ON-SITE TESTING

JUPITER1000 by naTran

The Jupiter 1000 site provides a platform for testing your equipment and materials (sensors, electrolyzers, valves, regulators, etc.) under industrial conditions.

- Pressures 30, 70 and 200 bar
- Hydrogen flows up to 200 m3/h
- Presence of syngas and CO_2

Our site can supply decarbonated hydrogen to power your equipment during the qualification and testing phases.

They trust us

conexus BALTIC GRID · enagas · fluxys · GERG THE EUROPEAN GAS RESEARCH GROUP · GRDF GAZ RÉSEAU DISTRIBUTION FRANCE · nationalgrid · ONTRAS · PRCI Pipeline Research Council International · storengy · SWISSGAS · TERĒGA

Our research partners

cea liten · CNPP · RÉPUBLIQUE FRANÇAISE Liberté Égalité Fraternité · INERIS maîtriser le risque pour un développement durable · MINES PARIS | PSL · universités de technologie Belfort-Montbéliard Compiègne Troyes

Your NaTran R&I contacts

Integrity, mechanical characterization tests Maxime Bertin | maxime.bertin@natrangroupe.com

Study of corrosion phenomena Alexandre Perrot | alexandre.perrot@natrangroupe.com

Hydrogen's impact on equipment Alban Sesmat | alban.sesmat@natrangroupe.com

Industrial safety Romain Jambut | romain.jambut@natrangroupe.com

Energy systems modeling Hippolyte Lochon | hippolyte.lochon@natrangroupe.com

Gas detection and fugitive emissions Jean-Luc Fabre | jean-luc.fabre@natrangroupe.com

Gas quality Lorena Cuccia | lorena.cuccia@natrangroupe.com

Preferred contact H2 Julien Estienne | julien.estienne@natrangroupe.com

If you have other requirements, please contact us: contact_natranr&i@researchbyrice.com

naTran R&I

linkedin.com/company/rice-research-innovation-center-for-energy/

@NaTran_RI

1-3 rue du commandant d'Estienne d'Orves
92390 Villeneuve-la-Garenne (FRANCE)
https://ri.natrangroupe.com/

NaTran - SA au capital de 620 424 930 € - Enregistré au Registre du Commerce et des Sociétés (RCS) de Nanterre sous le numéro SIREN 440 117 620. Head office: 6, rue Raoul Nordling, 92277 Bois Colombes Cedex - Telephone 01 55 66 40 00 - www.natrangroupe.com - Photo credits: NaTran photo library, P. Durrell, G. Brandel, B. Bechet - créapix - March 2023

naTran R&I

Services for your Hydrogen projects

NaTran R&I: AN INTERNATIONAL R&D CENTER FOR GAS INFRASTRUCTURES AND ENERGY TRANSITION

Energy operators, industrialists, equipment manufacturers, technology developers, research organizations: we provide you with tailor-made services to help you to the decarbonization of your activities.

We support you in the development of hydrogen through high value-added expertise and cutting-edge resources located in our Villeneuve-la-Garenne laboratories, our FenHYx platform in Alfortville and our Jupiter 1000 Power-to-gas industrial demonstrator in Fos-sur-Mer.

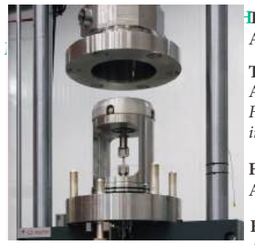
On FENHYX by naTran our R&D platform in Alfortille

naTran R&I

At our other sites in Villeneuve-la-Garenne and Fos-sur-Mer JUPITER1000 by naTran

MECHANICAL CHARACTERIZATION TESTS

UNDER PRESSURE UP TO 100 OF BAR OF HYDROGEN GAS AND MIXTURES



Tensile tests
According to ASTM E8, ISO 6892

Toughness tests
According to ASTM E1820, ISO 12135
For non-standard geometries, external recommendations (DNV, Cravero et Ruggieri, PRCI, etc.) are taken into account.

Fatigue crack growth (FCG) tests
According to ASTM E647

Fatigue tests
According to ISO 1099

STUDY OF CORROSION

ELECTROCHEMICAL AUTOCLAVE

Q Aging of samples under gas loading, electrolytic or electrochemical with or without static stress

Electrochemical operational responses
Corrosion rates, passivation, pitting...

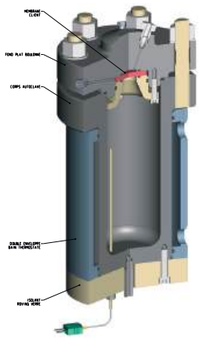
Operational mechanical responses
Qualification of materials, assessment of toughness and threshold stresses under static loading.

Production conditions
Bending, pre-cracked, coated or bare, metallic or polymer samples...
Loading conditions:

- Gaseous, electrolytic or mixed hydrogen
- Pressure: 1 to 100 bar
- Temperature: -20 to 60 °C
- Gas composition: H2-GN mixtures 0 to 100%, trace elements, impurities
- Electrolyte composition: NS4...

PERMEATION CELL

Q **Permeation flux measurements through thin plates and metal coupons**



Material effects
Microstructures and surface conditions

Evaluation of blocking coatings

Loading conditions :

- Pressure: 10, 100 or 200 bar
- Temperature: 0 to 200 °C
- Test gases: hydrogen and mixtures, possibly with trace elements and impurities in the gas matrix...

IMPACT OF HYDROGEN ON EQUIPMENT

PRESSURE TESTING OF EQUIPMENT

H2 ENVIRONMENT with climatic conditioning (-20 °C to 60 °C)

Endurance tests on valves, with cycling and torque measurement torque measurement, temperature gradients...

Measurement of operating characteristics on safety plugs, valves and a wide range of other equipment.

Leak testing by measuring external leaks on equipment (regulators, meters or any other e flanges or mechanical connections...).

Internal leak testing on valves up to DN300

Terms and conditions

- Pressure: 0 to 100 bar
- Temperature: -20 to 60°C
- Gas composition: hydrogen and various mixtures (non-corrosive gases only)
- Static testing

STATIC AGEING IN HYDROGEN ENVIRONMENTS, with periodic monitoring of equipment dynamic performance

Assessing the impact of H2 on equipment operating characteristics

- Static ageing test in presence of hydrogen mixture
- Determination of operating characteristics before and after ageing test (curve performed on dynamic benches with natural gas or air).

Dynamic tests on the Jupiter 1000 site (max flow 200 m3/h H2, up to 70 bar)

INDUSTRIAL SAFETY

Q Industrial safety studies, regulations and technical arguments
Q Theoretical and practical H2 risk awareness training courses

Means of testing

- Mobile in situ thermal radiation measurement and flame characterization equipment.
- Gas dispersion tests (venting of LNG vapors) and gas migration tests in soils

- Network of partner test sites.
- Definition and follow-up of experimental campaigns to characterize hazardous phenomena for gases (natural gas, H2, CO2) and liquefied gases (LPG, LNG).

Simulation capabilities

- Development of PERSEE+ software, the French benchmark for modeling hazardous phenomena on H2, CH4 and LNG (e.g.: estimating hazard distances or ATEX zones).
- 30 years' experience in modeling hazardous phenomena with CFD software (FLACS, KFX).

ENERGY SYSTEM MODELING

Q Development of decision support and simulation tools

for sizing and managing hydrogen networks.

Q Technical and economic optimization

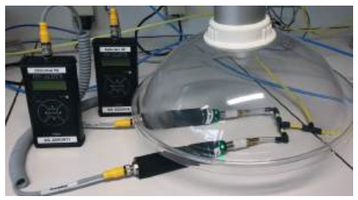
network connections, optimization transmission costs, dynamic network simulations...

GAS DETECTION AND FUGITIVE EMISSIONS

Q Laboratory and on-site evaluation of detectors (under real-life
Q conditions) Testing and qualification of aspiration detectors Testing and
Q qualification of diffusion detectors (fixed or used for personal protection
Q of employees)

Test equipment

- Gas mixer: H2 mixtures in air or H2/GN in air, addition of interferents such as CO2...
- Humidity generation, climatic chamber.
- Gas library of standard mixtures for simulating different gas mixtures.



QUALITY GAS QUALITY

Q Qualification of measuring equipment

gas quality (technologies such as gas chromatography, laser spectrometry, etc.)

Test equipment

- Gas library of standard mixtures for simulating different gas mixtures.
- Climatic chamber to study analyzer behavior in the event of variations in outside temperature.

- A laboratory on Jupiter 1000 enables
- industrial conditions. Hydrogen and syngas analysis.

Terms and conditions

- Implementation of laboratory and field test protocols, followed by statistical studies for precise performance evaluation.

Participation in European projects

EXAMPLE: THE OPTHYCS PROJECT

OPTHYCS

Development of a new sensor technology (fiber optics) to increase the safety level of hydrogen (H2) applications. This sensor technology will be tested in several gas installations (open and closed pipelines, H2 refueling stations (HRS), compressor stations), both with pure H2 and mixed with natural gas.

Funded by the European Union

This project has received investment under the Clean Hydrogen Partnership 2022 program.