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Erratum

Erratum to "Safe radioisotope thermoelectric generators and heat sources for space applications" [Journal of Nuclear Materials 377(2008) 506–521]

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On page 508, the third paragraph of Section 2 should read:

"Despite its high thermal power density (see Table 1), the use of ^{90}Sr as a direct substitute for ^{238}Pu in the GPHS architecture and use within a low mass heat source is impractical without enhancement of shielding structures due to Bremsstrahlung and the emission of secondary gamma rays; 2.186 MeV gamma rays from ^{90}Y [19], the short-lived daughter nuclei from the beta decay of ^{90}Sr."

On page 509, right-hand column, the sentence starting in line 7 should read:

"Eight centimetres of aluminium shielding would reduce the intensity of the gamma ray radiation to 10% of its original, compared to the same degree of shielding achieved by 0.38 millimetres of tungsten. In addition to this, ^{241}Am is also easily extracted from stockpiles of transuranic waste; the bi-product of nuclear fission reactors."

On page 509, in Table 1, for ^{90}Sr, in the last row, the following values are corrected:

Theoretical specific activity (Ci g^{-1}): 118.87.

Theoretical specific thermal power (W g^{-1}): 0.785.

Gamma ray energy (keV): 2186.2 (^{90}Y).

Mass required for 5We (g): 127*.

Due this change, Figs. 11 and 12 are changed. See new versions enclosed.

On page 515, left-hand column, the second sentence of the last paragraph should read:

"As indicated by the results in Table 2, the received neutron dose rate at a distance of 1 m from the centre of the current ^{238}Pu fuelled GPHS module is of the order of 0.05816 mSv/h (5.816 mRem/h)."

Following the above corrections and to correct other typos, Table 2 is changed. See new version enclosed.

On page 519, the heading of Fig. 16 should read:

Comparison of neutron dose rates at 1 m radius from oxygen enriched $^{238}PuO_2$ & $^{241}AmO_2$ sources. For approximately equal dose rates, $^{241}AmO_2$ sources have no shielding and $^{238}PuO_2$ sources have 15 cm of Boron loaded Polyethylene neutron shielding.

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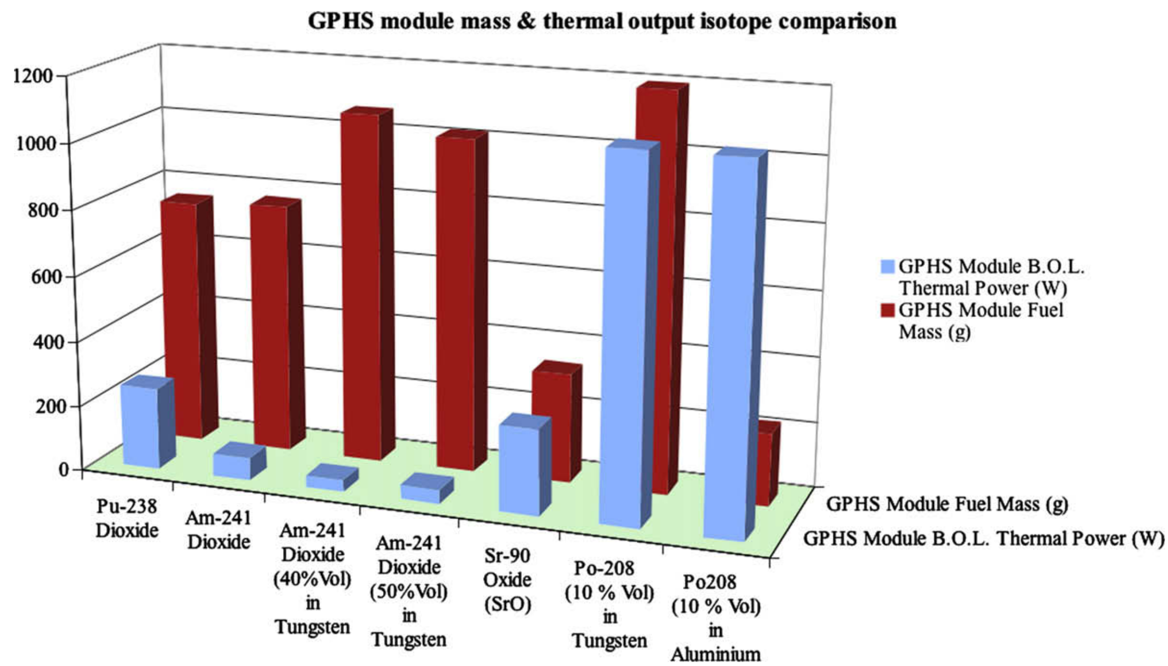

Fig. 11. A thermal performance and fuel mass comparison of substitute isotope candidates (excluding ^{210}Po) when used to fuel a GPHS module in contrast to the current performances of the GPHS modules fuelled by $^{238}PuO_2$.

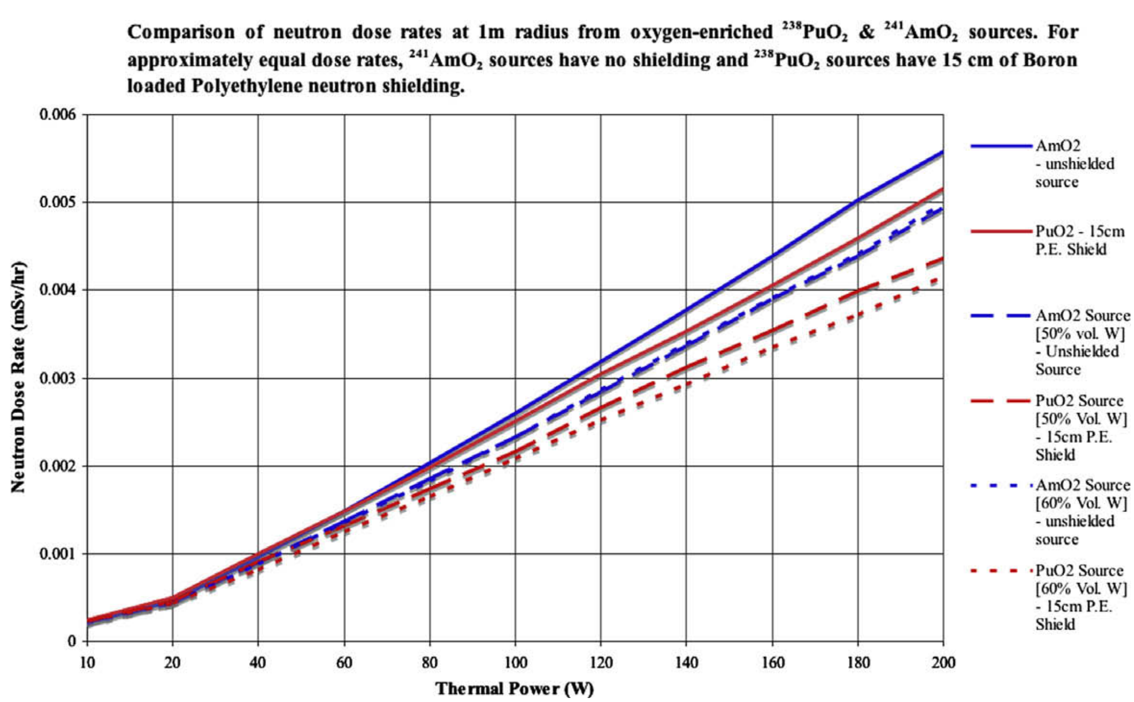

Fig. 12. A thermal performance and fuel mass comparison of all substitute isotope candidates when used to fuel a GPHS module in contrast to the performances of the GPHS modules fuelled $^{238}PuO_2$.

Table 2
Alternative isotope study results for the replacement of the current PuO_2 fuel in the GPHS module. Data for oxygen enriched oxides and oxides of natural oxygen composition is given for $^{238}PuO_2$ and $^{241}AmO_2$ fuelled modules. '>' Signifies that a practically unlimited annual exposure time is permissible.

GPHS Module fuel form:	Pu-238 $^{238}PuO_2$ Ceramic pellet	Am-241 $^{241}AmO_2$ (40%vol.) and W (60% vol.) Cermet	Am-241 $^{241}AmO_2$ (50%vol.) and W (50%vol.) Cermet	Am-241 $^{241}AmO_2$ Ceramic pellet	Sr-90 ^{90}SrO Ceramic pellet	Po-208 ^{208}Po (10%vol.) and W (90%vol.) Cermet	Po-208 ^{208}Po (10%vol.) and Al (90%vol.)Cermet	Po-210 ^{210}Po (10%vol.) and W (90%vol.) Cermet	Po-210 ^{210}Po (10%vol.) and Al (90%vol.) Cermet
Pellet Mass (g):	1.88×10^2	2.66×10^2	2.54×10^2	1.91×10^2	8.3×10^1	2.99×10^2	5.50×10^1	2.99×10^2	5.50×10^2
Total Fuel Mass (g):	7.51×10^2	1.07×10^3	1.02×10^3	7.66×10^2	3.34×10^2	1.20×10^3	2.20×10^2	1.20×10^3	2.20×10^2
Change in Module Mass (g):	0	+314	+264	+14	−417	+445	−531	+446	−531
Pellet Activity (Ci):	2.84×10^3	2.89×10^2	3.47×10^2	5.21×10^2	9.87×10^3	9.00×10^3	9.00×10^3	6.85×10^4	6.85×10^4
Change in Pellet Activity (Ci):	0	-2.55×10^3	-2.49×10^3	-2.32×10^3	$+7.03 \times 10^3$	$+6.16 \times 10^3$	$+6.16 \times 10^3$	$+6.80 \times 10^4$	$+6.80 \times 10^4$
Module Activity (Ci):	1.13×10^4	1.16×10^3	1.39×10^3	2.08×10^3	3.95×10^4	3.60×10^4	3.60×10^4	$+2.74 \times 10^5$	$+2.74 \times 10^5$
Change in Module Activity (Ci):	0	-1.01×10^4	-9.91×10^3	-9.22×10^3	$+2.82 \times 10^4$	$+2.46 \times 10^4$	$+2.46 \times 10^4$	2.72×10^5	2.72×10^5
Module Thermal Power (W):	2.50×10^2	3.63×10^1	4.30×10^1	6.80×10^1	2.61×10^2	1.09×10^3	1.09×10^3	8.36×10^3	8.36×10^3
Change in Module Thermal Power (W):	0	-2.14×10^2	-2.07×10^2	-1.93×10^2	$+1.10 \times 10^1$	$+8.36 \times 10^3$	$+8.36 \times 10^2$	$+8.33 \times 10^3$	$+8.33 \times 10^3$
Neutron Dose rate at 1 m radius from GPHS (Sv/hr):	$6.534 \times 10^{-4} \pm 9.00 \times 10^{-6}$	$3.036 \times 10^{-5} \pm 7.94 \times 10^{-7}$	$3.788 \times 10^{-5} \pm 2.68 \times 10^{-7}$	$8.238 \times 10^{-5} \pm 1.86 \times 10^{-7}$	–	–	–	–	–
Neutron dose rate as a Percentage of $^{238}PuO_2$ fuelled GPHS dose rate (%):	100	4.6	5.8	12.6	–	–	–	–	–
Gamma dose rate at 1 m radius from GPHS (Sv/hr):	$1.880 \times 10^{-6} \pm 1.09 \times 10^{-8}$	$6.882 \times 10^{-8} \pm 3.17 \times 10^{-10}$	$8.273 \times 10^{-8} \pm 2.79 \times 10^{-10}$	$1.740 \times 10^{-7} \pm 1.44 \times 10^{-9}$	$6.448 \times 10^{-2} \pm 1.90 \times 10^{-4}$	–	–	–	–
Gamma dose rate as a Percentage of $^{238}PuO_2$ fuelled GPHS dose rate (%):	100	3.7	4.4	9.3	3.854×10^7	–	–	–	–
Worker maximum recommended exposure time (hours per year):	31	657	527	242	0.31	>	>	>	>
Neutron Dose rate at 1 m radius from GPHS fuelled with oxygen enriched materials (Sv/hr):	$5.816 \times 10^{-5} \pm 1.14 \times 10^{-6}$	$6.162 \times 10^{-7} \pm 1.61 \times 10^{-8}$	$7.691 \times 10^{-7} \pm 5.44 \times 10^{-9}$	$1.672 \times 10^{-6} \pm 3.77 \times 10^{-9}$	–	–	–	–	–
Neutron dose rates for modules fuelled by oxygen enriched materials as a percentage of the $^{238}PuO_2$ fuelled GPHS module dose rate (%):	100	1	1.3	3	–	–	–	–	–
Gamma Dose rate at 1 m radius from GPHS module fuelled with oxygen enriched materials (Sv/hr):	$1.673 \times 10^{-7} \pm 1.38 \times 10^{-9}$	$1.397 \times 10^{-9} \pm 6.44 \times 10^{-12}$	$1.679 \times 10^{-9} \pm 5.66 \times 10^{-12}$	$3.532 \times 10^{-9} \pm 2.91 \times 10^{-11}$	$6.448 \times 10^{-2} \pm 1.90 \times 10^{-4}$	–	–	–	–
Gamma dose rates for modules fuelled by oxygen enriched materials as a percentage of the oxygen enriched $^{238}PuO_2$ fuelled GPHS module dose rate (%):	100	0.8	1	2	3.854×10^7	–	–	–	–
Worker maximum recommended exposure time to modules fuelled by oxygen enriched materials (hours per year):	343	3.24×10^4	2.59×10^4	1.19×10^4	0.31	>	>	>	>