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subject: Radioisotopes to be used in the 1996 CCA Calculations

The following 29 isotopes are the ones of interest from the BIR Report. They are as follows:

^{241}Am, ^{243}Am, ^{252}Cf, ^{243}Cm, ^{244}Cm, ^{245}Cm, ^{248}Cm, ^{137}Cs, ^{237}Np, ^{231}Pa, ^{210}Pb, ^{147}Pm, ^{238}Pu, ^{239}Pu, ^{240}Pu, ^{241}Pu, ^{242}Pu, ^{244}Pu, ^{226}Ra, ^{228}Ra, ^{90}Sr, ^{229}Th, ^{230}Th, ^{232}Th, ^{233}U, ^{234}U, ^{235}U, ^{236}U, and ^{238}U. ^{14}C is not included because of its small inventory and a large inventory of other forms of carbon.

There were chosen for their inventory content and CFR191 importance values.
All of these isotopes can be used in the codes that evaluate the direct releases from Cuttings, Spalling, and Blowout.

For the codes that compute the indirect releases (i.e., NUTS, CCDFGF and SECOTP), we need a shorter list in order to maintain a reasonable calculation burden.

^{241}Am, ^{243}Am, ^{245}Cm, ^{137}Cs, ^{237}Np, ^{238}Pu, ^{239}Pu, ^{240}Pu, ^{242}Pu, ^{226}Ra, ^{90}Sr, ^{229}Th, ^{230}Th, ^{232}Th, ^{233}U, ^{234}U, ^{235}U, ^{236}U, and ^{238}U are selected because they all have an EPA normalized release greater than .01. This is still a large (19) number of isotopes to transport.

To further reduce the number of isotopes to transport, let us look at uranium. From a EPA normalized perspective, ^{233}U and ^{234}U are a factor of $10^{1.5}$ to 10^{2} higher than the other uranium isotopes. We could drop ^{235}U, ^{236}U, and ^{238}U without any impact on the final EPA normalized release. Since the inventory in moles of ^{233}U and ^{234}U is less than one percent of the uranium inventory, we can reduce the solubility of uranium by a factor of 100. Furthermore, we can combine ^{233}U and ^{234}U into ^{234}U, since their half-lives are similar. Likewise, with thorium we can combine ^{229}Th and ^{230}Th into ^{230}Th and reduce the solubility by a factor of 1000 and drop ^{232}Th. With plutonium, we can combine ^{239}Pu, ^{240}Pu, and ^{242}Pu into ^{239}Pu and we can also combine ^{90}Sr and ^{137}Cs into ^{90}Sr because of similar half-lives and transport properties.

This will leave us with the following ten isotopes:
^{241}Am, ^{243}Am, ^{245}Cm, ^{237}Np, ^{238}Pu, ^{239}Pu, ^{226}Ra, ^{90}Sr, ^{230}Th, ^{234}U.
At late times, we can drop ^{90}Sr and ^{238}Pu because of their short half-lives.

To define late times for ^{90}Sr, we can look at the plots and determine when the EPA releases drop below .1. This is about 300 years. For ^{238}Pu, we can define late times as when the ratio of ^{238}Pu to ^{239}Pu is less than .01. This is about 800 years.

We can rank these isotopes in order of EPA normalized release.

	all times:		early times only:
1)	^{239}Pu releases from 2000 to 1000	1)	^{238}Pu from 3000 to 100@800yr
2)	^{241}Am releases from 1000 to .1	2)	^{90}Sr from 8 to .07@300 yr
3)	^{234}U releases from 7 to 8		
4)	^{230}Th releases from .06 to 5.0		
5)	^{237}Np releases from .1 to .3		
6)	^{245}Cm releases from .2 to .1		
7)	^{226}Ra releases from .02 to .2		
8)	^{243}Am releases from .06 to .025		

It then appears that we only need to transport ^{239}Pu, ^{241}Am, ^{234}U, and ^{230}Th. Any realizations that are close to the regulatory limit can be re-computed with the ten isotopes listed above. This scheme can be verified by a duplicate run using the 19 isotopes listed above.

If a further reduction in the number of radioisotopes in needed to reduce calculation time, we could also eliminate ^{234}U and ^{230}Th. This elimination should only be done as a last resort.

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