Increasing demands on fuel consumption and emissions are driving the emergence of innovative solutions from marine propulsion suppliers, argues Oliver Riemenschneider, head of ABB Turbocharging, in this month’s leader interview.

RIEMENSCHNEIDER, WHO HAS worked with the business unit since 1991 (the last four years at the head of the organisation), believes that the Switzerland-based inventor of the turbocharger is well placed to deliver those solutions. Not only does the company – accounting for around a third of the global turbocharging market for marine two-stroke engines – share a common research roadmap with the main turbocharging market for marine two-stroke engines – but it can also draw on extensive experience from land-based applications including trains, trucks and power stations.

Together these land-based applications represent around 40% of ABB Turbocharging’s installed base. That puts the company in a strong position as issues previously encountered on land – among them increasing emissions regulations and the emergence of gas engines – come to bear in the marine market.

In the following interview, Riemenschneider outlines what he sees as the main near-term challenges facing the market, and how ABB Turbocharging is striving to address them.

Q In the hierarchy of industry requirements, improving fuel efficiency is right at the top. What recent contributions has ABB Turbocharging made in that area?

A Through our long standing cooperation with the leading 2-stroke and 4-stroke engine builders around the globe, we have developed a very good understanding of what is needed in the long term. We have our own R&D activities aligned to that view and we provide equipment for their test beds. The advantage that we bring is that we cover such a wide spread of applications we can really learn from all of those what might be the next steps and add additional value. For example the experience we have with gas engines, which are well advanced in power plants, means we are a good partner with a lot of experience.

An example of that cooperation is the new Wärtsilä 31 engine. It is now the most efficient engine on the market for diesel, dual-fuel or gas, and it uses a two-stage turbocharging system from ABB which was specifically designed for that engine. And the efficiency that Wärtsilä has achieved is ground breaking.

Turbocharging efficiency is around 75% with the two-stage concept, compared to around 68% for conventional turbochargers. This translates directly into engine efficiency – the maths, for example for two-stroke engines, is that 1% of turbocharger efficiency represents about 0.3% of engine efficiency – and allows for higher power output, which means reduced costs. The higher pressure ratio also means we can work on NOx emissions, which is related to the temperature of combustion. With more pressure you can do much more in that direction, balancing fuel consumption and NOx formation.

Q Did your experience on land-based applications come into play when designing the Power2 two-stage turbocharger for the marine market?

A Yes, we have around 150 Power2 installations on stationary high speed gas engines and one on a medium speed engine at a power plant. When engine builders were canvassing industry response for two-stage turbocharged engines, one of the comments that came back was about serviceability. The Power2 turbocharging system has a cartridge system, new to the second generation unit, that allows you to extract the inside of the turbocharger much more easily, allowing for very short downtimes. The engine itself is also designed with more modules so you can take components out in a very short time. It’s all about serviceability, which has always been a key demand. Now we are in a better position to cater for it.

Q So the higher pressure offered by two-stage turbocharging is one major boost for engine efficiency. And I understand improved control of the turbocharging process is another area of development?

A Yes. Valve Control Management (VCM) allows us to make best use of the pressure gains from two-stage turbocharging. There we are progressing with three OEMs, testing a hydraulic component with control software that allows much more flexibility in opening the valves once or multiple times during the cycle. We expect to launch in serial production in 2017. This offers new possibilities in the combustion process. Combined with the capabilities of multiple injections and different injection volumes, it gives totally new liberty to work on the combustion at different load points. At different engine load points you have different temperatures and fuel/air mixes, so this ability to improve efficiency and performance of the engine across load profiles is essential.

Q Why is efficiency across engine loads becoming a greater focus for ABB?

A Because we see that the operational profiles of the equipment changes is far more varied these days than in previous times. If you look at container vessels, previously there was one design point and the vessel would run at that design point for more or less 80% of the time. These days you see much wider use of an engine’s speed range over the course of a voyage. At the end that is about the fuel efficiency of vessels, versus meeting schedules.

Q There has been a lot of discussion about the fact that future gains in efficiency will be found more through enhanced control and monitoring, as opposed to mechanical improvements. Do you agree with that view?

A Completely. I think we will see much more development in monitoring and planning. Today there are a lot of activities around voyage planning, including weather, currents, trims and fouling parameters. That’s the first level of getting immediate results.

The second level, which will come in the next three to four years, is to optimise the energy ‘household’ on the ship. There is more equipment available to accurately measure parameters such as torque and fuel consumption. What also comes out of this is that the roles and responsibilities between teams onboard and onshore will change. All this capability to extract and analyse data about what is happening to the ship allows for more support from the onshore staff. Looking at our R&D roadmap, performance monitoring – and related technologies to make it connectable – is a major thrust for us.

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Oliver Riemenschneider, head of business unit, ABB Turbocharging
LEADER BRIEFING

The other major thrust of our activities is looking at what kind of ships are being built right now. We still see capex-intensive propulsion is used, with derated engines and slow steaming. It is a fuel saving matter, but the capex investment is huge, and we believe there should be better solutions. The clear direction is that we should have smaller engines with higher efficiency, even on the biggest ships.

Q That seems to go against the industry belief in ever-bigger two-stroke engines?
A The common knowledge right now is based on a huge installed base. The immediate reaction to high fuel prices and a tough market situation was slow steaming. The assets were already available so the natural solution is to slow down and run more assets to get loads from A to B. But they are existing assets and current ideas, the next logical step to us is finding better solutions.

This challenge goes hand-in-hand with discussion on gas or dual-fuel applications and how to make them efficient from an installation point of view. Different gas installations have different capex requirements – high-pressure systems tend to cost more to install but are more fuel efficient, while low-pressure gas concepts are less efficient in diesel mode right now, but provide for IMO Tier III compliance without aftertreatment in gas mode. That is in a development stage. I think that the future lies in smaller engines, used better.

The turbocharger has a key role to play here as it increases power density. That goes for the main engine as well as the auxiliaries, which are not so much in focus at the moment. But looking at their fuel efficiency will draw attention to them.

Q What is the challenge for fuel efficiency concerning auxiliary engines?
A Most auxiliaries are currently optimised for fuel consumption at 100% load. That doesn’t make sense because auxiliary engines hardly ever run at full load except on a test bed. Previously it was not in focus, everyone promoted their efficiency level at 100% load, but as owners are getting sophisticated and looking at fuel consumption and the energy house onboard the ship, they are also looking at the auxiliary engine system. Some went to shaft generators saying they don’t care about auxiliary engines at all, so there as well you can see that this market is moving. Engine manufacturers need to ask how they can address these changes.

Our strategy, since a year ago, is to be much more segmented in our offering and our service. Next year the market is moving. Engine manufacturers need to ask how they can address these changes.

Q Looking at the impending IMO Tier III NOx limits, which come into force next year; you have already mentioned the role that high-pressure turbochargers can play in combating NOx formation. Do you have a view on the other NOx abatement technologies available?
A Solutions have to get better. What we are really looking for in the long term is a Tier III solution internal to the engine, rather than the whole after-treatment chemical plant. A built-in solution involving better control and more advanced combustion. Some designers are working towards this and there are some results in particular constellations that suggest we shouldn’t give up on the idea.

After-treatment is expensive. It is not easy to handle for the crew and any solution without that complication would be valued by the market. It is a good business proposition and that is why we are looking into it.

Q What are the other key regulations on the horizon that are likely to influence the development of marine propulsion?
A I anticipate that we will have to deal with methane slip regulations for gas engines, as well as legislation on formaldehyde [another by-product of gas combustion]. Formaldehyde regulations are already being discussed for land-based engines but it will come forward for marine as well.

I assume the SOx limitations that we already face will be made tougher. And on top of that we have the IMO’s Energy Efficiency Design Index. That will trigger further developments to make engines much more environmentally friendly, and much more profitable for the user.

Finally I think that China’s inland waterways and short-sea shipping regulations will toughen up - and I think that will give a big technology boost to a market which is not regulated with regard to emissions. There is a heightened public awareness in China about the environmental impact of business, and waterways are an important part of the economy in China, and also to get higher living standards further into the inland. This combination will see some regulations coming into force that will allow for advanced technologies to be applied.

Q As this issue goes to the Marintec exhibition in Shanghai, let’s conclude on China, where you have a long established business. What’s your perspective on that market today?
A We have had a license agreement in China for almost 40 years, and since 2006 we have a joint venture with our licensee. We have a manufacturing footprint, as well as a service footprint along the coast. We have around 500 people in China for turbocharging alone.

Engine imports to China are slowing down as subsidies from the Chinese government for building new ships incentivise the use of domestic, China-built engines for new ships. The Chinese engine market is regrouping and also starting to be more engaged in design – CSSC buying 70% of Wärtsilä’s two-stroke business [to form Winterthur Gas & Diesel] is a good example.

There is a clear drive towards technology for the Chinese marine industry, and for me it is clear that this will be a global player with even more significance in the future than today. Therefore I think the Chinese engine market will remain pretty stable, while we see some slowdown in other areas.

Q How do you view some of the challenges engine designers have traditionally found in the Chinese market? Specifically, in protecting their intellectual property?
A I think there are precautions to be taken concerning intellectual property, but we have issues elsewhere too, for example in Europe. China is an important market, technology is moving forward and there are resources for research on engine development.

It would not be wise to hold back on technology because of those issues.