22.251 Systems Analysis of the Nuclear Fuel Cycle Due: Oct 21, 2005
Fall 2005

Lab #3: CASMO-4 Assembly Calculations

Using the whole-assembly CASMO-4 PWR input given in class, answer the following:

(A) Calculate and plot $\rho(B)$ up to 60 MWd/kg with and without the burnable poison (Gd). Estimate the residual poison $\Delta\rho$ at high burnup.

(B) At zero burnup calculate the following reactivity feedback coefficients for gadolinium-poisoned fuel assemblies:
   (1) Moderator Temperature Coefficient, MTC, in units of $\Delta\rho$ per K by reducing moderator temperature 10 K from the reference value. Compare the boron-free MTC to the value when the coolant contains 1000 ppm boron.
   (2) Fuel Temperature Coefficient ("Doppler" coefficient), $\Delta\rho$ per K, by reducing the reference average fuel temperature to 600 K.
   (3) Void Coefficient, $\Delta\rho$ per %void, by reducing moderator density by 10%.

(C) Calculate the additional effects:
   (1) $\Delta\rho$ from cold zero power (CZP) to hot zero power (HZP) (i.e., isothermal moderator and fuel), between 30°C and 300°C.
   (2) $\Delta\rho$ from hot zero power to hot full power (HFP).
   (3) $\Delta\rho$ due to xenon buildup at HFP by burning for 100 EFPH (Effective Full Power Hours).

(D) Calculate the control rod worth: $\Delta\rho$ between water filled and Ag-In-Cd (AIC) rod filled guide tubes.

(E) Use these results to prepare your own "reactivity ladder" (attached in the next page).

Note: Questions (B), (C), (D), and (E) all assume poisoned fuel assemblies.

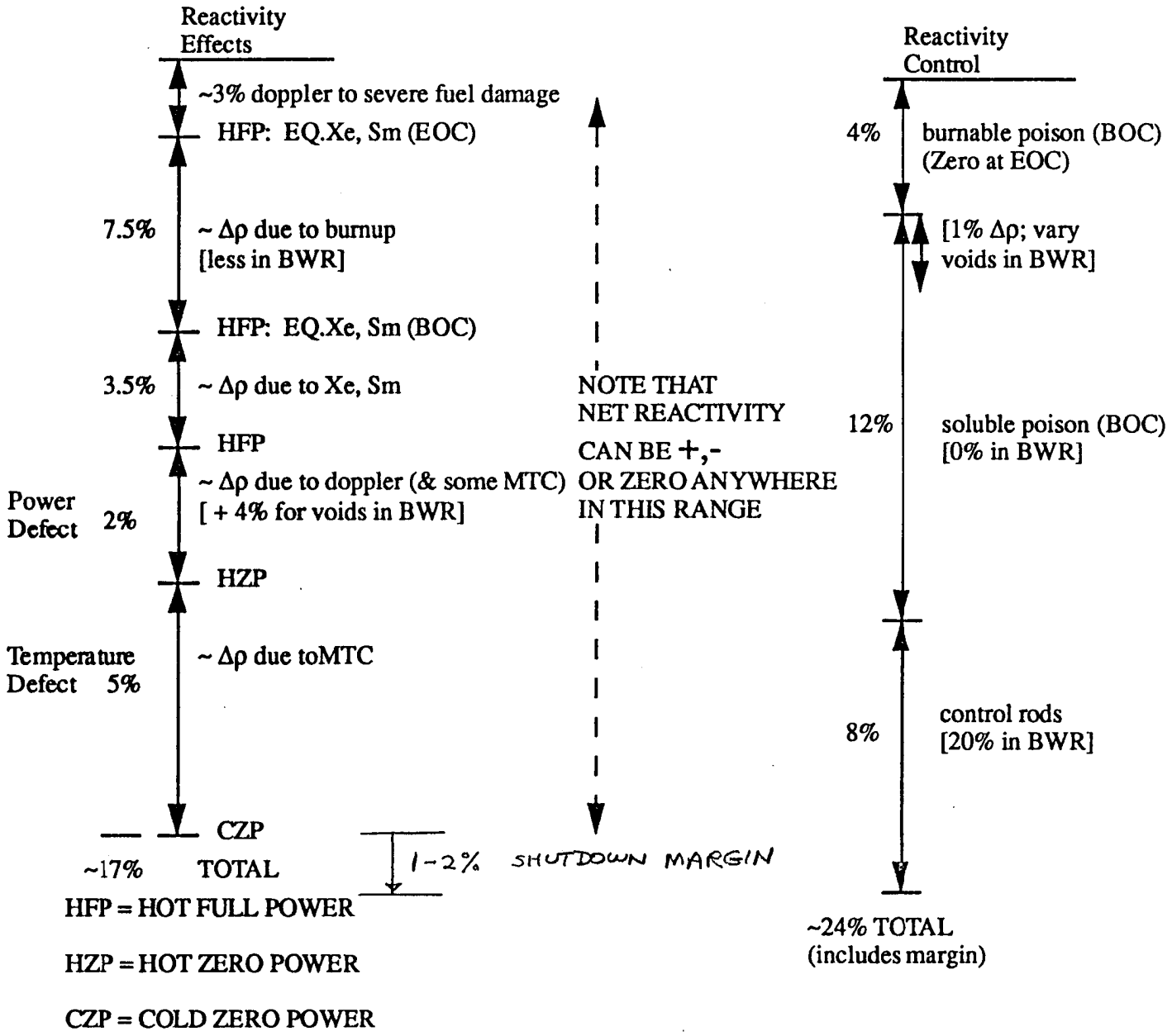

FIGURE APPROXIMATE REACTIVITY LADDER FOR LWR