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# Non-Intrusive Inspection Technology deployments

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TLB Technology Managers' Network meeting

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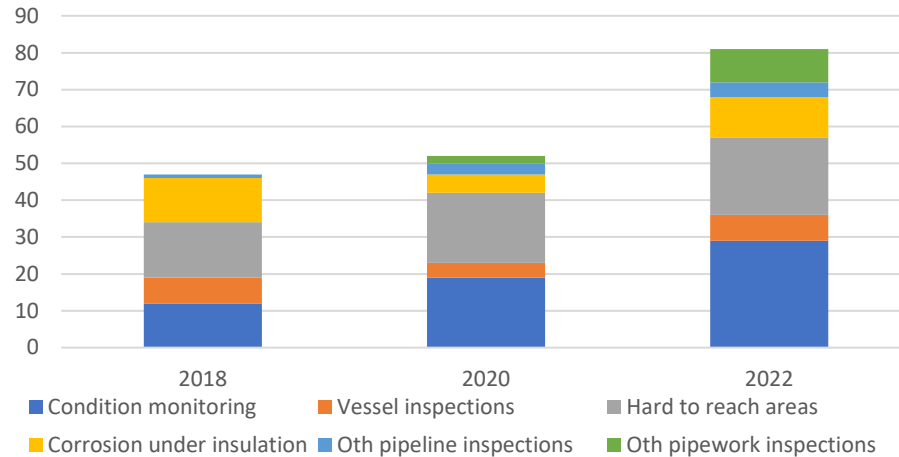
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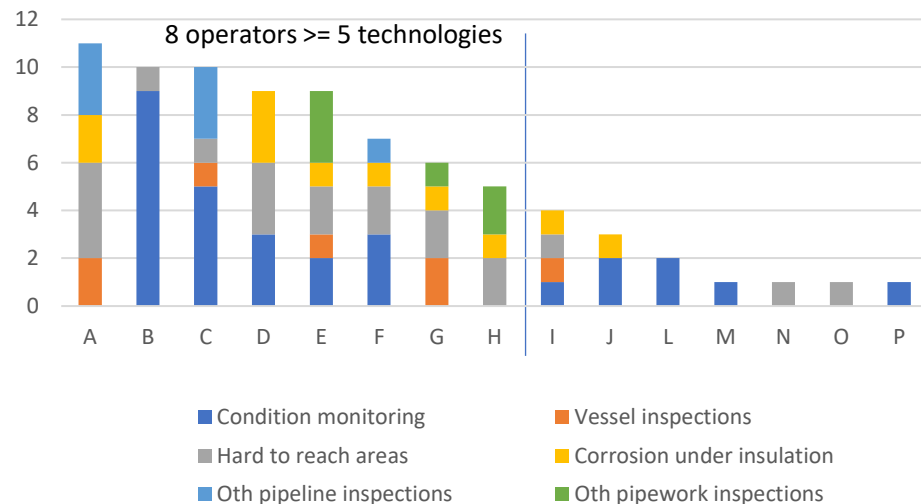
- NII technologies have gained far more widespread use on UKCS in the past 4-5 years
- Insights from Operators' experience reported in their Technology Plans (2018-22)
- Zoom into four sub-groups of technologies, to appreciate their benefits and Operators' experience
  - Condition Monitoring (CM)
  - Vessel Inspections (VI)
  - Hard to Reach Areas (H2R)
  - Corrosion Under Insulation (CUI)
- Discussion
- *Beyond NII* – future technology topics based on readout from Operators' plans

# Growing interest in NII technologies

N. of NII technologies by category (all stages)



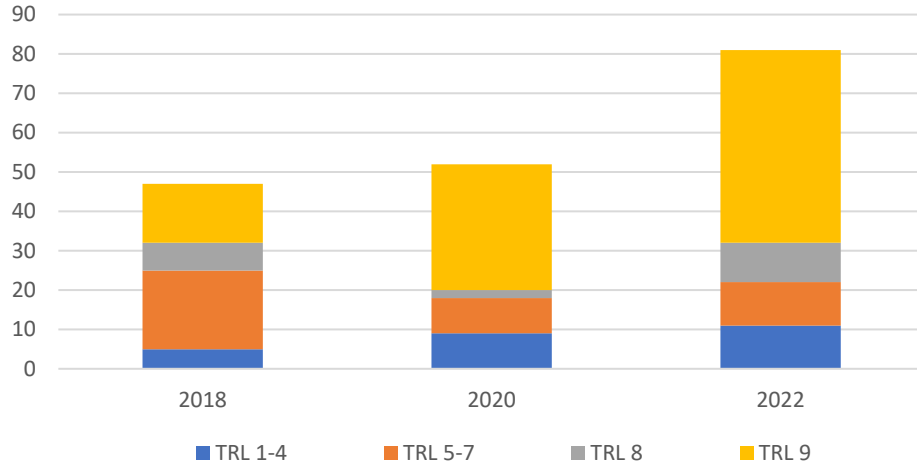
N. of NII Technologies by Operator (anonymised)



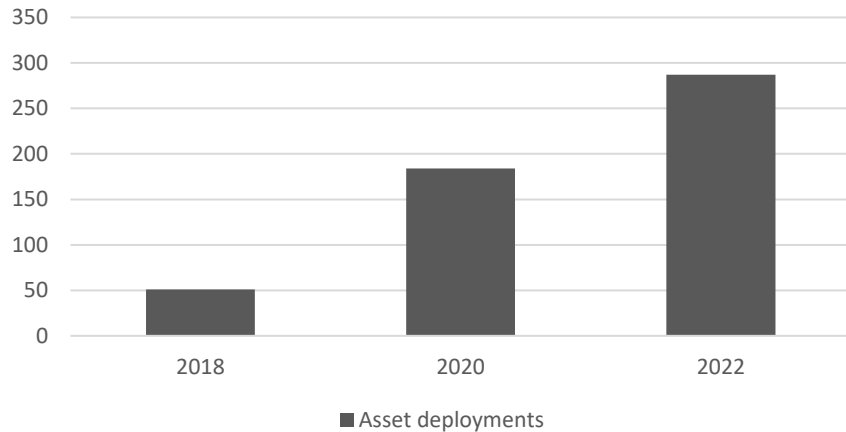
+ 35 operators not reporting NII

- Over 50 technology plans submitted each year
- 2018-22 trends analysed
- Steady increase in number of technologies, with emphasis on condition monitoring and hard to reach areas, followed by CUI and VI
- Industry participation growing from 4 operators in 2018, 8 operators in 2022 have more than 5 NII technologies in their plans
- Large number (35) of respondents not yet considering this theme (based on submissions)

N. of NII Technologies by Maturity



NII deployments on assets (actual & planned)



Time horizon 2021-23

- Growing number of available technologies targeted for deployment
  - first use (TRL 8)
  - more widespread (TRL 9)
- Interesting pipeline of solutions in the pilot/testing stage (TRL 5-7)
- Once familiar with the technology the same operator deploys it at multiple assets (over 280 deployments reported/planned for 2021-23)
- Is this progress fast enough?

# 1. Condition monitoring (CM)

## Enhanced detection and monitoring capabilities

- Vibration sensors (standard technology for critical equipment)
  - Generally applied on most offshore assets, not reported in technology plans, BAU for most / all operators
- Wireless sensors (enhances reach)
  - Easy to add monitoring points, particularly used in retrofit applications (Apache, CNR)
- Camera image amplification (further extends reach to additional rotating equipment and pipework)
  - Easy to add monitoring points, particularly used in retrofit applications (Shell)
- Online condition monitoring (critical equipment continuous monitoring – predictive/responsive)
  - Ultrasonic Testing (UT) for live integrity monitoring (wall thickness, internal corrosion and erosion)
    - RSRUK on Piper
  - Bolt integrity, continuous load monitoring
    - Anasuria Hibiscus

## Data analytics and decision support

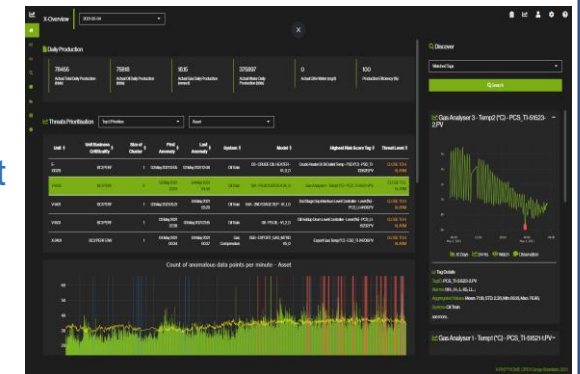
- Wireless / portable analytics
  - Hand-held analysers e.g. Baker Hughes SCOUT
- Visualisation via PI and control systems/room
  - Several operators, incl. Apache

- Offline predictive analytics Machine Learning and AI

E.g. Opex Group XPAS used by several operators (RSRUK, CNOOC, Harbour)

## Data Analytics - AI for Reliability OPEX Group

- Asset surveillance & monitoring
- Pre-configured digital modules – rapid deployment
- System wide model to identify best practice deviations/anomalies
- Prioritised threats & actions



## 2. Vessel inspections (VI)

### From the outside

- Conventional ultrasonic (UT) and Phased array ultrasonic (PAUT)
  - Readily available UT, significant progress with PAUT to resolve complex geometries and limitation of access. Wide deployment offshore, incl. RSRUK
- Eddy Current probes, Eddy Current Array (ECA), Pulsed eddy current (PEC) and arrays (PECA)
  - Ability to measure steel thickness also in presence of cladding and air gaps. Offshore deployment, incl. Harbour
- CT scan (X-ray)
  - Provides convincing evidence, when receiver can be located other side of equipment, e.g. cladded
- NII applications on online pressurised vessels
  - Significant advantage, proven by operators like RSRUK & Harbour. Potential interest by ~6 additional operators

### Confined space entry

- Caged drone inspection of vessels
  - Several operators, incl. Shell, Dana, Harbour, TotalEnergies
- Digital imaging, digital twins of internals
  - Shell & TotalEnergies



- Robotic arms, Crawlers, Magnetic crawlers

TotalEnergies



### TotalEnergies – Robotics tank inspection Hydromea

- Collects visual inspection data, validating system performance
- Wireless navigation & communications
- Tetherless operation in complex spaces



# 3. Hard to reach areas (H2R)

## Monitoring & inspection at height

- Controllable cameras and lights on extendable poles

Widespread use by multiple operators. BAU for operators incl. TAQA, Harbour and Ithaca

- Drones for visual and thermal inspections

Established technology, good market availability and economies of deployment. BAU for most operators

- More payload and capabilities (Visual and IR, Chemical sensors, Ultrasonic probes)



Used for tank and pipework inspections at many chemical plants

- Extended reach beyond visual flights

Promising technology for emission and environmental monitoring, with reduced crew logistics (BP, Shell, Harbour)

## Splash zone

- Long range ultrasonic

Applications to risers in caissons (Apache)

- Internal and external inspections of platform legs

Using crawlers (RSRUK)

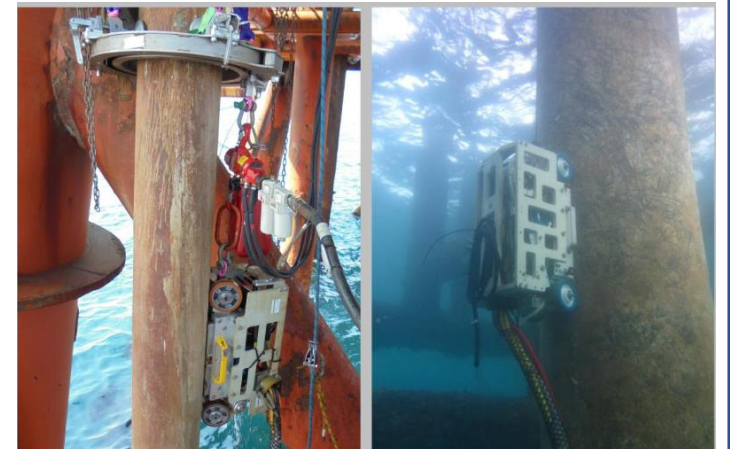
- External caisson cleaning and corrosion mapping

RSRUK deployment at Clyde

## Crawlers for caissons, risers and conductors

### Innospection

- Magnetic crawler
- Minimal surface preparation
- Various detectors incl. UT, PECT, camera and laser
- Operates to various depths



Increased safety, reduced ancillary costs (scaffolding etc), more access to structures (internals)



# 4. Corrosion under insulation (CUI)

## High TRL

- Phased-array Ultrasonic (PAUT) of structures without removing claddings and coatings

Probes and software commercially available e.g. FlexoFORM and Tracerco  
Harbour applying on 10 assets, RSRUK 3 assets

- Pulsed Eddy Current (PEC) for CUI detection

RSRUK 1 asset

- Pipeline CT scan – quality images if detector can be located opposite the source

CNR, RSRUK applying Trace applying Tracerco's technology

- *Corrosion Radar<sup>TM</sup>* – combination of EM Guided Wave Radar and moisture detection

Harbour on 10 assets  
TotalEnergies on Elgin/Franklin

## Mid TRL

- Moisture detection

BP, Neutron backscatter (CNR) and wireless inductance monitoring (3-Sci)

- Pulsed Eddy Current – modified shape and reach of PEC probes (wands, large diameter pipes)

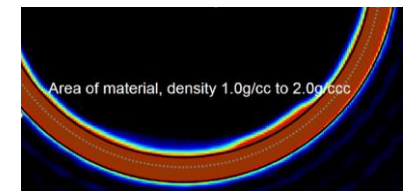
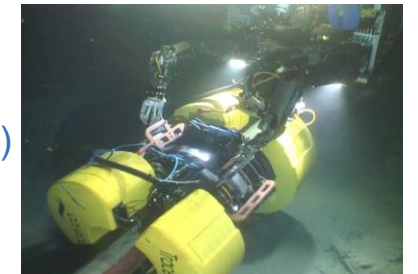
Harbour Energy programme

- Subsea PEC inspection methods

Shell programme

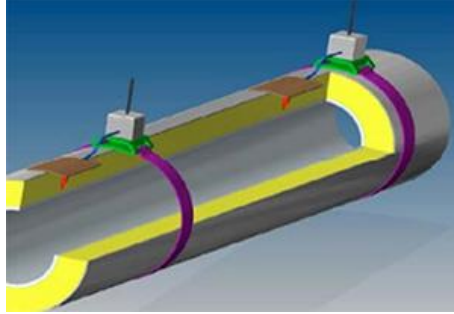
### Inspection on non-piggable subsea pipelines RSRUK various assets (2018+)

- Commercial technology (Tracerco)
- Requires vessel & ROV support (cost)
- However significant saving vs alternative of installing pigging
- Able to resolve wall thickness and internal corrosion and other deposits
- Applicable under cladding and insulation and even pipe-in-pipe





### Non-intrusive inspection



Safety, accuracy, planning and cost benefits, in a context of ageing assets and declining PE

### Well surveillance & intervention

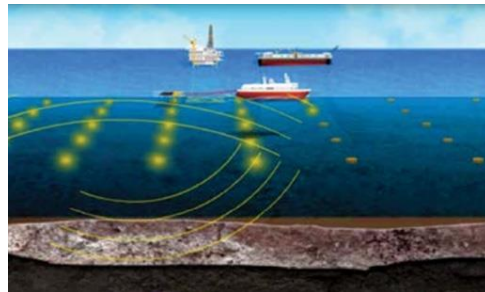
More active surveillance and intervention to improve performance of UKCS wellstock (shut in wells) and CCS monitoring



### F&V monitoring & abatement

North Sea Transition Deal industry commitments, and zero routine flaring by 2027

### Ocean bottom seismic



Illuminate difficult (near-field) exploration targets, support CCS monitoring and wind power colocation



### Alternative P&A barriers

Accelerate rigless P&A for cost efficiency, achieving superior containment results and enabling CCS redevelopment



### Subsea decommissioning

Achieve significant, and more adoption of remote, autonomous, and 'factory' subsea decom solutions

- Focus on key technology ‘themes’ – one at the time
- Industry, Supply chain and Government working together (Technology Leadership Board)
- Openly discuss the technology opportunities and field experience (Technology Managers' Network)
- Extract insights and lessons learned from technology plans and case studies
- Address technical and non-technical barriers to adoption in parallel
- Measure and monitor progress
- Support further innovation showing that deserving technologies can be successful in the market



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# Thank you

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