A Review of Trends Shaping the Grid of the Future
By Julio Romero Agüero, Quanta Technology; Shay Bahramirad, ComEd; and Amin Khodaei, University of Denver

The electric utility industry is in the middle of an unprecedented evolution driven by a combination of regulatory mandates and economic incentives. These factors are intended to address important electric grid challenges and societal concerns via investments in infrastructure and adoption of advanced and emergent technologies. Such challenges include, among others, grid resiliency improvement, aging infrastructures and aging workforce.

On the grid resiliency side, rising costs of weather related outages, particularly those caused by Super Storm Sandy, have driven greater attention and investments toward improving the resiliency of the grid. It is worth noting that the average annual cost of power outages caused by severe weather is estimated to be between $18 billion and $33 billion per year.1 Similarly, recent events affecting utility assets, such as PG&E’s Metcalf substation attack2, have highlighted the importance of ensuring both the cyber and physical security of the electric grid.

On the aging infrastructure side, 25% of the U.S. electric infrastructure is of an age and situation where condition is a concern; average systems in the U.S. are 50 to 60 years old. According to the DOE, 70% of transmission lines and transformers are 25 years or older and 60% of circuit breakers are more than 30 years old. Industry analysts estimate that approximately 50% of distribution poles are 30 to 50 years old, and near the end of their useful life3.

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LETTER FROM THE PRESIDENT

'Attending' to Business: Participation & Leadership

Dear Colleagues,

As we begin a new year with renewed goals and focused strategies, it's important to keep in mind that our relationships and teamwork are at the core of creating progress in the power industry.

Partnerships formed from working closely with our client partners and participation in industry organizations, such as IEEE and CIGRÉ, have led to the development of solutions addressing exciting, but complex, industry changes. We are very proud of our participation in projects and initiatives that have been changing our industry for the better and that have served as a foundation for setting trends.

There have been many opportunities throughout the year to come together and foster those business and technical relationships — conferences, working groups, panel discussions, workshops, etc. These venues provide a place where synergistic affiliations can begin and provide resources for many years. Together with our client partners, Quanta Technology continues to grow relationships and show leadership through practical and innovative projects, tutorials, panel discussions, industry-leading papers, participating in working groups, and more.

To achieve exceptional results, our team follows the motto: “Teamwork is wanting and helping your partners and colleagues to succeed”.

This edition of the e-News quarterly newsletter discusses trends and industry hot topics — Grid of the Future, Renewable Integration and Microgrids, and Distribution System Analysis.

• Julio Romero Agüero outlines the main themes that are shaping the Grid of the Future, such as grid resiliency improvement, aging infrastructures and the aging work force, and the contributions of microgrids and distributed generation to improve grid performance.

• Farid Katiraei introduces a cost-effective and reliable design and testing approach for the protection, control and automation of Renewable Integration and Microgrids.

• Li Yu details a time series simulation method for slow dynamic analysis in distribution systems with DERs, recommending their inclusion into future software solutions.

Also, we are again honored to co-organize (along with PG&E and Mississippi State University) the 12th Annual i-PCGRID (Innovations in Protection & Control for Greater Reliability Infrastructure Development) Workshop, to be held in San Francisco in March. The 2015 Workshop will emphasize the lessons learned from the deployment of advanced technologies, strategies and operational aspects of managing the grid system and equipment assets toward building a more resilient and efficient grid.

If we didn’t get to talk with you at the recent DistribuTECH Conference & Expo, we will hopefully see you at other industry meetings, such as IEEE PES Innovative Smart Grid Technologies (ISGT) and i-PCGRID.

Sincerely,

Damir Novosel and the Quanta Technology Team

Recent Quanta Technology Presentations & Publications

DistribuTECH Conference & Expo, February 3-5, San Diego, CA:

"Distributed Generation: Utility Best Practices & Lessons Learned" by J. Romero Agüero – Utility University (UU101)

"Smart Substations: Protection, Control, Communications, Wide-Area Measurement & Enterprise Applications" by D. Boroughs and E. Udren – Utility University (UU104)

"Planning of Smart Distribution Systems" by L. Dow, F. Katiraei and J. Romero Agüero – Utility University (UU311)

"Industry Experiences with Microgrids Applications in Modern Power Distribution Systems" – Distributed Energy Resources and Renewables Panel – J. Romero Agüero, moderator

"Microgrids" Breakfast Roundtable – J. Romero Agüero, moderator

"Smart Substations – Protection, Communications, Control, Wide-Area Measurements, Enterprise Integration & Applications" by D. Boroughs and E. Udren – IEEE Innovative Smart Grid Technologies (ISGT) Conference, February 17, Washington, DC
Aging workforce is also a critical challenge. It is estimated that through 2020, more than half of the workforce (including engineers and skilled workers) will be eligible to retire or leave for other reasons. This represents a major talent gap for the utility industry.

These and other challenges, such as the need to integrate growing levels of renewable generation (according to EIA projections, non-hydro renewable sources are expected to grow 3.2% annually, solar energy in particular is expected to grow 7.5% annually to 2040), are intended to be addressed by a combination of infrastructure and technology initiatives.

On the infrastructure side, for instance, FERC Order 1000 eliminated the Right of First Refusal (ROFR) or monopoly status for building transmission unless mandated by states. Therefore, it is expected to lead to increased transmission development.

Technology trends include the:

- Emergence and consolidation of the Smart Grid concept
- Proliferation of Distributed Generation (DG)
- Adoption of Plug-in Electric Vehicles (PEVs)
- Deployment of Phasor Measurement Units (PMUs) for implementation of the Wide-Area Monitoring, Protection, Automation and Control (WAMPAC) concept
- Convergence of Operations and Information technologies (OT/IT), including the deployment of Advanced Metering Infrastructures (AMI) and Advanced Distribution Management Systems (ADMS)
- Application of Distributed Energy Storage (DES) and microgrids to improve system resiliency and facilitate integration of renewable resources

Microgrids, although still incipient, represent an exemplary Grid of the Future solution, i.e., one that utilizes state-of-the-art technologies to address multiple objectives such as variable DG integration and resiliency, efficiency, reliability and power quality improvement. U.S. Microgrid capacity is expected to reach 1.8 GW by the end of 2017. There are currently 81 operational microgrids (including utility-owned deployments such as SDG&E’s Borrego Springs) and 35 under development.

These infrastructure and technology trends are being accompanied by changes in the way power systems are planned, operated and analyzed. Proliferation of variable DG is making the Transmission and Distribution (T&D) grid more complex and dynamic. This is creating an increasing need for grid analytics applications pertaining to modeling, analysis, planning and real-time operation of joint T&D systems and distributed grids, as well as better data gathering, processing, analysis and visualization functionalities. These applications should be able to handle the potentially massive amounts of data provided by Smart Grid technologies (e.g., AMI, voltage and current sensors, smart switches and reclosers, PMUs, etc.) with the purpose of extracting information that can be used in utility planning, operation and engineering activities in general, such as outage management, reliability analysis, etc.

Grid analytics are expected to be at the heart of OT/IT integration and play a key role in the operation of modern and future power delivery systems, with advanced functionalities and applications residing at the core of ADMS, Distributed Energy Resources Management Systems (DERMS), Energy Management Systems (EMS), and utility enterprise systems. It is expected that the global utility grid analytics market will grow to $3.8 billion annually by 2020, with U.S. utilities spending nearly $100 per home in grid operation and consumer-related analytics during the 2013-2020 period.

Figure 1 – Annual Capacity Additions and Cumulative installed Capacity of Grid-Connected PV

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Although tremendous progress has been made in these areas in the last decade, particularly in the technology space, slower changes have occurred from a utility business standpoint. This is starting to change, particularly among those electric utilities whose regulatory frameworks and business models made them vulnerable to threats posed by high penetration levels of DG.

A survey conducted among 200 utility executives and professionals indicates that increased interconnection of DG is the most significant challenge facing the utility industry over the next five years. Photovoltaic (PV) DG in particular has shown tremendous growth in the last decade. For instance, Figures 1 and 2 show the annual capacity additions, cumulative installed capacity and installed capacity by state in the U.S. of grid-connected PV DG for the 1998-2013 period. These figures show the exponential growth of PV DG and how proliferation of this technology is occurring not only in the Southwest, but also in the Northeast and Mid-Atlantic regions.

As discussed in numerous publications, including some describing evidence from recent experiences in Germany, under applicable conditions, DG proliferation might lead to a vicious cycle of decreasing electricity sales, customer grid defection, lost revenues and higher rates, commonly known as the "utility death spiral", which is shown in Figure 3. Although there is no consensus regarding the magnitude of the potential impacts of this cycle on the U.S. electric utility industry (some authors and industry experts foresee a very negative scenario, others acknowledge the threat but believe that the utility industry is financially robust enough to face this challenge, and others see it as a lobbyist effort), there is agreement that electric utilities need to pay attention to the emergence of DG. This includes assessing if under their existing regulatory framework and potential DG adoption rates the "utility death spiral" could represent a threat to their business.

Grid parity of DG technologies, such as PV and customer grid defection, might represent a "game changer" for electric utilities. It is worth noting that when and where this is expected to happen is still a matter of debate. For instance, results of studies conducted by the Rocky Mountain Institute and the Institute for Local Self-Reliance indicate that PV grid parity is expected to occur in the next 15 years in various markets in the U.S. Although these results depend on various assumptions and have been debated by industry analysts, the trend is clear; PV and energy storage are becoming less expensive and adoption is expected to continue growing. This is shown in Figure 4, which presents historical prices for residential and commercial PV systems.

Figure 2 – Installed Capacity by State and Year (Residential & Commercial PV)
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Prices of energy storage technologies, which are potential enablers of further proliferation of DG\textsuperscript{21}, have also decreased steadily in the last decade\textsuperscript{22} and favorable legislation, such as the mandate to install 1.3 GW of energy storage passed by California in 2013\textsuperscript{23}, or Oncor’s intention to invest $5.2B to deploy 5 GW of distribution-grid-connected utility-owned battery energy storage systems\textsuperscript{24}, could accelerate this trend. It is worth noting that the potential threat from grid parity and grid defection is being acknowledged beyond the utility industry. For instance, in May of 2014, Barclays downgraded the bond market rating of the entire U.S. electric utility sector against the U.S. Corporate Bond Index. The driver behind this recommendation was the increasing opportunities from ratepayers to reduce electricity consumption via PV and battery energy storage systems\textsuperscript{25,26}, which could "reconfigure the organization and regulation of the electric power business" in the next ten years.

Utilities in general need to pay attention to the decreasing prices of DG and to potential disruptive changes in technology and regulation. Although there is disagreement regarding when grid parity of DG technologies will be achieved, there is overall agreement about historical trends showing decreasing prices and growing R&D expenditures that may trigger the emergence of a disruptive solution. As shown in Figure 4, PV prices have decreased steadily and rapidly in the last decade\textsuperscript{27}, if the trend continues or accelerates and if there are regulatory changes, PV or other technologies can become an alternative for some customers. These customers may not disconnect from the grid completely, but may use sufficient electricity generated by their own PV systems to decrease utility revenues and become an important threat.

The need for modern business models that address not only the aforementioned challenges associated with grid parity and customer grid defection, but also the business opportunities created by the proliferation of distributed grids and evolving customer requirements, has prompted the emergence of proposals such as New York’s “Reforming the Energy Vision” (REV)\textsuperscript{28}. This proposal considers the introduction of regional distribution markets where DERs and prosumers (customers with the ability to produce and consume electricity) are expected to be able to conduct physical and financial transactions, as well as the establishment of market and grid operators, analogous to the Independent System Operator (ISO) concept used in bulk power systems. Evidently, this proposal to empower customers requires significant regulatory and policy changes, and "soul-searching" from electric utilities regarding their future role and strategy to provide value to end-users.

It is important to highlight that the acuteness of some of the issues previously described will certainly vary among different regions of the country. However, they provide a good indication of emerging trends that the industry is considering and that are already shaping the Grid of the Future.

References:

6. Electric vehicles have experienced a steady although slower growth than DG, forecasts by different organizations are not fully consistent regarding the adoption rate of this technology, however, all of them coincide that the market is expected to grow. Projections prepared by the Electric Vehicle Transportation Center forecast cumulative sales for the 2013-2023 period to be in the range of 1.8 to 7.3 million vehicles, http://evtc.fsec.ucf.edu/reports/EVTC-RR-01-14.pdf
Protection, Control & Automation for Renewable Integration & Microgrids
By Farid Katiraei, Bahman Koosha, Tim Chang, Ahmad Momeni and Saman Alaeddini

The need for substation controls and system automation is getting more and more attention as the grid becomes more complex and new Smart Grid applications are introduced. Today, large scale solar farms, wind farms and MW-sized Battery Energy Storage Systems (BESSs) are integrated in many HV/MV substations as part of independent power producer plants or by utilities to support grid operation.

Due to their variable generation profile and uncertainty in resource availability (i.e., change in wind speed and solar radiations), Renewable Energy sources (RES) should be closely controlled with more precise and intelligent control schemes to minimize any adverse impact on the operation of the grid and meet the utility interconnection requirements.

In addition, especially for integration into transmission systems (66kV and above), Transmission System Operators (TSOs) have introduced several Grid Codes and Market Rules for any participating generation facilities. The main objective of market rules is to ensure grid stability (voltage and frequency) and achieve flexible control and dispatch of all generation assets including variable renewable energy resources.

Various levels of protection and automation, as well as remote monitoring and controls through system operator commands, are needed to meet grid integrity and stability criteria during sudden changes in the operating conditions and/or system contingencies. For example, similar to dispatchable generators, RESs should also be able to follow voltage reference set points issued by system operators and curtail their output if there is more generation compared to the system demand from critical/base plants and/or low cost sources (e.g., hydro generators and nuclear plants). Examples of typical control and protection functionalities for an RES interconnection are listed in the table above.

**Control & Communications Challenges**

One of the major challenges in control and monitoring of Distributed Energy Resources (DERs) – comprising renewable generation and energy storage – is the communication among various power electronics, control, metering and protection devices from various vendors, as well as interface to utility operation centers. Typically, not all devices communicate through similar protocols. On the other hand, a secure and reliable gateway for utility access and remote control is also required. A variety of legacy and proprietary protocols can be expected. More commonly DNP3 protocol is used for utility communications and in protective relays interfacing at substations.

In dealing with large-scale deployment of RESs, the key objective of the communications and monitoring for renewables and microgrids is to provide visibility into and controllability of a distributed system for utility operators. Although any DER interconnection is required to go through screening and impact study evaluation, to ensure system stability and integrity, a system operator needs to have the capability to oversee the operation of an RES unit and to dispatch controllable resources (generation, energy storage and adjustable loads). In addition, the control schemes should work reliably if the remote communications to the control center is lost. Hence, proper localized (autonomous) supervisory control and monitoring solutions that operate remotely and in a stand-alone mode will be required to meet the reliability and resiliency of the design (fail safe mode).

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Today, utilities are experiencing a proliferation of power electronic-based devices in the system, being utilized as part of generation (PV inverters or wind inverters), energy storage (battery or flywheel) or power conditioning devices (STATCOM, Dynamic Voltage Controller, Solid State transformers, etc.). Dynamic response and behavior of power electronic-based DERs and power conditioning devices are completely different than conventional rotating machine-based generation and electromechanical voltage control devices. As an example, in response to a fault on a distribution system, a PV or wind inverter can only provide a very limited amount of fault current that may not be adequate for conventional overcurrent relays to detect and clear a fault case.

Their responses to symmetrical and asymmetrical faults are also different than those of conventional generation plants, making it challenging for utility engineers to analyze protection requirements and ensure coordination among devices. The key protection design aspects in the presence of renewables are:

- Setting adjustment and protection flexibility to avoid nuisance trip due to fast-clearing switching events, such as faults on transmission systems (LVRT, HVRT, and in general, fault ride-through requirements)
- Change in protection coordination and impact on circuit breaker fault interruption capacity with large number of inverter-based DERs
- Sequential (delayed) reconnection of DER facilities and segregation of startup processes for multiple units in a facility to avoid inrush and large transients during restoration

In addition, for Microgrids, changes in protection requirements and re-coordination during the islanded operation and transition between various zones or stages of circuit/load energization need to be investigated. Upon islanding, the short-circuit capacity of the system will drastically change. Also, power flow direction in the islanded area will be different than the normal operation when the circuit is supplied from the main grid. All of the above changes require in-depth evaluation of the protection methodology and relay settings for the islanded area. Change in the protection zones and use of relay setting groups should be analyzed to ensure reliability and dependability of the protection schemes within the islanded area.

An Integrated Design & Development Approach

Quanta Technology experts have been working with several North American utilities on pilot microgrids and community renewable energy systems that include high penetration of renewable generation resources and fast acting power electronic devices (for power conditioning). Through these projects, our team has introduced a cost effective and modular approach for Renewable Automation and Microgrid Protection and Controls (RAM-PAC). The RAM-PAC method is able to control and determine operating setpoints for solar and wind farms, BESSs, diesel/gas generators and loads in a coordinated manner.

The control system is designed according to the IEC 61131-3 standard language and has a modular structure for applying various controls and communications blocks. It also incorporates a Human-Machine-Interface (HMI). An example of HMI representation for a Renewable Community Energy System (RCES) is shown in Figure 1 on the previous page.

Figure 2 - Main building blocks of a power balancing logic for

Figure 3 - Proposed scheme for microgrid controller based on RAM-PAC approach

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The example RCES consists of renewable generation (solar PV systems), battery energy storage units, diesel generators and multiple loads. The point of interconnection of the RCES with the rest of the grid is controlled with a circuit breaker to disconnect the community load and generations from the grid upon system abnormality (including grid outage) and operate as island (micro-grid).

RAM-PAC incorporates control and protections for two separate modes – Grid Connected Mode (GCM) and Stand Alone Mode (SAM) – as well as managing transitions between the two modes. In GCM, the ‘battery’ State of the Charge (SOC), the switching capacitor status and On Load Tap Changer (OLTC) are controlled to maintain proper voltage/reactive power profiles and reserve capacity. In SAM, or ‘islanded’ mode, the controller acts as a supervisory control system as part of substation controls and protection to apply a power balancing scheme with the aim of increasing contribution of renewable resources (PV & wind).

The RAM-PAC approach incorporates an autonomous control and monitoring method linking several communication protocols and schemes used in commercial devices (meters, protective relays, DER interfaces) to allow remote control access for an operator. The method also incorporates provisions for localized supervisory control for continuous operation in case of communication failure. Challenges such as integration of multiple devices, development and troubleshooting of settings and configuration files to manage the commissioning process in the field are typically addressed and verified in a laboratory environment before before deployment to the field.

Advanced Testing & Verification Requirements

Implementation of distribution automation and smart grid applications in a utility environment involves introduction of several emerging and advanced technologies as part of existing systems or as new additions. Targeting a variety of grid supporting applications, the proposed smart grid technologies are based on complex intelligent electronic devices (IEDs) and digital controllers as building blocks to provide a multitude of operational features and asset management capabilities expected from these systems. Moreover, field deployment of the technologies brings about many new technical and non-technical challenges that require detailed investigations and understateing of possible interoperability and interaction issues prior to wide-scale utilization. The desired technology may still be in a prototype stage and/or not mature enough to consider a utility grade product. These challenges emphasize the need for extensive testing prior to deployment of devices and system integration in the field.

For the above reasons, the controller functionality is extensively tested and verified, using a Real-Time Digital Simulator (RTDS®) hardware-in-the-loop setup, in which multiple system conditions and various operating scenarios are simulated and evaluated. The approach utilizes hardware-in-the-loop testing of IEDs and digital controllers in interaction with a simulated model of the selected part of the grid under study. An example of RTDS setup for hardware in loop testing is shown in Figure 4. The testing approach incorporates:

- Defining testing methodologies for the end-to-end functional and system integration testing
- Development of proper test plans and identifying a series of evaluation criteria that can be applied to and investigated on the test setup
- Performance examination of controllers and energy management systems (commanding, data monitoring, and protection functions) prior to field deployment

The community energy systems are simulated in the RTDS. Various resources and control/protection devices that are part of the energy management system and supervisory controls are integrated with the RTDS through actual hardware. Extensive test cases are proposed to verify control system operation under normal and contingency conditions. The test results are utilized to troubleshoot the controller, communication schemes, and data exchange among various devices.

In summary, the proposed design and testing approach has proven to be cost effective and introduces a reliable method for development of supervisory controls and automation requirements for the renewable systems. The approach is vendor-independent and can be implemented on different commercial control platforms available in the market.
A Time Series Simulation Method for Slow Dynamic Analysis in Distribution Systems Planning Study with DERs

By Li Yu

With the increase of Distributed Energy Resource (DER) proliferation levels in distribution systems, utilities are concerned about impacts introduced by the kinds of DER interconnections, especially when IEEE 1547 allows DERs to have voltage support function. Traditionally, a snapshot load-flow based steady state planning study was performed before the interconnection of a DER. Currently, many planning software programs are equipped with load-flow based quasi- dynamic simulation tools (dynamic module of CYMEDIST, SynerGEE, EPRI OpenDSS, etc), which can study the slow dynamics caused by the intermittent characteristics of DERs.

The slow dynamics mainly contain the system voltage, loading profile and operations of voltage regulation devices. Slow dynamic analysis, which fully models the intermittency of DERs, can provide much closer system evaluation than snapshot load-flow analysis. However, since the DER voltage support function is not modelled in these quasi-dynamic tools, they do not have the capability to completely address the condition when DER has voltage support function.

Also, the modelling function of most existing tools is limited within the modeling voltage regulator, LTC and capacitor control. Theoretically, EMTP-type simulation can be used for all of these kinds of slow dynamic simulations. However, using EMTP-type simulation is obvious overkill and, due to the limitations of computer CPU capability and RAM size, it has limitations for aspects of length of simulation and time consumed for simulation.

In this article, a time series simulation method for slow dynamic analysis in distribution systems with DERs is introduced. Compared with existing planning software, this method is for a script-based simulation environment, and can model and simulate a DER’s voltage support function, voltage control and regulation

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Time Series Simulation Method  **Continued from page 9**

devices (LTC, voltage regulator, capacitor), and some protection devices (network protector).

This method only requires a load-flow calculation engine which can be easily found from other software, such as OpenDSS, Matlab-PST, CYMEDIST. It models all control functions (control of LTC, capacitor and DER voltage support function) outside the load-flow calculation in the script according to their control mechanism. It uses previous snapshot load-flow calculation results and time delay information of the control devices to predict the next step control actions and time delay of the voltage regulation devices and DERs. Based on the prediction, it modifies the load-flow calculation input files for next-step load-flow calculation and generates a time stamp for it.

The calculation starts when system status changes, such as DER generation change, voltage regulator tap change, and stops when system reaches steady state, which means no device will operate. Since it is load-flow calculation based, the running time of the simulation is much shorter than the EMTP-type simulation. A system with ‘n’ different kinds of time related control functions and a DER intermittent generation profile is used to illustrate how to determine time stamp of m-th snapshot load-flow calculation in Figure 1.

This method has been applied to several studies when both voltage regulation devices and DERs with voltage support function are involved. By comparing with EMTP-type simulation, only negligible mismatch is observed (Figures 2 to 4). It can be found that the introduced time series simulation method can produce simulation results very close to those produced by commercial EMTP-type software in much less time. As DER proliferation increases and distribution systems evolve into complex active grids, it is expected that there will be growing needs for robust and efficient methodologies, such as the one presented in this article.

Software developers have started to recognize this need and, in the last five years, have started adding new features to distribution system analysis software. As discussed in this article, it is highly recommended that future software solutions are able to handle both steady state and dynamic modeling and analysis using the same computational models. This will further increase efficiency in performing distribution engineering and planning studies.

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References (continued from page 9)

14 S. Nadel, Utilities are frightened of a “death spiral.” They shouldn’t be, ACEEE, http://aceee.org/blog/2014/06/utilities-are-frightened-death-spiral
In continuation of the protection project for Centro Nacional de Control de Energía (CENACE) and TRASELECTRIC in Ecuador, the Quanta Technology team had the opportunity to take a technical tour of two key CENACE/TRASELECTRIC substations in December 2014. During these visits to the Santa Rosa and Pomasqui substations, Quanta Technology, CENACE and TRASELECTRIC staff had technical conversations regarding the protection management tool that they are using to record events in the electric power system.

Once the events are captured using the tool, the operators use an automated system to classify events based on their location, characteristics, and the protection devices and alarms to which they reacted. This protection management tool is used in all electric power substations in Ecuador and has provided outstanding results. It will be evaluated further as the project continues and Quanta Technology develops additional functional requirements.

In late October, Quanta Technology staff visited XM in Colombia to present the final results of the USTDA-funded “Technical Assistance for the Intelligent Supervision and Advanced Control System for the Colombian Transmission Grid” project. The final task proposed regulatory modifications in Colombia so the synchrophasor technology could be successfully implemented in the electric power system. According to the planning authority that directs the transmission plans in Colombia, new requirements are being developed which would mandate a PMU in every substation. This is exciting news as these PMUs will provide additional observability of the electric power system which is particularly important for the extensive 500 kV infrastructure that is planned to be built in the next few years. With this visit, Quanta Technology delivered the final results to XM and successfully finished the project commitments.

IEEE PES President Elect, Dr. Damir Novosel, was the keynote speaker for the regional chapter meeting of the IEEE PES Latin America in Ecuador in December 2014. Dr. Novosel spoke on “IEEE Involvement in Addressing Sustainable Power Grids.”

Quanta Technology aims to be not only a company, but an integral part of our greater community, as well. In November 2014, our international business director, Dr. David Elizondo, was featured on the Fox50 TV news channel as an emerging voice here in the Latino community in North Carolina (https://www.youtube.com/watch?v=fiLZuxX5ZWo&feature=youtu.be).
WELCOME OUR NEW PEOPLE

Bobbi Welch, Principal Advisor, Transmission & Regulatory, has over 25 years of utility industry experience including operational compliance with NERC Reliability Standards. She has an extensive background spanning regulated and deregulated business environments, wholesale and retail markets, generation, transmission and distribution.

Aidan Murphy, Advisor, Protection & Control, has over nine years of experience within the Transmission and Distribution industry, both in the U.K. and the U.S. He is a Chartered Electrical Engineer (CEng) with a background in Power System Protection and Control and Project Management.

RECENT & UPCOMING CONFERENCES

January 12-15 IEEE PES Power System Relaying Committee Meeting (Garden Grove, CA)
January 12-16 IEEE PES Joint Technical Committee Meeting (Garden Grove, CA)
January 21-22 Transmission Summit West (Sweetwater, TX)
February 17-20 DistribuTECH (San Diego, CA)
February 17-20 IEEE PES Innovative Smart Grid Technologies (Washington, DC)
March 23-25 North American SynchroPhasor Initiative (San Mateo, CA)
March 23-25 Power Grid Resilience (Arlington, VA)
March 25-27 i-PCGRID (San Francisco, CA)
March 30 -April 2 Texas A&M University Relay Conference (College Station, TX)

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Quanta Technology’s e-News online newsletter is published four times per year, in both electronic and printed form, and in special editions for important industry events. If you would like to receive your copy, please contact Lisa Williams at (919) 334-3071 or lwilliams@quanta-technology.com.

Yi Hu - IEEE Fellow
Congratulations to Dr. Yi Hu for recently becoming an IEEE Fellow. Dr. Hu has over 24 years of experience working with electric utilities and vendors and is the Director of the Wide-Area Monitoring, Protection and Control (WAMPAC) business area. He has developed a number of concepts and methods to improve power system operation, protection and control.

ABOUT QUANTA TECHNOLOGY

Quanta Technology is an expertise-based, independent consulting company providing business and technical expertise to the energy and utility industries for deploying holistic and practical solutions that result in improved performance. Quanta Technology has grown to a client base of over 100 companies with an exceptional staff, many of whom are foremost industry experts for serving client needs.

We are a subsidiary of Quanta Services, Inc., headquartered in Houston, TX, (NYSE: PWR), member of the S&P 500, with 2013 revenue of $6.5 billion. The company is the largest specialty engineering constructor in North America, serving energy companies and communication utilities, according to McGraw Hill’s ECN. More information is available at www.quantaservices.com.

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