

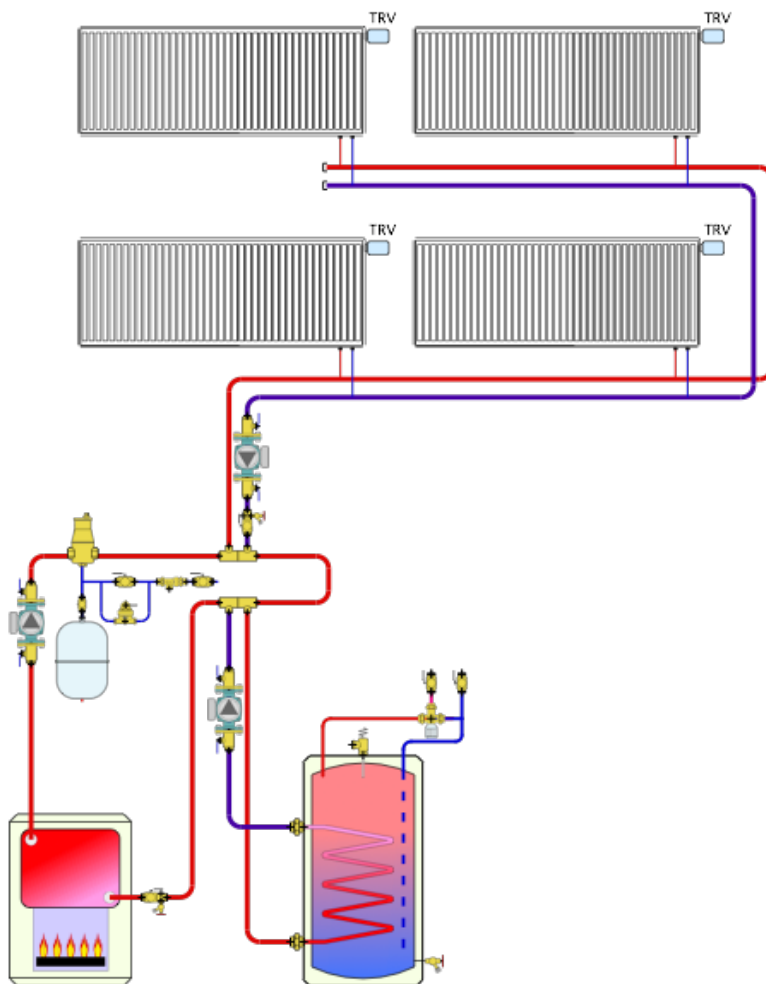
Overwhelmed

The Glitch:

Figure 1 shows a hydronic system that's intended to supply four panel radiators, each with its own thermostatic radiator valve, and an indirect water heater from a gas-fired sectional cast-iron boiler. The system is designed using primary / secondary piping. The primary circulator operates whenever the space heating load or the indirect water heater call for heat.

- A. Can you spot at least five details that are incorrect?
- B. Beyond the incorrect details, can you describe ways to provide the same radiators and water heater using fewer components?

➤ Figure 1



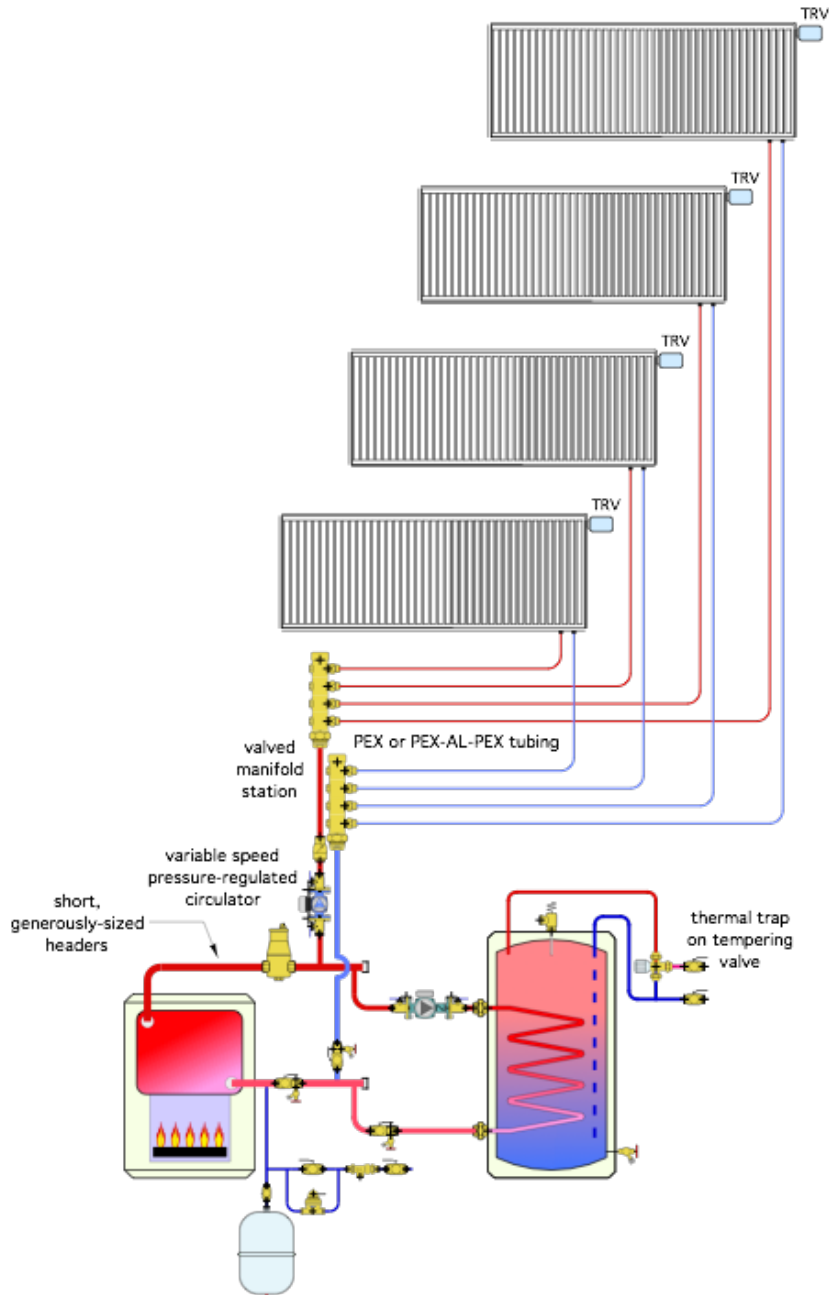
The Fix:

Before reducing component count, here's a listing of the errors in the original system:

1. The primary circulator is pumping toward, rather than away from the point of no pressure change (e.g. where the expansion tank connects to the system).
2. The secondary circulators are both pumping toward, rather than away from the primary loop. This is incorrect because each secondary circuit "sees" the primary loop connection as its point of no pressure change (because the expansion tank is in the primary loop). Therefore, all secondary circulators should pump into their respective secondary circuits.
3. The heat exchanger coil within the indirect water heater is not piped for counterflow. The hot water should always enter the top connection of the coil.
4. There is no thermal trap installed on the thermostatic tempering valve of the indirect tank. This will lead to thermosiphoning and wasted energy.
5. Assuming primary / secondary piping is used, the indirect tank should be the first load connected to the primary loop, and thus able to operate with the highest available water temperature.
6. The purging valve is missing on the return side of the secondary circuit serving the indirect water heater.
7. There is no means of differential pressure control within the zoned secondary circuit serving the panel radiators.
8. The lack of check valves in the secondary circulators will allow for heat migration. As shown, the indirect water heater will use its secondary circuit piping to continually dump heat to its surroundings.

Figure 2 shows what I consider to be an improved design that provides the same functionality, and eliminates one of the circulators required in the previous approach.

➤ [Figure 2](#)



Although a primary / secondary piping system could work in this application, there's a simpler way to achieve the same functionality. The low head loss boiler and generously sized header piping provide sufficient hydraulic separation between the two load circuits, even when one of the loads operates with a variable speed circulator. Just keep the headers relatively short, and sized for a maximum flow velocity of 2 feet per second. This approach eliminates the installation and operating cost of a primary circulator.

Another change is use of a pressured regulated circulator within the circuit serving the zone panel radiators. This eliminates the need of a differential pressure bypass valve and significantly reduces operating cost compared to a fixed speed circulator. Today, it's likely to be less

expensive to install a pressure regulated variable speed circulator than it would be to install a fixed speed circulator along with a differential pressure bypass valve. A check valve is included in this circuit to prevent reverse flow when the indirect water heater load is active.

The panel radiators are now supplied by PEX or PEX-AL-PEX tubing using a home run distribution system. This is likely to install faster and at a lower cost relative to the hard piped 2-pipe direct return system on the original drawing.

A thermal trap is shown on the piping leading to the thermostatic mixing valve on the indirect water heater.

Because of the very low hydraulic resistance of the boiler and headers, it is possible to locate the system's expansion tank on the inlet of the boiler where its temperature will remain a bit cooler, and thus its internal air pressure will be less effected by the elevated water temperature in the system.