February 2014, The Glitch and The Fix

It's just like a boiler

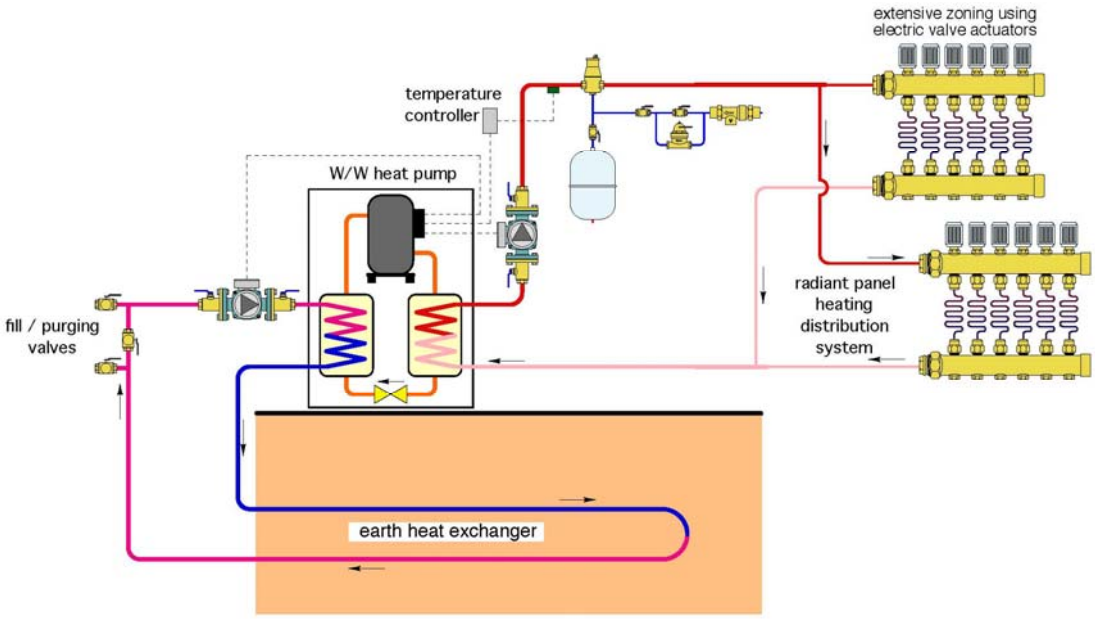
The Glitch

A homeowner asks his local heating installer if a geothermal heat pump can be combined with radiant floor heating. He responds: "No problem, it's just a matter of using the heat pump like a boiler."

The system he creates is shown below. It's meant to supply a dozen independently controlled zones of low-temperature floor heating. The geothermal water-to-water heat pump is a single-speed unit with a rated output of 60,000 Btu/hr. It has plenty of capacity to handle the design heating load of the building.

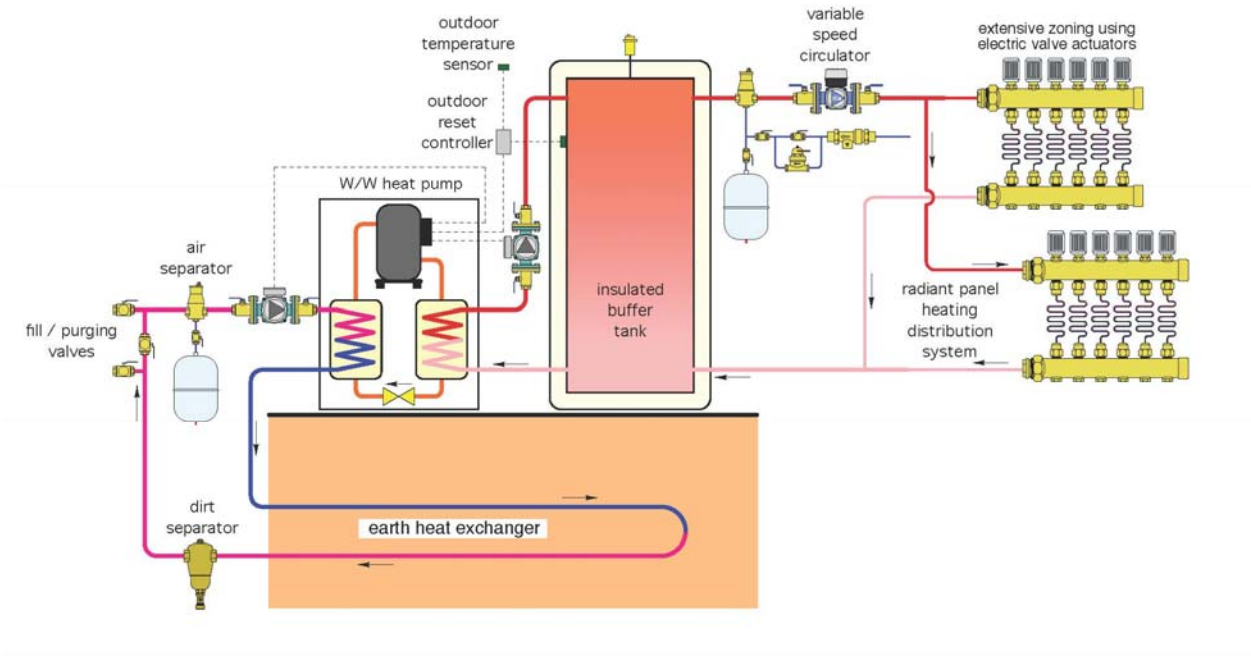
When an end switch in any of the manifold valve actuators closes, a controller starts monitoring the supply water temperature to the distribution system. It turns the heat pump on if the supply temperature drops below 100° F and off it the supply temperature reaches 110°.

So what's wrong with this system design?



The Fix

The single-speed heat pump will respond just like a fixed-capacity boiler. Whenever there is a call for heat from a zone, it will turn on. Most of the time it will generate heat at a rate greater than the rate of heat dissipation by the active zone(s). The combination of an on/off heat source, lots of zoning and a low thermal mass distribution system will almost certainly lead to short-cycling of the heat pump. This is especially hard on the compressor and the compressor contactor.



The system needs thermal mass. That mass has been added as a well-insulated buffer tank. It also should have an expansion tank and air eliminator on the earth loop. I also like to specify a low-velocity zone dirt separator within the earth, as shown on the Fix drawing.

Because of the extensive zoning using valve actuators, the distribution system would benefit from a variable-speed, pressure-regulated circulator that can instantly adjust to changing flow requirements. The temperature in the buffer tank can be regulated with an outdoor reset control in response to outdoor temperature. This allows the heat pump to operate with the lowest possible supply water temperature and, thus, the highest possible efficiency.