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DEEP DIVE: Power challenges of a multi-purpose net zero vessel

By Stevie Knight 19/12/2024

Subsea vessel *REM Pioneer* is being built to cover a broad range of subsea construction, from traditional energy to wind activities with a net zero operation.

But the sheer variety of operations has a fundamental impact on how the power is handled.

The 117m long, 23m beam of the ST245-based design yields a big 1,400m2 working deck and is designed for multiple duties, says Kristian Stavset, project head of Norwegian offshore services company REM Offshore.

Source: Skipsteknisk

The ST245 *REM Pioneer* will have dual-fuel methanol gensets working in combination with battery packs on a DC bus.

He itemises a comprehensive list: "ROV subsea and recycling works, IMR crane operations, trenching, offshore wind construction and commissioning, and also walk to work operations." That means a 250t, active-heave compensated crane with around 3km of wire and a motion-compensated access gangway, along with other kit.

The vessel also has a high DP capability, so the Brunvoll thruster package consists of two, 3MW main propulsion units, plus a bow-mounted 1.8MW tunnel thruster and two 1.5MW retractables - one also capable of 'tunnel thruster' operation.

On top of that, energy conservation will require absorbing up to 2MW of regenerated power from the lifting gear.

Shifting demand

All this brings with it a very labile, shifting demand that required a "change of mindset", says Bengt Olave Berntsen, CEO of independent electrical system integrator HPS.

He admits that HPS originally began thinking about AC distribution, using variable speed drives for both propulsion and cranes with energy storage – batteries – on a DC spur off the main bus. But a look at the specs made them reconsider.

Centrally, REM Offshore wanted a multi-role subsea construction vessel able to operate across various sectors, including recycling and offshore wind. And each has different demands, often using different equipment.

"Of course, when we understood that REM Offshore's plan was to use the vessel across a very wide spread of conditions – high loads, low loads and the very dynamic loads coming from active heave compensation – we changed our minds," says Berntsen.

HPS proposed a DC bus distribution.

"It's actually not a big change in equipment. But the integration method is very different," he says.

As Asbjorn Halsebakke, senior manager of Marine Concepts for Finnish power electronics firm The Switch, explains, this allows a fundamentally different take on the challenges.

For example, the vessel's total installed combustion power comes to 9.2MW, from three different gensets.

These aren't all the same type, Halsebakke points out: while those on the starboard and port sides are 3.5MW medium speed, dual-fuel bio-diesel-biomethanol engines, the slightly smaller one is a high-speed 2.2MW unit. And they should all be set up for variable speed operation.

But that requires a DC bus: an AC distribution requires a fixed frequency output to get its three phases to weave together. In contrast, DC means you can run the engines at whatever speed you like – it's brought back to AC for the consumers.

"Variable-speed operation means you get more from the conversion between fuel and electric power – how many cubics of liquid or gas you're using compared to how many kilowatts you get out," says Halsebakke.

Battery installation

So while fixed-rpm gensets may be efficient at high loads for the engine itself, reducing the speed means, overall, a better ratio between actual fuel consumption and output energy – especially at low loaded variable speed gensets.

But, he underlines, the pair of medium-speed gensets onboard the REM build aim to run on biomethanol, and these – like so many alternative fuels – have a slightly slower response rate. That's where the battery comes in handy, as it will take the edge off steep load steps.

"So we have installed three batteries, one on each of the switchboards, port, centre and starboard," says Stavset. The system is divided into three sections for two main reasons. First, redundancy: "If one complete switchboard fails, you can still continue operating with the remaining two thirds," he says.

But then there's also short circuit current management.

"If all batteries were connected to a single switchboard, a critical fault could generate currents that exceed the switchboard's limitations," he says, with significant operational risks.

"And since we have split the system into three redundancy groups, including the batteries, this will actually enable us to only run the generators necessary for the actual load condition," adds Berntsen.

Although the installed energy storage totals around 1.7MWh, it's possible to cycle the batteries at a higher power for a short time: up to 5MW for 12 to 15 minutes, says Halsebakke, potentially up to 20 minutes if pushed.

There's also that 2MW of regenerated input to absorb, so it relies on a robust power-handling system, plus the battery chemistry itself needs to be designed for a 3C (three times nominal output) cycle rate. As getting this right is important, the supplier is long-time trusted partner Corvus Energy.

Notably, if all the power generation and energy storage tied their peak output together, the ship would have close to 14MW of available power “though this will never be necessary”, Halsebakke says.

Switching operations

With so much going on, it could be a complicated business. Like earlier vessels using different modes, the answer is a fair amount of automation, which simplifies things for the crew.

“Of course the various sequences must be handled in the proper way,” says Berntsen. “So we make mode control systems which start and stop the generators, open and close breakers, and regulate the voltage.”

It’s not all that straightforward, as some types of work need special treatment, for example, trenching operations.

“We can use a 1,000kW trenching pump,” says Berntsen, however, the high power draw means the trencher has to be connected directly to a generator.

Source: Skipsteknisk

The ST245 REM Pioneer’s multiple duties will draw on its inherently flexible power arrangement

The power integration needs careful handling, but this is often very different from vessel to vessel. As the saying goes, ‘if you know one ship well… well, you only know one ship’.

To help speed things up, The Switch uses standardised building blocks that are tailored for the specific circumstance: that means, for example, pre-built switchboards that can be sent to the yard, ready for installation.

“It also helps shorten downtime as the crew can change the parts themselves,” says Halsebakke. “The modules are retractable, so you can take them out and insert a new one if you have a spare onboard – ” so as a result, getting everything up and running again generally takes only between 30 and 60 minutes.

The providers (The Switch/HPS), will train the crew on how to change the modules – and in case they forget, there’s also a handy YouTube video to remind them.

Energy and efficiency

The overall efficiency of this design also results in a 30% reduction of total energy expenditure. As Berntsen explains, that 30% drop in fuel demand has a very useful effect. Methanol is one of the few energy sources suited for maritime operations, but it does have a couple of downsides as far as energy density is concerned. This configuration makes methanol a potential fuel choice.

“Still, it’s much easier to make a net zero emission vessel if it’s on a dedicated route, like a ferry going from A to B, end of story,” says Halsebakke.

He says you can’t assume offshore wind installation will have the charging infrastructure in place, and other construction works may be a long way from a plug.

“The vessel that REM Offshore is now building has a wide variety of things it can, or will be doing in future… But still being able to make it a net zero emission vessel - that is really impressive,” he says.