The RET KERS panel faces the audience (left to right: Puts, Toom, Wildner, Hilton, Dalla, Czapski – Wood is standing at the lecturn)

Semi-automatic?

The RET KERS Seminar at PMWE was a revealing event

We organised a KERS (Kinetic Energy Recovery Systems) Seminar at the PMWE in Cologne, Germany on November 12 2008. The one hour event had a simple format: a panel of six, all experts on this emerging technology and a packed audience of powertrain professionals, keen to learn more about it. The event was moderated by RET Contributing Editor David Wood, who ensured that the discussion focussed on topics relating to KERS in general rather than the specifics of individual systems. Some of our esteemed panellists were privy to confidential information on certain 2009 Formula One systems and the event was not designed to try to pry this from them. It was intended to make powertrain professionals aware of the issues surrounding KERS as it spreads beyond Formula One into Le Mans Prototype and many other forms of racing on a global scale.

THE PANEL

Godfried Puts, Managing Director, Evisol

Evisol is a company specialising in petrol/electric hybrid technology for road cars – in effect by embracing KERS, motorsport is following where road cars have already gone

Randolph Toom, Managing Director, Heat2Power

Heat2Power is the inventor of a specific Thermal Energy Recovery System (TERS) following Toom's exhaustive investigations into many different forms of energy recovery system technology

Oliver Wildner, Manager, Research and Development, Bosch Motorsport

At the PMWE Bosch Motorsport launched a modular KERS suitable for a wide range of applications including Formula One. This features different types of motor/generator and of storage medium according to specific requirements

Jon Hilton, Director, Flybrid Systems

Flybrid has devised a mechanical flywheel KERS suitable for Formula One and many other automotive applications. Aston Martin is currently co-developing the system for a high performance road car application

Roberto Dalla, Director of Motorsport, Magneti Marelli

In 2009 Magneti Marelli is set to equip a good number of the teams on the Formula One grid with KERS. Like Bosch it also launched wide-ranging system technology at PMWE, anticipating the spread of the technology

Tad Czapski, Vehicle Technology Director, Renault F1

Czapski is well known over many years in Formula One for his electronics wizardry. For 2009 Renault F1 is developing an electric KERS with battery rather than supercapacitor or flywheel storage

THE SEMINAR

Wood: Let's start by getting the panel's views about the safety issues of KERS in motorsport.

Dalla: Only with big attention to studies, to development, to engineering will we control this aspect; it is certainly something that we cannot underestimate. Having a car with thousands of amps or hundred of volts is something new and it has to be properly managed.

Hilton: From the point of view of our mechanical flywheel system, safety absolutely is a priority for us. Please rest assured it is completely safe.

Audience: What is the panel's opinion on the rules next year banning mechanical systems, allowing only electrical systems for Le Mans cars?

Hilton: If you take a 2009 Formula One spec system I believe the battery would be dead in something like four hours whereas our flywheel keeps on running. So it's a shame for endurance racing, I hope they change their minds and open it up.

Audience: What is your opinion about how the rule makers should encourage teams to bring these new technologies into racing? On the one side you can do it by giving them an advantage in lap time. Or should they gain their advantage throughout the whole race by the higher efficiency reducing fuel stops?

Czapski: We've got to do both. We've got to look at the sexiness of quick laps and I think if we avoided that we'd be wrong. The sexiness of quick laps is also overtaking. That's even better than just a quick lap so we have to be mindful of that when we frame the regulations. Equally we can't escape the responsibility that we have to actually target fuel efficiency.

Dalla: All who work in Formula One know how it's very difficult to place a 40-kilo device into a car. This means that in order to have something good there must be strong development and that will help the transfer of the technology into road cars.

Puts: Very important right now is that energy recovery in the main is still seen as quite dull by the public. Fuel efficiency has to be cool, so the association with motorsports is something that is needed. Of course the technology can be driven a lot faster by motorsports.

Audience: Are the sports regulators currently holding back the development of energy recovery technology?

Czapski: No.

Hilton: Yes.

Dalla: No.

Toom: I've been trying to introduce thermal energy regeneration into racing and so far the regulations don't show any sign that it's going to be accepted soon. It's coming in the future but when?

Czapski: The regulations don't hold back the technology. Randolph and Godfried have companies exploiting the technology, developing it and trying to sell it to customers. Motorsport would be just one of those customers. So I don't think the regulations will stop that research work. They have an effect on the deployment of it. Motorsport has its place but it's not the only place for the new technology.

Wood: What is the panel's view on the effect of KERS on braking?

Hilton: The effect on braking is quite noticeable. Under the 2009 F1 KERS rules it is maybe 10% additional braking and it is maybe half a second per lap from gaining time on the brakes. One of the effects, though, is the manageability of that braking. You need to give the driver a feel he's comfortable with and that is always the same each time he brakes. And that is quite a challenge.

Czapski: Probably the most outstanding thing about a Formula One car is the braking. And it's the thing most people don't see: you don't notice it much on the TV unless someone has overtaken someone else. If you can imagine your eyeballs popping out of your head pulling 6-G peak – it's quite a ferocious event. As Jon has said quite rightly, KERS has a big percentage influence on that braking effort.

The regulations as they stand for next year leave us with a big challenge because we're not allowed to do what we would naturally do, which would be to have brake by wire, so we can balance the system correctly with the KERS requirement, with a stable charge of the battery, with the driver's braking requirement. I think the guys in the cockpit will earn their money next year a bit more than they have done this year...

Wood: KERS is storing energy and giving it back; you're also talking about getting some advantage from braking, but we also know there are some serious packaging problems and weight problems and weight distribution problems. How will that be dealt with in the coming Formula One season?

Czapski: It's a very good question because every 10 kilograms of excess weight in a Formula One car means it is 3/10ths of a lap slower. KERS as it stands is about 3/10ths of a lap quicker with the current regulations so you can see if we go overweight by 10 kilos we've lost it.

KERS is an overtaking device. It adds 80 bhp to the engine for almost seven seconds a lap. In Formula One and probably in most motorsports today, there's little differentiation in the power output of the cars. For example, today in Formula One, you need to be at least two seconds a lap faster to be able to overtake another car. KERS brings a new dimension in that it provides a certain amount of power for a short period of time. That will allow overtaking without that two second advantage so you have to start trading the benefit of KERS in terms of overtaking with its cost in weight, with its cost in weight distribution, in packaging.

Audience: In Formula One braking is grip limited. Can you therefore ▶

try to recover some of the weight of the KERS by downsizing a bit the rear brake system?

Czapski: You are right to say braking is grip limited. But there are several things that get in the way of downsizing the brakes having a KERS. For example, if your battery is full you can't take on any more energy, so you need a back up system; so you'd still need the same brakes as before. I don't see a scope for that weight reduction and I don't think it would be that significant anyway.

Audience: Can you perhaps divide the KERS braking energy recovery event throughout the lap, so is there always the braking that you need?

Czapski: We race at a lot of different circuits, which all have very different braking characteristics. They are significantly different, one circuit to the other. What you do at each one of them is quite different.

Audience: How do you adapt your KERS to these different circuits? How big a factor is that in your control system?

Czapski: It's not so much a factor in the control system as a strategic factor. It's how you plan to use your system through the weekend.

Dalla: The braking phase is quite complex. Sometimes you brake using the engine so it's not like by adding another brake you can downgrade the performance of the braking system. Globally, it's based on the energy balance but also on other characteristics. I'm not able to give a precise answer in terms of what we can and cannot do.

Wood: Most electrical systems need some form of additional cooling. What effects might that have on the aerodynamics of the car?

Czapski: There's no doubt KERS needs cooling and we work to maximize efficiency and to minimize the amount of heat rejection we have to cope with. We work very hard on that.

Toom: I'm curious to know how much heat needs to be dissipated from a KERS.

Puts: You can always say that for electrical systems, it can quite easily have an effect on the efficiency to the extent of 80%. So the amount of extra cooling that could be needed outweighs the potential gains quite easily. However, you don't need that much cooling because the systems we have today are very efficient.

Toom: What is the difference in efficiency between a state-of-the-art battery today compared to a state-of-the-art battery five years ago and to a supercap system?

Puts: Supercaps are quite efficient but they add a lot of kilos and that's not efficient. So it's very difficult to exactly say what would be the most efficient solution – supercaps or batteries. Batteries can store more energy than supercaps and in fact batteries have become more and more like supercaps, in terms of their properties.

Toom: And the state-of-the-art batteries of today, what technology are you thinking of; what kind of chemistry?

Puts: I think lithium based batteries are excellent for motorsport – that is quite new chemistry. Still quite expensive but somebody has to start with it first. A big part of the cost of batteries nowadays is not due to the price of the material but due to the production volume. We are producing lithium based batteries in low volumes. To be able to get these volumes up, first these batteries will have to be used in applications where the extra price is not a big deal. Motorsports could help to get the volume up.

Wood: Everything in F1 eventually finds its way down to the lower forms of motorsport. What is the opinion of the panel of what timeframe that might be and where KERS best fits?

Czapski: KERS is probably the wrong way to describe it. Motorsport will have 'ERS'. It could be KERS, it could be TERS, it could be lots of things. I do see in the future, motorsport bringing in a lot of energy recovery systems overall.

A timescale?

I think that depends on the will of the sporting organisations to a great extent because it's not cheap and any change is expensive. The cost of it can be prohibitive.

I imagine that energy recovery systems will permeate down through other motorsports: if I had to guess, within the next five years.

Hilton: We're expecting to be in production with road car solutions in 2012 or 2013 and at that point we may make a low-cost motorsport system, for the masses if you like. I would have thought most sports bodies would choose to make one system mandatory to fit all the cars. I can't see them allowing a range of options across all the vehicles.

I certainly think that rally cars are an interesting opportunity. They're vehicles with a huge amount of throttle modulation so there are lots of opportunities to store energy there and to recover it again. And, for example, you could fit a downsized, very heavily turbocharged engine with loads of turbo lag and fill in that lag with the KERS device. That would be a way to achieve a dramatic down-sizing and big fuel savings and improve performance and driveability.

Dalla: I feel KERS development now is like semi-automatic gearbox technology was once. I remember in the beginning when we introduced it there was a lot of discussion, a lot of doubt; a lot of negative things. Now the semi-automatic gearbox can be found in different formulae. We can have this solution also in road cars. My view is that today, we are with KERS as we were twenty years ago with the semi-automatic gearbox. ■

You can watch the KERS Seminar online at **www.ret-monitor.com**. While there, make sure you sign up to receive our free, technical online newsletter launching in 2009.