Project Background

- Sandoval County drilled two exploratory wells in 2007 in Rio Puerco Basin/SE portion of San Juan Basin.
- Penetrated brackish water aquifer 3500 below ground surface.
- Brackish water under artesian pressure (over 150 psi) and 150 degrees Fahrenheit.
- Well 6 production capacity approximately 600 gpm.
Project Purpose

- Sandoval County proposed to develop a wholesale water utility
- Provide water to the City of Rio Rancho (5 MGD)
- Provide water to sustain growth over next 40 years in the area
- No other sources of potable water in the area
Water Chemistry

- Brackish water defined by concentration of total dissolved solids
  - Fresh water <1000 mg/L
  - Brackish water: 1000-10,000 mg/L
  - Seawater: 30,000 mg/L
- Sandoval County TDS: 12,000 mg/L
Water Chemistry

◆ Constituents of Concern

❖ TDS -12,000 mg/L
❖ Hardness – 1500 mg/L (100 mg/L acceptable for drinking water systems)
❖ Calcium- 450 mg/L
❖ High Alkalinity -1800 mg/L
❖ Bicarbonate- 1800 mg/L
Water Chemistry

- Arsenic – 635 ppb (over sixty times MCL)
- Radium- 80 mg/L (sixteen times higher than MCL)
- Boron -9.7 mg/L (nearly twice as high as that found in seawater (5 mg/L)
- Carbon dioxide gas -1900 mg/L
Treatment Challenges

- $\text{CO}_2$ and $\text{H}_2\text{S}$
- Arsenic and radionuclides
- Hardness (calcium and magnesium)
- Alkalinity
- Boron
- High temperature
Treatment Processes

- Aeration to remove CO$_2$ and H$_2$S
- Coagulation/sedimentation to remove arsenic and radium
- Warm lime softening to reduce hardness and alkalinity
- Granular filtration to remove solids
- Ion exchange to remove remaining hardness
- Reverse osmosis to remove TDS and boron
- Cooling towers to reduce temperature
Treatment Goals

- Produce 5 MG of potable water meeting EPA Drinking Water Standards
  - Reduce TDS to <500mg/L
  - Reduce arsenic to < 8 ppb
  - Reduce hardness to 100 mg/L
  - Reduce radium to < 16 pCi/L
- Selective recovery of treatment by-products
  - Sodium chloride (NaCl)
Bench Scale Testing

- Conducted in June 2009
  - Determine pre-treatment processes
  - Focus on hardness, alkalinity, TDS, and removal of arsenic and radium
  - Determine dosages of pre-treatment chemicals
  - Estimate chemical usage and volume of treatment system waste products
Pre-Treatment Process Train

- Raw Well Water
- Energy Recovery
- Dissolved Gas Stripping
- Dissolved Gasses
- Arsenic & Radium Removal
- Warm Lime Softening
- Media Filtration
- Zeolite or WAC Ion Exchange
- Reverse Osmosis
- Treated Water

- Re-Calcination
- Recycled Lime
- Lime Make-up
- Solids Bleed-off
- Ion Exchange Regeneration Waste
Pilot Testing

- Conducted September – November 2009
- Evaluated pre-treatment processes and RO system
- Generate water quality projections for product and waste streams
- Establish design criteria and operating conditions for full-scale plant
Pilot Testing Parameters

- Caustic soda used in softening process instead of lime
- Coagulation and softening occur in same contact clarifier
- WAC ion exchange to remove remaining hardness and divalent ions
- High Efficiency Reverse Osmosis process using both brackish water and seawater membranes (4 stage process)
- 80% recovery target for RO process
Pilot Testing Trailer and Equipment
Pilot Testing Trailer and Equipment
Pilot Testing – RO Process
Pilot Testing – Clarifier/Softening Process
Pilot Testing – Clarifier/Softening Process
Pilot Testing – Holding Pond
Pilot Test Results – Pretreatment Processes

- Pretreatment processes successful
  - Hydrogen sulfide and CO₂ reduced in aeration
  - Arsenic and radionuclide reduced in coagulation/sedimentation
  - Significant hardness removal in warm lime softening process
  - Effective radionuclide removal in softening and granular filtration processes
  - Ion exchange effective in reducing remaining hardness
Pilot Test Results – RO Process

- RO Process Successful
  - Achieved 80 percent recovery
  - TDS reduced to < 200 mg/L
  - Boron removal from 9.7 mg/L to 3 mg/L
  - Concentrate contained primarily sodium chlorides and sodium sulfates
  - Permeate requires stabilization to reduce corrosiveness of water
  - Cooling required before introduction into system
Conclusions

- Brackish water supply can be treated to meet EPA Drinking Water Standards
- Significant pre-treatment required before RO process
- Significant challenges with disposal of waste products
- Possibility of beneficial recovery of by-products, namely sodium chloride
Conclusions

- Estimated construction cost of full scale 5 MGD plant - $62.4 million
- Estimated annual O&M - $15.2 million ($6.75/100 gallons)
- Funding challenges
Questions and Comments