



WHEN TRUST MATTERS

Hydrogen Research at Scale

Introduction to our Hydrogen Services

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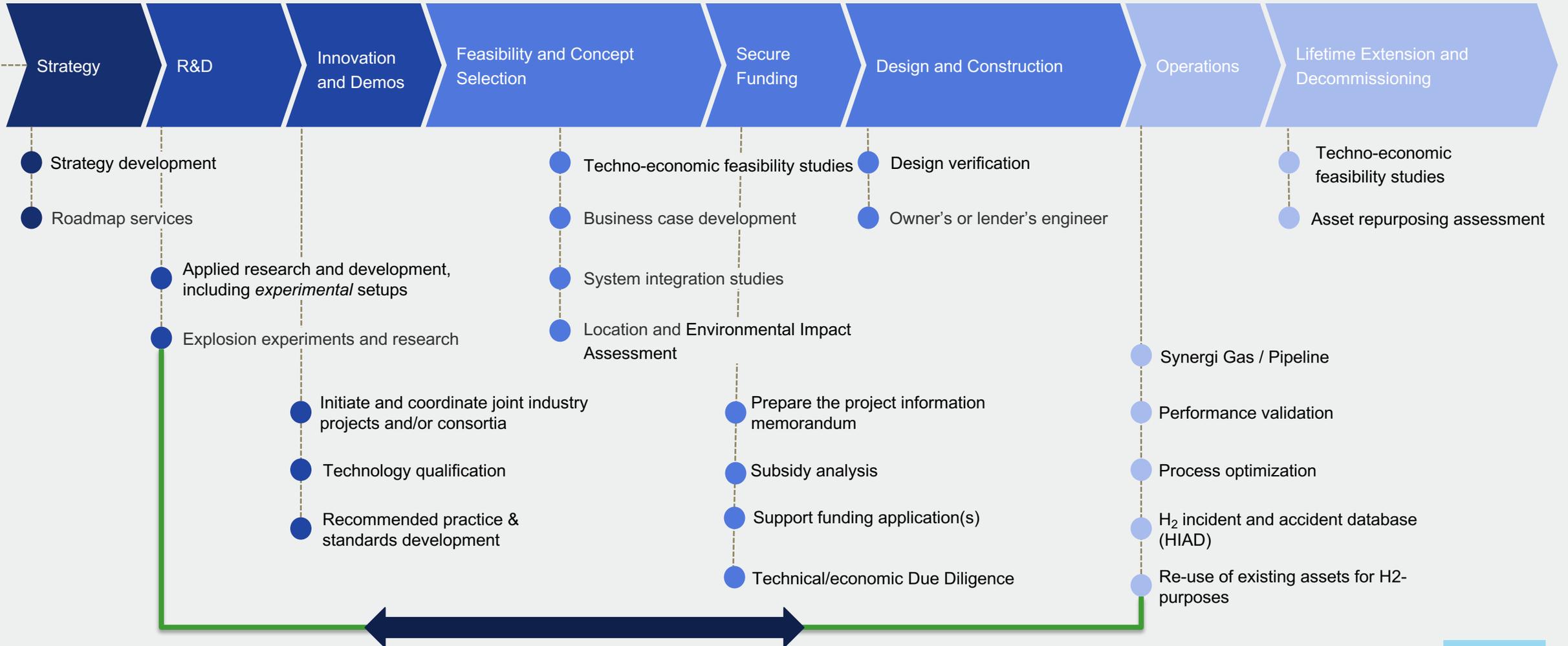
Our purpose

To safeguard life,
property, and the
environment

Our vision

A trusted voice
to tackle global
transformations

Hydrogen project lifecycle – repurposing assets



Research Facilities

Overview



Large scale research facility supporting the Energy Transition, strong heritage from the British Gas legacy.

Flammable gas hazards

- Important properties
- Hazards from flammable gases
- Effect of hydrogen properties on hazards

Hazards from carbon dioxide

- Focused on dense gas dispersion from transportation failures
- Potential for harm

Risk assessment

- Methodology
- Differences from hydrocarbons

Our services and approach

Research

It is important to evaluate and to predict the behaviour of major hazards and evaluate the consequences. We design and conduct tests to client-specific requirements in a secure, confidential, 'real world' environment. Its remote location means we can enforce large exclusion zones, so that tests of up to 1 tonne TNT equivalence can be carried out safely. We operate across a broad range of major hazard industries, to manage their operations safely and push the technological boundaries of asset reliability and performance. DNV has a significant experience on major hazard research and safety and has conducted large-scale test programmes including pipeline rupture and large and small scale ignition experiments.

Hydrogen Research programmes

Understanding hazards and behaviour of hydrogen DNV offers a risk assessment of high-pressure hydrogen transport pipeline system in order to achieve appropriate levels of safety and integrity of the infrastructure and to satisfy regulatory and corporate criteria. This will give network managers or pipeline operators better understanding of the risks associated with hydrogen transport and will help them identify the most effective mitigation measures that can reduce these risks.



Heritage

Pipeline Fracture Propagation tests





www.dnv.com/spadeadam





www.dnv.com/spadeadam



DNV

Pipeline Fracture Propagation tests

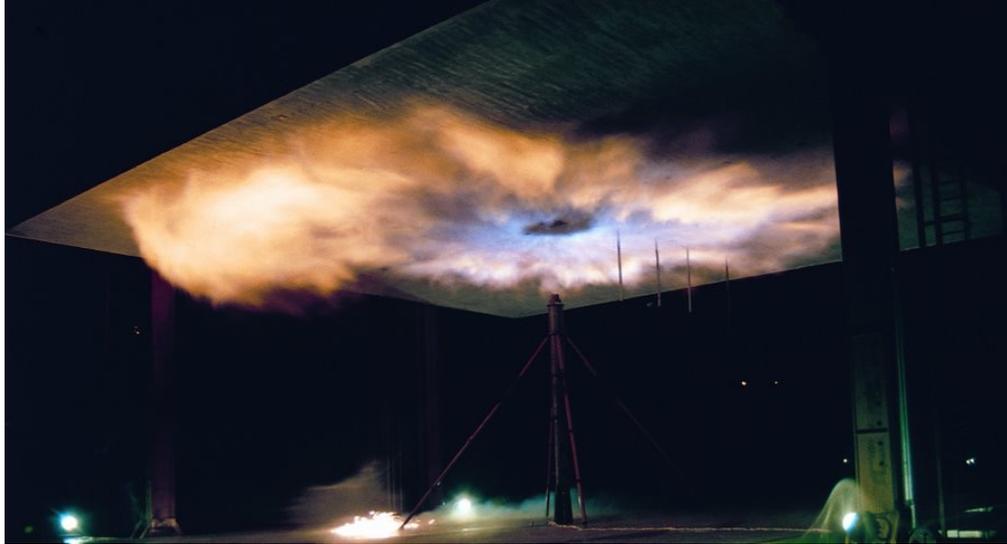


Piper Alpha Disaster

Gas release from condensate pump, 6th July 1988
Explosion resulting in further loss of containment
Fires destroyed the platform in 2 hours
167 fatalities

Research Explosions & Fires Offshore

- Industry Joint Industry Projects to study explosions & fires at large/full scale



Hydrogen Research

HyStreet: DNV funded research houses.

FutureGrid

Under construction – full gas transmission loop

 **Hy4Heat**

Releases from domestic pipework downstream of the meter

 H_2

Phase 2: MicroGrid distribution network for assessing working procedures for H_2 network

 H_2

Phase 1: Releases from gas distribution network upstream of the meter

A Hydrogen Network Research Facility

DNV HyStreet

- Houses funded by DNV
- Fully controlled system for hydrogen and natural gas releases. Accommodating a variety of gas accumulation scenarios.
- Network connections for H21 project.
- Appliance testing/ demonstration houses.



Hy4Heat Project

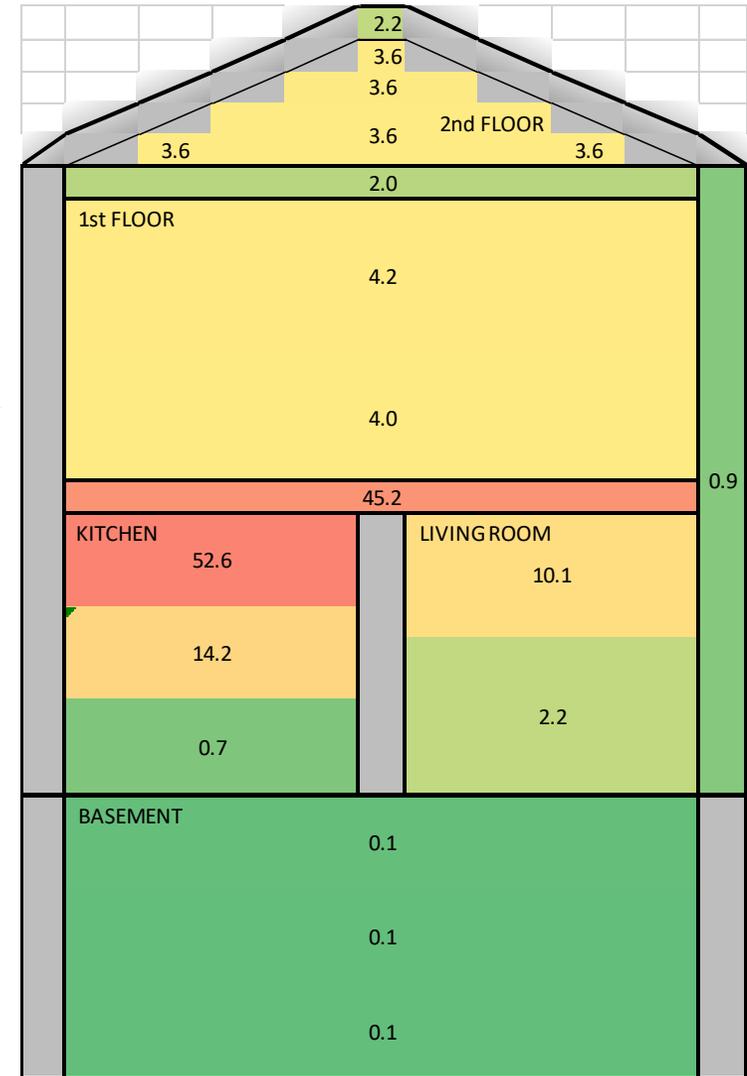
Accumulation in Practice (domestic, low pressure)



Hydrogen →

Same hole, same supply pressure

Hydrogen concentrations higher due to greater volumetric flow rate



H21 Project

H21 Phase 1

- WBS1 Small Releases
- WBS2 Large Releases
- WBS3 Ignition Potential
- WBS4 Explosion Severity



H21 Phase 2 – distribution facility 7 bar –25mbar

HyStreet

H21 Distribution test rig

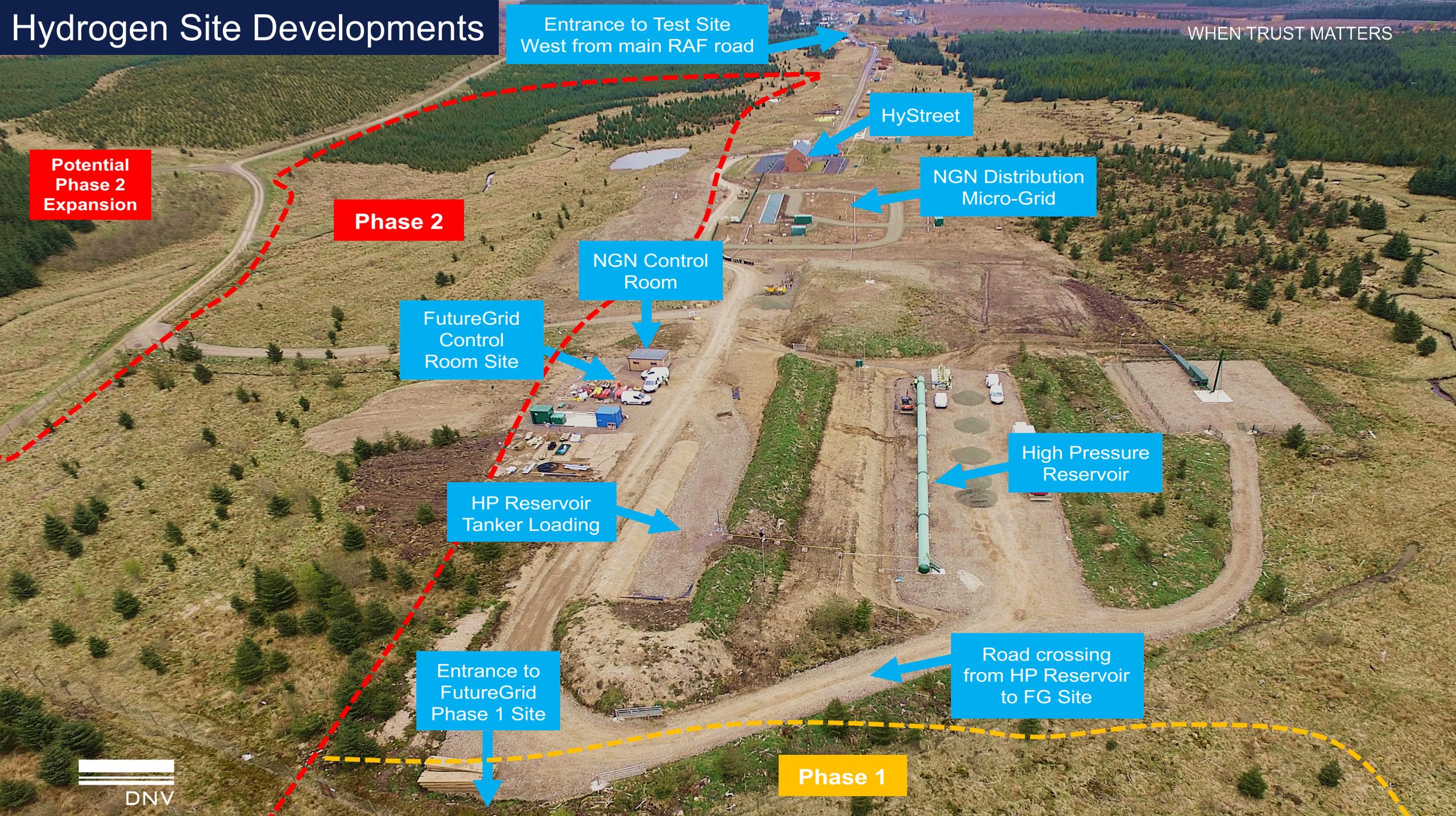
Pressure Regulation unit.



FutureGrid Project

Hydrogen Site Developments

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Entrance to Test Site
West from main RAF road

HyStreet

NGN Distribution
Micro-Grid

Potential
Phase 2
Expansion

Phase 2

NGN Control
Room

FutureGrid
Control
Room Site

High Pressure
Reservoir

HP Reservoir
Tanker Loading

Road crossing
from HP Reservoir
to FG Site

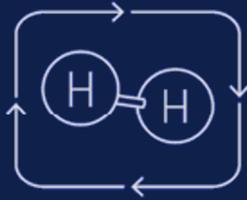
Entrance to
FutureGrid
Phase 1 Site

Phase 1



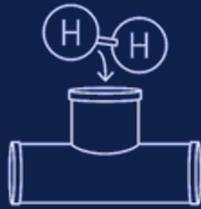
FutureGrid

- An ambitious programme to build a hydrogen test facility from decommissioned assets at DNV's facility to demonstrate the National Transmission System (NTS) National Grid can transport hydrogen. Testing will be completed in two parts:



Offline Hydrogen Test Facility

NTS assets of different types, sizes, and material grades will be tested with 2, 20 & 100% hydrogen



Standalone Hydrogen Test Modules

Standalone hydrogen test modules will provide key data required to feed into the main facility

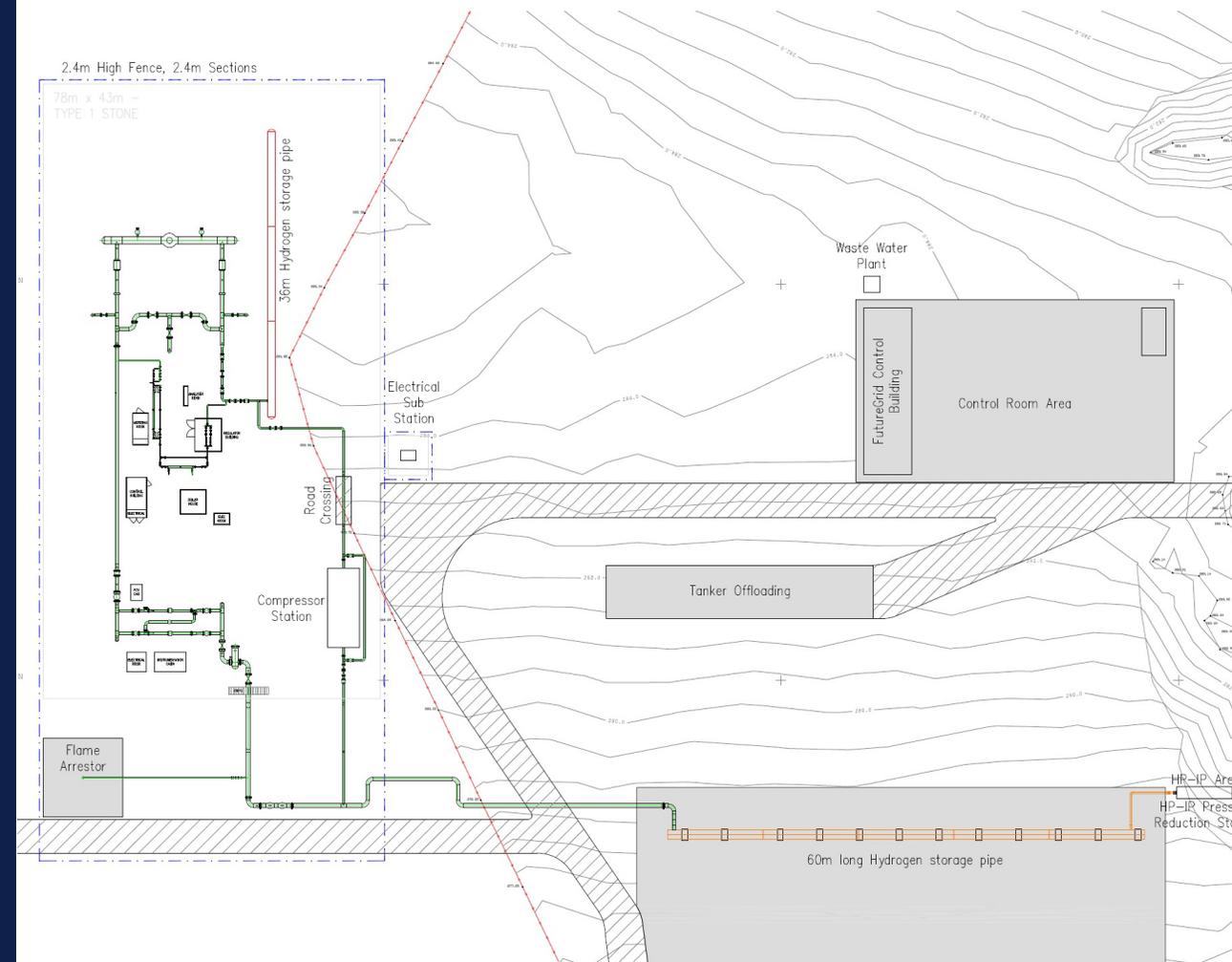


FutureGrid LTS Futures



FutureGrid Design

- Based on Decommissioned transmission assets from National Grid.
- X65 pipelines 18" & 36"
- Entry and Exit points included.
- Regulators, filters, block valves, slam shuts, Compressor included.
- Control Room.
- 36" Hydrogen storage Reservoir.
- Operating pressure up to 85 bar working with ASME 31.12 & IGEM TD/1



FutureGrid Project – Phase 2 (2023)



■ Other tests to be considered: -

- Offline valve testing
- Orifice plate testing
- Regulator Seal testing
- Burst/rupture testing
- Hot works/mechanical damage/defects.
- Filter performance and characteristics.
- Effect of hydrogen on performance of pipeline damage
- Large releases
- Thermal radiation
- Debris throw
- Proximity distances
- Flammability limits
- Ignition probability

Safety considerations

- Large releases
- Thermal radiation
- Debris throw
- Proximity distances
- Flammability limits
- Ignition probability



Discussion areas.

- Compression
- ATEX issues
- Cathodic Protection
- Training
- Ongoing Maintenance of standards
- Gas and Fire Detection
- Rupture Test
- Metering & Billing
- Technology Watch on hydrogen developments
- Modelling of the existing gas system
- Training

