Thums Subsea Pipeline
Mechanical Integrity Program
Thums Subsea Pipelines

Original Pipelines installed in 1966
New Pipeline Installations in 1987 and 1993
Thums Subsea Pipelines

- Pipelines Located in an Environmentally Sensitive area
- Potential Impact if Pipeline failure occurs
- Rigorous Integrity Strategy Program must be in place
Mechanical Integrity Program

- Monitoring Program (Inspection Surveys)
- Cathodic Protection
- Chemical Inhibition
- Pipeline Cleaning Program (Pigging)
Monitoring Program History

- Magnetic flux surveys conducted annually from 1960’s to early 1990’s
- Best available technology until 1992
- Problems identifying mill defects and certain anomalies
Monitoring Program History

- Ultrasonic Surveys conducted starting in 1992
- Excavations correlated well with survey data
- Excellent Repeatability of Data between Surveys
Survey Results Summary

- General localized External Corrosion on Land Portion of pipelines
- Subsea Portions have Low Corrosion rates
- Piping in good shape
Monitoring Program Improvements

- Long History of Correlating Surveys
- Improvements to UT Technology have increased the Measurement Accuracy of Metal loss Contours
Monitoring Program Improvements

• The Improved Resolution
  • Increased the Accuracy of the data
  • Increased the Number of minor corrosion pits
  • Need to compare the Corrosion rates between surveys

• Thums utilized a Corrosion Growth Assessment software called RUNCOM™
Monitoring Program Improvements

RUNCOM™ Objectives

• Compare Data between Surveys

• Identify corrosion features which have grown between surveys

• Identifies areas of New corrosion
Monitoring Program Improvements

Corrosion Growth Data from RUNCOM™ is used to determine:

- Future Growth Behavior
  (Key to Integrity Assessment)

- Develop a Schedule
  of Repairs

- Provide a Basis for Re-inspection Intervals
Mechanical Integrity Program

- Monitoring Program (Inspection Surveys)
- Cathodic Protection
- Chemical Inhibition
- Pipeline Cleaning Program (Pigging)
Cathodic Protection Program

Rectifier Monitoring

- Cathodic Protection based on an Impressed Current Design
- Monthly Voltage Monitoring
- Data Analysed to determine Adequate Level of Protection
Cathodic Protection Program

Cathodic Protection Surveys

- Annual Over-the-line Close Interval Potential Survey
- Annual Inspection of Isolation Flanges
- Quarterly Pipeline surveys
- Monitor the Potential across the pipelines
- Adjustment made to maintain correct Potential
Chemical Corrosion Inhibition

- Active Pipelines Treated Continuously with Chemical Corrosion Inhibitor

- Batch Treat the Pipelines with Corrosion inhibitor during Maintenance Cleaning (Pigging) Operations

- Corrosion coupons analyzed to ensure adequate Corrosion protection

- Deposits analyzed for evidence of corrosion products
Maintenance Cleaning (Pigging)

- Oil & Gas Pipelines are Pigged on Alternating Weekends.
  - Brush and Wiper Mechanical Pigs
  - Established Pig Maintenance Program

- Solids are Analyzed for Evidence of Corrosion
Subsea Pipeline Program Review

• Peer review conducted in early July 2006

• Well-represented team (16 people): Oxy, LBGO, SLC, Chemical Experts & Industry Consultants

• Objective was to utilize industry expertise to conduct an independent review of Thums Pipeline mechanical integrity program

• Identify improvement opportunities and validate the existing program elements
Subsea Pipeline Program Review

General Results

- Good existing Corrosion program in place
- Well documented Maintenance Pigging Program
- Utilizing state of the art Smart Pig tools and data analysis
Mechanical Integrity Program Summary

- Maintaining Pipeline Integrity is a dynamic Process
- THUMS Oil & Gas Pipelines are well protected
  - Well Maintained Cathodic Protection system
  - High Level of Chemical Protection
  - Regular Cleaning Program
  - Frequent Monitoring of the Pipelines
Questions?
Support slides
## Subsea Pipeline Peer Review Team

<table>
<thead>
<tr>
<th>Name</th>
<th>Company</th>
<th>Role</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kathye Griffis</td>
<td>THUMS</td>
<td>Thums Pipeline Engineer/ Engineering Team Lead</td>
</tr>
<tr>
<td>Jim Van Camp</td>
<td>THUMS</td>
<td>Unit Improvement Team Engineer</td>
</tr>
<tr>
<td>Charles Oney</td>
<td>Oxy</td>
<td>Senior Corrosion Engineering Consultant, OOGC</td>
</tr>
<tr>
<td>Jim McWhinnie</td>
<td>Oxy</td>
<td>Head of Asset Integrity, Oxy Qatar</td>
</tr>
<tr>
<td>Trent Adcock</td>
<td>Oxy</td>
<td>Senior HES Advisor, OOGC</td>
</tr>
<tr>
<td>Adel Nasr</td>
<td>WorleyParsons</td>
<td>Materials Application Specialist</td>
</tr>
<tr>
<td>Gene Brock</td>
<td>BJ Chemical</td>
<td>Vice President Technical Services</td>
</tr>
<tr>
<td>Eric Smith</td>
<td>BJ Chemical</td>
<td>Site Corrosion Specialist</td>
</tr>
<tr>
<td>Ken Delunas</td>
<td>BJ Chemical</td>
<td>Consultant Corrosion Engineering</td>
</tr>
<tr>
<td>Cliff Moore</td>
<td>Schiff Associates</td>
<td>Senior Engineer, Consulting Corrosion Engineers</td>
</tr>
<tr>
<td>Rick Finken</td>
<td>LBGO</td>
<td>City of Long Beach Gas &amp; Oil Petroleum Engineer</td>
</tr>
<tr>
<td>Quang Nguyen</td>
<td>LBGO</td>
<td>City of Long Beach Gas &amp; Oil Division Manager LBU</td>
</tr>
<tr>
<td>James Hemphill</td>
<td>SLC</td>
<td>Division Engineering Manager</td>
</tr>
<tr>
<td>Greg Scott</td>
<td>SLC</td>
<td>Assistant Division Chief</td>
</tr>
<tr>
<td>Steve Curran</td>
<td>SLC</td>
<td>Drilling Engineer</td>
</tr>
</tbody>
</table>
Survey Data Analysis Techniques

- Basic Integrity Data Analysis use Clustered Data

- Rely on Peak Depth
  Comparisons between surveys

- Analysis based on Peak Depth may not detect active growth areas
Survey Data Analysis Techniques

Key Analysis Issue:

- Maximum corrosion growth does not always occur at the peak depth on the feature.

- In order to reliably determine corrosion growth rates, a method is required that doesn’t rely on peak depth comparison between surveys.
RUNCOM™ uses Raw Signal Matching

- Accurate matching of corrosion sites (joint-joint)
- Survey to Survey inaccuracies associated with tool performance & sizing algorithms are eliminated
- Compares the metal loss profiles between surveys
- Difference is the rate of Corrosion Growth