



Lürssen's 86m Quatroelle at anchor making full use of her generators

Photo: @Klaus Jordan

The generation game

In spite of increasing demands, and variability thereof, of demand for electrical power aboard superyachts, generator manufacturers are ably meeting the challenge with product development harnessing the latest electronic and mechanical technology

WORDS BOB GREENWOOD



Northern lights genset

Seldom seen and barely heard these days, thanks to ongoing refinement, generators are the beating heart providing the electrical power that's the lifeblood that sustains comfortable life aboard superyachts. Away from shore power and often even when that's available, nearly every system aboard a big yacht depends on them. Duties can range from air conditioning to zero-speed stabilisers and including navigational systems, all electronics and watermakers, thrusters and all 'hotel' loads. Just about all superyachts will have at least two generators, generally located in the engine room to ensure redundancy backup. Many will have a third for night duty, while for hybrid propulsion they're an integral component.

With the myriad of electronically interconnected systems aboard today's superyachts, generators, like almost everything else, have become digitized as part

of 'the internet of things'. Not only are they generally powered by diesel engines that themselves have to be electronically managed in order to meet ever more stringent emissions regulations, they also need to communicate with other systems so that they can meet precisely the different electrical loads being demanded of them. And, more often than not these days, they need to be accessible via Wi-Fi and internet connection with personal and laptop computers, smart phones and tablets.

Many of the larger manufacturers of marine engines also produce the generator sets that are most widely used in superyachts. For instance, Northern Lights, which claims global market leadership in the superyacht sector, is the generator brand of the Seattle, USA-based Alaska Diesel. Also based in the US is Onan, another important player in the superyacht generator sector and a business of Cummins, the world's largest manufacturer of diesel engines. US company Caterpillar, is also

a major force in diesel power and a manufacturer of marine generators, while Wisconsin-based Kohler, the largest manufacturer of generators used in smaller cruising craft, is also now making inroads into the superyacht sector.

For Onan, Brian Barnes, Onan Marine sales manager, describes his brand's position in onboard power for superyachts as growing. "Traditionally Onan has led the recreational market where power demands are below 99kW and has only been a niche player in the true superyacht market. That said, as a division of Cummins Inc we are uniquely positioned to start addressing the superyacht market as a single supplier of both generators and engines for onboard power and propulsion."



Brian Barnes

Brian Barnes, like others in this review, observes a substantial upsurge in demand for onboard power. "If you haven't seen onboard power demand double or triple in the past ten years then you probably aren't paying attention," he states.

He continues: "Power demand dominates our society and yachting is no exception. Not only have we seen boats of all sizes require more power to drive an ever increasing number of electrical products – a true glass bridge, yacht stabilisation and all the electronics that we live with in our daily lives – but we also need more and more power for the shipboard systems that work behind the scenes as many of the mechanical systems traditional to yachting give way to electronic ones."

Asked how important has electronic control and integration with other ship-board systems become via CAN bus systems, he replies: "Ten years ago I would have told you moderately so. Five years ago, I would have told you very important. Today however I see a future moving away from CAN bus systems and into completely wireless ones. We live in an age of connectedness fuelled by demand for three things – intelligent devices, intelligent systems, and end to end analytics and telematics. Intelligent devices are growing as everyone knows and are already here.

"In yachting CAN bus systems provide the framework for the second – intelligent systems or 'systems of systems'. However, that can only reach what is wired in.

Superyacht customers (and the talented staff that makes them run) are a discerning group and they are growing in their demand for information on their yacht no matter where they are. This as well as end to end analytics and telematics requires a wireless framework. While a CAN bus system may be relevant today, if you aren't paying attention to those three items, you are going to miss market in the not too distant future and see yourself quickly replaced by those that are," Barnes warns.

Greg Klompenhouwer, senior product manager for Kohler Marine, comments that "the multitude of electronic systems and devices on most yachts has made onboard power a more important consideration than ever. While many of these systems have become significantly more efficient over the years, they've also grown in quantity on most vessels. So, the demand for reliable and high-quality onboard power is only going to grow."

His company, he says, "is well positioned to maintain a leadership role in the superyacht segment. We have just introduced powerful new 175 kW (50 Hz) and 200 kW (60 Hz) models to our growing line of EPA Marine Tier III compliant diesel generators. These new models are ideally suited for superyacht applications and the market has responded favourably."

Klompenhouwer observes that "The past 10 years have been a roller coaster for global

the superyacht segment."

He continues: "Devices powered by large compressors or motors – like air conditioners and winches – are the highest consumers of power. The broader question, though, is how often these large power consuming devices are used throughout the life of a vessel and what's the most appropriate way to size the generator to power these loads?"

Kohler's response to this problem has been to develop its own paralleling power system, PGEN. Klompenhouwer explains that "most of these high-power consuming loads are only used for short durations. In the past, this meant that builders had to grossly oversize their generators just to handle peak loads."

Such over-sizing, he says "can lead to wet stacking, smoke, unburned fuel and other issues." He maintains, however, that "Load management through the use of PGEN changes all that. With PGEN, two smaller generators can be used and electrically 'coupled' together only when needed. During daytime loads, a smaller genset will burn less fuel and will be loaded



Greg Klompenhouwer

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marine. The economic crisis hit our market hard in 2009. Since that time, we've been in a period of recovery. As you'd expect, the segment that was least affected was the superyacht segment. Following the economic collapse, we saw – and continue to see – very high demand for high-output generators from



Kohler 200 175KW

more heavily – both of which are extremely beneficial to the life of the generator. When the owner needs to power a heavy load, the PGEN will 'tell' the second unit to start and carry the load. Then when the heavy load demand ends the second generator turns off and the smaller generator takes back the entire load."

Like others in our industry sample, Klompenhouwer acknowledges the growing importance of electronic integration of power generation into vessel management systems. "Owners are requesting more and more information to be available at their fingertips," he notes. "Flat-screen manufacturers are including inputs for generator data into their latest

products. Kohler's software engineers equip all marine controllers with both SAE J1939 and NMEA 2000 software that is selectable via controller interface. The controls can be wired to the inputs of these flat screens to provide all the data that owners today are looking for," he adds.

While American companies dominate onboard power provision on the generator side, it would be a mistake to believe that they are the only players in town. Europe, for example, also has a number of generator manufacturers that also serve the superyacht market, among them Germany's Fischer Panda and Italian companies Mase Generators and Coelmo.

Although Fischer Panda's prime market is the sub-70ft yacht market segment, lately it has turned its attention to the superyacht



Jens Langer

sector. Indeed, this is an area where the company is now focusing some of its latest product development, as Jens Langer, sales and marketing director, points out. "Fischer Panda generators are planned for night power supply as a

main generator in a power range up to 160kW," he reveals.

Fischer Panda's marine speciality is variable-speed generators, which are offered in models producing either AV or DC power, the latter being useful for providing direct current supplies for sensitive, low-voltage electronic equipment in place of AC/DC inverters. The company claims to offer the largest range of variable-speed generators available in the global yachting market. Advantages over conventional fixed-speed generators include high power output within a smaller package size, lower fuel



Fischer Panda p60i genset

Coelmo generators



consumption with reduced emissions and quiet running.

Variable-speed gensets "with the possibility of using an electro-magnetic clutch for mounting a PTO (power takeoff) has become very attractive at the moment," comments Jens Langer. "For instance, installations on famous yachts built by Nautor Swan, Baltic Yachts, CNB and Ferretti are milestones in Fischer Panda smart-energy solutions," he adds.

As well as variable-speed generators, Langer views easy paralleling of generators, connectivity with other on-board control systems and the implementation of new exhaust regulations for diesel engines as paramount issues in onboard power generation these days. He believes that "emissions regulations are still the most

equipment onboard. "This remains an important challenge for all participating suppliers to the superyacht sector," he adds.

For leading Italy generator set manufacturer Coelmo, the company's CEO Marco Monsurrò comments:

"Developments in normal onboard power applications and also hybrid propulsion systems have forced most manufactures to approach the marine market in a new way, requiring integration and communication between



Marco Monsurrò

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challenging task for engine and generator manufacturers today and will be so for the next five years."

He also sees that, for the onboard power generation sector, the development of hybrid diesel-electric propulsion represents an important growth area in the yachting market and a growing business opportunity. "Electric propulsion systems have been one of the key developments in the past 10 years and will continue to grow," he believes. "All other onboard electrical consumers remain more or less constant," while he also sees that a crucial factor will continue to be the networking and communication of all

different systems in multi-role situations such as docking, sailing, mooring and anchoring. This demand has resulted in a significant increase in electronic systems, software support and automation that, from the user's point of view, corresponds to more user-friendly installation as well as easier maintenance and equipment management."

Like others interviewed for this article, Monsurrò observes that "the total values of loads have grown in recent years, even though power consumption by individual demand components has reduced. However, new comfort standards ask for an intensive quality of power delivery, for aircon, washing

machines and stabilisation systems. The key factor here is not the power consumption of individual electrical components, but how an onboard system can support and balance the power for so many components at sea, always in respect of priorities of efficiency, safety, comfort, environment and cost reduction.”

He continues: “Contrary to what might be imagined, comparing like-size of superyachts but with old and new technologies installed onboard, the increased efficiency of the individual components has led to an actual overall reduction of power demand. What has changed, however, has been the increase in numbers of items of equipment and the management of electrical consumers.

Monsurrò concludes: “Such innovation has been continuously growing in recent years, bringing Coelmo to study new solutions and marine generators that have the adequate technology to face the most advanced onboard installations. We have been able to meet not only the overall electrical power demand, but at the same time, the rising quality of electrical power equipment and all safety requirements.”

Mase Generators, also an important Italian manufacturer of marine generators, offers a range of gensets from 10 to 120kW for superyacht applications. This, says company vice president Dino Salvemini, is a market sector where Mase has been performing well of late.

For Mase, the most important technical advances have been in CBU (MOD-BUS) electronic control, which he says, “is now standard in onboard power generation”. On the way to becoming so too, he adds, is variable-speed generation: “We are all working on variable speed generators now because you can use the necessary power.”

For an independent view of technical and market advances in marine generators and onboard power management SB contacted Dallas, Atlas Marine System, a Texas-headquartered firm that claims world leadership in the design of marine electrical power systems,



Dino Salvemini



Mace CBU remote & cavo



Atlas Marine Shore 2

and Dutch company Tijssen Elektro, which specialises in turnkey electrical engineering for the superyacht industry.

For Atlas, Andy Ford, design and application engineer based at the company’s UK office, comments: “We don’t see CAN bus systems in yachts of 80ft and above (but rather) in smaller vessels. Larger vessels use different communication systems such as serial communication and Modbus protocol.”

Owing to variety of connective channels, he adds: “The need for developers to be able to adapt and communicate with multiple protocols and buses had been increasing over the years. Flexibility in design is becoming increasingly important.”

Marcel Pith, Tijssen Elektro’s manager of software engineering, affirms: “We would say the most important technical awareness in power provision and management is the connectivity and communication with all the onboard installed systems. The more open the systems are to communicate with, the better the outcome for the entire project/yacht.”

In a market sector with customer expectations of excellence far greater than most, he points out that “Many yacht owners today want to have the same experience that they have at home also on their yacht.” That, he says, means “no interruptions and/or fluctuations in power. (Customers) don’t want to compromise their yacht experience with flickering lights (owing to harmonic distortion) or failing AV systems because the

chef needs to use the galley to its full potential or the captain is docking the yacht. You wouldn’t accept that either when you are staying in a suite at an expensive hotel.”

With such a high expectation level in the superyacht market, generator manufacturers along those who supply and install onboard electrical systems, have been upping their game by demonstrably meeting the new and increasingly varied power demands being placed upon them.

Propelled by increased demand for electrical power from all quarters in the superyacht industry and boosted by the development of hybrid propulsion, generator manufacturers have been upping their game by demonstrably meeting the new and increasingly varied power demands being placed upon them.

Onboard power ancillaries

When it comes to onboard power, the sheer scale and complexity of demand has traditionally dictated that superyachts rely heavily on substantial diesel generators. That’s in marked contrast with small to mid-size recreational craft where the mix of power providing products is more varied, with greater use of inverters and battery chargers. Here, boat size has reduced the role of generators to that of a bit-part players or, in the case the smallest powered craft, kept them out of the play list altogether.

For obvious reasons, generators that are used in smaller craft are themselves also small, often with outputs of less than 15kW. In the US, the world’s largest recreational boating market, most generators of this size are gasoline fuelled, whereas in Europe diesel predominates even at the small end of the output scale. Otherwise, alternators running off the boat’s propulsion engine produce AC electricity which is transformed by inverters to keep battery chargers and battery banks topped up while the boat is at sea in order to provide a continuous



Andy Ford



Marcel Pith

supply of DC for most of the boat's power requirements.

Superyachts inverters and chargers have been seen as being of marginal interest, although now, as the use of DC power onboard has been growing rapidly such ancillary equipment is becoming more relevant with the burgeoning use of electronic navigation, communication and entertainment.

Californian company Newmar – together with its sister company ASEA, which are now owned by the same equity group – produce a full range of marine power products including chargers, current conditioners and full power management systems. Newmar's marine sales manager and applications specialist Jim Kaplan says these "are now able to provide a greater depth of product to the superyacht industry."



Newmar PTMP 24 150



Jim Kaplan

He observes that "With the advent of DC microprocessors in everything from engine controls to communications and navigation equipment the need for clean DC power is greater than ever."

He adds that "We are very well positioned because of our wide power range offering 24 VDC battery chargers, now to 150 amps, which addresses the need for additional DC power onboard. Our new series of PTMP (smart) chargers are perfect for superyacht applications, being fully programmable for battery type and application and usage, with diagnostics and redundant plug and play components."

Of the major marine power systems producers serving the yachting industry, Dutch company WhisperPower has one of the most comprehensive suites of equipment available anywhere, spanning both the superyacht market and the broader recreational boating market as well as

commercial vessels. Products range from lithium and gel batteries and alternators for power takeoff from propulsion engines to compact, self-contained power packages combining generators of up to 150kW programmable-speed generators to inverters which can be linked in parallel to provide up to one megawatt of power – sufficient to power both diesel-electric hybrid propulsion systems and full hotel loads.

Company owner Roel ter Heide says the business "Supplies shipyards complete packages and all electrical components. In that respect we are also a logistics service provider. With our systems it is possible to plug in to any mains socket wherever you are in the world, just as you can with an iPhone charger."



Roel ter Heide

Ter Heide states that his company's biggest growth is now in the sector for vessels upwards of 24m. Recently a WhisperPower genverter system of more than 100kW in combination with a 50kW propeller shaft was installed on a 46m yacht designed by Hoek Design Naval Architects.

This was developed by WhisperPower in collaboration with Diesel Center Italia, one of major yacht engine manufacturer MTU's main distributors, as an 'eco-mode' for fast motor yachts. As Roel ter Heide explains, "It is a parallel hybrid system with an electric motor that is integrated into every drive train. These are fed by our Hy-Gen Genverter systems of

We expanded and improved our power management system to participate with the higher power demands and more interface opportunities

150 kW each, which take over the propulsion and ensure a speed of 10 knots. At the same time, the system provides enough power for the hotel load."

Onboard power in superyachts is not just provided by generators, or indeed via inverters in DC form. Shore power is also a major source of input, although its quality can be described as variable. This is an area where marine electrical power systems designer Atlas Marine Systems has special expertise. "With hundreds of switchboard power management systems and thousands shore

power converters in the field we have a unique leadership in onboard power," says Andy Ford, a company design and application engineer based in the UK.

The company's latest product offerings in this area are its Remote VPN (Virtual Private Network) Machine Access for Equipment Support (EWON) and its AutoSHORE Power Conditioner to support the smaller vessel market. "The Remote VPN Access allows monitoring and control of vessel electrical power system from a remote location," Ford explains. "For example, this product can be used to support an un-crewed sport fishing boat in the Bahamas as well as allow a yacht owner in Chicago with the ability to start, stop and monitor the generators onboard his yacht located in the Mediterranean by simply using the internet."

Meanwhile, the company's new AutoSHORE product, Andy Ford says, "gives smaller vessels a low-cost alternative to isolation transformers, allowing them to utilise any available dock voltage source and regulate onboard power".

Dutch electrical engineering company Tjsssen Elektro's forte is targeted at the high end of the yachting market, where as a turnkey supplier to yards it provides all electrical engineering for alarm, control and monitoring systems. Its signature product is its MPA system which manages power distribution, navigation and communication and audio/video systems.

"Last year we expanded and improved our power management system to participate with the higher power demands and more interface opportunities with other onboard systems," says Marcel Pith, the company's manager of software engineering. "This year

we upgraded the user interface of our MPA system to make the power management and load management even easier to interpret," he says.

With these latest improvements, he adds, "We can balance the power demands even better so it will reduce the over-capacity of electric power and save on fuel consumption and enhance the generator's performance, especially to reduce soot. All these power demands are easy to understand by the graphical representation on each MPA screen throughout the yacht."

The next generation - Variable-speed?

Despite still being a niche segment, variable-speed generators are now gaining more momentum in the market

Could variable-speed power generation signal the way ahead for superyacht power systems? Few in the industry are suggesting yet that this so far minority technical approach to onboard power generation is going to usurp fixed-speed generators as the main source of electrical power anytime soon. But equally, few reject it out of hand. Indeed, many generator manufacturers already offer variable-speed alternatives in their generator ranges.

Of the major manufacturers of marine generators for yachts in this SB review, by far the most enthusiastic proponent is Fischer Panda, which received a 2014 DAME Award nomination for its Panda 150i PMS

model, combining a variable-speed genset with an inverter in a single unit, at last year's METS exhibition.

The new model is targeted at superyachts and other larger craft, where the generator-inverter combination is designed to extend its suitability for handling varying electrical demands.

According to the company, this model marks a "quantum leap in generator technology for superyachts". Sales and marketing director Jens Langer adds: "There is definitely a way and change of thinking in relation to variable-speed technology. It's more expensive, but it brings definite improvements to power generation."

Among the main points he cites are weight saving. At an all-up weight of 600kg, the above-mentioned 150kVA model which he claims is less than half that of some competing conventional gensets.

With that comes reduced size, with overall external dimensions that are 30% less than those of other marine generators.

At the same time, the fact that is synchronised with power demand – so when

that's low it runs more slowly and consumes less fuel – promises greater fuel efficiency. Fischer Panda claims a fuel saving advantage of 15-20% compared with conventional generators. And with that comes commensurately lower engine emissions.

The box ticked on the company's list of advantages is easy paralleling since sets are designed to be connected in parallel without any additional switching.

Other generator manufacturers, who are also practitioners in the science of variable-speed generator design and manufacturing, are a little more circumspect. Onan for one.

When asked if there has been a strong move towards

variable-speed, Onan's Brian Barnes answers: "That's an interesting question. To directly answer that, I would say yes, but wouldn't use the word 'strong'. Variable-speed generators are something Onan released into the RV market in 1996. That said, while gaining a little more momentum in the

Coelmo's CEO Marco Monsurrò, whose company also produces variable-speed generators, says: "Such interest is mainly felt for smaller yachts, owing to reduced unit dimensions which optimises space onboard," adding "Another area of interest is the increasing number of DC motor drives used on the superyachts. The use of DC variable-speed generating set with DC output connected with a dedicated battery bank produces better performance than having large inverters."

The trend among generator manufacturers, Monsurrò points out, is to "follow market requests to invest in variable speed in order to meet fuel consumption and noise reduction requirements, while keeping an eye on high costs of production and, in some case, limited reliability of some electronic components."

He adds: "Certainly the next steps are to improve variable-speed generators with increased quality standards at reasonable costs."

Meanwhile Atlas Marine System's Andy Ford says that "We have not seen recent requests for variable-speed generators". He cautions: "Although quieter and more efficient generator operation can be gained, moving the generator engine speed from its designed operating point may increase its emissions. Testing in this area is needed, adding "We expect to see more development in this area as new emissions standards take effect in coming years."

Marcel Pith of Tjissen Elektro concludes: "We haven't seen a strong movement, but there has been a slight move toward variable-speed generators to decrease the carbon-footprint of yachts. The idea is to



Fischer Panda 150i PMS

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marine industry, it is still a niche segment."

He believes that "The tipping point will come from widespread adoption of true hybrid systems – not the partial ones we see today. My personal belief is that variable-speed marine power generation will grow in direct correlation to adoption of those hybrid systems, but there are other technologies that will become more prominent in the near future that will determine a company's success in the marine market."

run a generator only at a certain speed to charge the onboard battery system at a voltage around 800V DC and from there to convert it into 400V AC."

His own view of the future is that "that the traditional diesel generators will be replaced by micro turbine generators. These provide power generation without vibrations, resulting in lower levels onboard and extremely low emissions. And they are even more compact". **SB**