Product Definition

Hydrogen can be used in many different sectors, ranging from laboratories to transportation, from nuclear cooling to feedstock for chemical industry. Hydrogen provides a means to efficiently store large quantities of energy for extended periods of time. Furthermore, hydrogen can be transported and distributed using existing infrastructure. Highly efficient and meeting the international (safety) standards, the Frames Electrolyzer System delivers a robust, cost-effective, and turn-key solution to generate hydrogen from electricity and water for any environment, onshore and offshore.

Product Description

The Frames Megawatt (MW) Electrolyzer System is integrated in a standard shipping container that is easy to install with a minimum of on-site activities.

Deminerlalized water generation section
The electrolyzer stacks within the system require a feed of ultra-pure water that is partially consumed and converted into hydrogen and oxygen in the process. In order to allow for autonomous and continuous use of the system, the package is equipped with a deminerlalized water generation section to produce deminerlalized water from tap water.

Anode/water conditioning section
The purpose of the water conditioning and anode section is to provide the electrolysis stacks with the required amount of deminerlalized water, and to degas the produced oxygen from the return flow in the buffer/degassing tank.

H₂ generation section
In collaboration with technology partners, Frames is able to offer one of the largest commercially proven stacks currently on the market. The megawatt scale stack has the best-in-class price-performance in the production range from 30 Nm³/h to 400 Nm³/h within an extremely compact single assembly.

H₂ conditioning section
The hydrogen produced by the electrolysis stacks will contain both liquid water and water vapor. The hydrogen dew pointing section is designed to remove moisture and upgrade the produced hydrogen to a purity of 5.5, which is an equivalent gas purity of 99.9995%. To meet the purity requirements, oxygen is removed in a catalytic reactor, and hydrogen is dried using a molecular sieve. To run the unit continuously, the molecular sieve vessels are installed in duplex configuration (duty/regeneration). One vessel is in operation while the other one is being regenerated.

H₂ storage section
The system can be supplied with an optional storage section to allow produced hydrogen to be stored through compression, liquefaction or via liquid organic hydrogen carrier (LOHC).
## Technical Details

<table>
<thead>
<tr>
<th></th>
<th>1 MW</th>
<th>2 MW</th>
<th>5 MW</th>
<th>10 MW</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Operating Pressure</strong></td>
<td>0 - 40 bar(g)</td>
<td></td>
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<tr>
<td><strong>Nominal Hydrogen Flow</strong></td>
<td>0 - 210 Nm³/h at rated capacity (19 kg/h, 450 kg/day)</td>
<td>0 - 420 Nm³/h at rated capacity (38 kg/h, 900 kg/day)</td>
<td>0 - 1050 Nm³/h at rated capacity (95 kg/h, 2250 kg/day)</td>
<td>0 - 2100 Nm³/h at rated capacity (190 kg/h, 4500 kg/day)</td>
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<tr>
<td><strong>System Efficiency</strong></td>
<td></td>
<td></td>
<td>75% at rated capacity based on higher heating value</td>
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<tr>
<td><strong>Hydrogen Purity</strong></td>
<td>Up to 5.5 (99,9995%); Atmospheric water dew point: -70°C</td>
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<tr>
<td><strong>Electrical input</strong></td>
<td>3x380-480 VAC / 50/60 Hz / 1200 kVA</td>
<td>3x380-480 VAC / 50/60 Hz / 2400 kVA</td>
<td>3x380-480 VAC / 50/60 Hz / 6 MVA</td>
<td>3x380-480 VAC / 50/60 Hz / 12 MVA</td>
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<tr>
<td><strong>Water Consumption</strong></td>
<td>200 L/h</td>
<td>400 L/h</td>
<td>1000 L/h</td>
<td>2000 L/h</td>
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<tr>
<td>- Ultra pure water generation system / Typical feed water quality is tap water</td>
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<tr>
<td><strong>Installation Area</strong></td>
<td>Outdoor (onshore/offshore) in safe area</td>
<td></td>
<td></td>
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<tr>
<td><strong>Operating Temperature</strong></td>
<td>-20°C to +40°C (extended range on request)</td>
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<tr>
<td><strong>Dimensions Package</strong></td>
<td>6.09m x 2.44m x 2.80m (+1.40m with dry cooler) - standard 20 ft. container</td>
<td>12.19m x 2.44m x 2.80m (+1.40m with dry cooler) - standard shipping container(s)</td>
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Project Management

At Frames, we know that precise project management is only the starting point for completing complex projects in the international energy industry. Our clients can rely on sharp thinking and a deep understanding of their operating conditions to find the best solution. Our quality management system focuses on a process of continuous improvement, and our team is always looking for new solutions that improve productivity, cut operating costs, and give our clients a competitive edge.

In a challenging industry, we understand that safety is a priority. We also know that in order to deliver maximum value to our clients we must complete each project on schedule, on spec and within budget.

At Frames, our close-knit team of engineering experts is open, honest, and focused on delivering you the best possible solutions. We are passionate about the international energy industry, and have been a leading provider of safe, high-productivity systems for more than 30 years.

Added Value

- In-house engineering
- Standardized or customized offerings
- Rapid deployment
- Purity hydrogen up to 99.9995%
- Global services
- European fabrication capabilities
- Proven technology
- Worldwide certification
Frames Family Tree

Onshore

Renewables

Offshore

Flow Control & Safeguarding

Floaters

Oil

Water

Gas

Wellsite Packages

- Production Wellsite Skid
- Water Injection Skid

Safety Instrumented Systems

- High Integrity Protection System (HIPS)
- Buoy Telemetry
- Tank Farm Control & Safeguarding

Chemical Injection

- Chemical & Methanol Injection System
- Chemical Distribution System

Hydraulic Systems

- Wellhead Control
- Subsea Hydraulic Power Unit
- Hydraulic Power Unit
- IWOCs (Intervention Workover Control System)
- TUTU (Topside Umbilical Termination Unit)
- Cargo Ballasting System

Valve Automation Center

- Actuator and Actuated Valve Package
- Control System

Services

- Asset Life Cycle Management
- Maintenance & Field Services
- Commissioning & Start-up
- Spare Parts
- Operator Training

Bulk Separation

- 2/3 phase Production Separator
- Degasser
- Slug Catcher
- Test Separator
- Separation Internals

Deoiling

- Hydrocyclones
- Plate Coalescer
- Filter Coalescer
- Gas Floation Unit (Compact & Multi-cell)
- Nutshell Filter

Separation

- Demister
- Scrubber
- Filter

Sweetening (H₂S & CO₂)

- Amine
- Thiopaq O&G
- Solid Bed Scavenger
- CO₂ Membrane
- Molecular Sieve

Dehydration

- Glycol (TEG)
- Molecular Sieve

Dew Point Control

- Low Temperature Separation (LTS)
- Solid Desiccant

Hydrate Inhibition

- MEC/DEG Recovery
- Methanol Recovery
- MEG/DEG Desalination

Light Hydrocarbon Recovery

- Condensate Stabilization
- Fractionation

Flare Gas Recovery

Biogas Upgrading

- Green Gas Installations (GGI)
- Combined Heat and Power (CHP)
- Compressed Biomethane (CBM)
- Liquefied Biomethane (LBM)

Synthesis Gas Upgrading (CO₂, H₂S, VOC, NH₃ & H₂O)

- Hybrisol®
- Laminol®
- Galloxol®
- Terpene (VOC) Removal
- Ammonia Scrubber
- Hydrogen Separation
- Metering & Odorizing
- N₂-injection & LPG-addition
- Liquefied CO₂

CO₂ Capture

- Industrial Capture and Application of CO₂
- Carbon Capture and Storage (CCS)
- Bio-CO₂ for Horticulture

Hydrogen

- Electrolyser
- Fuel Cells
- Purification
- Liquid Organic Hydrogen Carrier (LOHC)
- Compression
- Liquefaction
- Green Hydrogen
- Process Integration

Off-grid Power Solutions

- Hybrid Energy Module
- Standalone Solar Solution

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05-2018