

U.S. NUCLEAR REGULATORY COMMISSION  
CERTIFICATE OF COMPLIANCE  
For Radioactive Materials Packages

1.(a) Certificate Number 9167	1.(b) Revision No. 0	1.(c) Package Identification No. USA/9167/B( )	1.(d) Pages No. 1	1.(e) Total No. Pages 3
----------------------------------	-------------------------	---	----------------------	----------------------------

2. PREAMBLE

- 2.(a) This certificate is issued to satisfy Sections 173.393a, 173.394, 173.395, and 173.396 of the Department of Transportation Hazardous Materials Regulations (49 CFR 170-189 and 14 CFR 103) and Sections 146-19-10a and 146-19-100 of the Department of Transportation Dangerous Cargoes Regulations (46 CFR 146-149), as amended.
- 2.(b) The packaging and contents described in item 5 below, meets the safety standards set forth in Subpart C of Title 10, Code of Federal Regulations, Part 71, "Packaging of Radioactive Materials for Transport and Transportation of Radioactive Material Under Certain Conditions."
- 2.(c) 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—

3.(a) Prepared by (Name and address): Amersham Corporation 2636 South Clearbrook Drive Arlington Heights, IL 60005	3.(b) Title and identification of report or application: Amersham Corporation application dated August 25, 1982, as supplemented
	3.(c) Docket No. 71-9167

4. CONDITIONS

This certificate is conditional upon the fulfilling of the requirements of Subpart D of 10 CFR 71, as applicable, and the conditions specified in item 5 below.

5. Description of Packaging and Authorized Contents, Model Number, Fissile Class, Other Conditions, and References:

(a) Packaging

- (1) Model Nos.: 3206B, 3227B, and 3218
- (2) Description

The KEG containers are designed for use as Type B shipping containers for neutron sources in special form. The containers are constructed of stainless steel and the dimensions are 16.8 inches in diameter by 20.4 inches high. The containers are filled with water extended polyester (WEP) which provides radiation and thermal protection to the contents. The Model No. 3206B and 3227B containers each have one receptacle for the source (2-inch diameter and 3-inch diameter receptacles, respectively). The Model No. 3218 container has two (2) receptacles for the sources (2-inch diameter and 1.3-inch diameter receptacles). The smaller receptacle will be used only for a reference or calibration source. A stainless steel encased WEP plug will be inserted into the receptacle and held in place by a knurled stainless steel screw cap. A stainless steel latch bar is locked in place over the screw cap with a key operated padlock. The gross weight of each container is 165 pounds.

8303300117 830311  
PDR ADOCK 07109167  
PDR  
C

5. (a) (3) Drawings

The packagings are constructed in accordance with Amersham Corporation Drawing Numbers:

Model No. 3206B

0A22413, Rev. D  
1A22299, Rev. G  
3A22297, Rev. C  
3A22420, Rev. B  
2A22442, Rev. A  
2A22385, Rev. B  
2A22419, Rev. C

Model No. 3227B

0A22527, Rev. D  
1A22299, Rev. G  
3A22297, Rev. C  
3A22416, Rev. A  
2A22528, Rev. A  
2A22417, Rev. A

Model No. 3218

0A22440, Rev. D  
1A22299, Rev. G  
2A22441, Rev. A  
2A22442, Rev. A  
3A22302, Rev. C  
3A22439, Rev. A  
3A22443, Rev. A  
3A22444, Rev. A  
3A22321, Rev. C

and the "NOTES ON DRAWINGS" given on pp 1-34 and 1-35 of the application (01/17/83).

(b) Contents

(1) Type and form of material

Am-241/Be neutron sources that meet the requirements of special form as defined in 10 CFR §71.4(o).

(2) Maximum quantity of material per package

25 curies

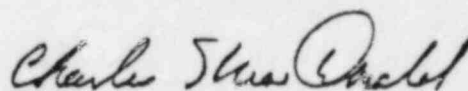
6. Venting of the source receptacle(s) in event of decomposition of the WEP shielding plug due to the accident conditions of transport, shall be provided for by drilling a 1/4-inch hole in the top surface of the screw cap(s). The hole shall be filled with plastic, rubber, or low temperature melt alloy to preclude entry of rain water during normal conditions of transport.
7. Name plates on the container must be fabricated of materials capable of resisting the fire test of 10 CFR Part 71 and maintaining their legibility.
8. The packaging authorized by this certificate is hereby approved for use under the general license provisions of 10 CFR §71.12(b).
9. Expiration date: March 31, 1988.

REFERENCES

Amersham Corporation application dated August 25, 1982.

Supplement dated: January 17, 1983.

FOR THE U.S. NUCLEAR REGULATORY COMMISSION



Charles E. MacDonald, Chief  
Transportation Certification Branch  
Division of Fuel Cycle and  
Material Safety, NMSS

Date: MAR 11 1983

U.S. Nuclear Regulatory Commission  
Transportation Certification Branch  
Safety Evaluation Report  
Model Nos. 3206B, 3227B, and 3218 Packagings  
Docket No. 71-9167

SUMMARY

By application dated August 25, 1982, as supplemented, Amersham Corporation requested design approval of the Model Nos. 3206B, 3227B, and 3218 (KEG) packages. Shielding of the 25 curies of Am-241/Be neutron sources is provided by water extended polyester. Containment is provided by the source capsules meeting the requirements of special form.

Based on the statements and representations contained in the application, and the conditions listed below, we have concluded that the KEG packages meet the performance requirements of 10 CFR Part 71.

REFERENCES

Amersham Corporation application dated August 25, 1982.

Supplement dated January 17, 1983.

DRAWINGS

The packagings are constructed in accordance with Amersham Corporation Drawing Numbers:

<u>Model No. 3206B</u>	<u>Model No. 3227B</u>	<u>Model No. 3218</u>
0A22413, Rev. D	0A22527, Rev. D	0A22440, Rev. D
1A22299, Rev. G	1A22299, Rev. G	1A22299, Rev. G
3A22297, Rev. C	3A22297, Rev. C	2A22441, Rev. A
3A22420, Rev. B	3A22416, Rev. A	2A22442, Rev. A
2A22442, Rev. A	2A22528, Rev. A	3A22302, Rev. C
2A22385, Rev. B	2A22417, Rev. A	3A22439, Rev. A
2A22419, Rev. C		3A22443, Rev. A
		3A22444, Rev. A
		3A22321, Rev. C

and the "NOTES ON DRAWINGS" given on pp 1-34 and 1-35 of the application (01/17/83).

### PACKAGING DESCRIPTION

The KEG containers are designed for use as Type B shipping containers for neutron sources in special form. The containers are constructed of stainless steel and the dimensions are 16.8 inches in diameter by 20.4 inches high. The containers are filled with water extended polyester (WEP) which provides radiation and thermal protection to the contents. The Model No. 3206B and 3227B containers each have one receptacle for the source (2-inch diameter and 3-inch diameter receptacles, respectively). The Model No. 3218 container has two (2) receptacles for the sources (2-inch diameter and 1.3-inch diameter receptacles). The smaller receptacle will be used only for a reference or calibration source. A stainless steel encased WEP plug will be inserted into the receptacle and held in place by a knurled stainless steel screw cap. A stainless steel latch bar is locked in place over the screw cap with a key operated padlock. The gross weight of each container is 165 pounds.

### CONTENTS

(1) Type and form of material

Am-241/Be neutron sources which meet the requirements of special form as defined in 10 CFR §71.4(o).

(2) Maximum quantity of material per package

25 curies.

### CONTAINMENT

The Am-241/Be neutron sources are encapsulated to meet the requirements of special form as defined in 10 CFR §71.4(o).

### STRUCTURAL

A. General Standards for all Packaging

Chemical and Galvanic Reaction

The KEG containers have been designed and constructed of such materials (stainless steel and WEP) that there will be no significant chemical, galvanic, or other reaction between packaging components or between packaging components and the package contents.

Positive Closure

The sources in the KEG containers are held in place by a key-operated padlock and latch bar and a screw cap. Therefore, this system insures a positive closure.

### Lifting Devices

The lifting handles of the KEG containers are shown by analysis to be capable of lifting three times the maximum package weight as prescribed in 10 CFR §71.31(c). Failure of the lifting device under excessive load will not impair the packaging to meet the other requirements of this Part.

### Tie-Down Devices

The applicant has shown by analysis that the lifting handles which could be used as tie-down devices are adequately designed to meet the requirements of 10 CFR §71.31(d). Failure of the tie-down devices under excessive load will not impair the packaging to meet the other requirements of this Part.

## B. Structural Standards for Type B and Large Quantity Packaging

### Load Resistance

The KEG containers are shown by analysis to be capable of withstanding statically five times its fully loaded weight uniformly distributed along its length without generating stress in any material of the packaging in excess of its yield strength.

### External Pressure

The KEG containers are open to the atmosphere. Therefore, there will be no differential pressure acting on it. In addition, the source capsules can withstand an external pressure of 25 psig.

## C. Normal Conditions of Transport

### Heat

The applicant has shown by evaluation that the KEG containers can withstand the normal heat conditions of transport.

### Cold

The metals used in the manufacture of the KEG containers can all withstand a temperature of -40°C. Since the WEP is made largely of ethylene glycol and polyester resin, no significant effects occur at -40°C. Thus, the package can withstand the normal transport cold condition.

### Pressure

The KEG containers are open to the atmosphere, therefore, there will be no pressure differential acting upon it. The source capsules can withstand a pressure reduction of 1/2 atmosphere.

### Vibration

The source securing system (key-operated padlock, latch bar, screw cap) are not expected to fail due to vibration normally incident during transportation. All internal and external components are welded and the internal support tube is solidly encased in WEP. Therefore, the KEG containers can withstand the vibrations normally incident to transport.

### Water Spray

Water spray is judged not to have significant affects on the package safety, since the container is constructed of stainless steel and all openings into the package are covered or sealed.

### Free Drop

The KEG containers are not expected to be affected by free drop requirement in Appendix A of 10 CFR Part 71.

### Penetration

The applicant has performed one penetration test on the top of a KEG container which deemed most probable to be damaged in transit. As a result of this test, the top of the KEG container received a slight dent. There was no loss of shielding nor structural integrity.

### Compression

The KEG containers are shown by analysis to be capable of withstanding a load of five times the package weight without generating stress in any material of the packaging in excess of its yield strength.

## D. Hypothetical Accident conditions

### Free Drop

The applicant's evaluation of the KEG containers to meet the 30-foot drop test of 10 CFR Part 71 is based on actual test results. The applicant has analyzed the packaging for four (4) orientations of impact for the 30-foot drop test. These four orientations of impact are: flat bottom drop, flat top drop, side drop, and top corner drop. These tests resulted in the failure of the padlock base. These tests had no significant affect on the screw cap. There was no release of the contents. The container itself received only superficial damage. Shielding effectiveness was not reduced.

### Puncture

The prototype KEG container was subjected to a total of four (4) free drops from a height of 40 inches onto a steel bar 6 inches in diameter and eight inches high. The container was dropped on its end, on its side, and twice on its closing mechanism. The tests inflicted only superficial damage to the container. There was no reduction of shielding effectiveness or release of contents.

### Thermal

The staff agrees with the Applicant's conclusion that the KEG containers' ability to retain the contents is not effected by the thermal conditions specified in 10 CFR Part 71. The shielding effects are discussed below (SHIELDING).

### Immersion

Not applicable; fissile packages only.

## THERMAL

The KEG design containers are completely passive thermal devices which have no mechanical cooling or relief valves. All cooling of the package under normal operating conditions is assumed to occur by free convection and/or radiation from the packages external surfaces. The maximum internal heat source is 25 curies of Am-241/Be with a corresponding decay heat of 0.825 watts (33 milliwatts/curie).

In evaluating thermal performance, the applicant has assumed an ambient temperature of 38°C (100°F) and an average solar heat flux of 104 BTU/ft<sup>2</sup>-hr for the normal condition heat test and an overall equilibrium temperature of -40°C (-40°F) for the normal condition cold test. Package temperatures for these conditions ranged from -40°C to 68.5°C (155°F). The staff analysis for the normal condition heat test, which assumed an ambient temperature of 130°F and an average solar heat flux of 122 BTU/ft<sup>2</sup>-hr, yielded a maximum temperature of 159°F (70.5°C). Within this temperature range, there were no appreciable problems with either material properties or thermal stresses.

In evaluating the thermal performance of the package under fire conditions, the critical element is the behavior of the WEP shielding layer at temperatures in excess of its decomposition temperature (about 300°F). At that temperature, the WEP layer will have decomposed into a variety of flammable and nonflammable gaseous by-products. These gases would exit the package through vent holes and non-leak tight assembly joints. Gases produced in the shielding plug would be released through vents in the end plates of the plug. Any gases generated in the support tube would be vented through a vent hole in the screw cap (see condition 1. below). The decomposition of the WEP layer would absorb most of the incoming heat load and appreciable heat would be transferred from the KEG by the out-venting of the hot gaseous by-products. The maximum temperature achieved by the source could be expected to be in the 150-200°C (300-400°F) range. Since the source itself is in special form, it is able to withstand a temperature and pressure of at least 1475°F and 290 PSI. The KEG containers are open to the atmosphere and therefore there will be no internal pressure buildups which would damage or alter the source or threaten the KEG's structural integrity.

The KEG design containers would survive the thermal accident conditions without losing structural integrity but would be subject to some loss in shielding capability. Tests performed by the applicant on a similar but smaller WEP filled container indicated that the WEP layer was reduced by about 6% in diameter (or from 178 to 166 mm) under fire accident conditions. Similar results would be expected for the proposed KEG designs.

#### SHIELDING

The applicant has established the shielding adequacy of the KEG design containing 25 curies of a Am-241/Be neutron source by performing radiation surveys before and after the accident sequence. Both the surface dose rates for normal conditions of transport and the dose rate at three feet from the package surface following the accident conditions of transport are met.

Furthermore, even if all the shielding is vaporized, the 10 CFR Part 71 limit of 1000 mrem/hr at three feet from the package surface would be satisfied.

The staff has examined the data supplied in the above application and finds it to accurately represent the cases intended.

OPERATING PROCEDURES

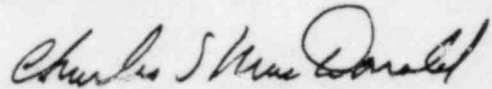
The information provided in Chapters 7 and 8 of Amersham's application is adequate for this review to assure compliance with the applicable parts of Subpart D of 10 CFR Part 71 for packages in service. Written instructions are provided in Chapter 7 for loading, unloading and preparing empty packages for transport. Chapter 8 specifies acceptance tests and a maintenance program for packages.

CONDITIONS

1. Venting of the source receptacle(s) in event of decomposition of the WEP shielding plug due to the accident conditions of transport, shall be provided for by drilling a 1/4-inch hole in the top surface of the screw cap(s). The hole shall be filled with plastic, rubber, or low temperature melt alloy to preclude entry of rain water during normal conditions of transport.
2. Name plates on the container must be fabricated of materials capable of resisting the fire test of 10 CFR Part 71 and maintaining their legibility.

CONCLUSION

Based on our review, the statements and representations contained in the application and the conditions listed above, we find that the KEG packages meets the requirements of 10 CFR Part 71.



Charles E. MacDonald, Chief  
Transportation Certification Branch  
Division of Fuel Cycle and  
Material Safety, NMSS

Date: MAR 11 1963