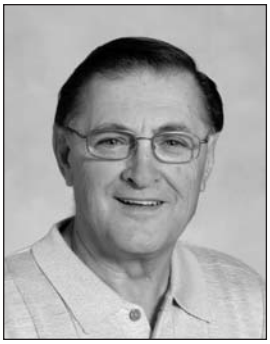
by Bert Zerr

Russell completes new electrodialysis reversal water plant

The city of Russell, located in the west-central part of the state is the Russell County seat. It is located at the intersection of two major highways, Interstate 70, a long east-west interstate highway and U.S. Highway 281 which is a north-south route extending from Brownsville, Texas, the extreme southern tip of Texas to Dunseith, North Dakota at the Canadian border. The city was incorporated in 1872 and is the largest city in the county with a population of about 4,500. The economy of Russell and Russell County is primarily agriculture but the area is also widely known for being one of the leading counties in the production of oil in the state of Kansas. Russell is also famous for being the boyhood home of two well known U.S. senators, Bob Dole and Arlen Spector.



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The city of Russell currently utilizes two sources of water: surface water from Big Creek in the Smoky Hill River Basin and groundwater from the Pfeifer well field located about 22 miles southwest of town. The nine Pfeifer wells are shallow wells at about 50 feet in depth. The city constructed their original clarification/softening plant in 1935. Various upgrades were made in the 1960s and 1990s. However, due to the limited capacity of the original plant during high usage times, the city made the decision to explore alternative treatment methods.

The firm of Bartlett & West, Inc., Topeka, Kan., was retained to assist with the selection and eventual design of a treatment process. City officials took an active interest in the process. After visiting various plants across the country, the city chose to utilize an electrodialysis reversal (EDR) plant to soften well water and to continue utilizing the existing clarification/softening plant to treat surface water. Factors considered in selecting the EDR process over other processes include less overall loss of water

Left: *Russell Public Works Director Arlyn Unrein explains that operators can control finished water quality by adjusting the amount of electricity being applied to the EDR units.*

Below: *This highway sign on the way to Russell, Kan. advertises the political heritage of Russell and the community pride in two of the city's favorite sons.*

Left: *The chlorine dioxide generator is shown in the main plant room. Chlorine dioxide is being used to oxidize iron and manganese for removal later.*

Below: *The front of the EDR units shows the piping system and train activity lights alerting operator of pressure in the unit. (circle)*

Below right: *The onsite generator is a 600 KW electrical generator with 1,220 HP diesel engine. Public Works Director Arlyn Unrein points out that engine block heater that allows the system to be at full power in five seconds.*

(about 15%), less pressure requirements, (about 35 to 40 psi) to force water through the membranes, and greater flexibility and adaptability than other options. As noted by LaVene Brenden, project engineer for Bartlett & West, Inc., "This option is infinitely variable especially when considering potential future sources of water."

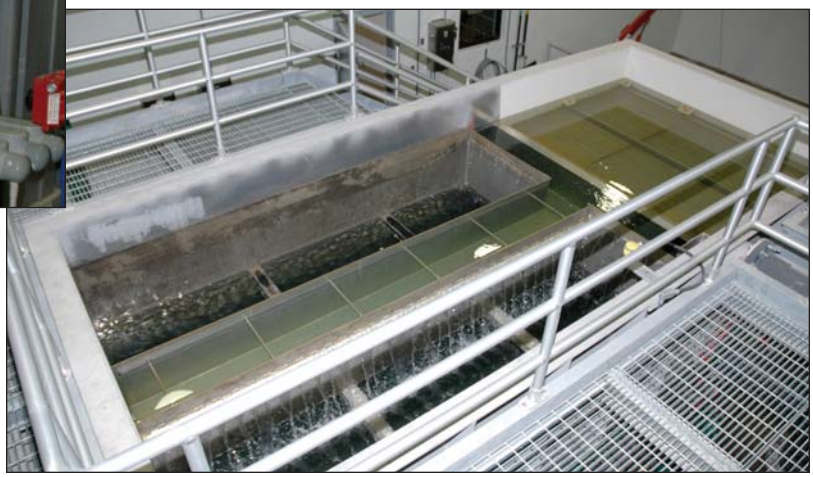
Exactly what did Russell build and what is an EDR process?

The $5.2 million project basically increased the overall plant production capacity from 1.3 million gallons per day, which is the original plant capacity, to 2.5 million gallons per day. The new plant was placed into operation in March of 2008. The plant is located adjacent to the original plant. With a capacity of 1.2 million gallons per day the city has the flexibility to take one plant off line if necessary during all but the highest water usage days.

The first treatment process in the new plant, which treats well water from the Pfeifer well field, consists of three WesTech ClariCell™ package units to remove oxidized iron and manganese. Chlorine dioxide is utilized as the oxidant and is injected into the water line prior to entering the ClariCell™ units. Each package unit contains an upflow clarifier followed by a dual media filter to remove iron and manganese precipitates. Filter backwash water is stored in a backwash pit where solids are allowed to settle. Clear water is returned to the filters and solids are discharged to the sanitary sewer. Also, with the addition of the Pureline chlorine dioxide generator in this project, the city was able to utilize chlorine dioxide as their primary disinfectant at the original surface water treatment plant to further control disinfection byproducts in the finished water.

Treated water from the ClariCell™ units flows to a below ground storage basin. Water from this basin is pumped through a set of cartridge filters, then to the

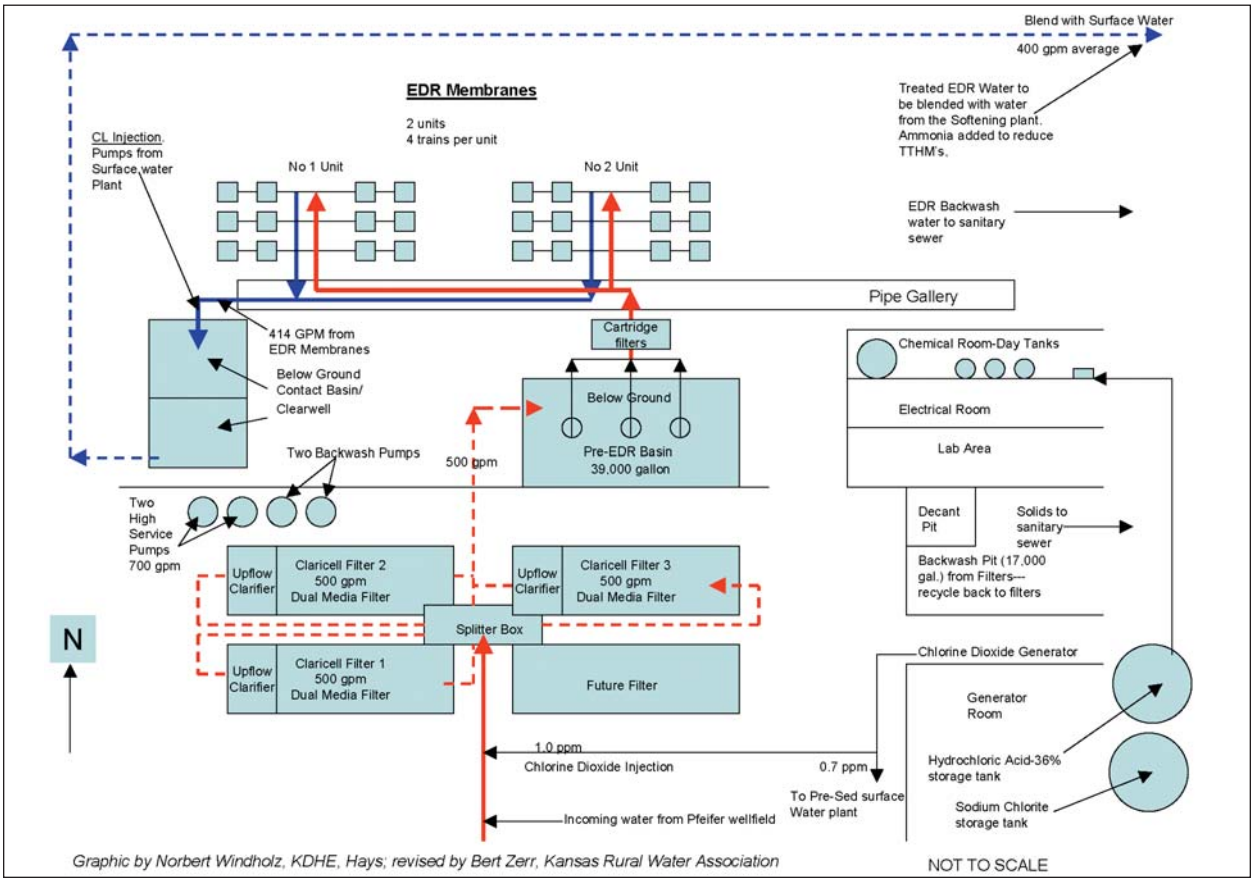
EDR membrane units. GE Water & Process Technologies supplied the units at Russell. The EDR plant layout has eight trains in two individual units (four trains per unit). There are three stack pairs per train. The stacks each contain about 600 membranes. Each membrane surface is either positively or negatively charged and during installation, a spacer section is placed between the two electrically charged membrane surfaces of opposite polarity. The EDR process uses electrode polarity to automatically clean the membrane surfaces. For



Above: *The trains are composed of stacks of membranes. Arlyn Unrein, Public Works Director, opens the end of an EDR unit showing the stack of membranes that removes total hardness.*

Right: *This is a top view of the ClairCell™ unit with upflow clarifier and dual media filter that removes oxidized iron and manganese.*

Below: *Water plant schematic shows EDR process.*



example, at the Russell plant, routine operation is to allow normal flow through the membranes for about 20 minutes followed by a one minute electrical ion exchange during the cleaning process. This process continues with part of the waste stream being returned and rerouted through the membranes.

well field is about 600 mg/L. Treated water from the EDR plant is about 100 mg/L in TH. However, when blended with water from the original plant, TH in the water to customers is around 120 mg/L. The overall treatment efficiency at the EDR plant can be controlled by varying the flow, which is monitored and

with the new plant and are taking a special interest in plant operation and maintenance."

Another part of this project included standby power in the event of a power failure. A 600 KW generator powered by a 1,220 HP Cummins diesel engine was installed on site. The unit is exercised weekly and can be

Above left: *Cartridge filters are seen here with EDR units in the background. These filter vessels are used as prefilters to the EDR units.*

Right: *This is an EDR unit back side view.*

Left: *The cartridge filters pictured here are are packed inside the cartridge filter vessels.*

Doug Langhofer, Water Production Superintendent, explained, "Currently, flow to the EDR units is about 470 gpm with about 415 gpm of treated water being blended with treated surface water from the original plant. About 55 gpm of waste water with total hardness (TH) of 7,000 milligrams per liter (mg/L) is being discharged to the sanitary sewer. Raw water TH from the

controlled by SCADA systems, or by making adjustments at the rectifier panel."

Arlyn Unrein, Public Works Director, said, "The rectifiers allow the operator to control the amount of electricity being applied to the EDR units to control water quality. The plant has not been in operation long enough to determine actual operational costs, especially chemical and electrical, but we think that it will be comparable to other filtration units." Arlyn and Doug agreed with each other saying, "Overall, operational staff are very satisfied

brought up to full power in five seconds.

The $5.2 million project was funded by a $400,000 community development block grant and loan from the Kansas Public Water Supply Loan Fund. Water rates to customers increased from 42.5 cents to 52.5 cents per 100 gallons for water usage up to 5,000 gallons. The current rate schedule consists of a basic customer charge of $22.50 plus 52.5 cents per 100 gallons for usage up to 5,000 gallons. The city utilizes an increasing rate for residential customers using water in excess of 5,000 gallons. The rate increases to 54 cents per 100 gallons for usage of 5,001 to 15,000 gallons; 59 cents for usage of 15,001 to 25,000 gallons; and 66.5 cents for all usage above 25,000 gallons.