

Certificate of Approval

D/4343/IF-96 (Rev. 5)

for a transport package sample of Type IP-2 for fissionable radioactive materials

Based on the application of Advanced Nuclear Fuels GmbH, Lingen, of October 24, 2011 (File Ref.: 562/11/BfS/DST), last modified with the letter dated Jan. 31, 2012 (File Ref.: 579/12/BfS/DST), the container with the manufacturer's designation "Fuel assembly shipping container Type ANF-18" is approved as a Type IP2 transport package sample for fissionable radioactive materials, in accordance with the following regulations governing transportation by road, rail and sea:

Regulations for the Safe Transport of Radioactive Material, 2009 Edition, International Atomic Energy Agency (IAEA), No. TS-R-1,

European Convention of September 30, 1957 governing the international conveyance of dangerous goods by road (ADR) (BGBl. 1969, II p. 1489), Appendices A and B in the edition of the notification of November 25, 2012 (BGBl. 2010 II p. 1412), last amended by the 21st ADR Amendment Ordinance of October 7, 2010 (BGBl. 2010 II p. 1134),

Ordinance for the international conveyance of dangerous goods by rail (RID) – Appendix to Annex C of the Convention governing international rail transportation of May 9, 1980 (COTIF-Convention) (BGBl. 1985 II, p. 130), in the edition of the notification of May 16, 2008 (BGBl. 2008 II p. 475), last amended by the 16th RID Amendment Ordinance of Nov. 11, 2010 (BGBl. 2010 II p. 1273),

International Maritime Dangerous Goods Code (IMDG-Code), Amendment 35-10,

Ordinance governing the domestic and cross-border conveyance of dangerous goods by road, rail and inland waterways (Dangerous Goods Ordinance, Road, Rail and Inland Waterways – GGvSE) in the edition of the notification of Dec. 16, 2011 (BGBl. 2011 I p. 2733),

Ordinance governing the conveyance of dangerous goods with seagoing vessels (Dangerous Goods Ordinance, Maritime - GGvSee) in the edition of the notification of Dec. 16, 2011 (BGBl. 2011 I p. 2784, 2012 I p. 122),

in conjunction with the Directive of the Federal Ministry for Transport, Building and Urban Development (BMVBS) in the edition of the notification of November 17, 2004 (VkBli. 2004 p. 594) and with the notification of the BMVBS with regard to directives concerning dangerous goods regulations of July 1, 2010 (VkBli 2010, p. 282).

It is hereby confirmed that the Bundesamt für Strahlenschutz, Salzgitter, is the authority authorized by the Federal Ministry for Transport, Building and Urban Development pursuant to Section 7.9 of the IMDG Code.

Certificate holder: ADVANCED NUCLEAR FUELS (ANF) GmbH
Am Seitenkanal 1
49811 Lingen, Germany

Documents:

1. Application of Advanced Nuclear Fuels GmbH (ANF), Lingen, of Oct. 24, 2011 (File Ref.: 562/11/BfS/DST) with appendices and amendment of the application of Jan. 31, 2012 (File Ref.: 579/12/BfS/DST).
2. Safety report of ANF, No. ANFG-11.105 (03), Rev. 21, of Jan. 25, 2012
3. Test certificate by the Federal Institute for Material Research and Testing (BAM), Berlin, of May 27, 2002 (File Ref.: III.3/20711) with letters of the BAM dated June 26, 2002 (File Ref.: III.3/20711), July 04, 2002 (File Ref.: III.3/20711), July 09, 2002 (File Ref.: III.3/20711), Oct. 28, 2002 (File Ref.: III.3/20711), Jan. 07, 2003 (File Ref.: III.3/20711), Feb. 19, 2003 (File Ref.: III.3/20711), Feb. 24, 2003 (File Ref.: III.3/20711), Dec. 02, 2003 (File Ref.: III.3/20991), Nov. 22, 2004 (File Ref.: III.3/21094), Nov. 22, 2006 (File Ref.: III.3/21167), Feb. 04, 2009 (File Ref.: III.3/21305), Feb. 11, 2009 (File Ref.: III.3/21305), July 30, 2009 (File Ref.: III.3/21326), Oct. 12, 2009 (File Ref.: III.3/21326), Nov. 23, 2009 (File Ref.: III.3/21326), Feb. 08, 2010 (File Ref.: III.3/21326), and Feb. 21, 2012 (File Ref.: 3.3/21410).

With respect to the verification of criticality safety we refer to the work reports ANFG-5.060 (065) Rev.001 of Jan. 19, 2012, ANFG-5.060 (066) Rev.001 of Jan. 19, 2012, ANFG-5.060 (067) Rev.001 of Jan. 19, 2012, and ANFG-5.060 (068) Rev.001 of Jan. 19, 2012 contained in the safety analysis.

Manufacturer's designation: Fuel Assembly Shipping Container Type ANF-18
Identification mark of the package: D/4343/IF-96
Period of validity of the certificate: Up to and including March 31, 2017
Criticality Safety Index (CSI): 1

Permissible contents:

1. Maximum of two fuel assemblies (FA) for pressurized water reactors of type 14*14-(16+1), 15*15-20, 15*15-(20+1), 16*16-20, 16*16-(20+1), 17*17-24 17*17-(24+1), 18*18-24, containing uranium oxide pellets or gadolinium oxide / uranium oxide pellets, with the pellets being encased in cladding tubes of zirconium alloy. The FAs comply with the data specified in Tables 1 and 2 below. The uranium contained in a fuel assembly may be in the form of reprocessed uranium (RU) or enriched reprocessed uranium (ERU), while complying with the specifications regarding fuel composition detailed in Table 3.

The permissible FA patterns are specified in Figures 1 to 8.

Each FA can contain a control element.

2. Maximum of two fuel assemblies for pressurized water reactors of type 16*16-20 (each with 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 encased in cladding tubes of zirconium alloy. The uranium contained in the fuel assemblies may be in the form of reprocessed uranium (RU) or enriched reprocessed uranium (ERU), whereby the specifications regarding fuel composition detailed in Table 3 are to be complied with. The maximum pellet diameter is 9.2 mm, the maximum cladding tube inner diameter is 9.35 mm, and the minimum cladding tube outer diameter is 10.65 mm. The fuel rod bundles are transported in a fuel rod carrier designed either (a) as a fuel rod box (completely made of steel) or (b) as a fuel rod tubular container (made of steel, with perforated plates made of polyamide).

The average hydrogen density of the material of the perforated plates shall not be greater than that of water.

Table 1: Geometric data of the fuel assemblies

No.	FA type (grid array)	No. of fuel rods	Fuel rod pitch [mm]	Active length of UO ₂ fuel rods	Diameter of UO ₂ pellets	Cladding tube outside diameter
				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	9.4	10.65
8	16*16-20	236	14.3	3912	9.4	10.65
9	16*16-(20+1)	235	12.32	3670	8.6	9.4
10	17*17-24	265	12.6	4215	8.6	9.4
11	17*17-(24+1)	264	12.6	3670	8.6	9.4
12	18*18-24	300	12.7	3912	8.3	9.4

- Fuel rods can be replaced with austenitic solid rods or with zircaloy solid rods of the same length and the same outer diameter.
- Zircaloy guide tubes may be replaced with:
 - o austenitic guide tubes
 - o austenitic solid rods or zircaloy solid rods
- For transport (one bundle each in the fuel rod carrier), fuel rods can be replaced by rods made of austenitic material or zircaloy with the same diameter as the required fuel rod diameter and the same length as the required fuel rod length.

Table 2: Fuel data of the fuel assemblies

No.	FA type (grid array)	Total mass per FA incl. structure material ¹⁾	Total mass in uranium per FA	Enrichment (mass content) in uranium 235
		maximum [kg]	maximum [kg]	maximum [%]
1	14*14-(16+1)	415	300	5.00
2	14*14-(16+1)	510	355	5.00
3	15*15-20	540	350	5.35
4	15*15-20	600	400	5.35
5	15*15-20	700	480	5.35
6	15*15-(20+1)	700	485	5.35
7	16*16-20	780	500	5.00
8	16*16-20	890	580	5.00
9	16*16-(20+1)	615	430	5.00
10	17*17-24	810	580	5.35
11	17*17-(24+1)	715	500	5.35
12	18*18-24	880	580	5.00

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

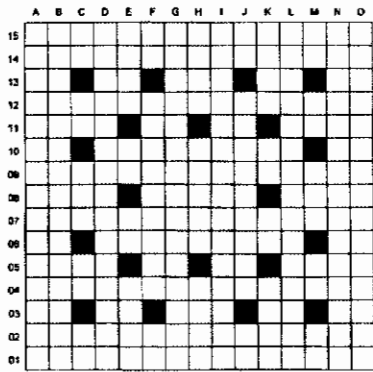
Table 3: Characteristics of fuel from ERU or uranium, maximum pellet density of 10.96 g/cm³

Nuclide	Content by mass, max. [%]	Activity per gram of uranium, max. [Bq]	Gamma output per gram of uranium, max. [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⁾ Meaning: 5.00E-06 = 5.00 · 10⁻⁶

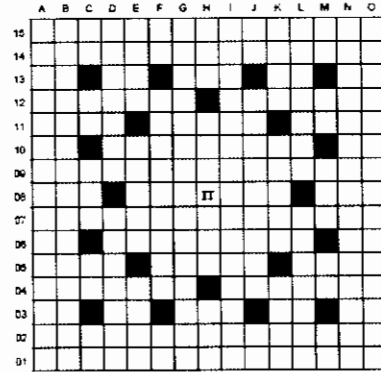
²⁾ Restriction of fission nuclide activity is nuclide-independent and is governed by the upper limit (specified above) for energy release from gamma radiation per second and gram of uranium.

Fuel assembly patterns



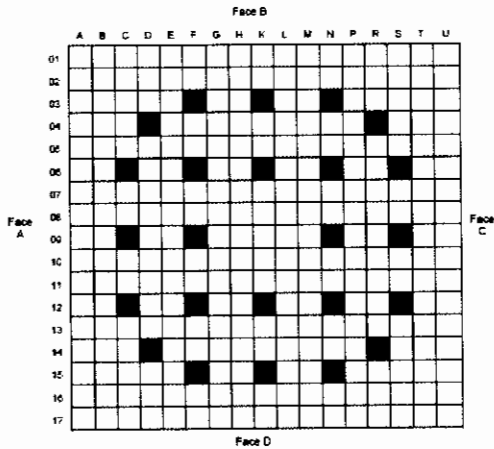
■ Guide tube
□ Fuel rod

Fig. 1: 15x15-20 fuel assembly



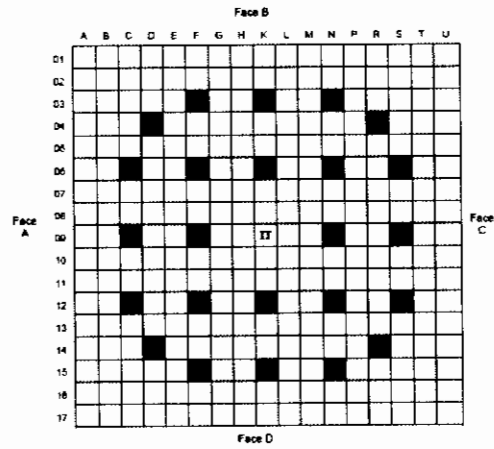
■ Guide tube
□ Fuel rod
□ IT Instrumentation tube

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



■ Guide tube
□ Fuel rod

Fig. 3: 17x17-24 fuel assembly



■ Guide tube
□ Fuel rod
□ IT Instrumentation tube

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

Fuel assembly patterns (continued)

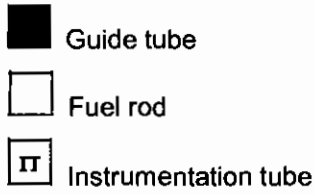
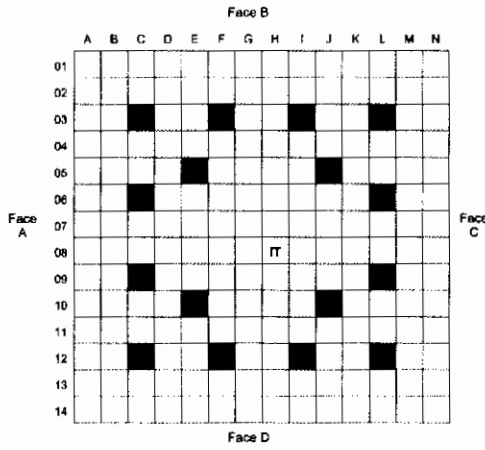


Fig. 5: 14x14-(16+1) fuel assembly

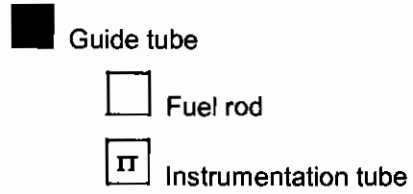
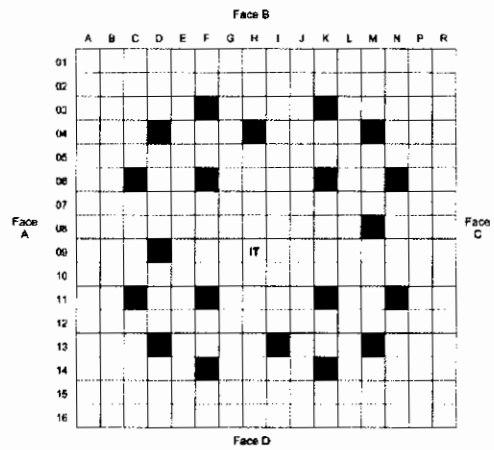


Fig. 6: 16x16-(20+1) fuel assembly

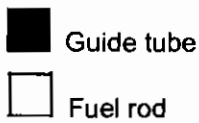
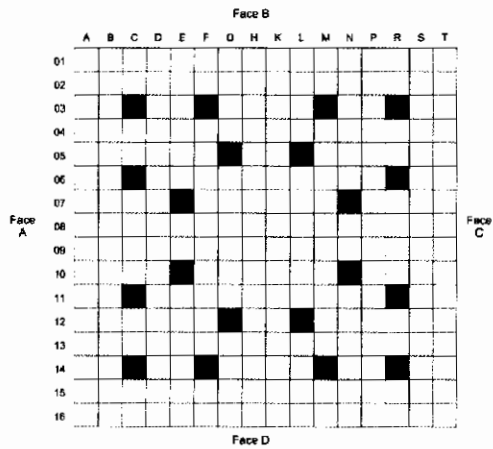


Fig. 7: 16x16-20 fuel assembly

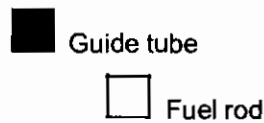
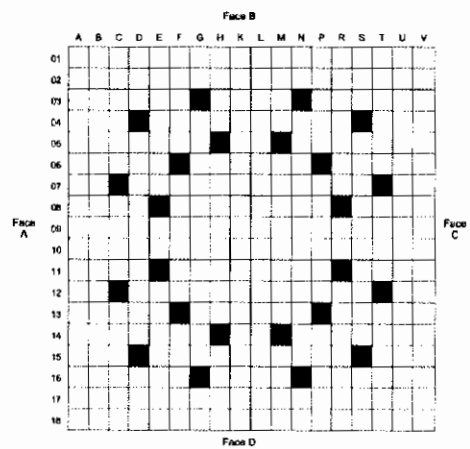


Fig. 8: 18x18-24 fuel assembly

Package design:

In terms of its mechanical and thermal properties, in accordance with the test certificate and the BAM, Berlin, expert report detailed above, and in terms of its criticality safety and radiation shielding, according to testing by the Federal Office for Radiation Protection - BfS, the design for the fuel assembly shipping container Type ANF-18 conforms to the requirements laid down for a Type IP-2 transport package for fissionable radioactive substances (IAEA Regulations §§ 622 and 671).

In the criticality safety analysis the penetration of water into all cavities/hollow spaces of the package was assumed.

Description of the package:

The transport package sample consists of an outer protection sheath, which is made up of the bottom shell and the container cover which is screwed to the bottom shell, and the fuel assembly cradle (strongback) with L-shaped doors, the foot adapter base plate and the head cover. The fuel assembly cradle is attached to the bottom shell by round rubber bearings.

The bottom shell consists of a circumferential channel section, the base plate as well as transverse channel sections below the base plate, all manufactured from austenitic steel. The dome shaped cover is made up of layered aluminum honeycomb and austenitic hollow sections running length- and crosswise, encased on both sides with austenitic steel plate. The end faces of the bottom shell and the cover are made from layered aluminum honeycombs which are encased on all sides with austenitic steel plate as a shock mount.

Together with the L-shaped doors (manufactured from hollow sections), the foot adapter base plate and the head cover, the fuel assembly cradle (an upside-down "T" with internal reinforcing structure) forms two void cavities which can each hold one PWR fuel assembly. The walls of the fuel assembly cradle on the fuel assembly side and the L-shaped doors are welded to stainless steel plates at least 3 mm thick with a mass fraction of at least 1.75 % boron in natural composition.

A schematic diagram of the package (drawing no. ANF-5-122-3711-03 Rev. 1) is attached as Appendix 1.

The external dimensions are: Length approx. 5,866 mm, width approx. 1,136 mm and height approx. 792 mm.

Mass: packaging (tare): max. 3500 kg. Package (gross) max. 4700 kg

The 'containment system' is formed by the following parts or components:

- Fuel rod cladding tubes welded gas-proof

The 'confinement system' is formed by the following parts or components:

- Base
- Container cover
- Cradle with L-shaped doors, bottom support plate and top cover
- Fuel assembly structure with fuel rods or fuel rod carriers with fuel rods
- Fuel rod cladding tubes welded gas-proof

The packages identified in Appendix 2 by the relevant revisions in the index of drawings currently comply with this approval (see also Supplementary Condition No. 7).

Supplementary conditions and notes:

1. All quality assurance measures relating to planning, monitoring inspections and operation must be performed in accordance with the BAM dangerous goods regulation "Quality Assurance Measures of Packagings for Competent Authority Approved Package Designs for the Transport of Radioactive Material" (BAM-GGR 011, Rev. 0).
2. The remanufacture of packing materials is only permissible in accordance with the register of drawings with the highest revision index in Appendix 2 including the amendments in accordance with Supplementary Condition No. 7.
3. This approval applies only in conjunction with the certificate of acceptance issued for the relevant series-production sample; this certificate shall be sent to the BAM (Federal Institute for Material Research and Testing) and BfS (Federal Office for Radiation Protection) without being asked. Any deviations tolerated by the BAM in accordance with BAM-GGR 011, Rev. 0 and any changes as per supplementary condition No. 7 shall be documented in this certificate of acceptance. In case of already manufactured series-production samples, the deviations tolerated by the BAM and the changes as per Supplementary Condition No. 7 shall be documented for the series-production sample in an inspection and test log book.
4. It must be ensured that each user of the package registers with the BfS before first-time use and confirms that he has received and complied with the inspection and test log book, which in particular contains the instructions for handling and maintenance and the instructions for recurring tests. These are in particular:
 - Container instruction "Handling and maintenance of ANF18 PWR fuel assembly shipping containers" ANFG 11.101 (18), Rev. 9, of Feb. 21, 2012
 - Container instruction "Recurring tests of ANF-18 PWR fuel assembly shipping containers" ANFG 11.101 (19), Rev. 6, of Feb. 21, 2012

Within the frame of this Approval, the use of documents with a higher revision index is only permissible after prior release by the BAM and with authorization of the BfS.

5. Each series-production sample shall be subjected to recurring tests at the appropriate times. For series-production samples that are to be used solely outside the Federal Republic of Germany, the recurring tests can be performed and certificated by testing personnel authorized by the responsible authorities in the relevant country. The certificates for the recurring tests shall be forwarded to the Federal Institute for Material Research and Testing (BAM) and to the Federal Office for Radiation Protection (BfS) without these organizations having to request them.
6. Each series-production sample must be provided permanently with the identification mark detailed above and with the date (month/year) of the next recurring inspection.
7. Changes relating to the Index of Drawings and the drawings listed therein, upon which the approval is based, require after their release by the BAM the consent of the BfS for the Revision Certificate or an extended type list (in accordance with Appendix 2). Thus they become part of the present Approval.
8. The package shall be transported under sole use.
If the maximum dose rate on the surface of the package exceeds 2 mSv/h, it is pointed out that transportation by ship will require special arrangement, unless the package on board the ship is in or on a train or road vehicle under sole use from which it is at no time unloaded.
9. This approval does not relieve the sender from the obligation to comply with all statutory regulations of any country through which or in which the transport package is conveyed.

Costs:

1. Costs, charges and expenses shall be levied for this Decision in accordance with § 12 paragraph 1 and 2 of the Act Governing the Conveyance of Dangerous Goods (GGBefG) in the version of the notification of July 7, 2009 (BGBl. I p. 1774, corrected p. 3975), in connection with Article 1 and Appendix (to Article 1), Part 1, Fee Number 007 in the Order Governing Costs for Safety Measures with Conveying Dangerous Goods (GGKostV) of November 13, 1990 (BGBl. I p. 2490), last amended by the Third Order Revising Orders Governing the Conveyance of Dangerous Goods of December 17, 2004 (BGBl. I, p. 3711).

2. The costs shall be borne by Advanced Nuclear Fuels GmbH, in accordance with Section 12 paragraph 1 of the GGBefG in conjunction with Section 13 paragraph 1 No. 1 of the Administrative Costs Act (VwKostG) of June 23, 1970 (BGBl. 1970 I p. 821), last amended by Article 3 of the Act on the Implementation of the Services Directive in the Weights and Measures Act as well as in the Equipment and Product Safety Act and on the Amendment of the Administrative Costs Act, of the Energy Industry Act and of the Energy Line Extension Act of March 7, 2011 (BGBl. 2011 I p. 338).

3. The costs shall be determined by a separate decision.

Information about available legal remedies:

Objections may be lodged within one month of notification of this decision. Objections must be lodged either in writing or be recorded at the Bundesamt für Strahlenschutz (Federal Office for Radiation Protection), Willy-Brandt-Strasse 5, 38226 Salzgitter, Germany.

Salzgitter, March 27, 2012

By order

Thiele

Appendices

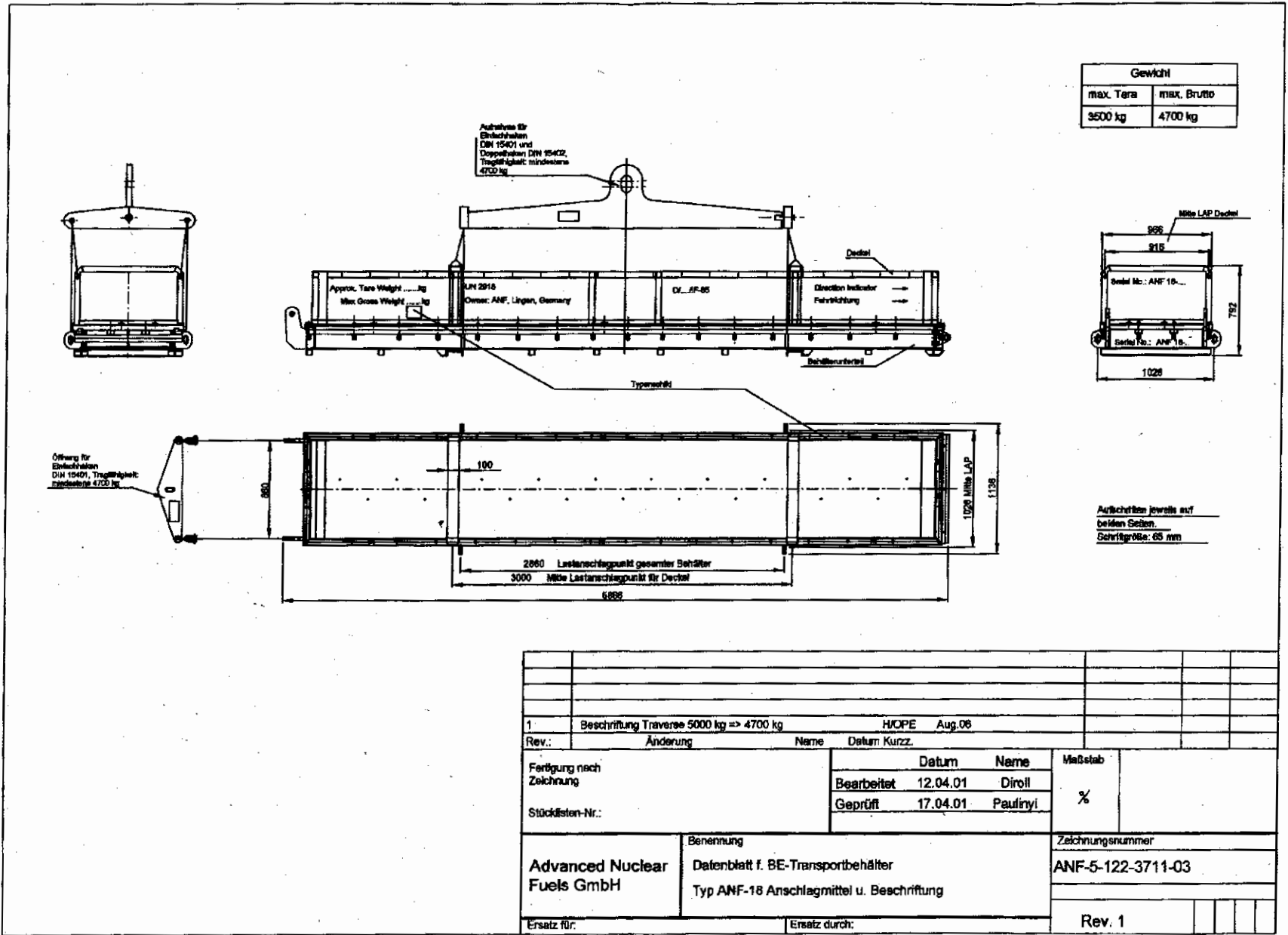
Annex

Appendix 1: Data sheet for FA shipping container Type ANF-18, Drawing number ANF-5-122-3711-03, Rev. 1

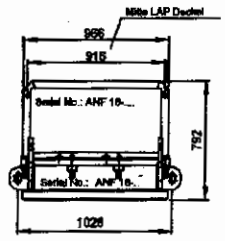
Appendix 2: Type list

- Annex to Approval Certificate D/4343/IF-96 (Rev. 5) -

Rev. no.	Date of issue	Validity	Reason for revision
0	July 11, 2002	July 31, 2005	Initial issue
1	Feb. 05, 2004	Feb. 28, 2007	Integration of new 17*17-(24+1) FA, Note: Revision 0 remains valid up to and including February 28, 2005.
2	Dec. 12, 2006	Dec. 31, 2009	Integrating new 15*15-20, 16*16-20 and 17*17-24 FA. Increasing the maximum enrichment for all 15*15 and 17*17 FA Note: Revision 1 remains valid up to and including February 28, 2007 (see supplementary condition No. 10).
3	Mar. 5, 2009	Mar. 31, 2012	Integration of shielding element type 17*17-(24+1). Increase of the maximum active fuel rod length of all FA types by 5 mm and extension of the type list Note: Revision 2 remains valid up to and including Dec. 31, 2009 (see supplementary condition No. 10).
4	Feb. 09, 2010	Mar. 31, 2012	Integration of fuel assemblies (FA) with a side length of approx. 215 mm Increasing the maximum enrichment auf 5.35% for all 15*15 and 17*17 FA Introduction of enveloping FA parameters in the verifications Extension of the type list Note: Revision 3 remains valid up to and including July 31, 2010 (see supplementary condition No. 10).
5	Mar. 27, 2012	Mar. 31, 2017	Integration of fuel rod carriers for the transport of fuel rods for 16*16-20 fuel assemblies Note: Revision 4 of the approval certificate remains valid until it expires as scheduled.



Gewicht	
max. Tara	max. Brutto
3500 kg	4700 kg



Anschriften jeweils auf beiden Seiten.
Schriftgröße: 65 mm

1		Beschriftung Traverse 5000 kg => 4700 kg		H/OPF Aug.06	
Rev.:	Änderung	Name	Datum	Kurz.	
Fertigung nach Zeichnung		Datum	Name	Maßstab	
Stücklisten-Nr.:		Bearbeitet	12.04.01	Diroil	%
		Geprüft	17.04.01	Paulinyi	
Advanced Nuclear Fuels GmbH	Benennung			Zeichnungsnummer	
	Datenblatt f. BE-Transportbehälter			ANF-5-122-3711-03	
	Typ ANF-18 Anschlagmittel u. Beschriftung				
Ersatz für:	Ersatz durch:			Rev. 1	

**Type list
for ANF-18 fuel assembly shipping container**

Type ANF-18 shipping containers, which shall be or have been manufactured in accordance with the following Index of Drawings, conform to the model type specified in this Certificate of Approval (please cf. Supplementary Conditions 2, 3 and 7).

Revision of the Index of Drawings	Release by the BAM
5-3-22-3900-04. Rev. 4	Test certificate by the BAM of May 27, 2002 (File Ref.: III.3/20711) and letters of the BAM dated June 26, 2002 and July 9, 2002
5-3-22-3900-04. Rev. 5	Letter of the BAM dated Oct. 28, 2002
5-3-22-3900-04. Rev. 6	Letters of the BAM dated Feb. 19, 2003 and Feb. 24, 2003
5-3-22-3900-04. Rev. 7	Letter of the BAM dated Dec. 02, 2003
5-3-22-3900-04. Rev. 8	Letter of the BAM dated Nov. 22, 2004
5-3-22-3900-04. Rev. 9	Letter of the BAM dated Nov. 22, 2006
5-3-22-3900-04. Rev. 12	Letters of the BAM dated Feb. 04, 2009 and Feb. 11, 2009
5-3-22-3900-04. Rev. 14	Letters of the BAM dated July 30, 2009, Oct. 12, 2009, Nov. 23, 2009 and Feb. 08, 2010
5-3-22-3900-04. Rev. 15	Letter of the BAM dated Feb. 21, 2012

Salzgitter, March 27, 2012

By order

Thiele