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

U.S. Department of Transportation

Pipeline and Hazardous Materials Safety Administration

COMPETENT AUTHORITY CERTIFICATION FOR A TYPE FISSILE RADIOACTIVE MATERIALS PACKAGE DESIGN CERTIFICATE USA/0827/AF-96, REVISION 0

REVALIDATION OF GERMAN COMPETENT AUTHORITY CERTIFICATE D/4377/AF-96

The Competent Authority of the United States certifies that the radioactive material package design described in this certificate satisfies the regulatory requirements for a Type AF package as prescribed in the regulations of the International Atomic Energy Agency[1] and the United States of America[2] The package design is approved for use within the United States for import and export shipments made in accordance with applicable international and domestic transport regulations.

1. Package Identification - ANF-10.

2. Package Description and Authorized Radioactive Contents - as described in German Certificate of Competent Authority D/4377/AF-96, Revision 0 (attached).

3. Criticality - The minimum criticality safety index is 2.8. The maximum number of packages per conveyance is determined in accordance with Table 11 of the IAEA regulations cited in this certificate.

4. General Conditions -

   a. Each user of this certificate must have in his possession a copy of this certificate and all documents necessary to properly prepare the package for transportation. The user shall prepare the package for shipment in accordance with the documentation and applicable regulations.

   b. Each user of this certificate, other than the original petitioner, shall register his identity in writing to the Office of Engineering and Research, (PHH-23), Pipeline and Hazardous

[1] "Regulations for the Safe Transport of Radioactive Material, 2012 Edition, No. SSR-6" published by the International Atomic Energy Agency (IAEA), Vienna, Austria.

[2] Title 49, Code of Federal Regulations, Parts 100-199, United States of America.

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.

d. Records of Management System activities required by Paragraph 306 of the IAEA regulations[1] shall be maintained and made available to the authorized officials for at least three years after the last shipment authorized by this certificate. Consignors in the United States exporting shipments under this certificate shall satisfy the applicable requirements of Subpart H of 10 CFR 71.

5. Marking and Labeling - The package shall bear the marking USA/0827/AF-96 in addition to other required markings and labeling.

6. Expiration Date - This certificate expires on March 21, 2024.

This certificate is issued in accordance with paragraph(s) 816 of the IAEA Regulations and Section 173.472 and 173.473 of Title 49 of the Code of Federal Regulations, in response to the May 17, 2019 petition by TN Americas LLC, Columbia, MD, and in consideration of other information on file in this Office.

Certified By:

May 22, 2020

William Schoonover (DATE)
Associate Administrator for Hazardous
Materials Safety

Revision 0 - Issued to revalidate German Certificate of Approval D/4377/AF-96, Rev. 0.

Certificate of Approval

D/4377/AF-96 (Rev. 0)

for a transport package sample of type A for fissionable radioactive materials

Based on the application of Advanced Nuclear Fuels GmbH, Lingen, dated December 22, 2015 (File Ref.: 697/15/BfS/DST), last amended on September 7, 2018 (File Ref.: 757/18/BfE/RW), the container with manufacturer's designation "**Fuel assembly shipping container type ANF-10**" is approved as a type A transport package for fissionable radioactive materials according to the following regulations for transports by road and sea:

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

European Convention of September 30, 1957 governing the International Transport of Dangerous Goods by Road (ADR) (BGBl. 1969 II p. 1489), Appendices A and B in the edition of the notification of November 29, 2017 (BGBl. 2017 II Sp. 1520), last changed by 27th ADR amendment ordinance dated October 25, 2018 (BGBl. 2018 II p. 443),

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 – GGVSEB) in the edition of the notification of March 30, 2017 (BGBl. 2017 I p. 711, 993, 3859), which was last amended by article 1 of the ordinance dated February 20, 2019 (BGBl. 2019 I p. 124),

Ordinance governing the conveyance of dangerous goods by seagoing vessels (Dangerous Goods Ordinance, Maritime – GGVSee) in the edition of the notification of December 7, 2017 (BGBl. 2017 I p. 3862; 2018 I p. 131),

International Maritime Dangerous Goods Code (IMDG-Code), Amendment 38 16, published in the official German translation on November 10, 2016 (vkBl. 2016 p. 718)

in conjunction with the Directive for the procedure for the design approval of packages for transporting fissionable materials, special form radioactive materials, easily dispensable radioactive materials and exempted fissile materials (R003) in the edition of the notification of June 9, 2016 (VkBl. 2016 p. 430) and the BAM Dangerous Goods Regulation on quality assurance measures of package designs of transport packages requiring approval for the transport of radioactive materials (BAM-GGR 011) Rev. 1 dated October 1, 2018 (official information sheet of BAM 2018 p. 109).

It is hereby confirmed that the Bundesamt für kerntechnische Entsorgungssicherheit (German Federal Office for the Safe Disposal of Nuclear Material) is the authority authorized by the Bundesministerium für Verkehr und digitale Infrastruktur (German Federal Ministry for Transport and Digital Infrastructure) pursuant to Section 7.9 of the IMDG Code.

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

Documents:

1. Letters of ANF GmbH dated December 22, 2015 (File Ref.: 697/15/BfS/DST), February 17, 2016 (File Ref.: 701/16/BfS/DST), November 6, 2017 (File Ref.: 736/17/BfE/DST), June 6, 2018 (File Ref.: 751/18/BfE/DST), June 27, 2018 (File Ref.: 755/18/BfE/DST) and September 7, 2018 (File Ref.: 757/18/BfE/RW), with respective appendices
2. Safety report of ANF GmbH, no. ANFG-11.105 (06), Rev. 5, dated August 30, 2018
3. Test certificate of the Bundesanstalt für Materialforschung und -prüfung (BAM) (German Federal Institute for Materials Research and Testing), Berlin, dated January 31, 2019 (File Ref.: 16018496)

With respect to the verification of criticality safety, we refer specifically to the reports ANFG-5.060 (086), Rev. 2 and ANFG-5.060 (087), Rev. 2, contained in the safety report.

Manufacturer's designation: **Fuel assembly shipping container type ANF - 10**

Identification mark of the package: **D/4377/AF-96**

Period of validity of the certificate: **up to and including 21. March 2024**

Criticality Safety Index (CSI): **2.8**

Permissible contents:

A) Maximum of two non-irridated fuel assemblies for boiling water reactors of type SVEA-96/L or SVEA-96 Optima2 with non-irradiated enriched uranium according to the terminology in ADR 2.2.7.1.3, consisting of four fuel rod partial bundles. The four partial bundles are mounted in a fuel assembly channel with integrated water cross and central channel. They contain uranium oxide pellets and gadolinium oxide / uranium oxide pellets with a ^{235}U enrichment (mass content) of max. 5 %. The pellets are enclosed in zirconium alloy cladding tubes with an internal pressure of max. 0.85 MPa at 25°C. Furthermore, the conditions specified in Tables 1 and 2 in Appendix 1 are to be observed. The fuel assembly channel has a square cross section at an internal width of maximum 135.8 mm. The fuel assemblies must contain 16 gadolinium oxide fuel rods with a Gd_2O_3 content of minimum 0.5 % in relation to the mass and a pellet density of 10.943 g/cm^3, which have to be arranged corresponding to the figures in Appendix 2. The Gd_2O_3-free end zones of the fuel rods must not be longer than maximum 178 mm. The arrangement of the partially long fuel rods of fuel assembly type SVEA-96 Optima2 must also correspond to the figure in Appendix 2, whereby the partially long fuels rods may be absent.

   The plastic mass inside the inner protective boxes is not subject to any weight restrictions. All plastics up to a density of 1.04 g/cm^3, whose hydrogen mass fraction is less than/equal to 11.8 % and whose carbon mass fraction is less than/equal to 73.0 %, as well as polyethylene with a maximum density of 0.95 g/cm^3 may be used. Polyethylene and other plastics must not be present in the active fuel assembly zone.

B) Non-irradiated fuel rods for boiling water reactors, packed in maximum two fuel rod shipping tubes. The fuel rods contain uranium oxide pellets or gadolinium oxide / uranium oxide pellets and they are enclosed in zirconium alloy cladding tubes (Zry-2 Liner with an internal pressure of max. 0.85 MPa at 25°C), whose outside diameter is at least 9.80 mm. The fuel rods must correspond to the data indicated in Table 3 in Appendix 1. The number of fuel rods is limited by the shipping tubes' capacity and admissible (composition-dependent) overall mass only. The composition of the fuel must correspond to that of non-irradiated enriched uranium according to the terminology in ADR 2.2.7.1.3 or satisfy the composition in Table 4 in Appendix 1.

   The plastic mass inside the inner protective boxes is not subject to any weight restrictions. All plastics up to a density of 1.26 g/cm^3, whose hydrogen mass fraction is less than/equal to 7.3 % and whose carbon mass fraction is less than/equal to 62.6 %, as well as polyethylene with a maximum density of 0.95 g/cm^3 may be used. Polyethylene and other plastics must not be present in the active area.

Package design:

In terms of its mechanical and thermal properties, in accordance with 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 - BfE, the design for the fuel assembly shipping container Type ANF-10 conforms to the requirements laid down for a Type A transport package for fissionable radioactive substances (IAEA Regulations §§ 635 and 673).

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

Description of the package:

The transport package sample consists of the following components: container bottom, container cover, head cover with two guide tubes and top-end adapters, two inner protective boxes with bottom-end adapters and the enclosure of the inner protective boxes with polyethylene and foam material. The top-end and bottom-end adapters are removed for transporting fuel rods in shipping tubes. The container walls, the central divider in the container bottom, the container cover and the head cover, all of which form part of the outer protective enclosure, consist of multiple layers of aluminium honeycombs covered with aluminium sheeting and enclosed on all sides by austenitic steel plates. The inner protective boxes are made of boronized, austenitic steel plate with a natural boron mass content of at least 0.8% and have a wall thickness of minimum 3 mm.

A schematic diagram of the package (drawing number ANF-5-121-3075-03, Rev. 1) is attached as Appendix 3.

The containment system is formed by the fuel rod cladding tubes which are welded gastight.

The confinement system is formed by the container bottom, container cover, the head cover with the guide tubes and top-end adapters, the inner protective boxes with the bottom-end adapters and the fuel assemblies with the fuel channels or fuel rod shipping tubes with the fuel rods.

The external dimensions are: Length approx. 4725 mm, width approx. 668 mm, height approx.

362 mm.

Mass: packing (tare) 1160 kg max., package (gross) 1550 kg max.

The packages identified by the relevant revisions of the Index of Drawings in Appendix 4 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 of Transport Packages for the Transport of Radioactive Material" (BAM-GGR 011, Rev. 1).
2. The remanufacture of packing materials is only permissible in accordance with Index of Drawings 5-3 21-3100-04 with the highest revision index in Appendix 4, including the changes in accordance with supplementary condition no. 7.
3. This Certificate of Approval is valid 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 BfE (Federal Office for the Safe Disposal of Nuclear Material) without a specific request being issued. Any deviations tolerated by the BAM in accordance with BAM-GGR 011 and any changes as per supplementary condition no. 7 shall be documented in this certificate of acceptance. In the case of series-production samples already manufactured, the deviations tolerated by the BAM and the changes as per supplementary condition no. 7 shall be documented for the series-production sample in the inspection log book.
4. It must be ensured that each user of the package registers with the BfE before first-time use and confirms that he has received and complies with the inspection log book, which mainly contains the Certificate of Approval, the instructions for handling and maintenance and the instructions for in-service inspections. These are in particular:
   - Container instruction "Handling and maintenance of ANF10 BWR fuel assembly shipping containers ANF-10" ANFG-11.101 (11), Rev. 8,
   - Container instruction "Recurring tests of ANF-10 fuel assembly shipping containers ANF-10" ANFG-11.101 (12), Rev. 4.

   Within the framework 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 BfE.
5. Each series-production sample shall be subjected to in-service inspections in due time. For series-production samples that are to be used solely outside the Federal Republic of Germany, the in-service inspections can be performed and certificated by testing personnel authorized by the

responsible authorities in the relevant country. The certificates for the in-service inspections conducted shall be forwarded unasked to the Federal Institute for Material Research and Testing (BAM) and to the Federal Office for Radiation Protection (BfE).

6. Each series-production sample must be provided permanently with the identification mark detailed above and with the date (month/year) of the next in-service 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 BfE for the Revision Certificate or an extended type list (in accordance with Appendix 4). Thus they become part of the present approval.
8. 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) as published on July 7, 2009 (BGBl. 2009 I p. 1774, 3975), last amended by Article 5 of the Act dated July 26, 2016 (BGBl 2016 I p. 1843) in conjunction with Section 1 Paragraph 2 of the Ordinance Governing Costs for Safety Measures When Conveying Dangerous Goods (GGKostV) dated March 7, 2013 (BGBl. 2013 I p. 466), last amended by Article 2 of the Ordinance dated December 7, 2017 (BGBl. 2017 I p. 3859). Fees arise from §2 in connection with attachment 2 of GGKostV.
2. The costs shall be borne by Advanced Nuclear Fuels GmbH, in accordance with § 12 paragraph 1 of the GGBefG in conjunction with § 13 paragraph 1 no. 1 of the Administrative Costs Act (VwKostG) of June 23, 1970 (BGBl. I p. 821), in the version valid up to August 14, 2013 of December 5, 2012 (BGBl. 2012 I p. 2415).
3. The costs shall be determined by a separate decision.

Information about available legal remedies:

Objections may be lodged to the Bundesamt für kerntechnische Entsorgungssicherheit in Berlin within one month of notification of this decision.

Salzgitter, dated 21. March 2019

pp

Dr. Ruprecht

Appendices

Appendix:	Revision list
Appendix 1	Inventory parameters
Appendix 2:	Arrangement of the partially long fuel rods and gadolinium oxide fuel rods in the SVEA-96/L-and SVEA-96 Optima2 fuel assemblies
Appendix 3:	Data sheet for FA shipping container of type ANF-10, drawing number ANF-5-121-3075-03, Rev. 1
Appendix 4:	Type list

Rev. no.	Date of issue	Validity	Reason for revision
0	21.03.2019	21.03.2024	First registration

Table 1: Geometry data of the fuel assemblies

Fuel assembly type		SVEA-96/L	SVEA-96 Optima2
No. of fuel rods	in total	96	96
No. of full-length fuel rods		96	84
No. of partial-length fuel rods		0	0 to 12
Active length	max.	3820.5 mm	3820.5 mm
Fuel rod pitch	max.	12.7 mm	13.0 mm
Diameter of uranium oxide pellets	max.	8.21 mm	8.50 mm
Cladding tube outside diameter	min.	9.58 mm	9.80 mm
Cladding tube wall thickness	min.	0.58 mm	0.56 mm

Table 2: Fuel data and overall mass of the fuel assemblies

Fuel assembly type		SVEA-96/L, SVEA-96 Optima2
Enrichment (mass content) of ^{235}uranium in the uranium	max.	5.00 %
Pellet density	max.	10.96 g/cm^3
Overall mass per fuel assembly incl. structure material	max.	320 kg
Uranium mass per fuel assembly	max.	236 kg
^{235}U mass per fuel assembly	max.	11.8 kg

Table 3: Fuel rod data

^{235}U enrichment (mass content)	max.	5.00 %
Pellet density maximum	max.	10.96 g/cm^3
Pellet diameter		8.45 to 8.50 mm
Active length	max.	3820.5 mm
Cladding tube wall thickness	min.	0.56 mm
Uranium mass per fuel rod shipping tube	max.	236 kg[1)]
^{235}U mass per fuel rod shipping tube	max.	11.8 kg[1)]

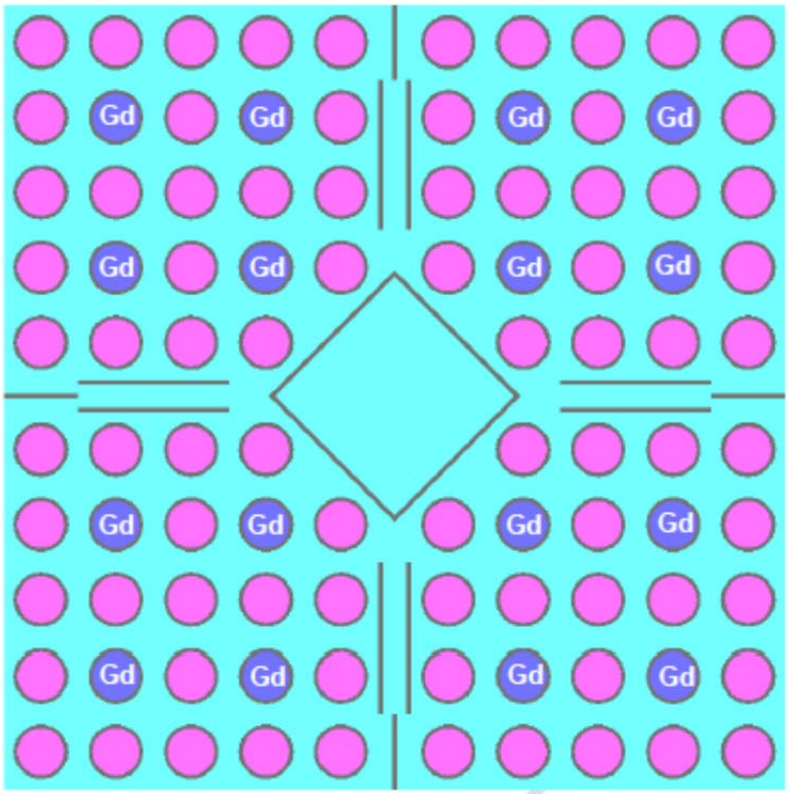
1) The mass data applies for non-irradiated enriched uranium according to the terminology in ADR 2.2.7.1.3. For uranium whose composition only corresponds to Appendix 1 of the Certificate of Approval, the following maximum permissible masses apply: Uranium mass per shipping container 45.27 kg, ^{235}U mass per shipping container 2.26 kg.

Table 4: Characterisation of the permissible fuel, which is not non-irradiated according to the terminology in ADR 2.2.7.1.3

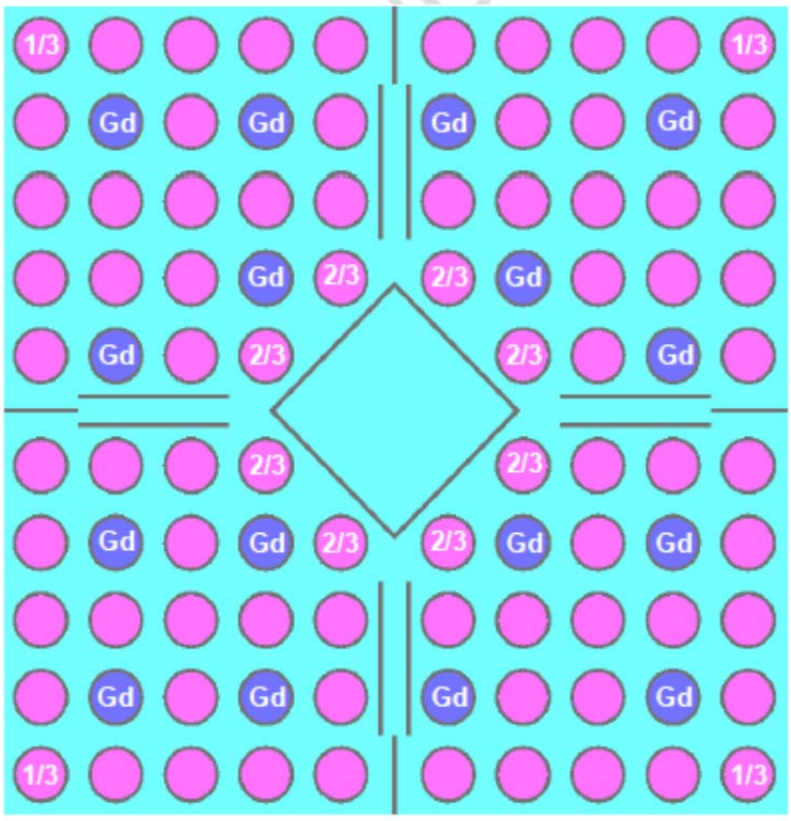
Nuclide	Mass fraction of uranium nuclides maximum in %	corresponds to activity per 45.27 kg uranium of maximum in Bq	Mass of the uranium nuclides per transport package maximum in g
U-232	2.00×10^{-8}	7.49×10^{6}	9.05×10^{-6}
U-234	5.50×10^{-2}	5.73×10^{9}	2.49×10^{1}
U-235	5.00	1.81×10^{8}	2.26×10^{3}
U-236	1.00×10^{-1}	1.08×10^{8}	4.53×10^{1}
U-238[1]	≥ 94.84	$\geq 5.34 \times 10^{8}$	$\geq 4.29 \times 10^{4}$
Fission nuclide Ce-144		2.81×10^{7}	
Fission nuclide Tc-99		2.88×10^{5}	
Transuranic elements Pu-238, Pu-239, Pu-240		9.05×10^{5}	

1 The maximum fractions depend on the actual composition of the uranium and can be up to 100 %

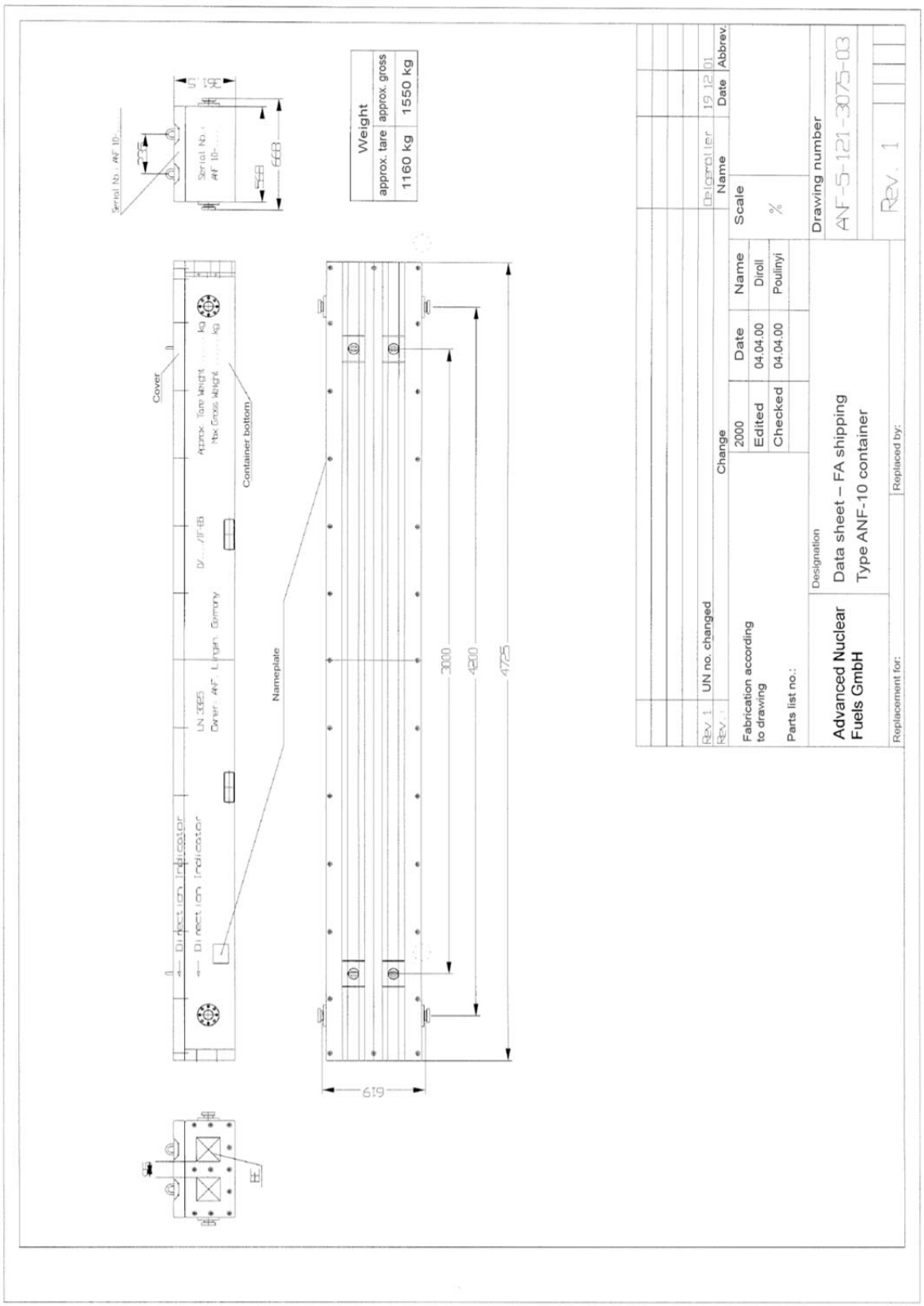
Fuel assembly type SVEA-96/L



Fuel assembly type SVEA-96 Optima2



Arrangement of the partially long fuel rods and gadolinium oxide fuel rods in the SVEA-96/L-and SVEA-96 Optima2 fuel assemblies


Weight
approx. tare approx. gross
1160 kg 1550 kg
Cover
Container bottom
Nameplate
Direction indicator
Direction indicator
UN 3325
Owner: AVF Lingen, Germany
Approx. Tare Weight ..... kg
Max. Gross Weight ..... kg
3000
4200
4725
619
668
Rev. 1 UN no. changed
Change
2000
Edited
Checked
Date
04.04.00
04.04.00
Name
Diroll
Poulinyi
Scale
%
Fabrication according to drawing
Parts list no.:
Designation
Data sheet – FA shipping
Type ANF-10 container
Advanced Nuclear Fuels GmbH
Drawing number
ANF-5-121-3075-03
Rev. 1
Replacement for:
Replaced by:

Type list

for ANF-10 fuel assembly shipping container

Type ANF-10 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 (see also supplementary conditions 2, 3 and 7).

Revision of the Index of Drawings	**Release by the BAM**
5-3 21-3100-04, Rev. 29	Test certificate of BAM (File Ref.: 16018496) dated 2019-01-31.

Salzgitter, dated 21. March 2019

pp

Dr. Ruprecht

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U.S. Department of Transportation

Pipeline and Hazardous Materials Safety Administration

CERTIFICATE NUMBER: USA/0827/AF-96

ORIGINAL REGISTRANT(S):

TN Americas LLC
7135 Minstrel Way, Suite 300
Columbia, MD, 21045
USA