An INDEPTH Analysis of Spent Pebbles

By: Ben Impson, Zeyun Wu, and Braden Goddard
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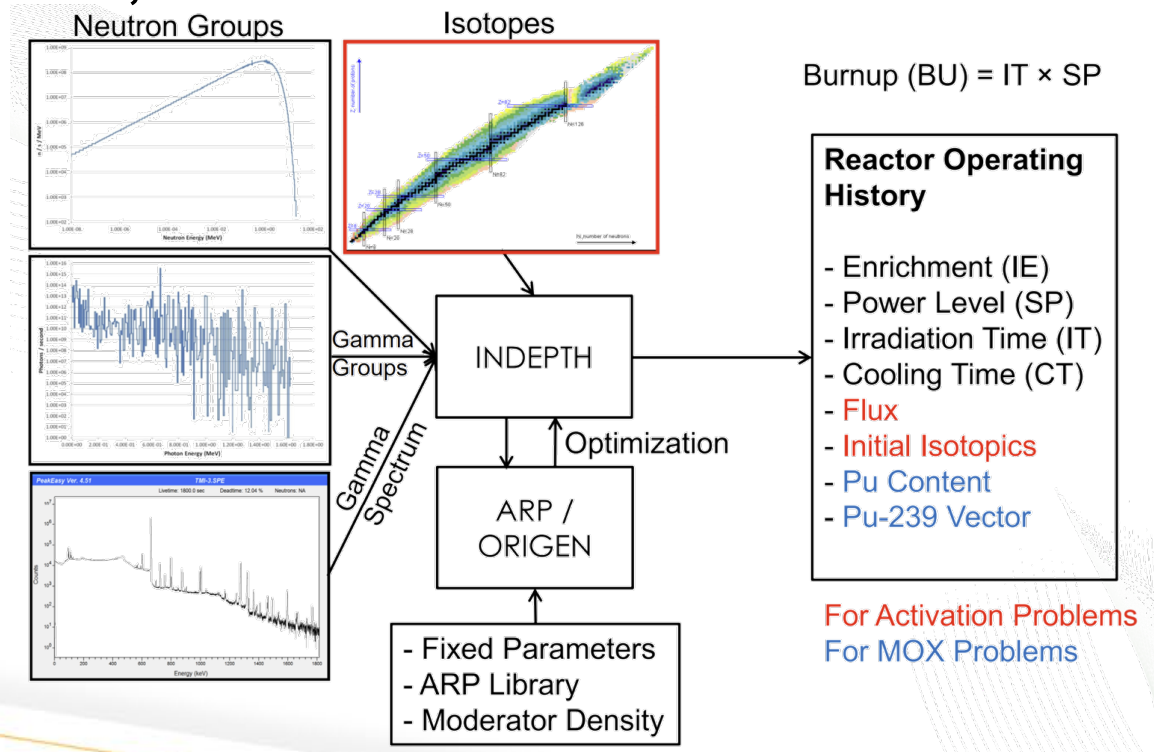
VCU College of Engineering

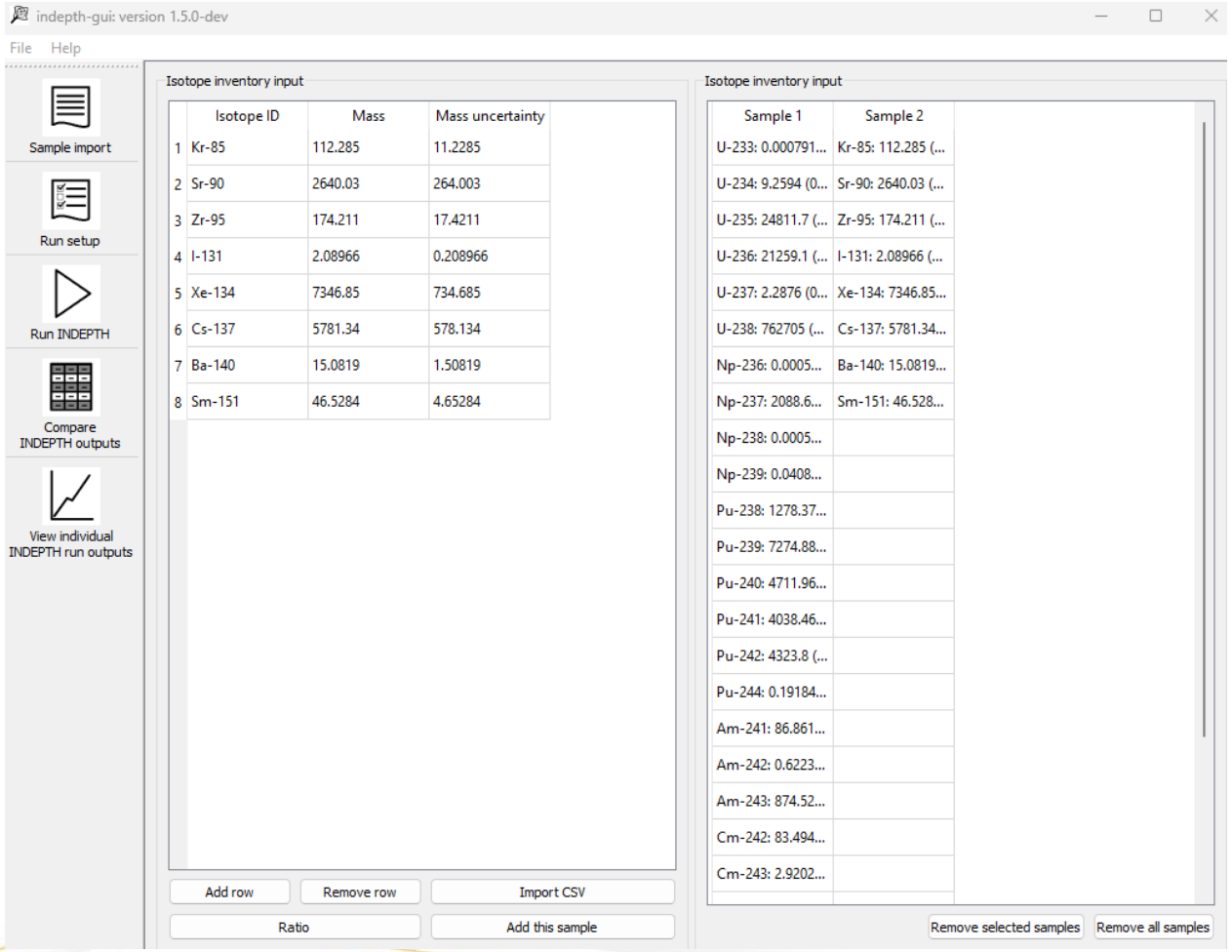
What is INDEPTH?

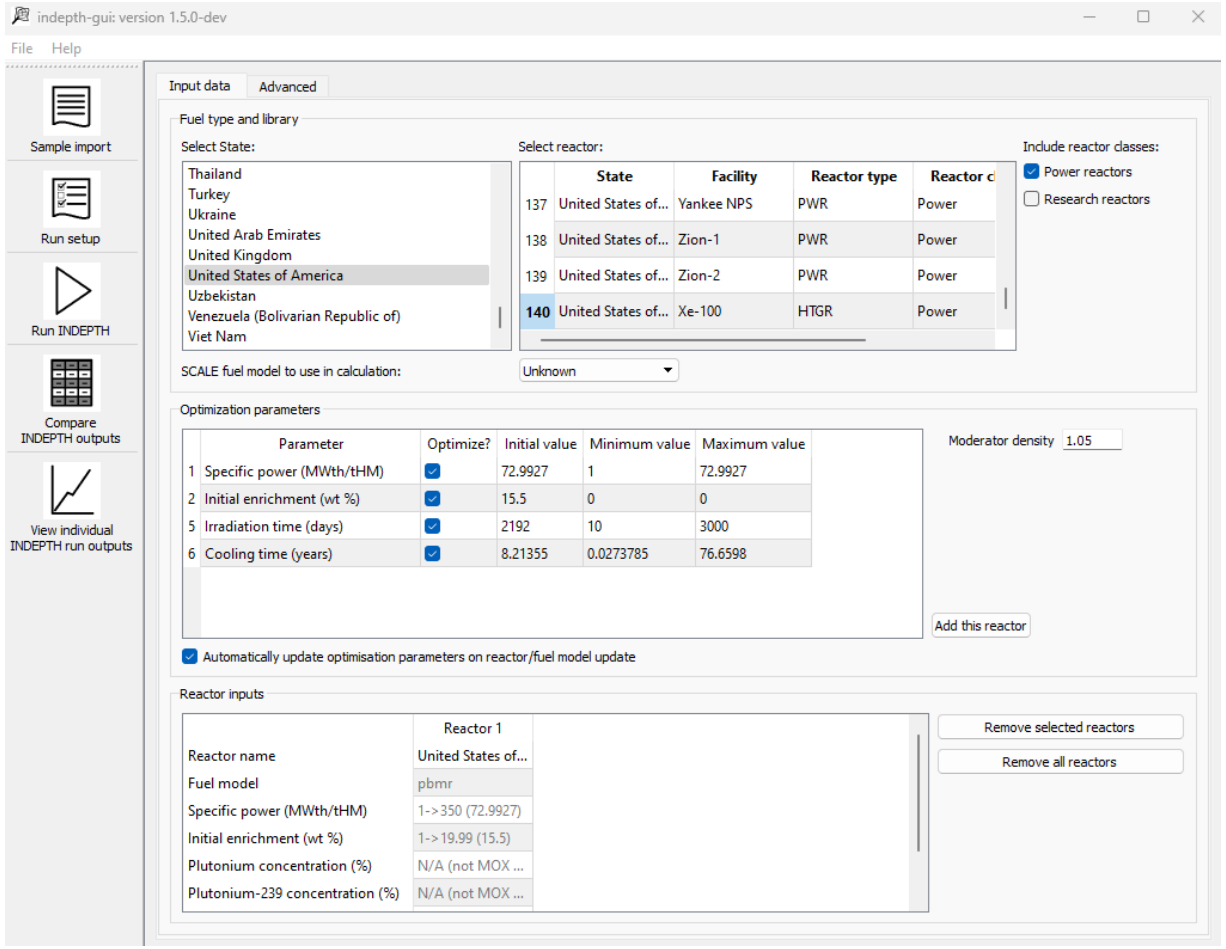
INverse DEPletion THeory code [1]

Takes isotopic data, turns it into initial reactor conditions using ORIGEN [2]

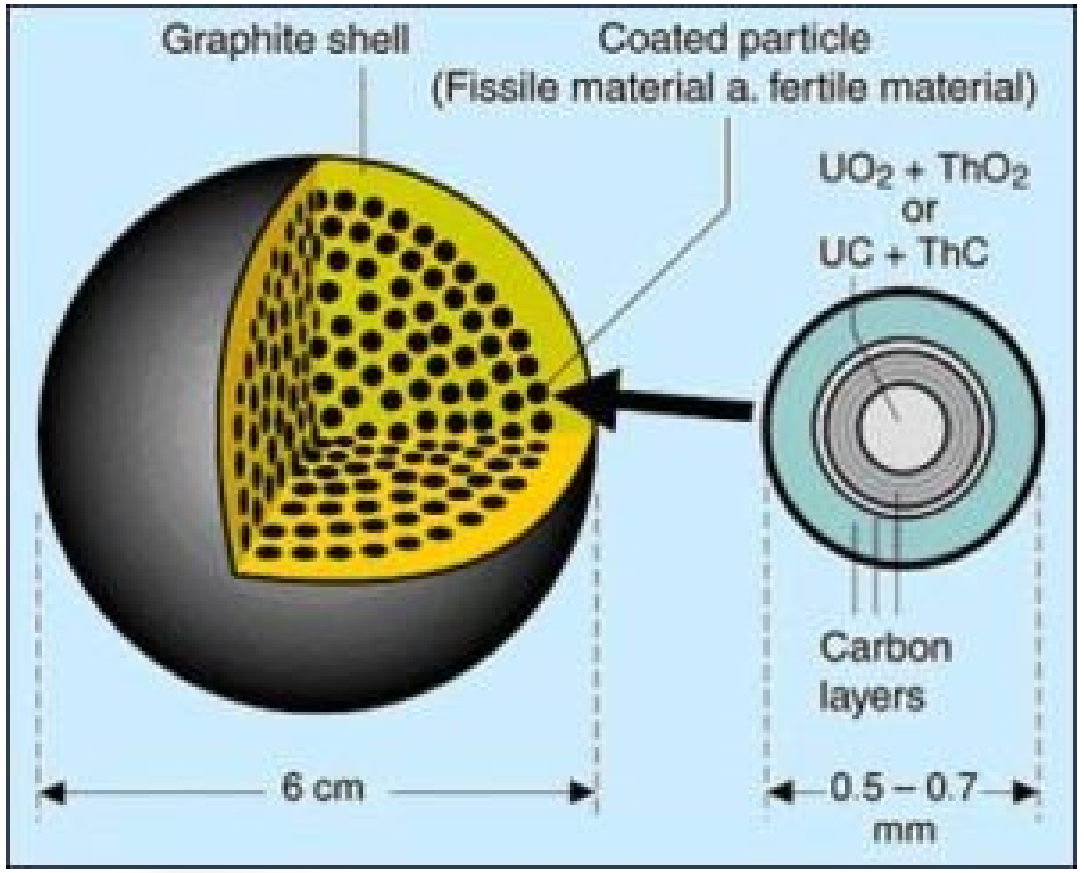


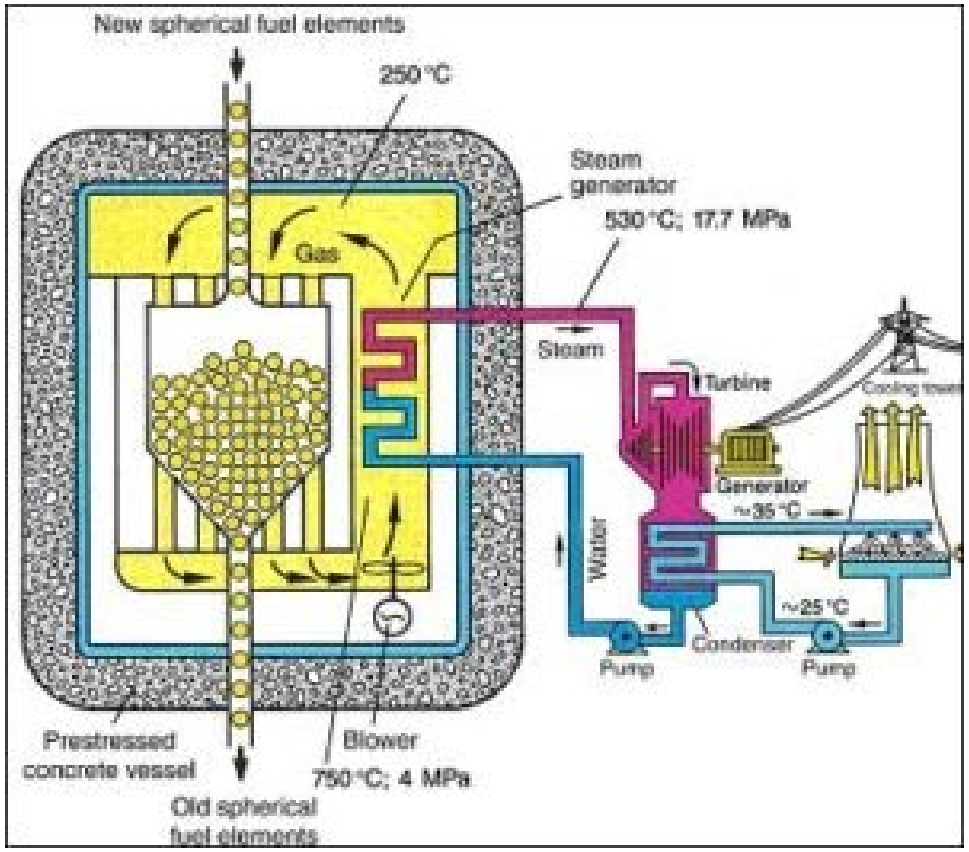
What INDEPTH Looks Like





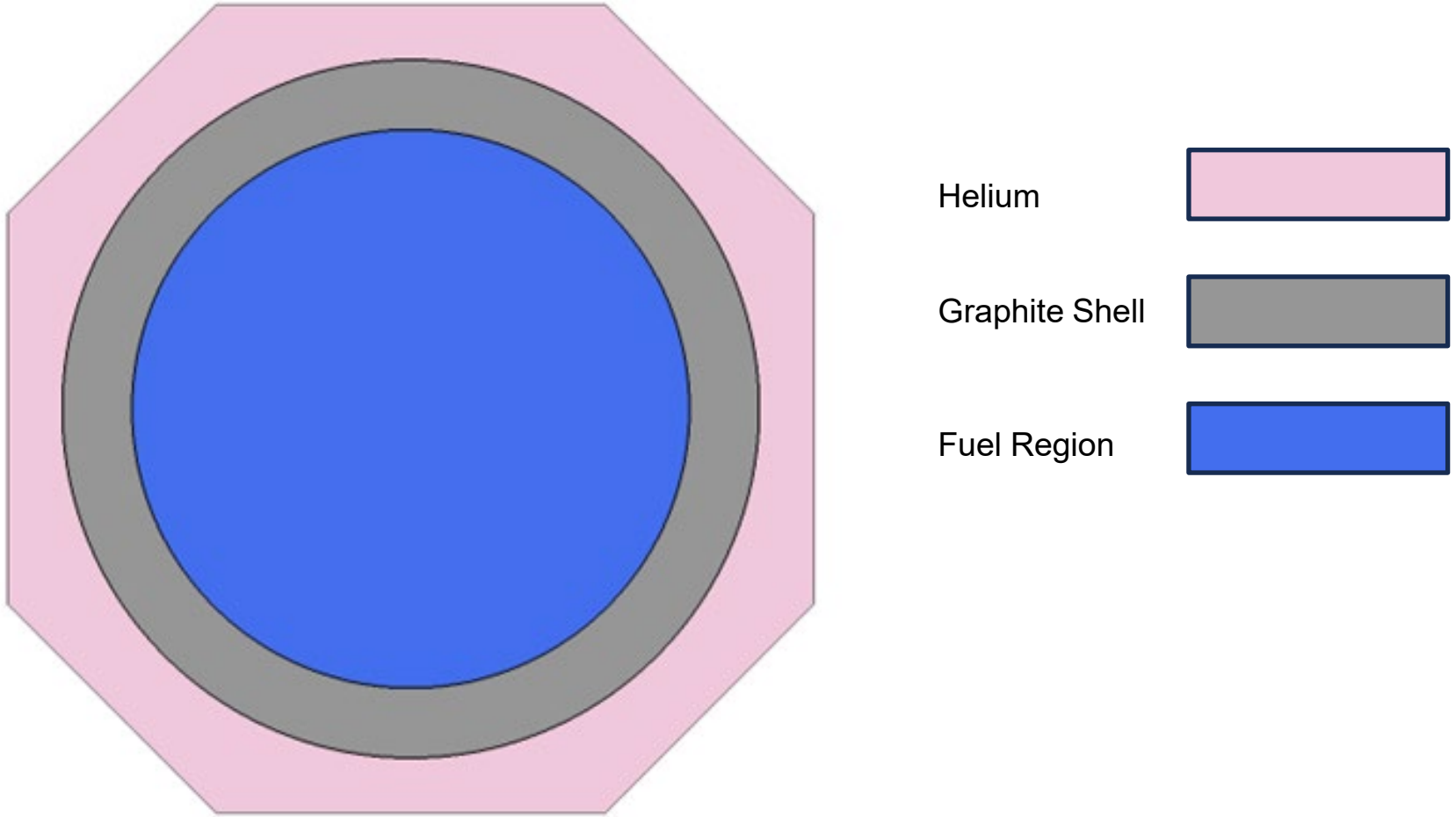
What does a real pebble look like?



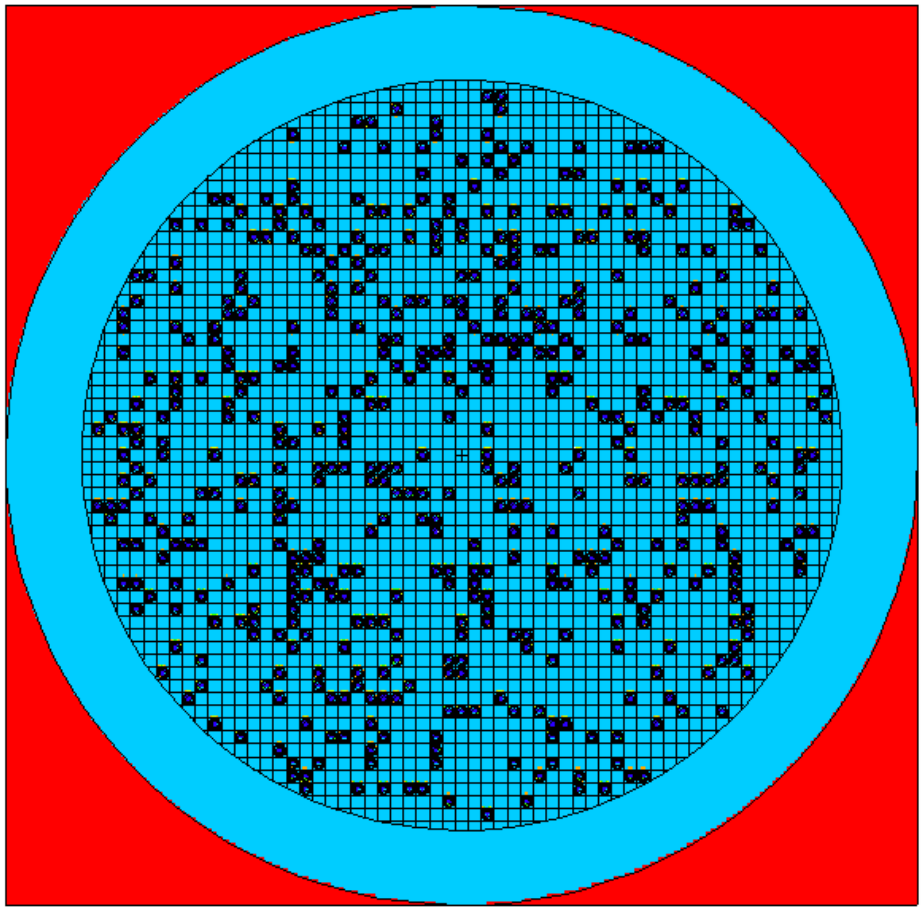


European Nuclear Society [3]

SCALE Libraries [4][5]



MCNP Pebble Model [6][7]



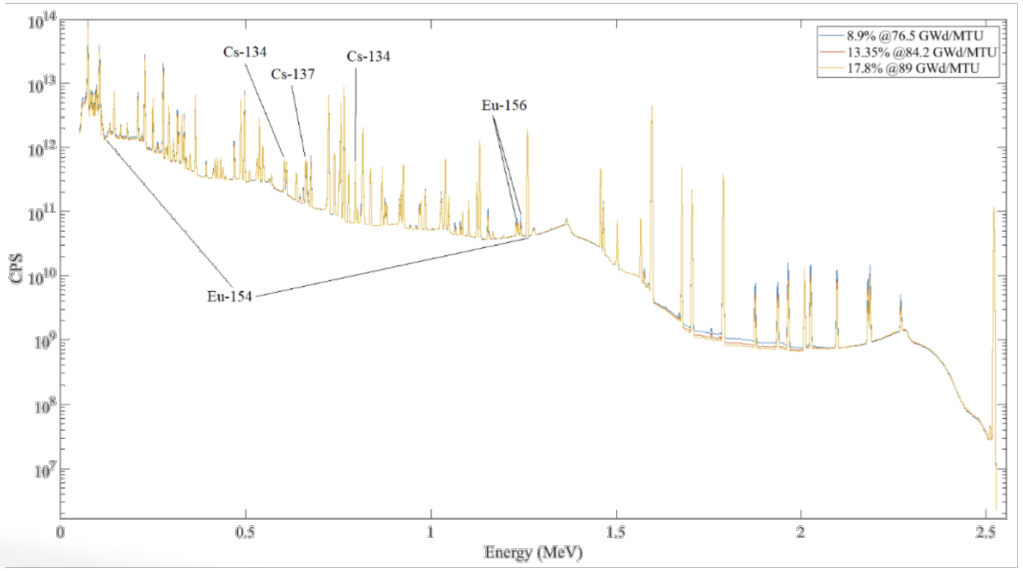
Which isotopes do you use?

Things HPGe detectors like

- Gamma emitters
- Fission products like ^{137}Cs
- Gamma emitting actinides like Am and Cm

Things INDEPTH likes

- Actinides, particularly ^{235}U
- Large isotope inventories
- Lots of data improve speed and accuracy



Gamma Spectrum of spent pebble [8]

Depletion Conditions

Condition	Enrichment	Burn Time	Cooling Time
Value	15.5%	1304 days	30 days

Based on Xe-100 Topical Report [7]

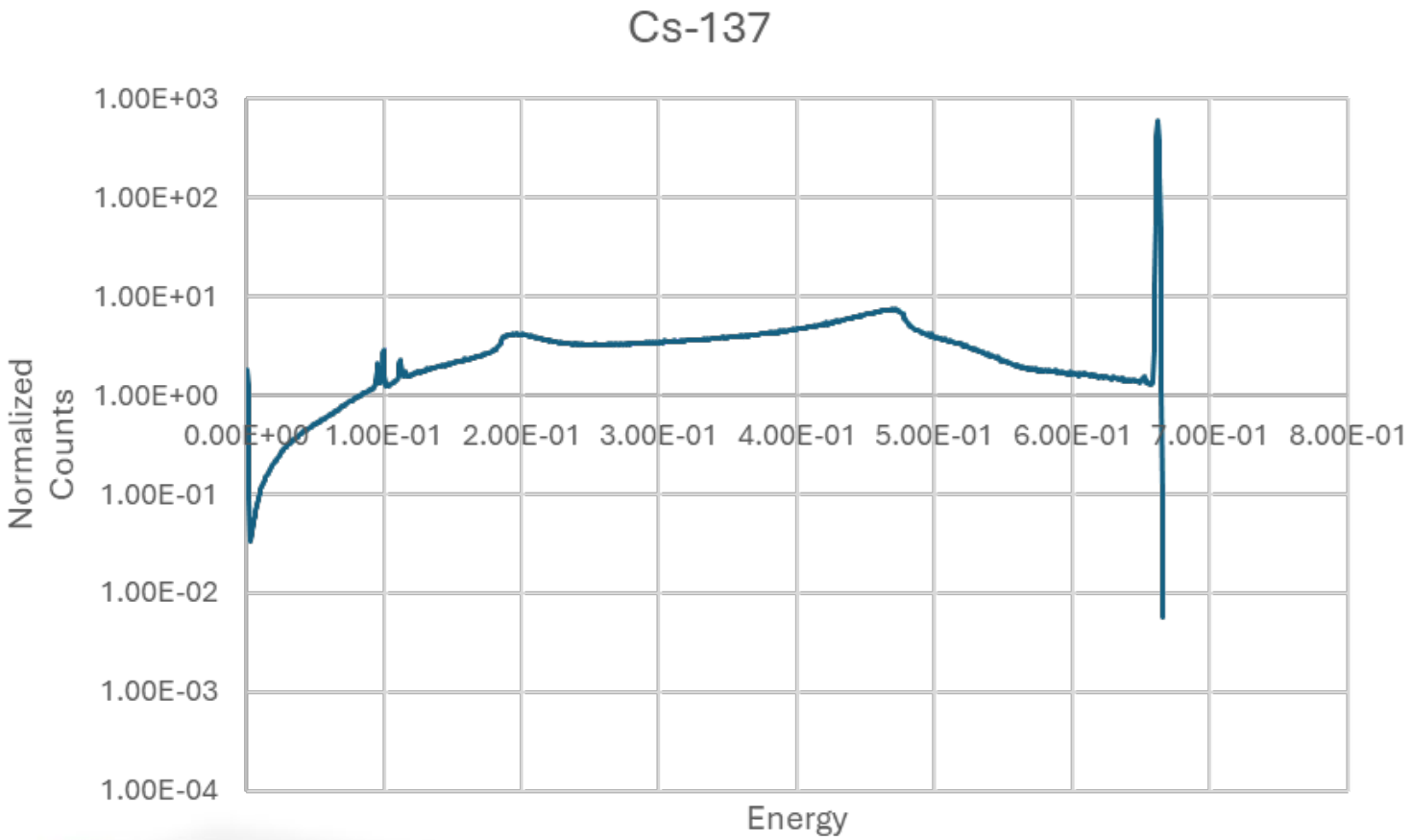
Isotope and Elemental Cases

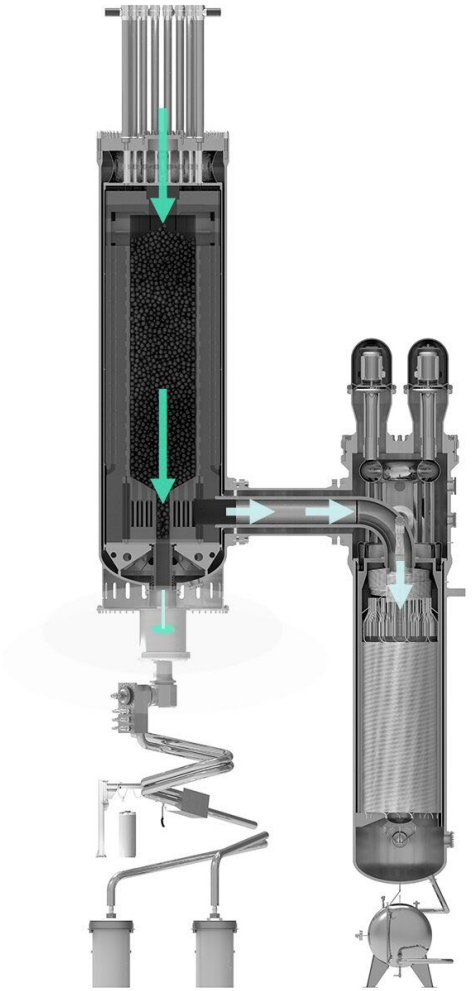
Case 1	Case 2	Case 3	Case 4
U, Pu	U, Pu, Am, Cm, Np	Am, Cm, Np	Select Fission Products (Kr-85, Sr-90, Zr-95, I-131, Xe-134, Cs-137, Ba-140, Sm-151)

Results with different Elemental combinations

Combination of Isotopes	Irradiation Time (days)	Cooling Time (days)	Enrichment (%)
Case 1	990	9340	12.2
Case 2	2003	47	15.4
Case 3	2164	159	12.4
Case 4	1126	3373	11.3
Operational Conditions	1304	30	15.5

In progress work





Acknowledgement

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SCALE Pebble model created by Jonathan Wing of UTK, who also helped with the library generation.

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References

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