

Bureau Veritas



SUMMARY

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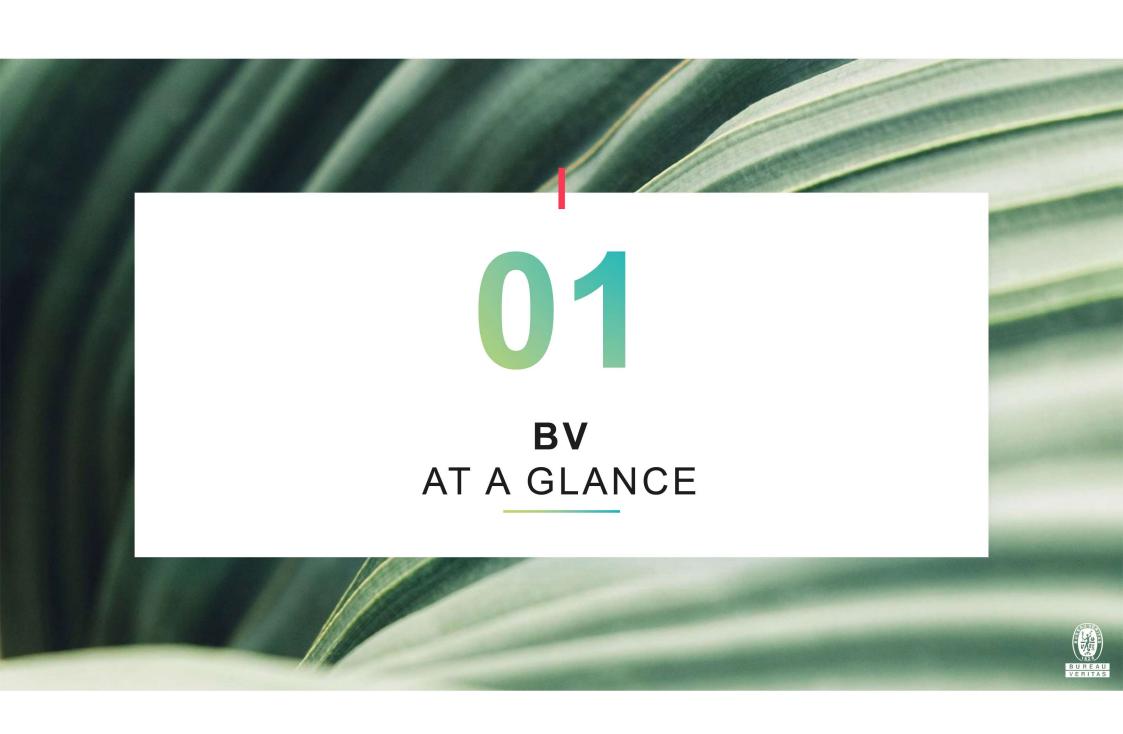
BV AT A GLANCE 02

BV POSITIONING
ON HYDROGEN
& AMMONIA

03

VALUE PROPOSITION









CREATED IN 1828

100+ years in the energy industry



BUSINESS TO BUSINESS TO SOCIETY

Quality, health & safety, environmental protection & social responsibility

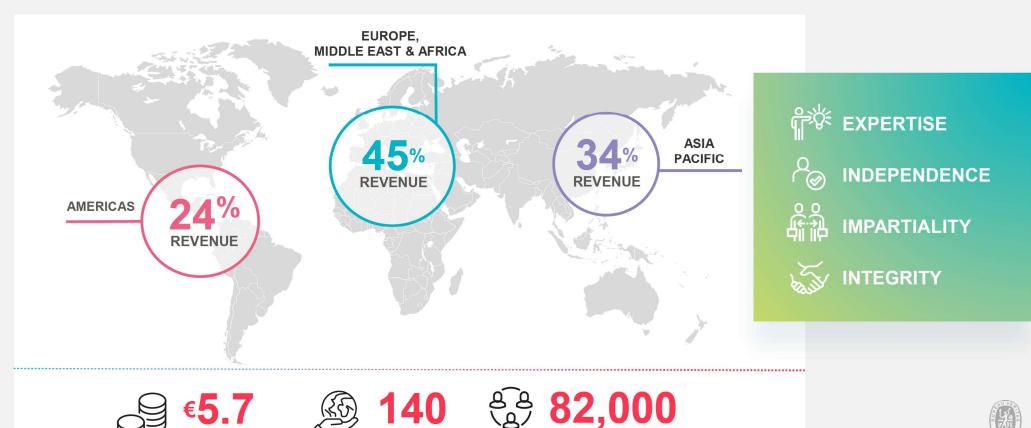


FACT BASED UNDERSTANDING

Testing, inspection, certification & technical services



UNIQUE REACH, UNIQUE SCOPE **UNRIVALLED GLOBAL PRESENCE AND SERVICE PORTFOLIO**

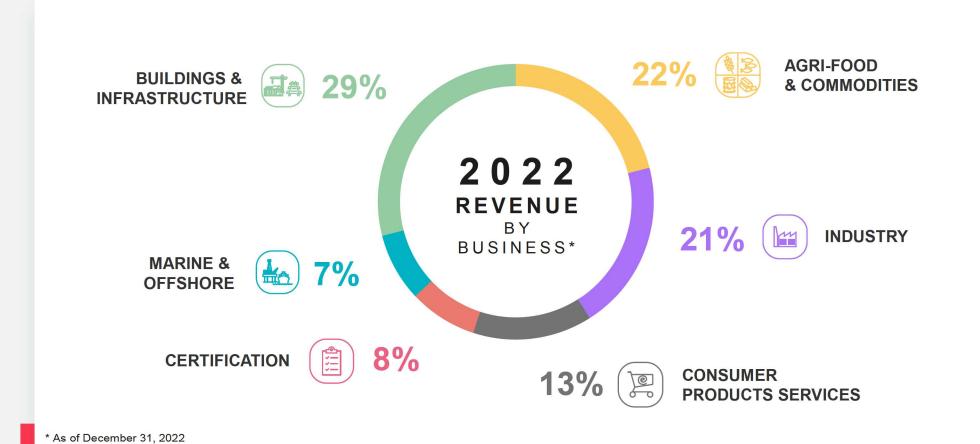














RENEWABLES & HYDROGEN TECHNICAL HUBS



5.7_{bn€ revenue}



140 countries



82,000 employees

BV's Centers of Expertise are under global technical governance and support during local execution of projects



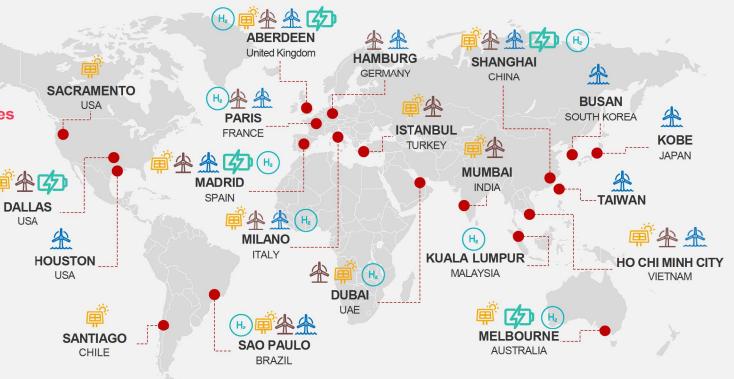








Bureau Veritas' Centres of Expertise







BUREAU VERITAS POSITIONNING ON HYDROGEN: BRINGING TRUST AND TRANSPARENCY

With our long-standing experience in the energy industry, especially in **risk & safety management** and **quality assurance**, our overarching role is to **bring trust** to the hydrogen energy industry.

As an independent third party:

- Certification of assets
- Certification of equipment
- Supply chain quality assurance
- Independent testing and measurement

As a technical expertise provider:

- Owner's engineer
- Technical advisory
- Permitting support
- Risk & safety management



INVOLVEMENT IN THE HYDROGEN ECOSYSTEM: CERTIFICATION OF HYDROGEN PRODUCTION ASSETS

Bureau Veritas has launched voluntary schemes for the certification of HYDROGEN and AMMONIA that brings transparency and assurance that production is SAFE, SUSTAINABLE & RENEWABLE or DECARBONIZED.

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SAFETY

- Compliance with safety standards
- Application of best practices
- Process safety from design until operations

2



SUSTAINABILITY

- Water footprint
- Assessment of sustainability through ESG criteria

3



RENEWABLE INPUT & CARBON INTENSITY

- I 100% renewable power supply
- Overall carbon footprint under 2kg CO₂eq/kg produced H2 0,5kg CO₂eq/kg produced NH3



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A CERTIFICATION PROCESS IN 3 STEPS

BV RENEWABLE H₂ / NH3 CERTIFICATION SCHEME At Design Stage At Operational Stage CERTIFICATE CERTIFICATE Certificate of Conformity 3 years validity period - no surveillance activities -- with annual surveillance audits -LCA LCA Safety Safety **ESG ESG** Asset life cycle – Renewable H₂ / NH3 certificate plant based



Conversion of Renewable Hydrogen to Ammonia is covered with a dedicated Certification & Label scheme using the same process.



INVOLVEMENT IN THE HYDROGEN ECOSYSTEM: CONTRIBUTING TO ESTABLISHING A NEW INDUSTRY

Hydrogen Council

- Bureau Veritas is a member of the Hydrogen Council since 2020.
- I Co-chair of the Certification task team under Sustainability Program



Technical Committee of ISO in charge of all normalisation aspects pertaining to Hydrogen

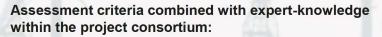
- Part of ISO TC197 WG 34 related to safety requirements for H2.
- Contribution to New revision of ISO 22734 kick off July 2021



PARTNERSHIP - EXPERT-KNOWLEDGE

NORTH SEA ENERGY PROGRAM

- Public-private research consortium; 30+ international parties from the energy value chain launched in 2017
- Investigates the North Sea's potential for a new reliable and affordable energy system after 2030
- At the heart is an integral approach of the energy system and its benefits



- Availability of existing infrastructure
- Expected activities in the field of gas, electricity, hydrogen &CO2
- Data availability
- Potential for international interconnection
- Ecological circumstances
- Landing and market opportunities

BV brings expert-knowledge following working packages

- WP1: North Sea Energy Hubs and transport infrastructure
- WP2: Society, Governance and communication
- **WP3:** Safety, Integrity & Reliability of system integration options
- WP 4 until 7: reviewer







BUREAU VERITAS SERVICES ALONG THE VALUE CHAIN

PRODUCTION

- Risk & Safety Management
- Permitting support
- Construction supervision
- Owner's engineer
- Technical advisory
- Supply chain services
- Asset certification
- Hydrogen Label
- Electrolyzer certification

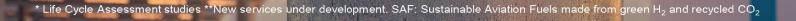
STORAGE & TRANSPORTATION

- Gas/H2 blending feasibility studies
- H2 pipelines technical advisory
- H2 liquefaction
- H2 / H2 derivatives bunkering
- H2 & derivatives powered ship classification
- Certification of onboard energy systems (engines, fuel cells)

END USES

- Refueling stations certification
- Refueling stations other services
- Equipment certification
- H2-readiness certification**
- LCA* review
- Independent quality testing of molecules (hydrogen, SAF**)

Training of operators and new users of hydrogen equipment and assets





NEW SERVICES TO ADDRESS SPECIFIC NEEDS OF THE HYROGEN NASCENT MARKET

BV is a global reference in hydrogen risk & safety management

TRAINING

- As a pressurized gas, hydrogen present risks
- Need for training on hydrogen safety
- BV delivers certifying training

TRACEABILITY

- Hydrogen industry foresees global trading
- Though certification of data, BV is expected to enable traceability of environmental attributes

BV act as an enabler of global hydrogen trading

BV is a reference in safe & sustainable hydrogen production assurance

CERTIFICATION

- Asset certification / Hydrogen Label
- Industrial Equipment Certification
- H2 readiness certification

TESTING

- H2 purity testing*
- H2 derivatives quality testing and control*
- Testing of Equipment

BV is a leader in testing of commodities with 100+ laboratories operated globally

* New services under development.

OUR ADVISORY SERVICES

TECHNICAL ADVISORY





Plans and Roadmaps
Business Case & Financial model
Value Chain Analysis
Risk & Safety Analysis
Project Risk Assessment
Carbon footprint Calculation
Technical & Market Due Diligence
Workshops & Trainings
Troubleshooting Analysis

PM CONSULTANCY





EPC Tender Process

- Preparing Technical Requirements / Performance Tests / Contracts
- Technical-Economic Comparison of EPC Contractors

Reviewing Engineering Design

Reviewing O&M Procedures & Manual

Defining Quality Assurance Plan

Supervising Construction, Commissioning & Acceptance Tests

PROJECT DEVELOPMENT





Pre-feasibility/Feasibility Studies

- Vendor's Assessment
- Cost Estimation
- · Business Model

Permitting

Risk & Safety Assessment

Market and Off-taker Analysis

Regulatory framework and Certification Impact Analysis

Subsidies and Funding Application









BV OFFERING FOR RENEWABLE HYDROGEN ASSETS



Owner's engineer



Risk & Safety Management



Permitting support



Technical Advisory



Supply Chain services



Asset Certification



Asset Performance





SINOPEC



PROJECT

A 300-megawatt photovoltaic and 20,000-ton-per year hydrogen electrolysis plant(52 unit) include Storage tank with capacity of 210,000 cubic meters and pipelines able to transport 28,000 Nm3/h&6 km.

DURATION

LOCATION

2022 - 2024

Xinjuang, China

BUREAU VERITAS ROLE

Bureau Veritas provides:

- Photovoltaic farm project management assistance (PMA)
- Power skid PMA
- Hydrogen plant PMA
- I Hydrogen storage & pipeline PMA





NEOM GREEN HYDROGEN COMPANY



نيوم меом

PROJECT

The NEOM Green Hydrogen Project is the world's largest utility scale, commercially-based hydrogen facility powered entirely by renewable energy.

DURATION

LOCATION

PRODUCTION

2023 - 2028

Saudi Arabia

2,2 GW

BUREAU VERITAS ROLE

Bureau Veritas provides:

- Construction Quality Inspection
- I Quality Assurance/Quality Control
- I Global Vendor Inspection Services





SHELL



PROJECT

Construction of a mega renewable hydrogen plant in Europe powered by offshore wind from the North Sea

DURATION

LOCATION

PRODUCTION

2023 - 2025

Rotterdam, Netherlands

200 MW

BUREAU VERITAS ROLE

Bureau Veritas as the Notified Body of the project provides:

- I Design Review
- I PED Inspections
- Inspection before first use according to local regulations





TECHNIP ENERGIES



PROJECT

Development of an industrial scale hydrogen production facility in Ruwais called "Crystal Project".

DURATION

LOCATION

1 year - 2022

Abu Dhabi, UAE

BUREAU VERITAS ROLE

Bureau Veritas provides:

- I HSEIA screening study,
- Social Risk assessment,
- I Green House gases emission estimation,
- Preliminary HAZOP
- Coarse Quantitative Risk Assessment, and
- Environmental permitting.





DEWA



PROJECT

Green H2 production unit installed in existing facilities based on existing solar park, safe integration of H2 plant onto its landmark plant

DURATION

LOCATION

2019 - 2021

Dubai, UAE

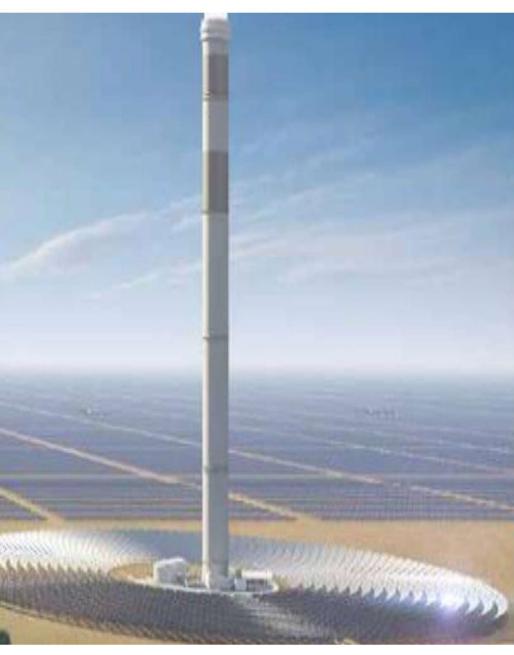
BUREAU VERITAS ROLE

Bureau Veritas provides:

- Advisory towards safe integration of H2 plant in existing large PV power plant park
- ATEX study
- I Hazardous area classification of facility
- Verification of the ATEX conformity of equipment and protective
- Ignition hazard assessment report (IHAR)
- explosion protection document (EPD)
- SIL Assessment & Verification study

I Computational Fluid Dynamics (CFD) Study to determine ventilation /eritas Group Characteristics





DEWA



PROJECT

H2 production and distribution plant (pilot) for industrial vehicles

DURATION

LOCATION

2019 - 2021

Dubai, UAE

BUREAU VERITAS ROLE

Bureau Veritas provides:

- I Initial Design Review:
 - I Evaluation of Location including applicable safety zones/areas report.
 - Risk assessment
 - Gap analysis
- I Detailed Design Review:
- I Detailed HAZOP study and improvement report.
- I Develop framework, regulations for the project

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BV OFFERING FOR HYDROGEN TRANSPORT IN PIPELINES



Material and component suitability assessment



Technical advisory



Feasibility study review



Certification according to existing standards



Leakage measurement and monitoring





NORTHERN OFFSHORE GAS TRANSPORT (NOGAT)



PROJECT

Pipeline system transporting gas produced on Danish, German and Dutch part of the continental shelf. Expert assessment on repurposing 470Km pipeline network for hydrogen transportation.

DURATION

LOCATION

2021-2022

The Netherlands

BUREAU VERITAS ROLE

Evaluate the technical suitability of reversing end-use of existing gas pipelines in North-Sea owned for transporting hydrogen.

- Pipelines of 470 km
- I Repurposing for hydrogen transport
- I Technical suitability assessment





SOCIETÀ GASDOTTI ITALIA



PROJECT

Impact assessment of the use of hydrogen (pure or in blending with natural gas) on existing industrial manufacturing plants,

DURATION

LOCATION

Q1 2021 - Q1 2022

Italy

BUREAU VERITAS ROLE

Bureau Veritas provided, for four different plants the following:

- I verification of the possibility of burning hydrogen in already installed equipment (according to 4 different gas compositions)
- I calculation of the reduction of CO2 emitted according to the 4 scenarios
- I definition of any changes to be made to the burners impact verification according to applicable regulations
- I qualitative cost-benefit analysis





REDE ELECTRICA NATIONAL (REN)

PROJECT

Technical suitability and certification of conformity for hydrogen injection into gas grid.

DURATION

LOCATION

Sept 2022- Sept 2024

Portugal

BUREAU VERITAS ROLE

3rd independent certification entity, to ensure the proper adequacy of the transmission grid, (84 bar), underground storage facilities, and distribution pressure (20 bar), on national natural gas assets, holding a blending of H2 (from 10%, 20%, and 100% as a milestones), thus delivering the certificate of conformity.

- I Blending of hydrogen from 10% to 100%
- I Transmission and distribution grids
- I Delivery of the certificate of conformity





BV OFFERING FOR HYDROGEN REFUELING STATIONS



Commissioning services (FAT, SAT, commissioning procedures)



Certification of complete assets or individual components



Risk and safety management



Training of operators and end-users



Conversion of bus/trucks depot to hydrogen





CHN ENERGY



PROJECT

2*2.5MW green hydrogen electrolysis plant and filling station in Chongli and Hydrogen refueling station combined with gas station in Baicity.

DURATION

LOCATION

2021 - 2022

Hebei, China

BUREAU VERITAS ROLE

Bureau Veritas provides:

- I HAZOP study for Green Hydrogen electrolysis Unit
- I Quality Inspection for ALK Hydrogen Production Unit
- I QA/QC for electrolysis and HRS station.
- I Commissioning support.





ENGIE



PROJECT

20 distribution stations, powered by 15 electrolysers.

DURATION

LOCATION

2022

France

BUREAU VERITAS ROLE

Bureau Veritas provides:

- ATEX studies on some stations (Chambery) for 2 months. Acceptance audits were provided of these distribution stations (FAT/SAT/Inspections) to ensure the safety of these installations for the first 5 stations with possibility to continue for other stations.
- Provision Deg 360 risk safety assessment and studies concluded with Remedial measures to minimize/eliminate the ignition risk & employer compliance requirements of ATEX workplace directive 1999/982/CE.



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MCPHY

McPhy

PROJECT

High capacity and high pressure (700 bars) H2 refueling stations (McFilling)

DURATION

LOCATION

2021-2022

Europe

BUREAU VERITAS ROLE

Bureau Veritas provides:

- I Risk assessment for high capacity and pressure H2 refueling stations
- I HAZOP sessions to identify systematically all process hazards and related safety functions
- I CE compliance covering Machinery Directive, Pressure Equipment Directive and ATEX Directive
- Modelling of explosion overpressure and heat radiation from fire in case of accidental hazard





BV OFFERING FOR EQUIPMENT CERTIFICATION



Technical due dilligence



Certification of electrolysers according to ISO 22734 (including performance test)



CE marking



Certification of conformity to ASME, Australian Standards





ALSTOM



PROJECT

Hydrogen train regulatory submission and Assessment Body (AsBo)

DURATION

LOCATION

3 years

France

BUREAU VERITAS ROLE

To ensure the safety of the modification, Alstom has commissioned the AsBo (Assessor Body) to assess the impact of the modification of the vehicle to a hydrogen vehicle.

BV is accompanying the project from 2022 to 2025 on the modification of the Hydrogen train as an Independent Safety Assessor (ISA)

Bureau Veritas was also involved to carry out a regulatory assessment to identify the European directives applicable to the project.





PERIC



PROJECT

Certification for different capacity electrolysis unit export Europe and Australia

DURATION

LOCATION

2021 – on going

Hebei, China

BUREAU VERITAS ROLE

Bureau Veritas provides:

- CE-PED Pressure Vessel Directive Certification
- I CE-MD Machinery Directive Certification
- I CE-LVD Low Voltage Directive Certification
- I CE-EMC Electro Magnetic Compatibility Directive Certification
- I ATEX Explosive Atmosphere Directive Certification
- AS certification
- ASME certification



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SUNGORW



PROJECT

5MW eletrolysis units production certification

DURATION

LOCATION

2022

Anhui, China

BUREAU VERITAS ROLE

Bureau Veritas provides:

- Testing of current density
- Capability test
- Static testing
- Hydrogen purity testing
- Consumption testing
- Leakage testing
- Pressure testing



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BV OFFERING FOR HYDROGEN & DERIVATIVES CARGO



Hydrogen liquefaction (licensing and permitting)



LH2 loading/offloading



Ammonia loading/offloading

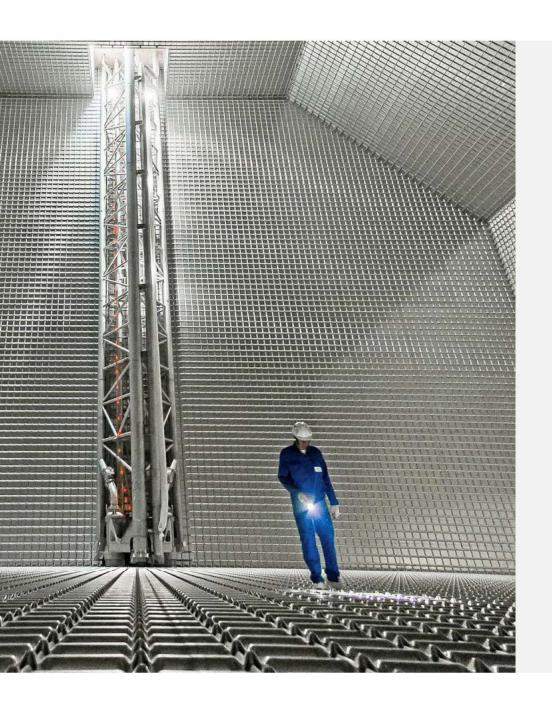


Methanol loading/offloading



Synthetic fuels (e-methane, e-jetfuel) cargo





TOTALENERGIES & GTT





PROJECT

Joint Development Project to develop a 150,000+ m³ capacity LH₂ carrier concept design

DURATION

LOCATION

2023

France

BUREAU VERITAS ROLE

- Derisk Study
- I Design review in accordance with the latest regulatory requirements and will ensure it meets BV's rules with the goal to deliver an Approval in Principle





BV OFFERING FOR HYDROGEN & DERIVATIVES AS LOW CARBON FUEL FOR MARITIME



Use of ammonia / methanol as a fuel in ships transporting ammonia

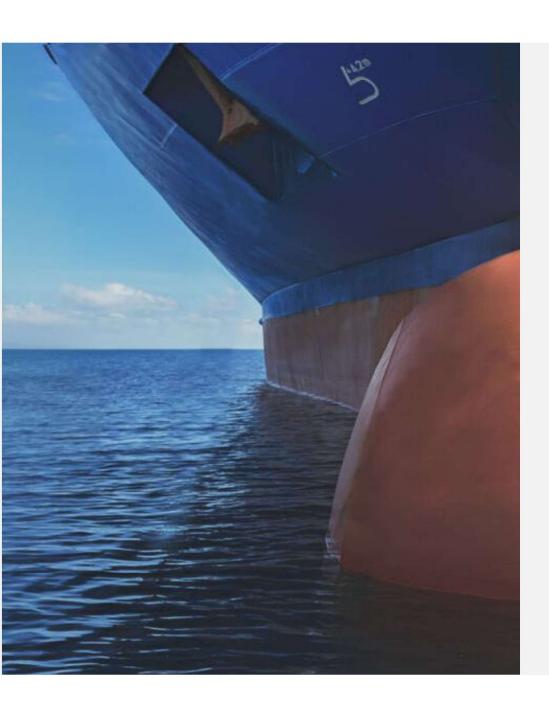


Classification of low-carbonfuel-powered ships



Certification of onboard energy & supply systems (fuel cells, engines)





NAFTOMAR



PROJECT

Classification of world's largest order for ammonia fueled carriers with the production of four 93,000 m³ ammonia fueled vessels

DURATION

LOCATION

2023 - 2027

South Korea

BUREAU VERITAS ROLE

- I Classification of the LPG Tanker
- Design Review
- Risk Assessment





VIRIDIS BULK CARRIERS



PROJECT

Issuing of Approval in Principle for project of new standard for zero carbon short sea bulk logistics by using Ammonia as fuel

DURATION

LOCATION

2023

Farsund, Norway

BUREAU VERITAS ROLE

- I Approval in Principle of the design
- Design Review
- Risk assessment





CMA CGM



PROJECT

Classification of new 15,600 TEU dual fuel engines Containership using emethanol and/or methanol as fuel

DURATION

LOCATION

2023

France

BUREAU VERITAS ROLE

- I Classification of the Container ship
- I Design review
- I Risk assessment



OTHER REFERENCES IN HYDROGEN SERVICES



LCA* & CARBON FOOTPRINT CALCULATION OR REVIEW









GLOBAL EPC GROUP

PROJECT

Creation of a new company through a joint-venture with an alkaline electrolysis manufacturer based in Europe and China.

DURATION

LOCATION

2023 / 6 weeks

Europe

BUREAU VERITAS ROLE

- I Technical Due Diligence, including
 - I Document review
 - I Site audits
 - I Interviews of management and technical teams





YARA

PROJECT

Certification of Yara Pilbara green ammonia production plant according to Smart Energy Council rules.

DURATION

LOCATION

Q3 2022

Western Australia

BUREAU VERITAS ROLE

Assessment and verification of the carbon footprint calculation of Pilbara green ammonia production plant and delivery of the certification

- First green ammonia plant in Australia, powered by renewable energy
- I Certificate delivery according to Smart Energy Council methodology





ENGIE



PROJECT

Masshylia is the 1st large-scale initiative to decarbonize hydrogen used in industrial processes.

DURATION

LOCATION

2019 - 2021

France

BUREAU VERITAS ROLE

- I Firefighters' Officer School and Bureau Veritas have created a training course on hydrogen risk.
- BV is co-leading this training with the 3 other actors; registration through BV website. The first session: 30 participants.
- Ad hoc association with dedicated school in order to create an educational track & teach specific sessions on "first of a kind" large scale asset.





RAFFINERIA DI VENEZIA



PROJECT

Firing tests on 5 different process streams containing hydrogen in order to verify, for different light conditions, the flame visibility in case of accident

DURATION

LOCATION

2 months - 2021

Italy

BUREAU VERITAS ROLE

- Drafting of fire tests procedure
- Gas preparation
- I Fire tests execution
- I Fire tests registration and measurements
- Final test report





Shaping a World of Trust







