Gas Facility Replacement Program
Keyhole Technology
Aldyl A Main Pipe Replacement Program &
Service Tee Transition Rebuilds Program (STTR)

GTI FALL KEYHOLE MEETING & DEMOS
PG&E Training Facility
Winters, CA

November 8, 2017
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<th>APPROACH</th>
<th>METHODS</th>
<th>GREEN</th>
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<td>WORK PLANNING/GIS STATISTICS</td>
<td>CONSTRUCTION METHODS &amp; KEYHOLE</td>
<td>CARBON FOOTPRINT</td>
<td>VIDEO &amp; Q &amp; A</td>
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[Images of various topics and a man using equipment]
OUR FOCUS

Our Vision
Delivering reliable energy service and the choices that matter most to our customers.

Our Purpose
To improve life’s quality with energy.
Safely – Reliably – Responsibly

Our Lasting Principles
TRUSTWORTHY
Our word is reliable, we do what is right

INNOVATIVE
We continuously improve and find better ways to get things done

COLLABORATIVE
We are respectful and are at our best when working together

Customer Engagement & Value
Deliver more value to more customers and strengthen engagement

People & Performance
Reinforce a values-driven culture of employees who do the right thing to help us succeed

Responsible Resources
Control a portfolio of resources that responsibly meet our long term energy needs

Financial Performance
Strengthen financial performance to remain a healthy company and an attractive investment

Community Vitality
Act through partnerships, financial resources and service to enhance community vitality and prosperity in the communities we serve

Effective Public Policy Outcomes
Drive positive outcomes at the local, state, regional and federal level

CONTEXT

GFRP

2016 Focus Areas

Customer Engagement
Products & services
Digital strategy
Customer choice

Financial Performance
Alaska opportunities
System modernization
Investments for growth

Community Vitality
Economic development
Avista partnership
Smart City

People & Performance
Safety
Innovation
Alignment

Updated April 2016
MANAGING THE ASSETS

MAIN PIPE
- 1 ¼” TO 4” DIAMETER PIPE
- INSTALLED 1964 TO 1987
  (PRE 1984 ALDYL A PIPE)

SERVICE TEE
TRANSITION REBUILD (STTR)
- ALDYL A SERVICE PIPE AT STEEL TEE
  LOCATED ON STEEL MAIN

“BENDING STRESS”
PROTOCOL FOR MANAGING ALDYL ‘A’ PIPE
AVISTA ASSET MANAGEMENT
(FEBRUARY 2012)
20 YEAR TIME FRAME IS OPTIMUM

PRIORITYZATION

DISTRIBUTION INTEGRITY MANAGEMENT PLAN (DIMP)

KNOW WHAT IS IN YOUR SYSTEM
IDENTIFY THREATS
EVALUATE & RANK RISKS
IDENTIFY & IMPLEMENT MEASURES TO REDUCE RISK
MEASURE / MONITOR & EVALUATE EFFECTIVENESS
REPORT RESULTS

LEAK SURVEYS CONTINUE TO CAPTURE NEW DATA & IDENTIFY THREATS

Forecast Failure Rates for Natural Gas Piping

Percentage of Pipe Expected to Fail

Years

- Service Tee Trans. Rebuild
- Bending Stress Services
- Main Pipe
- Pre-1984 Aldyl A
- 20 Year Program
LOCATION & SCOPE

737 MILES OF MAIN PIPE (20 YEARS)

SERVICE TEE TRANSITION REBUilds (STTR’S) 17,769 (5 YEARS)

○ = HIGHEST CONCENTRATIONS

= SERVICE TERRITORY
APPROACH - LEVERAGING GIS & WORK PLANNING

GEOGRAPHIC WORK PACKAGING

- Project areas defined
- Project phases created
- Job locations identified

MASS PRODUCED JOB CARDS (SINGLE DESIGN)
KEYHOLE REINSTATEMENT VS. CONVENTIONAL CUT

CONVENTIONAL 4’ X 5’ PAVEMENT CUT & PATCH

AVG. CUT ≈ 365 LBS. CO₂

KEYHOLE TECHNOLOGY BENEFITS

- ELIMINATES SAW CUTS & OVERCUTS
- PERMANENT WATER TIGHT BOND
- REDUCES RESTORATION FOOTPRINT
- MINIMIZES ROAD IMPACTS & CLOSURES
- REQUIRES FEWER PIECES OF EXCAVATION EQUIPMENT & HAUL TRUCKS AND TRIPS
- ATMOSPHERIC EMISSIONS OF GREEN HOUSE GASES REDUCED SIGNIFICANTLY
- IS 1/6TH THE CARBON FOOTPRINT THAN CONVENTIONAL OPEN CUT
- ASPHALT COUPON/CORE IS REUSED
- REDUCES CONSUMPTION OF ASPHALT
- REDUCES ASPHALT WASTE DISPOSAL & IMPACT TO LANDFILLS
- MINIMAL IMPACT TO CUSTOMERS

24” DIAMETER CORE
≈ 84 % SMALLER THAN CONVENTIONAL CUT

≈ 60 LBS. CO₂
ROAD DISTURBANCE

4 PRIMARY METHODS EMPLOYED

1. HARD SURFACE CUT & PATCH
2. KEYHOLE CORE & REINSTATEMENT
3. SOFT SURFACE BELLHOLE
4. RECORDS RESEARCH & MAP CORRECTION
## LEVERAGING TECHNOLOGY FOR STTR PROJECTS

<table>
<thead>
<tr>
<th>Keyhole Technology</th>
<th>Vacuum Excavation</th>
<th>Hard Surface Cut &amp; Patch</th>
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<tr>
<td>Urban Micro-Surgery</td>
<td>Safe Excavation</td>
<td>Greatest Disturbance</td>
</tr>
<tr>
<td></td>
<td>Re-instanted Core</td>
<td>Rebuild Assembly</td>
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<tr>
<td></td>
<td>Soft Surface Bell Hole</td>
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### Keyhole Technology
- Urban Micro-Surgery

### Vacuum Excavation
- Safe Excavation

### Hard Surface Cut & Patch
- Greatest Disturbance
- Rebuild Assembly

### Soft Surface Bell Hole

### Service Tee Transition Rebuild
- Parts with red arrow are to be replaced or installed
- O-Ring
- Compression Nut (re-use if possible)
- Compression Washer
- Excess Flow Valve Stick
- Coupling
- Existing Service Tee

### Protective sleeve - 12' Minimum
- Service Tee Transition Rebuild
LEVERAGING KEYHOLE TECHNOLOGY TO AVOID RESTORATION COSTS

STTR METHOD (%) BY YEAR

<table>
<thead>
<tr>
<th>Year</th>
<th>Keyhole</th>
<th>Soft Surface</th>
<th>Pavement Patch</th>
</tr>
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<tbody>
<tr>
<td>2013</td>
<td>12%</td>
<td>43%</td>
<td>45%</td>
</tr>
<tr>
<td>2014</td>
<td>9%</td>
<td>47%</td>
<td>43%</td>
</tr>
<tr>
<td>2015</td>
<td>7%</td>
<td>39%</td>
<td>54%</td>
</tr>
<tr>
<td>2016</td>
<td>20%</td>
<td></td>
<td>22%</td>
</tr>
<tr>
<td>2017</td>
<td>30%</td>
<td></td>
<td>71%</td>
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</tbody>
</table>

PERCENT BY METHOD

- Keyhole: 45%
- Soft Surface: 15%
- Pavement Patch: 40%

MULTI-YEAR ROLL-UP

KEYHOLE MINIMIZES ROAD IMPACTS & RESTORATION FOOT PRINT

= AVOIDED COSTS

2013 - 2017 STTR PROFILE
STTR PROGRAM COST AVOIDANCE

AVOIDED COSTS

2013: $865,968
2014: $2,109,685
2015: $2,035,806
2016: $993,856
2017: $375,822

TOTAL: $6,381,137

PROGRESS

98% COMPLETE
>17.3 K UNITS

CUSTOMER CARE

POSITIVE RESULTS

COMPLAINTS < 1%
LEVERAGING TECHNOLOGY FOR MAIN PIPE PROJECTS

- **OPEN TRENCH EXCAVATION**
  - Greatest footprint

- **HORIZONTAL DIRECTIONAL DRILL (HDD)**
  - Minimal footprint

- **SPLIT & PULL**
  - Minimal footprint
TRENCHLESS TECHNOLOGY UTILIZATION (MAIN PIPE)

TRENCHLESS UTILIZATION BY YEAR

- **2012**: 2%
- **2013**: 100%
- **2014**: 31%, 69%
- **2015**: 51%, 47%
- **2016**: 65%, 34%
- **2017**: 83%, 17%

Legend:
- **HORIZ. DIRECTIONAL DRILL**
- **OPEN TRENCH**
- **SPLIT & PULL**
# Keyhole Technology Used on Main Pipe Projects

## Keyhole Technology
- Supports Main Pipe HDD/Bore Operations

## Soft Excavation
- Spotting Crossing Utilities Safely

## Approximate Avoided Costs 2014-2017

<table>
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<tr>
<td>Keyhole</td>
<td>$917,144</td>
<td>$653,775</td>
<td>$756,024</td>
<td>$2,326,943</td>
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<tr>
<td>Soft Excavation</td>
<td>$375,946</td>
<td></td>
<td></td>
<td><strong>$2.7 M</strong></td>
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</table>
GREEN TECHNOLOGY

BY LEVERAGING KEYHOLE TECHNOLOGY
AVISTA’S ALDYL A PIPE REPLACEMENT PROGRAM HAS ELIMINATED

≈ 254 10 YARD DUMP TRUCKS, OR NEARLY 10 MILLION POUNDS
OF ASPHALT WASTE & NEW ASPHALT

≈ 1.5 MILLION POUNDS OF CO₂ AVOIDED
SERVICE TEE REBUILD PROCESS

- JOB IS LOCATED, PAVEMENT IS CORED, CORE IS REMOVED
- VACUUM / SOFT EXCAVATION EXPOSES MAIN & TEE ASSEMBLY
- SERVICE PIPE REMOVED FROM SERVICE TEE AT MAIN PIPE
- EXCESS FLOW VALVE INSTALLED
- EXISTING SERVICE PIPE TESTED
- SERVICE PIPE IS RECONNECTED TO MAIN PIPE
- ASSEMBLY IS PROTECTED BY A COMPLETION SLEEVE
- ASSEMBLY BEDDED IN SAND
- BACKFILL PER MUNICIPAL REQUIREMENTS
- STEEL ROAD PLATE CAN BE USED PRIOR TO CORE REINSTATEMENT
KEYHOLE SATELLITE CORE

CROSS SECTION
KEYHOLE REINSTATMENT VS. CONVENTIONAL CUT

UNCUT PAVEMENT (DISTRIBUTED LOAD)

CONVENTIONAL PAVEMENT CUT (CONCENTRATED STRESS)

KEYHOLE CORE & REINSTATMENT (DISTRIBUTED LOAD)

REINSTATED CORES RESTORE THE ABILITY OF THE ROAD TO PERFORM AS ORIGINALLY DESIGNED, ARE WATER TIGHT, AND MINIMIZE POTENTIAL DAMAGE TO SUB-GRADE.
## RESULTS (2012 - 2017)

<table>
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<tr>
<th>SCHEDULE</th>
<th>BUDGET</th>
<th>SCOPE</th>
<th>SCOPE (M)</th>
<th>SCOPE (T)</th>
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<tr>
<td>5 OF 20 YEARS COMPLETE</td>
<td>$75M INVESTED</td>
<td>39 PROJECTS 3 STATES</td>
<td>14% MAIN PIPE &gt; 107 MILES</td>
<td>92% STTR &gt;16.2K UNITS</td>
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- **Schedule**: 5 of 20 years complete
- **Budget**: $75M invested
- **Scope**: 39 projects, 3 states
- **Scope (M)**: 14% main pipe > 107 miles
- **Scope (T)**: 92% STTR >16.2K units

### CUSTOMER CARE
- Positive results
- Complaints < 1%

### PROJECT MANAGEMENT
- Earned value reporting & managing the investment

### POSITIVE RESULTS
- < 1% variance

### CUSTOMER CARE
- Positive results
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