Safety

- Safety is number one focus
- Zero LTI’s for project
- PWTP has the potential to be a hazardous environment – pressure, acids, caustic

Overview & Business Case

- Treats highly acidic process water from phosphate fertilizer manufacturing plant
- Designed to produce 24/7
- Multi-stage membrane treatment process
- Concentrates from various stages are reused within the PWTP or may be reused within the phosphate manufacturing process
- Treated water will meet Florida Class III surface water discharge standards

Project Timeframe

- First study work began March 2003
- Studies continued 2003/04
- First pilot – Riverview September 2004
- New Wales pilot – April 2006
- Bartow pilot – September 2006
- Selected for Bartow PWTP April 2007
- Contract signed for plant supply June 2008
- PWTP – Currently in start-up mode

General Characteristics of Process Water

- Highly acidic (pH 1.6)
- Feed temperature ~110°F (range 90°F-128°F)
- TDS ~35,000 mg/L. Supersaturated, high solute concentrations; greater than 1,000 mg/L each of P, F, SO4, Si/SiO2, Na, and Ca
  These six contaminants make up over 80% of TDS present in the stream
- Scaling species (calcium sulfate, calcium fluoride, sodium fluorosilicate)
- Large volumes to treat – 4 billion gallons typical per site
### Process Water Feed

<table>
<thead>
<tr>
<th>Analyte</th>
<th>Pond Water (average ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>1.5 – 2</td>
</tr>
<tr>
<td>TDS</td>
<td>30,000 – 40,000</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>6,000 – 7,000</td>
</tr>
<tr>
<td>Fluoride</td>
<td>6,000 – 7,000</td>
</tr>
<tr>
<td>Sulfate</td>
<td>5,000 – 6,000</td>
</tr>
<tr>
<td>Silicon</td>
<td>3,000 – 3,500</td>
</tr>
<tr>
<td>Sodium</td>
<td>2,000 – 2,250</td>
</tr>
<tr>
<td>Calcium</td>
<td>1,250 – 1,500</td>
</tr>
<tr>
<td>Ammonium</td>
<td>700 – 750</td>
</tr>
<tr>
<td>Potassium</td>
<td>200 – 300</td>
</tr>
<tr>
<td>Magnesium</td>
<td>200 – 300</td>
</tr>
<tr>
<td>Iron</td>
<td>100 – 200</td>
</tr>
<tr>
<td>Aluminum</td>
<td>100 – 200</td>
</tr>
<tr>
<td>Chloride</td>
<td>50 – 100</td>
</tr>
</tbody>
</table>

### Membrane Treatment of Process Water

#### The Process
- Targets removal of fluoride (F), nitrogen (as NH₃), and phosphate (P)
- TDS reduced from 30-40,000 mg/L to < 250 mg/L
- Treated water meets F, N, P limits for discharge to Florida Class III surface water

#### Piloting – Knowledge Gained
- Discharge quality fluid could be economically produced with membrane technology alone, (numerous other water treatment companies had failed to do this)
- Multi-unit / Multi-stage membrane process
- Sequential removal of targeted species
- Operation at low recoveries was key to scale management
- Optimized operating conditions used for final plant design
- Determined best membrane types/brands, materials of construction

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Bartow Process Water Treatment Process

Custom-built Membranes

PLC Process Control

Typical SCADA HMI Screen

Project Execution

Joint Project Execution with Client

- Civil design and construction
- Electrical installation
- OSBL infrastructure

Hatch
- Process design
- Pilot Plant studies
- Structural, mechanical, piping, PLC, instrumentation, electrical design
- Procurement, construction, commissioning

Results

<table>
<thead>
<tr>
<th>Analyte</th>
<th>Actual Value (minimum or range)</th>
<th>Typical Value (minimum or range)</th>
<th>Control Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>7.5 – 9.5</td>
<td>7.8 – 8.5</td>
<td>6.5 – 8.5</td>
</tr>
<tr>
<td>Conductivity (μS/cm)</td>
<td>30 – 50</td>
<td>30 – 50</td>
<td>1,275</td>
</tr>
<tr>
<td>Phosphorus (ppm)</td>
<td>0.006</td>
<td>0.1</td>
<td>10</td>
</tr>
<tr>
<td>Fluoride (ppm)</td>
<td>0.175</td>
<td>0.1</td>
<td>10</td>
</tr>
<tr>
<td>Ammonium (ppm)</td>
<td>701</td>
<td>ND</td>
<td>0.02*</td>
</tr>
</tbody>
</table>

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