Seminar overview

- Reactor dynamics: $d\rho/dT$
  - Isolating graphite contribution for a depleted core
- NB: http://web.utk.edu/~ochvala/MSR/
- Thanks to Terrestrial Energy Inc.
Calculation Strategy – depletion

- To take account for burnup, we burn the salt in infinite lattice in SCALE6.1, using specific power 21 MW/MTU, burned for 5000 days.

- Fission product concentrations are taken after 11 years.
  - Gases are scaled down to 5% and 1% concentrations.

- Actinide contractions are taken after 7 years but for U235 and U238, whose concentrations are found by the criticality search (see enrichment values in the plots). This roughly approximates continuous refueling with LEU.

- Presented on April 17th 2015.

- Update for graphite-only contribution.
Isolating the graphite contribution to $d\rho/dT$

- What happens when the core gets hotter?
- The salt will be kept at 1100K in all calculations.
- The graphite and tank will increase in temperature (including dimension and density effects) from 800K to 1100K.
  - Imagine that the salt heats up by a reactivity insertion, and the rest of the core starts to warm up consequently.
- Then for every core graphite temperature we calculate reactivity for all salt the selections, core sizes from 2m to 7m, and two different lattice configurations (FoM and FoM at 15cm pitch).
- All cross-sections have been properly Doppler-broadened every 50K, including $S(\alpha,\beta)$ libraries.
FoM

2x2m cores, 5% gases

FoM $\rho = 15\text{cm}$

Graphite only

$\langle d\rho/dT \rangle = -4.401 \text{ pcm/K}$

Graphite only

$\langle d\rho/dT \rangle = -4.787 \text{ pcm/K}$
FoM

3x3m cores, 5% gases

Graphite only

$\langle d\rho/dT \rangle = -3.686 \text{ pcm/K}$

Graphite only

$\langle d\rho/dT \rangle = -4.573 \text{ pcm/K}$
5x5m cores, 5% gases

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FoM

\[ \text{Graphite only} \]
\[ \langle \frac{\text{d}p}{\text{d}T} \rangle = -2.463 \text{ pcm/K} \]
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FoM $\rho=15\text{cm}$

\[ \text{Graphite only} \]
\[ \langle \frac{\text{d}p}{\text{d}T} \rangle = -3.606 \text{ pcm/K} \]
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FoM

7x7m cores, 5% gases

FoM $p=15\text{cm}$

Graphite only

$\langle dp/dT \rangle = -1.856 \text{ pcm/K}$

Graphite only

$\langle dp/dT \rangle = -3.140 \text{ pcm/K}$
2x2m cores, 1% gases

Graphite only
\[ \langle d\rho/dT \rangle = -4.339 \text{ pcm/K} \]

Graphite only
\[ \langle d\rho/dT \rangle = -4.864 \text{ pcm/K} \]
3x3m cores, 1% gases

Graphite only
\[ \langle dp/dT \rangle = -3.702 \text{ pcm/K} \]

Graphite only
\[ \langle dp/dT \rangle = -4.526 \text{ pcm/K} \]
5x5m cores, 1% gases

Graphite only

$\langle d\rho/dT \rangle = -2.460$ pcs/K

Graphite only

$\langle d\rho/dT \rangle = -3.523$ pcs/K
FoM

7x7m cores, 1% gases

Graphite only

$\langle dp/dT \rangle = -1.971 \text{ pcm/K}$

Graphite only

$\langle dp/dT \rangle = -3.088 \text{ pcm/K}$
Conclusions

• Similar reactivity effects as seen with the BoC cores, shown on 2014-11-06.

• The slides have been posted: 
  http://web.utk.edu/~ochvala/MSR/

• Thank you for your attention!