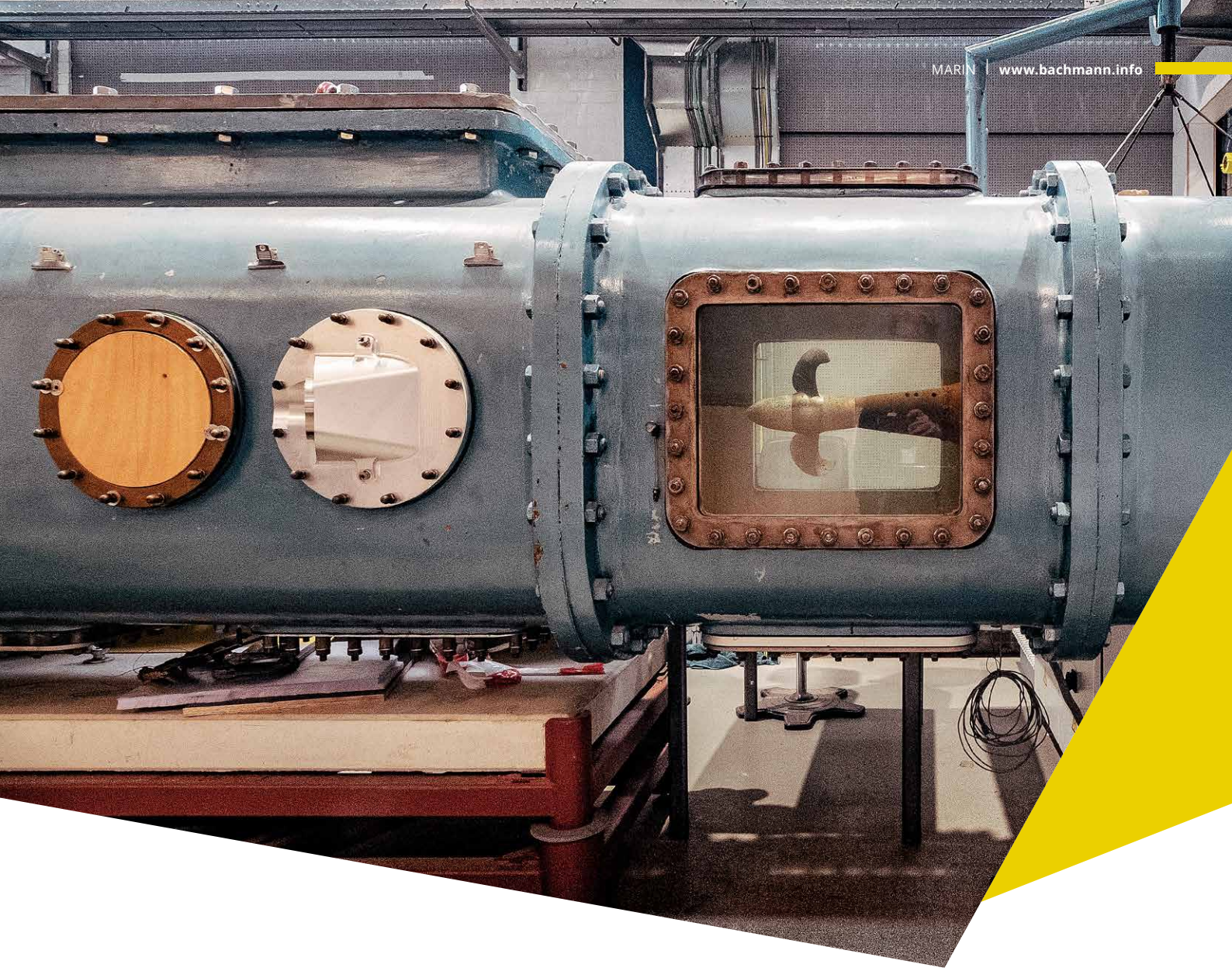
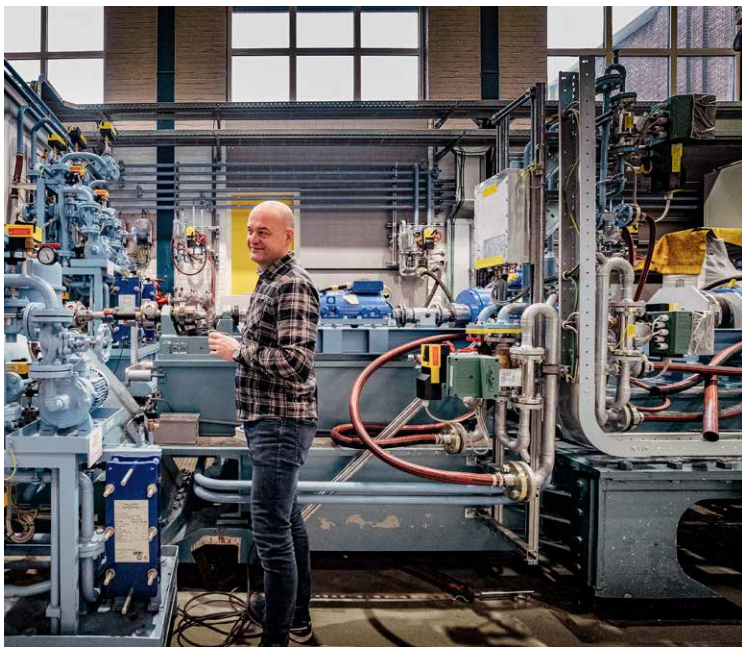


Outwitting technical limits

Designing the blueprint for MARIN's Zero Emissions Lab

In 2017, the Maritime Research Institute Nederland (MARIN) started researching the concept of a Zero Emissions Lab (ZEL), a facility to configure and test the propulsion performance of climate neutral or zero emission ships. This 'engine room of the future', which combines power components such as batteries, super capacitors, fuel cells and internal combustion engines with a propeller in a cavitation tunnel, is now becoming a reality.

(left) Rob van Rooijen – Sr. Lead Engineer at Raster Industrial Automation, (middle) Hans Bruisten – Zero Emissions Lab Operator and Maintenance Engineer at Marin, (right) Jeroen Willemsen – Design and Test Engineer at Marin



Jeroen Willemsen with in the background the drive line of the Zero Emissions Lab

Balancing flexibility and safety

To make the ZEL a reality, MARIN paired up the maritime automation experts at Bachmann electronic with system integrator Raster, an ICT Group company that specializes in high-end, functional safety systems and sophisticated production and process automation. Both parties were up to the challenge.

“MARIN knew what they wanted the ZEL to be capable of now, but weren’t sure what the requirements might be in five years,” says Rob van Rooijen, Architect at Raster. “So, flexibility and future viability were key demands from the get-go.”

In this golden age of automation, the possibilities often seem unlimited. Yet translating your automation-related needs and wants into technically feasible, future-proof solutions can be difficult. After all, there are always limits – both technical, and in terms of safety.

In the ZEL case, the design process was even more difficult, because it had never been done before. There were no examples to draw conclusions from.

“Luckily, Raster is great at inventing the wheel – any wheel,” states Joeri ten Napel, Key Account Manager at Bachmann electronic. “It’s a group of specialists, that thrive designing one-offs.”

First, Raster helped MARIN define the framework safety conditions that needed to be laid down in the software. MARIN opted for a modelling tool named Capella: an open-source solution for model-based systems engineering (MBSE).

Software as a flexible energy source

The system that Raster designed for the ZEL, consists of three main sections.

- The first section is the shaft line. Two motors on the shaft line power a propeller in a cavitation tunnel.
- The second is a 700 Volt DC-bus, a direct current voltage bus that distributes power from sources to consumers. All kinds of power sources can be
- connected to the DC-bus: batteries, generators on methanol or other fuels, a super capacitor, and a fuel cell.
- The third is the utilities section; the systems that are required to keep the entire ZEL up and running. Things like water cooling for motors on the shaft line and systems connected to the 700-Volt DC-bus, for example, the converter and transformer for the 400-V-AC power supply.

There isn’t much physical room for additional hardware – say, a second generator set – in the lab. In order to

guarantee flexibility for future test configurations despite the physical lack of space, MARIN asked for two software controlled generic systems on the 700 Volt DC-bus that can be modelled as an additional battery, or an additional engine. “MARIN can load models into these systems that have the characteristics of such devices. This provides the flexibility in energy sources for the DC-bus that MARIN requires,” explains Mr van Rooijen.

»The biggest challenge for companies like ours is the amount of time it takes to customize automation systems.«

Martijn Kooij
Managing Director at Raster

Creative encounters

In their design, Raster uses an extensive cross section of Bachmann’s product range and the possibilities that their plc’s provide. The ZEL communicates with seven plc’s in its current setup; a number that will more than double in the future. A redundant set will be added, as well as safety communication on safety plc’s.

Making all of these systems match and function as a whole, was a massive challenge. “Raster did a tremendous job in creating the flexibility that MARIN wanted within an architectural shell that guarantees both machine and process safety,” says Mr ten Napel.

During the designing process, Raster and MARIN encountered various technical boundaries, and tackled them together. Martijn Kooij, Managing Director at Raster: “We get together with MARIN to keep the project progress aligned two, three times a week. They even have personnel working from our office on a regular basis, and vice versa! That is pretty unique, in my experience.”

Project meeting at Marin's Zero Emisions Lab: Exchange between project partners (from left: Martijn Kooij (Raster Industrial Automation), Joeri ten Napel (Bachmann electronic), Rob van Rooijen (Raster Industrial Automation).

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The control system installation of the ZEL consisted of several cabinets. The switch cabinets are assembled in Raster's workshop factory located in Dreumel, Netherlands.

A board group has also been formed on project management level, that gets together on a regular basis to discuss the general status of the project and tackle potential issues.

Complementary partners

The partnership between Raster and Bachmann also grew strong. “Raster’s line of work really is complementary to ours, due to their qualifications and expertise in safety,” Mr ten Napel states. “There is a lot of expensive equipment in the ZEL, so you really want to prevent those machines from being damaged by a faulty test configuration.”

“Bachmann proved to be an excellent partner during this project,” adds Mr Kooij. “During the starting phase, they provided us with product training sessions and lots of support, which helped us determine what adjustments were required to improve the setup’s technical feasibility.”

By the end of 2022, the construction of the control panels and software components of the utilities section had been completed. The next phase of the project is connecting two of the three motors that are connected to the propeller in the cavitation tunnel. The first cavitation tunnel tests are already scheduled in May 2023. In the meantime, Raster continues working on the engine room of the future - at least for another six months. “The biggest challenge for companies like ours is the amount of time it takes to customize automation systems,” concludes Mr Kooij. “We start by taking stock of our customers’ needs and wants, in order to create a blueprint of their ideal system. We make sure it’s modular, scalable, and repeatable. For some companies, a general and generic solution based on standard functionality suffices. Raster serves the ones that do need tailor-made solutions with specialized functionalities. That kind of customization is what sets us apart.”

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Highlights in the Maritime Sector

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