Tweaking Torrington's Combined RO Plant

Torrington Wyoming is a farm community located in the fertile North Platte River basin. The water department recently completed a new water plant to provide high quality water to the town residents. In the past, Torrington utilized remote wells with small Reverse Osmosis filters at each well. With the new water system, new wells were drilled at the golf course, and then all four of the small RO units were re-located to the central water plant. The challenge of this system was keeping the correct flow from four wells on Variable frequency drives (VFDs), through four RO skids each with VFD control, and distributed through four High Service pumps on VFDs. To use an analogy, **balancing this system was a bit like trying to drive a car with 12 different gas pedals!**

Here is a short list of the components in the system:

- 3 Golf Course wells and one back up well, each controlled with Motorola Moscad radio telemetry units and VFD pump speed control.
- 4 RO Skids of various sizes controlled with Allen Bradley SLC programmable logic controllers and VFD flow control.
- Large pipe gallery for blending permeate water with well water
- 2 finished water "blend" tanks at WTP to store the blended RO/well water
- 1 Permeate tank to rinse RO filters
- 4 High service pumps
- 4 Potable water tanks in distribution system
- 2 Booster Stations

New Torrington WTP
Showing Four RO skids

Scott Coulson from Timber Line Electric and Control explained some of the control details that had to be worked through. "The system demand needed to be coordinated with the level of the "blend" tanks at the water plant, the flow rates from the wells, and the blending rates of permeate water with well water. The central computer is the only point where all of this data comes together."

The following calculations were required:

1. Total system demand based on hourly calculations of water volume in distribution tanks, and totals from all four high service pump flow meters
2. Flow capacity of the RO units currently "in service" with allowance for 25% loss to concentrate waste (this is variable depending on water quality)

3. Blending rates between well water and permeate, usually set at three parts well water to one part permeate (this rate is operator selectable depending on water quality)
4. Well production to match system demand with flexibility to allow for "out-of-service" wells.
5. High service pump flow cannot significantly exceed well capacity or RO plant capacity
6. Permeate tank must be refilled after each RO flush cycle

Here is a sample of the final control:
If system demand is 2000 GPM, then WTP must produce 120,000 gallons of finished water in one hour. If three RO units are available to run, they will process 1400 gallons of raw water per minute, with finished permeate of 1100 GPM. This is blended at a ratio of 3 parts well water to one part permeate resulting in 4400 GPM total plant production. The ratio is controlled by an analog output to the solenoid on the mixing valve. Given these variables, the RO filters will need to run about 28 minutes of each hour. Each RO filter is rinsed, in consecutive order, after each filtration cycle. Rinse cycle cannot commence if Permeate tank is low.

Blending Pipe Gallery Showing Valve

Total demand from well field in this example is 4700 GPM for 28 minutes of each hour. This load is then split primarily between the three golf course wells with VFD set points being transmitted over the radio for each well. If necessary, the computer can vary the pumping rates for each well.

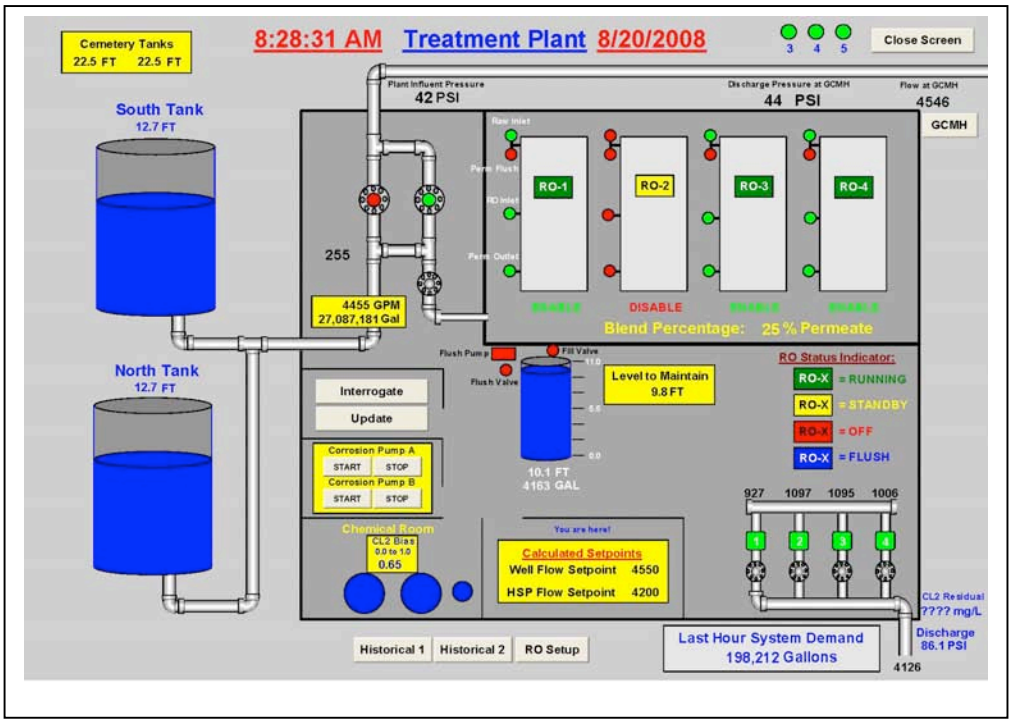

High Service Pumps

The High Service Pumps are allowed to pump to the distribution system based on system demand and the level of the blend tanks. If blend tanks are depleted, High Service Pumps will turn off, but RO plant continues to run until Blend tanks are refilled. Ideally, the effluent flow rate through the high service pumps is matched to the higher ratio of flow rate from the wells. If needed, the flow rate through the high service pumps can be controlled via VFD speed control. This is helpful if one pump is out of service.

Coulson further noted: "Now that all the RO skids are in one building, the system is a bit easier to manage because of the buffering capacity of the blend tanks. It allows us to have one point of demand to turn on the wells and RO skids."

Tom Troxel, manager of the Torrington Water Department says, "Without the assistance and knowledge of the entire Timberline Team this plant would probably not be operational today. It is my recommendation to all water districts to have your instrumentation integrator involved with any project, small or large, from the initial design, to plan reviews, construction meetings and start-up. They may end up saving you a lot of time and money! If you are lucky enough to have a really good integrator, they can bring a lot of value and expertise to your projects."

Tom also noted that, "It helps to have your staff involved in the final product. Our operators Chris Powell and Jeff Craig helped to think out all of the 'What if?' scenarios with the various flow controls such as, 'What if one of RO units shuts down during a high-demand event?' These brain storming sessions helped to prevent some big problems. Jeff also helped to design the graphics for the computerized display. This makes them very 'user-friendly' for the operator on duty."



The final steps in this excellent plant process are data-logging, reporting, and creating data back-ups. The data allows the City to compare maximum demand with maximum supply. It is worth noting that a back-up computer is being requested in the Water Department's 2009 budget. With the many calculations and data transfers between raw water collection, plant process, and the distribution system being handled by the computer, redundancy is always a good idea!