Services along the hydrogen value chain

Distribution/transport:

Pipelines

TÜV®

TÜV NORD GROUP

H_2 competence @ TÜV NORD

1. Energy generation

Wind energy ■ ■ ■

2. H_2 generation

Electrolysis ■ ■ ■

Seawater desalination plants ■ ■ ■

3. Distribution/transport

Electrical grid ■ ■ ■

Pipelines ■ ■ ■

District heating ■ ■ ■

Intelligent networks ■ ■ ■

Pipelines ■ ■

Refuelling stations/ filling systems ■

Tankers (lorry, train, ship) ■

4. Storage

Battery storage ■ ■ ■

Gas tanks ■ ■ ■

Cavern storage (H_2 and CO_2) ■ ■ ■

Pressure vessels ■ ■ ■

H_2 hybrid storage ■

5. Consumption/use

Fuel cell systems ■ ■ ■

Methanol synthesis units ■ ■ ■

Refinery ■ ■ ■

Mobility ■ ■

In every field of services, we support you in the following phases:

■ Concept/planning ■ Production ■ Operation

Concept/planning

We support you in the concept phase with comprehensive services that will give your project the security it needs in technical and legal aspects from the very start. From product design through the assessment of requirements and technical specifications to plant development and process optimisation, our specialists have the details and the desired goal in view and are equipped and prepared for your tasks with ultra-modern IT and AI instruments as well as a broad spectrum of risk analysis, certification, test and evaluation services.

Production

With specific testing,auditing and approval services, we provide neutral and technically competent support as a notified and accredited body for manufacturers. This includes assessment and certification as a material manufacturer, obligatory for the production of certain products. Our range of services also includes the assessment of manufacturing processes, material assessments, stress tests, damage appraisal and product certifications. In addition, on top of monitoring production, we also support commissioning, assembly works and personnel instruction in production processes.

Operation

After setup and commissioning, we help you when operations are up and running to avoid shutdowns, eliminate technical sources of danger and reduce costs with the use of software-supported maintenance systems. We take on the task of carrying out all recurring inspections and specific tests of electrical and mechanical plants and systems. We can also create risk-based maintenance plans and provide you with tailor-made strategies to reduce operational risks and increase plant safety over the long term.

How H_2-ready are existing pipeline infrastructures?

In parts, Europe already has an established pipeline infrastructure for the transportation of gaseous hydrogen. Thus, in Germany's Rhine-Ruhr region and Saxony-Anhalt, for decades, hydrogen pipelines have been used to supply chemicals and petrochemicals industries. With a view to the planned extent of a sector-coupled hydrogen economy, however, there is a need for development at a national scale.

To allow the development of a suitably large hydrogen grid, alongside the establishment of additional and new dedicated hydrogen pipelines, the national natural gas network is to be used. Tests of the natural gas pipelines and their technology with regard to the strength and toughness of metallic microstructures are needed to show if they are suitable for the transportation of high-pressure hydrogen.

We are your partner for the investigation, evaluation and conversion of existing gas pipelines and the establishment of new dedicated hydrogen pipelines. With the most modern analytical methods and competent specialists, we are at your side to complete projects successfully, draw up studies and benefit from public subsidies. Do get in touch.

Requirements of hydrogen pipelines

Hydrogen pipelines need to withstand unusually high pressures. The existing pipelines in Germany are made of steel in low-strength quality. They are designed for pressures up to 210 bar and are operated at 20 to 25 bar. Thus they are only subject to minimal loads with regard to their strain rate. To make a comparison: in France and Benelux, hydrogen pipelines made of low-strength materials are operated at pressures of 65 to 100 bar.

Because of their low size, hydrogen molecules can penetrate materials and thus affect their mechanical stability – a process termed “hydrogen embrittlement”. To prevent this, high-purity steels and alloys with homogeneous, fine-grained microstructures should be used for new pipelines. Likewise, the interior welded seam surfaces should be smooth and flawless. Besides steel pipelines, plastics can also be used; these, however, usually only allow pressure levels up to 30 bar.

Use of existing gas networks

In relation to the few hundred kilometres of dedicated hydrogen pipelines in Germany, the natural gas network is gigantic, running to around 540,000 kilometres. At a pressure of up to 200 bar, imported natural gas enters regional networks from large-scale long-distance transmission systems. Pressure regulating stations here reduce it to pressures between 1 and 70 bar to transport it to industrial consumers and municipal distribution networks. There, it enters plastic pipes and is brought, say, to the homes of private consumers at a pressure of up to 30 millibar.

The planned step-by-step increase in the level of hydrogen in the German natural gas network requires the inspection of natural gas pipelines and their control facilities for suitability of the materials used and for critical damage from previous operation. The background to this is the ability of hydrogen molecules to penetrate materials and, at high concentrations, affect their mechanical strength, something known as hydrogen-promoted fracture formation or hydrogen embrittlement.

During simulation studies and material investigation projects, findings are currently being sought to give statements as to whether the operational safety of natural gas pipelines is assured and the step-by-step increase of hydrogen in the network is possible.

Our services

Whether it's setting up dedicated hydrogen pipelines or converting existing natural gas systems – with comprehensive services in the fields of testing, inspection and certification, we support industrial, institutional and academic actors in the following phases of the project in question:

	Concept / planning	Production	Operation
Inspection of the components' ability to withstand internal pressure, temperature, local loads and vibration (e.g. pressure waves)	■		
Evaluation of special tension and stability certifications on the basis of analytical and numerical methods (FEM) for mechanical and thermal loads	■		
Evaluation of operational stability certifications for cyclical loads through fatigue calculations	■		
Construction monitoring as part of manufacture/repair of components for storage/transport of H_2		■	

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