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Underwater NDT

Overview

Applications

Training & Certification

Presented by

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Technical Authority
MISTRAS Group, Inc.

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ASNT...CREATING A SAFER WORLD!®

Underwater NDT

An introduction to Non-Destructive Testing and inspections performed in underwater and subsea environments.

Joshua de Monbrun, CEng

Technical Authority – MISTRAS Group, Inc.

Owner – SubSea NDT, LLC

Chair – ASNT Underwater NDT Committee





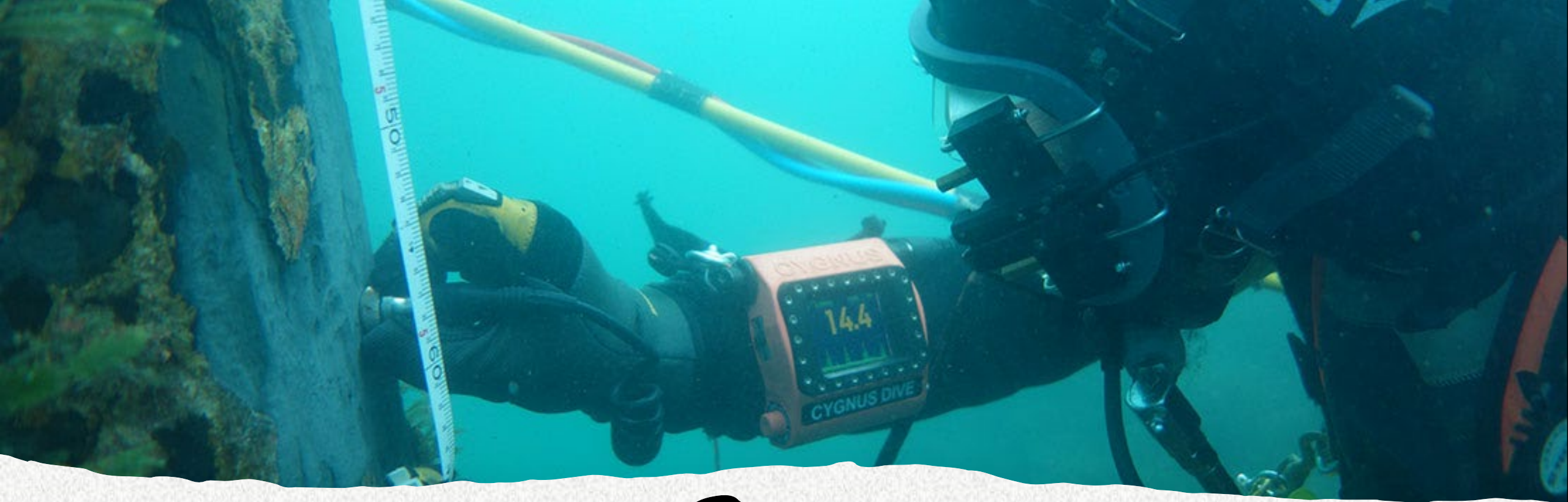
Introduction



Poll Question #1

What industry sector are you joining us from?

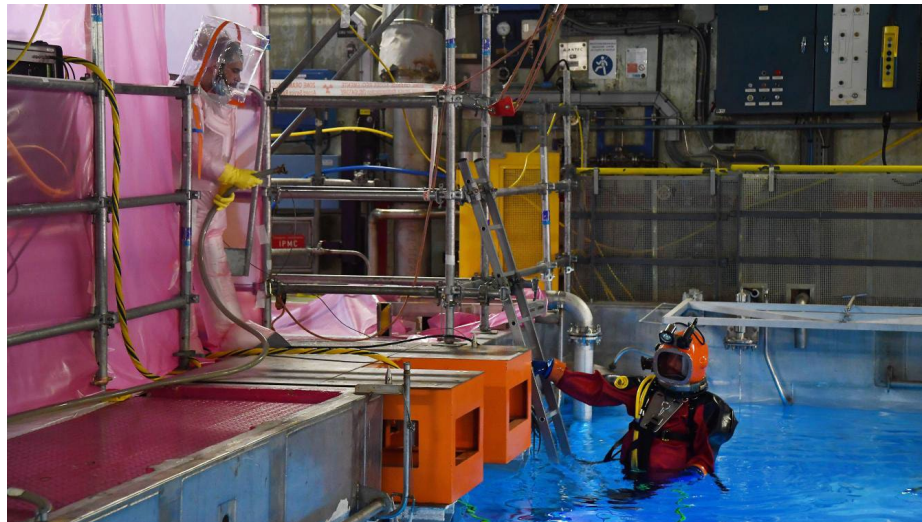
- NDT Technician
- Commercial Diver
- Engineer
- Just Curious



What is UWNDT?

What is there to inspect?

- Offshore platforms
- Subsea pipeline
- Marine vessels (barges, ships, submarines)
- Bridges
- Docks
- Dams
- Wharves
- Piers
- Above Ground Storage Tanks
- Water Towers
- Nuclear Cooling Pools
- Locks
- Water Treatment



The Beginning



Portland Ferry Bridge

William Thompson

Created the first underwater photograph in 1856, a mere 20 years after the first photograph was ever recorded!

He was curious as to the structural integrity of the underpinnings of the Portland Ferry Bridge, and created a water-proof housing to set his camera in.



First underwater portrait

The first underwater portrait was taken in 1899 by Louis Bouton in France. The picture is of Emil Racovitza, a Romanian oceanographer and biologist. Amazingly, this photo was taken at a depth of 164 feet and took over 30 minutes of exposure time!



Konstantin Khrenov

Soviet engineer who was the first to invent a method to join and cut metals underwater in the early 1900's. The father of underwater welding.

This new technology exploded onto the scene during WWII, as metals were in short supply, and nothing could be wasted.



1894

Konstantin
Khrenov born

1932

Successful
UW testing

1936

UW lifts
Boris out
of water

1942

Jensen begins
welding
research

1945

US Navy
expands UW
program



Cyril Jensen

Head of the underwater welding research and training at the Naval Engineering Experiment Station at Annapolis.

Ran the underwater projects salvaging several sunken ships at Pearl Harbor.

His technologies and processes have since been used in the construction and inspection and salvage of many underwater assets.



OSHA, 1970

From 1947, with the installation of the first offshore platform in the GOM, there were only “self-implemented” requirements for inspection of offshore platforms.

In 1970, OSHA gained statutory permission to conduct and require inspections of structures in US waters.



Poll Question #2

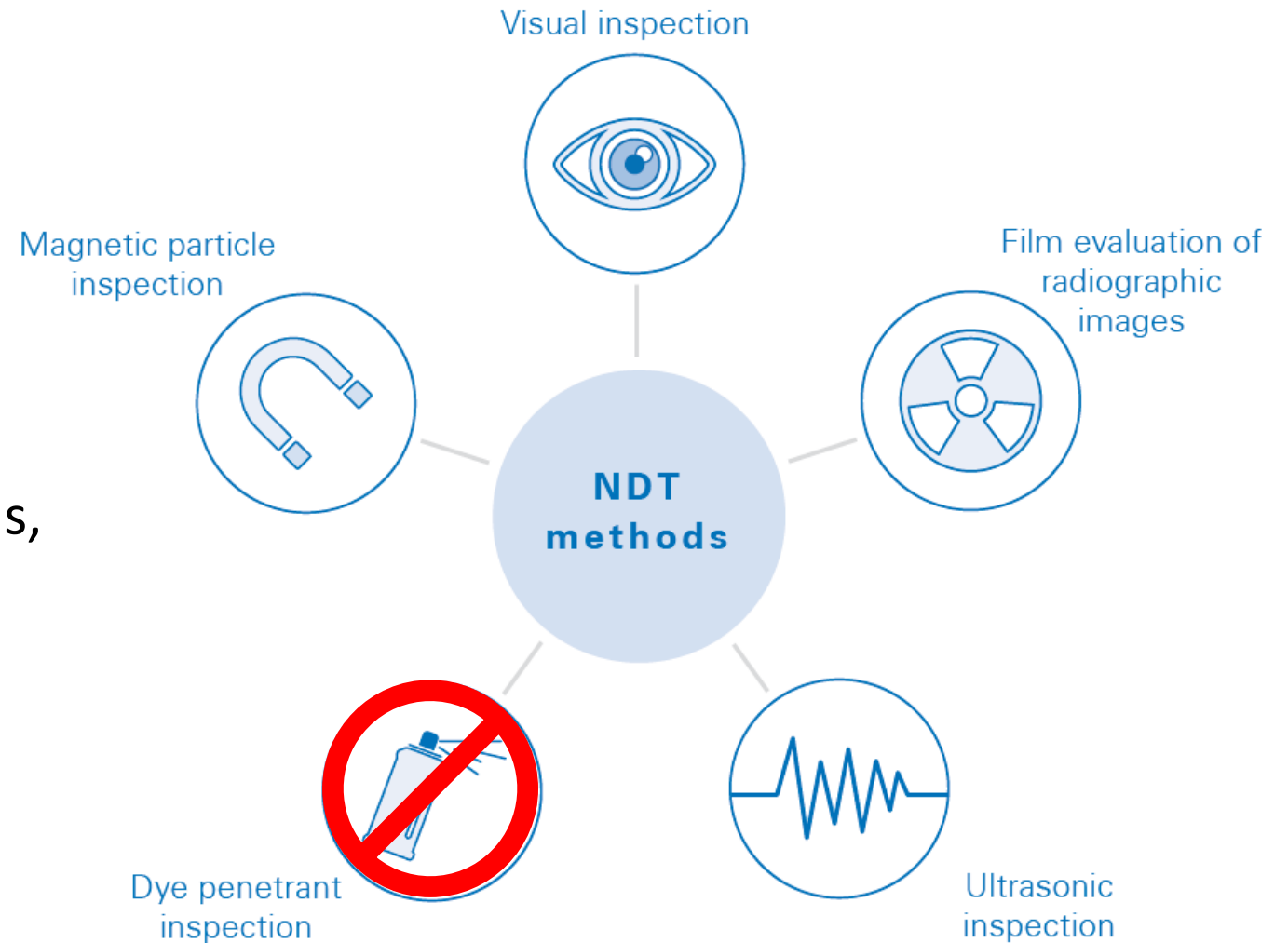
Of the traditional NDT methods, which is not used underwater?

- Magnetic Particle Inspection
- Liquid Penetrant Inspection
- Radiographic Inspection
- All of the above

Types of Inspections

Traditional NDT Methods

Of the five traditional NDT methods, all can be adapted for underwater use, save for penetrant.



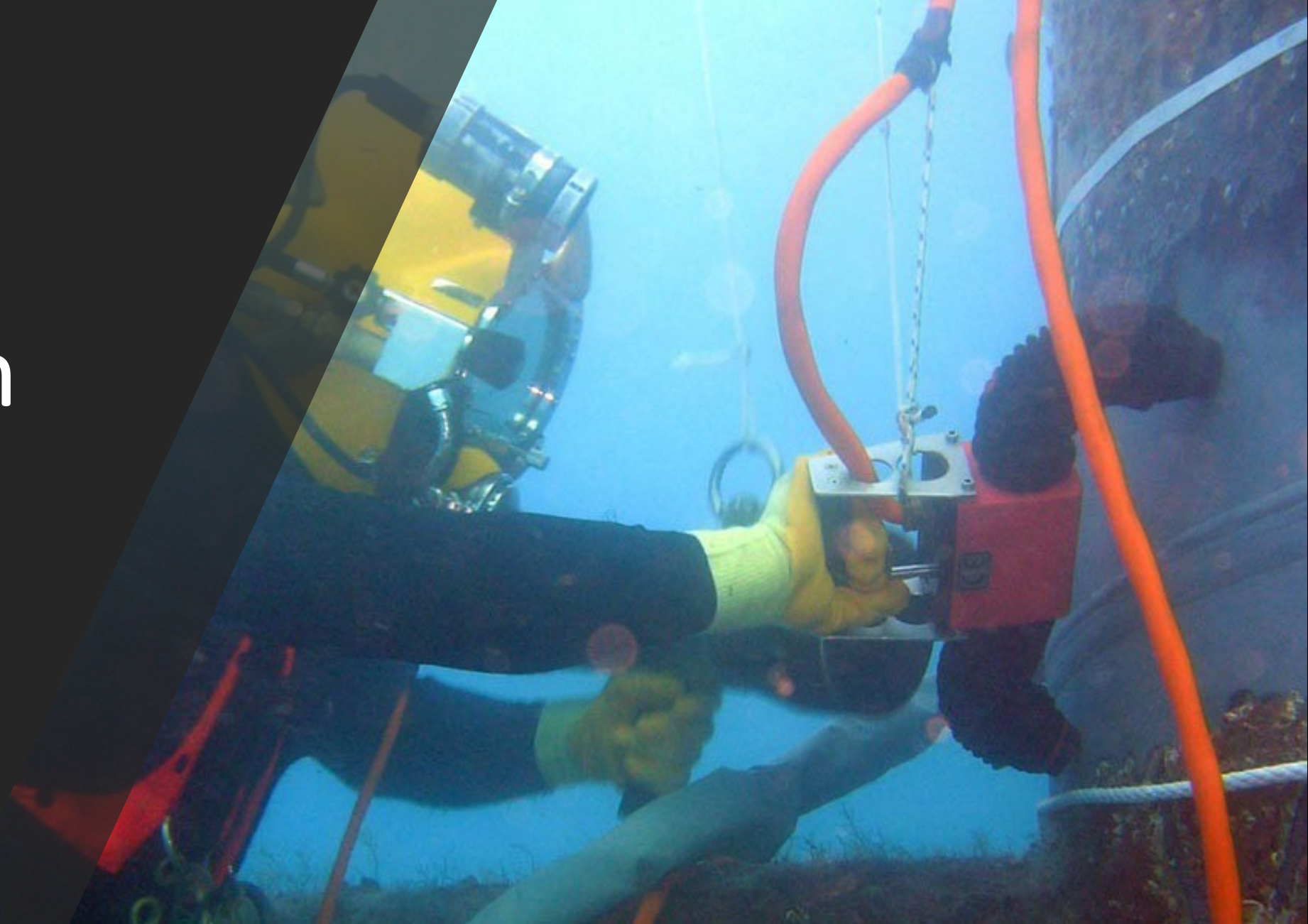
Visual Inspection

Still Photography
Videography



Magnetic Particle Inspection

Visible
Fluorescent



Ultrasonic Inspection

UT Thickness Readings (& AUT)
FMC (Flooded Member Detection)
UTSW/PAUT Weld Inspection
LRUT (Guided Wave)

Radiographic Inspection

Computed & Digital Radiography
Gamma Isotope & X-Ray Tube

Corrosion Potential Inspection

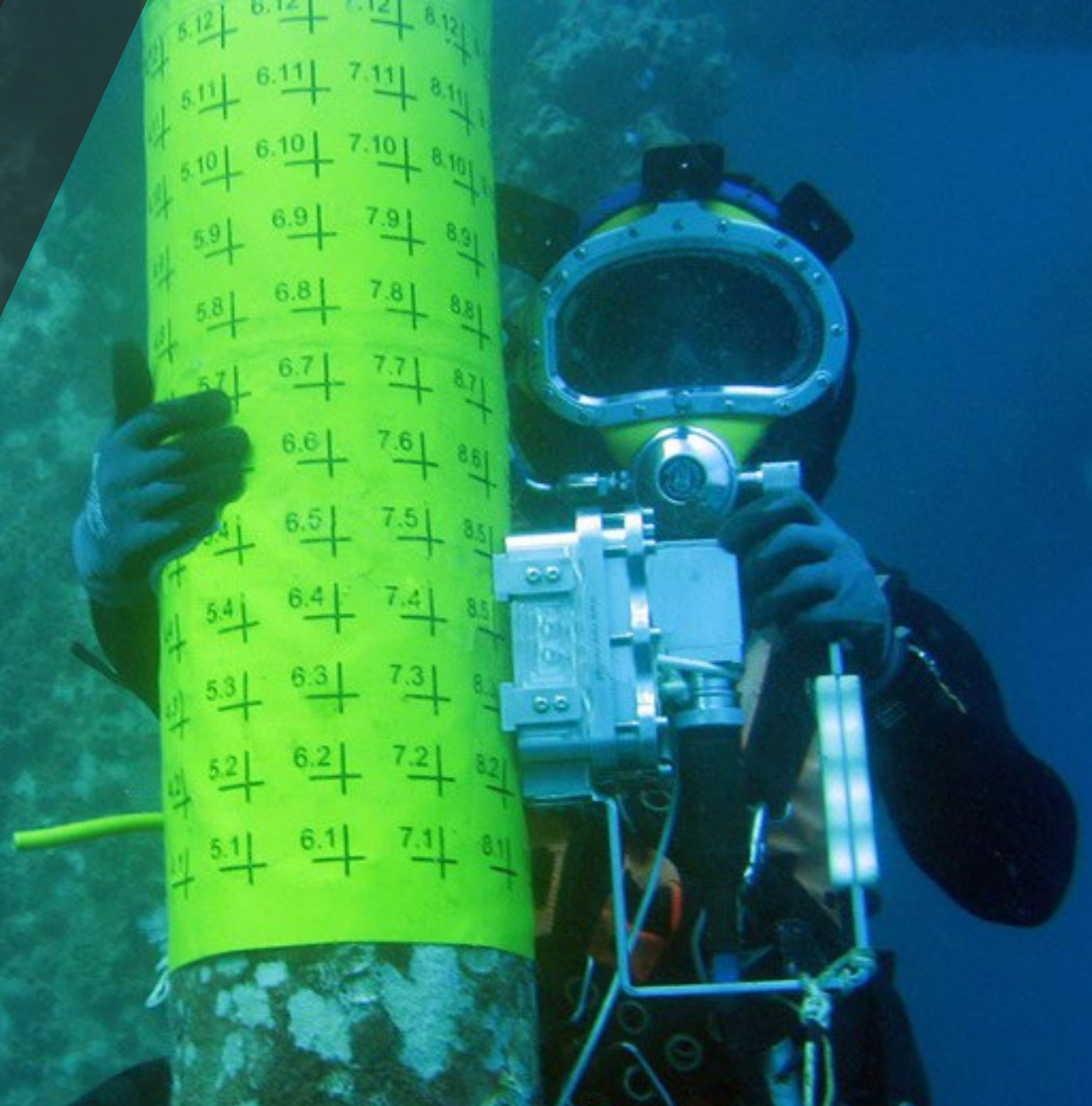
Cathodic Protection (CP)



Eddy Current Inspection

Pulsed Eddy Current (PECT)

Alternating Current Field
Measurement (ACFMT)



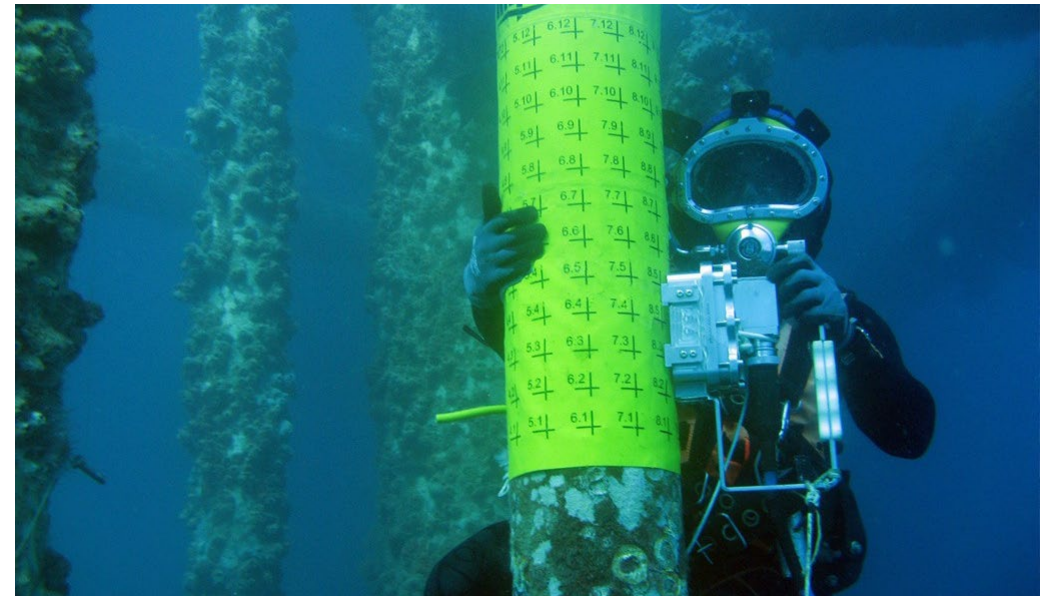
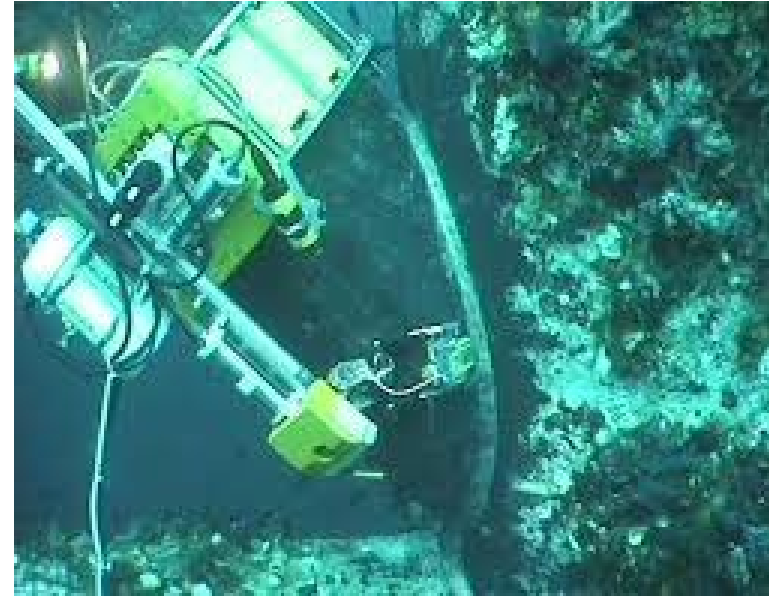
Advanced Applications

Offshore

Offshore Oil Platforms and pipeline seems to be what first comes to mind when thinking of NDT inspection of SubSea or underwater assets. It is a very large industry, the Gulf of Mexico alone holding over 80% of all underwater billable commercial diving hours worldwide.

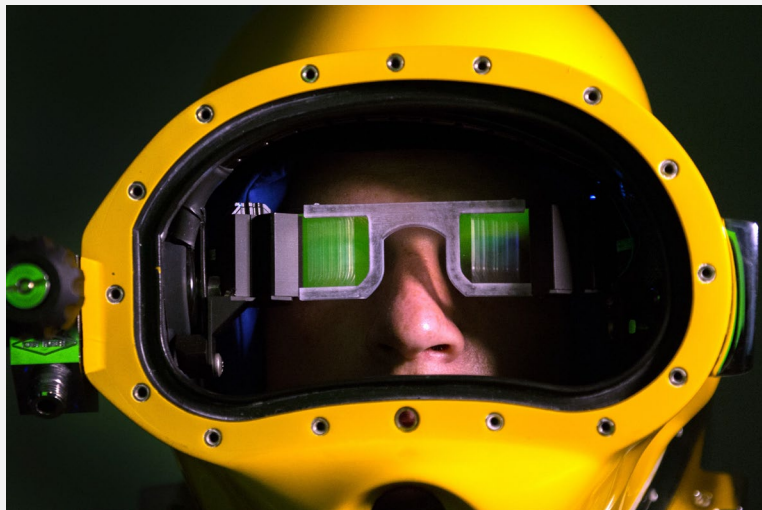
Inspections are not just your “traditional NDT” methods, however. Yes, there are a lot of visual, Ultrasonic Thickness measurements, and magnetic particle inspections, but in these remote locations, especially in “zero-vis” or hard to access areas, Advanced NDT methods have been growing steadfastly.

- Automated UT (AUT)
- Alternating Current Field Measurement (ACFM)
- Pulsed Eddy Current (PEC)
- Digital/Computed Radiography
- Phased Array Ultrasonic



Advanced Techniques

Incorporating waterproof screens and helmet view displays of PAUT data to Diver Inspector for the purpose of real-time PAUT and TOFD weld inspections underwater.



Ultrasonic Techniques

Automated Ultrasonic Testing (AUT)
for Corrosion Mapping

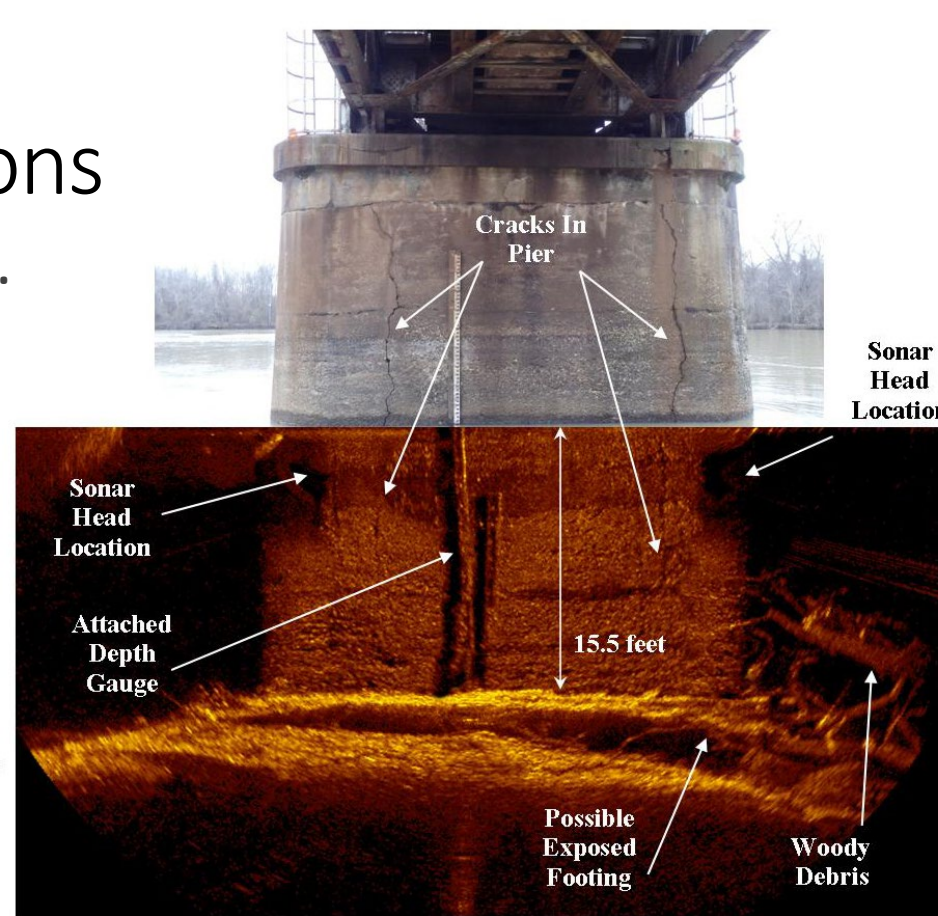
Has been used for the detection of internal corrosion on subsea pipelines, risers, structures, and even for hull inspections of vessels.



Importance of UW Inspections

What is “out of sight” shouldn’t be “out of mind”.

- Asset Integrity and Maintenance programs rely on underwater inspections as a necessary part of an effective program.
- NDT, condition monitoring, structural health monitoring, and quality management
- Regulatory and international standards requirements



“Prerequisites necessary for competent inspection of an object, is knowledge of the manufacturing process by which it was made, of its service history, and of its potential failure modes, as well as industry related experience.”



Importance of Inspections

Reduce construction & maintenance costs

Maintain operational readiness

Provide reliable service

Protect personnel and property



Unfortunately,
when underwater
assets fail, they
often make the
news.



Infrastructure

Industry Needs

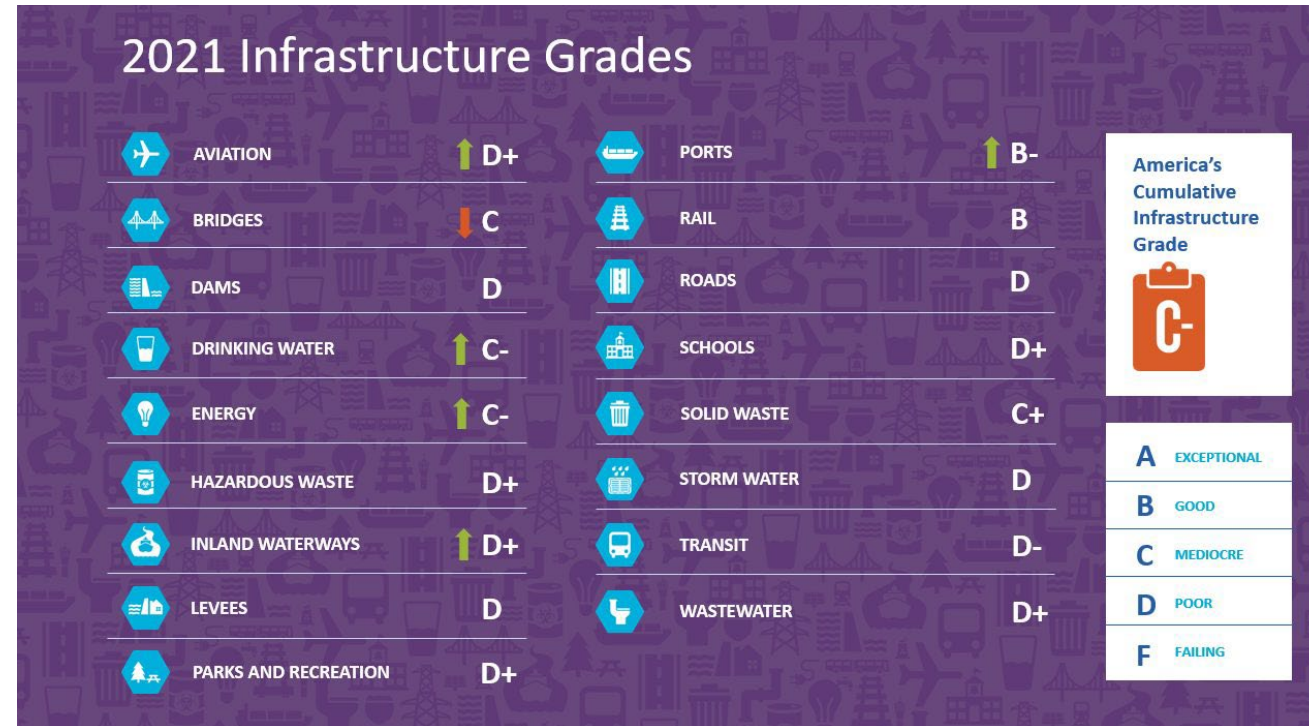
617,000 bridges in the United States alone, half of which are at least 50 years old and nearing the end of their life cycles. Over 46,000 of which are considered “structurally deficient”.

To put it another way, every day there are 178 million trips taken across these “structurally deficient” bridges.

Over 91,000 dams in the US, 2,300 of which are considered “deficient high-hazard-potential”.

More than 16,000 wastewater treatment plants that are functioning, 81% are at design capacity and another 15% over capacity.

Clearly there is a need for qualified and certified underwater NDT services of multiple methods of inspection, not just in the US, but worldwide.



Fern Hollow Bridge Collapse, Pittsburgh

January 28, 2022



Poll Question #3

Underwater Structural Damage

Would you feel safe driving across this bridge?

Why Specialized UWNDT?

- Increased production & lower maintenance costs
- Reduction in inspection durations
- Increased reliability and usability of data
- Increased safety

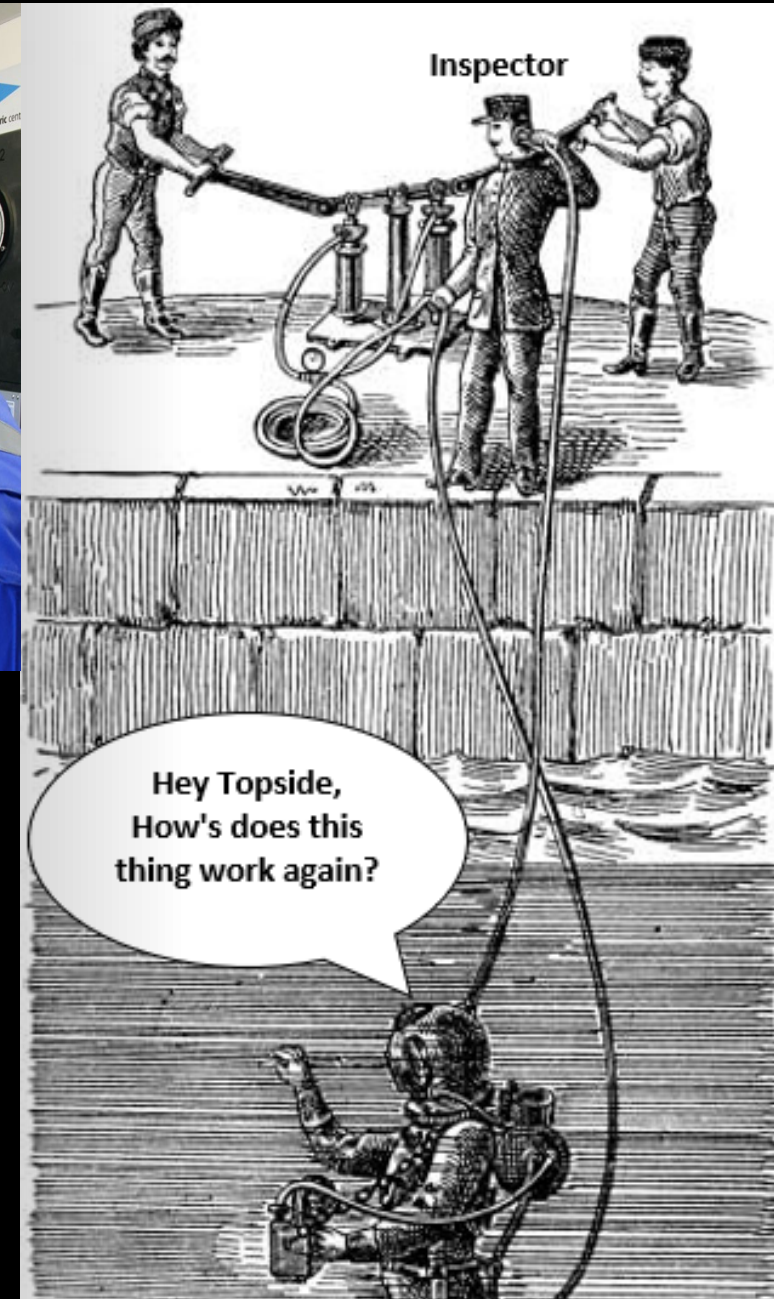


Application of Inspection Methodologies

Commercial Divers – The Jack of all Trades

Traditionally, commercial divers had little technical experience in engineering or inspection. An NDT inspector topside would observe and guide the diver.

Presently, certification protocols are being developed to regulate underwater inspection, and more companies are requiring formal qualification and certification for underwater inspectors.

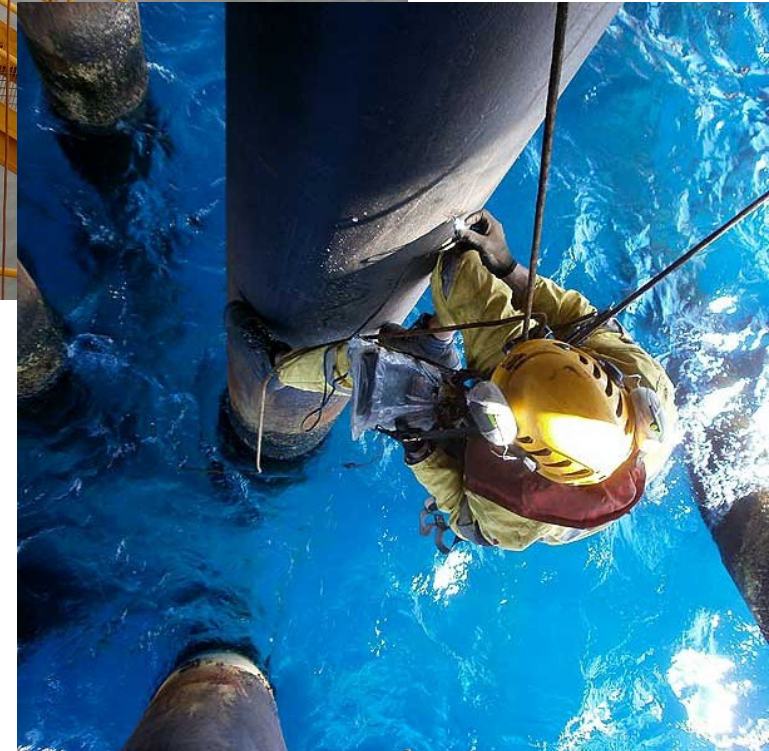
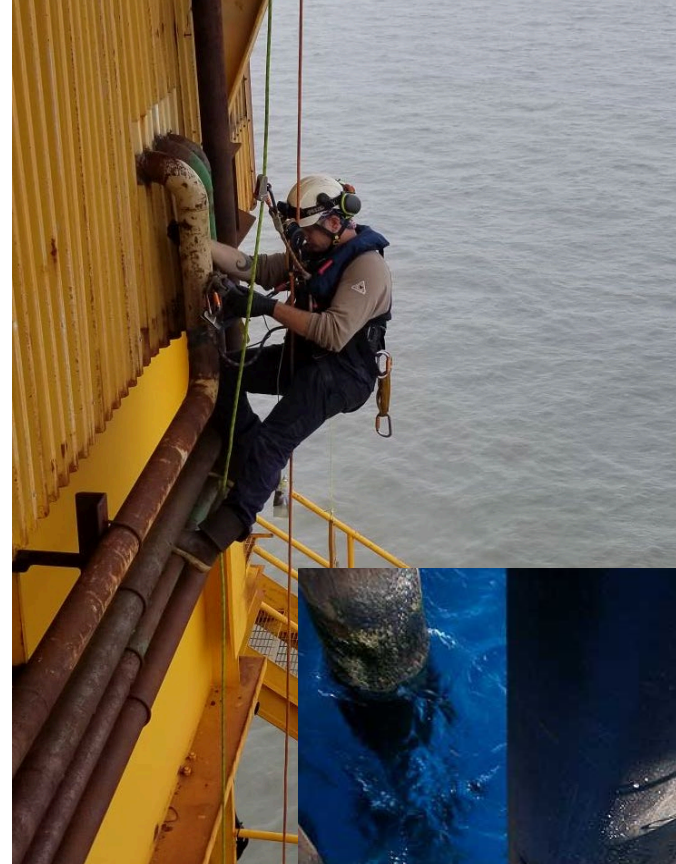


“Access Vehicles”

Clients and Codes have several requirements governing a technician’s eligibility to perform an NDT inspection on their assets. Including formal education, OJT (training), examination and certification.

Would you give a rock climber a UT Scope to perform a weld inspection at height, simply because they know how to use rope access gear? NO! You train your NDT technician how to climb.

Same should go underwater. Like rope access gear, commercial diving is simply a “vehicle” to transport the qualified and certified inspector to the location the work needs to be performed.



The need for specialized Underwater NDT Training

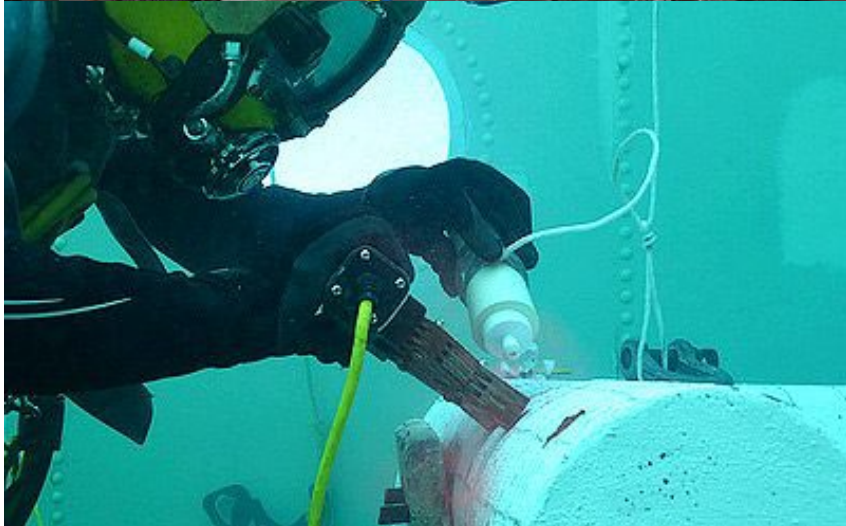
The Need

- SubSea assets are in a more invasive and aggressive environment, needing more periodic surveillance.
- SubSea assets, being more sensitive in nature, therefore require a more skilled and experienced inspector, as the location of the asset is more difficult to fully assess.
- Most SubSea assets require an Advanced NDT technique to inspect.

The Status Quo

- Currently, most assets that are underwater are “out of sight, and out of mind”.
- If a SubSea inspection is actually called for, most of the time it is kicked to a commercial diving company, deploying divers with very little, if any NDT training or experience. Same for operators of Remotely Operated Vehicles (ROV's).
- Limited training/certification schemes for underwater inspection personnel.

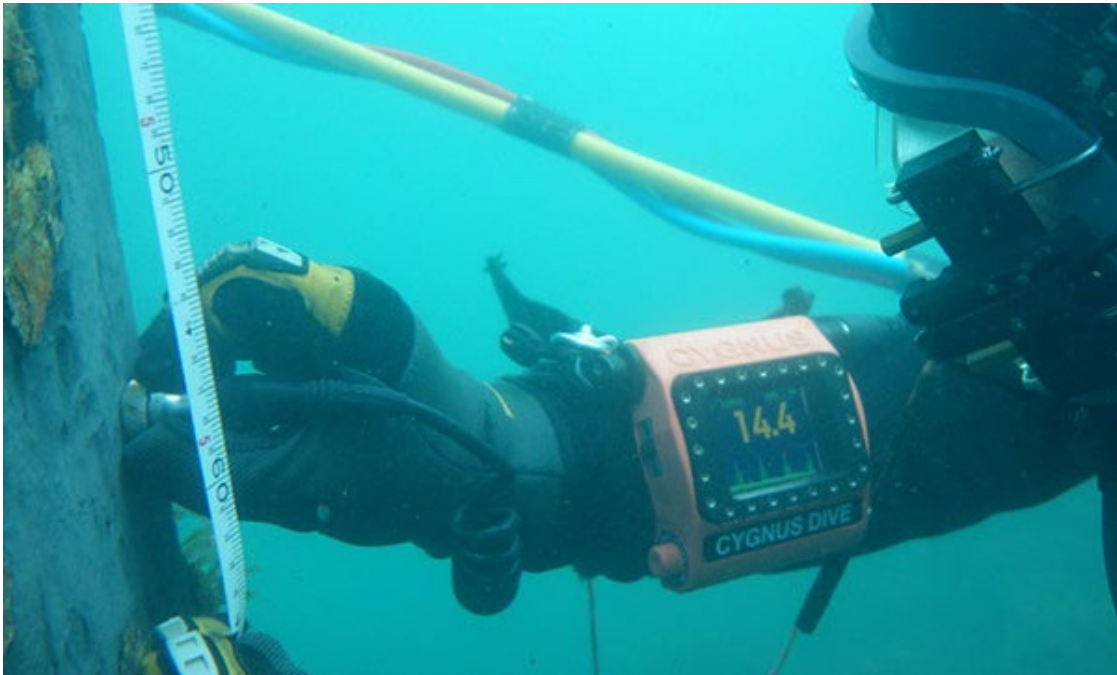
Underwater NDT Training



Case Example

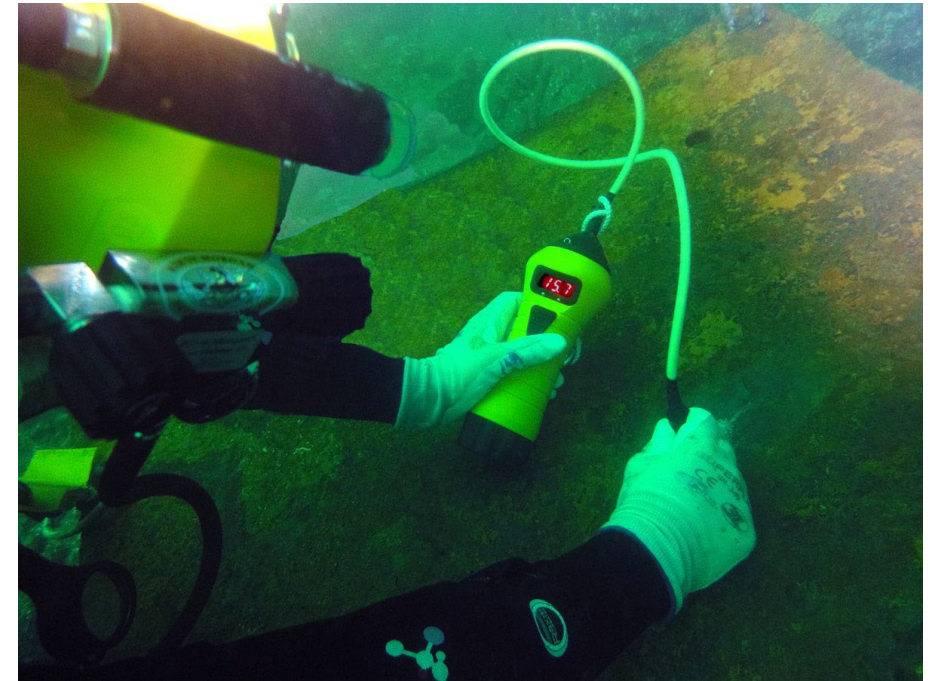
The Need

- According to MOST codes, Ultrasonic Thickness readings require an A-Scan readout, in conjunction with the digital reading.



The Status Quo

- Most commercial diving companies deploy divers with only Digital readout meters, with very little training or proper certification to any scheme.



Qualification

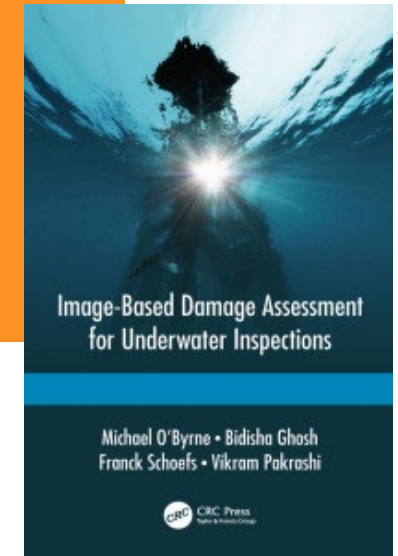
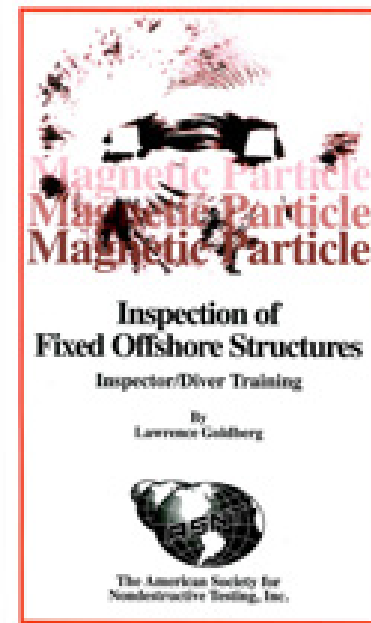
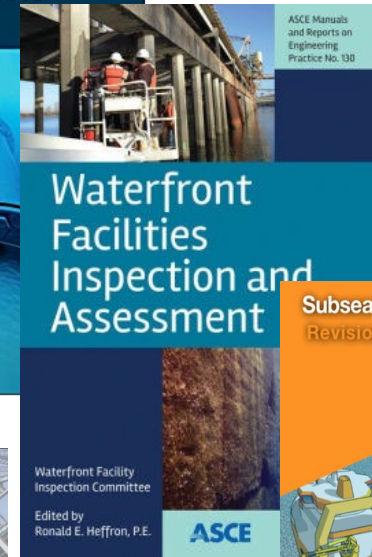
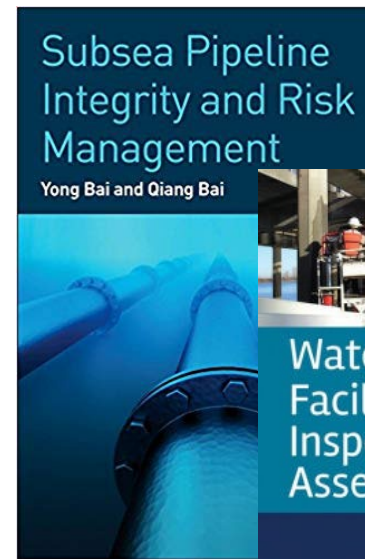
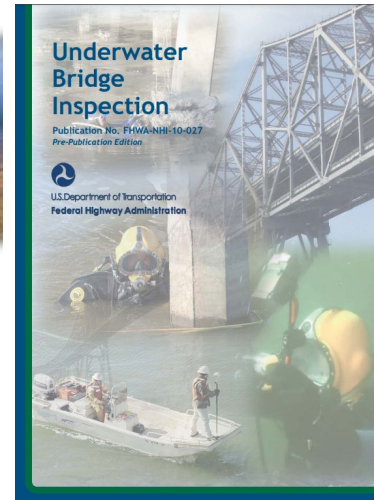
“A ‘qualification’ is defined as “the condition(s) that must be fulfilled before a right can be acquired”.

- working underwater is immediately considered a “confined space”
- most of the time has limited or no visibility
- diver’s equipment causes significant restriction of motion and accessibility
- the surface of most underwater assets are usually covered with marine growth and/or calcareous deposits of some kind, requiring significant cleaning and closer visual inspection prior to the application of an underwater NDT method



Underwater Inspection References

SUBSEA INSPECTION, MAINTENANCE & REPAIR



More reference guides are being published trying to establish guidelines for certain sectors of the industry. ASCE, for example, has published the Waterfront Facilities Inspection and Assessment book.

Get Involved!

JOIN A COMMITTEE!

The councils and committees that make up the structure of ASNT are where work is done, and decisions are made to guide the direction of the Society. Committees serve the Society by guiding publications, certification, research, engineering, and sections. Explore the councils and their subcommittees below. Once you submit your application to join a committee, it will be reviewed by the Chair of that committee.

https://www.asnt.org/MajorSiteSections/Membership/Join_a_Committee.aspx

Poll Question #4

Who is taking the next step into underwater NDT?

- Let me dive in!
- Maybe get my feet wet.
- No way, there's sharks down there!
- Just Curious

“

It is not enough to do your best, you must know WHAT to do, and then do your best.”

~W. Edwards Deming

**QUESTIONS?
THANK YOU!**

Joshua de Monbrun, CEng

Technical Authority – MISTRAS Group, Inc.

Chair – ASNT Underwater NDT Committee