Frazier Reliability Solutions is a subsidiary of Frazier & Associates, Inc.

Since 1996, Frazier Reliability Solutions has been providing industrial inspections, nondestructive testing and reliability technologies to industrial clients around the world.

Our mission is to provide practical, cost effective solutions that help our customers operate safely and profitably.

We have a passion for finding innovative technical solutions to help our clients solve real world problems, better, faster, smarter, safer.

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Frazier Risk Solutions, also a subsidiary of Frazier & Associates, provides property insurance risk engineering services to Risk Manager, Brokers and Insurance Companies.

Our clients have included FM, Swiss Re, GRC, Allrisk and Wortham.
Corrosion is the destruction of a metal by chemical or electrochemical reaction with its environment.

CUI is any type of corrosion that occurs due to the presence of moisture on the external surfaces of insulated equipment.

Typically galvanic.
The Average Refinery Has Enough Pipe To Go Around The World 4 Times.

1/3 Of The Cost Of The Plant Is Piping
40% Of All Major Losses At Refineries Involve Piping.

Corrosion Is The Single Largest Cause Of Piping Failure.

And that corrosion mechanism is predominately CUI.

Fig. 1-1 Asset loss risk as a function of equipment type. Source: Ref 1
60% of all pipe leaks are caused by CUI.

In almost every case, the piping was protected by organic coatings before installation.

Service life of pipe coatings in CUI service? 5 to 13 years.
40-60% of pipe maintenance costs are due to CUI.

10-20% of total maintenance budget spent to repair CUI damage.
Corrosion Under Insulation (CUI) can occur in equipment operating at ambient, low, and heated services. CUI can also occur in equipment in service, out of service, or in cyclic service.
CORROSION UNDER INSULATION

API 510 & 574

Carbon & low alloy: 10°F - 350°F

Stainless: 140°F - 400°F

Above 600°F when insulation is soaked during downtimes by deluge systems and rain.
CUI and Stress Corrosion Cracking (SCC)

Repeated cycles of wetting and drying can concentrate chlorides which, combined with stress, can result in the complete degradation of the stainless steel.
HOW CAN I DETECT CUI?

Visual Inspection.

Requires removal of insulation in areas that have a high probability of CUI (e.g. insulation rings, skirt to vessel attachment welds, etc.).

Time-consuming & expensive, especially if insulation contains asbestos.
HOW CAN I DETECT CUI?

Conventional Radiography.

Does not require the removal of the insulation.

Can be used with insulation of any thickness or type and on pipes of varying diameters and wall thicknesses.

Not very practical for pressure vessel.

Safe radiation zones can interfere with operations.

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HOW CAN I DETECT CUI?

Digital Radiography.

Requires less radiation than conventional radiography resulting in less impact on operations.

Images stored digitally. Easy to reproduce & share.

Does not require the removal of the insulation.

Can be used with insulation of any thickness or type and on pipes of varying diameters and wall thicknesses.

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HOW CAN I DETECT CUI?

Low Intensity X-Ray.

Portable hand-held fluoroscope using a low-energy radioactive source.

This can be a very quick way of qualitatively screening pipe for CUI.
HOW CAN I DETECT CUI?

Pulsed Eddy Current.

Useful for rough surfaces or difficult to access areas.

No surface preparation or insulation removal is required.

A pulsed magnetic field penetrates through the non-magnetic insulation, inducing eddy currents in the pipe that are then evaluated to determine the presence of corrosion.
Guided-Wave Ultrasonics.

Guided waves are produced along the axial direction of the pipe. The echoes are evaluated to determine size and location of corrosion.

Useful for rough surfaces or difficult to access areas.

No surface preparation or insulation removal is required (e.g. sphere legs covered in fireproofing or underground piping).

Accuracy very operator dependent.

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Other screening techniques, such as neutron back scatter and infrared thermography, can help to find moisture under insulation.

Conventional ultrasonic thickness measurements and direct measurements (pit gages, etc.) are used for flaw sizing and determining remaining thicknesses.
“An ounce of prevention is worth a pound of cure” – Ben Franklin.

It’s more cost effective (not to mention safer) to prevent CUI than to repair the damage or replace the equipment later.
HOW CAN I PREVENT CUI?

The first line of defense is the proper application of a suitable organic corrosion inhibiting coating before placing the equipment in service.

And, these coatings must be maintained for the life of the equipment.
HOW CAN I PREVENT CUI?

The second line of defense is the proper installation of insulation and metal lagging with good beaded or lapped seams and proper caulking.

Once coated and insulated, every reasonable effort should be made to ensure the integrity of the insulation.

Stay off the insulation!
Third, you must identify which assets are susceptible to CUI and what parts of those assets are most likely to exhibit CUI (e.g. insulation rings, skirt to shell welds, etc.).
HOW CAN I PREVENT CUI?

Fourth, you must have an ongoing inspection program to ensure the mechanical integrity of insulation lagging.
HOW CAN I PREVENT CUI?

Fifth, you must have a screening process that identifies wet insulation.
Finally, you must have an ongoing vessel and piping inspection program taking into consideration the condition of insulation lagging and the life expectancy of coatings.
CORROSION UNDER INSULATION

CUI is hidden from sight.

It progresses undetected.

Around the clock, 24/7, slowly reducing the pressure retaining strength of vessels, tanks and piping.

An effective CUI program is essential for safe and reliable operation.

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An effective CUI program must be:

- Focused (Formal assessments of all assets.)
- Budgeted
- Measured (KPI’s such as LOPC’s, ROI, etc.)
Since the February 2008 event, industry has been pushing for mechanical integrity assessments of this widely overlooked risk.

MI assessments of vertical deep well pump casings are easy...unless the pump is encased in concrete!
VERTICAL “DEEP WELL” CANNED PUMPS IN SITU

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INSPECTING CAN PUMPS IN PLACE

To inspect a pump casing in situ, try the following:

1. Remove the pump from the casing.

   Clean the internal surfaces of the casing insofar as practical and perform a visual inspection.

   A good borescope would be the most practical method.
2. Nondestructively examine the casing for loss of thickness.

There are several methods that can be tried such as guided wave, phased array, pulsed eddy current.
3. Nondestructively examine the casing welds insofar as possible.

There are several methods that can be tried such as shear wave, time of flight diffraction and acoustic emission.

Immersion type ultrasonic scanner corrosion mapping a pump casing in situ.
The most challenging weld to inspect is the bottom head to casing weld.
4. Hydrostatically test the casing in accordance with the National Board Inspection Code.
A final note: If these types of pumps are located in congested hydrocarbon process areas with nearby ignition sources, the installation of area gas detection with voting (2ooX) connected to emergency shut down systems is highly recommended.
The government projects that by 2025 the unmanned aircraft business could be worth $82 billion and support up to 100,000 jobs.
The FAA projects that the top five markets served by commercial drones will be:

1. Industrial Inspections: 42%
2. Real Estate/Aerial Photography: 22%
3. Agriculture: 19%
4. Insurance: 15%
5. Government: 2%
Commercial use of an unmanned aerial vehicles must meet stringent FAA requirements.

The latest FAA rules limit flights to daylight and visual line-of-sight operations, limits flight altitudes and requires registration and marking of aircraft.
DRONES

Operators must be at least 17 years old, pass an aeronautical knowledge test, obtain an operator certificate, meet applicable TSA requirements.

To maintain certification, the operator must requalify every 2 years.

A private pilot license and medical rating are not required.
DRONES

Industrial Inspection Applications

Power lines, pipelines, antenna, cell phone towers, process towers and columns, cooling towers, flares, wind turbines, bridges, buildings, pipelines, construction sites, infrastructure, power plants, dams, substations, transportation (aircraft, trains, ships, rail roads, docks, highways, bridges).

Internal inspections: storage tanks, boiler furnaces, flue gas ducts, silos, stock chests, buildings.
DRONES

Advantages

✓ Reduced personnel risks.

✓ Can operate in most weather conditions.

✓ Can inspect while equipment in operation.

✓ Eliminates confined space and elevated work, scaffolding, lifts, cranes, etc.
DRONES

Advantages - continued

✓ Superb data capture. Defects can be located in 3D and analyzed from multiple angles. Can produce 2D mapping, 3D point clouds and digital surface models. Using ground control points, drones can survey and develop as-built site data accurate to within ¼".
Advantages - continued

✓ Infrared capable.

✓ Fast with excellent ROI. Drones can complete industrial inspections in half the time at half the cost and zero risk compared to conventional methods.
FINAL THOUGHTS

The property insurance industry has been a key stakeholder in ensuring the financial stability of industry since the first market was created in London in 1686.

Everyone in this room is an important contributor to that effort.

Thank you for your service.

If I can ever help you or your clients, please contact me at 817-416-4306

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