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Oral Discussions on Session: "Island Systems and Interconnections" – Part I

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Abstract

This paper contains the first part of the transcribed oral discussions of Session "Island Systems and Interconnections" of the 2013 IREP Symposium-Bulk Power System Dynamics and Control, held on Sunday afternoon, August 25, 2013. Papers [1]-[4] were presented followed by the presentation of the written discussion [5] and the response included in the closure [6].

Discussion

Chair: Thank you. Some other answer or comment?

Sandro Corsi (Italy): I have a comment about the analysis you performed about the frequency contingencies in Crete and the solution you propose about overfrequency protection and about special protection schemes [2]. My question is the following: have you considered the fact that with the HVDC link is possible to have very fast frequency control in Crete according to some rule? I want to give the example of the Sardinia Island, where frequency control is by the HVDC link with the mainland in Italy. Sardinia is roughly largely controlled by the HVDC in terms of the energy during frequency transients due to the fast HVDC control.

John Kabouris (IPTO): Of course it was not possible to present everything in such short time, but actually we would do the same here. If you noticed the contingencies and the cases that we have examined were rather extreme like the loss of half the interconnection capacity. In most other cases what you said is valid. The variations of the load can be undertaken by the HVDC link. I agree.

Fernando Alvarado (Wisconsin): Since I live a good part of the year in Hawaii these days, I am extremely interested in this session, obviously because of the renewables and the island nature, so I hope to take a lot out of this session. A problem that has not been recognized openly (it has been recognized but not openly) in the greater penetration of renewables is what was brought up in a couple of the papers ([2], [3]) and has to do with inertia. One of the effects of renewables is that they have no inertia. And we are not talking of longer-term storage, we are talking of the effect on contingencies and recovery, and what am I asking really is if anybody is seriously looking at inertia enhancing opportunities, either actual inertia or what I call artificial inertia. You can create a lot of artificial inertia with the right equipment. And you have to be very careful when you ask for variable speed drives, because unless you program them properly they actually work against you, not for you. They can create a problem, not solve a problem. So in general I want to see if rather than load shedding, which is an extreme form of inertia management, I am wondering if anyone wants to really address the issue of inertia as a necessary component of greater penetration of renewables. Any of the panelists?

J. Kabouris: I have not the complete answer of course. I agree with you. I think it was mentioned here that actually what we connect here is a very huge, actually infinite inertia system to a system of very low inertia. But we did not examine any other methods of increasing the inertia in Crete. We made just a conventional, typical study for that.

Nikos Sakellaridis (CRES): Just to say that I agree with this. We have shown the effect of the low inertia in one scenario that I have shown; the substitution of some conventional power plants with hybrid power plants. We have seen the fact that when adding generators with smaller inertia, system stability and security gets worse. I agree with you, it's one of the examples we have shown in the presentation.

J. Kabouris: Maybe you can try a flywheel or something. Of course transient stability is a problem of inertia. The question is, and I don't have the answer, how to create the inertia that is missing.

F. Alvarado: There was an answer in a couple ways. There are creative ways. Once you recognize the problem, that inertia is an important component of greater penetration of renewables, you can begin thinking creatively. For example, you can run hydro plants without water that provides you inertia, power plants that are not using much fuel, just because they are rotating. Also, providing incentives to customers to use the smart grid in

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smart ways: appliances that are frequency-sensitive, things of that sort. Just all I am proposing is people never begin recognizing this as a problem that would really help greater penetration of renewables more than many other things that people are looking at. That's my only comment.

Chair: Any other comments along these lines?

Joao Peças Lopes (University of Porto): I can comment on the same lines, although my first comment would not be exactly on the topic. Of course inertia is a critical issue, especially in an isolated system with a lot of renewable generation. As it has already been pointed out here, it is possible to synthetize inertia and have it, for instance, as a response to the derivative of frequency versus time and this is presently being used and developed in some wind generators for instance. So it is possible to do it in some way. But I have another question and comment to the panelists…

Chair: Sorry, let's first take comments along the same line.

Jim Lyons (retired, General Electric)**:** GE wind turbines actually do that. They use the derivative of frequency to introduce inertia. This is really a standards issue. The wind industry in 2002 went through a huge change on Low Voltage Ride Through, after some major blackouts in Northern Germany and solar industry in US and Germany is going through that same revolution of standards right now. There is no requirement for virtual inertia however. And with increased penetration that has to happen. To your point: if you don't program those renewables you make things much worse, because inherently they lack inertia, any converter connected system does so... It's an essential thing that has to happen. The Standards Board has not addressed this as yet.

Chair: Ok, thank you. So now you go with your question.

J. Peças Lopes: So I have a comment and a question to John Kabouris [2]. We are experimenting similar situation in the islands of Azores and in Madeira, where consumption has been decreasing lately due to the economic crisis, and there was large investment in renewable generation, wind generation, PV, and in geothermal. Geothermal is a little bit different because geothermal is like nuclear power plant, doesn't like to participate in frequency control for instance, but the problem that we have now and that the local System Operator is trying to find out and we are working with them to find a solution, is to look at generation curtailment, or at least to limit generation for those operating conditions where we are forecasting extremely severe changes of renewable generation. So in those cases and because it is necessary that those decisions are transparent and afterwards they can be audited, we are developing a procedure for the TSO for them to decide when to curtail and in this way to make the system more robust. So I would like to ask if have considered this possibility in Crete.

J. Kabouris: We have not considered that in Crete. But as a general answer I think that in Europe what we have opted as TSOs is to ask for some reserves from wind turbines for the time being. And this will be a regulation I think from 2015 on.

J. Peças Lopes: I may say that for instance in Spain they do it already. Not in Portugal, but in Spain generation curtailment is a reality.

J. Kabouris: Yes, but what I am saying is that this will be a European standard probably from 2015 on.

J. Peças Lopes: Yes but this exists already.

J. Kabouris: Yes, of course, and in Denmark also.

George Gross (University of Illinois): If I can comment on that, we had for example in PG&E, where I worked for nearly 20 years, we had contracts with geothermal, very good contracts. They had negotiated long time before renewables started very, very rigid contracts where basically we had to run those units. So as a question basically in terms of how you negotiate those contracts, if those contracts are negotiated independent of everything else, then you could try anything you want, but it becomes a legal case. So you have to be very careful, because we are very, very unwilling to curtail wind or solar, because we want that energy. So this point becomes a big, big match but the economics are very important also.

Chair: We have one more question.

Janusz Bialek (Durham University): Coming back to Fernando's question, Fernando if you want to learn more about it, I think you should move to another part of the world, which is almost as sunny as Hawaii, that's Ireland.

(Laughter)

J. Bialek: Irish are already having that problem, because Ireland is a very interesting example because it's a relatively small island with a high penetration of wind. And they have done system studies and they have discovered that if the instantaneous system penetration of wind over demand is more than 50%, they may lose the system if there is a contingency. So, at the moment they are shedding wind. That happens usually at night, when there is a windy night, demand is low, they have over 50%. They have already done studies on it. The next one in the line is

Britain, where I come from, well, where I work now. National Grid is doing already studies that are looking not only on the question what they call synthetic inertia, which was mentioned here, but also you can program DFIGS using their controls in order to provide frequency control. Interestingly because both Britain and Ireland are connected to Europe and the surrounding countries by DC links you can also theoretically program DC converters in order also to provide frequency response. So there are ways around it, no one has done it yet, but there are of course risks, but people are working on it, let me assure you that people are working on it. Actually with high penetration of renewables there are the inertia problems mentioned, but there's also dynamic stability problems and this is what Irish have discovered, that at very high penetrations actually there's a problem with small signal stability. For low levels of wind it's well known that induction generators are quite stable, that means that the small signal stability improves, but for very high penetration of renewables the dynamic stability is a problem. Generalizing the comment which I have made, there is a number of studies around the world in the States and in Europe etc., saying that you can go to very high penetration levels about 80%, 90% etc., and I am saying that at the moment you can't. There is a lot of research needed to be done in order to overcome this very important technical barrier to penetration. People think that the main barrier for penetration is balancing. We know how to do balancing, it's no big deal, we've doing it for ages. But we don't know how to provide frequency response, it's not only wind, of course PVs are even worse, because the power electronics have no inertia whatsoever. At least wind has some inertia behind it and you can make use of it. With PVs there is no inertia behind it; it means it doesn't provide anything at all. If there are authors of wind/renewable penetration studies in the audience, please think about that before you go to very high penetration levels you have to think how to overcome these very serious technical problems. Thank you.

Chair: Some reaction from the panel?

J. Kabouris: I fully agree.

Chair: OK, let's stop here, let's go for a coffee, and we come back for the second part of the session. Thank you.

References

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[6] M. Karystianos, Y. Kabouris, T. Koronides and S. Sofroniou, Closure of "Operation of the Electrical System of Crete in Interconnection with the Mainland Grid: A Stability Study," Bulk Power Systems Dynamics and Control – IX (IREP), August 25-30, 2013, Rethymnon, Crete, Greece.