



71-9036

June 14, 2006

ATTN: Document Control Desk  
Director, Spent Fuel Project Office  
Office of Nuclear Material Safety and Safeguards

Dear Sir,

On May 1, 2006 we submitted a renewal application for our SPEC Model C-1 Transport Package, certificate number USA/9036/B(U)-85. The purpose of this letter is to request the addition of two more radionuclides to the approved contents, <sup>75</sup>Selenium and <sup>169</sup>Ytterbium. These radionuclides will be contained, secured and locked within the Model C-1 in exactly the same manner as the <sup>192</sup>Iridium sealed sources.

None of these radionuclides is fissionable. In addition, <sup>75</sup>Selenium and <sup>169</sup>Ytterbium weigh less, have a lower decay heat rate, and lower exposure rates. Therefore there will be no adverse affect on the Model C-1 packages ability to acceptably contain and shield the additional isotopes and lower gamma ray energies.

An in depth analysis of these issues is attached. Should you require any additional information please do not hesitate to contact me.

Sincerely,

Kelley Richardt  
Regulatory and Quality Manager

Enclosure: Additional Renewal Application dated June 15, 2006

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**ADDITIONAL RENEWAL APPLICATION  
for  
NRC CERTIFICATE OF COMPLIANCE  
USA/9036/B(U)**

**June 14, 2006  
Revision (1)**

**Model SPEC C-1  
Type B(U) Radioactive Material Package**

**SOURCE PRODUCTION AND EQUIPMENT CO., INC.  
113 Teal Street St. Rose, Louisiana 70087**

Pressure and Heat of Decay:

In our application (sections 1.1.3.1.1.E, 2.4.7, 2.4.8 and 3.1), we state that the heat of decay for 300 curies of Ir-192 is infinitesimal, and that the void space in the source capsule is negligible, therefore pressure build up is not a factor. The following analysis demonstrates that the heat of decay for Se-75 and Yb-169 is less than that for Ir-192. Therefore, pressure build up will not be a factor for either of these two additional radioisotopes.

The total decay heat rate (Power) generated from a source is the product of the energy released per decay (Q) and the activity of the source. The decay heat rate can be calculated by multiplying the Q-Value for the radionuclide by disintegrations per second by the conversion constant.

A good reference for the Q-Values for radionuclides (the total energy released in the transformation from the Ground-State of the parent radionuclide to the Ground-State of the daughter radionuclide) is the Brookhaven National Laboratory site ([http://www.nndc.bnl.gov/nudat2/indx\\_dec.jsp](http://www.nndc.bnl.gov/nudat2/indx_dec.jsp)). This site provides the following data:

Parent Radionuclide	Daughter Radionuclide	Decay Type	Decay Fraction	Q-Value (MeV)
<sup>192</sup> Iridium	<sup>192</sup> Osmium	EC	4.87%	1.0462
	<sup>192</sup> Platinum	β <sup>-</sup>	95.13%	1.4597
<sup>75</sup> Selenium	<sup>75</sup> Arsenic	EC	100%	0.8636
<sup>169</sup> Ytterbium	<sup>169</sup> Thulium	EC	100%	0.9080

Using the conversion constant of  $1.602 \times 10^{-13}$  W-s/MeV, the decay heat generation rates for the radionuclides of interest are:

Radionuclide	Decay Heat Rate (mW/Ci)	Decay Heat Rate for 300Ci
<sup>192</sup> Iridium	8.53	2.56 Watts
<sup>75</sup> Selenium	5.12	1.54 Watts
<sup>169</sup> Ytterbium	5.38	1.61 Watts

Clearly, the decay heat generated by <sup>75</sup>Selenium and <sup>169</sup>Ytterbium sources is lower than the decay heat generated by an equivalent activity <sup>192</sup>Iridium source. Consequently, the effect of decay heat generation for the source capsules and Model C-1 packages containing <sup>75</sup>Selenium and <sup>169</sup>Ytterbium sources will be less than when containing <sup>192</sup>Iridium sources of equivalent activity.

## Exposure Rates

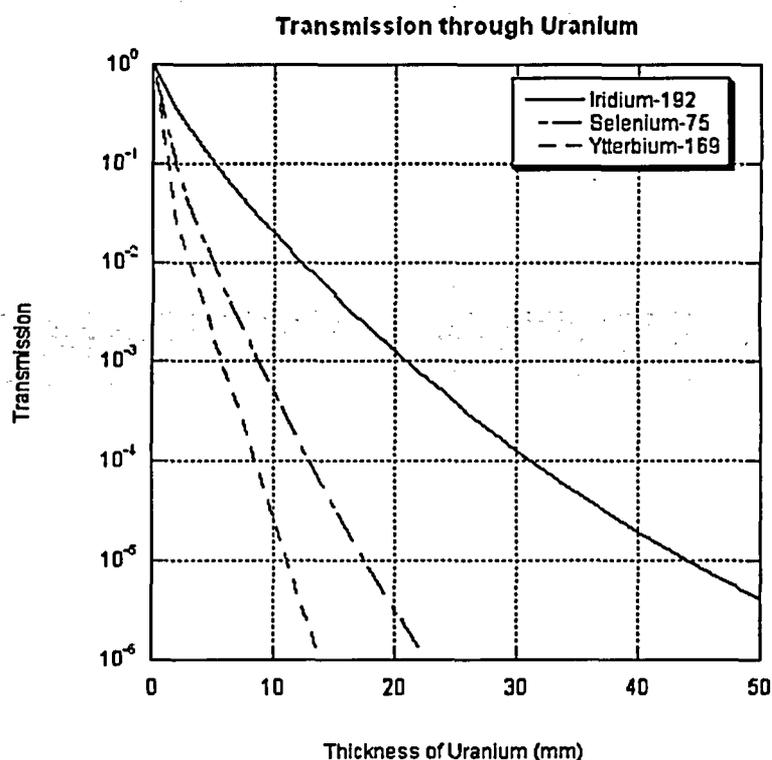
In our application (sections 2.4.11, 5.3.1 and 5.3.3), we state that the exposure rate for the Model C-1 when loaded with <sup>192</sup>Iridium is acceptable. Those values would be even lower for Se-75 and Yb-169 as their exposure rates are less than those for Ir-192.

The Specific Gamma Ray Constants and outputs per curie for <sup>75</sup>Selenium and <sup>169</sup>Ytterbium are lower than those for <sup>192</sup>Iridium:

Radionuclide	Specific Gamma Ray Constant (R m <sup>2</sup> /h Ci)
<sup>192</sup> Iridium	0.480
<sup>75</sup> Selenium	0.203
<sup>169</sup> Ytterbium	0.125

Therefore, for equivalent activity, <sup>75</sup>Selenium and <sup>169</sup>Ytterbium sources will exhibit lower unshielded exposure rates than for an equivalent activity source of <sup>192</sup>Iridium.

Additionally, the photon energies of <sup>75</sup>Selenium and <sup>169</sup>Ytterbium are generally lower than those of <sup>192</sup>Iridium. Therefore, the photons from <sup>75</sup>Selenium and <sup>169</sup>Ytterbium are more greatly attenuated by a given thickness of shielding than the photons of <sup>192</sup>Iridium. The attached figure shows the relative transmission of photons from each of these radionuclides through Uranium:



This demonstrates that the shielding thickness that is sufficient for <sup>192</sup>Iridium will be more efficient for the attenuation of photons from <sup>75</sup>Selenium and <sup>169</sup>Ytterbium.

Consequently, because of the lower specific gamma ray constant and the greater shielding efficiency, the exposure rates on the outside of a C-1 package containing <sup>75</sup>Selenium or <sup>169</sup>Ytterbium will be substantially lower than the exposure rates from <sup>192</sup>Iridium for an equivalent activity.

Weight: In the discussion of the inner packaging contents (section 1.1.3.1.1.C.), we state that the weight of the iridium pellets is negligible, the two new isotopes weigh even less than iridium.

Radioisotope	Ir-192	Se-75	Yb-169
grams / cm <sup>3</sup>	---22.5---	4.79	6.96

Conclusion:

The only difference between the <sup>192</sup>Iridium sources that the SPEC Model C-1 is approved to contain and the proposed <sup>75</sup>Selenium and <sup>169</sup>Ytterbium sources is the radioisotope. As fabricated, the <sup>75</sup>Selenium and <sup>169</sup>Ytterbium sources will weigh slightly less, have a lower decay heat rate, lower exposure rates, and lower photon energies than <sup>192</sup>Iridium. Therefore there will be no adverse affect on the Model C-1 packages ability to acceptably contain the additional isotopes and shield the lower gamma ray energies.