Virtual FutureGrid

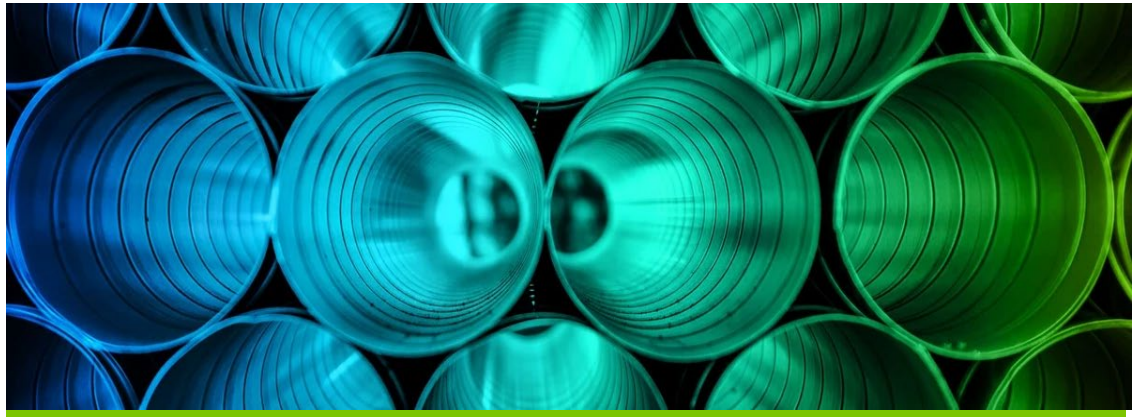
A pioneering approach to a hydrogen digital twin

5th December 2023

Introductions

DNV

- Global independent assurance and risk management company assuring that energy systems work safely and effectively through monitoring, verifying and advising on the energy infrastructure through the full concept, finance, design, build and operating cycles.
- Published the energy industry's first recommended practice (RP) on how to quality-assure digital twins in November 2020.
- In October 2023 we published our recommended practice (RP) that provides guidance on how to assure that AI-enabled systems are trustworthy and managed responsibly.
- Home to one of the world's leading large scale industrial test sites, DNV Spadeadam, located in the north of England.



National Gas Transmission

- National Gas Transmission is the backbone of Britain's energy system today and working to play a leading role in the transition to a clean energy future that works for every home and business.
- Own and operate the national gas network, delivering energy to where it is needed in every part of the country.
- Gas is currently a critical part of Britain's energy needs. We keep households warm and underpin their quality of life. For business, we fuel growth and innovation, and we are looking to the future by developing the hydrogen transmission system of tomorrow.

DNV Spadeadam

Located in a remote part of northern England, DNV Spadeadam Research and Development offers the opportunity to carry out rarely available trials in a controlled and secure 'real-life' environment.

Physical assets made digital

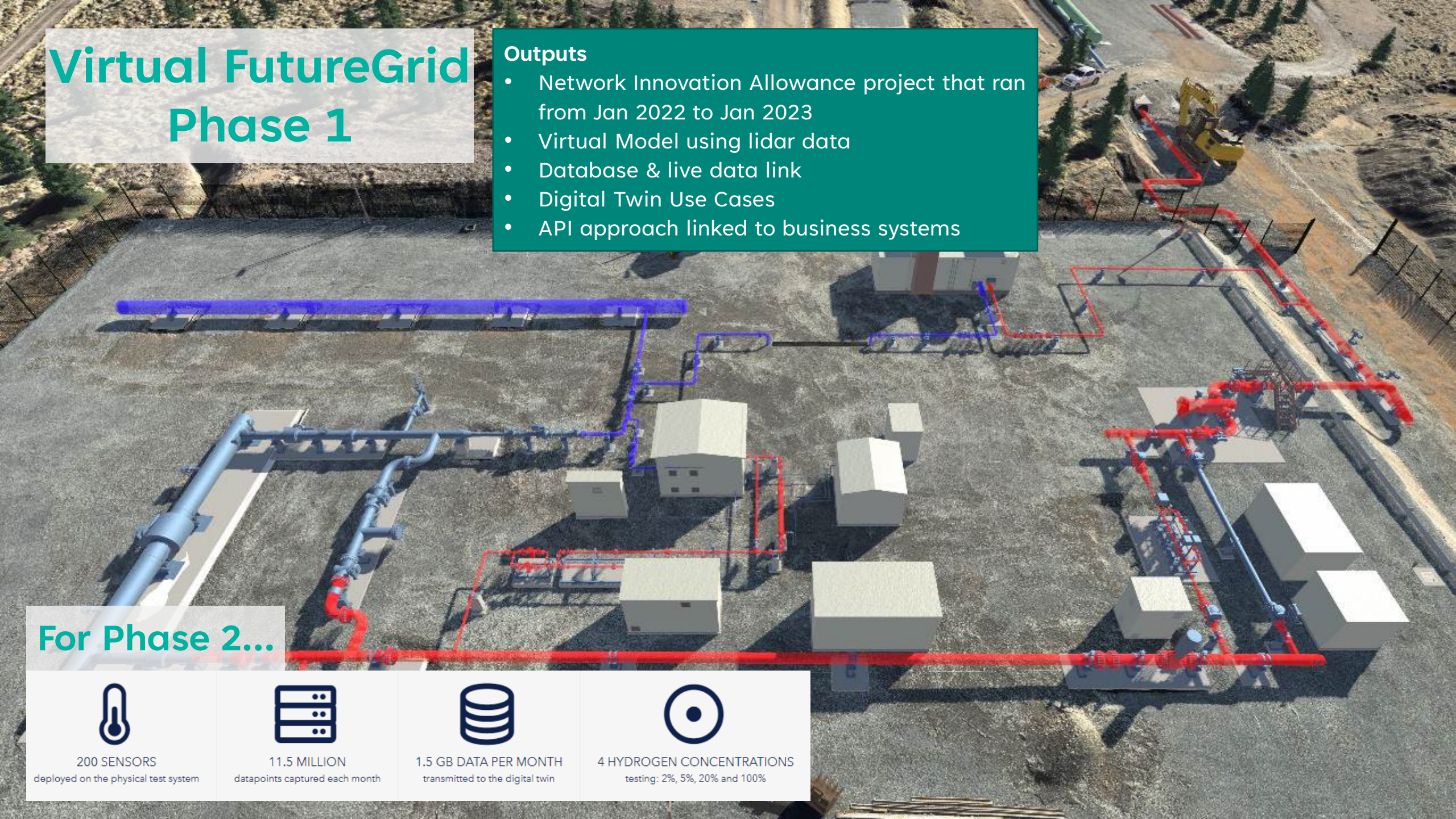
DNV Spadeadam is home to FutureGrid, National Gas' hydrogen demonstrator project, onto which a cloud-enabled Digital Twin is being created. This is the first of many projects at Spadeadam where a Digital Twin - API-ready and connected via our data platform - is playing a central role.

National Gas' goal is to deliver a **World-Class** Hydrogen Test & Demonstration facility for Compression systems providing the key evidence to transition the UK network in **2026**

Virtual FutureGrid Phase 1

Outputs

- Network Innovation Allowance project that ran from Jan 2022 to Jan 2023
- Virtual Model using lidar data
- Database & live data link
- Digital Twin Use Cases
- API approach linked to business systems



For Phase 2...

200 SENSORS
deployed on the physical test system

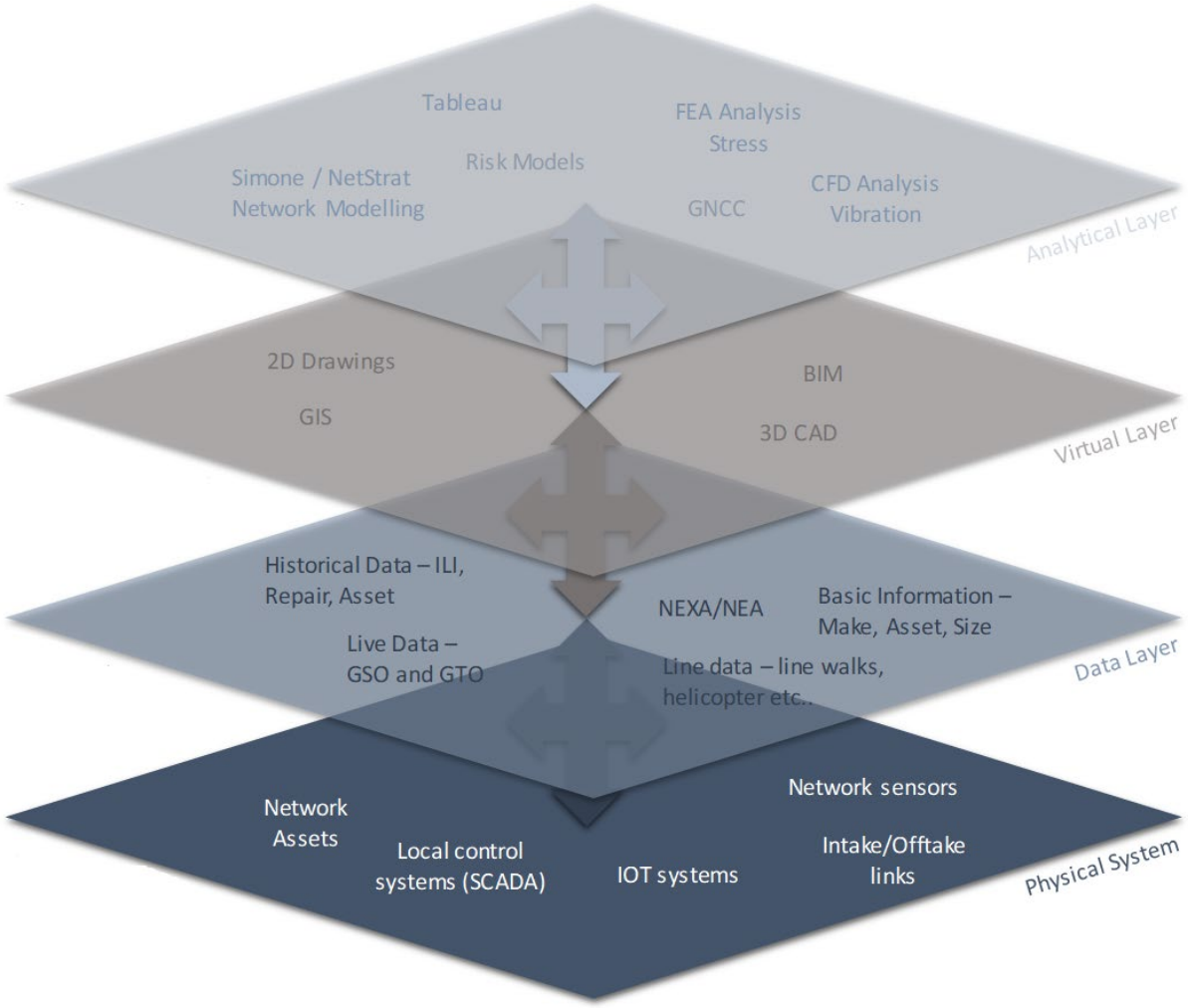
11.5 MILLION
datapoints captured each month

1.5 GB DATA PER MONTH
transmitted to the digital twin

4 HYDROGEN CONCENTRATIONS
testing: 2%, 5%, 20% and 100%

The Challenge for Phase 2

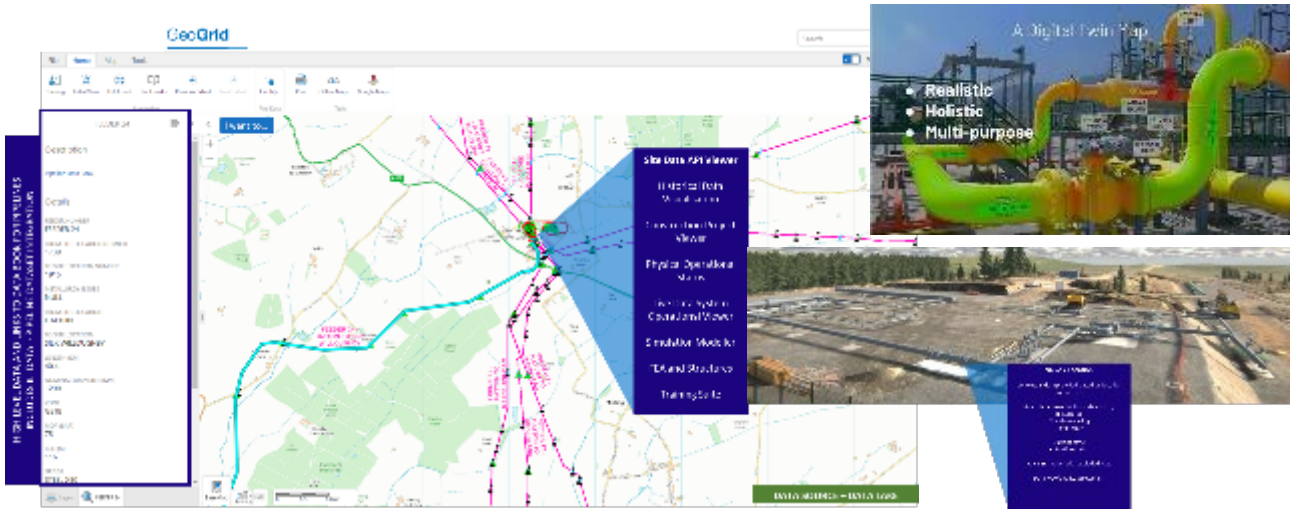
- Phase 1 enabled us to provide the groundworks for the digital twin of the FutureGrid facility whilst allowing the team to identify the use cases and associated systems that could deliver benefits to the business through the use of digital twins.
- The introduction of historic and live asset data into network models will allow us to understand how an asset is currently behaving and will subsequently behave under altering conditions.
- Overlaying simulation and data analytics can further improve the understanding of the network and provide insight into how various scenarios will impact its running.
- A digital twin could help us to fully understand the intricacies of how our assets are affected by the introduction of hydrogen.
- The FutureGrid programme is a perfect opportunity to explore how the virtual world can directly benefit our physical understanding of our plant and network.



The Objective

- Phase 2 of our project is focusing on demonstrating the potential and benefits of digital twins building upon the collaborative visual data twin developed through the phase 1 project in 2022.
- Six use cases have been refined through phase 1 to be demonstrated covering data management, digital construction and live data manipulation. Seen in the table on the right ->
- The API Digital Twins will directly link into our CDE and live site data demonstrating the opportunity to connect a wide range of data.
- Use cases around operational and control are important for our future energy networks, e.g., enabling asset predicative maintenance and optimized operations of networks, but not feasible for demonstration at FutureGrid site at the current stage.
- We are also building AR and VR based solutions to support training, stakeholder and community engagement; and sustain support for our project.

Data Accessibility & Dissemination	• Data Structure link to associated Virtual Visualisation • Data Quality & Integrity Assessment
Project Visualisation & Dissemination	• Virtual Site Model – Pre Construction • Automated assessment of build operations
Data Analytics & Predictive Analytics	• Live Data Viewer • Extrapolation of time for hydrogen



Use Cases

USE CASE 19
Data Accessibility & Dissemination

- **Current NTS Use Case – Phase 1 FutureGrid Demo**
- Asset knowledge base - clear view of number of assets, types etc... enable us to make a clear decision on the readiness of feeders for hydrogen, historic and current data
- Geo tagged where possible and aligned to GIS (Review updated GeoGrid)
- FutureGrid have already begun to collate data for the assets and HyNTS Pipeline Dataset is looking at this for the network

USE CASE 30
Project Visualisation & Dissemination

- **Future NTS Use Case – Phase 2 FutureGrid Demo**
- Dissemination of the Project data/findings to external stakeholders
- Construction project dissemination use case a focus – how best to communicate progress
- Project status and outcomes demonstrated in a visual manner overlayed on a facility will enable dissemination of FutureGrid and enable improved engagement with main work contractors in our core business

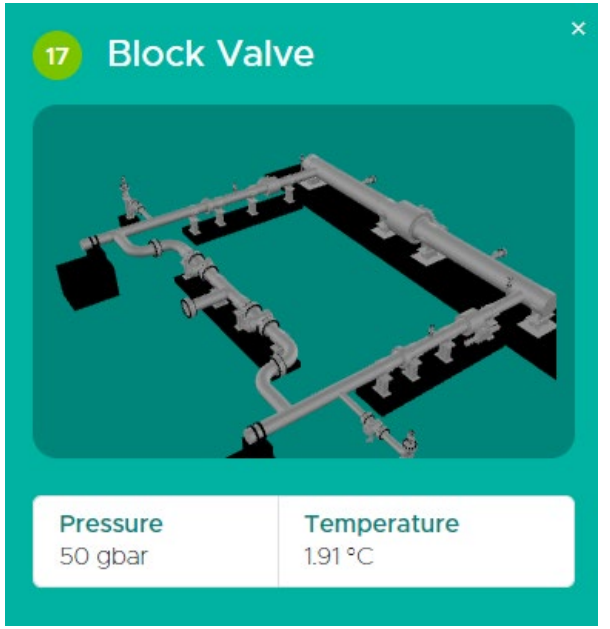
USE CASE 62
Data Analytics & Predictive Analytics

- **Future NTS Use Case – Phase 1 FutureGrid Demo**
- Live data view in easy to understand methodology
- Predictive impact of hydrogen on the FutureGrid assets using current project findings
- Analytical systems behind the digital twin should be demonstrated and in this scenario predictive analytics of how the project findings could progress over time would be of interest and should be rolled out on the remainder of the network

Demo


CVDT Dashboard
cvdt.cfms.org.uk/map-view
CVDT FutureGrid
SPADEADAM
Phase One
1 HP Reservoir
2 Isolation Valves
3 Ball Valve 1
4 Ball Valve 2
5 Filter Meter Area
6 Meter Skid
7 Filter Skid
8 Flow Control Valve
9 FCV
10 NRV
11 Pressure Reduction
12 Filters
13 Meter Skid
14 Heat Exchanger
15 Boiler LDU
16 Pressure Reduction
17 Block Valve


Virtual
FutureGrid


17 Block Valve
Pressure
50 gbar
Temperature
1.91 °C

Thank you

For more information

Read more about FutureGrid

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national gas