

Massachusetts Institute of Technology
Department of Nuclear Science and Engineering
Oral Qualifying Exam, February 2015
Reactor Engineering and Thermalhydraulics Question

The DOE is interested in reducing the amount of discharged fuel that has to be stored while a repository program is being developed. Thus, it is proposed that future reactors be of a harder spectrum, so that the conversion ratio in the core can be close to one.

Three designs have been proposed:

- A Boiling Water Reactor that would have a higher void fraction in the core by at least 50% (from 40% to 60%).
 - A helium cooled, SiC clad fuel with exit temperature of about 750 C.
 - A sodium cooled, steel clad fuel with exit temperature of about 550 C.
- 1- How would you obtain the higher void fraction in the BWR core? What are the implications of your approach for the core size and the vessel volume?
 - 2- What power cycle would you choose for the gas cooled and sodium cooled reactors and why?
 - 3- How would you rank these reactor choices relative to:
 - a. potential for achieving reliable operation
 - b. potential for achieving a high safety margin.

For Reactor Engineering:

4. What are the major neutronic challenges you need to address in creating a BWR with a very hard spectrum?
5. Compare the pros and cons of the three approaches in terms of potential for the desired goal or reduction of the spent fuel volume

For Reactor Thermal-hydraulics:

6. How would you determine the appropriate safety margin for the operating power of the tight lattice core?
7. What are the major T-H challenges you need to address in creating such a BWR ?