District dilemma

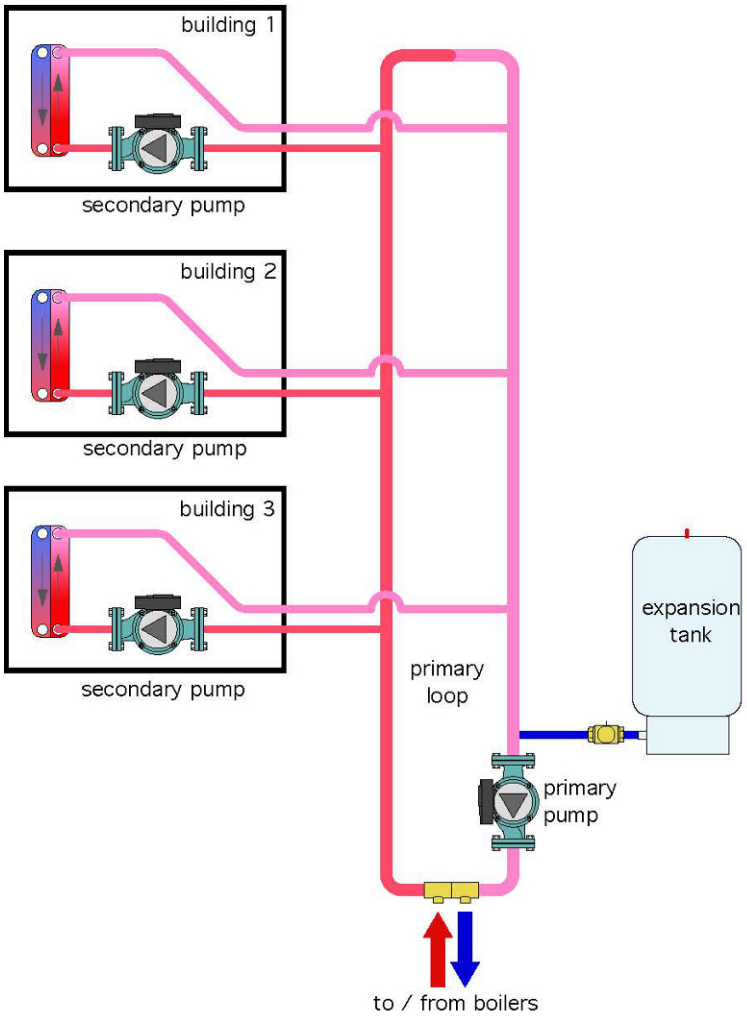
The Glitch

An engineer is planning underground insulated piping for a small district heating system, which receives heat from a central boiler plant and distributes it to three separate buildings. The engineer is planning what he calls a “primary/secondary” piping system, as shown in the Glitch drawing on the next page.

A primary loop from the boiler plant will connect to three separate secondary circuits, each with their own circulator. Each secondary circuit delivers heat to a heat exchanger within its associated building.

Controls will be configured so that that primary circulator will operate whenever any of the three buildings require heat. The secondary circulators within each building will only operate when their associated building requires heat.

Can you confirm that this is primary/secondary piping? Do you anticipate that the system as shown below will operate as expected? What (if any) changes would you propose?



Glitch drawing.

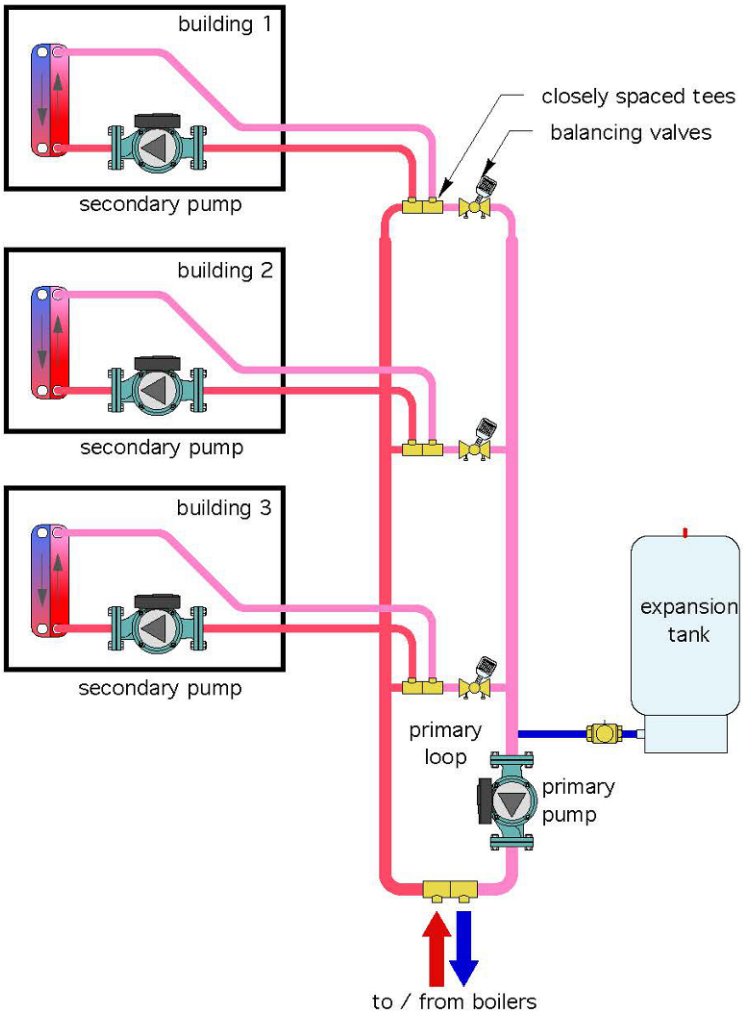
The Fix

The piping shown above is not primary/secondary piping. There is no means of hydraulic separation (such as a pair of closely spaced tees or a hydraulic separator) between the various circuits. This will lead to unexpected flows.

For example, imaging a scenario when Building No.1 requires heat and thus the primary loop is operating. However, Building No. 3 doesn't require heat during this time. A significant differential pressure will develop between the points where the "secondary" circuit for Building No. 3 connects to the primary loop. This pressure differential is caused by head loss along the primary loop piping. This pressure differential will push flow through the secondary circuit serving Building No. 3, even though the secondary circulator in Building No. 3 is off. Ditto for Building No. 2.

One could argue that heat flow to Buildings No. 2 and No. 3 could still be prevented if there were no flow on the secondary side of their respective heat exchangers. Still, allowing flow to develop through portions of the system that don't require it just wastes pumping energy and increases heat loss through the associated piping.

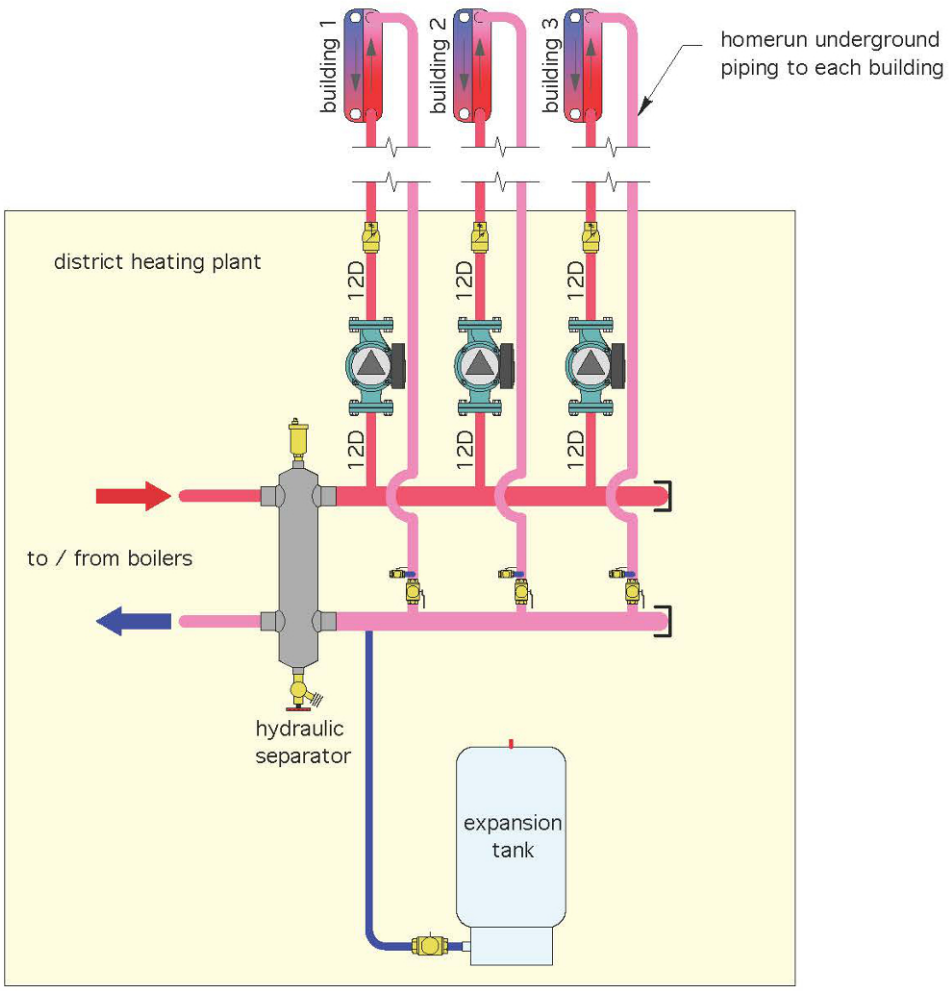
One solution is to modify the system into a true parallel primary loop configuration as shown in the first Fix drawing on the next page.



Fix drawing No.1.

This configuration provides the required hydraulic separation between all the circulators. However, it also requires access to the balancing valves on each of the three piping crossovers. For underground piping installations, this typically implies access pits. It can be done, but it certainly adds complexity and cost to the system.

A preferred solution is to use a homerun piping layout to each building as shown in the second Fix drawing on the next page.



Fix drawing No. 2.

This arrangement eliminates the need for a primary loop and a primary circulator, which certainly reduces installation cost as well as life-cycle operating cost. It also allows the potential for underground piping to run from the boiler plant to each building without need of access pits. Depending on the distance between the boiler plant and each building, it might even allow for “seamless” underground piping runs with no buried joints.

Finally, this approach allows the secondary circulators to be located in the boiler plant rather than the individual buildings. This would simplify wiring, controls and centralize maintenance.

A central hydraulic separator, in combination with short and generously sized headers, provides excellent hydraulic separation between all the circulators. It also provides air and dirt separation for the system.