Department of Energy
Washington, DC 20585

July 6, 2021

MEMORANDUM FOR ROBERT D. BOSTON
MANAGER
IDAHO OPERATIONS OFFICE

FROM: JULIA C. SHENK
HEADQUARTERS CERTIFYING OFFICIAL
DIRECTOR
OFFICE OF PACKAGING AND TRANSPORTATION

Julia C. Shenk
Digitally signed by Julia C. Shenk
Date: 2021.07.06 09:33:52 -04'00'

SUBJECT: Amendment and Renewal of Department of Energy Certificate of Compliance Number 9341

In response to the email request from Carl Friesen, Idaho Operations Office, dated October 3, 2019, as supplemented, to Dr. James Shuler of my staff, Department of Energy (DOE) Certificate of Compliance (CoC) Number 9341, Revision 1, for the Model BEA Research Reactor (BRR) Package is issued with its attached Safety Evaluation Report (SER). Changes to the CoC are indicated by vertical bars in the right page margin.

This CoC is issued by DOE under the authority of 49 CFR 173.7(d) and is conditional upon fulfilling the applicable Operational and Quality requirements of 49 CFR Parts 100-199 and 10 CFR Part 71, and the conditions specified in Item 5 of the CoC.

The expiration date of CoC 9341 is January 31, 2025.

If you have any questions, please contact me or Dr. Shuler at (301) 903 5513.

Attachments

cc: Carl Friesen, DOE-ID
Craig Tyler, INL
Phil Noss, Orano Federal Services, LLC
James Shuler, EM-4.24
Docket 20-02-9341

U.S. DEPARTMENT OF ENERGY

DOE Packaging Certification Program

CERTIFICATE OF COMPLIANCE
For Radioactive Materials Package

OE F 5822.1
5-85 Formerly EV-618)

1a. Certificate Number	1b. Revision No.	1c. Package Identification No.	1d. Page No.	1e. Total No. Pages
9341	1	USA/9341/B(U)F-96 (DOE)	1	13

2. PREAMBLE

2a. This certificate is issued under the authority of 49 CFR Part 173.7(d).

2b. The packaging and contents described in Item 5 below meet the safety standards set forth in subpart E, "Package Approval Standards" and subpart F, "Package, Special Form, and LSA III Tests" Title 10, Code of Federal Regulations, Part 71.

2c. 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 —

(1) Prepared by (*Name and Address*):	(2) Title and identification of report or application:	(3) Date:
U.S. Department of Energy Idaho Operations Office 1955 Fremont Ave. Idaho Falls, ID 83415	Safety Analysis Report *BEA Research Reactor Package Safety Analysis Report*, Docket No. 71-9341, Revision 2 DOE, as supplemented [see 5(e)].	December 2020

4. CONDITIONS
This certificate is conditional upon fulfilling of the applicable Operational and Quality Assurance requirements of 49CFR parts 100 – 199 and 10CFR Part 71, and the conditions specified in Item 5 below.

5. Description of Packaging and Authorized Contents, Model Number, Transport Index, other Conditions, and References:

(a) Packaging

(1) Model Number: BEA Research Reactor (BRR) Package

(2) Description:

The purpose of the Model No. BRR package is to transport irradiated fuel elements or loose plates of a square fuel element from various test and research reactors. The packaging is comprised of a lead–shielded package body, payload basket, square loose plate box, 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 packaging 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).

6a. Date of Issuance: July 6, 2021	6b. Expiration Date: January 31, 2025

FOR THE U.S. DEPARTMENT OF ENERGY

7a. Address *(of DOE Issuing Office)*	7b. Signature, Name, and Title *(of DOE Approving Official)*
U.S. Department of Energy Office of Packaging and Transportation (EM-4.24) 1000 Independence Avenue, SW Washington, DC 20585	Julia C. Shenk Digitally signed by Julia C. Shenk Date: 2021.07.06 09:36:01 -04'00' Julia C. Shenk Headquarters Certifying Official Director Office of Packaging and Transportation

Fuel Baskets - There are six baskets used with the package, one for each type of fuel transported and one for isotope production targets. 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 length of 53.45 inches, and features a number of 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.

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 (lb.).

(3) Drawings:

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

Drawing Number	Revision	Title
3022946	0	BRR Package Assembly SARP Drawing, Sheets 1-5
3022947	0	BRR Package Impact Limiter SARP Drawing, Sheets 1-2
3022948	1	BRR Package Fuel Baskets SARP Drawing, Sheets 1-5
3022949	0	BRR Package Isotope Target Basket SARP Drawing, Sheets 1-2

(b) Contents

(1) Type and Form of Radioactive Material:

(i) *Irradiated MURR Fuel Element*. Irradiated University of Missouri Research Reactor (MURR) 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 element contains 24 fuel plates. Each fresh MURR fuel element contains 775.0 ± 7.8 g 235U. The enrichment range is 93 ±1 wt.% ^{235}U. The MURR 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 fuel element.

Table 1.1 MURR - Key Fuel Element Parameters

Parameter	Value
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 MITR–II Fuel Element*. Irradiated Massachusetts Institute of Technology Research Reactor (MITR–II) 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 element contains 15 fuel plates. Each fresh MITR–II 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 element overall length, including irradiation growth, is 26.52 inches. The maximum decay heat per element is 150 W. The maximum number of 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 fuel element.

Table 1.2 MITR–II - Key Fuel Element Parameters

Parameter	Value
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

(iii) *Irradiated ATR 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.% 235U. 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 element overall maximum length, after removal of the end box structures, 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 fuel element.

Table 1.3 ATR–II - Key Fuel Element Parameters

Parameter	Value
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

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

Table1.4 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

Table 1.4 Notes:

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.

(iv) *Irradiated TRIGA fuel elements (continued)*. 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.

Table 1.5 Maximum Burnup and Minimum Cooling Time for TRIGA Fuel Elements[1]

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

Table 1.5 Note:

1. 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.

(v) *PULSTAR Fuel*. Table 1.6 includes the characteristics of the pulsed training assembled reactor (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 lb., 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 (inch)	0.423
Minimum cladding thickness (inch)	0.0185
Cladding material	Zirconium alloy
Maximum cladding OD (inch)	0.474
Maximum active fuel length (inches)	24.1
Fuel rod pitch X (inch)	0.607
Fuel rod pitch Y (inch)	0.525
Box outer dimensions (inches)	3.15 x 2.74
Box thickness (inch)	0.06
Box material	Zirconium alloy
Maximum overall length (inches)[1]	38.23

Table 1.6 Note:

1. Includes 0.25 inch for irradiation growth.

(vi) *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.

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.)[1]	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[1-2]	no	no	no	Yes[3]	Yes[4]	Yes[5]	no

Table 1.7 Notes:

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

(vii) *Isotope Production Targets.* Targets are irradiated in nuclear reactors to produce ^{60}Co 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 isotope production targets.

Table 1.8 Characteristics of Isotope Production Targets, Payload Type 1

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

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 isotope production targets.

Table 1.9 Characteristics of Isotope Production Targets, Payload Type 2

Parameter	Value (pellet design)	Value (rod design)
Target Diameter (inch)	5/8	5/16
Maximum Target Length (inches)	16.5	16.5
Cladding Material	6061-T6 aluminum alloy	Stainless steel
Target Contents (pellets/rods)	5,500 (approximately)	1 solid or segmented rod of cobalt metal
Pellet Size Diameter (mm)	1	
Pellet Size Thickness (mm)	1	
Maximum ^{60}Co Activity (Ci)	4,000	
Payload Quantity (targets)	20	
Maximum Total Activity (Ci)	80,000	

(viii) *Pu-238 Production Targets.* Pu-238 production targets contain Np-237 which is irradiated in a nuclear reactor to produce Pu-238 heat source material. Two different targets will be transported: the HFIR Gen II target (a.k.a., HFIR) and the ATR target. Both targets are of similar design and both will be irradiated in the ATR located at the Idaho National Laboratory. Both unirradiated or irradiated targets can be shipped. Both targets are approximately 0.4 inch in diameter and consist of a stack of NpO_2 cermet pellets clad in aluminum. The end structures include a plenum and may be made from aluminum or stainless steel. The HFIR target is 33.6 inches long with a pellet stack length of 19.7 inches, and the ATR target length is bounded by 33.6 inches with a bounding pellet stack length of 23 inches. Up to 16 targets can be placed into each target rack, and up to six target racks can be placed into the outer tubes of the square fuel basket (Drawing 3022948, Assembly A5) for a maximum payload quantity of 96 targets. When transporting Pu-238 targets, the center two square holes are not used. The personnel barrier does not need to be used with Pu-238 production targets.

Table 1.10 below assumes full complement of 96 targets and maximum pellet stack length of 23.0 inches. The isotopic distribution and activity limits for unirradiated targets is Appendix E of SARP Section 1.3.1 Reference 3 and for irradiated targets Table 6 of SARP Section 1.3.1 Reference 3.

Table 1.10 Characteristics of Pu-238 Production Targets

Item	Characteristic/Limit
Unirradiated targets	3.5 kg (max) of Np-237
Irradiated targets (cooling and activity)	180 days (min) cooling prior to shipment and 50,122 Ci (max per package)
Irradiated targets (fissile mass)	64 g (max per package)
Irradiated targets (decay heat)	5.32 W (max target, 511 W per package)
Pellet cermet composition	65% aluminum (min), 10% void (approximately), and the balance NpO_2
Nominal Cladding thickness	Wall thickness is 0.035 inches (minimum between ribs)

(b) Contents (cont.)

(2) Maximum Quantity of Radioactive Material per Package:

See Table 1.11.

Table 1.11 Radioactive Material Package Limits

Content Type & Form	Item	Package Limit	Loading Condition
MURR	Irradiated fuel elements	8	Only one fuel element is allowed per basket location.
MITR–II	Irradiated fuels elements	8	Only one fuel element is allowed per basket location.
ATR	Irradiated fuels elements	8	Only one fuel element is allowed per basket location.
TRIGA (26 Types)	Irradiated fuel elements	19	Only one fuel element is allowed per basket location.
PULSTAR	Irradiated fuel elements	8	Only one fuel element is allowed per basket location.
Square Fuel and Loose Plates (excluding PULSTAR)	Irradiated fuel elements or loose plate boxes	8	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.
Isotope Production Targets Payload Type 1	Target holders	10	Up to 10 target holders may be placed into the inner row of holes in the isotope basket
Isotope Production Targets Payload Type 2	Target holders	20	Up to 20 target holders may be placed into any of the 20 holes in the isotope basket
Pu-238 Production Targets	Irradiated or unirradiated targets	96	Up to 16 targets can be placed into each target rack, and up to six target racks can be placed into the outer tubes of the square fuel basket, except the center two square holes are not used.
Pu-238 Production Targets	Plutonium (Ci)	11,010	Package limit is based on SARP Table 6.10-1
All (others)	Plutonium (Ci)	6,500	Package limit is based on 4% ^{235}U enrichment of PULSTAR fuel

(c) Criticality Safety Index

The Criticality Safety Index CSI is 0.0

(d) Conditions

(1) In addition to the requirements of Subpart G of 10 CFR Part 71, the package must be prepared for shipment and operated in accordance with Chapter 7 of the Safety Analysis Report (SAR), as supplemented by 5.(e) of this certificate.

(2) Each packaging must be acceptance tested and maintained in accordance with Chapter 8 of the SAR, as supplemented.

(3) For TRIGA fuel, spacer pedestals must be used as described in Table 7.1-2 of the SAR, as supplemented.

(4) For PULSTAR fuel, square fuel, or loose plates, spacer pedestals must be used as described in Table 7.1-1 of the SAR, as supplemented.

(5) For Square Fuel and Loose Plates, spacer pedestals must be used as described in Table 7.1-1 of the SAR, as supplemented.

(6) For 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 SAR, as supplemented.

(7) For Isotope Production Targets, a personnel barrier must be used as described in Section 7.1.4 of the SAR, as supplemented.

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

(9) Each DOE consignor or consignee of the package must have a 10 CFR 71 Subpart H Quality Assurance Program approved by the DOE Headquarters Certifying Official.

(10) Only DOE or persons working under contract to DOE may consign the package for shipment.

(11) Nuclear Regulatory Commission or Agreement State licensees must not consign a DOE certified package for shipment, but can transfer the material onsite to DOE or persons working under contract to DOE, for consignment of the package.

(e) Supplements

None