Increasing Uptime and Plant Reliability by Deploying Asset Monitoring Solutions

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Edmonton, Alberta

Agenda

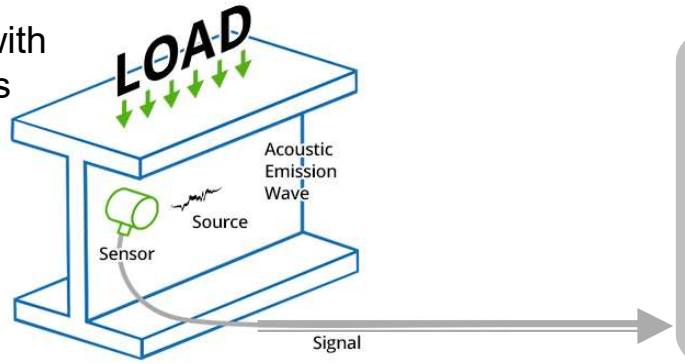
- ✓ Benefits of Monitoring
- ✓ Acoustic Emission
  - ✓ Transformers
  - ✓ Valves
  - ✓ Boiler tube leaks
  - ✓ Pressure Vessels
  - ✓ Stator Vane Cracking
  - ✓ High Energy Piping
- ✓ Ultrasonic Thickness Monitoring
- ✓ Metal Loss Detector

Benefits Of Monitoring

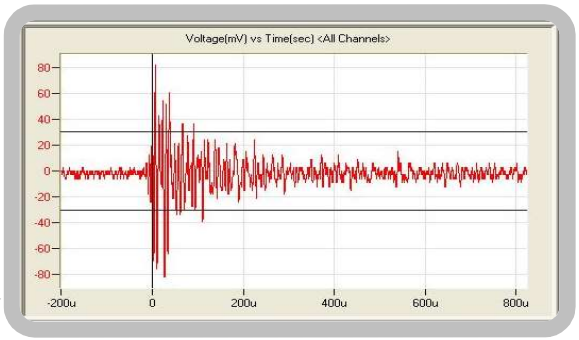
- ✓ More data available, better idea of condition of the asset
- ✓ Allows the user to see correlation with operating parameters
- ✓ Reduces the costs of multiple trips to evaluate the asset
- ✓ Information provided in real time, early detection of potential problems allows better planning

Acoustic Emission

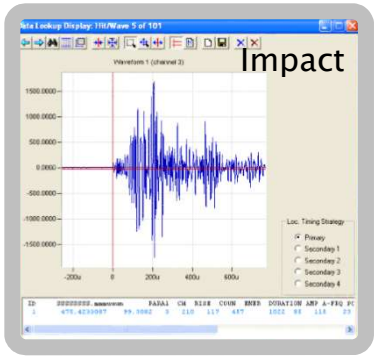
Structure with AE sensors

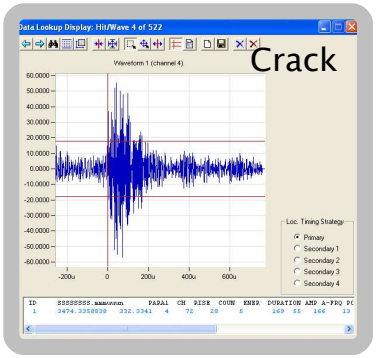


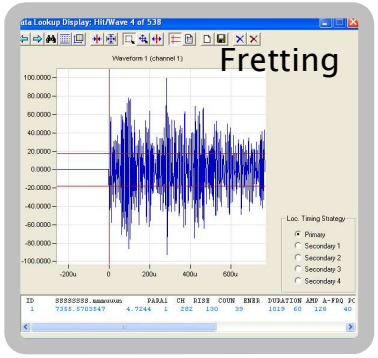
Signal collected by AE sensor



Shape and characteristics (ranges for specific AE features) vary depending of the mechanism producing the emission.







Asset Monitoring Installations ~1700

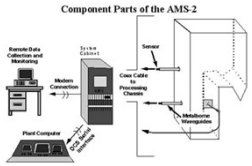
1,040
Valves

230
Transformers

- ✓ GSU
- ✓ Transmission
- ✓ Distribution

55
ACTMS

- ✓ Combustion Turbines



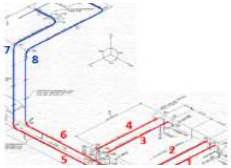
323
AMS

- ✓ Power Boilers
- ✓ HRSG
- ✓ Feed water heaters
- ✓ Recovery Boilers

25
Bridges

8
Pressure Vessels

- ✓ Reactors
- ✓ Columns
- ✓ Separators



4
High Energy Piping

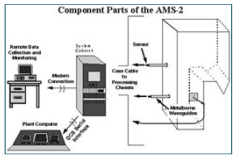
Other applications:

- ✓ PIPES – Thickness, corrosion
- ✓ Cranes
- ✓ Blast Furnace
- ✓ Flexible risers
- ✓ Above Ground Storage tank
- ✓ Generators, motors, HV Cables - **NEW**

What Are We Detecting?

TRANSFORMERS

- Electrical faults (Partial Discharge and/or Arcing)
- Thermal faults
- Mechanical Faults



BOILER/HRSG

- Tube Leaks
- Sootblower effectiveness, stuck sootblowers
- Leaking valves
- Slag/pluggage
- Damaging backpass vibration
- Aspirating and cooling leaks
- SCR horn operation

COMBUSTION TURBINES

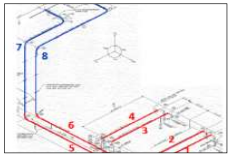
- Crack growth on stationary blade
- Rubbing
- Clashing
- Foreign object damage

BRIDGES

- Wire break in post tensioned concrete and cable structures.
- Strain, rotation, acceleration, displacement. Steel fatigue, crack detection.
- Concrete micro fracture detection.
- Structural health.

PRESSURE VESSELS

- Local overstressed areas
- Crack growth and/or corrosion products de-cohesion



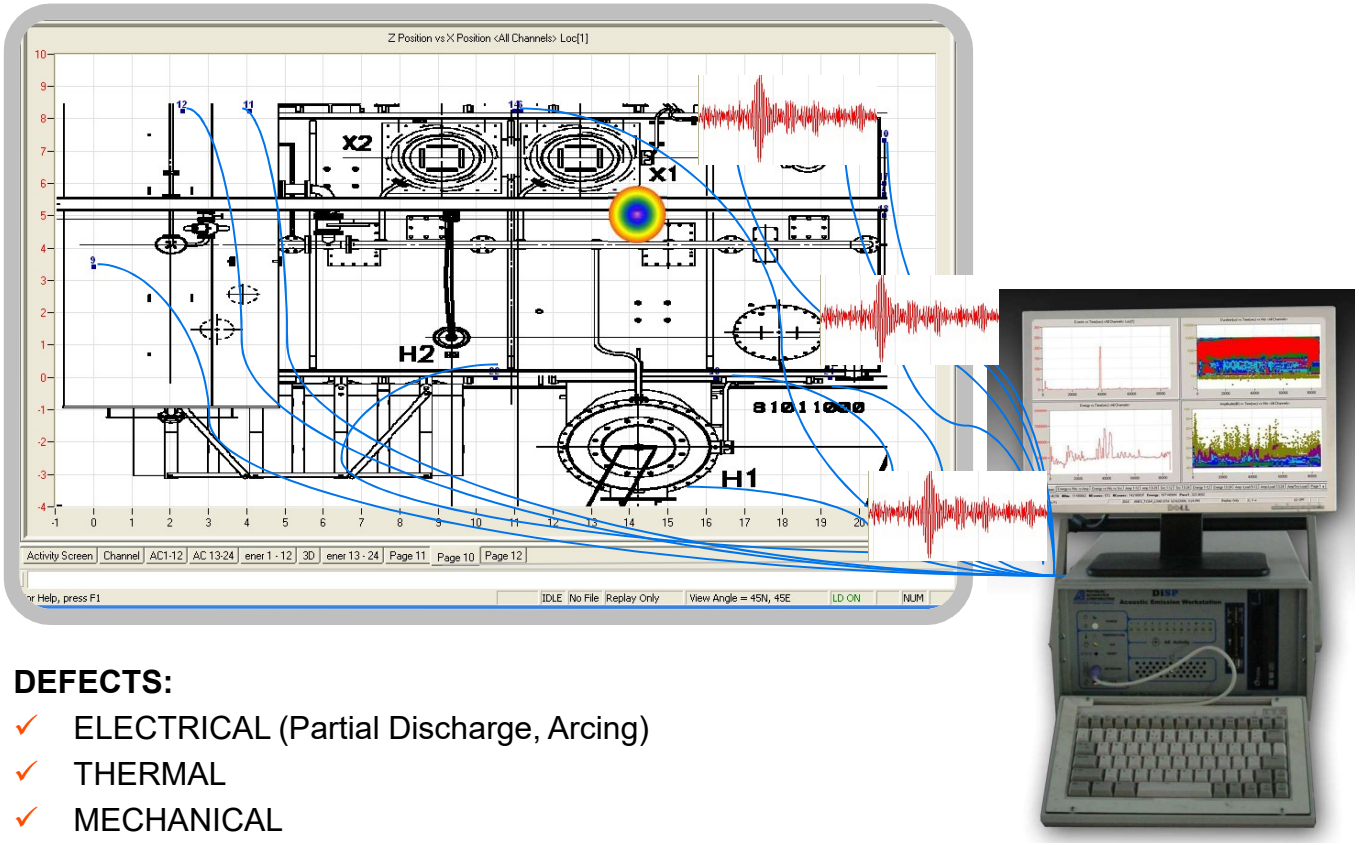
HIGH ENERGY PIPING

- Micro and macro cracks

VALVES

- Through-valve loss

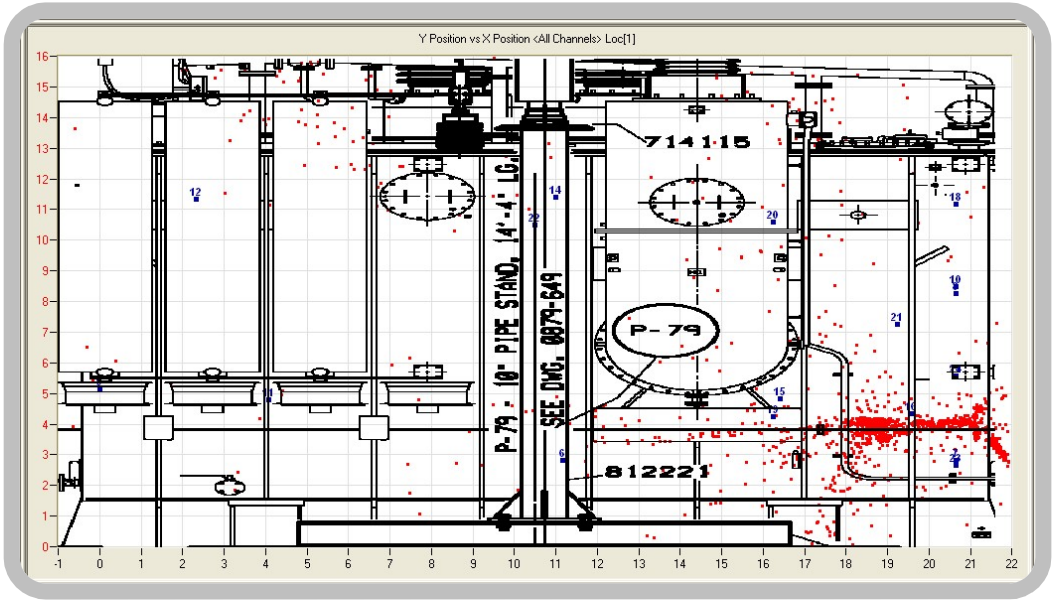
Power Transformers

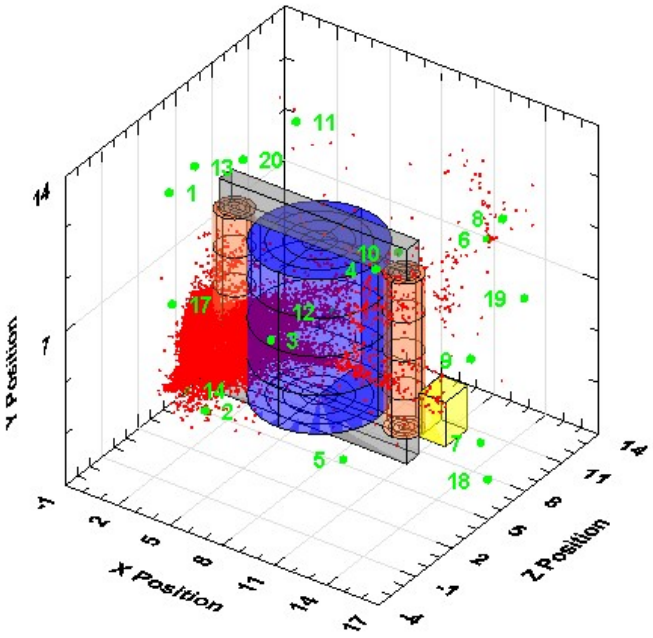


DEFECTS:

- ✓ ELECTRICAL (Partial Discharge, Arcing)
- ✓ THERMAL
- ✓ MECHANICAL

Source Location





Acoustic Emission On-Line Monitoring System

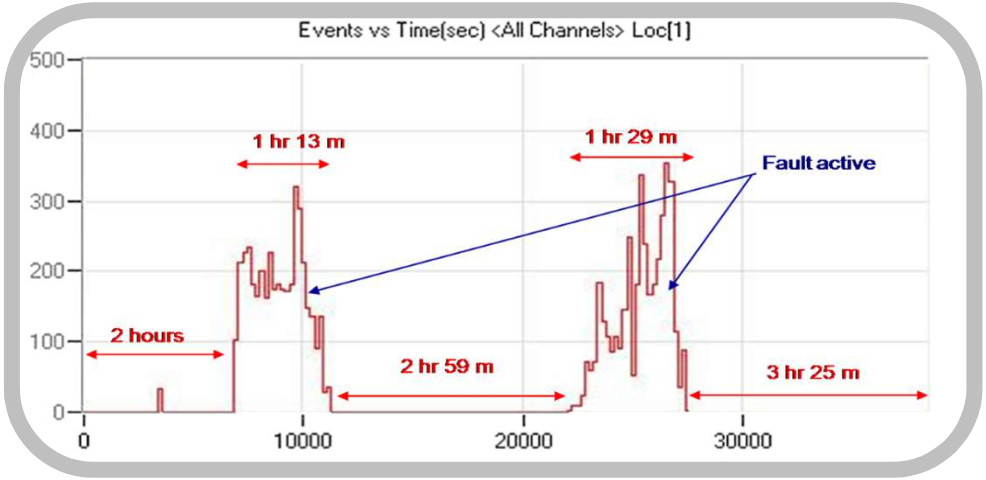
Power Transformers

- ✓ 24/7 Monitoring
- ✓ Short term or permanent

OLM Webpage	**Utility's Data Center:** OPC or MODBUS
Remote Access	**http://monitor.transformer.clinic/**

Case Study

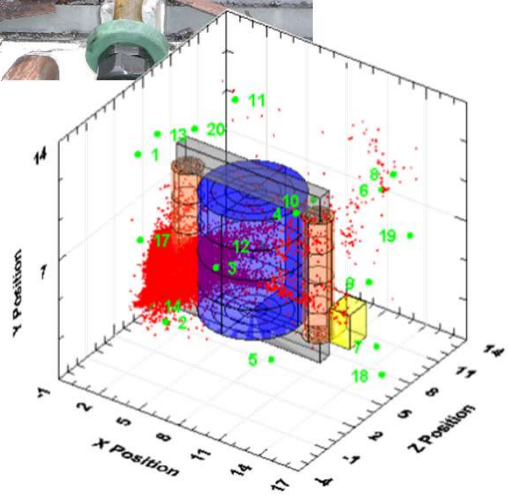
Case 6 On IEEE STD. C57.127, 2018

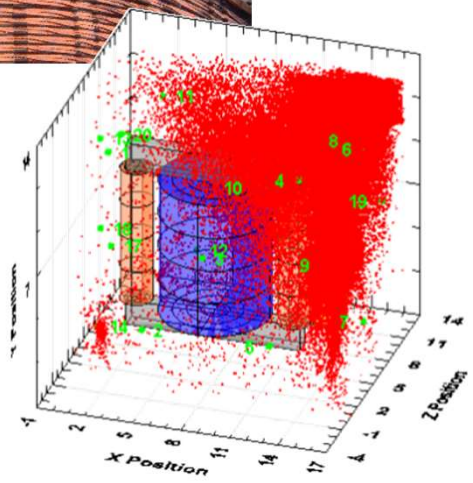


Date	H2	CO	CO2	CH4	C2H6	C2H4	C2H2	TDCG
5/31/05	192	187	728	17	5	3	0	404

Case Study

Case 6 On IEEE STD. C57.127, 2007



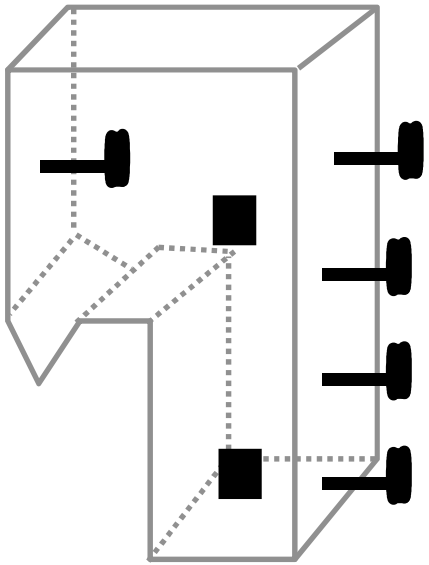


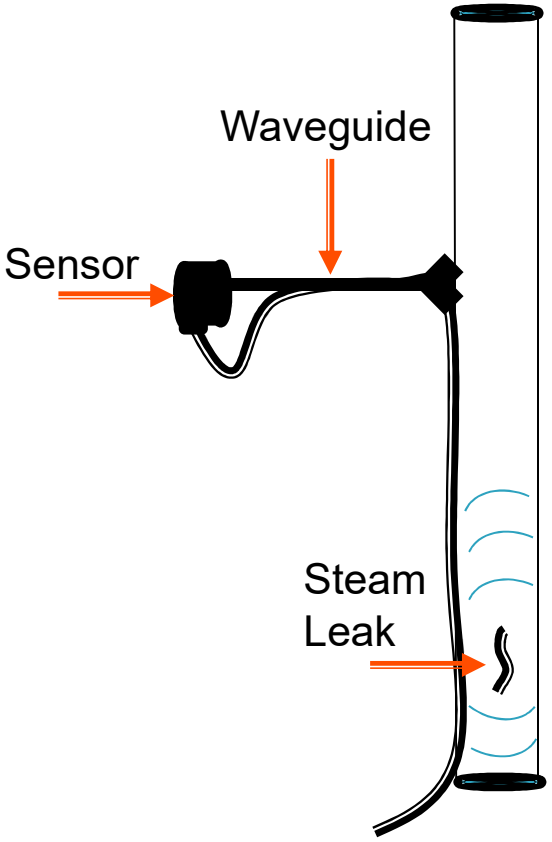
Valves

- ✓ 5-10% of valves suffer through-valve leakage.
- ✓ 1-2% of these passing valves are responsible for 75% of total losses.
- ✓ Real-time on-line valve leak detection and quantification.
- ✓ Instant response when a valve leaks or sticks.
- ✓ Enables monitoring of difficult to reach valves.
- ✓ Can be connected to the plant DCS with a suitable galvanic or zener barrier.

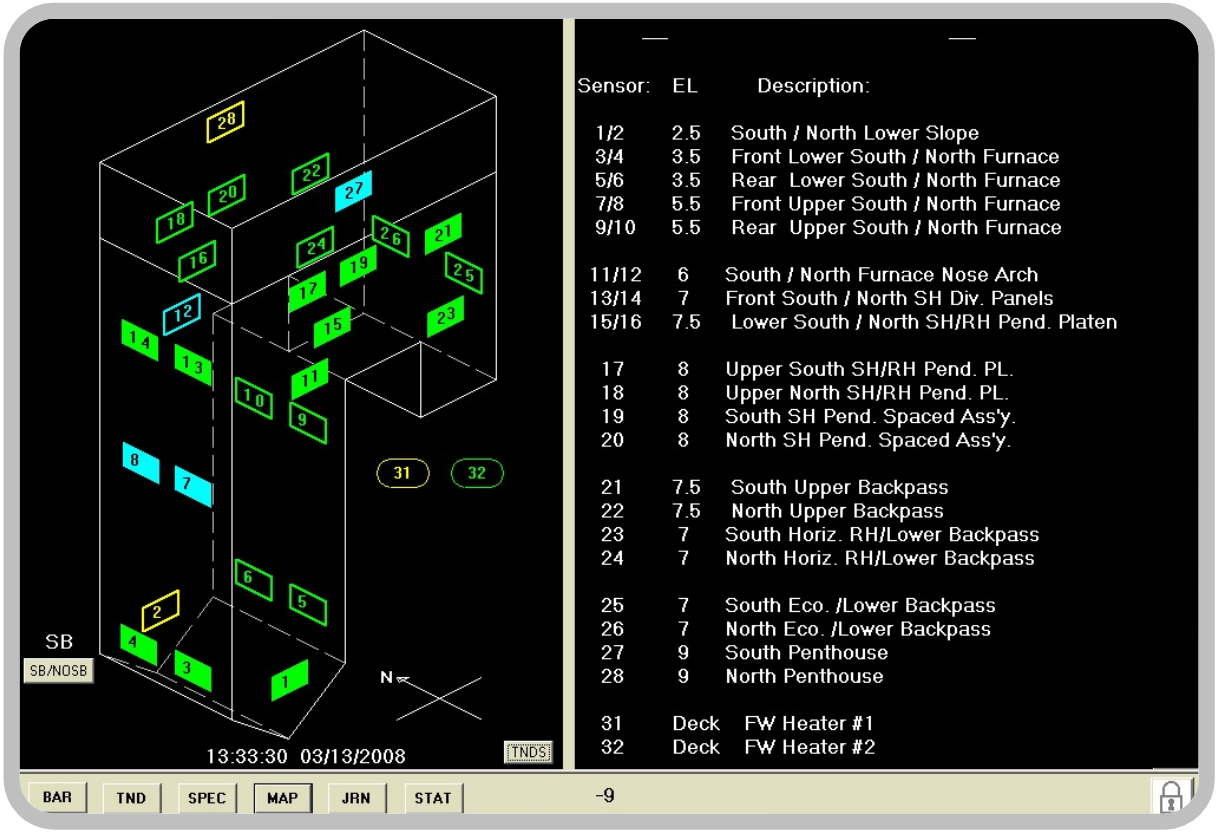
Boiler Tube Leak Monitoring

Acoustic signals are obtained from processes such as formation\growth of cracks, leaks, and variables such as load.

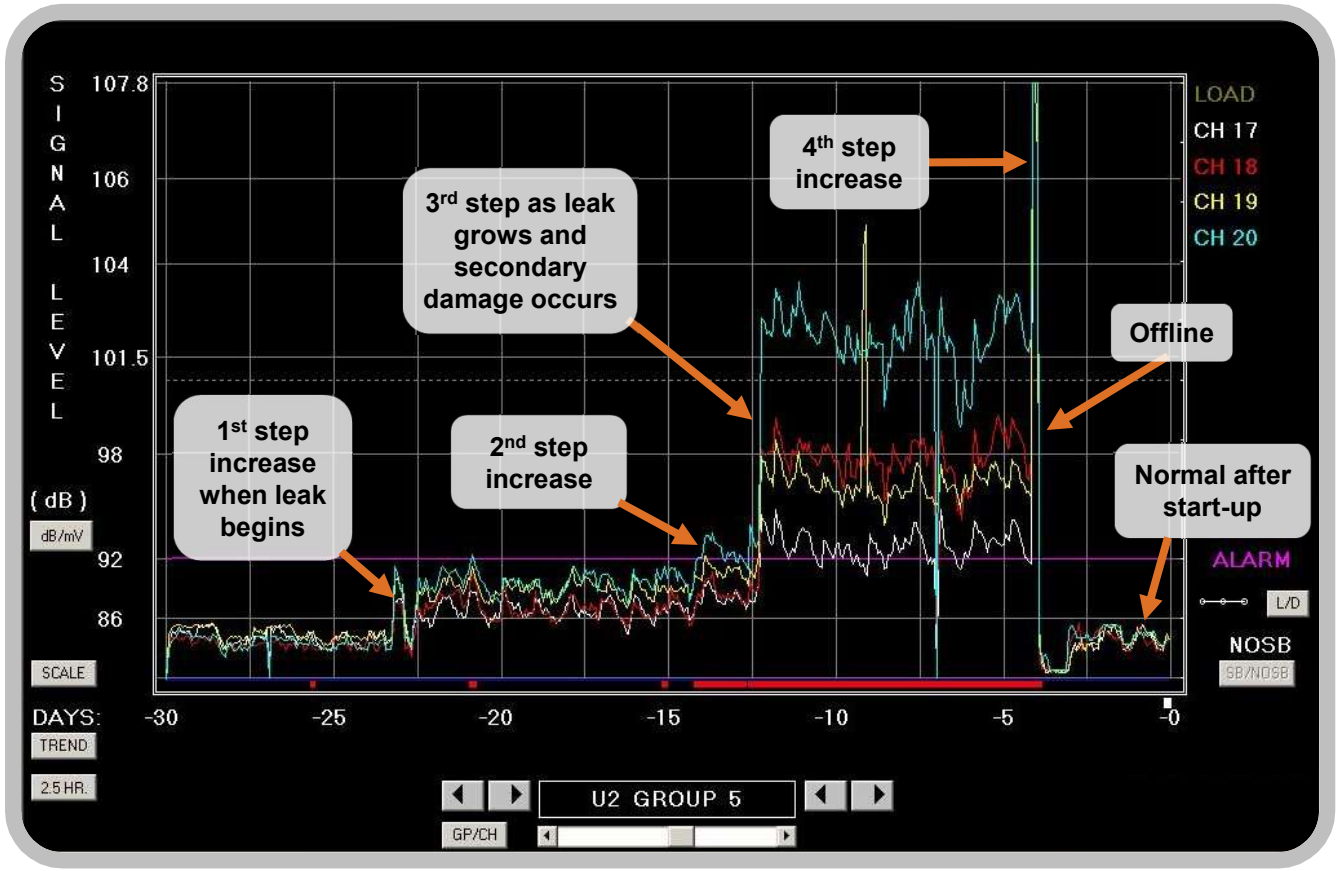




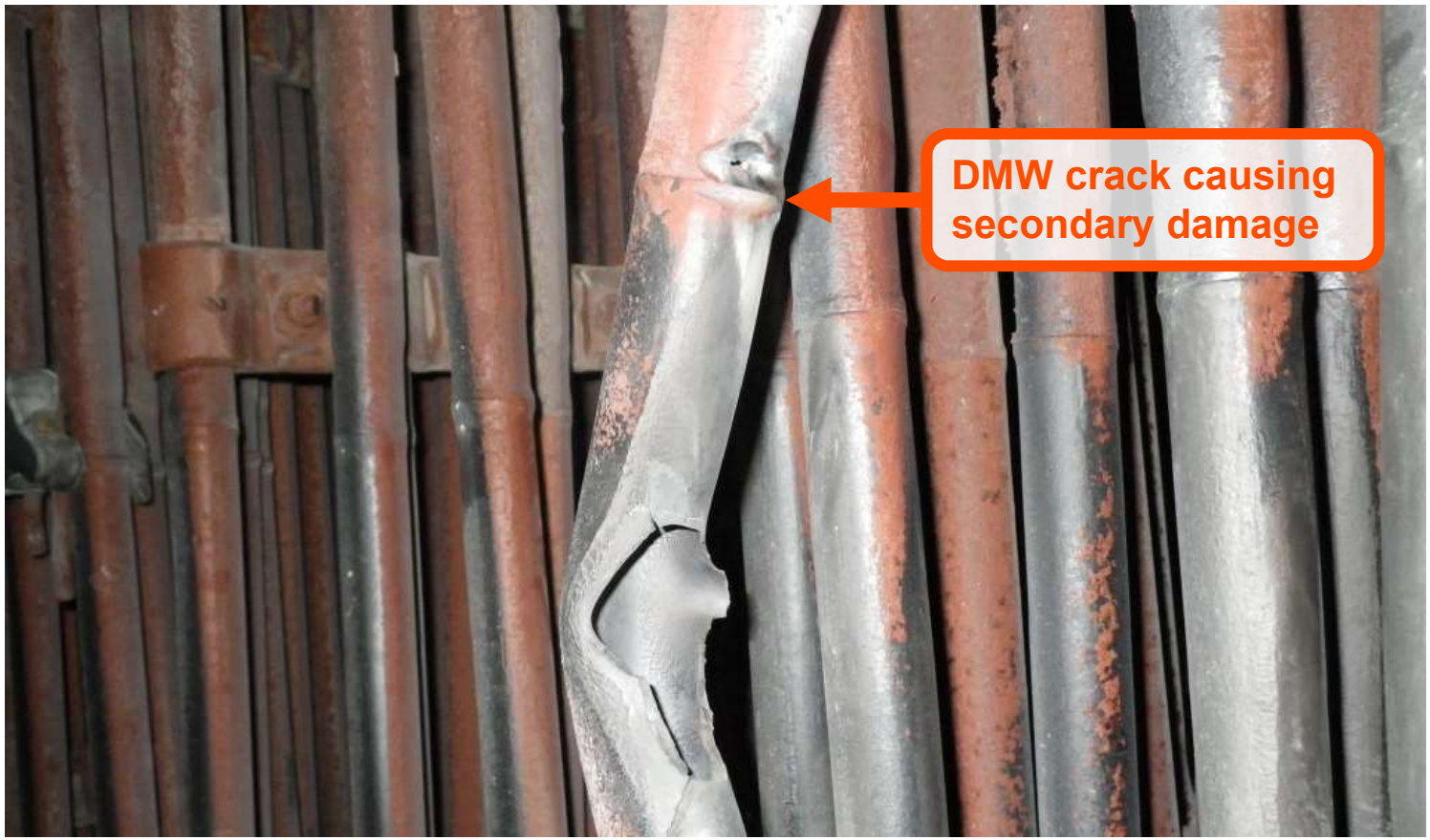
Sensor Location Layout



Finishing Superheat Leak



Finishing Superheat Leak



Pressure Vessels

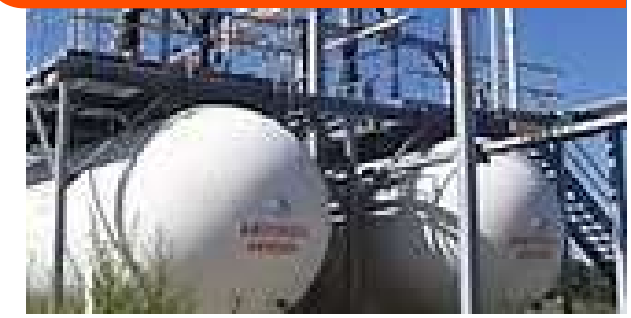
- ✓ Safety
- ✓ Reliability
- ✓ Longevity
- ✓ Economics
- ✓ Compliance

The Procedure:

- ✓ Techniques for Sensing
- ✓ Techniques for Analyzing
- ✓ Guidelines to Determine Nature, Severity and Location of Structural Defects
- ✓ Criteria to use as a Basis for Assessing Structural Integrity
- ✓ Guidelines for Loading (depending on vessel type and history)

Significance

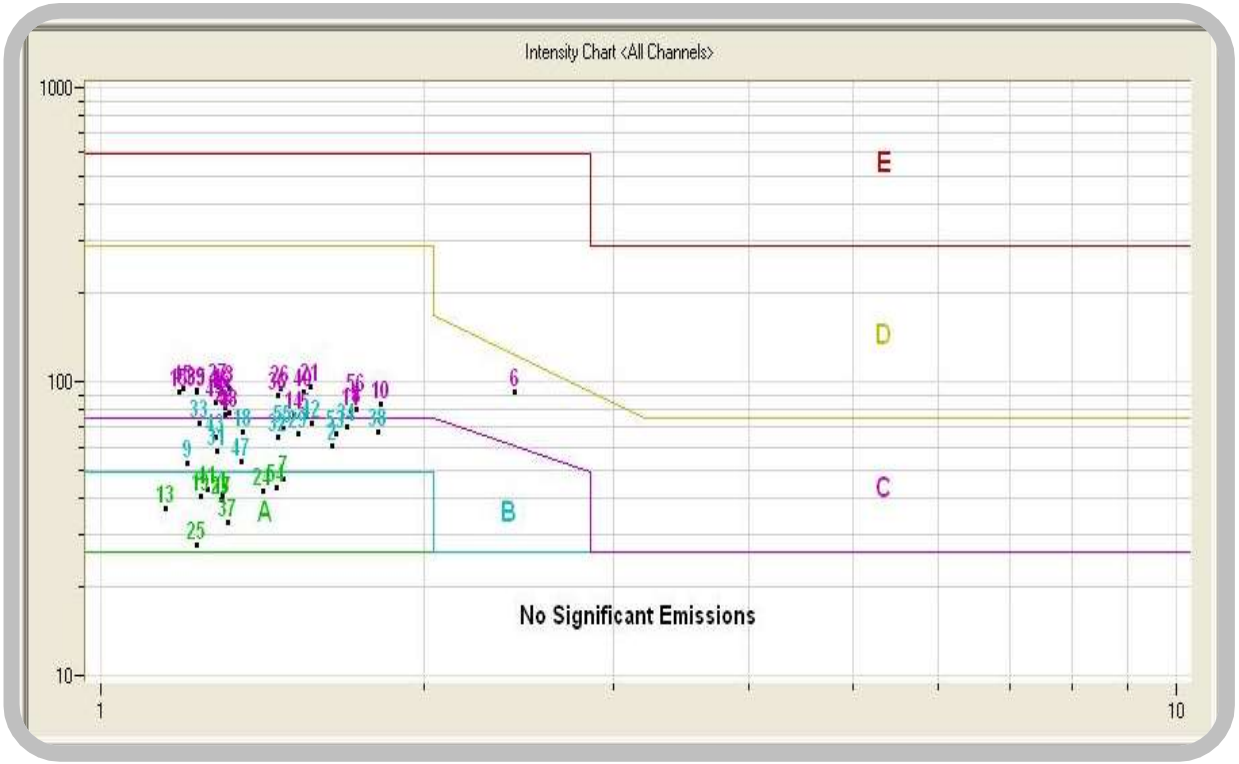
AE can detect defects and damage through a variety of failure modes



Pressure Vessel Data Interpretation

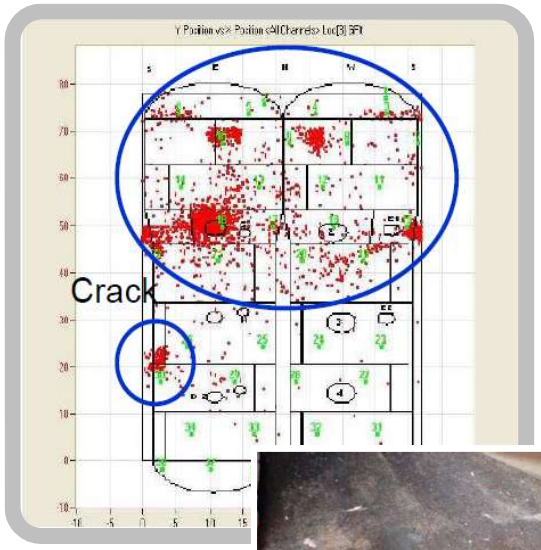
Intensity Analysis

- ✓ Expanded Data Base
- ✓ Signature Analysis
- ✓ Source Correlation
- ✓ Individual Channel Evaluation

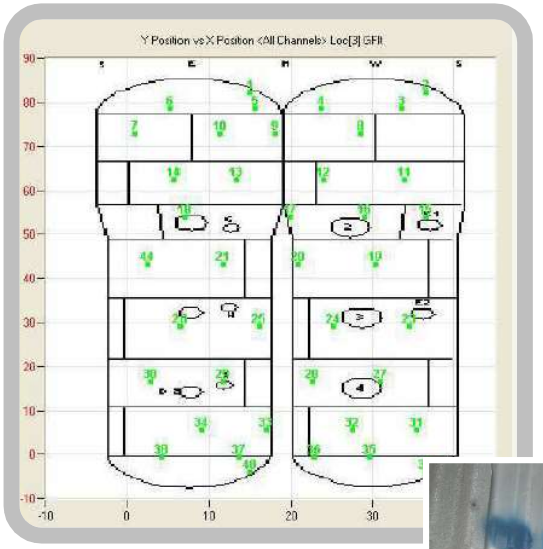


Pressure Vessels

Crack Locations



Sensor Positions

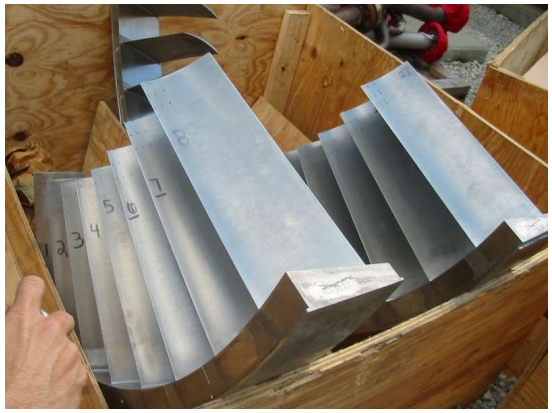


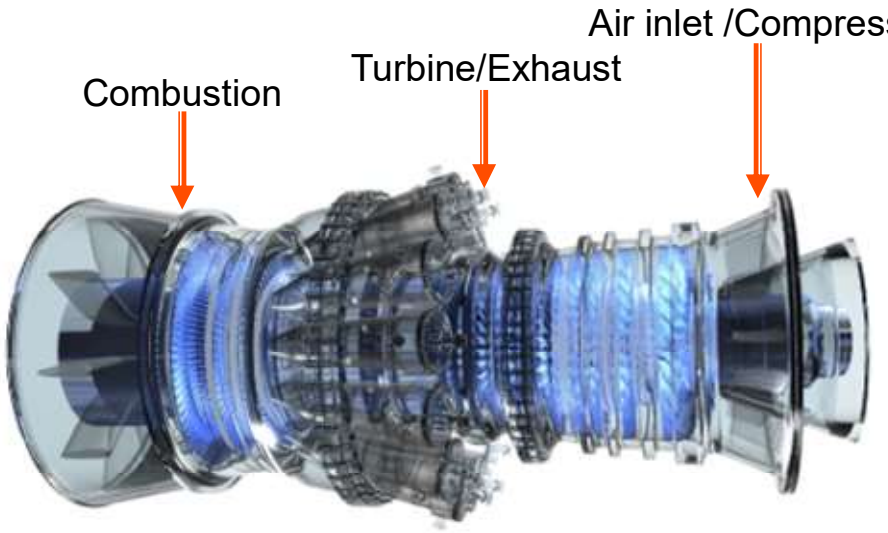
Sensor on Waveguide

Online Detection of Stator Vane Cracking Using AE

GE F-Class Gas Turbine

- ✓ Compressor Stator vanes
  - ✓ Alternate with Rotor blades
  - ✓ Largest in the front
  - ✓ Numbered from 0 through 17
    - ✓ i.e. S0, S3

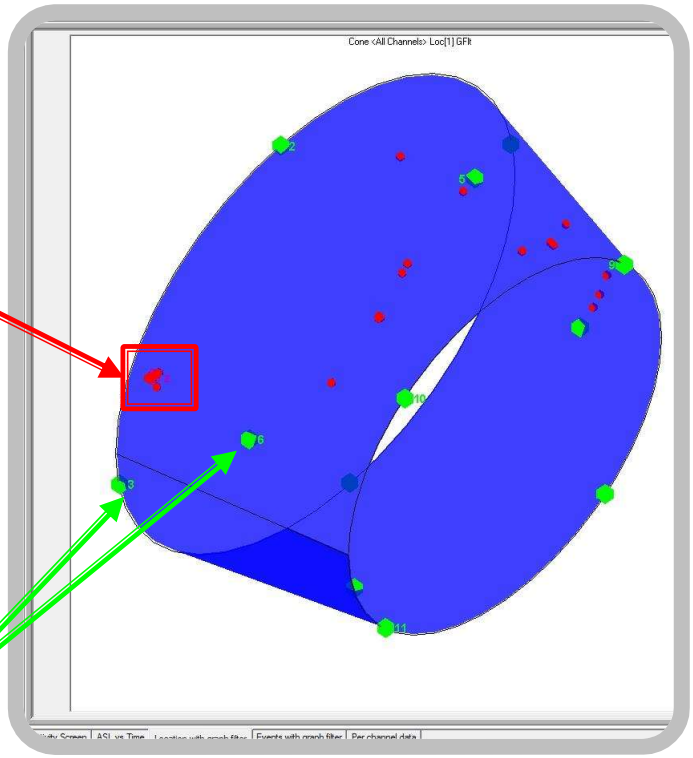




Stator Vane Cracking Using AE

Cluster of Activity over S1 row

Sensor Locations



Crack Detection, Fretting and Clashing

S1 Vane crack found in location of ACTMS indication

Turbine B crack cluster location

High-Energy Piping (HEP)

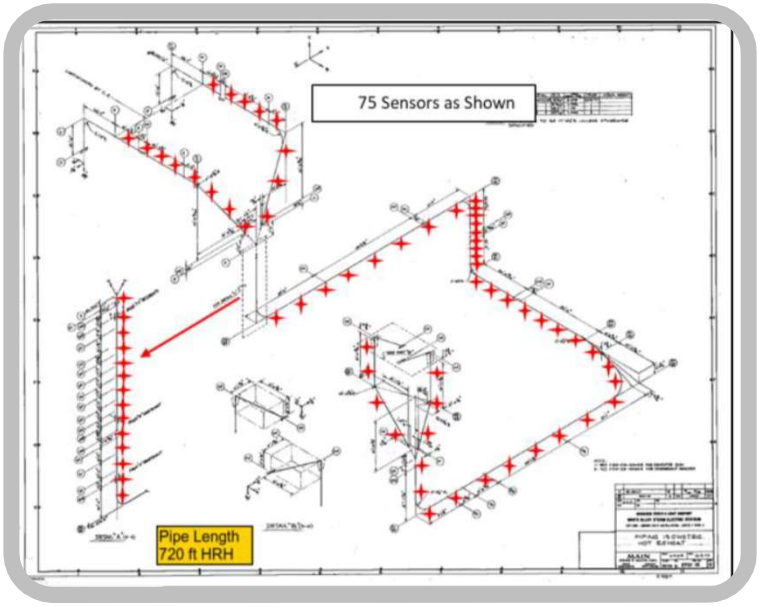
- ✓ Creep
- ✓ Fatigue
- ✓ Thermal fatigue
- ✓ Creep-fatigue
- ✓ Microstructural instability
- ✓ Flow-accelerated corrosion

AE is the best possible technology to:

- ✓ Detect signals as micro and macro cracking occur
- ✓ Easily deployed for continuous monitoring

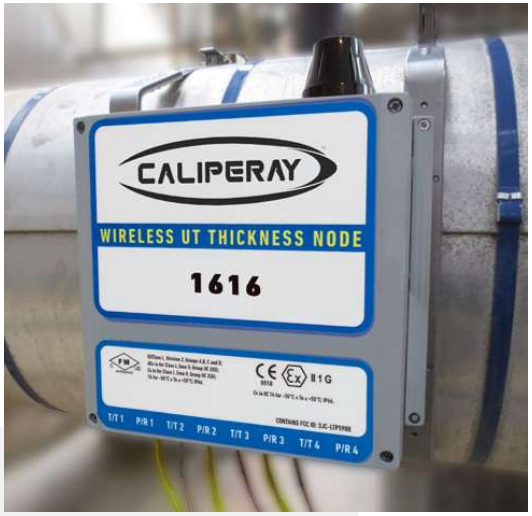
High-Energy Piping (HEP)

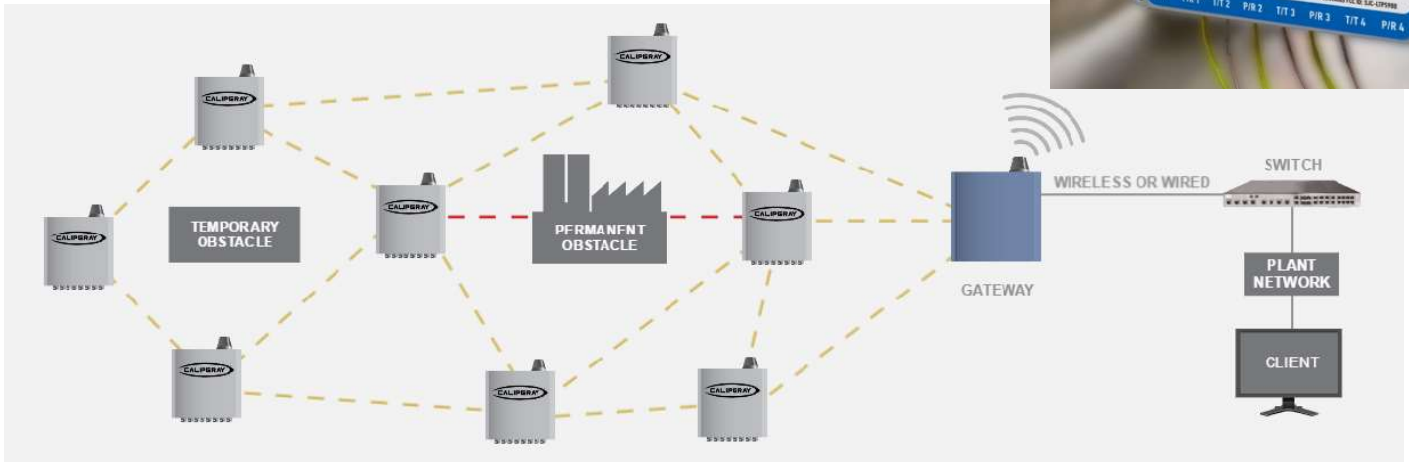
- ✓ All channels receive data all the time
- ✓ Less likely to loose sudden crack jumps
- ✓ It requires higher count of channels in the system



Ultrasonic Thickness Monitoring

- ✓ Very good accuracy of readings
- ✓ Not necessary to have personnel access
- ✓ Can be used at High Temperature (up to 550 °C)
- ✓ Identify corrosion issues at an early stage
- ✓ Improved corrosion management





Ultrasonic Thickness Monitoring

ADVANTAGES
Non-intrusive design and installation
Highly precise readings
High temperature functionality
Self-organizing and self-healing network
Increased reading intervals
Improved corrosion management & detection equiptment
Reduced installation costs (no welding or wires required)

KEY FEATURES
Single Channel Pulser and Receiver
Four Channel Multiplexer for 4 Single or Dual Crystal Transducers
Receiver: 20 - 70 dB Gain, 1 MHz - 8 MHz Bandwidth
Pulser: Square Wave
Smart Sensor Network Wireless Communication
Ultra Low Power - 5 year Battery Life
Intrinsically Safe Certified

Ultrasonic Thickness Monitoring

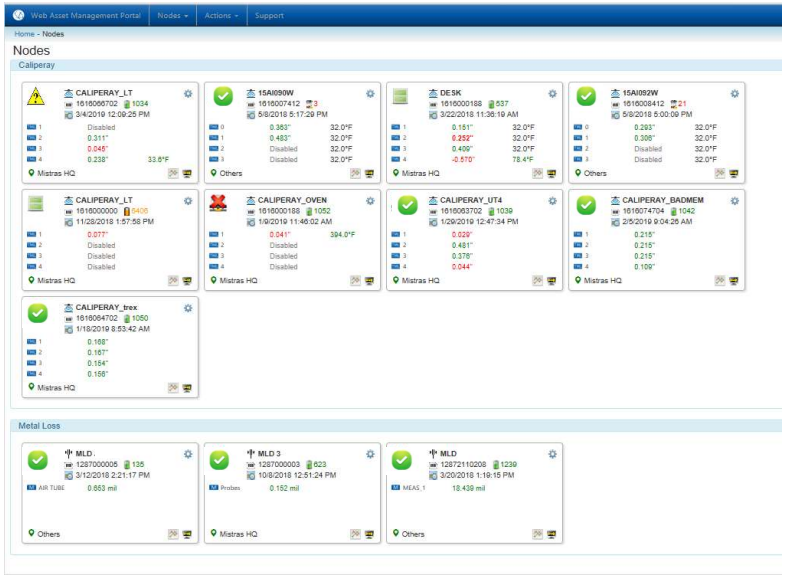
Transducers

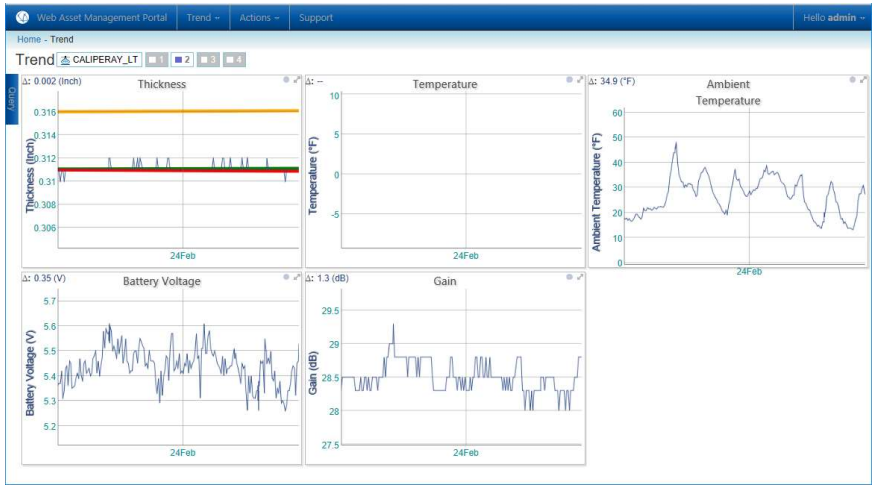
- Dual crystal transducer
- Operating temperature up to 150 °C
- Thickness measurement range between 0.1” to 2.5”
- Gel or glue coupling

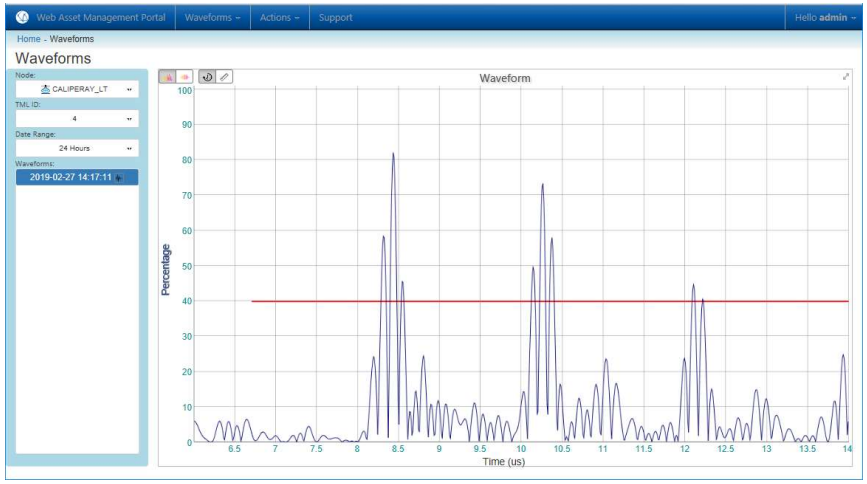
- Single element transducer
- Built-in thermocouple for temperature compensation
- Operating temperature up to 350 °C
- Thickness measurement range between 0.1” to 0.9”
- Dry coupling (metal foil)

Ultrasonic Thickness Monitoring

Web Application Management Portal (WAMP)







Metal Loss Detector (MLD)

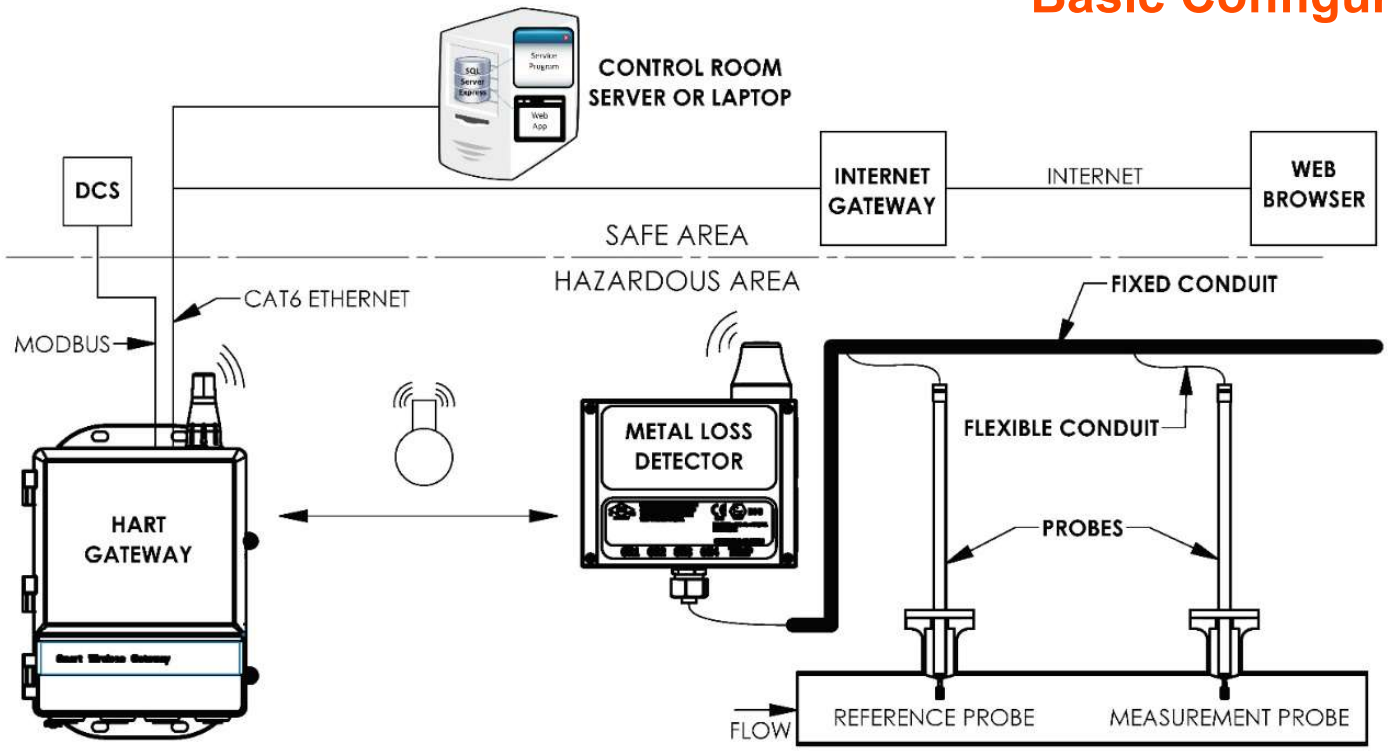
- A novel type of sensor for monitoring and measuring on-line corrosion in process piping and vessels with high sensitivity
- System connects to existing or new WirelessHART networks.
- Measurements are made available for analysis through the monitoring host software suite
- Provides continuous automated monitoring of piping in corrosive environments and early detection of unexpected corrosion rates
- Allows rapid evaluation of risk while piping systems remain online

Metal Loss Detector

- Based on Tuning Fork Principle
- Two probes are required, a reference probe and a measurement probe.
- Probes compensate for temperature, flow, and pressure variations, so measurements are not affected by non-corrosion environmental conditions
- High Temperature – up to 450° C.
- High Pressure Operation
- Long Life – 6 years at corrosion rate of 10 mpy
- High Resolution – 0.3 mil
- Usable in conductive and non-conductive environments
- Almost 6 years of in-service experience & data

Metal Loss Detector (MLD)

Basic Configuration



Metal Loss Detector

Trending of Corrosion Rates

Summary

Multiple applications have been developed in collaboration with asset owners, in order to:

- ✓ Ensure safe operation of assets
- ✓ Determine the condition of the asset at the time of evaluation
- ✓ Extend inspection intervals
- ✓ Identify necessity and level of inspection follow up

THANK YOU

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