A PWR with Once Through Steam Generators is critical at Hot Zero Power, BOC. Heat rejection is via the Turbine Bypass Valves (TBVs) operating in pressure control mode. The pressure set point is the same as the normal full power set point on the Turbine Control Valves (TCVs).

a) Prior to loading the turbine (i.e. TCVs closed) at about 15% reactor power, low power feed control is based on level inferred from a differential pressure measurement across the steam generator. Why is this controller used instead of the normal power range feed controller? Why does this level indication become problematic as power increases? How should the level set point be adjusted (i.e. up or down) as reactor power is increased to maintain the same boiling length? Justify your answer.

b) The reactor is brought to 15% power by withdrawing rods at a rate such that $T_{avg}$ increases by no more than 50 degrees per hour and power increases by no more than 0.5 Decades Per Min (DPM). Assuming an automatic rod controller exists that will withdraw rods according to this control algorithm, describe the response of the rod controller, TBVs, feed and pressurizer control systems during the power ascension.

c) The operator terminates the rod withdrawal by placing the rods in manual just prior to the reactor reaching 15% power and allows the system to stabilize. Describe the system response following termination of the rod withdrawal.

d) In preparation for loading the turbine, the Feed Control Valves (FCVs) are operating in their low power feed control mode, and rods are in manual. The TCVs are placed in their normal automatic control mode and the TBVs ramped shut. Describe the system response.

e) Once the system is stabilized, with the rods still in manual and the feed control via the low power feed controller, the turbine is loaded by initiating a 15% step increase in load. Describe the system response. Note: prior to loading the turbine, the turbine is spinning, but there is no electric demand (load) on the generator.

f) With the turbine loaded and rods still in manual, the switch is made to the normal power range feed controller. Assuming a slight mismatch between the low power feed controller and the normal power range feed controller such that the low power controller is over predicting the feed flow relative to the reference feed flow rate at the time of the switch, describe the system response. You can assume no shim is necessary in the power range feed controller.

g) In preparation for final power ascension, the rods are switched from manual to automatic. Describe the system response.