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IFI RPAS BVLOS Feasibility Study
Electricity and Gas Distribution Asset Inspections

Amazon & Google Go “Drone”…

Light UAS BVLOS Operations…

- The Holy Grail…
  - Long range & endurance
  - Ability to hover (for long periods of time)
  - Flexible launch & recovery
  - Precision flight
  - High degree of manoeuvrability
  - Hot swappable payloads

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Introduction

- UK Electricity & Gas RPAS BVLOS Feasibility Study
- Sponsored by NGN, SGN, NPG, SP, SSE & UKPN through the Energy Innovation Centre
- Feasibility of operating RPAS BVLOS from the following perspectives
  - Commercial [ROI]
  - Technical [ConOps]
  - Regulatory [CAA]
- Identify the principle GDN and DNO ConOps

Why A Feasibility Study?

- Are commercial BVLOS RPAS operations viable?
- What payloads / combination of payloads will deliver an optimum inspection capability?
- What type, size, range and endurance are required for optimum inspection operations?
- Can CAA approval be secured and what engagement is necessary for operational roll-out of such a solution?

Core Feasibility Study Elements…

- Requirements Gathering
  - Operational processes and stakeholders
  - Commercial / ROI requirements
  - Technology requirements
  - Concept of Operations specification(s)
  - Regulatory compliance qualification
- Requirements Analysis
  - Develop process / Concept of Operations simulation
  - Demonstrate “Proof of Concept” (physical demos)
  - Risk mitigation analysis and handling
  - Regulatory compliance confirmation
- Develop An Industry Standard Solution Specification
  - Develop a detailed solution specification
  - Define full project costs
  - Define clear acquisition/development programme timescales
  - Close co-operation engagement with the UK CAA

Why BVLOS?

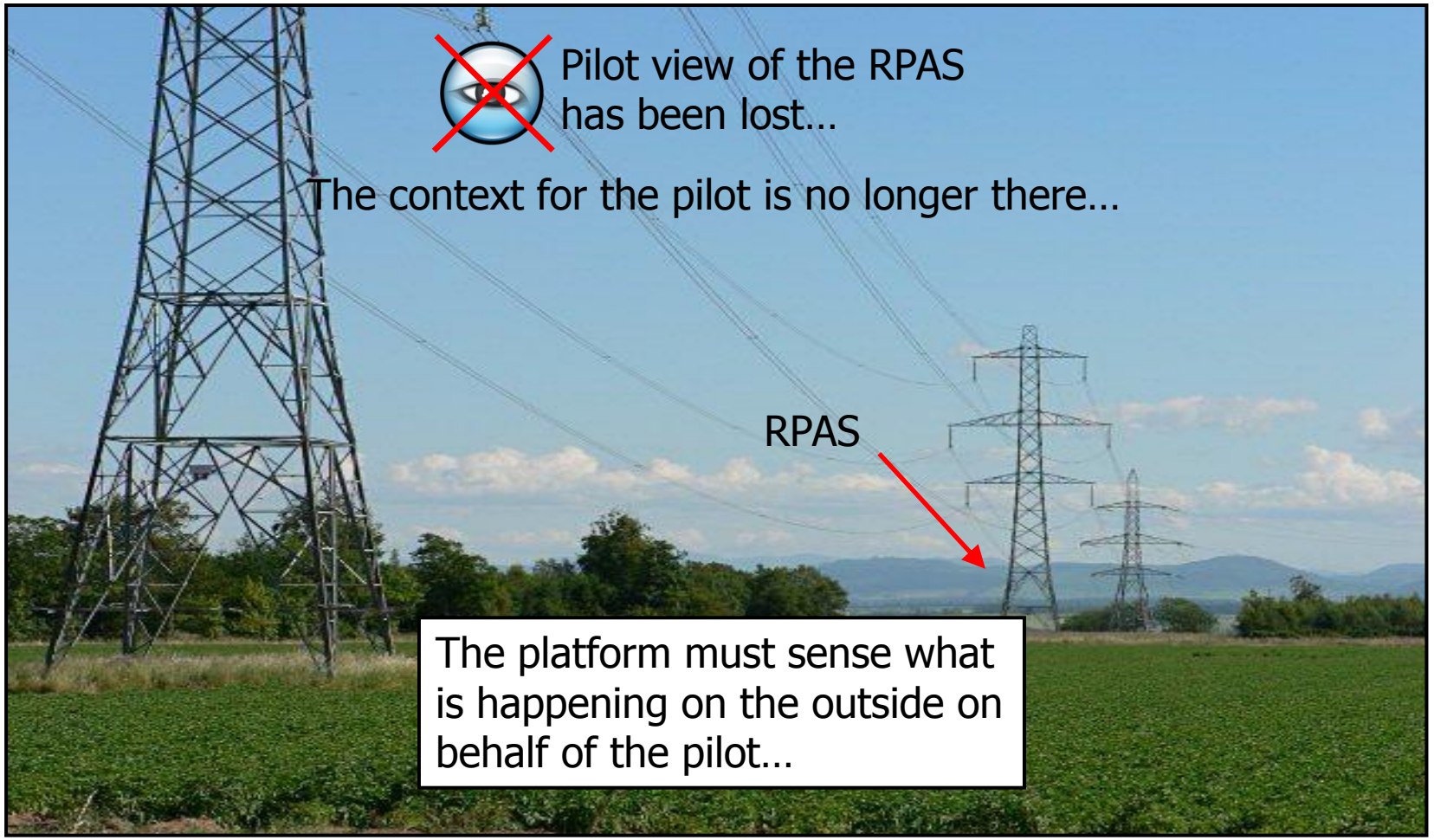
- Automate aerial inspection processes.
- Achieve precise, repeatable flight paths.
- Eliminate human error/lapses of concentration.
- Take advantage of automated data acquisition downstream post-processing techniques (data comparison, inspection data sharing, etc).

WVLOS Operations…

Understanding the context…

Outside looking on…

BVLOS Operations…



The BVLOS Challenge…

- Within Visual Line of Sight [WVLOS]
  - Complete context is viewable by the operator/pilot.
- Beyond Visual Line of Sight [BVLOS]
  - The context can only be sensed using electronics on board the RPAS.
  - *Virtual Reality* imaging is needed to understand the WVLOS ‘lost context’.
- Not only is a new airframe required, but multiple additional electronic / sensor systems increasing GTOW and power consumption…

BVLOS versus WVLOS Operations…

- Differences are like…

Feasibility – Core Technical Requirements

Required Technology	Specific Requirements
Precision GNSS	Absolute positional accuracy <20cm
Miniature Collision Avoidance Technology	360°, 0-250m object identification
BVLOS Communications	Total UK coverage, persistent, low latency
Miniaturised Payloads	Total payload weight <1.5kg
Higher Density energy Storage	Double current LiPo energy density (150Wh/Kg)
High-Precision, Long-Endurance RPAS	New type of RPAS platform

Technology Breakthrough…

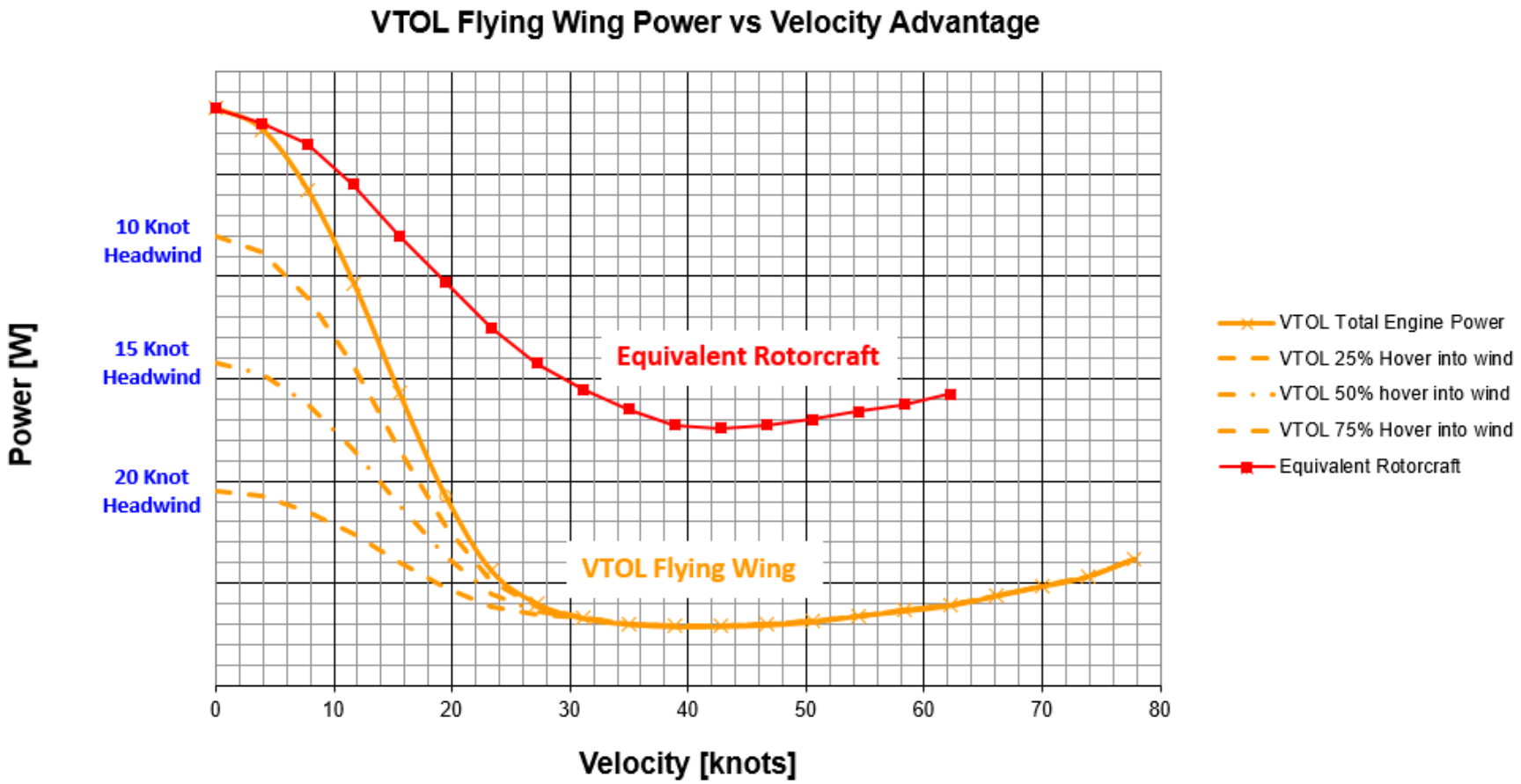
+

Advantages	Disadvantages
VTOL	Limited endurance
Hover	Cannot glide / safety
Stable	Camera field of view
Easy to control	Orientation
Portable	Slow accel and decel.
Modular payloads	Drift in headwinds

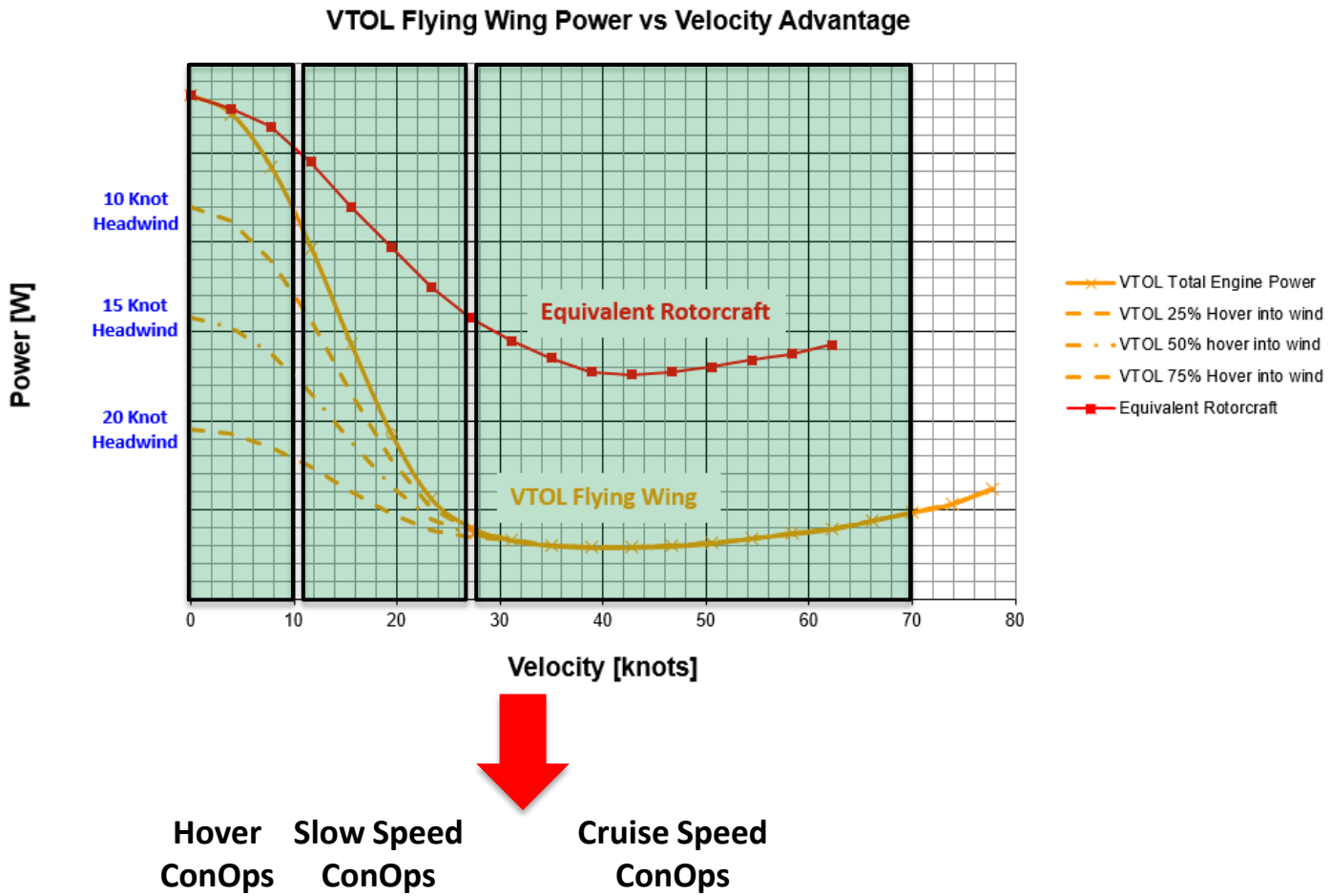
Advantages	Disadvantages
Endurance	No VTOL
Low cost	No precision flight
Quiet flight	Minimum flight speed
Glide / safety	Camera position
Portable	Slow accel & decel
Extra lift into wind	Multiple payloads

A Short Video…

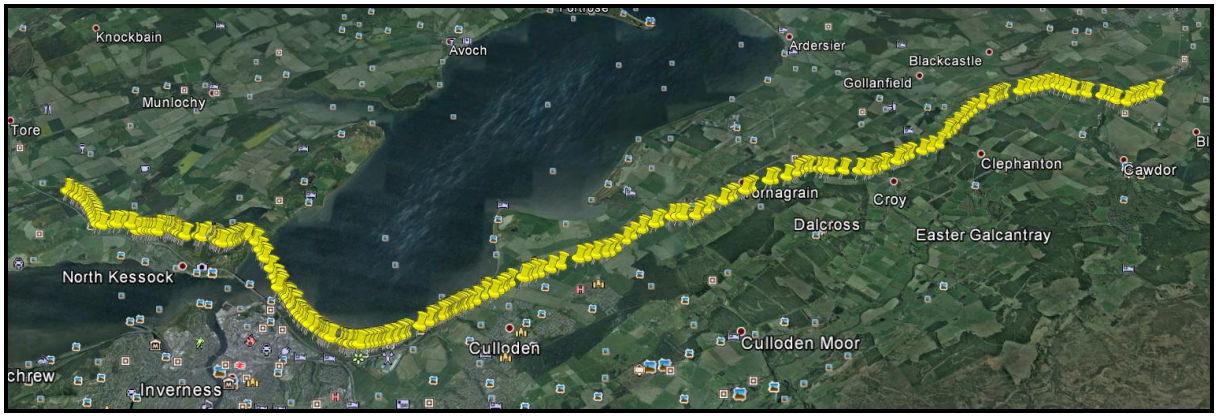
ConOps Drivers…

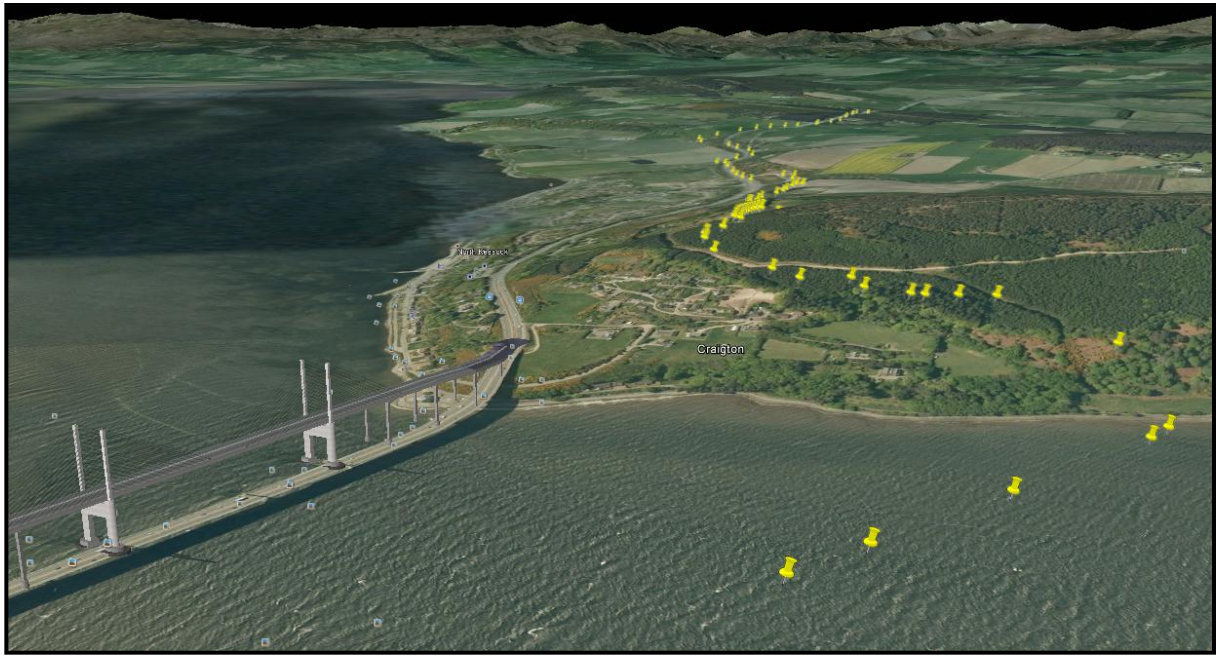


ConOps Drivers…

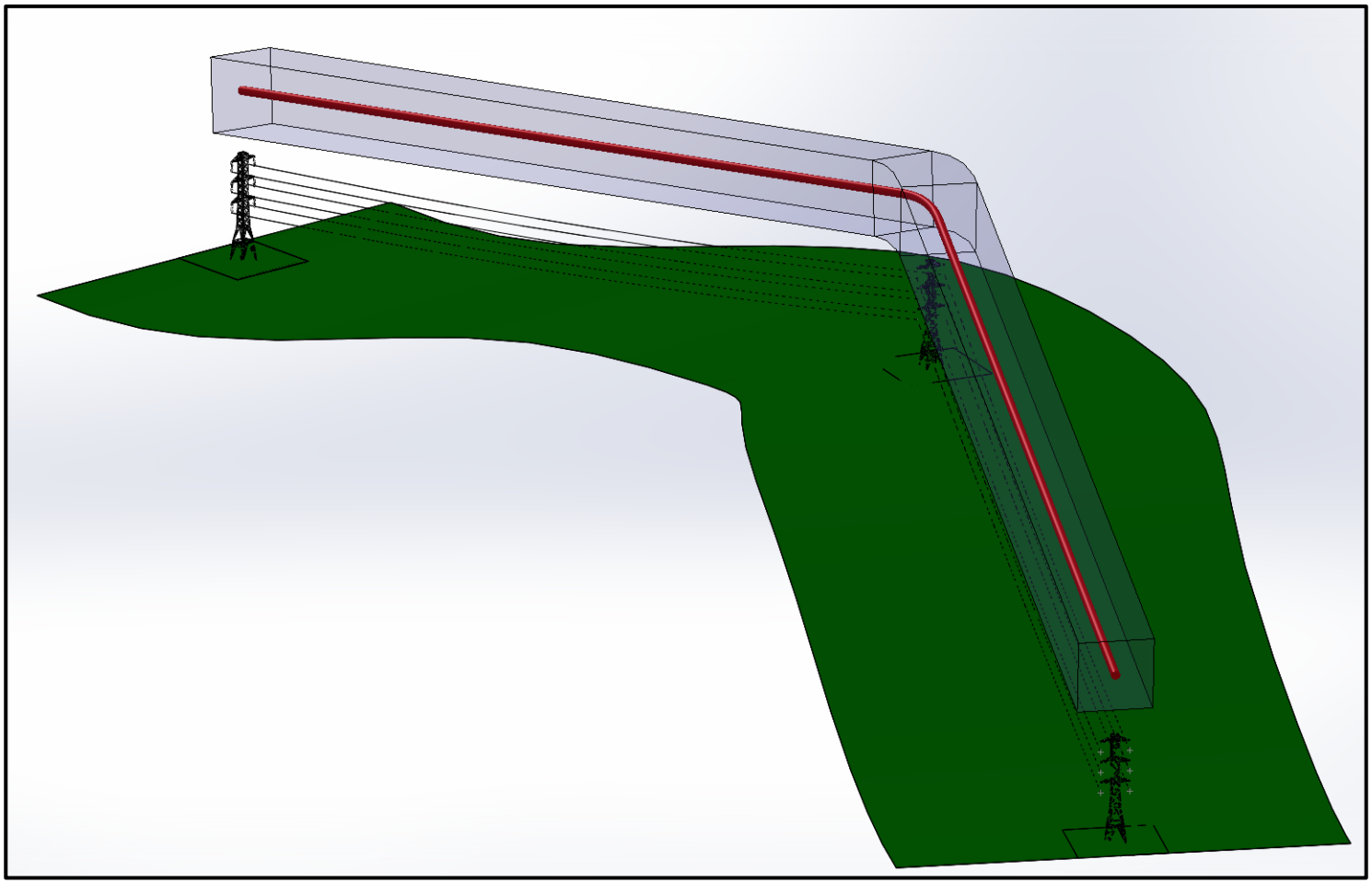


ConOps – Gas





ConOps – Electricity



ConOps – Electricity

Ferrybridge, 132kV steel pylon circuit &
Isle of Wight, wooden pole circuit

ConOps – Success Criteria

Typical Simulation Study Success Criteria:

- Speed, accuracy, quality and repeatability of image capture.
- Ability to identify gas pipeline infringements in a range of weather conditions.
- Generate data report for a standard GDN infringement data base.
- Ability to accurately and continuously capture 300m strip of land either side of the pipeline for LiDAR processing and ground topology analysis and comparison.
- Establish power consumption requirements for both flight and payload.
- Establish the type of RPAS architecture most suited to this particular type of aerial inspection operation (fixed-wing, rotary including quad or VTOL Flying Wing).
- Establish the optimum RPAS specification for this type of aerial inspection operation (in terms of type, GTOW, size, required payloads, endurance, range, cruise flight speed, etc.).
- Secure confirmation from the CAA that such operations can achieve regulatory compliance, confirm the process required to achieve regulatory compliance, together with the cost of achieving regulatory compliance.

Simulation Advantages…

- See and feel the inspection operations as if they were real.
- Test any situation or scenario required (obviously within reason)!
- Explore areas of potential risk and failure to truly establish what is and is not possible.
- Simulate ConOps in all weathers, times of day and environments.
- Develop and define new ConOps.
- Compare against current inspection operations (manned helicopters, foot patrols, etc.).
- Use the outcomes of simulation to inform the decision-making process.
- Provides the ability to perform detailed ROI analyses, based upon anticipated inspection operations.
- Use the environment to continuously innovate.

Feasibility – CAA Regulations

- Flying below 400’
- Flying at less than 70knots
- RPAS platform weight <25kg
- RPAS collision avoidance technology
- BVLOS communications

Feasibility - CAA Position…

- *"In summary, we view this simulation approach as an essential next step to achieving the end goal of eventually securing CAA approval(s) for small UAS operating BVLOS in support of UK electricity and gas distribution company aerial inspection operations and one which the UK CAA fully supports".*

- *"The CAA also supports VTOL Technologies working in close co-operation with the CAA and the UK electricity and gas distribution industries to introduce such BVLOS operations into service in a stepwise manner, if this project were to progress to such a stage".*

Conclusions

- Light RPAS BVLOS operations are not that far away.
- The core technologies essential for successful BVLOS operations are maturing fast.
- Simulation modelling is key to successful BVLOS operational exploitation.
- Both the EU and UK CAA are focused on delivering a common European light UAS WVLOS & BVLOS regulatory framework.
- VTOL Technologies has a unique VTOL RPAS platform uniquely suited to BVLOS operations.

Thank You

- Contact details…

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