

Innovation with High Pressure

In Resato Hydrogen Technology's modular hydrogen refueling stations, Turck's IP67 ATEX I/O modules guarantee scalability and fast commissioning

If this hydrogen filling station is to be extended by additional dispensers, further buffer storage tanks can be added relatively easily

Hydrogen will play an important role as an energy carrier in the future. Buses and trucks in particular will increasingly run on hydrogen. And hydrogen also seems to be establishing itself as an energy carrier for passenger cars in the long term. One of the companies profiting from this trend with its hydrogen filling stations is Resato Hydrogen Technology B.V. from Assen in the Netherlands. The core of the company's innovation lies in high-pressure technology. In the niche market of waterjet cutting, Resato had made a name for itself since the early 1990s. Since 2018, the

engineers have also been applying this know-how to the development and construction of hydrogen refueling stations. The company has already produced and commissioned more than 45 hydrogen refueling stations in Europe, nine of them in the Netherlands.

Two pressure levels for trucks and cars

Hydrogen refueling stations can obtain their fuel in two ways, either through an electrolyzer, which uses electric current to cause a chemical reaction that separates water into hydrogen and oxygen, or through



»Resato's ambition is to be the global technology leader in the field of hydrogen refueling stations. For this, we need partners like Turck.«

Niels de Jong | Resato Hydrogen Technology



hydrogen tankers called tube trailers. The hydrogen from the tube trailer is compressed to 350 bar in three stages and cooled down. It is then stored in buffer tanks for refueling trucks or, in a fourth compression stage, compressed to 700 bar and stored in a separate buffer. Due to the precooling of hydrogen cars can be refueled much more quickly via 700-bar pumps.

A hydrogen filling station is therefore much more complex than a filling station for carbon-based fuels. The system must bring the hydrogen to the necessary pressure in a series of cooling and compression steps. Since greater pressure leads to increased temperatures, the hydrogen must also be repeatedly cooled down.

Hydrogen requires explosion protection concept

The complexity of the refueling systems lies in the control system. Resato developed a patented algorithm that realizes the fastest possible refueling depending on temperature and pressure. At the I/O level, explosive hydrogen poses a challenge to the automation concept. It requires an explosion protection concept and products with the appropriate approvals. In addition, the system must be low-maintenance to the maximum extent possible, since no personnel are on site to make any adjustments. The signals to be processed are mainly temperature and pressure signals as well as switching signals from control valves. In addition, there are safety-related signals from valves, emergency stop buttons and other safety sensors.

In the first version, the manufacturer still wired its refueling systems with passive I/O technology. The sensor and actuator signals were routed to passive distributors at the buffer tank and from there to the controller via multicore lines. Although this solution



QUICK READ

Companies investing in hydrogen infrastructure today place a lot of importance on the scalability of a system in order to be able to respond flexibly to future market requirements. This is precisely why the Dutch hydrogen filling station manufacturer Resato Hydrogen Technology B.V. relies on Turck's decentralized IP67 I/O module concept. It is the only one on the market that offers a comprehensive solution for modular systems, even in hazardous areas - and for all signal types including safety.



The buffer storage tanks hold the hydrogen ready for refueling at 350 bar (truck) or 700 bar (car)

worked reliably, it was not very flexible if the system was to be expanded to include additional buffer storage tanks. “Electrotechnically, it was very complex to add a unit. We also had to completely rework the software. So we decided to divide the whole system into modules so that we could control each module individually,” says Remco Lagendijk, Electrical and Instrumentation Engineer at Resato, explaining the start of the modular filling station concept.

Modularization for more flexibility

The second generation of Resato hydrogen filling stations is modular. Buffer storage, compressors and cooling units can thus be added and combined

should also have approval for ATEX zone 2 and also be suitable for connecting intrinsically safe signals from zones 1 and 0.

The search for an automation partner who could also support this decentralized concept in the Ex area also led the Resato team to the Hannover Messe. The engineers were presented with many IP67 IO solutions at the booths. But when asked about IP67 with ATEX approval, many suppliers had to pass. “Except for Turck. They were able to offer us different solutions for IP67 in ATEX zones. We understood that Turck is familiar with this and also already has corresponding components on the market,” Lagendijk reports about the search for a decentralized I/O solution.



»Turck was able to offer us different solutions for IP67 in ATEX zones. At the customer’s site, we then only have to connect the power and data lines. This saves a couple of days of the commissioning time for the electrical work.«

Remco Lagendijk | Resato Hydrogen Technology

flexibly. To make it easier to add aggregates, all signals on each aggregate must converge in one data line. The buffer storage units therefore require an I/O solution with Industrial Ethernet, or more precisely Profinet. Since Resato wanted to save on protective housings and the mechanical effort involved, the experts looked for I/O modules with IP67 protection, which are temperature-resistant and suitable for outdoor use. Up to that point, the requirements profile would not make any automation engineer sweat. However, the modules

Intensive consulting during concept development

As a result, Resato worked with Turck experts to develop a decentralized I/O concept for its buffer storage units. “The support was really good. We weren’t handed a few products and told ‘Good luck with that,’ but we had an intensive exchange about the products and thought through different possibilities. Turck even recommended the exact cable types with the right lengths for us,” explains Niels de Jong, research and development engineer. “Resato’s ambition is to be

the global technology leader in the field of hydrogen refueling stations. For this, we need partners like Turck. The I/O concept was implemented completely decentralized - including the intrinsically safe sensor signals from ATEX zones 0 and 1. With the devices of the IMC family, Turck offers special interface modules in IP67. They are connected between the Ex sensor (or actuator) and the I/O device, safely isolate the circuits and transform the signal currents. Even the safety-related signals are decentralized to the IP67 I/O module TBPN, which communicates with the safety controller via Profisafe protocol.

Modular concept facilitates offline testing and shortens commissioning time

“One of the advantages why we chose the Turck solution is the possibilities for offline testing” explains Lagendijk. “Previously, we had to test at our production site, then we dismantled everything and rewired everything again on site at the customer. Then, of course, we had to test again whether all inputs and outputs were connected correctly. Today, we test the systems on our premises and leave all the connectors connected to the remote I/O modules. At the customer’s site, we then only have to connect the power and data lines. This saves a couple of days of the commissioning time for the electrical work and can be done with fewer electrical engineers.”

Remco Lagendijk emphasizes this advantage of the modular concept: “Commissioning is a very critical phase. If errors occur here, it usually takes much longer to fix them than in production. This is because all the experts, the right tools and even necessary spare parts are at hand in the company’s own production, but not at the customer’s site.”

Consistently modular - optimally scalable

Resato has thought the modular concept through to the end. Remco Lagendijk and his colleagues from software development have also made the control software modular. This means that a module can be added to the control software without having to rewrite the entire code. “It’s almost like copy-and-paste,” says Lagendijk. Thanks to the consistently modular concept, Resato’s hydrogen fueling stations are now conceivably easy to scale. “If the customer wants to expand their storage and needs more buffer storage, that’s not a problem for us - especially from the electrotechnical and control side, it’s very easy,” adds Niels de Jong.

Next step: series production

Demand for the hydrogen filling stations is rising continuously. It can be assumed that Resato will successively switch its production from project organization to series production in the near future - at least partially. With the modular filling station concept and the modular I/O architecture, Resato is optimally prepared for this. The concept enables series production. The individual modules, such as compressors or buffer storage units, can be pre-produced in stock and then assembled to meet specific customer requirements. These economies of scale will also reduce the costs and time-to-market of hydrogen filling stations.

Author | Herjan Grootens is project manager automation at Turck B.V. in the Netherlands
Customer | resato-hydrogen.com
Webcode | more22355e

Missing link: Thanks to the IMC interface devices in IP67, Ex sensors can also be connected safely to the I/O modules in zone 2 without the need for a control cabinet



With the TB-SG stainless steel protective housings, almost all TBN I/O modules are also approved for use in ATEX zone 2

