1RC FORM 618
(8-2000)
10 CFR 71

U.S. NUCLEAR REGULATORY COMMISSION

CERTIFICATE OF COMPLIANCE
FOR RADIOACTIVE MATERIAL PACKAGES

1 a. CERTIFICATE NUMBER	b. REVISION NUMBER	c. DOCKET NUMBER	d. PACKAGE IDENTIFICATION NUMBER	PAGE		PAGES
9341	12	71-9341	USA/9341/B(U)F–96	1	OF	17

2. PREAMBLE

a. This certificate is issued to certify that the package (packaging and contents) described in Item 5 below meets the applicable safety standards set forth in Title 10, Code of Federal Regulations, Part 71, “Packaging and Transportation of Radioactive Material.”

b. This certificate does not relieve the consignor from compliance with any requirement of the regulations of the U.S. Department of Transportation or other applicable regulatory agencies, including the government of any country through or into which the package will be transported.

3. THIS CERTIFICATE IS ISSUED ON THE BASIS OF A SAFETY ANALYSIS REPORT OF THE PACKAGE DESIGN OR APPLICATION

a. ISSUED TO *(Name and Address)*

Orano Federal Services LLC
32125 32nd Ave S., Suite 220
Federal Way, WA 98001

b. TITLE AND IDENTIFICATION OF REPORT OR APPLICATION

Orano Federal Services LLC application dated January 30, 2026

4. CONDITIONS

This certificate is conditional upon fulfilling the requirements of 10 CFR Part 71, as applicable, and the conditions specified below.

5.

(a) Packaging

(1) Model No.: BEA Research Reactor (BRR) Package

(2) Description

The Model No. BRR package transports irradiated fuel elements or loose plates of a square fuel element from various test and research reactors. The fuel consists of the following types: Highly Enriched Uranium (HEU) and Low Enriched Uranium (LEU), aluminum clad plate fuel, loose fuel plates, PULSTAR reactor fuel, and TRIGA fuel of varying enrichments. Other payload contents include isotope production targets, commercial irradiated fuel rod segments and irradiated metal. The fuel is loaded into a payload basket while irradiated metal is placed within a canister. Also, if required, loose fuel plates are contained within a loose plate box and irradiated fuel rod segments within encapsulated tubes.

The package is comprised of a lead–shielded package body, an upper shield plug, a closure lid, upper and lower impact limiters, and utilizes American Society for Testing and Materials (ASTM) Type 304 stainless steel as its primary structural material. The package is a right circular cylinder with a dimension of 77.1 inches in length and 38 inches in diameter, not including the impact limiter attachments and the thermal shield. Lead shielding is located between two circular shells, in the lower end structure, and in the shield plug. The payload cavity has a diameter of 16 inches and a length of 54 inches.

Impact Limiters. Impact limiters are attached to each end of the package body. Each impact limiter is 78 inches in diameter and 34.6 inches in length, with a 15-inches long conical section towards the outer end. The impact limiter design consists of ASTM Type 304 stainless steel shells and polyurethane foam with an approximate density of 9 pounds per cubic foot (lb/ft^3).

5.(a) Packaging – Description (continued)

Fuel Baskets. There are seven baskets and one canister for irradiated metal used with the BRR package. Except for the RITC basket, which is made of 6061-T6/T651 aluminum, the baskets are made from welded construction using ASTM Type 304 stainless steel in plate, bar, pipe, and tubular forms. Each basket has a diameter of 15.63 inches and a bounding height of 53.6 inches and features various cavities that fit the size and shape of the fuel. The basket for square fuel accommodates two types of fuel assembly: (1) flat type fuels and (2) a 5x5 array of fuel rods enclosed within a rectangular can.

Personnel Barrier. When transporting isotope production targets, a personnel barrier is used to limit access to the package body such that personnel are prevented from touching the cask surface where the surface temperature may exceed the allowable limit for exclusive use shipments. The barrier does not have a radiological purpose.

Spacer Pedestals. For fuel elements or assemblies shorter than the length of a basket cavity, spacer pedestals are used in each cavity, as required, to support the fuel elements at the top of the basket. All spacer pedestals are made of stainless steel

Square Box or Loose Plate Box. A square box accommodates square fuel loose plates. A loose plate box is used to transport up to 31 loose plates per box. The square fuel basket and loose plate box are made of stainless steel.

Canister Assembly. A canister accommodates the irradiated metal pieces, which consists of a circular shell with a base and a bolted lid. The lid is attached with four remotely operated bolts. A circular shell forms the lower skirt of the canister. A lifting bail is welded to the lid. The lid has a vent hole, and the baseplate includes a drain hole.

RIT. Rods-in-Tubes are PWR or BWR commercial fuel rods segmented and placed within encapsulated tubes.

RITC. Rods-in-Tubes Canister which is placed in the smaller 3.5-in. OD tubes of the RITC basket and which is used as holders for the RITs.

The package is designed to be transported as one package per conveyance, with its longitudinal axis vertical, by highway truck or by rail in exclusive use. When loaded and prepared for transport, the package is 119.5 inches in length, 78 inches in diameter (over the impact limiters) and weighs 32,000 pounds (lbs).

(3) Drawings

The packaging is constructed in accordance with Orano Federal Services LLC drawings:

- 1910–01–01–SAR, "BRR Package Assembly SAR Drawing," Sheets 1-5, Rev. 8
- 1910–01–02–SAR, "BRR Package Impact Limiter SAR Drawing," Sheets 1-2, Rev. 1

5.(a)(3) Drawings (continued)

- 1910–01–03–SAR, “BRR Package Fuel Baskets SAR Drawing,” Sheets 1-5, Rev. 8
- 1910–01–04–SAR, “BRR Package Isotope Target Basket SAR Drawing,” Sheets 1-2, Rev. 1
- 1910–01–05–SAR, “BRR Package RIT, RITC and RITC Basket SAR Drawing,” Sheets 1-3, Rev. 2

5.(b) Contents

(1) Type and form of material

(i) *Irradiated MURR HEU Fuel Element*. Irradiated University of Missouri Research Reactor (MURR) HEU fuel element to a maximum burnup of 180 megawatt-day (MWD) or a depletion of 30.9% of Uranium-235 (^{235}U). The minimum cooling time is 180 days after reactor shutdown. Each MURR HEU element contains 24 fuel plates. Each fresh MURR fuel element contains 775.0 ± 7.8 g ^{235}U. The enrichment range is 93 ±1 wt.% ^{235}U. The MURR HEU element overall length, including irradiation growth, is 32.75 inches. The maximum decay heat per fuel element is 158 watts (W). The maximum number of fuel elements per basket is 8. The bounding weight of one element is 15 lb. Table 1.1 includes characteristics of a pre-irradiated MURR HEU fuel element.

Table 1.1. MURR - Key HEU Fuel Element Parameters

Maximum active fuel length (inches)	24.8
Overall length (inches)	32.75
Minimum cladding thickness (inch)	0.008
Nominal fuel matrix thickness (inch)	0.02
Fuel matrix	UAl_x
Cladding material	Aluminum
Maximum ^{235}U per element (g)	782.8
Maximum enrichment (wt.%)	94.0
Maximum ^{235}U per fuel plate (g)	46.0

(ii) *Irradiated MURR LEU Fuel Element*. The MURR LEU fuel element contains 23 curved fuel plates and, except for the quantity of plates and their separation distance, is constructed the same way as the MURR HEU fuel element contents described in 5(b)(1)(i). The fuel active length is U-10Mo alloy and is nominally 24-in., while the fuel plate length is nominally 25.5-in. The cladding and structural materials are constructed of aluminum alloy. Like the MURR HEU element, the MURR LEU element overall length between the end fittings, including irradiation growth, is 32.75 inches. The nominal fissile material thickness varies between 0.009 and 0.020 inches. The plates are nominally 0.044-in. thick except for the outermost plate which is 0.049-in. thick. There are nominally 0.001-in. thick layers of zirconium between the active fuel and cladding. The fresh MURR LEU fuel element contains up to 1,660 g U-235, enriched up to 20 wt.% U-235.

5.(b)(1) Type and form of material (continued)

The fuel element weighs no more than 29 lb. Irradiated MURR LEU elements may be irradiated to a maximum burnup of 229 MWD. The minimum cooling time for shipment is 191 days, corresponding to a decay heat of 158 W.

(iii) *Irradiated MITR–II HEU Fuel Element*. Irradiated Massachusetts Institute of Technology Research Reactor (MITR–II) HEU fuel element to a maximum burnup of 165 MWD or a ^{235}U depletion of 43.9%. The minimum cooling time is 120 days after reactor shutdown. Each MITR-II HEU fuel element contains 15 fuel plates. Each fresh MITR–II HEU fuel element contains 510.0 +3.0/-10.0 g ^{235}U, which is 500 - 513 g ^{235}U. The enrichment range is 93 ±1 wt.% ^{235}U. The MITR–II HEU fuel element overall length, including irradiation growth, is 26.52 inches. The maximum decay heat per HEU fuel element is 150 W. The maximum number of HEU fuel elements per basket is 8. The bounding weight of one element is 10 lb. Table 1.2 includes the key parameters for a pre-irradiated MITR–II HEU fuel element.

Table 1.2. MITR-II - Key HEU Fuel Element Parameters

Maximum active fuel length (inches)	22.76
Overall length (inches)	26.52
Minimum cladding thickness (inch)	0.008
Nominal fuel matrix thickness (inch)	0.03
Maximum fuel matrix width (inches)	2.171
Fuel matrix	UAl_x
Cladding material	Aluminum
Maximum ^{235}U per element (g)	513
Maximum enrichment (wt.%)	94.0
Maximum ^{235}U per fuel plate (g)	34.3

(iv) *Irradiated MITR-II LEU Fuel Element.* The MITR-II LEU fuel element contains 19 flat fuel plates and, except for the quantity of plates and their separation distance, is constructed in the same way as the MITR-II HEU fuel element contents described in 5(b)(1)(iii). The active fuel is U-10Mo alloy while the cladding and structural materials are aluminum alloy. The nominal fissile material thickness varies between 0.013 and 0.025 inches. The plates are nominally 0.049-in. thick. There are nominally 0.001-in. thick layers of zirconium between the active fuel and cladding. The MITR-II LEU active fuel length is nominally 22.375-in., while the fuel plate length is nominally 23-in. Like the MITR–II HEU element, the MITR-II LEU fuel overall maximum length between the end fittings and including 0.25 inches of irradiation growth is 26.52 inches. The fresh MITR-II LEU fuel element contains up to 1,070 g U-235, enriched up to 20 wt.% U-235. The MITR-II LEU fuel element weighs no more than 19 lb. Irradiated MITR-II LEU fuel elements may be irradiated to a maximum burnup of 211 MWD. The minimum cooling time for shipment is 147 days, corresponding to a decay heat of 150 W.

5.(b)(1) Type and form of material (continued)

(v) *Irradiated ATR HEU Fuel Element.* Irradiated Advanced Test Reactor (ATR) fuel element to a maximum burnup of 480 MWD or a ^{235}U depletion of 58.6%. The minimum cooling time is 1,670 days (4.6 years) after reactor shutdown. Each ATR fuel element contains 19 plates. The YA fuel element has 19 plates, but only 18 contain fuel. There are two general classes of ATR fuel element, XA and YA. The enrichment range is 93 ± 1 wt.% ^{235}U. The XA fuel element has a fresh fuel loading of 1,075 ± 10 g ^{235}U. The YA fuel element has a fresh fuel loading of 1,022.4 ± 10 g ^{235}U. A second YA fuel element design (YA–M) has the side plate width reduced by 15 mils. The ATR HEU element overall maximum length, after removal of the end box structures is 51.0 inches. The maximum number of fuel elements per basket is 8. The bounding weight of one element is 25 lb. The maximum decay heat per element is 30 W. Table 1.3 includes characteristics of a pre-irradiated ATR HEU fuel element.

Table 1.3. ATR - Key HEU Fuel Element Parameters

Maximum active fuel length (inches)	48.77
Overall length (inches)	51
Minimum cladding thickness for Plate 1 (inch)	0.018
Minimum cladding thickness for Plates 2-18 (inch)	0.008
Minimum cladding thickness for Plate 19 (inch)	0.018
Nominal fuel matrix thickness (inch)	0.02
Fuel matrix	UAl_x
Cladding material	Aluminum
Maximum ^{235}U per element (g)	1,085
Maximum enrichment (wt.%)	94.0
Maximum ^{235}U per fuel plate (g)	85.2

(vi) *Irradiated ATR LEU Fuel Element.* The ATR LEU fuel element contains 19 curved fuel plates and has the same structural design as the ATR HEU fuel element contents described in 5(b)(1)(v). The active fuel is U-10Mo alloy while the cladding and structural materials are aluminum alloy. The nominal fissile material thickness varies between 0.008 and 0.016 inches. The ATR LEU fuel element plates are nominally 0.050-in. thick except the innermost plate is 0.080-inches. thick and the outermost plate is 0.100-in. thick. There are nominally 0.001-in. thick layers of zirconium between the active fuel and the cladding. The active fuel length is nominally 48 inches, while the overall fuel plate length is nominally 49.5 inches. Like the ATR HEU fuel, the ATR LEU element overall length, after removal of the end box structures is 51.0 inches maximum and 50.25 inches minimum. The fresh ATR LEU fuel element contains up to 1,681 g U-235, enriched up to 20 wt.% U-235. The ATR LEU fuel element weighs no more than 44 lb. Irradiated ATR LEU fuel elements may be irradiated to a maximum burnup of 540 MWD. The minimum cooling time for shipment is 729 days (i.e., 2 years), corresponding to a decay heat of 120 W.

5.(b)(1) Type and form of material (continued)

(vii) *Irradiated TRIGA fuel elements*. Table 1.4 includes the dimensions of pre-irradiated Training, Research, Isotopes, General Atomics (TRIGA) fuel elements. The TRIGA fuel matrix is uranium mixed with zirconium hydride. The BRR package is limited to the transportation of the following types of TRIGA fuel:

1. <u>Standard 100 series</u>.
2. <u>Instrumented 200 series</u>. The fuel region is the same as 100 series but contain thermocouples used to measure temperature during reactor operation. Instrumented rods may be longer than 100 series.
3. <u>Fueled Follower Control Rods (FFCR) (300 series)</u>. The rods contain boron carbide neutron absorber outside the active fuel region.
4. <u>Cluster Rods (400 series)</u>. It is typically built with three or four cluster rods to make a cluster assembly.
5. <u>Instrumented Cluster Rods (500 series)</u>. Fuel is the same as cluster rod but thermocouples are used to measure temperature during reactor operation. Instrumented cluster rods may be longer.

Cluster rods (i.e., TRIGA fuel series 400 and 500) must be disassembled from the cluster assembly for transport in the BRR package. The maximum length of a TRIGA fuel element, including irradiation growth, is 45.50 inches.

For all fuel elements, stainless steel spacers are utilized within the TRIGA baskets. The bounding weight of any TRIGA fuel element is 10 lb.

The maximum decay heat per element is 20 W. The number of TRIGA rods per element is 1. Table 1.5 includes parameters for irradiated TRIGA fuel.

5.(b)(1) Type and form of material (continued)

Table 1.4. Characteristics of Pre-Irradiated TRIGA Fuel

Type	ID[1]	Cladding	Fuel Length (in.)	U (wt. % Fuel)	^{235}U (wt. %)	U (g)	^{235}U (g)	Fuel OD[2] (in.)	Rod OD (in.)	Cladding Thickness (in.)	H/Zr	Overall Length[3] (in.)	Erbium (wt. %)
Standard 100 series	101	Aluminum	14	8.0	20	166	32	1.41	1.48	0.03	1.0	28.62	0
	101		15	8.5	20	189	37	1.41	1.48	0.03	1.6	28.62	0
	103	Stainless Steel	15	8.5	20	197	39	1.44	1.48	0.02	1.6	29.15	0
	105		15	12	20	285	56	1.44	1.48	0.02	1.6	29.15	0
	107		15	12	20	271	53	1.4	1.48	0.02	1.6	30.14	0
	109		15	8.5	70	194	136	1.44	1.48	0.02	1.6	29.15	1.2
	117		15	20	20	503	99	1.44	1.48	0.02	1.6	29.93	0.5
	119		15	30	20	825	163	1.44	1.48	0.02	1.6	29.93	0.9
Instrumented 200 series	201	Aluminum	15	8.5	20	189	37	1.41	1.48	0.03	1.6	28.78	0
	203	Stainless Steel	15	8.5	20	197	39	1.44	1.48	0.02	1.6	45.5	0
	205		15	12	20	285	56	1.44	1.48	0.02	1.6	45.5	0
	207		15	12	20	271	53	1.4	1.48	0.02	1.6	45.5	0
	217		15	20	20	503	99	1.44	1.48	0.02	1.6	40.35	0.5
	219		15	30	20	825	163	1.44	1.48	0.02	1.6	40.35	0.9
Fueled Follower Control Rods (FFCR) (300 series)	303	Stainless Steel	15	8.5	20	163	32	1.31	1.35	0.02	1.6	44	0
	305		15	12	20	237	47	1.31	1.35	0.02	1.6	44	0
	317		15	20	20	418	82	1.31	1.35	0.02	1.6	44	0.5
	319		15	30	20	685	135	1.31	1.35	0.02	1.6	44	0.9
Cluster rods (400 series)	403	Stainless Steel	15	8.5	20	166	33	1.37	1.41	0.02	1.6	30.38	0
	405		15	12	20	243	48	1.37	1.41	0.02	1.6	30.38	0
	417		15	20	20	427	85	1.37	1.41	0.02	1.6	30.38	0.5
	419		15	30	20	710	141	1.37	1.41	0.02	1.6	30.38	0.9
Instrumented cluster rods (500 series)	503	Stainless Steel	15	8.5	20	166	33	1.34	1.41	0.02	1.6	45.5	0
	505		15	12	20	243	48	1.34	1.41	0.02	1.6	45.5	0
	517		15	20	20	427	85	1.34	1.41	0.02	1.6	45.5	0.5
	519		15	30	20	710	141	1.34	1.41	0.02	1.6	45.5	0.9

1 General Atomics catalog numbers are not necessarily unique. TRIGA elements with the same ID could have different fuel parameters. Table 1.4 includes two variants of the Type 101 element.

2 Outer Diameter.

3 Overall length includes 0.25 inches for irradiation growth.

5.(b)(1) Type and form of material (continued)

Table 1.5. Maximum Burnup and Minimum Cooling Time for TRIGA Fuel Elements[4]

TRIGA Fuel Type (Enrichment)	Maximum Burnup (MWD)	Minimum Cooling Time (days)
101 (8.0%)	23	90
201/101 (8.5%)	26	90
109	88	350
	70	250
	52	170
	34	90
203/103	27	90
205/105	39	120
	33	90
207/107	38	120
	33	90
217/117	71	280
	52	180
	34	90
219/119	122	600
	91	370
	63	220
	34	90
303	22	90
305	32	90
317	58	210
	46	150
	34	90
319	97	420
	76	290
	55	180
	34	90
503/403	23	90
505/405	33	90
517/417	60	220
	47	150
	34	90
519/419	101	430
	79	290
	56	180
	34	90

[4] Based on an in-core residence time of 4 years resulting on a decay heat less than or equal to 20 W. Not applicable to fuel with an in-core residence time less than 4 years with a decay heat greater than 20 W.

5.(b)(1) Type and form of material (continued)

(viii) *PULSTAR Fuel*. Table 1.6 includes the characteristics of the PULSTAR fuel. A 5×5 array of fuel rods enclosed within a rectangular can. Each fuel rod contains cylindrical uranium oxide fuel pellets. The weight of a PULSTAR element is 48 lbs, including a spacer pedestal. The maximum heat load of the square fuel basket per compartment is 30 W.

Table 1.6. Characteristics of PULSTAR Fuel

Parameter	Value
Nominal ^{235}U Enrichment (%)	4.0/6.0
Fuel matrix	UO_2
Maximum burnup (MWD/MTU)	20,000
Decay time (years)	1.5
Maximum fuel pellet diameter (in.)	0.423
Minimum cladding thickness (in.)	0.0185
Cladding material	Zirconium alloy
Maximum cladding OD (in.)	0.474
Maximum active fuel length (in.)	24.1
Fuel rod pitch X (in.)	0.607
Fuel rod pitch Y (in.)	0.525
Box outer dimensions (in.)	3.15 x 2.74
Box thickness (in.)	0.06
Box material	Zirconium alloy
*Maximum overall length (in.)*①	38.23

Note: Maximum length includes 0.25 in. for irradiation growth.

(ix) *Square Fuel and Loose Plates (excluding PULSTAR)*. Table 1.7 includes the main characteristics of square fuel and square-loose-plate fuel. These types of fuel have a square, or nearly square-rectangular cross section. The flat-type fuels consist of either a uranium-oxide dispersion or uranium-silicide dispersion meat in an aluminum matrix, bonded with an aluminum alloy cladding. The maximum heat load of the square fuel basket per compartment is 30 W.

5.(b)(1) Type and form of material (continued)

Table 1.7. Square Plate Fuel Characteristics

Parameter	RINSC	Ohio State	Miss. S&T	U-Florida	Purdue	U-Mass (Al)	U-Mass (Si)
^{235}U loading (g)	275±7.7	200±5.6	225±6.3	175±4.9	129.92±2.52	167±3.3	200±5.6
Nominal ^{235}U enrichment (%)	19.75	19.75	19.75	19.75	19.75	19.75	19.75
Fuel matrix	U_3Si_2+Al	U_3Si_2+Al	U_3Si_2+Al	U_3Si_2+Al	U_3Si_2+Al	UAl_x	U_3Si_2+Al
Maximum burnup per fuel element (MWD)	52.5	64.0	74.0	87.0	0.57	9.7	9.7
Minimum decay time (D)	120	120	365	120	120	1,000	1,000
Nominal fuel meat width (in.)	2.395	2.395	2.395	2.395	2.395	2.320	2.395
Nominal fuel meat thickness (in.)	0.02	0.02	0.02	0.02	0.02	0.03	0.02
Nominal fuel plate thickness (in.)	0.05	0.05	0.05	0.05	0.05	0.06	0.05
Nominal active fuel length (in.)	23.25	23.25	23.25	23.25	23.25	23.25	23.25
Number of fuel plates	22	16	18	14	14	18	16
Maximum channel spacing (in.)	0.099	0.127	0.139	0.117	0.175	0.119	0.122
Weight (lb.)	14	12	14	10	10	12	12
Maximum overall length (in.) ④	39.75	35.25	34.50	27.38	32.49	39.75	39.75
Maximum cross section (in.)	3.097×3.097	3.05×3.05	3.036×3.212	2.9×2.424	3.011×3.011	3.097×3.097	3.097×3.097
Loose plate ④⑤	no	no	no	yes②	yes③	yes①	no

Notes:
1. U-Mass (Al) loose plates have a ^{235}U loading of 9.28 ± 0.18g and dimensions of 2.78 inches wide by 24.88 inches long.
2. U-Florida loose plates have a ^{235}U loading of 12.5 ± 0.35g and dimensions of 2.85 inches wide by 25.88 inches long.
3. Purdue loose plates have a ^{235}U loading of 9.28 ± 0.18g and dimensions of 2.85 inches wide by 25.88 inches long.
4. Maximum length includes 0.25 inches for irradiation growth.
5. Loose plates shall be extracted from fuel elements that meet the per-element burnup limits provided in this table.

5.(b)(1) Type and form of material (continued)

(x) *Isotope Production Targets*. Targets are irradiated in nuclear reactors to produce Co-60 and may be made of aluminum and contain a large quantity of small pellets, or they may consist of a cylindrical rod of cobalt material inside a stainless-steel tube. All targets must be placed into target holders prior to loading into the basket. There are two different payload types:

1. *Payload Type 1*. Type 1 consists primarily of higher-activity targets of a newer design, which may also include lower-activity targets as described under Payload Type 2. The pellets are arranged in several stacks in an annular configuration within the target body. Payload Type 1 consists of up to 10 targets, which must be loaded in the inner row of basket holes and be arranged using a loading plan into five zones of two holes each. The maximum activity in any zone is 22,000 Ci. A loading collar must be installed to block access to the outer row of holes before loading payload Type 1 targets. Table 1.8 includes the characteristics of payload type 1 of the isotope production targets.

Table 1.8. Characteristics of Isotope Production Targets, Payload Type 1

Parameter	Value
Target Diameter	1/2 inches
Target Length	16 inches
Cladding Material	6061-T6 aluminum alloy
Target Contents	6,000 pellets (approximately)
Pellet Size	1mm diameter × 1mm thick
Maximum Activity	up to 14,100 Ci, Co-60
Payload Quantity	10 targets
Total Activity	up to 82,000 Ci

2. *Payload Type 2*: Type 2 consists of lower-activity targets of an older design, which include:

   A. Design in which an aluminum core rod holds pellets placed in dimples on the outer surface and which are retained by a close-fitting outer sleeve, welded to the core rod on each end and

   B. Design using a solid rod of cobalt inside a stainless-steel tube with welded ends.

   Table 1.9 includes the characteristics of payload type 2 of the isotope production targets.

5.(b)(1) Type and form of material (continued)

Table 1.9. Characteristics of Isotope Production Targets, Payload Type 2

Parameter	Value
Target Diameter	5/8 inches (pellet design) 5/16 inches (solid rod design)
Target Length	Up to 16.5 inches
Cladding Material	Aluminum alloy 6061-T6 (pellet design) Stainless steel (solid rod design)
Target Contents	Approximately 5,500 pellets or one solid or segmented rod of cobalt metal
Pellet Size	1 mm diameter x 1 mm thick
Maximum Activity	Up to 4,000 Ci, Co-60
Payload Quantity	20 targets
Total Activity	Up to 80,000 Ci

(xi) *Irradiated fuel rods*. The irradiated fuel rod payload consists of up to the equivalent of four commercial irradiated fuel rods with a minimum enrichment of 4.7385% and a maximum burnup of 73,225 MWD/MTU. Each full-length rod may contain up to 1,573.5 grams of uranium and has an active fuel length of 152.9 inches. The fuel pellet diameter is 0.315 inches, and the cladding material is Zircaloy-4.

Table 1.10 provides gamma source strength limits at given gamma energies likely in the payload. Table 1.10 provides neutron source strength limits at given neutron energies likely in the payload. Up to 4 rods are trisected and sealed in an encapsulation tube to prevent material loss, for a total of up to 12 segments.

Each of the 12 rod segments is up to 51 inches long. The ATR basket is used to support the 12 segments, with up to six segments placed in each of a maximum two ATR basket openings.

5.(b)(1) Type and form of material (continued)

Table 1.10. Irradiated Fuel Rod Gamma and Neutron Spectrum Per Full Length Rod in the ATR basket[1]

Gamma Energy (MeV)	Payload Gamma Source Per Rod (γ/s)	Neutron Energy (MeV)	Payload Neutron Source Per Rod (n/s)
2.00E+01 - 1.00E+01	2.1240E+02	2.00E+01 - 6.38E+00	7.5422E+04
1.00E+01 - 8.00E+00	2.9017E+03	6.38E+00 - 3.01E+00	7.3547E+05
8.00E+00 - 6.50E+00	1.3511E+04	3.01E+00 - 1.83E+00	8.3901E+05
6.50E+00 - 5.00E+00	6.9315E+04	1.83E+00 - 1.42E+00	3.9698E+05
5.00E+00 - 4.00E+00	1.7002E+05	1.42E+00 - 9.07E-01	5.7144E+05
4.00E+00 - 3.00E+00	2.0949E+08	9.07E-01 - 4.08E-01	5.5759E+05
3.00E+00 - 2.50E+00	1.6762E+09	4.08E-01 - 1.11E-01	2.5632E+05
2.50E+00 - 2.00E+00	2.0426E+10	1.11E-01 - 1.50E-02	4.4843E+04
2.00E+00 - 1.66E+00	1.0559E+10	1.50E-02 - 3.03E-03	2.2005E+03
1.66E+00 - 1.33E+00	2.2885E+11	3.03E-03 - 5.83E-04	2.0184E+02
1.33E+00 - 1.00E+00	4.3958E+11	5.83E-04 - 1.01E-04	1.7218E+01
1.00E+00 - 8.00E-01	7.1098E+11	1.01E-04 - 2.90E-05	1.1386E+00
8.00E-01 - 6.00E-01	2.2596E+13	2.90E-05 - 1.07E-05	1.6022E-01
6.00E-01 - 4.00E-01	2.7885E+12	1.07E-05 - 5.00E-06	3.1272E-02
4.00E-01 - 3.00E-01	4.7561E+11	5.00E-06 - 3.06E-06	7.6904E-03
3.00E-01 - 2.00E-01	6.9776E+11	3.06E-06 - 1.86E-06	3.7236E-03
2.00E-01 - 1.00E-01	2.2723E+12	1.86E-06 - 1.30E-06	1.3785E-03
1.00E-01 - 4.50E-02	3.3590E+12	1.30E-06 - 1.13E-06	3.8056E-04
4.50E-02 - 1.00E-02	1.0539E+13	1.13E-06 - 1.00E-06	2.5553E-04
		1.00E-06 - 8.00E-07	3.7522E-04
		8.00E-07 - 4.14E-07	5.9249E-04
		4.14E-07 - 3.25E-07	1.0697E-04
		3.25E-07 - 2.25E-07	1.0362E-04
		2.25E-07 - 1.00E-07	9.9068E-05
		1.00E-07 - 5.00E-08	2.6965E-05
		5.00E-08 - 3.00E-08	7.8933E-06
		3.00E-08 - 1.00E-08	5.5353E-06
		1.00E-08 - 1.00E-11	1.3191E-06

Notes:
1. Length based on rod prior to sectioning

5.(b)(1) Type and form of material (continued)

(xii) *Irradiated metal*. The irradiated metal payload consists of up to 350 lb of radioactive metal and may include both activation of the solid material and a layer of surface contamination. The payload may include commercial reactor surveillance samples containing small dosimeter wires made using uranium and neptunium. The decay heat is bounded by a value of 120 W. Table 1.11 provides Irradiated Metal Gamma Source limits. The values in this table provide maximum source strengths at different gamma energies likely in the payload. Neutron emission for each payload must be less than 1×10^5 neutrons/sec.

Table 1.11. Irradiated Metal Gamma Source (per cm^3)

Gamma Bin Energy (E_{max}, MeV)	Gamma Source (γ/s)	Gamma Bin Energy (E_{max}, MeV)	Gamma Source (γ/s)
1.00E-02	-	1.66E+00	1.8146E+10
4.50E-02	8.4518E+05	2.00E+00	2.7695E-01
1.00E-01	4.8048E+03	2.50E+00	2.1779E+05
2.00E-01	1.2163E+03	3.00E+00	3.6297E+02
3.00E-01	1.3150E+02	4.00E+00	1.1874E-02
4.00E-01	1.3611E+06	5.00E+00	2.3862E-03
6.00E-01	4.4007E+02	6.50E+00	9.1461E-04
8.00E-01	2.0391E+05	8.00E+00	1.6796E-04
1.00E+00	2.2653E+06	1.00E+01	3.4568E-05
1.33E+00	1.8122E+10	2.00E+01	2.4579E-06

(xiii) *Irradiated and Segmented Rods-in-Tubes (RITs)*. The payload consists of a variety of segments of irradiated commercial PWR and BWR fuel rods encapsulated into RITs. As shown on SAR drawing 1910-01-05-SAR of the application, RITs consist of stainless-steel pipes containing segmented fuel rods and closed off with pipe endcaps. RITs may range in length from 10.1 to 51.1 inches, with fuel rod segment lengths from 8.5 to 49.5 inches per RIT. Up to 297-in. of fuel segments (6 x 49.5-in.) may be placed in up to four RIT Canisters (RITCs) per RITC basket per shipment. The fuel segments shall have either a stainless steel or a zirconium alloy cladding sheath and contain UO_2 fuel pellets with initial U-235 enrichments within the range of 0.711 to 5 weight % U-235, per the BWR and PWR maximum allowed burnups/enrichment combinations provided below. Each RIT has a bounding decay heat of 30 watts (W) for a combined RITC basket heat load of 180 watts (W). Any combination of fuel segments is allowed, if they comply with these limits:

- For PWR, maximum allowed burnup is based on initial enrichment and the equation: PWR Burnup ≤ (7.99 GWD/MTU ⁄ weight % U-235) × enrichment + (60.14 GWD/MTU).

5.(b)(1) Type and form of material (continued)

- For BWR, maximum allowed burnup is based on initial enrichment and the equation: BWR Burnup ≤ (7.90 GWD/MTU/weight % U-235) × enrichment + (51.56 GWD/MTU).
- Segments shall have been discharged from a commercial reactor and cooled for ≥ 1 year. Thus, the maximum decay heat is 0.59 watts per inch of pellet. Based on the maximum 297 inches of allowed fuel segments, the maximum bounding decay heat for the payload is 175.23 watts.
- For all commercial fuel types, all PWR and BWR assembly types are allowed except for segments originating from General Electrical (GE) 6 × 6 fuel assemblies.
- The mass of the fuel segments is bounded by a segment which contains UO_2 pellets with a maximum fuel pellet diameter of 0.477 inches and maximum 0.57 inches overall cladding diameter. Therefore, the bounding mass of a full 49.5-in. segmented fuel rod assuming 100% theoretical density pellets is 1.59 kg UO_2, or 2.09 kg total.
- The RIT contents may contain burnable neutron absorbers such as boron, gadolinium, or samarium.
- RITs contents shall not contain any organic or temperature sensitive material.

5.(b)(2) Maximum quantity of material per package

(i) For the contents described in 5(b)(1)(i) and 5(b)(1)(ii): 8 irradiated MURR fuel elements. Only one fuel element is allowed per basket location.

(ii) For the contents described in 5(b)(1)(iii) and 5(b)(1)(iv): 8 irradiated MITR-II fuel elements. Only one fuel element is allowed per basket location.

(iii) For the contents described in 5(b)(1)(v) and 5(b)(1)(vi): 8 irradiated ATR fuel elements. Only one fuel element is allowed per basket location.

(iv) For the contents described in 5(b)(1)(vii): 19 irradiated TRIGA fuel elements. Only one fuel element is allowed per basket location. There are 26 types of TRIGA fuel.

(v) For the contents described in 5(b)(1)(viii): 8 irradiated PULSTAR fuel elements. Only one fuel element is allowed per basket location.

(vi) For the contents described in 5(b)(1)(ix): 8 irradiated square fuel elements or loose plate boxes. Only one fuel element or loose plate box is allowed per basket location (i.e., compartment). Up to 31 loose plates may be placed in each loose plate box.

5.(b)(2) Maximum quantity of material per package (continued)

(vii) *Plutonium Quantity.* The maximum quantity of plutonium in the BRR package is 6,500 Ci (at 4% ^{235}U enrichment of PULSTAR fuel).

(viii) For the contents described in 5(b)(1)(x)(1), 10 target holders. For payload type 1, up to 10 target holders may be placed into the inner row of holes in the isotope basket.

(ix) For the contents described in 5(b)(1)(x)(2), 20 target holders. For payload Type 2, up to 20 target holders may be placed into any of the 20 holes in the isotope basket.

(x) For the contents described in 5(b)(1)(xi), 12 irradiated fuel rod segments.

(xi) For the contents described in 5(b)(1)(xii), 350 lbs of irradiated metal.

(xii) For the contents described in 5(b)(1)(xiii), up to 297 inches of fuel segments in up to 12 RITs.

(c) Criticality Safety Index (CSI): 0

6. In addition to the requirements of Subpart G of 10 CFR Part 71:

(a) Each package shall be operated and prepared for shipment in accordance with Chapter 7 of the application, as supplemented

(i) For TRIGA fuel, spacer pedestals shall be used as described in Table 7.1-2 of the application.

(ii) For PULSTAR fuel, spacer pedestals shall be used as described in Table 7.1-1 of the application.

(iii) For square fuel and loose plates, spacer pedestals shall be used as described in Table 7.1-1 of the application.

(iv) When shipping loose plates, use aluminum dunnage sheets to reduce the free space between the flat face of the loose plates and the box opening to a value of ¼ inches or less. The dimensions of the dunnage sheets shall be as shown in Figure 7.1-1 of the application.

(v) For isotope production targets, a personnel barrier shall be used as described in Section 7.1.4 of the application.

(vi) Up to six encapsulated fuel rod segments may be placed into any single opening of the ATR basket. A removable stainless steel mesh screen will be placed in the bottom of each cavity which is used to hold the encapsulated rods.

(vii) Irradiated metal must be shipped using the canister shown in Drawing 1910-01-03-SAR, Rev. 8 of the application. Up to 200 lbs. of metallic fixturing or dunnage may be added to stabilize the contents.

(viii) For fuel segments in RITs, RITCs shall be used and RITC spacer pedestals may be used, both as described in Section 7.1.2 of the application. Up to two RITCs shall be used within each of only the smaller openings of the RITC basket.

(b) Each package shall be acceptance-tested and maintained in accordance with Chapter 8 of the application.

7. The package authorized by this certificate is hereby approved for use under the general license provisions of 10 CFR 71.17.

8. Transport by air of fissile material is not authorized.

9. Revision No. 11 of the certificate may be used until March 31, 2026.

10. Expiration date: June 11, 2030.

REFERENCES

BEA Research Reactor Safety Analysis Report, Revision 20.1, dated February 2026.

FOR THE U.S. NUCLEAR REGULATORY COMMISSION

Devaser, Nishka signing on behalf of Diaz-Sanabria, Yoira on 02/26/26

Yoira Diaz-Sanabria, Chief
Storage and Transportation Licensing Branch
Division of Fuel Management
Office of Nuclear Material Safety
and Safeguards

Date: February 26, 2026

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

SAFETY EVALUATION REPORT

DOCKET NO. 71-9341
CERTIFICATE OF COMPLIANCE NO. 9341, REVISION NO. 12
MODEL NO. BEA RESEARCH REACTOR PACKAGE
PACKAGE IDENTIFICATION NO. USA/9341/B(U)F-96

SUMMARY

By letter dated January 30, 2026 (Agencywide Documents Access and Management System [ADAMS] Accession No. ML26033A417), Orano Federal Services LLC (Orano FS or the applicant) requested the U.S. Nuclear Regulatory Commission (NRC) to renew and amend Certificate of Compliance (CoC) No. 9341 for the Model No. BEA [Battelle Energy Alliance] Research Reactor (BRR) Package.

The applicant's January 30, 2026, submittal requested changes to the current version of BEA Research Reactor package Safety Analysis Report (SAR), Revision 20. Specifically, the applicant submitted Revision 20.1 of the SAR including minor changes to one of the BRR drawings, Drawing No. 1910-01-05-SAR. The staff noted that this SAR drawing was included in Revision 19 of the SAR.

The NRC staff reviewed the application using the guidance in NUREG-2216, "Standard Review Plan for Transportation Packages for Spent Fuel and Radioactive Material," August 2020 (ML20234A651). Based on the statements and representations in the application, and the "Conditions" section of this safety evaluation report, the NRC staff concludes that the package meets the requirements of 10 CFR Part 71, "Packaging and Transportation of Radioactive Material." The NRC staff's analyses are included in the sections below.

STAFF EVALUATION

1.0 GENERAL INFORMATION

The BRR Package is a Type B(U)F-96 package to ship irradiated fuel from research reactor facilities. The package's design allows transporting one package per conveyance, with its longitudinal axis vertical, by truck or by rail in exclusive use.

1.1 Packaging Description

The BRR package consists of a payload basket or canister, a lead-shielded package body, a separate, removable upper shield plug, a closure lid, 12 closure bolts, upper and lower impact limiters containing polyurethane foam, and a personnel barrier used only with the isotope payload.

The BRR package body is a right circular cylinder 77.1 inches (in.) long and 38 in. in diameter. It comprises inner and outer shells connected by a thick lower end casting. The shells and lower end casting are made of American Society for Testing and Materials (ASTM) Type 304 stainless steel with an encased lead shield. The cast-in-place lead shielding fills the annulus between the shells. Together with the removable 11.2-in. thick shield plug under the closure lid, the package body assembly constitutes the payload cavity, which has a diameter of 16 in. and a length of 54 in.

The principal components of the BRR are:

1) a lead-shielded package body,

2) a separate, removable upper shield plug,

3) a bolted closure lid,

4) upper and lower impact limiters containing polyurethane foam,

5) various payload baskets or canisters specifically designed for each type of fuel being transported, and

6) a personnel barrier for isotope production targets to limit access to the package body.

Except for the closure bolts, the lead shielding, and the impact limiter attachment pins, the package is primarily a welded structure using Type 304 austenitic stainless steel.

1.2 Drawings

By letter dated January 30, 2026, the applicant requested a revision to SAR Drawing No. 1910-01-05-SAR that adds an ASTM standard for fabrication of the Rods-in-Tubes Canister (RITC) basket tubes. The applicant stated that the SAR drawing only identifies one standard for each tube. The applicant added an additional ASTM specification to provide suitable alternative material for the RITC basket tubes.

2.0 MATERIALS EVALUATION

2.1 Proposed Drawing Revision

The applicant revised SAR Drawing No. 1910-01-05-SAR to add an alternative material for the standard RITC basket tubes. For the smaller tube, the material specification was changed to add ASTM specification B221 extruded aluminum alloy tube to the existing ASTM specification B210 for the drawn aluminum alloy tubing. For the larger tube the material specification was changed to add ASTM specification B221 extruded aluminum alloy tube to the existing ASTM specification B241 for the seamless pipe. The applicant stated that no other change was made to the drawing.

The NRC staff reviewed the changes to the SAR drawing using the guidance in NUREG-2216, and NUREG/CR-5502, “Engineering Drawings for 10 CFR Part 71 Package Approvals,” published in May 1998. In addition, the NRC staff used NUREG/CR-6407, “Classification of Transportation Packaging and Dry Spent Fuel Storage System Components According to Importance to Safety,” published in February 1996. The NRC staff verified that the drawings include the information described in NUREG-2216: (1) materials of construction; (2) dimensions and tolerances; (3) codes, standards, or other specifications for materials, fabrication, examination, and testing; (4) welding specifications, including location and nondestructive examination (NDE); and (5) coating specifications. The NRC staff found the changes to the drawing acceptable.

2.2 Material Properties of Alternative Aluminum RITC Basket Tube Materials

Since ASTM B221 was already a material used for other parts of the basket, SAR table 2.2-7 contains mechanical properties for ASTM specification B221 extruded aluminum alloy tube. The NRC staff reviewed the specifications for the existing aluminum alloys, as well as the specifications for the additional aluminum alloy included in BRR SAR drawing, 1910-01-05-SAR and SAR table 2.2-7. Based on the review, the NRC staff determined that the compositional specifications for the added ASTM specification B221 extruded aluminum alloy were identical to the existing alloy specification in the ASTM specification B210, and ASTM specification B241. In addition, the minimum room temperature yield strength for these alloys were the same, and that the room temperature tensile strength and ductility requirements for the ASTM specification B221 extruded aluminum were comparable to the existing alloys. Furthermore, the NRC staff determined that the ASTM specification B221 extruded aluminum alloy specified for the RITC basket tubes exceeds the mechanical properties listed in SAR table 2.2-7. Therefore, the NRC staff found that the addition of ASTM specification B221 extruded aluminum alloy specified for the RITC basket tubes to be acceptable.

2.3 Evaluation Findings

As described in sections 2.1 and 2.2 above, the NRC staff considered the regulation itself, appropriate regulatory guides, applicable codes and standards, accepted engineering practices, and its own confirmatory analysis in reaching the following findings:

F2.1 The staff has reviewed the package and concludes that the applicant has met the requirements of 10 CFR 71.33. The applicant described the materials used in the transportation package in sufficient detail to support the staff’s evaluation.

F2.2 The staff has reviewed the package and concludes that the applicant has met the requirements of 10 CFR 71.31(c). The applicant identified the applicable codes and standards for the design, fabrication, testing, and maintenance of the package.

Therefore, NRC staff concludes that the applicant’s request to revise SAR drawing, Drawing No. 1910-01-05-SAR, by specifying an additional ASTM standard for fabrication of the RITC basket tubes, meets the acceptance criteria of NUREG-2216 and regulatory requirements of 10 CFR Part 71.

CONDITIONS

The following revisions were made to CoC No. 9341:

Condition No. 3(b) was revised to reflect the January 30, 2026, application from Orano FS which included a consolidated SAR.

Condition No. 5(a)(3) was revised to show that the drawing, 1910–01–05–SAR, “BRR Package RIT, RITC and RITC Basket SAR Drawing,” Sheets 1-3, as Rev. 2.

Condition 9 was revised to state that Revision No. 11 of the certificate may be used until March 31, 2026.

The REFERENCES section was revised to include BEA Research Reactor Safety Analysis Report, Revision 20.1.

CONCLUSION

Based on the statements and representations contained in the application, and the conditions listed above, the NRC staff finds that the Model No. BRR package has been adequately described and evaluated, therefore concludes that the package meets the requirements of 10 CFR Part 71.

Issued with CoC No. 9341, Revision No. 12, dated February 26, 2026.