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PROJECT TITLE: ASSESSMENT OF THE UNIVERSAL FEASIBILITY OF USING POWER SYSTEM HARMONICS AS LOSS OF MAINS DETECTION FOR DISTRIBUTED ENERGY RESOURCES

CONTRACT NUMBER: RD3-21 **MILESTONE NUMBER: 12** **REPORT DATE: MARCH 29, 2012**

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MILESTONE REPORT

EXECUTIVE SUMMARY

The purpose of this project is to assess the universal applicability of harmonic signatures and/or synchrophasors as a means for detecting unintentional islanding of distributed generation equipment such as photovoltaics. This report covers the time period January 01, 2012 to March 30, 2012, and describes our progress on Milestone 12. Milestone 12 has been completed. Accomplishments in this reporting period include:

- Attend at least three relevant IEEE 1547 meetings, or meetings of other standards-making boards (such as IEC-62116) as appropriate, to initiate discussions on modifying the standard to support whichever methods are shown by this RDF project to work.

To meet this milestone, NPPT investigators attended three IEE 1547.8 writing committee meetings to propose and discuss the changes noted in Milestone Report #11. As a reminder, these changes involve edits that allow future distributed generators to decouple fault detection, loss of mains detection, and overvoltage prevention, so that the 2-second maximum run-on time limit currently imposed on anti-islanding techniques could be lengthened to 5 or even 10 sec with no loss of safety or system security.

Project funding is provided by customers of Xcel Energy through a grant from the Renewable Development Fund.

TECHNICAL PROGRESS

Milestone #12 consisted of:

- Attend at least three relevant IEEE 1547 meetings, or meetings of other standards-making boards (such as IEC-62116) as appropriate, to initiate discussions on modifying the standard to support whichever methods are shown by this RDF project to work.

NPPT's President and the PI on this project, Michael Ropp, attended three IEEE 1547.8 writing meetings and a number of relevant conference calls and webinars with support from this RDF grant. The three meetings were on February 10-11, 2011, in Las Vegas; August 4-5, 2011, in San Francisco; and February 9-10, 2012, in Atlanta.

Dr. Ropp first proposed the concepts of decoupling fault and island detection in San Francisco in August 2011. As reported in Milestone Report #11, he made official written recommendations to the writing group in October 2011 for edits to IEEE 1547.8 that would keep the door open for future technologies to enable this separation. There was a total of nearly twenty specific recommendations, but they can be summarized by stating that their primary aim was to allow the maximum run-on time for a non-faulted island to be longer than 2 seconds, *IF* the inverters have fault detection that is separate from the island detection. The fault detection would have to pass its own certification process. This recommendation is reasonable from a protection standpoint: faults must be detected and de-energized very quickly because of the risks of asynchronous reclosure, equipment damage, and the potential of the distributed generation to feed the fault, but because none of those factors are present in non-faulted islands, they could persist for perhaps as long as 10 sec or more without any significant increase in risk.

The link between these recommendations and this RDF project is that if longer than 2 sec can be allowed for detection of a non-faulted island, then the potential of passive island detection techniques rises considerably. This happens because today's passive island detection techniques are limited in their tradeoff between selectivity and sensitivity: if they are sufficiently sensitive to detect ALL island conditions (high sensitivity), they will also falsely trip under a number of non-islanded transient conditions (low selectivity), and vice-versa. However, if a longer time to trip can be permitted, that provides a third parameter for adjustment and allows a much more favorable tradeoff between selectivity and sensitivity, because more time can be allowed to do additional processing.

Dr. Ropp's recommendations were discussed by the writing group via teleconference in December 2011, and taken up by the entire group in the meeting in Atlanta in February 2012. All were accepted with little discussion, and will be in the next draft submitted for open discussion (Draft 3), scheduled to be posted on May 11, 2012.

Prior to and also at the Atlanta meeting, Dr. Ropp initiated a discussion of a second issue, and that is the issue of passive anti-islanding as a backup to communications-based methods. To summarize, the issue is that communications-based island detection methods should in theory work extremely well, with essentially no nondetection zones, as long as the communications are working. However, communications WILL fail from time to time (and in some cases communications reliability is more generally questionable), so the question becomes one of what the distributed generation should do when communication fails. One possibility is that all DGs stop operating, but that is highly undesirable because large amounts of generation could potentially be lost at every communications glitch. Another possibility is that DGs could revert to today's active anti-islanding when communications are lost. This could be a viable near-term solution, but it is not the ultimate solution because then instead of losing generation on every communications glitch, utilities would have to deal with the high-penetration impacts of active anti-islanding intermittently. A third option, and the one Dr. Ropp is promoting, is the use of passive anti-islanding as a backup method, and that this passive anti-islanding would be allowed a longer run-on time because it is a backup and not a primary method.

This discussion is gaining some traction as recognized leaders in the power engineering community are in agreement regarding the need for passive anti-islanding as a backup to communications-based methods. Dr. Ropp will continue to monitor and encourage this discussion.

Dr. Ropp continues to be active in the 1547.8 writing process on two of the writing subcommittees, and was also made part of a team of three people tasked with developing an official definition of high penetration (not an easy task!). Dr. Ropp would welcome any input from readers of this report on 1547.8 or the high penetration definition.

NEXT STEPS

We now turn our attention to Milestone #13, which involves presentations at the IEEE Photovoltaic Specialists Conference (PVSC) in June 2012, the IEEE Power and Energy Society General Meeting (PES GM) in July 2012, and the Minnesota Power Systems Conference (MiPSyCon) in November of 2012. Papers have been accepted to all three, and we will be presenting as planned.

PROJECT STATUS

We are on track to submit Milestone Report #13 in August 2012, and the final report (Milestone #14) in November 2012.

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