Jackson Prairie Gas Storage

Washington State Utilities & Transportation Commission
Citizens Committee on Pipeline Safety

David Mills – Vice President, Energy Operations
Ron Roberts – Director, Thermal Resources
Pat Haworth – Manager Jackson Prairie

March 22, 2016
Jackson Prairie - History

The first exploration well was drilled in 1958, to a depth of 8015 ft, by Continental Oil Company, looking for Natural Gas (dry hole).

In 1962, a partnership was formed by the predecessors of Puget Sound Energy, Avista Corp, and Williams Gas Pipelines to explore storage possibilities.

Gas was first injected in January of 1964.
Where Natural Gas Underground Storage Fields are Located
Type of Storage and Total Field Capacity, July 2014

Type of Storage
- Depleted Fields
- Salt Formations
- Depleted Aquifers

Total Field Capacity
(Billion Cubic Feet)
- Less than 14.5
- 14.5 to 37.8
- 37.8 to 73
- 73 to 122
- Greater than 122

NOTE: that the map includes both active and inactive fields.
Jackson Prairie – Key Statistics

- **45% of PSE’s peak-day supply**

<table>
<thead>
<tr>
<th>PSE Peak Withdrawal</th>
<th>454,000 Dth/d</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSE Working Gas</td>
<td>9,850,000 Dth</td>
</tr>
</tbody>
</table>

- **25% of the region’s peak-day supply**

<table>
<thead>
<tr>
<th>JP Peak Withdrawal</th>
<th>1,096,000 Dth/d</th>
</tr>
</thead>
<tbody>
<tr>
<td>JP Working Gas</td>
<td>25,584,000 Dth</td>
</tr>
<tr>
<td>JP Total Stored Gas</td>
<td>48,776,000 Dth</td>
</tr>
</tbody>
</table>

**Energy equivalent to 2 Grand Coulee Dams**

**Facility**
- 55 gas wells (1,200-2,800 feet deep)
- 104 total wells drilled to-date
- 33,000 HP of compression (8 turbines)
- 925 acres owned
- 3,200 acres leased from 120 landowners
- 8 miles of gathering lines (6” to 24”)
- 8 miles of transmission lines (14”/16”/20”/24”)

**Staffing**
- 16 person staff – staffed 24/7
Aerial View of Jackson Prairie Compression and Processing Facility

* 10 miles south of Chehalis, WA
The Jackson Prairie gas storage field lies beneath 3,200 acres of land, but its above-ground facilities require just five acres.

Layers of sediment, deposited and compacted over millions of years, form a cap to trap the gas underground.

Gas is stored 2,000 feet deep in porous sandstone—a prehistoric seabed buried by sediment eroded from ancient mountains.

Life proceeds undisturbed in homes, farms and forests lying above the storage field.

Underground water—trapped for millions of years—seals the edges of the storage field.
* Distance from storage field to Cal State Northridge; less than a mile from Porter Ranch community (population 30,000).
Aliso Canyon Well Failure  
(Owned By SoCal Gas)

- Aliso Canyon Well SS25 Failed on 10/23/15
  - SoCal reported the well failure after three days
  - Failure expected to be ~1,000 feet deep

- Located adjacent to the Porter Ranch Community in Los Angeles, population of 30,000

- Lost an estimated 30,000 Dth/day
  - Gas did not ignite; odorized, raw gas

- Has released a reported 80,000 tons of methane into the atmosphere (daily emissions equivalent to 4 MM cars)

- More than 4,400 households relocated

- Began drilling relief well on 12/4/15

- Well controlled on 2/11/16

- Well permanently plugged on 2/17/16

- LA sued SoCal on 12/7/15; numerous lawsuits or investigations by government entities currently in process
  - LA County filed criminal charges 2/2/16 (for not reporting the failure for 3 days)

- In late January, the CPUC ordered withdrawals from Porter Ranch stopped and the California State Senate passed a moratorium on injections at Porter Ranch until all wells have been inspected
Aerial View of Port Ranch Well Failure

Hole created by escaping gas
Aliso Canyon Relief Efforts

Figure 1: Natural Gas Well Leak
- Indicators are that natural gas is leaking from the well pipe casing into the ground near the well.
- Ground level to Natural Gas Deposit ~8,500 ft
- Surface Casing 15.254" diameter
- Well Production Casing 7" diameter
- Tubing 2.705" diameter
- Packer
- Liner
- Caprock

Figure 2: Pumping Fluids Via Relief Well
- Current Efforts to Remedy the Leak
- SoCalGas is constructing a relief well to stop the natural gas leak. This new relief well will connect to the leaking well and create an entry point through which we will pump fluid to seal the bottom of the leaking well. The relief well is finished in casing and piping and large in diameter allowing more fluids and cement to be pumped into the well more quickly.

Figure 3: Pumping Fluids Directly Into Leaking Well
- Ground level to Natural Gas Deposit ~8,500 ft
- Surface Casing 15.254" diameter
- Well Production Casing 7" diameter
- Tubing 2.705" diameter
- Packer
- Liner
- Caprock

* Graphic is for informational purposes only. Scale and technical detail are not accurate. 
## Aliso Canyon – Jackson Prairie Comparisons

<table>
<thead>
<tr>
<th>Comparison Criteria</th>
<th>Aliso Canyon - Porter Ranch</th>
<th>Jackson Prairie</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage Reservoir Type</td>
<td>depleted oil field</td>
<td>salt water aquifer</td>
</tr>
<tr>
<td>Location Area</td>
<td>Populated</td>
<td>Rural</td>
</tr>
<tr>
<td>Age of Field</td>
<td>1953 - 63 years old</td>
<td>1964 - 52 years old</td>
</tr>
<tr>
<td>Gas Wells in Field</td>
<td>229</td>
<td>55</td>
</tr>
<tr>
<td>Gas Reservoir Depth</td>
<td>8,500'</td>
<td>1,100' to 2,800'</td>
</tr>
<tr>
<td>Storage Volume (Bcf)</td>
<td>86 Bcf</td>
<td>46.9 Bcf</td>
</tr>
<tr>
<td>Average Flowrate (MMcf/d)</td>
<td>30 MMcf/d</td>
<td>40 MMcf/d</td>
</tr>
<tr>
<td>Reservoir Pressure (psig)</td>
<td>2700 psig</td>
<td>500 to 1,300 psig</td>
</tr>
<tr>
<td>Gas Odor (mercaptans)</td>
<td>odorized</td>
<td>none</td>
</tr>
<tr>
<td>Subsurface Safety Valves (SSV)</td>
<td>failed &amp; removed in 1979</td>
<td>no subsurface safety valves</td>
</tr>
<tr>
<td>Surface Safety Valves</td>
<td>unknown</td>
<td>all JP gas wells</td>
</tr>
<tr>
<td>Wellbore Integrity</td>
<td>7&quot; casing leak at ~ 990'</td>
<td>all records examined</td>
</tr>
<tr>
<td>Cathodic Protection on Casing</td>
<td>uncommon for well casings</td>
<td>protected since 1966</td>
</tr>
<tr>
<td>Leak Detection History</td>
<td>temperature &amp; pressure surveys</td>
<td>temperature &amp; noise surveys</td>
</tr>
<tr>
<td>Downhole Detection Plans</td>
<td>SoCalGas evaluating</td>
<td>all gas wells in 2016</td>
</tr>
</tbody>
</table>
Jackson Prairie Regulatory Compliance

- JP is in compliance with all applicable federal and state rules, laws and regulations

- JP is a FERC permitted and regulated gas storage facility
  - FERC approves facility modifications and approves the joint operating agreement amongst the owners

- Washington DNR permits and regulates the natural gas wells drilled at JP

- JP’s pipelines and processing facilities are regulated under Title 49 CFR Part 192
  - Adopted and governed by the Pipeline & Hazardous Materials Safety Administration (PHMSA)
  - Enforced by the WUTC’s Office of Pipeline Safety

- The Office of Pipeline Safety performs biennial audits at JP
  - results are shared with PHMSA and PHMSA is responsible for taking action as necessary

- On February 5, 2016, PHMSA issued an advisory bulletin encouraging underground storage facility operators to voluntarily implement the recently published American Petroleum Institute’s Recommended Practices for Underground Storage (API RP-1171)
  - JP (Janson and Haworth) participated in the development of API RP-1171
  - FERC also participated
  - JP will voluntarily implement API RP-1171
  - JP/PSE will encourage Washington DNR to support PHMSA’s advisory bulletin
Well Integrity Plan

**Planned:**

- Plug & abandon (P&A) 4 wells in April 2016
  - FERC application submitted in 2014
  - FERC authorization received in 2015

- Plan to request FERC approval on April 8, 2016 to plug 14 more wells in 2016 and 2017.

- Run noise and temperature logs in all natural gas wells in 2016; included in 2016 O&M plan.

- JP will voluntarily comply with the latest PHMSA natural gas storage advisory bulletin (ABD-2016-02) dated 2/5/2016 and API RP-1171.

- JP will continue to closely follow proposed regulatory changes, and evaluate lessons learned from Aliso Canyon.

**Under Consideration:**

- Hire an independent petroleum engineering firm to review JP operations, assess risk exposure, and make recommendations.
Community Outreach:

- JP falls under PSE’s companywide public awareness plan

- A biennial community letter to neighbors and public officials are sent out. The next is scheduled for later in 2016

- Biennial first responder outreach is performed locally by staff; last completed in January 2016 with a presentation and tour of the project

- County Commissioners and the Sherriff’s Office is very familiar with JP and have made site visits; the State Patrol has made site visits in the past

- JP has hosted meetings of the local Emergency Planning Committee (Mark Anders of JP Chairs the group, which consists of emergency responders from fire, law enforcement, county officials and the Red Cross

Emergency Plan:

- First responders are familiar with JP through the outreach program

- JP maintains “Jackson Prairie Gas Storage Facility Emergency Response Procedures”, which is updated as needed

- JP also maintains a Well Control Contingency Plan that addresses well failures, fires, or other emergencies that can occur during drilling activities