E+04	
Fission nuclides			440[2)]
Transuranic elements		250	

1) 5.00E-06 means $5.00 \cdot 10^{-6}$

2) The limitation of the fissile nuclide activity is achieved independently of the nuclides by the given upper limit for the energy release through gamma radiation per second and gram of uranium.

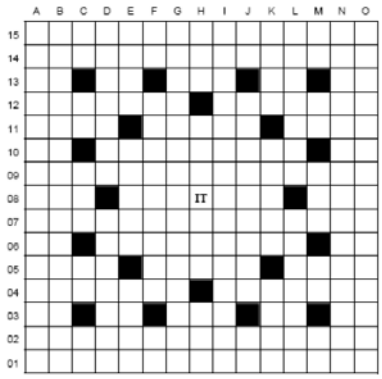
Fuel assembly design



Guide tube

Fuel rod

Fig. 1: 15x15-20 fuel assembly

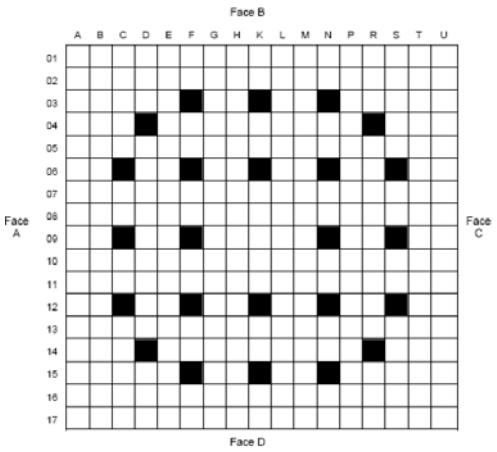


Guide tube

Fuel rod

IT Instrumentation thimble

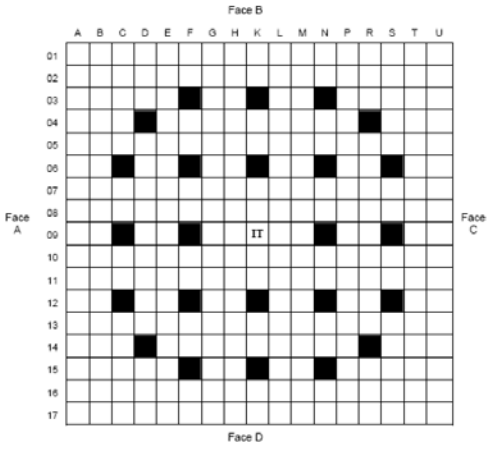
Fig. 2: 15x15-(20+1) fuel assembly



Guide tube

Fuel rod

Fig. 3: 17x17-24 fuel assembly



Guide tube

Fuel rod

IT Instrumentation thimble

Fig. 4: 17x17-(24+1) fuel assembly

Fuel assembly design (continued)

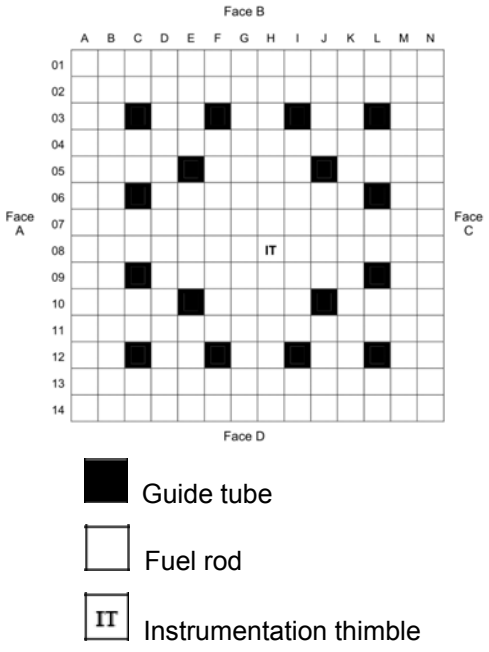


Fig. 5: 14x14-(16+1) fuel assembly

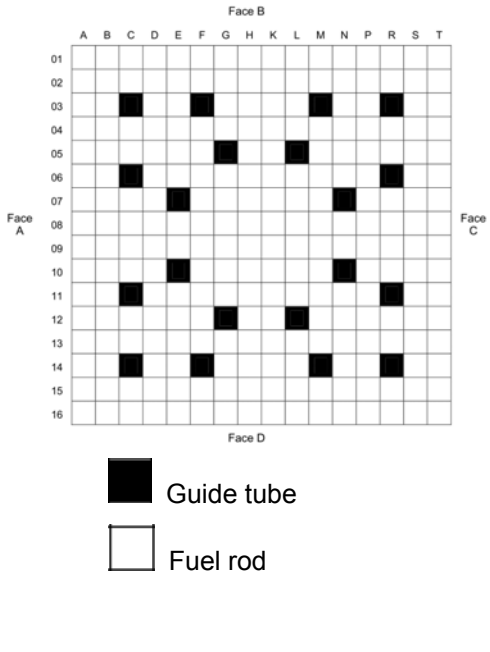


Fig. 6: 16x16-20 fuel assembly

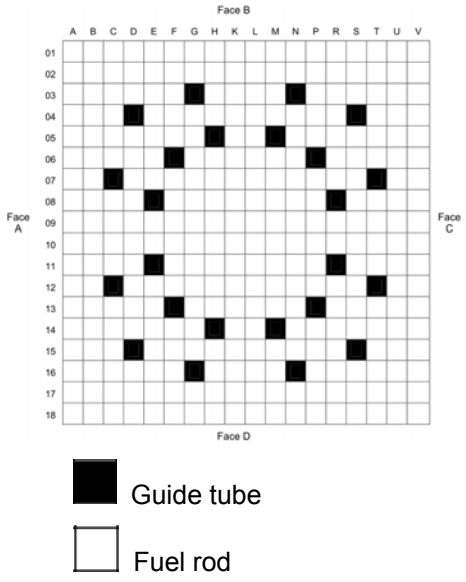


Fig. 7: 18x18-24 fuel assembly

Package type:

The mechanical and thermal properties of the fuel assembly transport cask type ANF-18 in accordance with the above-named test certificate and the above-named comments of the BAM, Berlin and regarding the criticality safety and radiation shielding after testing by the BfE, fulfil the requirements set for a type IP2 package for fissile radioactive material (IAEA regulations §§ 624 and 673).

The penetration of water into all void spaces of the package was assumed for the criticality analysis.

Description of the packaging:

The package design consists of an outer protective cladding, which is formed by the bottom pan and the cask cover connected to the bottom pan by bolts, and the fuel assembly carrier (cradle) with the L-shaped doors, the foot adapter baseplate and the head cover. The fuel assembly carrier is fixed onto the bottom pan via a round rubber bearing.

The bottom pan consists of an all-round U-section, the bottom metal plate and transverse U-sections beneath the bottom metal plate, all made of austenitic steel. The hood-shaped cover is formed by laminated aluminium honeycomb sheets and longitudinal and transverse austenitic hollow sections, sheathed on both sides with austenitic sheet steel. The end faces of the bottom pan and the cover are formed as shock absorbers with laminated aluminium honeycomb sheets, which are sheathed all-round with austenitic sheet steel.

The fuel assembly carrier (an inverted “T” with inner stiffening structure) together with the L-shaped doors (made of hollow sections), the foot adapter baseplate and the head cover, forms two hollow spaces, each of which can hold one PWR fuel assembly. At least 3 mm thick stainless steel sheets containing at least 1.75 mass percent boron of natural isotope composition are welded onto the sides of the fuel assembly carried facing the fuel assemblies and the L-shaped doors.

A schematic diagram of the package (drawing number ANF-5-122-3711-03, Rev. 1) is enclosed as Enclosure 1.

The outside dimensions are: Length approx. 5866 mm, Width approx. 1136 mm, Height approx. 792 mm.

Mass: Packaging (tare) max. 3500 kg, package (gross) max. 4700 kg

The “leaktight enclosure” is formed by the following components or elements:

- the gas-tight welded cladding tubes of the fuel rods

The “enclosure system” is formed by the following components or elements:

- the bottom pan
- the cask cover
- the cradle with L-shaped doors, foot adapter baseplate and head cover
- the fuel assembly structure with fuel rods or fuel rod carrier with fuel rods
- the gas-tight welded cladding tubes of the fuel rods

At the present time, the packages marked in Enclosure 2 by the respective revisions of the drawing list correspond to this approval (see also incidental provision No. 7).

Incidental provisions and notes:

1. All quality assuring measures in the planning, accompanying controls and operation must take place according to the BAM Dangerous Goods Rule on Quality Assurance Measures for Package Types for the Carriage of Radioactive Material Requiring Approval (BAM-GGR 011, Rev. 0).
2. New packages can only be produced according to the drawing in the drawing list with the highest revision index in Enclosure 2 including the changes in accordance with incidental provision No. 7.
3. This approval only applies in conjunction with the acceptance certificate issued for the relevant series design, which must be sent to the BAM and the BfE without request. Deviations tolerated by the BAM in accordance with BAM-GGR 011, Rev. 0, and changes in accordance with incidental provision No. 7 must be documented in this acceptance certificate. The deviations tolerated by the BAM and the changes in accordance with incidental provision No. 7 must be documented in the test log for series designs for already produced series designs.
4. It must be ensured that each user of the packaging registers with the BfE before using it for the first time and confirms that they have received and observe the test log, which in particular contains the approval certificate, the use and maintenance instructions and the regulations for in-service inspections. In particular, the following must be added to these:
   - Container instructions “Handling and maintenance of PWR fuel assembly transport casks ANF-18” ANFG-11.101 (18), Rev. 10, dated 28.04.2017
   - Container instructions “In-service inspection of PWR fuel assembly transport casks ANF-18” ANFG-11.101 (19), Rev. 6, dated 21.02.2012

   The use of documents with a higher revision index is allowed within the scope of this approval, only after release by the BAM and the consent of the BfE.
5. Each series design must be subjected to in-service inspections in good time. For series designs that are only used outside the Federal Republic of Germany, the in-service inspections can be carried out and certified by test personnel who are authorised by the competent authority of the respective country. The certificates of the in-service inspections carried out must be sent to the BAM and the BfE without request.
6. Each series sample must be permanently marked with the identification given above and the date (month, year) of the next in-service inspection.
7. Following release by the BAM, changes regarding the drawing list and the drawings listed in its, on which the approval is based require the consent of the BfE to the change certificate or extended type list (in accordance with Enclosure 2). They thus become part of this approval.
8. The package must be transported under exclusive use.
   In case of transport by ship, reference is made to the need for a special agreement if the maximum dose rate on the surface of the package exceeds 2 mSv/h; unless the package is on board the ship in or on a railway or road vehicle under exclusive use and is at no time unloaded from this vehicle.
9. This approval does not release the sender from their obligation to comply with any regulations of the government of a state into or through which the package is carried.

Costs:

1. Costs, charges and expenses for this notification shall be levied based on § 12 Para. 1 and 2 of the Law on the Carriage of Dangerous Goods (Gefahrgutbeförderungsgesetz - GGBefG) in the version published on 7 July 2009 (BGBl. 2009 I p. 1774, 3975), which was amended by Article 5 of the act dated 26 July 2016 (BGBl. 2016 I p. 1843), in conjunction with § 1 Para. 2 of the Costs Regulations for Measures for the Carriage of Dangerous Goods (Gefahrgutkostenverordnung - GGKostV) of 7 March 2013 (BGBl. 2013 I p. 466), last amended by Article 3 of the regulations of 17 March 2017 (BGBl. 2017 I p. 568). The charges result from § 2 in conjunction with Annex 2 of the GGKostV.
2. According to § 12 Para. 1 of the GGBefG in conjunction with § 13 Para. 1 No. 1 of the Administrative Costs Act (VwKostG) of 23 June 1970 (BGBl. I p. 821), in the version valid up to 14 August 2013 of 5 December 2012 (BGBl. 2012 I p. 2415), the costs shall be borne by Advanced Nuclear Fuels GmbH.
3. The costs assessment is sent by separate notification.

Legal instruction:

An objection to the notification can be lodged with the Bundesamt für kerntechnische Entsorgungssicherheit in Berlin within one month of its issue.

Salzgitter, June 06th 2017

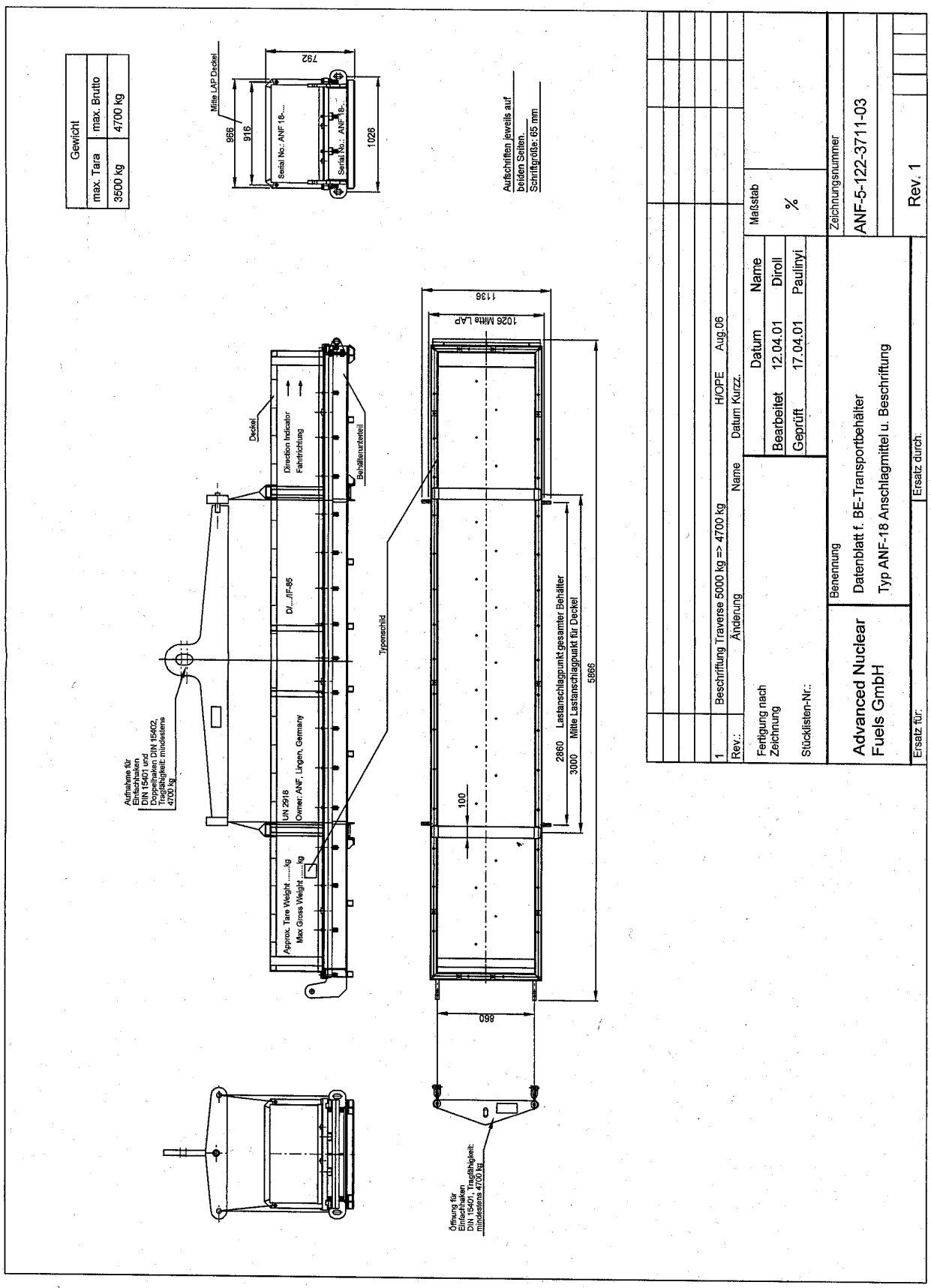
By order

Dr Ruprecht

Enclosures

Enclosure
Enclosure 1: Data sheet FA transport cask type ANF-18, Drawing number ANF-5-122-3711-03, Rev. 1
Enclosure 2: Type list

Rev. No.	Issue date	Validity period	Reason for the revision
0	11.07.2002	31.07.2005	First issue
1	05.02.2004	28.02.2007	Inclusion of new 17∗17-(24+1)-FA, Note: Revision 0 remains valid up to and including 28 February 2005.
2	12.12.2006	31.12.2009	Inclusion of new 15∗15-20, 16∗16-20 and 17∗17-24-FA, increase in max. enrichment for all 15∗15- and 17∗17-FA Note: Revision 1 remains valid up to and including 28 February 2007 (see incidental provision No. 10).
3	05.03.2009	31.03.2012	Inclusion of a shielding element type (17∗17-(24+1)), increase in the maximum active fuel rod length of all fuel assembly types by 5 mm and extension of the type list Note: Revision 2 remains valid up to and including 31 December 2009 (see incidental provision No. 10).
4	09.02.2010	31.03.2012	Inclusion of fuel assemblies (FA) with an edge length of approx. 215 mm Increase in max. enrichment to 5.35% for all 15∗15- and 17∗17-FA Introduction of general covering FA parameters for the verifications Extension of the type list Note: Revision 3 remains valid up to and including 31 July 2010 (see incidental provision No. 10).
5	27.03.2012	31.03.2017	Inclusion of fuel rod carriers for the transport of fuel rods for 16∗16-20 fuel assemblies
6	06.06.2017	30.06.2022	Definition of maximum allowable masses per fuel assembly of polyethylene or other plastic in the package, Inclusion of fissile material-free solid rods in fuel rod positions, Inclusion of modular rods in fuel rod positions


Gewicht
max. Tara
max. Brutto
3500 kg
4700 kg
Mitte LAP Deckel
966
916
792
1026
Serial No.: ANF-18-...
Aufschriften jeweils auf beiden Seiten.
Schriftgröße: 65 mm
1136
1026 Mitte LAP
Deckel
Direction Indicator Fahrtrichtung
Behälterunterteil
Typenschild
DI.../IF-85
UN 2918
Owner: ANF, Lingen, Germany
Approx. Tare Weight .....kg
Max Gross Weight .....kg
Aufnahme für Einfachhaken DIN 15401 und Doppelhaken DIN 15402, Tragfähigkeit: mindestens 4700 kg
2860 Lastanschlagpunkt gesamter Behälter
3000 Mitte Lastanschlagpunkt für Deckel
5866
100
860
Öffnung für Einfachhaken DIN 15401, Tragfähigkeit: mindestens 4700 kg
1 Beschriftung Traverse 5000 kg => 4700 kg H/OPE Aug.06
Rev.: Änderung Name Datum Kurzz.
Fertigung nach Zeichnung
Stücklisten-Nr.:
Datum Name
Bearbeitet 12.04.01 Diroll
Geprüft 17.04.01 Paulinyi
Maßstab %
Zeichnungsnummer
ANF-5-122-3711-03
Advanced Nuclear Fuels GmbH
Benennung
Datenblatt f. BE-Transportbehälter
Typ ANF-18 Anschlagmittel u. Beschriftung
Ersatz für:
Ersatz durch:
Rev. 1

Type list

for fuel assembly transport cask ANF-18

Casks of the type ANF-18, which have been or will be produced according to the following list of drawings, according to the type named in this approval certificate (see also Incidental provisions 2, 3 and 7).

Drawing list revision	**BAM release**
5-3-22-3900-04, Rev. 4	BAM test certificated dated 27.05.2002 (Ref.: III.3/20711) and BAM letter dated 26.06.2002 and 09.07.2002
5-3-22-3900-04, Rev. 5	BAM letter dated 28.10.2002
5-3-22-3900-04, Rev. 6	BAM letter dated 19.02.2003 and 24.02.2003
5-3-22-3900-04, Rev. 7	BAM letter dated 02.12.2003
5-3-22-3900-04, Rev. 8	BAM letter dated 22.11.2004
5-3-22-3900-04, Rev. 9	BAM letter dated 22.11.2006
5-3-22-3900-04, Rev. 12	BAM letter dated 04.02.2009 and 11.02.2009
5-3-22-3900-04, Rev. 14	BAM letter dated 30.07.2009, 12.10.2009, 23.11.2009 and 08.02.2010
5-3-22-3900-04, Rev. 15	BAM letter dated 21.02.2012

Salzgitter, June 06th 2017

By order

Dr Ruprecht