Due: November 1, 2005

22.251 Systems Analysis of the Nuclear Fuel Cycle
Fall 2005
PROBLEM SET #7

(1) (a) What is the waste fee of 1 mill per kWhre (that utilities pay DOE for disposal of spent fuel) equivalent to in $/kg U when the thermal efficiency of a nuclear plant is 32% and the average fuel burnup at discharge is 33,000 MWD/TU.

(b) What is the effect of the rise in average burnup of discharge fuel to 45,000 MWD/TU on the disposal fees per kg U?

(c) What was the total of disposal fees collected in 1998 if the national nuclear electrical capacity was 101 GWe and the plants operated at an average capacity factor of 0.75?

(2) Compare the decay heat from discharged fuel of a 1000 MWe plant after 18 months of continuous operation at full load to the decay heat of discharged fuel from a plant that operated 0.5 yr before it shutdown for 0.5 yr then re-operated for 1yr before the fuel was discharged.

Compare the decay heats at (1) two months after discharge, (2) 1 yr after discharge and (3) 100 years after discharge.

Based on these results, how does the intermittent operation affect: (i) the required cooling of a storage pool? and (ii) the amount of heat to be deposited in the repository?

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C) We are to compare NFF on periphery to MOX

Advantages of NFF-OP

- Net destruction of PU+ is greater; less remains and will have an isotopic mix of poorer quality.
- On the periphery these assemblies will have much less of an effect on core properties such as moderate temperature coefficient and other safety parameters (importance is proportioned to ~ power squared)

Disadvantages of NFF-OP

- Development program needed to qualify fuel, whereas MOX is already fully proven for such service
- Because no new PU+ is bred (converted, less total energy is produced per kg of mind natural U.