



## Digital Tools in Design & Construction

**Client**  
National Grid  
**Sector**  
Natural Resources

**Project start**  
March 2017

**Project end**  
September 2020

**Value**  
£30 Million +

**Date**  
17/10/18

**Author**  
Andy Harding

**Innovation Reference**  
SI-00058

## PROJECT OUTLINE

### Bacton Asset Health, Scheme 1a

Modifications to the top-tier COMAH natural gas terminal at Bacton. Installation of 35No. isolation valves ranging in diameter from 600mm to 900mm, including replacement of existing actuators, mechanical supports and associated electrical instrumentation works.

## TESTIMONY

“During the last 3 years working with Murphy and their designers Premtech, we have seen a positive impact in the use of innovative technologies and ideas that have created efficiencies in design & cost flowing through to improved accuracy in delivery.

The benefits to National Grid as the end user of having a 3D model fits in with the efficiency challenge, removing the need for hard copy databooks where all the information is available at the click of a mouse.”

**- John Taylor, Project Manager  
National Grid**

## KEY CHALLENGES

The work was carried out on an existing site designed and constructed in the 1960's, on assets that were approaching the end of their functional life, with known corrosion and condition problems.

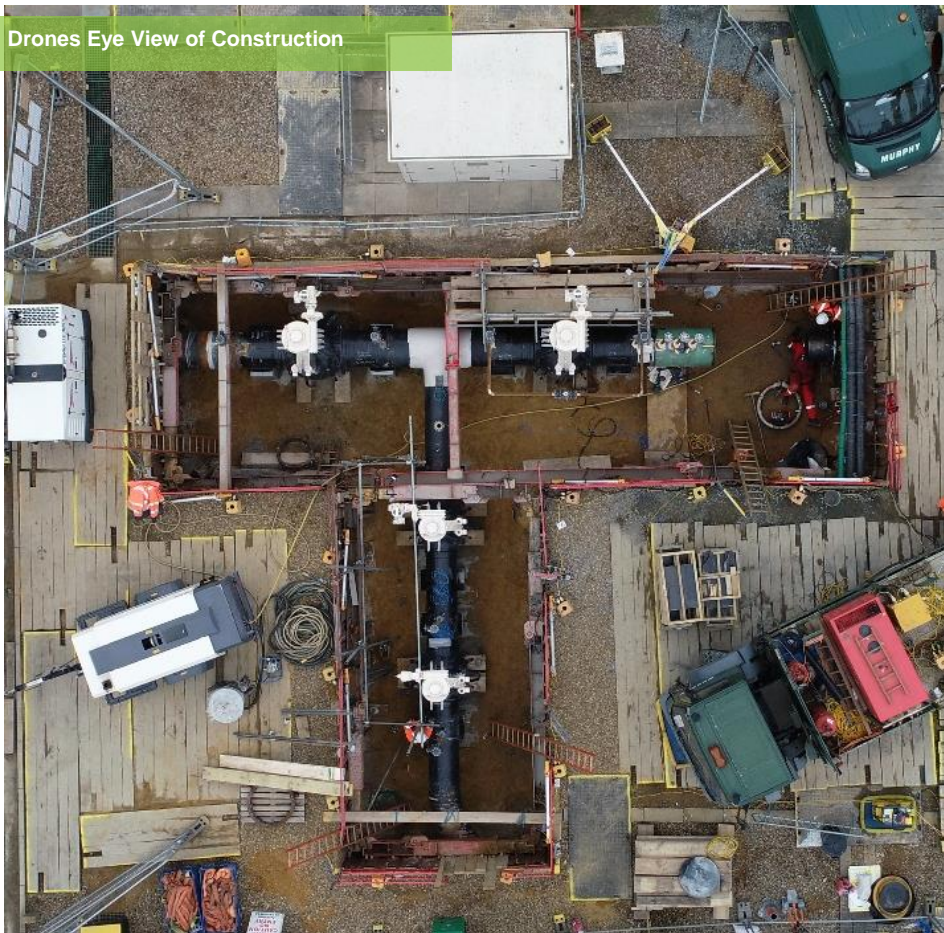
The site has been subject to significant modifications over the course of its 50 year operational life. Each modification was undertaken in accordance with the standards of the time, and is fully compliant with today's standards.

Some 8,000 drawings were received at the commencement of the project. As a result of the significant modifications made to the site over the years, these were found to contain inconsistent and at times contradictory information, prompting concerns of potentially unreliable, inaccurate information being used by the project team.

Construction was strictly scheduled to coincide with pre-planned localised outages, with the remaining site being fully operational. Design phase mitigation of construction risks was essential



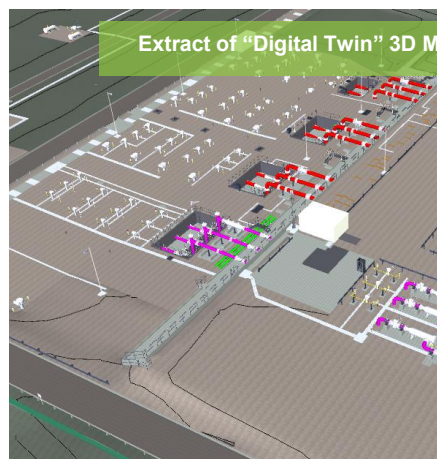
Drones Eye View of Construction



Aerial Photograph of Existing Site



Extract of "Digital Twin" 3D Model



## SOLUTION / INNOVATION

The details of the existing site were confidence coded to identify areas of low confidence.

Physical site works were undertaken to validate buried plant.

Digital data capture tools such as UAV/drone photogrammetry and terrestrial laser scanning was utilised to validate the as-built records. Trial-hole excavations were additionally laser scanned to provide permanent records of buried plant.

The "high confidence" validated records of above and below ground plant were combined in a 3D model "digital twin" of the existing site.

The digital twin was used throughout the design and pre-construction phase to rehearse construction activities and refine construction phase risk mitigation.

Following completion of the construction phase, the newly installed plant was laser scanned to provide high accuracy permanent record of the as-built modifications.

The as-built records and laser scan data was used to update the "digital twin" 3D model.

A digital handover pack was issued to the client, combining the as-built records in the 3D model with the design & construction phase records. The digital handover included a host of relevant information including material records, weld certification, pressure testing information, material certification, manufacturer's drawings, and as-built design information.

## KEY BENEFITS

■ **Improved safety** – Improved access to information. Using an easy to navigate and intuitive model environment, pertinent and accurate information is easily accessed. Using digital tools (drones and laser scanning) to generate the 3D model reduces the need for individuals to enter excavations, confined spaces and hazardous areas.

- **Improved accuracy** – A digital handover ensures that the information held by the client on their assets is accurate, up to date and reliable. Using digital surveying techniques is highly accurate, fast and efficient, and reduces the potential for human error.
- **Improved efficiency** – Improved access to operational and maintenance information. Digital storage of as-built data is easily accessed at the point of need. Access can be granted to those who require it and restricted for others without the relevant security clearance. Digital tools offer time savings over traditional data capture and storage methods.
- **Improved capability** - Because of the benefits listed above, both JMS & Premtech are pushing towards common use of drones for survey works where possible
- **Improved hazard studies** – Streamlining of the HAZID / HAZOP / HAZCON process as the model can be tabled as a visual aid to the discussions allowing the group to see and experience the installations.
- **Improved access to information** - Digital handover packs could potentially replace databooks in the future. End users can obtain key information from the model on components, welds and maintenance regimes almost instantly, without the need to trawl through masses of information.

## COSTS / SAVINGS / ROI

Improving access to historic information is a key driver for the client, this approach was incredibly well receive by the client.

During the scheduled HSE interventions with the client, this approach was identified as ALARP by the HSE and praised for the inherent safety improvements.





## IDEA ORIGINATOR

Client: **National Grid**  
 Principal Contractor: **J Murphy & Sons**  
 Principal Designer: **J Murphy & Sons**  
 Designer: **Premtech**

## CHAMPIONS

Contract Manager: Tom Keelan  
 Project Manager: Stacey Ledgerwood  
 Design Coordinator: Luke Taylor

## INNOVATION JOURNEY



## FUTURE OPPORTUNITY

This approach has been developed as a standard approach for all Design & Build Contracts in Natural Resources.

This has been adopted as a best practice on future projects by J Murphy & Sons and the client. It is likely to be included as a requirement on in similar future tenders.

In addition to working with Design partners, J Murphy & Sons are able to self-deliver this capability using resources from Murphy Applied Engineering. This capability and knowledge provides a USP opportunity for J Murphy & Sons that may differentiate us amongst other contractors.

This approach was presented as an example of Stakeholder Collaboration at a recent Engineering conference; and held up as a best practice to the wider industry.

The approach was agreed to represent “as low as reasonably practicable” (ALARP) by the HSE, and seen to represent the principles of PAS 1192 part 6.

