7.22. A reactor is cooled by circulating liquid through a heat exchanger that produces low-pressure (10 psig) steam. This steam is then split between a compressor and a turbine. The portion that goes through the turbine drives the compressor. The portion that goes through the compressor is used by 50 psig steam users. 100 psig steam can also be used in the turbine to provide power required beyond that available in the 10 psig steam.

Sketch a control concept diagram that includes all valve actions and the following control strategies:

(*a*) Reactor temperature is controlled by changing the setpoint of the turbine speed controller.

(*b*) Turbine speed is controlled by two split-range valves, one on the 10 psig inlet to the turbine and the other on the 100 psig steam that can also be used to drive the turbine. Your instrumentation system should be designed so that the valve on the 10 psig steam is wide open before any 100 psig steam is used.

(*c*) Liquid circulation from the reactor to the heat exchanger is flow-controlled.

(*d*) Condensate level in the condensate drum is controlled by manipulating BFW (boiler feed water).

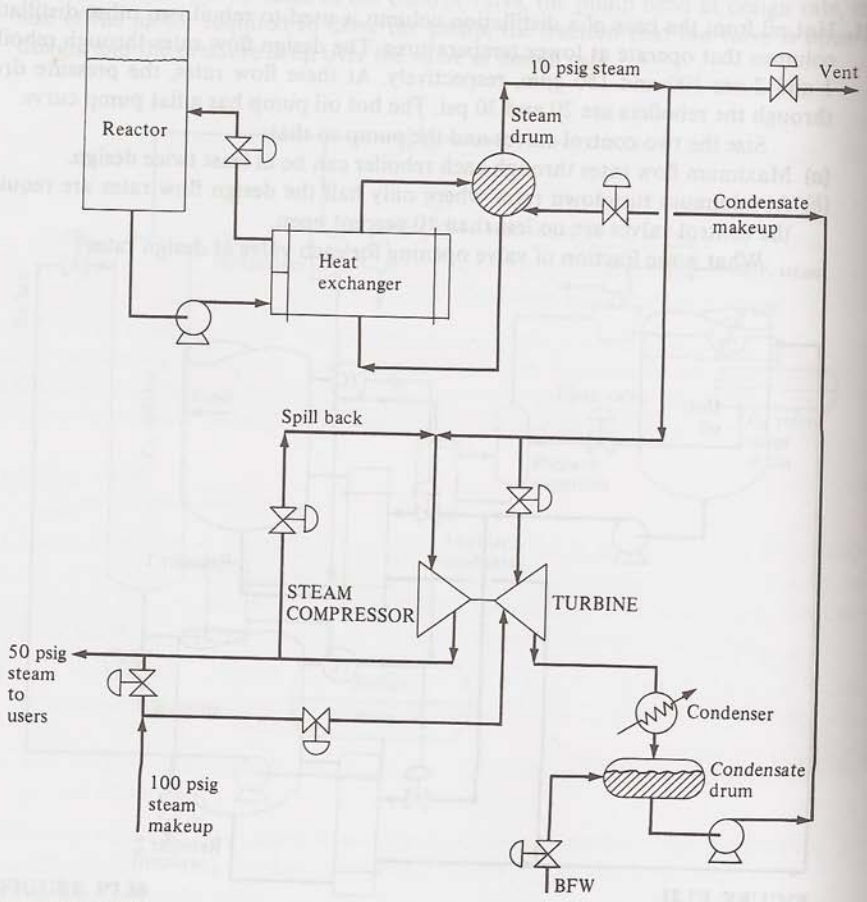

FIGURE P7.22

(*e*) Condensate makeup to the steam drum is ratioed to the 10 psig steam flow rate from the steam drum. This ratio is then reset by the steam drum level controller.
(*f*) Pressure in the 50 psig steam header is controlled by adding 100 psig steam.
(*g*) A high-pressure controller opens the vent valve on the 10 psig header when the pressure in the 10 psig header is too high.
(*h*) Compressor surge is prevented by using a low flow controller that opens the valve in the spill-back line from compressor discharge to compressor suction.