



LASER SCANNING UNKNOWN WELL HEADS FOR P&A ACTIVITIES AND SEABED REMEDIATION

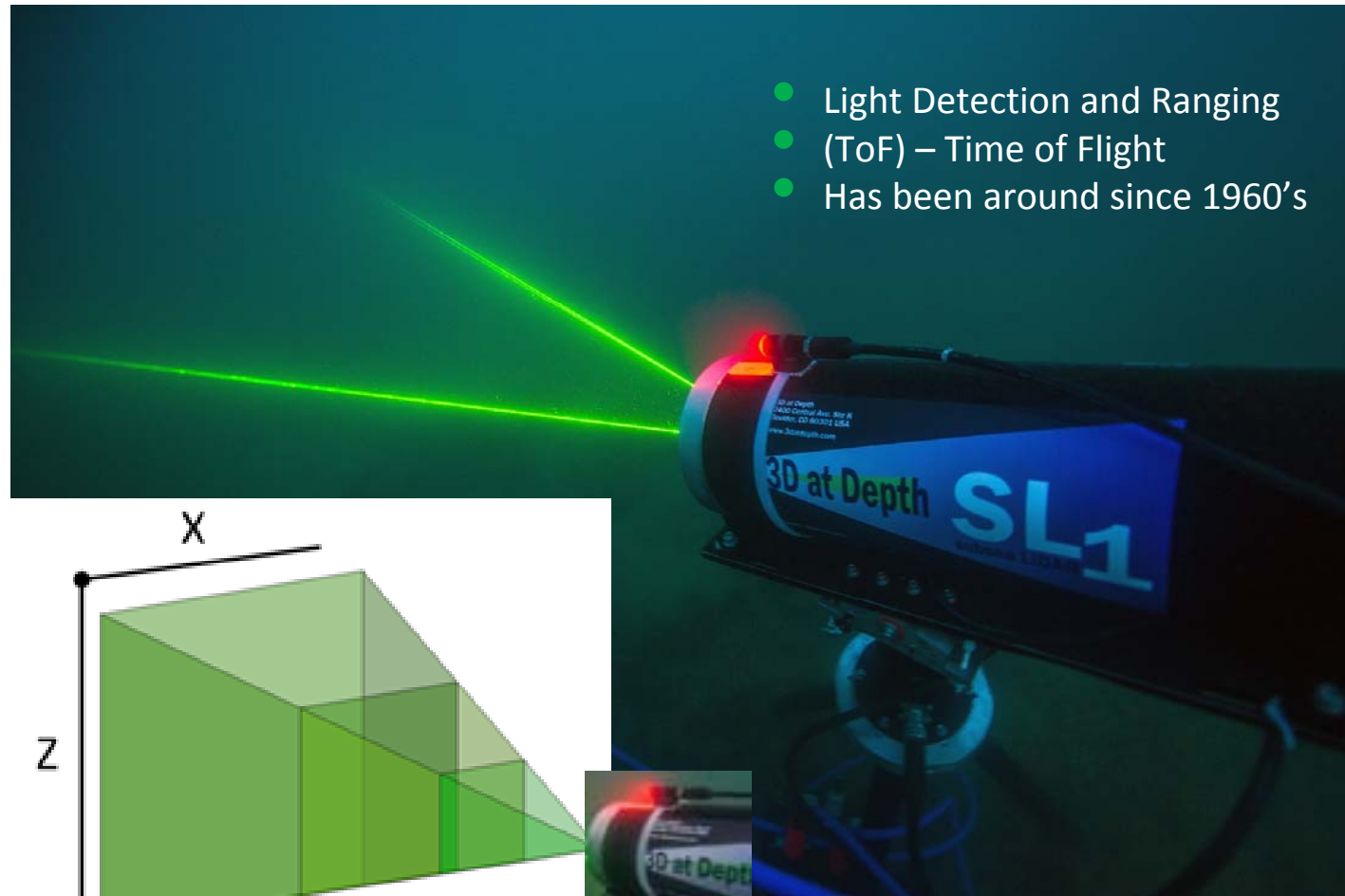
Neil Manning, July 2016

East of England Energy Group (EEEEGR)

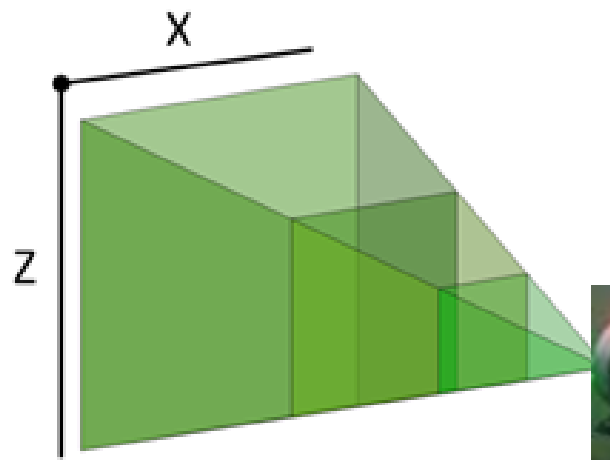




WHAT IS LIDAR?



- Light Detection and Ranging
- (ToF) – Time of Flight
- Has been around since 1960's



3D at Depth



Based in the technology hub of Boulder, Colorado, 3D at Depth is **dedicated to the development of underwater laser measurement sensors and software**

- Patented subsea LiDAR technology
- 6 full time working systems
- SL1 subsea LiDAR system launched in March 2013
- Track record; completed 70+ projects
- Recently completed second generation subsea LiDAR development; SL2
- Office locations in Boulder, CO / Houston, TX / Perth, WA



3D at Depth

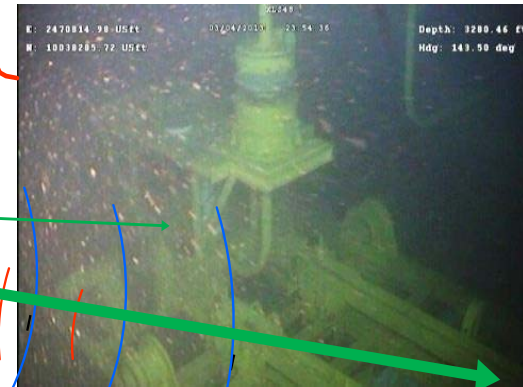


PRINCIPLES OF LIDAR



1) Laser pulse transmitted at 40kHz

2) Pulse reflected from target



3) Portion of Scattered Light Collected by sensor

4) Beam is moved to cover the target using servo mirrors

Phased Array Sonar

Beam divergence angle: 0.5

Beam diameter at 10m: 8.7cm

Beam diameter at 20m: 17.5cm

3D at Depth Optical Design

Beam divergence angle: 0.02°

Beam diameter at 10m: 3.6mm

Beam diameter at 20m: 7.3mm



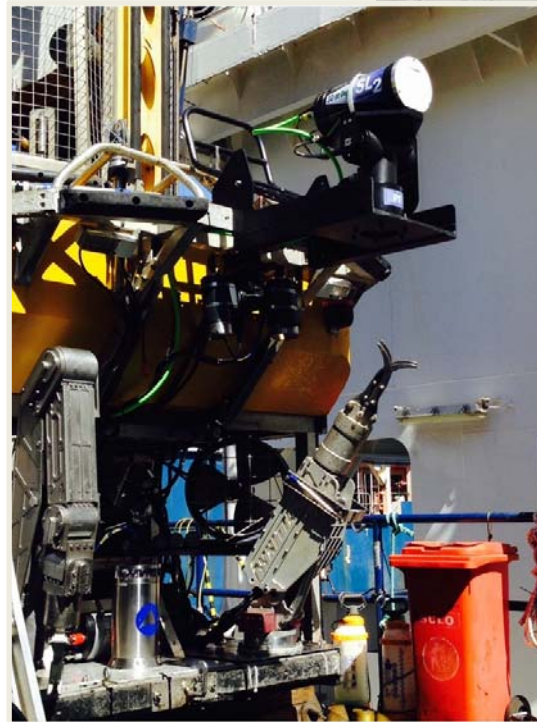
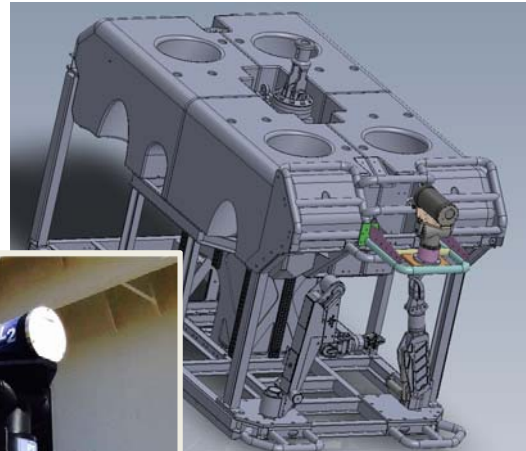
3D at Depth



ROV & DIVER DEPLOYED SOLUTIONS



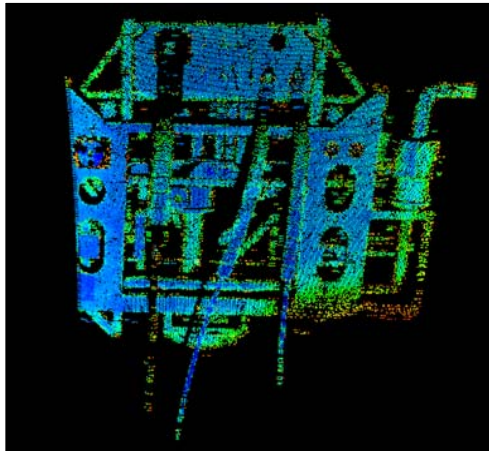
3km or 1.5km Rated ROV Mountable Pan and Tilt unit



3D at Depth

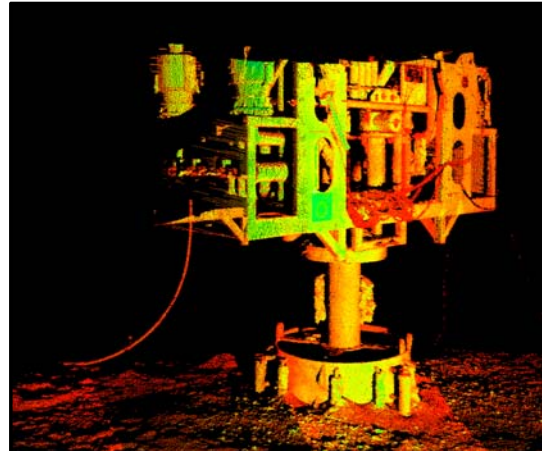


FAST SCAN & STATIC SURVEY SCAN



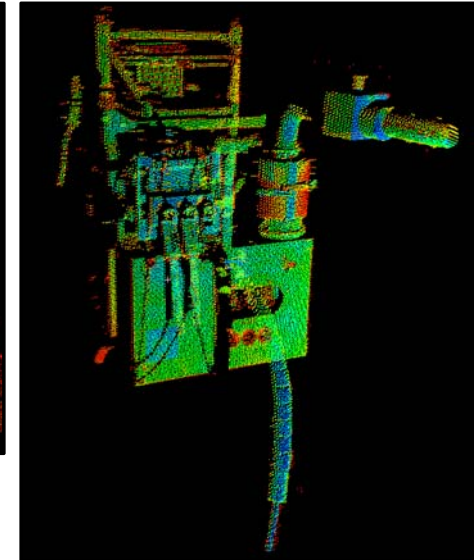
Fast Scan top of well
ROV mid water

Data Collection Time – 1.5s



Static Scan of Well
ROV landed "On bottom"

Data Collection Time – 3 to 5mins



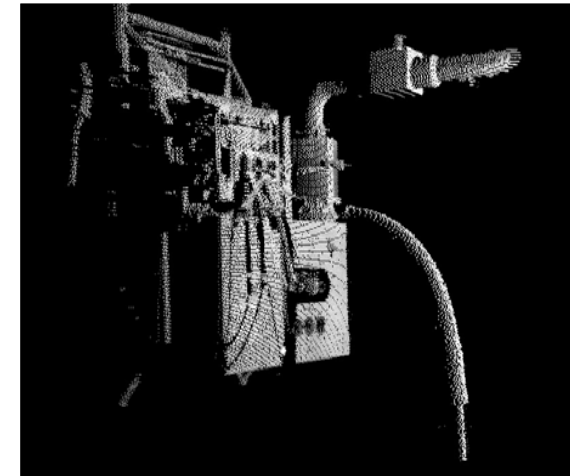
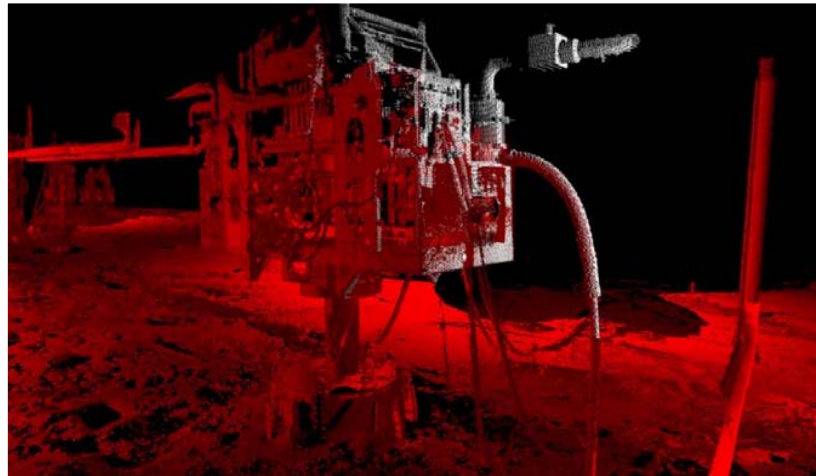
Fast Scan top of well
ROV mid water

Data Collection Time – 1.5s





COMBINE STATIC SURVEY SCANS AND FAST SCANS

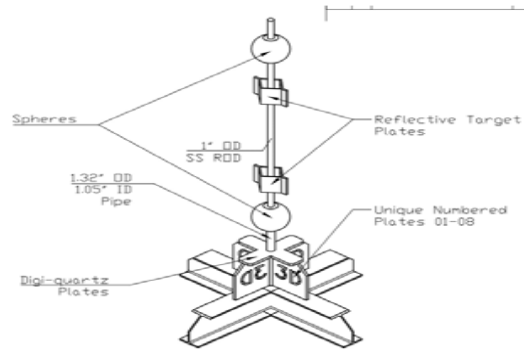


- Red point clouds were collected with the ROV on the seabed using survey mode (3 to 5 mins)
- Greyscale point cloud was collected while the ROV was mid water using fast scan mode (1 to 2 secs)
- The two datasets are easily merged.

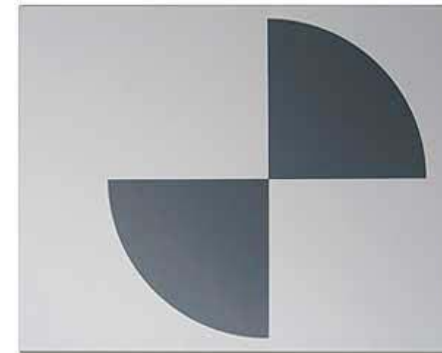




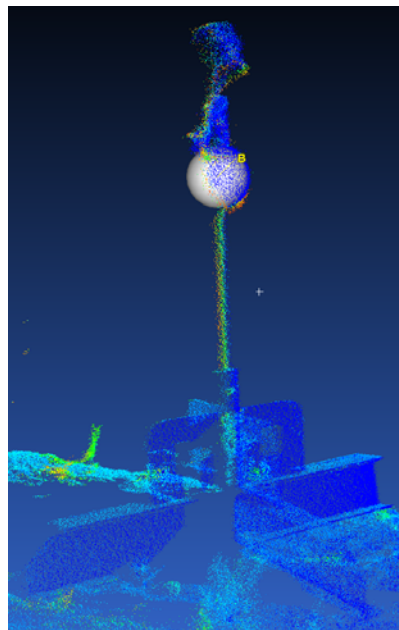
REGISTRATION TARGETS



Spheres



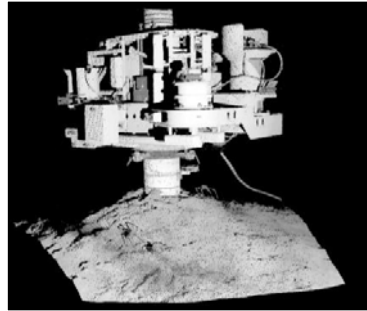
B/W Survey Targets



3D at Depth



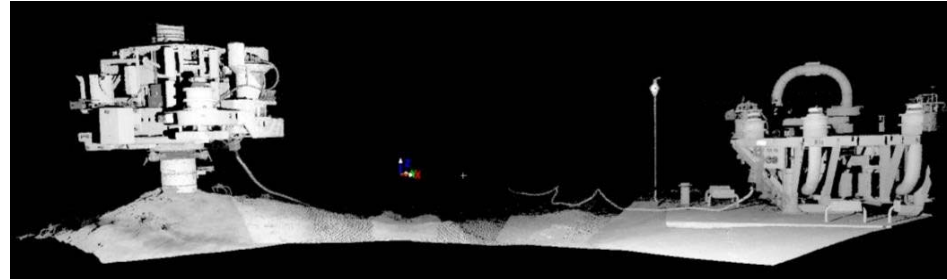
SCANS, REGISTRATION & ACCURACY



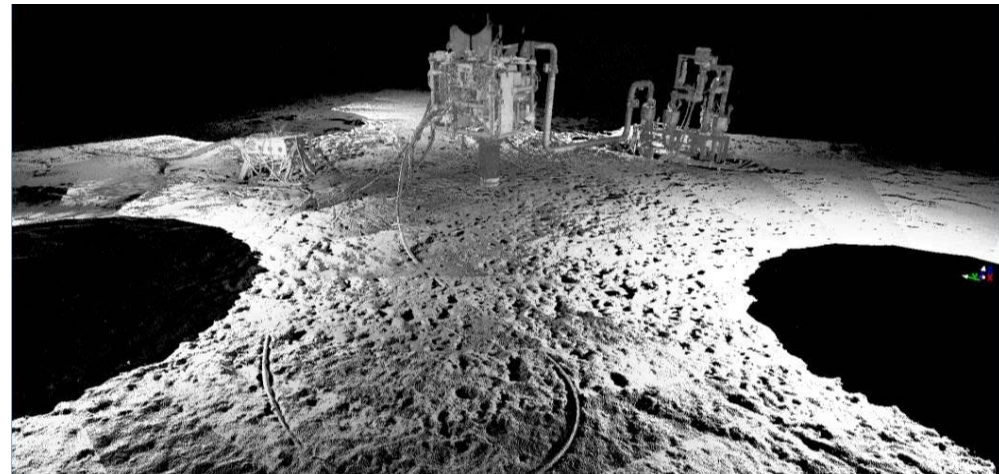
Single 30° x 30° scan.

±4mm Accuracy Point to Point distance measurement

Anywhere in the field of view



Full scan position – 18 Scans ±4mm to ±8mm accuracy.
For distances Anywhere in the field of view.



Pan & Tilt ±0.05°.

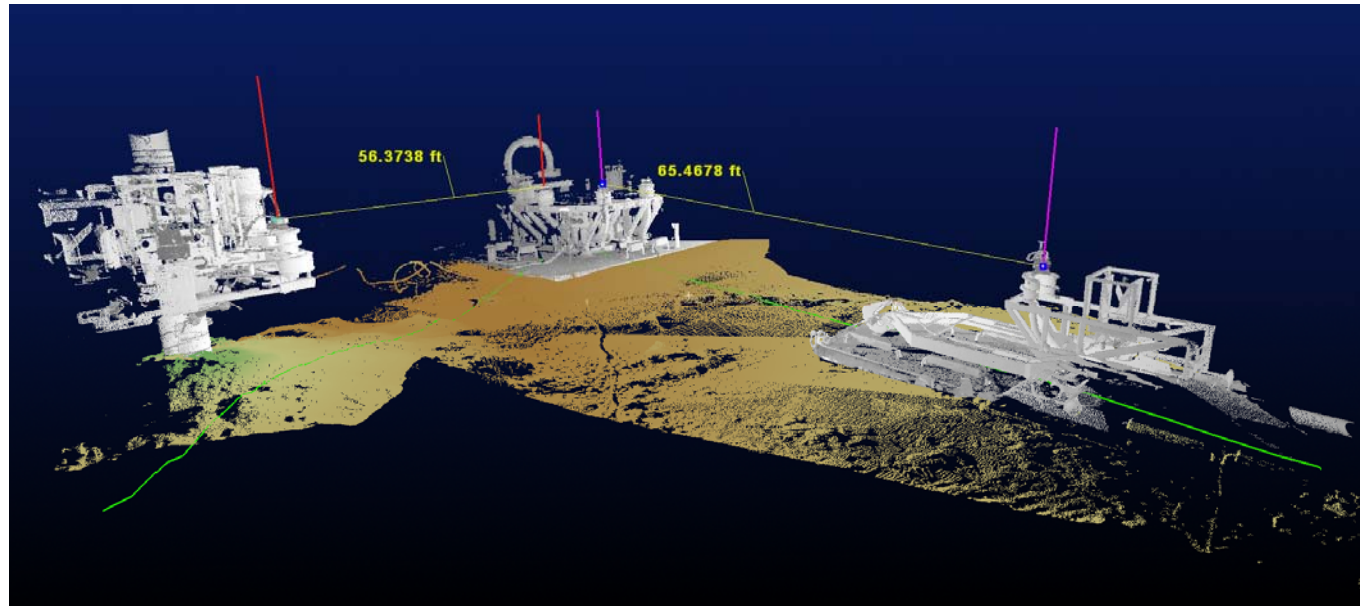
Multiple registered scan positions add a mean absolute error of approx. 5 to 15mm across all the registered scans



3D at Depth



SPOOL PIECE METROLOGY



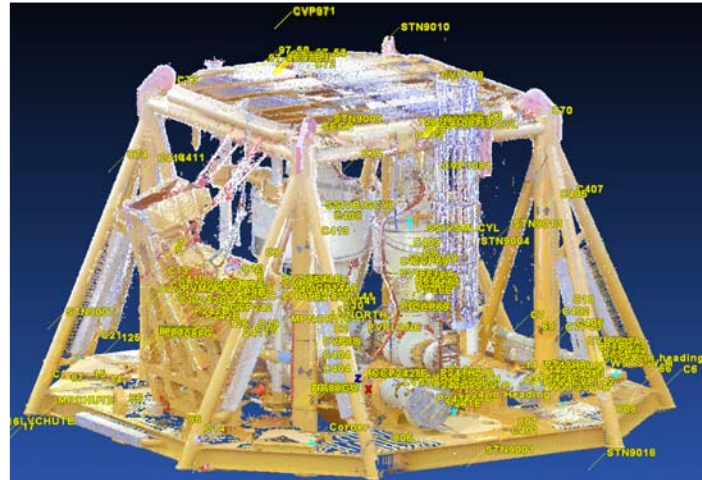
- Over 150 metrologies performed since Q2 2014
- All jumpers and spools successfully installed
- Average bottom time was only 2-3 hours per metrology
- Average time to complete metrology field report was 4 hours.



3D at Depth

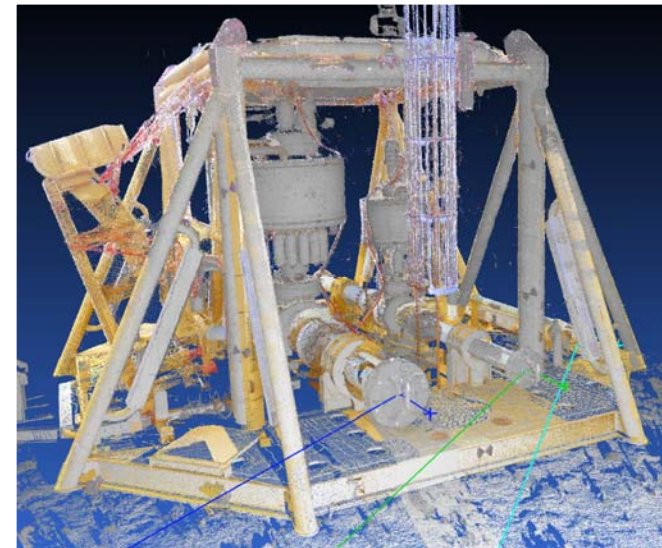


REGISTRATION OF SUBSEA STRUCTURES



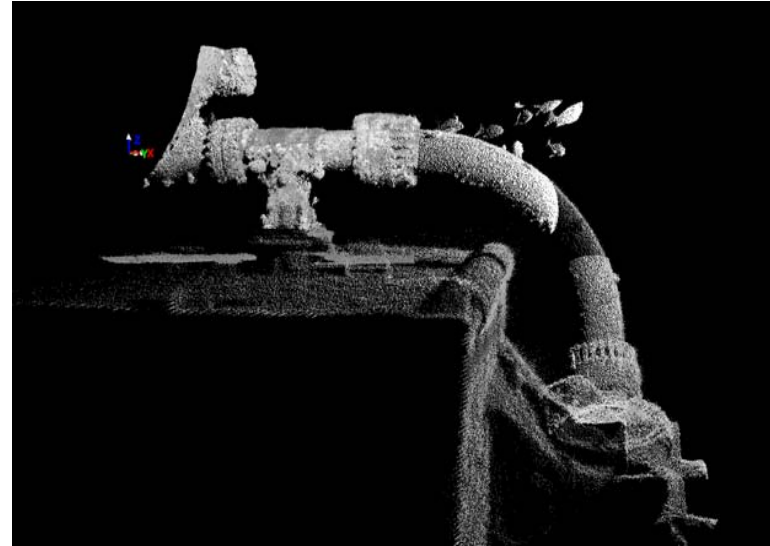
Terrestrial Scanned Structure
Registered into the subsea point cloud

Terrestrial Scanned Structure
Dimensional Control with Total Station

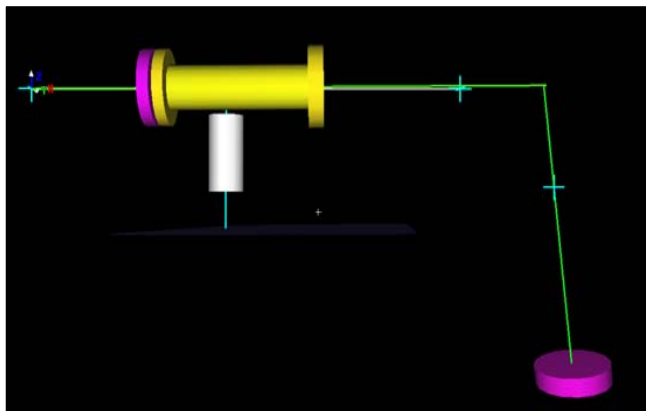




FAST SCAN – MID WATER



Flex Joint Scan – mid-water ROV

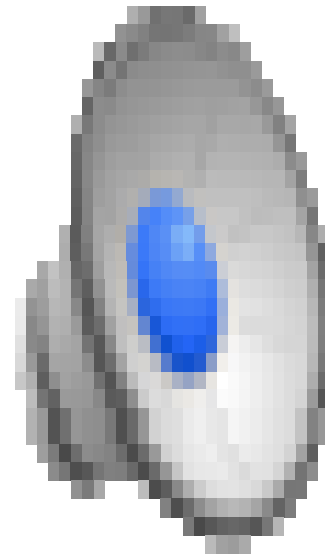


Processed vectors and liner measurements, Modeled in CAD





ADD SCANNING VIDEO



3D at Depth



THE PROBLEM



“Over 65% of upstream operator (oil and gas) respondents have little or no confidence in their oil and gas production data and a further 75% think this could lead to compliance issues and missed business opportunities.” Espy Systems, *Oil and Gas IQ Review*



3D at Depth



PRE WELL RECOVERY SURVEY



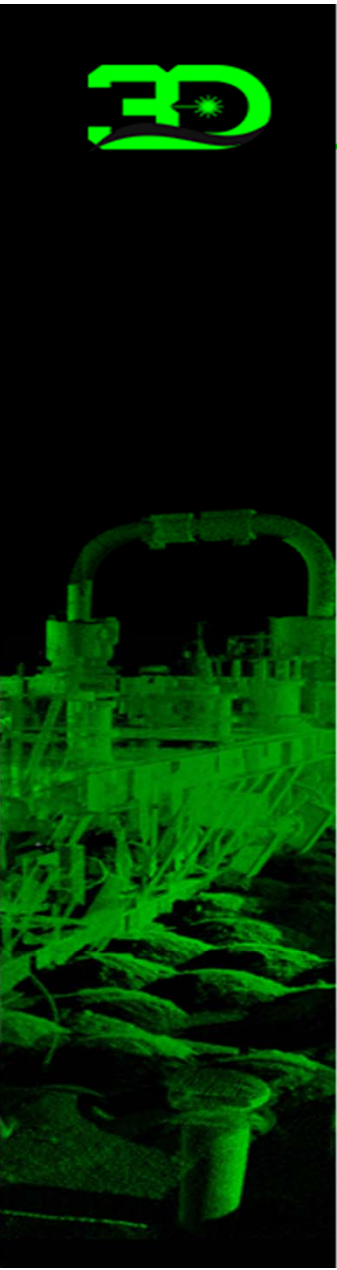
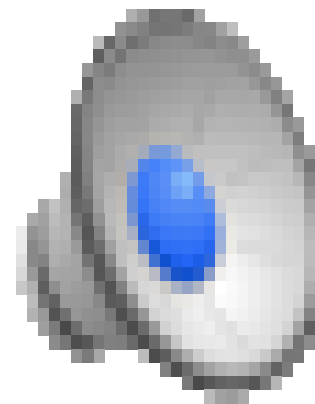
HDG 018.6
D 112.22m

16/02/2016
18:18:11
FCV 3077





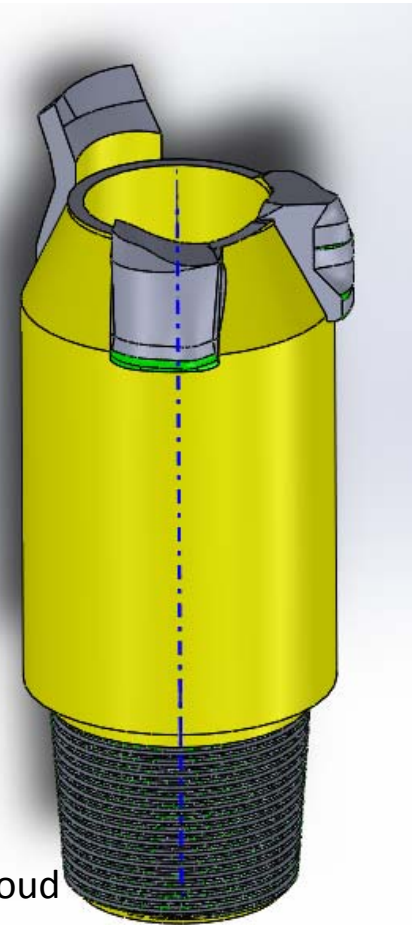
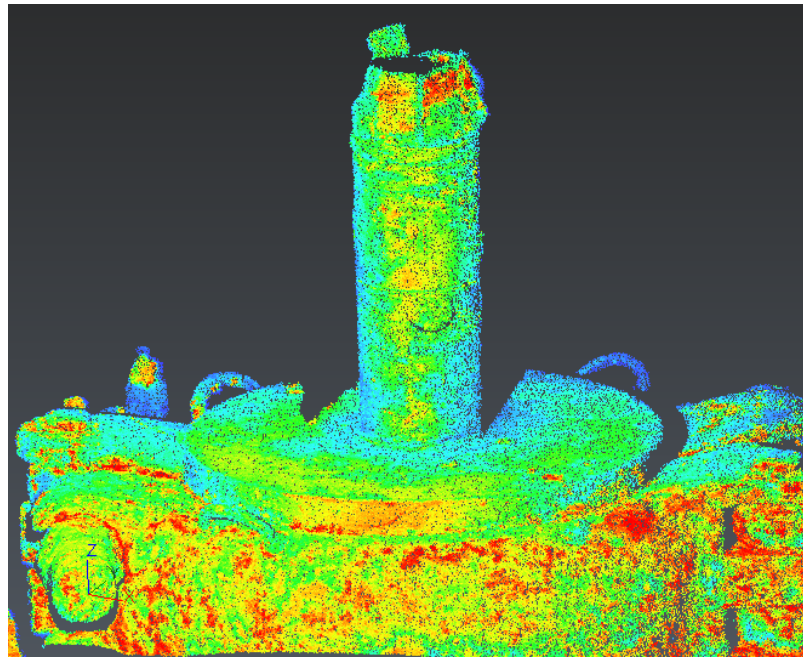
PRE SURVEY WELL DECOM



3D at Depth



3D MODELLING, 3D PRINTING, REVERSE ENGINEERING

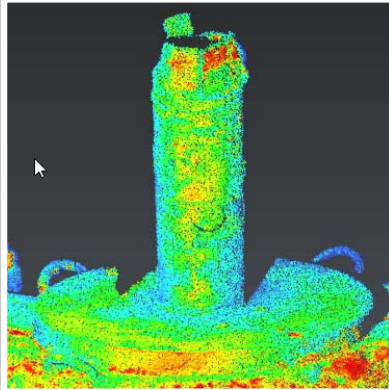


- A 3D CAD model was created from the point cloud





3D MODELLING, 3D PRINTING, REVERSE ENGINEERING

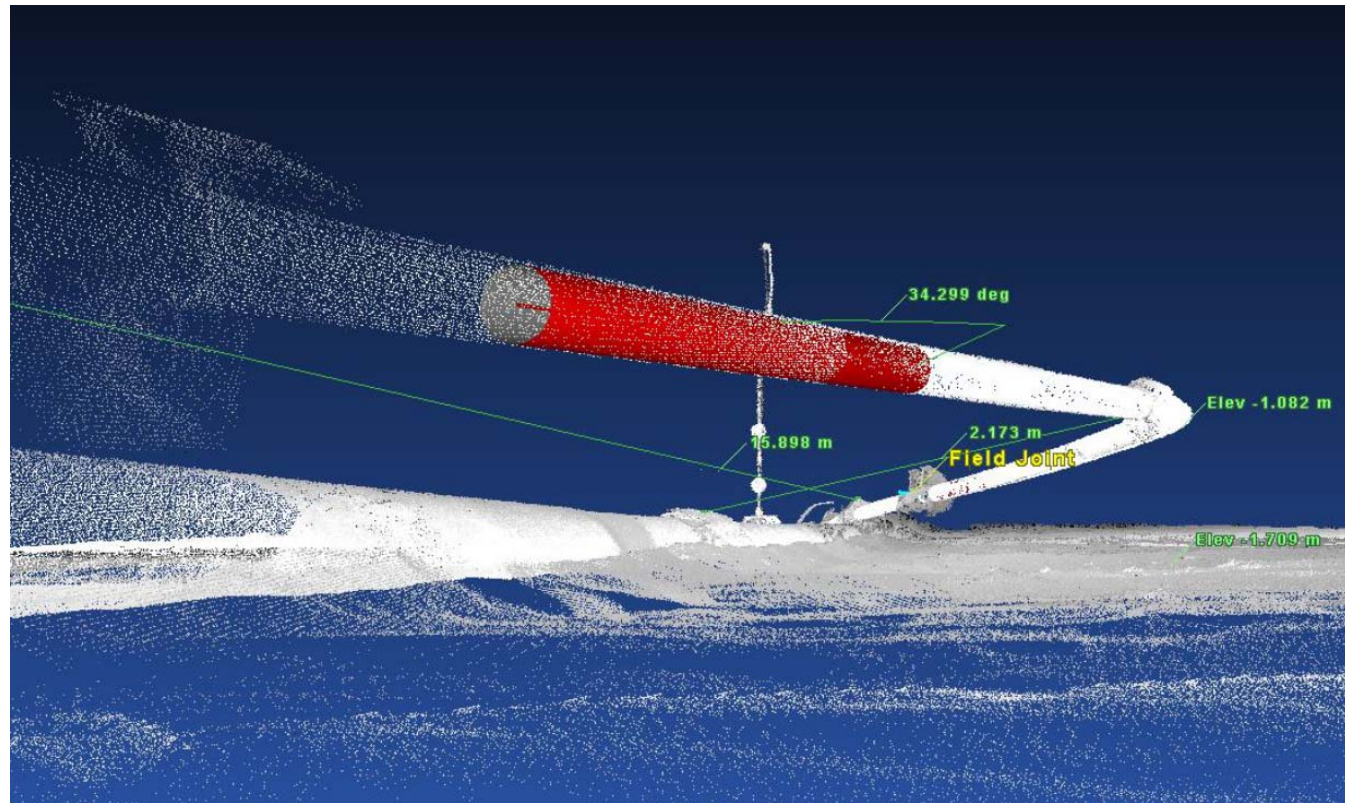


- From the 3D model, the physical part was 3D printed using Fused deposition modelling (*FDM*) technology.
- Assembled well cap shown on right 650mm diameter.





PIPELINE DAMAGE ASSESSMENT

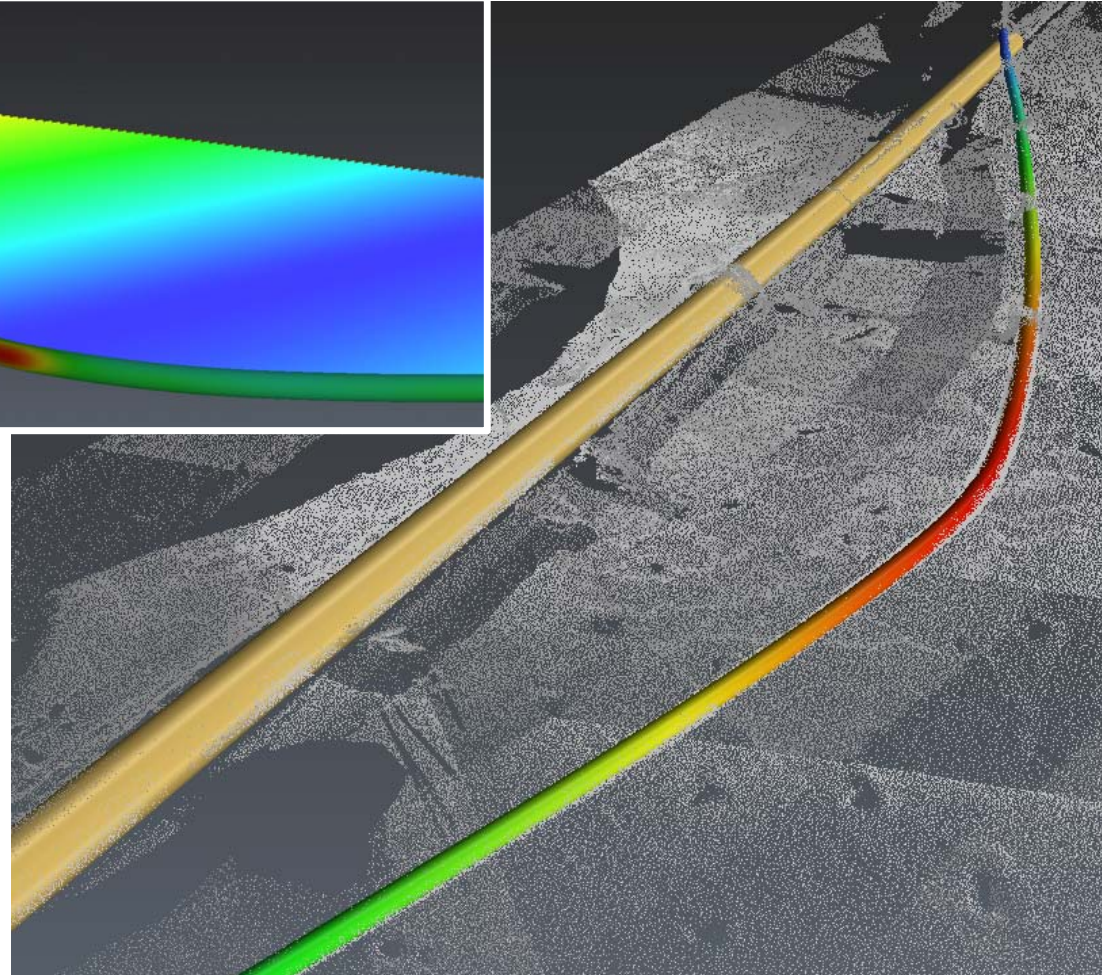
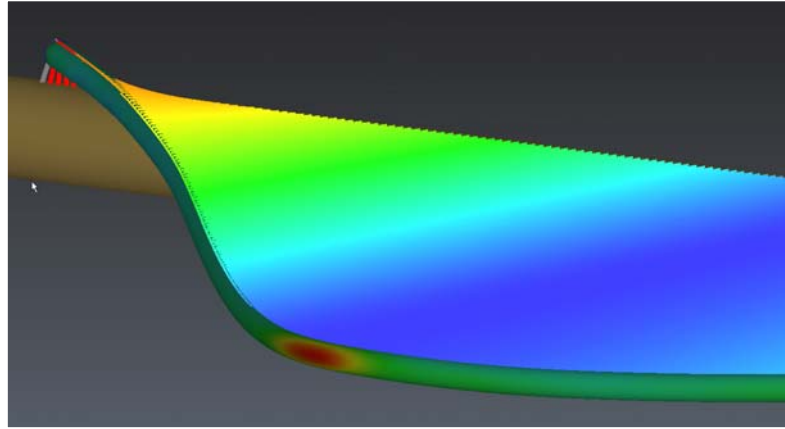


- Quantification of distances, angles and heights is straightforward.





PIPELINE DAMAGE ASSESSMENT

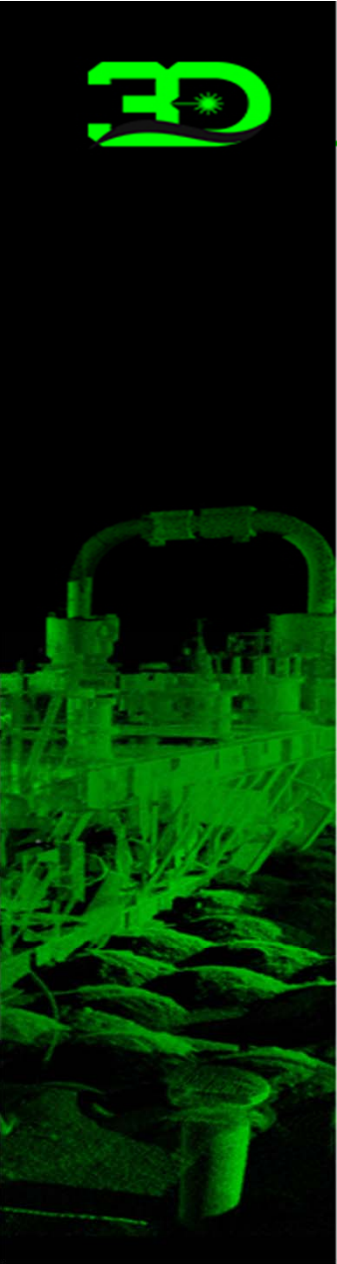
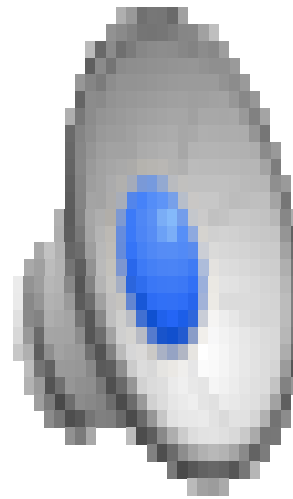


- Cloud extruded to 3D Mesh
- Curvature
- Lateral Distance



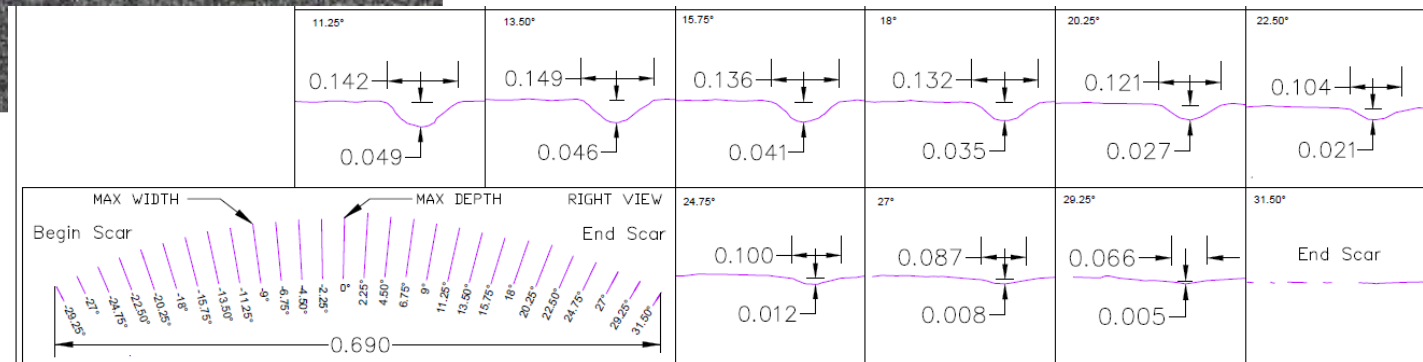
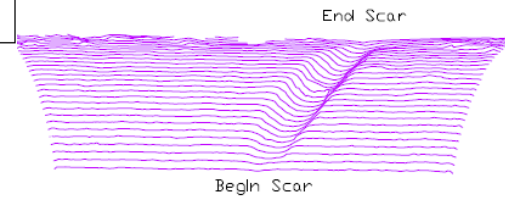
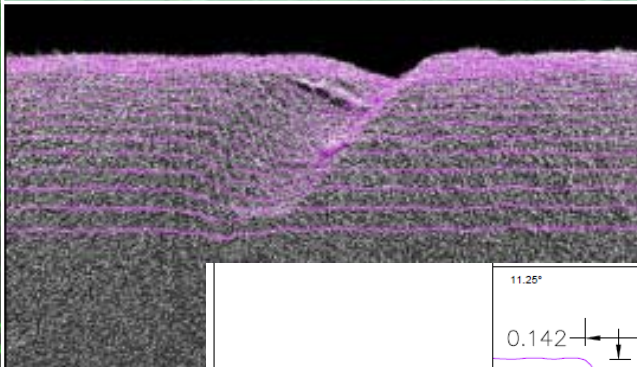
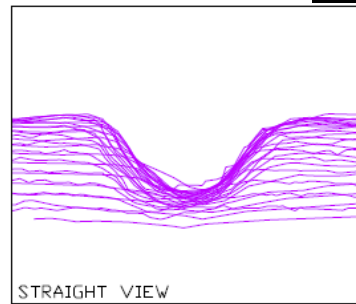
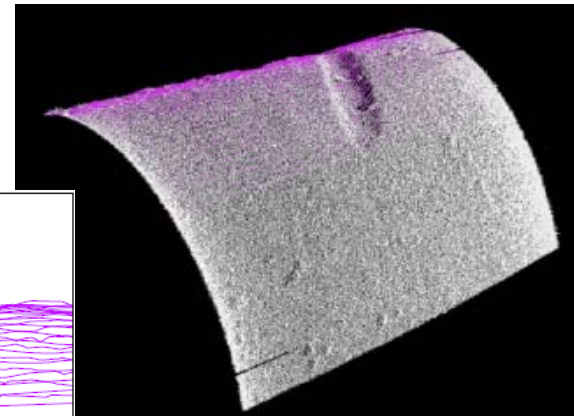


PIPELINE DAMAGE ASSESSMENT





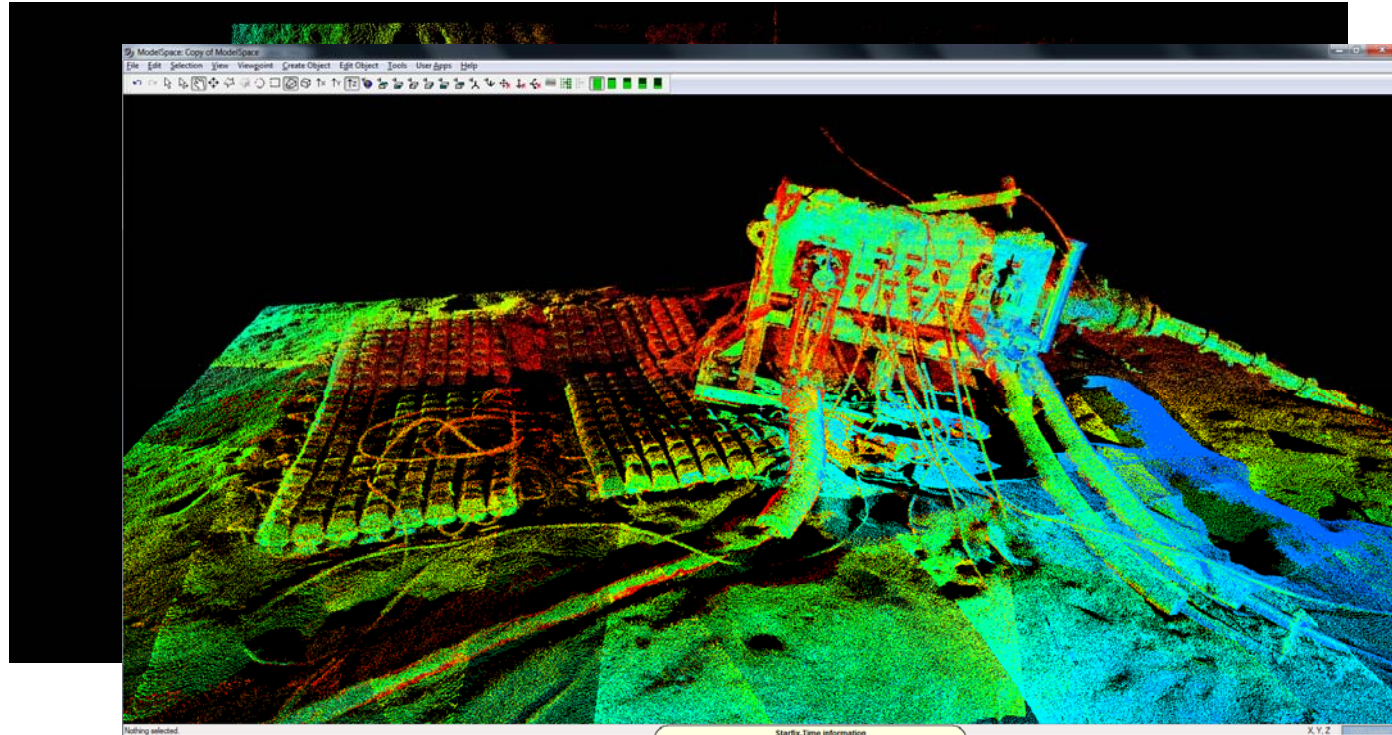
PIPELINE DAMAGE ASSESSMENT



at Depth



LIFE OF FIELD – STRUCTURE MOVEMENT



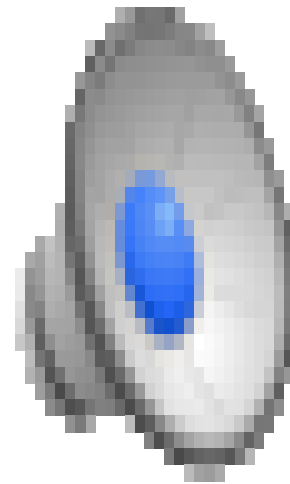
- Unparalleled 3D Subsea Point Cloud Data
- Map Entire Field Installations Quickly and Efficiently
- Create Baseline Point Cloud Maps and Compare Maps Annually
- Bend Radius Measurement
- Design Engineering and Planning



3D at Depth



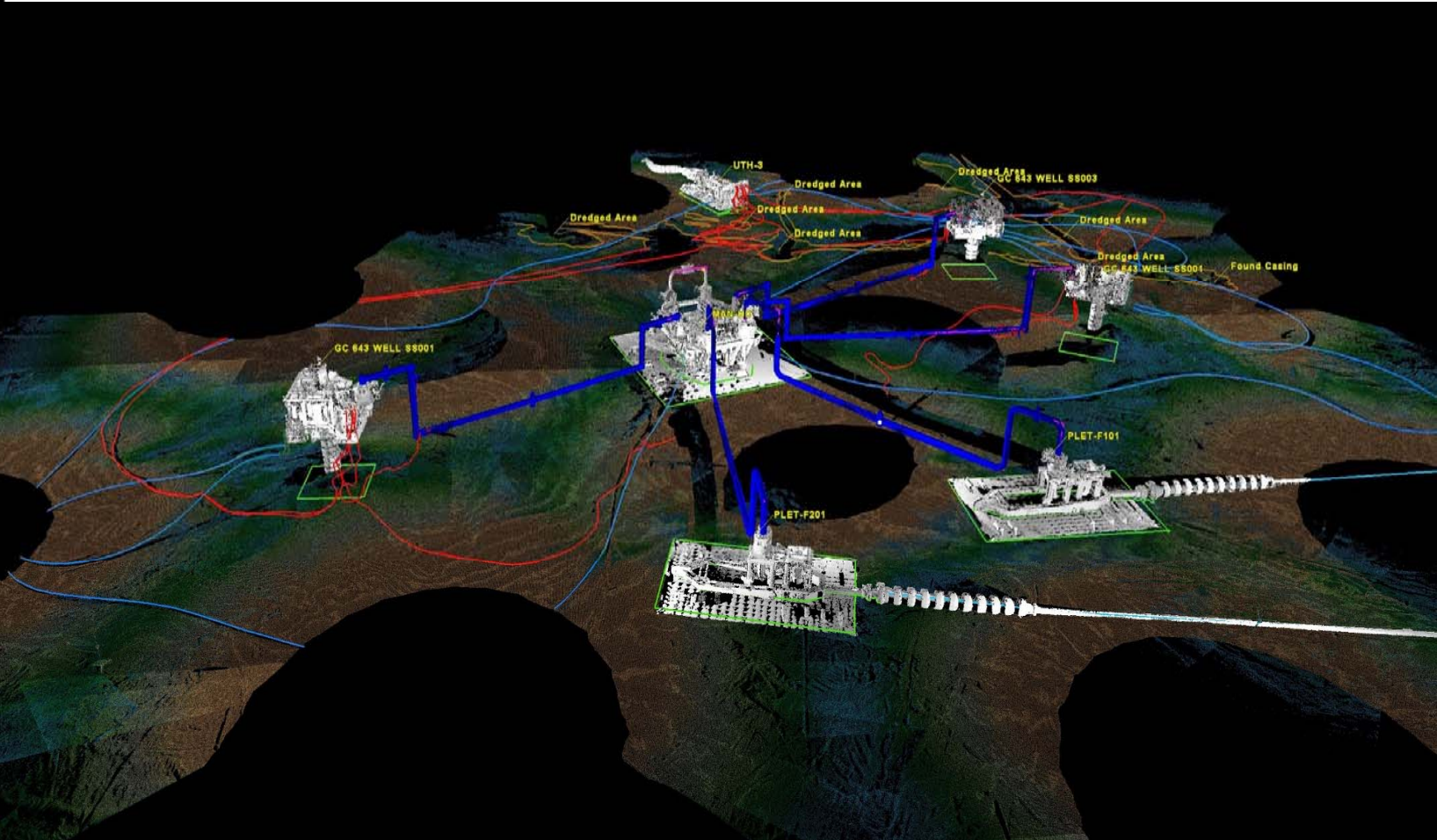
AS-BUILT SURVEYS



3D at Depth



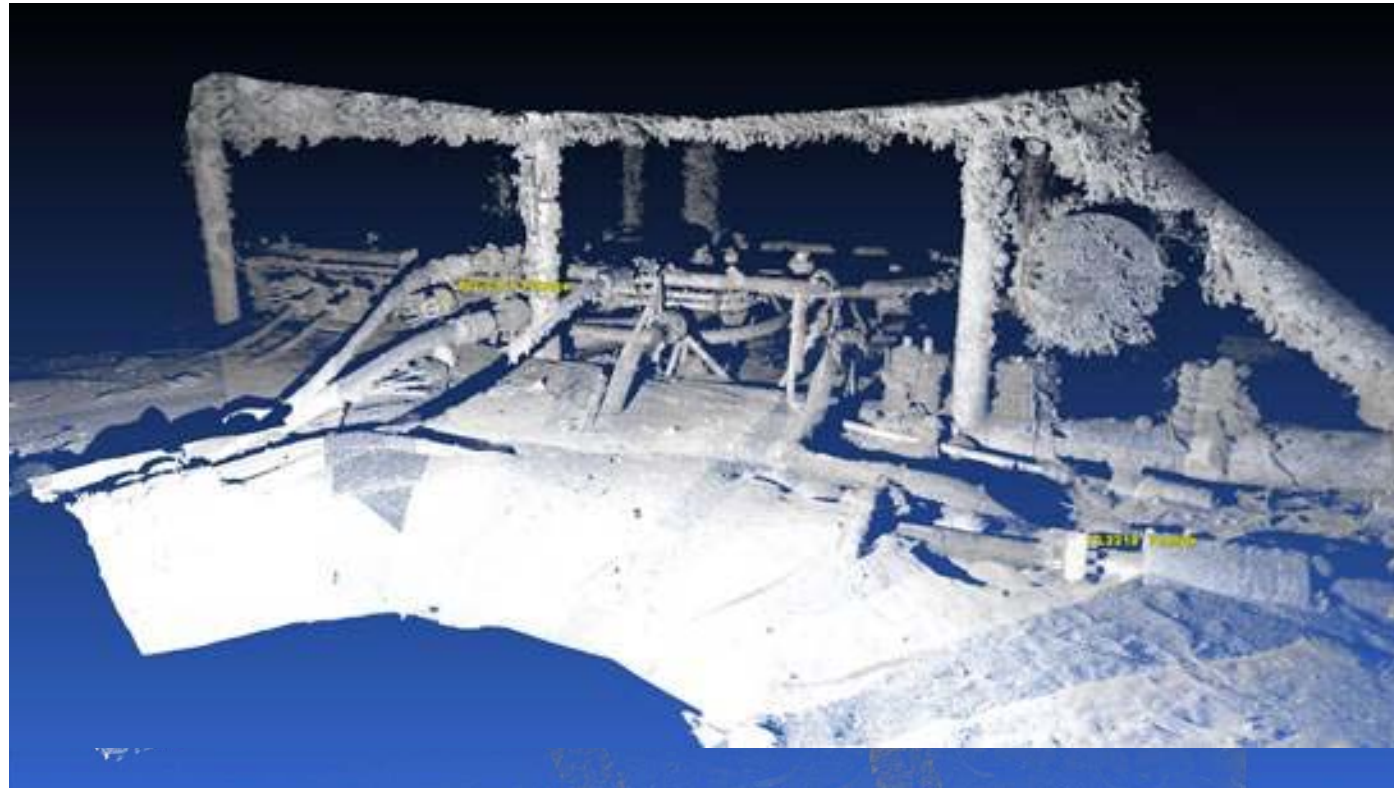
AS BUILT SURVEYS



3D at Depth

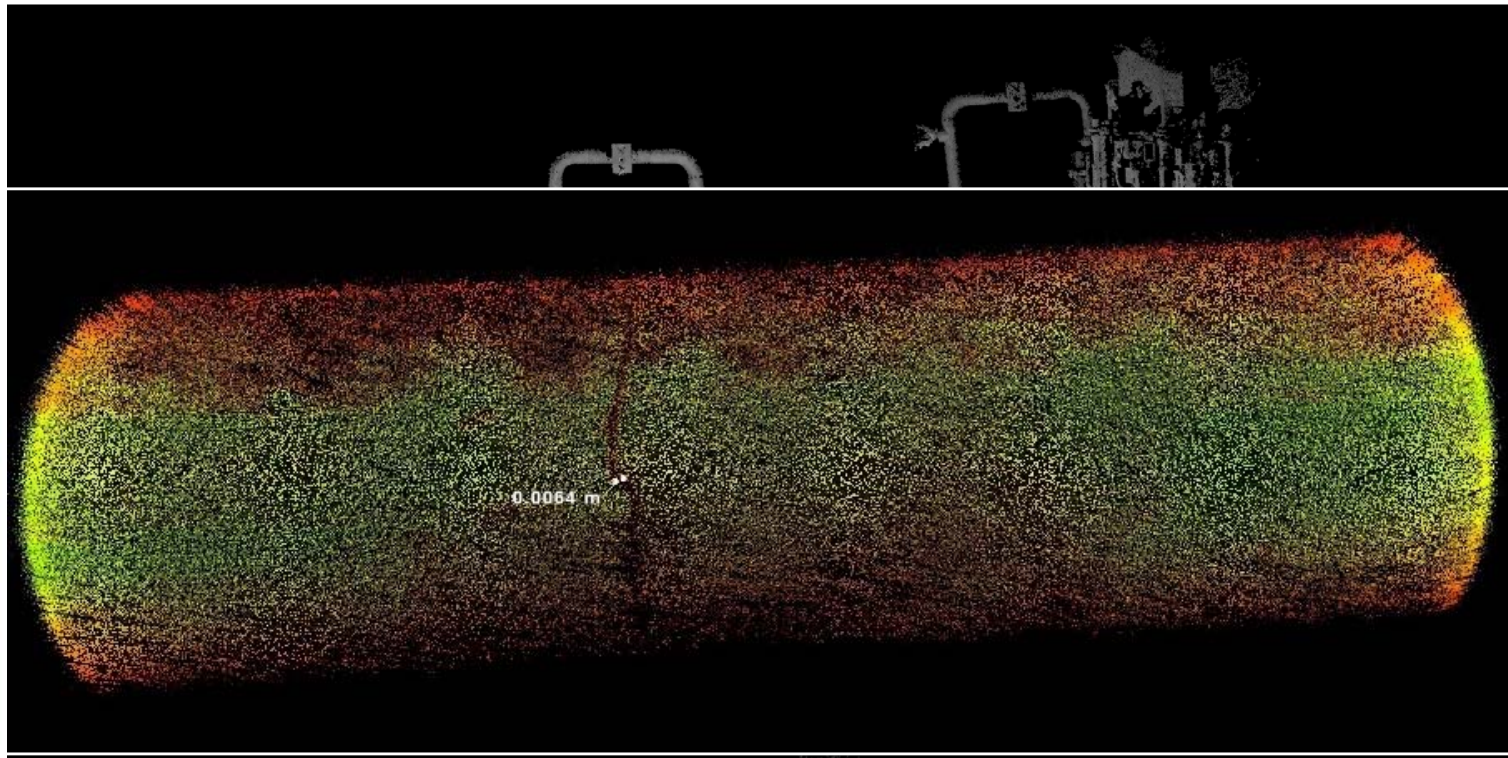


NEW JACKET AND RISER FLANGES





JUMPER / SPOOL / PIPELINE INSPECTION

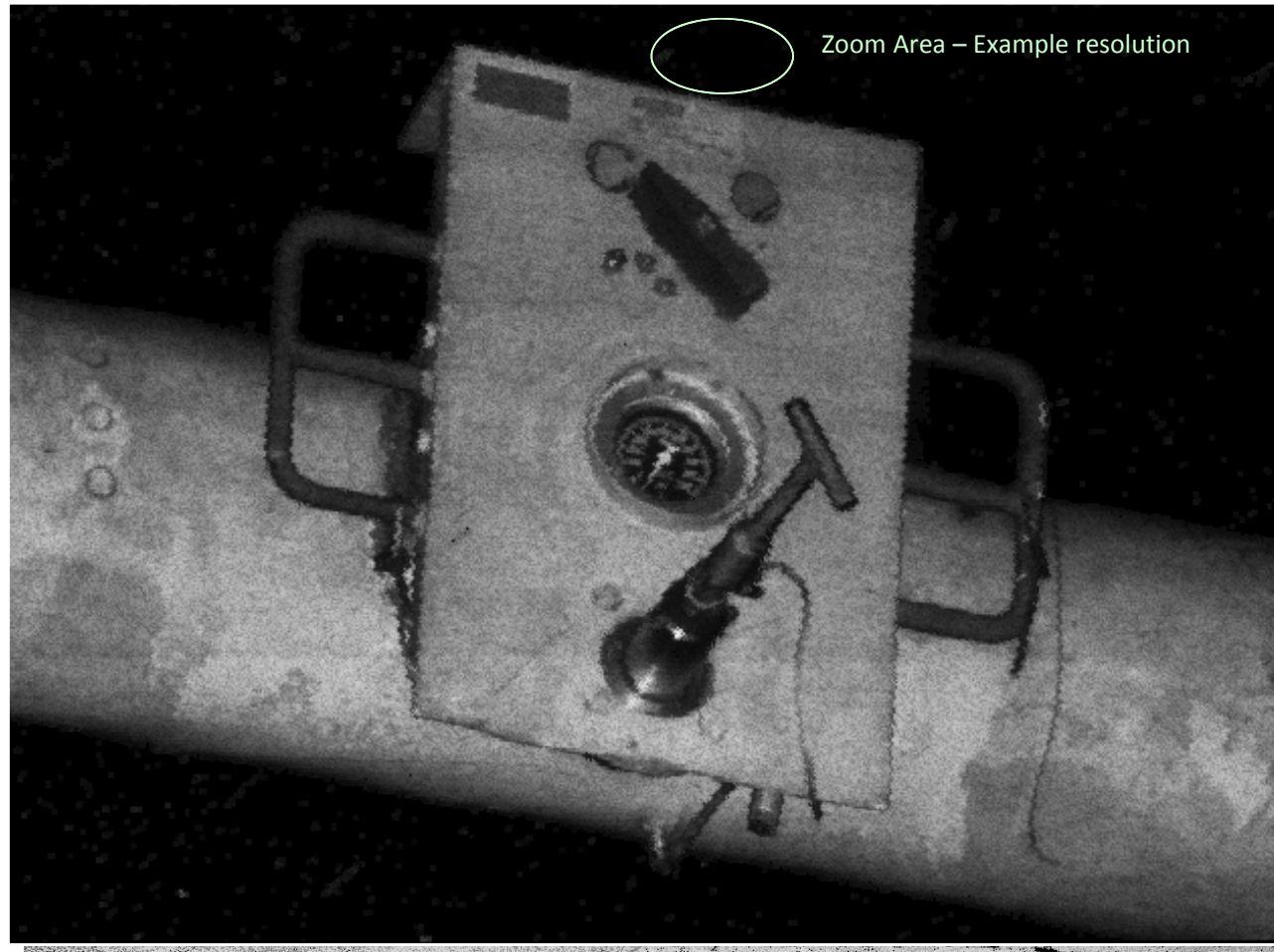


- 6mm Crack Detected from a range of 15m
- Intensity change helps with visualisation





JUMPER / SPOOL / PIPELINE INSPECTION



Zoom Area - Example resolution





WHO'S USING THE TECHNOLOGY



EXXON



Chevron



TAQA



subsea 7



3D at Depth

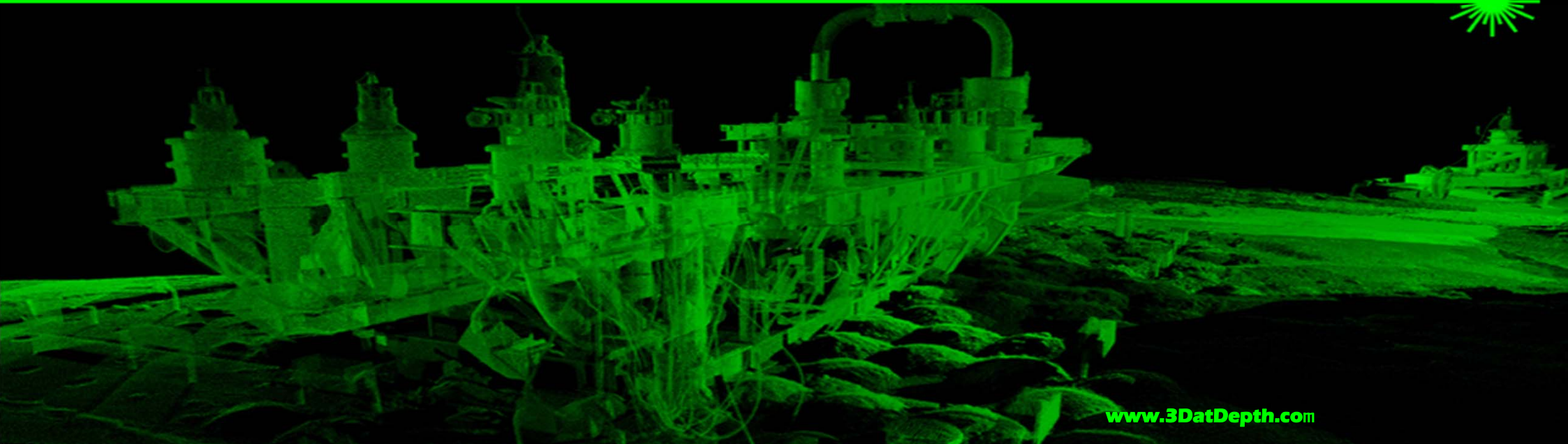


ITALY WITH THE BBC



3D at Depth

THANK YOU



www.3DatDepth.com