Water and Energy in Arizona

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Outline

- 91st Avenue Wastewater Treatment Plant
- Palo Verde Water Reclamation Facility (WRF)
91st Avenue Statistics

- Capacity 204.5 MGD
  - 229,000 AF/year
- Treating 135 MGD
  - 152,000 AF/year
- 65,000 AF/year to Palo Verde
  - Palo Verde receives and additional 5,000 to 10,000 AF/year from the cities of Tolleson and Goodyear
- 30,000 AF/year to Buckeye Irrigation
- 28,500 AF/year to Tres Rios Wetlands

An acre foot of water = 325,851 gallons
Nuclear Plant Water Use

- Primary Loop
- Secondary Loop
- Tertiary Cooling Loop
Because of its desert location, Palo Verde is the only nuclear power facility that uses 100 percent reclaimed water for cooling. Unlike other nuclear plants, Palo Verde maintains “Zero Discharge,” meaning no water is discharged to rivers, streams or oceans.
The Palo Verde Water Reclamation Facility (WRF), is a 90 MGD tertiary treatment plant that reclaims treated secondary effluent from the cities of Phoenix, Scottsdale, Tempe, Mesa, Glendale and Tolleson.
Conveyance System

28.5 miles of gravity flow with 100-foot elevation drop, 8 miles pumped flow with 150-foot elevation increase

22.5 miles of 96” gravity flow pipe
8 miles of 114” gravity flow pipe
8 miles of 66” pressure flow pipe

Hassayampa Pump Station

Phoenix-area Water Treatment Plants

6 miles of 114” gravity flow pipe
Inspection and Maintenance of 36-mile Pipeline
Processing WWTP Effluent

Cooling Water Treatment Systems

INFLUENT FROM WWTP

TRICKLING FILTERS

PUMP STATION

Cold Process Lime and Soda Ash Softening for Reduction in Scaling Potential

CHEMICAL STORAGE, MIX AND ADDITION SYSTEMS

Lime Slurry
Soda Ash
Carbon Dioxide
Sulfuric Acid

CHEMICAL SOLIDS HANDLING

100 tons/day average

ON SITE LANDFILL

43 KGPM Average
60 KGPM Summer
28 KGPM Winter

PUMP STATION

COOLING TOWERS

GRAVITY FILTRATION

STORAGE 1.16 B Gals
Trickling Filters

- Treatment of the secondary effluent begins with biological de-nitrification to remove ammonia, which takes place in the Trickling Filters.

- This process involves treated effluent trickling down over a biological growth maintained on plastic media.
1st Stage Solids Contact Clarifiers

- After the addition of the Slaked Lime to the influent of the 1st Stage Solids Contact Clarifiers elevating the pH to 11.2, hardness causing minerals settle to the bottom of the Clarifier in the form of a heavy sludge.

- This sludge is raked to the middle of the Clarifier and pumped from the system for recycle and disposal.
In the Second Stage Clarifiers, the pH is lowered to 10.2 by the addition of Carbon Dioxide Gas.

This pH drop and the addition of Soda Ash solution causes the precipitation of additional Calcium and further reduces hardness.
Gravity Filters

♦ The effluent from the 2nd Stage SCC flows to a common header where the pH is adjusted to 9.2 and goes to the 24 Mixed Media Gravity Filters.

♦ These Mixed Media Filters contain a layer of Anthracite Coal over a layer of Sand.

♦ They serve as a final polishing process to remove particulate Calcium.
Cooling Water Treatment

- Softening of wastewater treatment plant (WWTP) effluent is a necessity. Softening is performed to:
  - Minimize scaling potential
  - Maximize water use
  - Minimize quantity of water required

<table>
<thead>
<tr>
<th>Scale Forming Constituents</th>
<th>Influent Quality (ppm)</th>
<th>Effluent Quality (ppm)</th>
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<tbody>
<tr>
<td>Alkalinity (as CaCO₃)</td>
<td>189</td>
<td>27</td>
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<tr>
<td>Calcium (as CaCO₃)</td>
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<td>Magnesium (as CaCO₃)</td>
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<td>Silica</td>
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<td>Phosphate</td>
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<td>&lt; 0.1</td>
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Water Use

♦ 2010 cooling water Intensity
   - 778 gallons/MWh
     • 10 yr avg. = 764 gals/MWh

♦ 2010 cooling water use
   - 74,560 acre feet
     • 10 yr avg. = 66,538 acre feet
       - 25 billion gallons
         » ≈ 38,000 Olympic-sized swimming pools
         » ≈ 100 Empire State Buildings

♦ Cooling Water cycles
   - 23.3 - 5 year average
     • 25,000 – 29,000 TDS PPM
2010 Water Use by Type

Palo Verde 2010
Water Use = 74,560

Total APS 2010
Water Use = 119,692 AF
• **Cooling Tower Blowdown (Annual Rate)**
  – 950 Million Gallons
  – 2,900 Acre Feet
  – ~4% of the treated water

• **Evaporation Rate 60-72 inches/yr**
  – 3,250 - 3,900 AF/yr

• **Note redundancy in impoundments, allows for relining in 20 years**
Groundwater Monitoring

- Approximately 50 on-site monitoring wells
- Located down-gradient of structures that contain water and at the site boundary
- Palo Verde has installed many more wells than required allowing for early leak detection capabilities
Ancillary WRF Systems

♦ Domestic Water
  – Reverse osmosis units fed from on site wells to provide all potable water needs.
  – All WRF Operations personnel are required to have State Certification through Arizona Department of Environmental Quality (ADEQ).

♦ Demineralized Water
  – Mixed bed demineralizer utilized to meet high purity water requirements for the site.

♦ Sodium Hypochlorite Generation
  – Electrolytic cells used to produce bleach from brine.