**Williams Pipeline**

<table>
<thead>
<tr>
<th>Aim</th>
<th>Monitoring of pipelines where passing through geologically active terrain.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>Four locations located along Hood River in Washington and Oregon in the Cascades.</td>
</tr>
<tr>
<td>System Integrator</td>
<td>Durham Geo Slope Indicator (DGSI)</td>
</tr>
<tr>
<td>End Customer</td>
<td>Williams</td>
</tr>
<tr>
<td>Date</td>
<td>June 10-11, 2008</td>
</tr>
<tr>
<td>Instrumentation</td>
<td>(1) si325, Micron Optics Portable Sensing Interrogator</td>
</tr>
</tbody>
</table>
| Sensors | Sensors per location:  
- (3) os3110 Optical Strain Gage, Spot Weld  
- (1) os4350 Non-metallic Temperature Sensor, Armored Cable, Flange Mount |
| Software | ENLIGHTPro Sensing Analysis Analysis Software |
| FBG Technology Benefit | Conventional vibrating wire sensors were damaged during a process known as “Pigging”. The strong magnetic fields produced by the pig re-oriented the poles of the permanent magnet pickups. |
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- The install occurred on June 10-11, 2008 with plenty of rain and mud to contend with. There were a number of employees from Williams that were trained on the installation technique which we perfected during this trip. Alan Turner from Micron Optics was also in attendance and very helpful in the design of the installation process.
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- First strain gage (os3100) location with the current epoxy coated pipe. Strain gages taped in to location before welding.

- On this location the Williams crew hammered off the cold tar all the way around the pipe circumference. Then they bared surfaces through the undersurface coating for mounting the strain gages.
• Second strain gage location with cold tar and tape coated pipe. Surface preparation for install of strain gages.
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- Third strain gage location with cold tar coated pipe. Welding the strain gage in place.
- os4350, Non-metallic temperature sensor, epoxy type, in place.
- Fourth location, tape coat wrapped pipe. Strain gages covered in aqua seal.

- In this location the Williams crew installed the final string of optical strain gages using aqua seal to seal the gages.
• Also used, was a five minute epoxy to tack the sensor leads to the surface of the pipe.
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- Strain gages were monitored by the Micron Optics si325 interrogator while they were being installed.
The final step in the install process was to coat everything in a protective epoxy coating. The blue fiber optic cable exited out of the epoxy through an aqua seal sandwich to seal against water intrusion. The aqua seal also provided a strain relief between the epoxy and the cable.
Results and Acknowledgements

• Results
  ß The installation was a success.
    • Installation took 3 hours instead of 12.
    • No calibration required for long term monitoring.
    • Shift of 6\(\mu\)e measured for first time! 50\(\mu\)e is normal.
    • Accurate temperature information provides insight into gas flow conditions.
      • Portable interrogator used for monthly measurements.
  ß Williams had number of field technicians that where trained and they are looking forward to installing more fiber optic gages in the future.

• Acknowledgements
  ß Williams (End customer)
  ß Durham Geo Slope Indicator (DGSI)
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