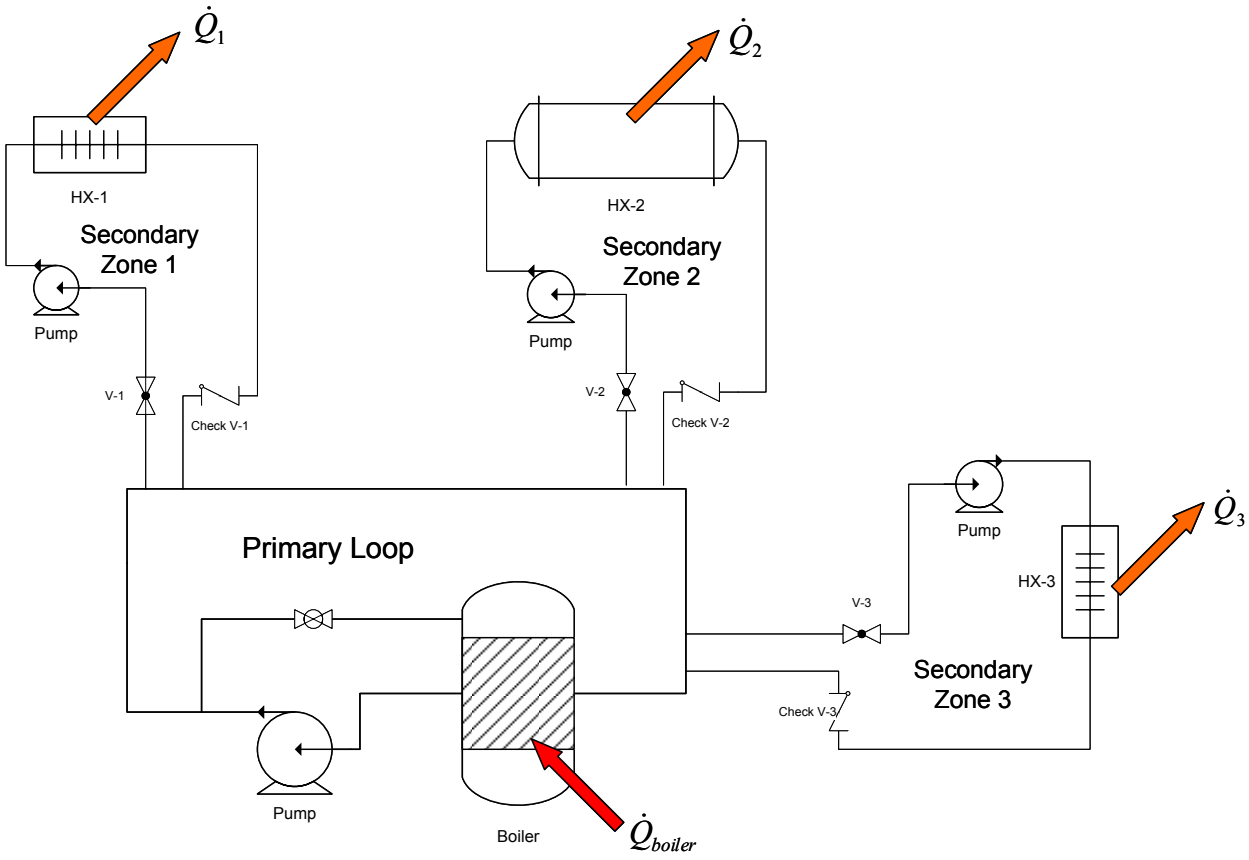
ME 4465 Thermal System Design

Design Project #3 **Fall 2018**
Due Monday, 5 November 2018 by 5:00pm

Project Description

You have been tasked with the design of a Primary-Secondary Water Loop System that will be used for a commercial heating operation. A schematic diagram of the system is given below.



Primary Loop: The maximum allowable water temperature in this loop will be 275 °F at a pressure of 50 psig. The equivalent length of piping (includes elbow and T-effects) for the primary loop is equal to 200D (i.e. the equivalent length of piping is equal to 200 times the diameter). The maximum fluid velocity is 7 ft/s.

Secondary Zone 1: The mean water temperature of zone 1 is 180 °F. The hot water will be used to heat air passing through the heat exchanger. The water will transfer 200,000 Btu/hr of heat to the air with a temperature drop of 20 °F. The air will enter the HX at 50 °F and exit at 85 °F. The maximum water velocity in this loop is 10 ft/s.

Secondary Zone 2: The mean water temperature of zone 2 is 150 °F. The hot water in this zone will be used to pre-heat a potable warm water system. Potable water at a flow rate of 5 gpm enters the HX at 50 °F and is heated to an exit temperature of 110 °F. The hot water will have a planned temperature drop of 30 °F. The maximum water velocity in this loop is 10 ft/s.

Secondary Zone 3: The mean water temperature of zone 3 is 120 °F. This hot water will flow through a tube/finned radiant heat exchanger to heat a room. The water will transfer 100,000 Btu/hr to the air with a temperature drop of 20 °F. The maximum water velocity in this loop is 10 ft/s.

Project Requirements

You are required to find the following information as part of your design:

1. Volumetric flow rate of water in the primary loop.
2. Pipe diameter of the primary loop.
3. Total boiler heat input (assuming no heat loss in piping).
4. Primary loop starting temperature (at discharge from boiler).
5. Secondary zone volumetric flow rates (for all 3 zones).
6. Common piping volumetric flow rates (between primary loop and all three secondary zones).
7. Secondary zone pipe diameters (for all 3 zones).
8. Heat Exchanger 1 air flow rate, type of HX, and HX size (product of $U*A_s$).
9. Heat removed from hot water in HX 2.
10. Type and size (product of $U*A_s$) of Heat Exchanger 2.
11. Size of Heat Exchanger 3.

Remember to provide proof of results by showing your calculations.

Deliverable

The deliverable for this project will be a bound memo report presenting the results of your design. Details and calculations will be included as an appendix.