Due: October 25, 2005

22.251 Systems Analysis of the Nuclear Fuel Cycle
Fall 2005
PROBLEM SET #6

1) Explain the behavior of the attached k-H/HM and B_1-H/HM plots in terms of basic reactor physics phenomena and principles. The plots show the initial effective (at zero burnps) and the reactivity-limited single batch burnup, B_1 as a function of the ratio H/HM of hydrogen to heavy metal atoms. The curves are all based on the standard Westinghouse 17x17 fuel geometry and dimensions. The variations in H/HM were obtained by arbitrarily changing the water density in CASMO. Address the dominant causes in each of the three regions designated, with emphasis on slope, minima and maxima.

2) What are the implications for operation in region (3) rather than (2) in Figure1 for
   - Core compactness
   -Reactivity control during a loss of flow and a loss of coolant accident

3) Consider the engineering aspects of the core design, where would you expect to draw lines in Figure 1 to represent heat transfer limiting lines for steady state operations.

4) Would you want the reactor to be designed at the point of maximum B_1 between (2) and (3)? Explain any considerations that you will have to consider

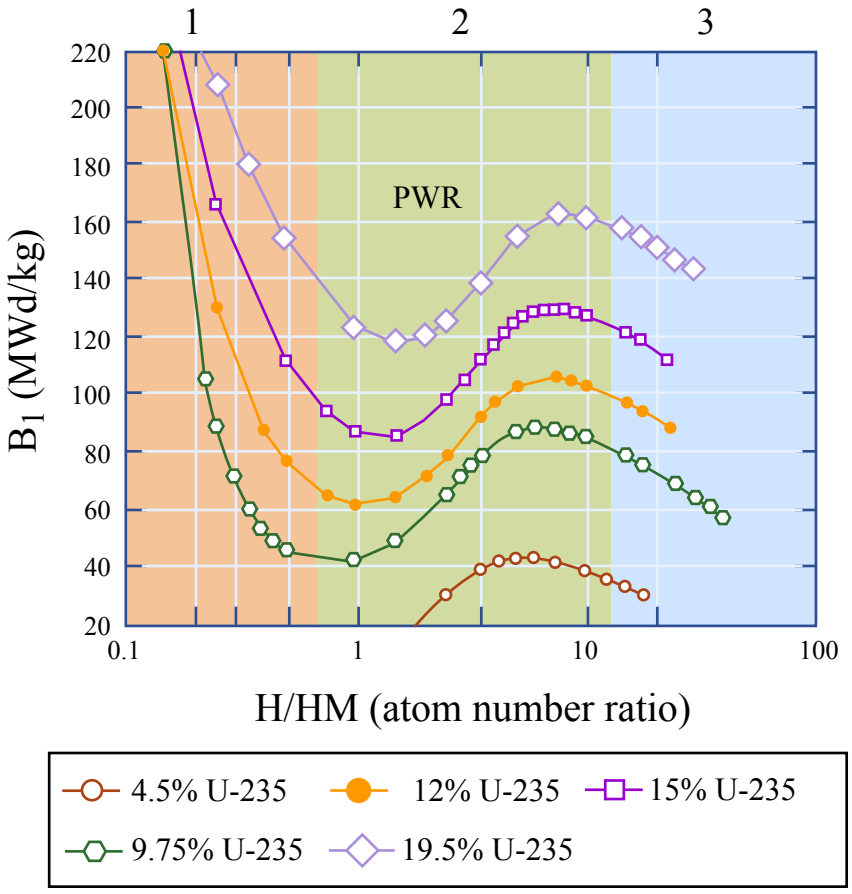

Figure 2. Reactivity-limited burnup as a function of hydrogen-to-heavy-metal ratio for uranium fueled lattices.

Fiigure by MIT OCW.

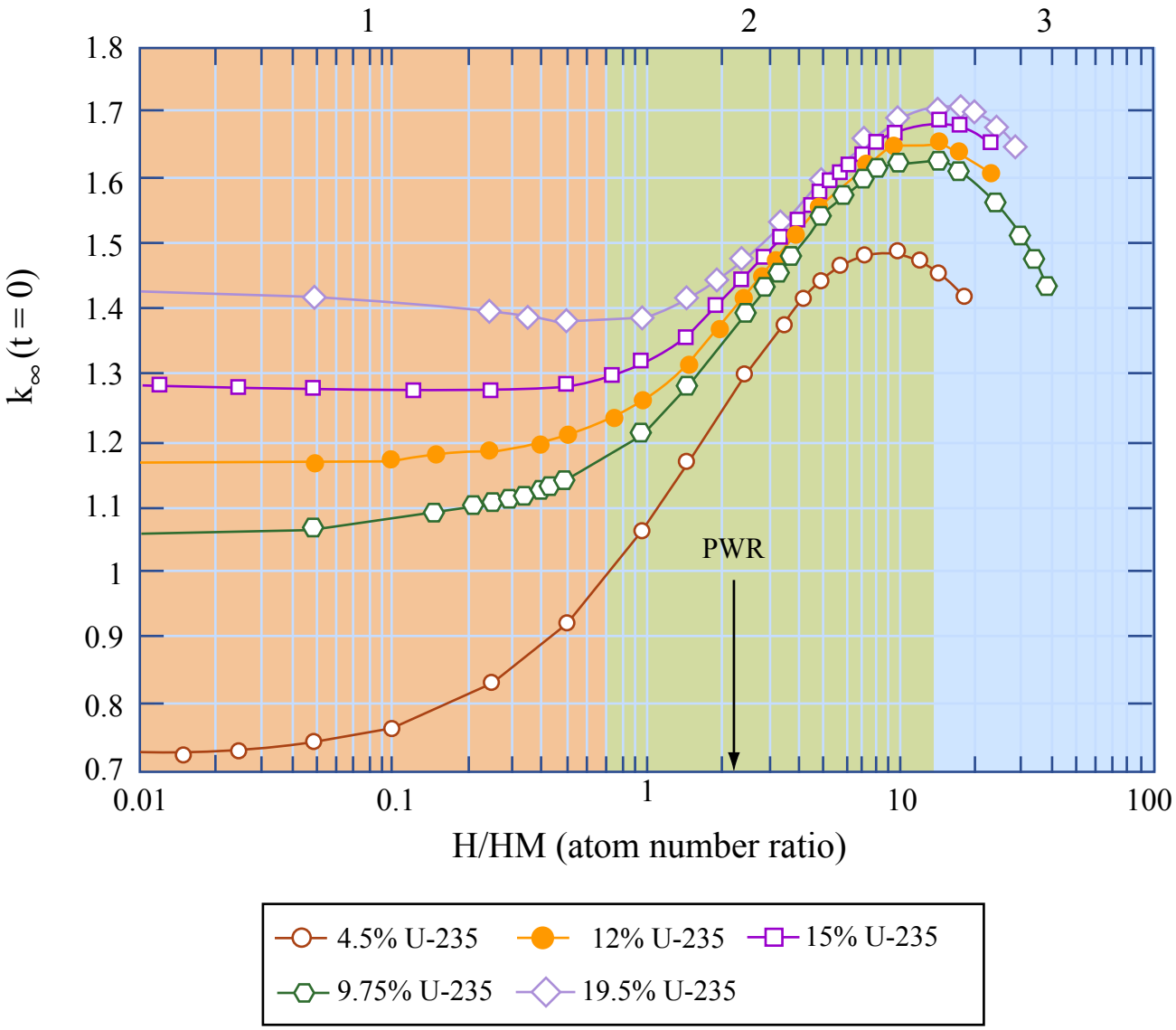

Fig. 1 ***Initial k_∞ as a function of hydrogen-to-heavy-metal ratio for uranium fueled lattices.***