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Keith Redfearn

CEO of Camlin Americas

Interview with **Keith Redfearn**

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Photo: Camlin Energy

Alan Ross: I'm Alan Ross with APC Media. I'm the Managing Editor, and I am delighted to have Keith Redfearn as my guest today who is the CEO of Camlin Americas. There's a Grid Edge conference that we're going to be doing at IEEE next year. I'm the chairman of the Smart Grid Reliability Alliance and I can promise you everything that I'm going to ask you. Including the problems with the grid, as well as the challenges.

So welcome. Thank you for joining me.

Keith Redfearn: Thank you, Alan.

AR There's a lot going on in the grid right now, and I know as you look at a vision for Camlin Americas, you have to be looking at this grid that you're going to be able to implement that vision through. It's kind of the road that you have to build your house on. Now I wasn't going to ask you about generation, but remind me to come back to that when we start talking about distributed energy resources, wind and solar. Because they in themselves are a solution, but to one problem decarbonisation, they are also a problem creating an inverter-based system. So, we're going to talk about that. However, from your perspective, looking at things from a reliability resiliency standpoint, what are the challenges that you see of the grid?

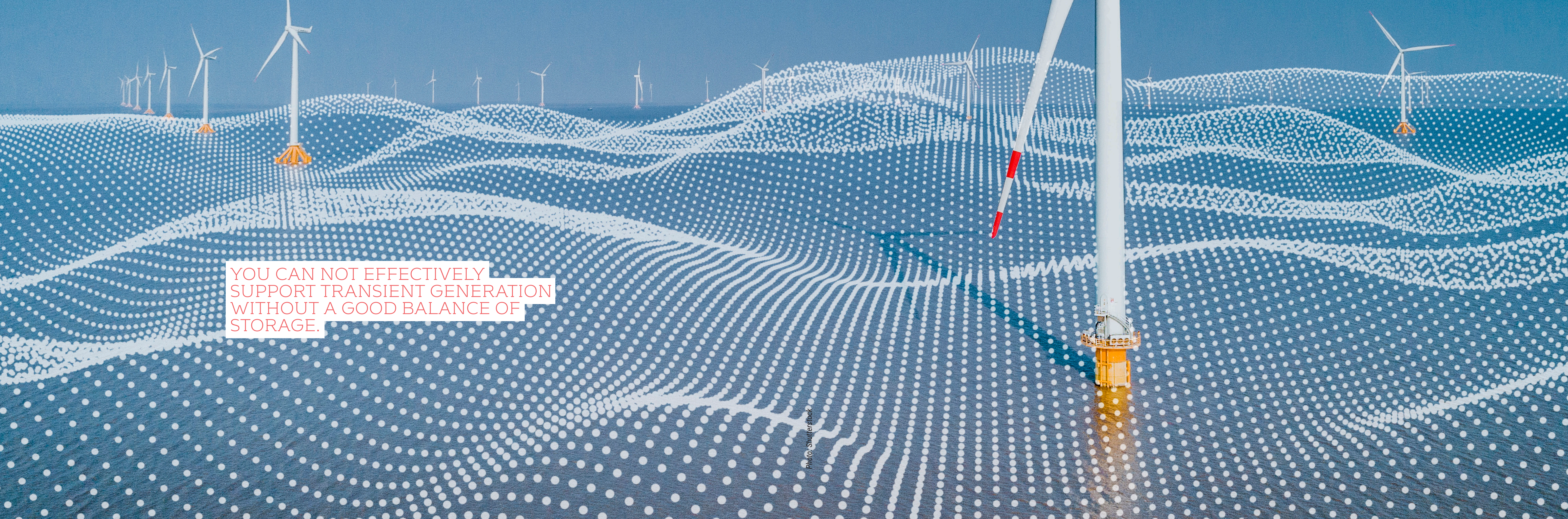
KR I think first and foremost, Alan, consumers expect us to have a fully resilient grid. They expect when they switch the light on, the lights come on, today the grid requirements are significantly more complex than they were when it was first designed. I think the accelerated deployment of distributed energy resources has, to the point you made earlier, an upside. It absolutely helps us on the journey to decarbonise, however in the pursuit of a zero-carbon future we cannot afford to negatively impact grid performance.

So, technology wise, if we look back to the mid 2000's when the industry first started talking about a smarter grid, it was in its infancy. There were a lot of good ideas, but the technology wasn't there to facilitate the deployment at scale of the smarter grid, we are now in a position where technology is no longer a limitation, it has become a facilitator of what's required to support grid modernisation. As we continue to deploy more distributed energy resources on transmission and distribution networks, we must understand what is required to effectively operate the grid to ensure it remains reliable and resilient.

This is one of the major challenges that we in the industry must overcome by working in close partnership with utilities, regulators and the wider eco-system.

AR I'm a reliability guy, and reliability is that an asset or a system works as it was designed for as long as it was designed, without failure or disruption. That's reliability. That's one issue that we've got. The grid has been fairly reliable from that perspective. We've had glitches here and there, which is to be expected. The other one is you mentioned it resiliency. One of the resiliencies is getting it back up when it goes

YOU CAN NOT EFFECTIVELY SUPPORT TRANSIENT GENERATION WITHOUT A GOOD BALANCE OF STORAGE.



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down, usually due to natural disaster event such as fire, hurricanes, tornadoes. And resiliency is making sure you bring stability back to the grid as quickly as possible so it again becomes reliable. That's a problem. That particular thing you said, technology is our friend. Now how can technology help in those instances when you talk about natural disasters?

KR So clearly you still have to have the generation capacity to bring the system back up again. Whether that's traditional fossil fuel, nuclear, or an abundance of distributed energy resources, each need to be resynchronized and connected to the grid. Now that's not a simple task following a black start, effectively the whole grid has sat down.

Traditionally you'd have to bring that up very slowly, one section at a time, and make sure you maintained grid stability. If we had a connected system of distributed energy resources set up as microgrids, you could most likely accelerate the restoration process. You wouldn't be relying on the full infrastruc-ture of a transmission grid to be restored, small pockets of generation in community microgrids could be restored immediately and then reconnected back to the grid over time. So, there's a great example of where technology can facilitate a faster power restoration without necessarily being delayed by a traditional black start procedure.

AR Let's go to technology for a bit. When you think about the technological advances, a lot of that has happened in the area of protection systems. Protection systems, and relay networks are so much better than they were in the past. We're moving away from mechanical to electromechanical to solid state. We talk a little bit about the technology as it relates to protection systems and anything else that is there today that wasn't there in the past. I have another question for you, which is how it relates to this thing that you just talked about, *microgrids*. I think that's what we're going to have to do a lot more of in the future.

KR Traditional network protection systems have performed well for many years. They were developed and designed for a top-down power flow network, from generation through transmission to distribution. Now, as we deploy newer more flexible forms of generation those long-established power flows no longer apply. Typical protection schemes and associated devices have predetermined settings based on a predominantly static grid configuration, for traditional mechanical relays this is relatively straightforward. Modern electronic relays allow for multiple settings to be programmed and selected remotely to ensure they remain effective, irrespective of generation mix & associated dynamic power flow.

These new digital devices give significantly more flexibility and control over adverse power flows associated with the proliferation of DER generation ensuring the safe and reliable delivery of power, even when a network is isolated as part of a microgrid configuration. This is an simple but effective example of how technology allows more flexibility on the grid.

AR Do you think microgrids are primarily, from a generation perspective, going to be DER wind and solar? Which are what powers a microgrid. So, you really don't have transmission as much as you go from generation to distribution. Is that what it's going to look like?

KR I think so, and I think you missed out on an element which is storage. You can not effectively support transient generation without a good balance of storage. That storage may be in the form of a battery, flywheel, pumped storage or one of the many new forms of storage currently in development, they play an important role in overcoming the transient nature of wind and solar.

It's that energy mix that is going to allow microgrids to really take off. We could say we have turned the clock back more than a hundred years in returning to a collection of loosely coupled microgrids generating and consuming power locally then leveraging the wider grid infrastructure as backup.

Personally, I don't think we will ever be able to cost effectively scale "normally" disconnected microgrids as default operation. However, there are certainly instances where islanding a section of network during a grid outage, both planned and unplanned, would allow a community to operate in a microgrid environment without an extended loss of service. For instance, across the US West coast where utilities have challenges with continuous supply through fire season.

AR That's a great word picture for me because we shut it all down when we should be thinking about building it so you don't have to shut down. I want to go back to this topic of technology and reliability and resilience and how the various technologies that help in one area can hurt in another. Particularly "DER".

Now there's a new reg or an order coming out in 2222, and it is specifically aimed at this whole new generation world of DER. What does that say, and what does it mean?

Photo: Camlin Energy

MORE AND MORE MOVING FORWARD, THE COMPLEXITY INVOLVED IN OPERATING THE GRID IS GOING TO REQUIRE MORE AUTOMATED INTELLIGENCE, GRID CONTROL WILL BE SEMI-AUTONOMOUS.

KR FREC's aim is to reduce the barrier of entry into the wholesale market for smaller DER participants. By establishing a minimum aggregation of 100KW, FERC have significantly reduced the size of generation required to participate in a wholesale transaction. Now, from my perspective that is fantastic. That allows many more participants to deploy & distribute DER generation and accelerate the journey towards our collective decarbonisation targets. However, it also adds significant complexity to the grid as in that scenario there's an expectation that grid capacity is infinite, irrespective of where or at what time of day DER is connected, the grid will consume all available generation and distribute appropriately.

For those in the industry there is a fundamental understanding that the grid has finite capacity coupled with physical network constraints that must be continuously managed, there's a cost to generate, there's a cost to distribute. Continuously optimising grid operation to reduce constraints and curtailment is key to maximising grid efficiency, this can no longer be effectively managed manually.

Moving forward grid optimisation can only be achieved through automation and deployment of new technology, only by calculating real time and predicted power flows, identifying and minimising grid constraints, can we optimize grid configuration to maximize the effectiveness of DER. This is a very difficult equation to solve, it must be solved in real time to ensure the grid always operates within acceptable limits.

AR You have mentioned something I read and it was about a greater operating control. What do you mean by a greater operating control?

KR More and more moving forward, the complexity involved in operating the grid is going to require more automated intelligence, grid control will be semi-autonomous. What I mean by that is the advanced control system is going to determine the optimal configuration of the network in real time, based on greater understanding of grid operating conditions, increased knowledge of the grid assets and hence improved insight into the capability and capacity of those assets. Grid control operators will remain present to handle the exception cases, I expect this mode of operation to become the norm within the next five years.

AR Technology is making decisions that we used to use human brain power to make and technology. So, you're going to grade the entire grid in terms of AI and machine learning. Where are we with that? Is it still nascent technology or have you seen it working?

KR If you're referring to actual grid control of the transmission and distribution network, then we will continue to rely heavily on the traditional advanced control systems operating semi autonomously. However, a couple of examples of where I have seen machine learning effectively be applied today is for smart meter connections, that is leveraging the huge volumes of smart meter data and network topology to greatly improve the accuracy customer connections. Also, we at Camlin are looking at leveraging machine learning to improve our insight into real time asset performance. By leveraging our vast library of historical asset data and our many years of field experience coupled with our industry renowned SME's we have been able to demonstrate a far deeper understanding of how assets both perform and fail under a diverse range of operating conditions. Its clear that assets operating in a "grid the future" will face very different challenges and that deep real time insight into assets will be required to ensure continued and reliable service.

Typically, machine learning has been able to develop insights based on complex patterns, to be truly effective this should be contextualised with support from subject matter experts. Now, is there a place for that in grid control? Absolutely.

As the grid gets more complex being able to accurately predict what is likely to occur on the network over the next 24 hours and beyond is becoming increasingly more important. Determining the optimal grid configuration and what contingency do we have should it deviate from a predicted state is where I believe machine learning has a big part to play. However, as of today we are far from deployment.

AR This is fascinating, again Thank you Keith. That was a wonderful.

KR Thank you very much, Alan. I appreciate it.

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