Pipeline Design, Construction & Operations Technical Committee

Detection and Assessment

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PRCI

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DC&O Mission Statement

Develop safe, environmentally responsible, cost-effective and reliable solutions for the design, construction, and operation of energy pipelines

Key Emphasis Areas

- Onshore & Arctic
- Offshore
- Damage Prevention & Detection
- Reliability-Based Design
- Integrity Practice Standards

Technical Programs (2001 – 2004)

1.	Prevention of Third Party Damage	$1,305k
2.	Implementing Integrity Standards	$3,060k
3.	Reliability-Based Design Alternatives	$918k
4.	Determination of Max. Safe Surface Loads	$994k
5.	Leak Detection and Notification	$350k
6.	Prevention of Critical Pipeline Strains	$1,363k
7.	Solutions for Adverse Crossings	$245k
		$8,235k

What does DC&O have in our 5-year plan?

- **Implementing Integrity Standards**
  – Technologies into Methodologies for Reliability and Safety
- **Reliability-Based Design for Alternatives**
  – Flexibility to Innovate & Address

- **Prevention and Notification of 3rd Party Damage**
  – RoW Security, Best Practices, Locate & Mark,
- **Determination of Maximum Safe Loads & Strains**
  – Static & Dynamic Surface Loads, Seismic, Subsidence
- **Leak Detection and Notification**
  – Active Laser & Passive, Satellite Aircraft & Ground Based
  – Gas & Oil

Technology for Energy Pipelines

Failed To Locate 2nd & Cut Branch

- **Locate & Mark**
  - Difficult Situations
  - Harbors & Deep Pipe
- **One Call Tracking**
  - Web Site
  - All Six Activities
  - Communications

Detection and Notification of 3rd Party Damage

Detection – Best Practices, Ensuring RoW Security, Locate & Mark, One Call Performance

Real Time Detection – Acoustic, Aircraft, Electrical, Fibre Optics

Objective

Replace Observers

Security & Reliability Validation

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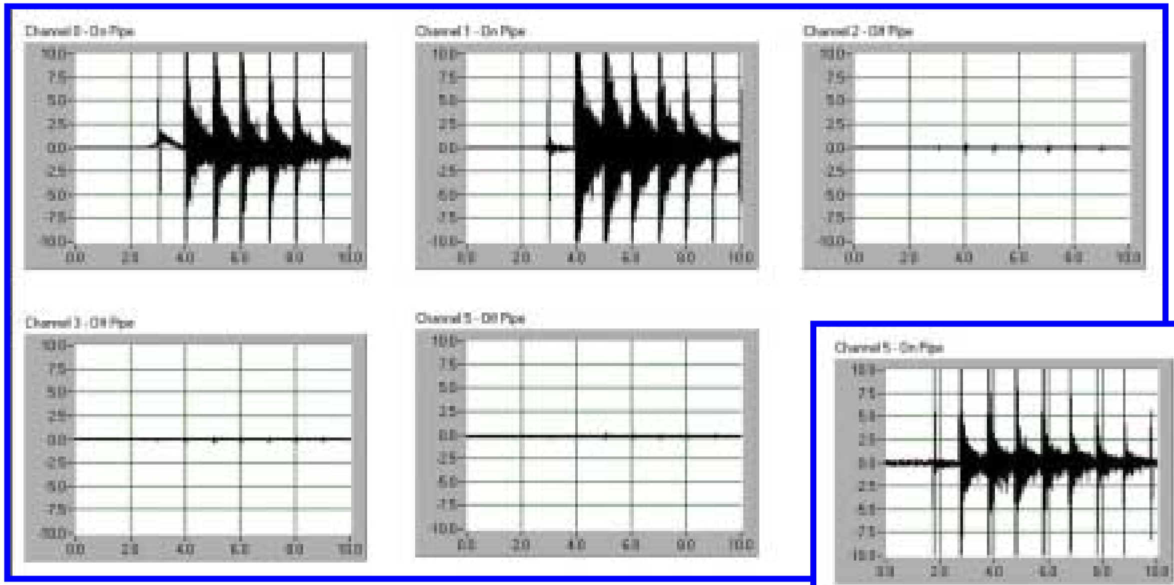
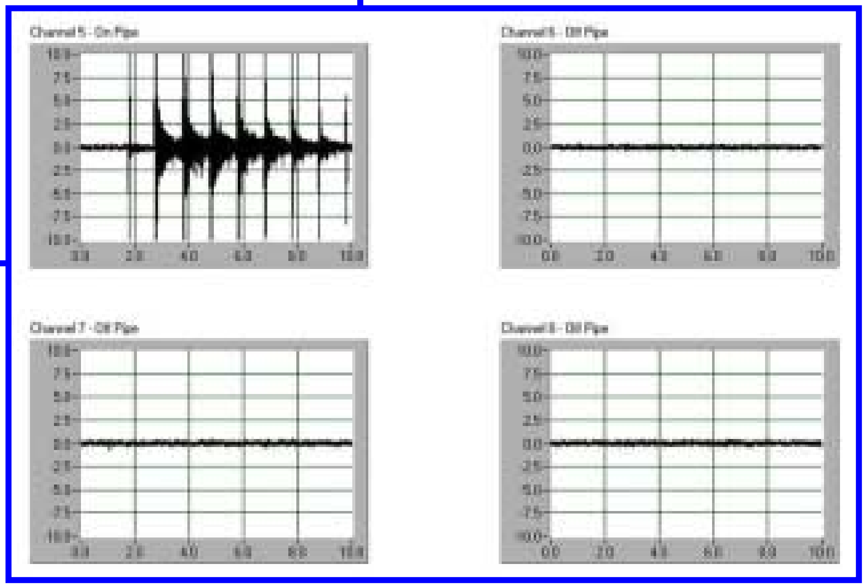
Technology for Energy Pipelines



Near Site



Far Site

Duke Site
Signal From Coating Removal

Non-authorized Trespass

Radar on Optical

IR for Activity

Technology for Energy Pipelines

Prevention Challenges

- **Methods**
  - – Establish Gaps in Proven Best Practices
  - – Accelerate an ASME Prevention Standard
  - – Quantify Benefits for Investment
  - – Improve Communications

- **Tools**
  - – Review Commercial, Developing, and possible Combinations of Sensors
  - – Lower risk with Case Studies
  - – Invest in Potential Winners beyond 2005

Maximum Safe Loads & Strains

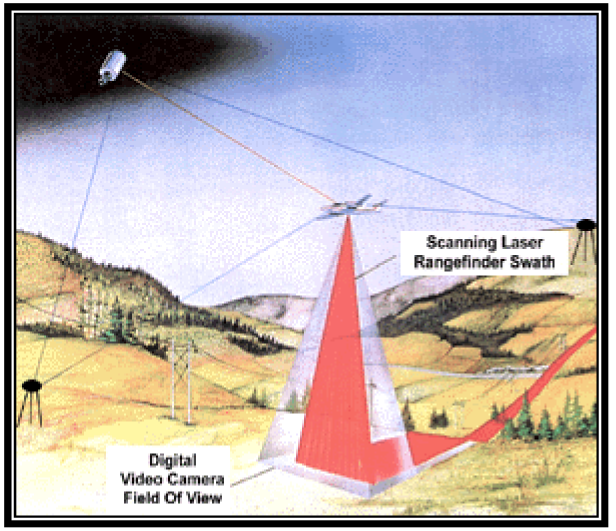
- Safe Static & Dynamic Surface Loads
  - Finite Element Models, Centrifugal models & Full-scale Tests
  - Methodology into Software?
- Subsidence & Landslides
  - Software Auto Detects, Classifies & Notifies
  - Need More Aircraft & Satellites – Too Few Images
  - Need Affordable Images – Real Alternative
  - Need Improved Sensors

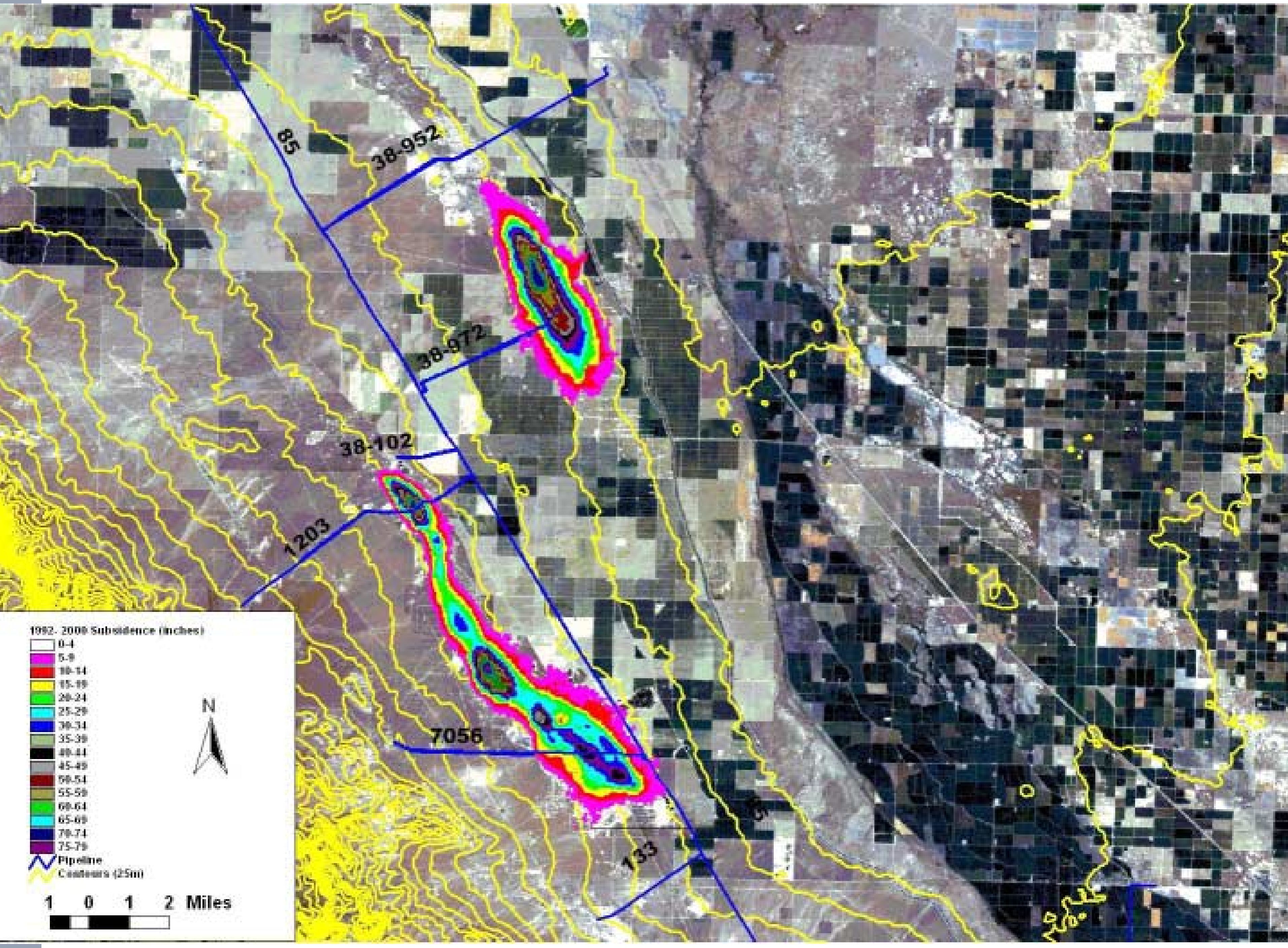
Earthquake & Landslide Detection

Monitor at < cm resolution

Survey by Laser Rangefinders

Excavate and add Strain Gauges





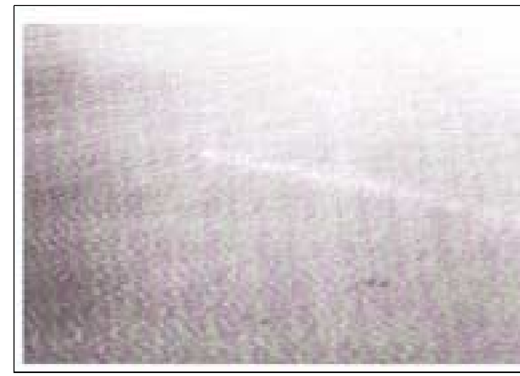
85
38-952
38-972
38-102
1203
7056
133
1992- 2000 Subsidence (inches)
0-4
5-9
10-14
15-19
20-24
25-29
30-34
35-39
40-44
45-49
50-54
55-59
60-64
65-69
70-74
75-79
Pipeline
Contours (25m)
N
1 0 1 2 Miles

Assessment Challenges

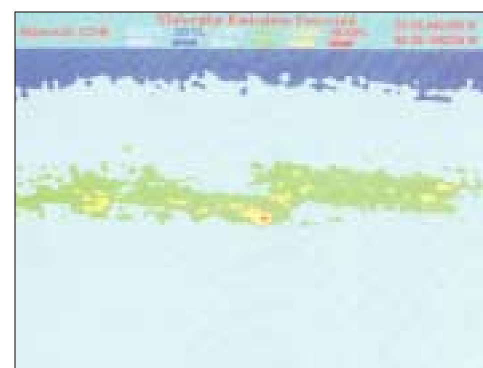
- **Calibrate Improved FEM Techniques**
  - Small Scale Modeling
  - Full Scale Calibration
- **More Sensors by Land, Air and Satellite**
  - Multi-spectrum, Smaller Spot, Multi-image Integration
- **Better, Faster Detection & Discrimination to Reduce False Calls**
- **Case Studies to Reduce Risk**

Leak Detection and Notification

- Gas
  - Methane/Ethane Detection
  - Improve Range past 30 ft
  - Multi-spectral Imaging
  - Ground, Aircraft & Satellite
- Oil
  - Computational Improvements



Optical Image



Detection Image

Leak and Notification Challenges

- Better Sensors – Increase Magnitude by 10^3
- Improve Resolution
- More Choice in Platforms
- Demonstration Reduces Risk

Performance Issues and Challenges:

- **Drive R&D from “<u>Cost</u>” to “<u>Investment</u>”**
- **Must Demonstrate Benefits**
  - to the CEO & Accountants
  - the Engineers
  - Regulators & Public
- **Need Business Not Regulatory Premises**

Design Construction & Operations

- **Path Forward**
  - Learn & Share with others
  - More & Better Sensor Resolution
  - More Frequent Sampling
  - Model & In-Field Calibration
  - Drive Down False Positives
  - Standardize Alternative Methods & Practices
  - Encourage Innovation

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