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Electric Energy T&D MAGAZINE

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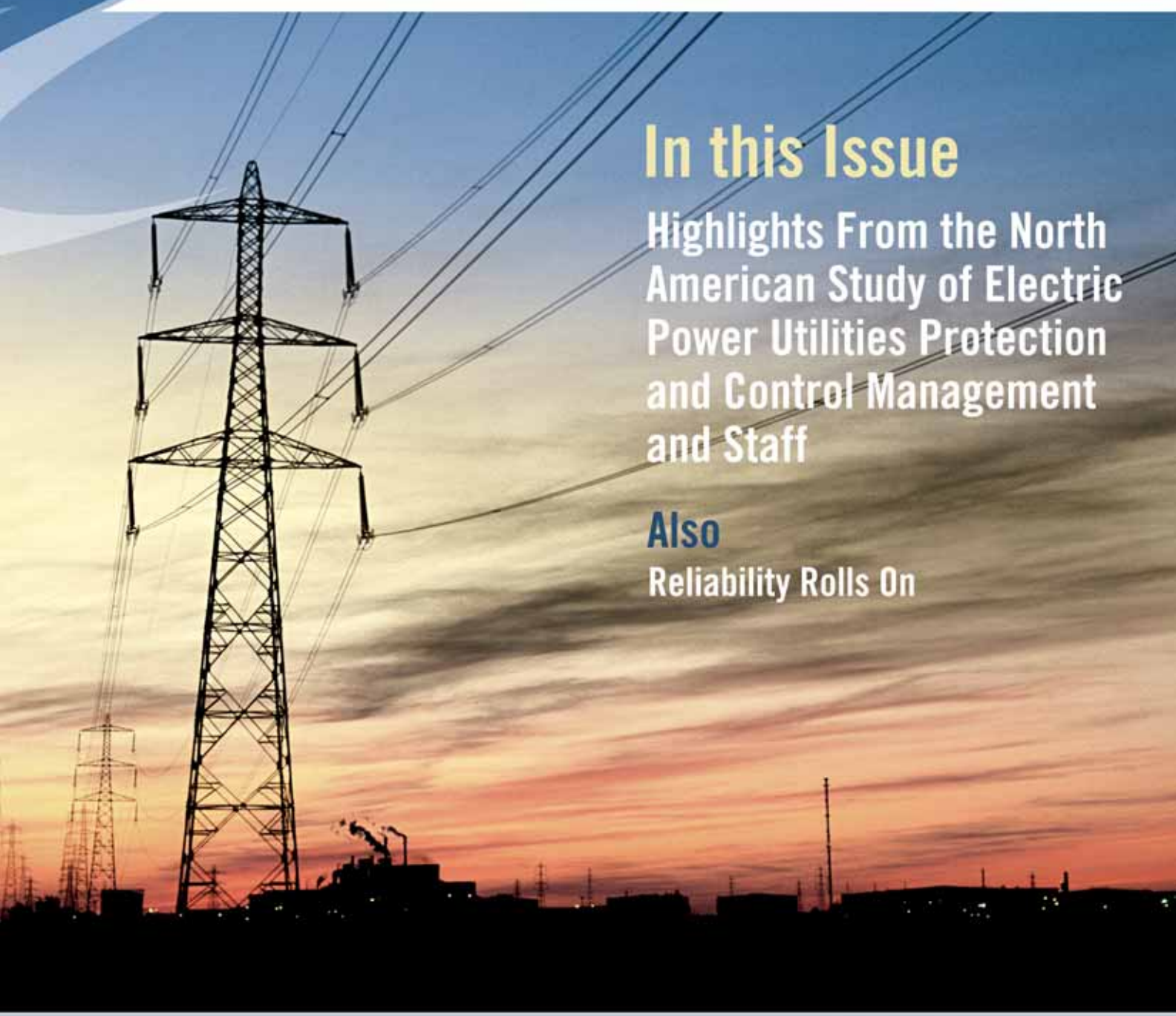

In this Issue

Highlights From the North American Study of Electric Power Utilities Protection and Control Management and Staff

Also

Reliability Rolls On

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IN THIS ISSUE

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Inner-Tite Corp. announces a three year contract to provide over 600,000 Meter Locking Rings

Holden, MA - Inner-Tite Corp., manufacturers of security devices for utilities, announces they have been awarded a three year contract to provide Sacramento Municipal Utility District (SMUD) over 600,000 Meter Locking Rings. The security devices are to be installed with their AMR deployment over the next three years. The order consists of both the 100% Stainless Steel Meter Locking Ring as well as the new Multi-Shot Preloaded Meter Locking Ring.

SMUD is a community owned utility that has been providing Sacramento County with electricity for over 60 years. With nearly 600,000 meters SMUD is the 6th largest community-owned electric utility in terms of customers served. The utility has been a customer of Inner-Tite for years, using such products as Front and Side Entry Meter Locking Rings as well as Clearseal meter seals. The Multi-Shot Ring was evaluated during the AMR pilot and has earned SMUD's approval and inclusion in their three-year AMR deployment.

The Multi-Shot Ring was designed to fill the need for an economical medium security locking device. "Everyone loves how this new ring performs!" states Inner-Tite Corp's General Sales Manager Lee Holovnia, "Our Engineering Team really hit a home run with the Multi-Shot. It is so easy to install because of our patented Pre-load design, and the Multi-Shot provides a level of security that is unmatched at this price. The economics are ideal for any utility that is deploying an AMI program."

The Multi-Shot Meter Locking Ring features a one-piece assembly and is available in carbon or stainless steel construction. Cadmium and yellow chromate plating on the carbon steel Multi-Shot provides superior weather and corrosion resistance for long term field performance. Options include your choice of standard or short length barrel lock. The patented Pre-Load feature enables the device to be installed quickly, easily and with exceptional reliability without the use of a key. Utility companies have found this option to be invaluable, particularly when using contractor installers, since keys do not need to be issued to non-utility personnel.

Visit www.inner-tite.com for more information.
Circle **103** on Reader Service

TriModTM 600R Vacuum Recloser with Single or Three Phase Operation Directly Compatible with the SEL 651R for Single Phase Tripping

The TriMod 600R is a 3 phase recloser with the ability to be programmed for 3 phase trip / 3 phase lockout, 3 phase trip / single phase lockout, or single phase trip / single phase lockout. The JHV TriMod 600R is the latest in a long line of Joslyn vacuum reclosers that incorporate solid dielectric insulation that has been field proven for over 40 years.

The new TriMod 600R is rated for 10,000 maintenance free operations, up to 16kA of current interruption, and up to 800 A of continuous load duty. Please refer to the list of features below that have made the TriMod line of reclosers, including the new 600R, the choice of industry professionals around the world:

Features:
- Single and three phase operation
- Three phase trip / single phase lockout programmable
- Long-life vacuum interrupters – no oil or gas
- 10,000 operations with no maintenance

- Field-proven solid dielectric insulation
- Up to 16kA of interruption ability
- Up to 800A continuous load duty
- Replaceable current transformers with metal safety covers, providing a safety ground barrier
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Joslyn Hi-Voltage manufactures power transmission and distribution equipment for electric utilities including reclosers, sectionalizers, capacitor switches & controls, transfer switches, distribution automation equipment, disconnect switches, load break interrupter attachments, and load break underground switches. Products use vacuum technology for fault interruption. The company also manufactures Fisher Pierce brand distribution equipment including Powerflex and Autocap capacitor controls, faulted circuit indicators (FCIs), current sensors, and Smartlink communications equipment for fault monitoring and reporting.

For more information visit: www.joslynhv.com.
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At EIS, we present a diverse, yet cohesive solution set to every customer. Core to our solution is the use of intelligent mobile and mesh network communications. Our system solutions deliver optimum performance and functionality today without impeding migration into new technology in the future.

Sharon Allan, president
Elster Integrated Solutions

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Crane Takes KUA to New Heights

KISSIMMEE, Fla., April 2, 2007 – Kissimmee Utility Authority (KUA) on Friday accepted delivery of the tallest aerial device in its 140-vehicle fleet. The hydraulic telescopic crane will be used by utility crews for construction and repair of utility poles and lines.

The crane has a working height of 168 feet – equivalent to a 17-story building – and a lifting capacity of 38 tons. On a clear day at full height, a passenger is able to see up to a distance of 22 miles.

The $273,300 truck was manufactured by Birmingham, Ala.-based Altec Industries, Inc. The investment is expected to pay for itself within five years in reduced crane rental costs.

When working on a job site, retractable outriggers are extended horizontally from the truck chassis then down vertically to level and stabilize the crane while stationary and hoisting. The outriggers must lift all the weight of the truck up off the tires to provide maximum stability.

KUA crews have been trained on the operation of the crane over the past several months using a loaner vehicle supplied by Altec.

At a ceremony held Friday, the device was extended to full height and christened with bottled water by KUA president and general manager Jim Welsh and Kissimmee City Commissioner Cheryl Grieb.

Founded in 1901, KUA (www.kua.com) is Florida's sixth largest community-owned utility providing electric and telecommunication services to 170,000 residents in five Central Florida counties.

For additional information, please visit www.kua.com.

Circle **105** on Reader Service

All banks need protection

Today, **shunt capacitor banks** play an increasingly vital role in **blackout prevention** and supporting the growth of **distributed generation** facilities like wind farms. Protecting this equipment has historically involved complex, custom protection schemes consisting of multiple products that rarely addressed the inherent system and bank unbalance.

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Advanced Mobile Technologies + Fleet Asset Management = Business Optimization

The electric and gas utility business climate has changed dramatically over the past decade. Deregulation has resulted in more scrutiny by regulators, elected officials, and consumer groups. As a result, deregulated utilities must meet performance metrics in order to maintain the rate of return received for their stockholders. The operations group has the greatest ability to impact these performance metrics based on how efficiently it is operating in the field. Due to a lack of accurate field data, they are unable to make the most efficient use of assets and personnel to effectively meet performance targets.

What can you do to help positively impact performance based metrics? Here's a good first step:

• Provide real-time field execution monitoring and feedback loop.

With consistent and accurate information about your field services via mobile resources – you can better manage your assets and people performing structured and unstructured work in the field. Armed with this field reality check, utilities can optimize the efficiency of their mobile operations to reduce Customer Average Interruption Duration Index (CAIDI), meet Dig-Safe commitments, and respond efficiently during emergency situations.

• Rather than relying on inefficient phone call or radio communication to mobile workers, install a mobile resources asset management system to manage your fleets.

Advanced mobile technologies automatically deliver location status and diagnostic details from vehicles using GPS, cellular network and Internet technologies. Immediately, you can visually monitor your entire mobile operation, locate vehicles and portable equipment, and determine actual routes driven to field locations.

With this level of visibility and real-time information, you can proactively manage your fleet and mobile workforce to drive the business optimization results your company demands.

Back-to-School for Business Optimization

If you really want to take your fleet management to the next level, below is an even more exhaustive look at areas for improvement. The following twelve exercises are designed to help you identify areas of business optimization that will drive the return on investment (ROI):

Labor Costs

1. Dispatch Workforce Productivity

Rather than hunting for vehicles or field crews, this will provide the exact location, improving the productivity of dispatchers. This capability will also enhance customer communications.

2. Field-based Workforce Productivity (time saved)

This allows dispatchers to make better decisions regarding how to leverage existing resources in the field. It translates into reduced travel time and reduced talk time for your field workforce.

3. Field-based Workforce Productivity (jobs completed)

Determine departure time in the morning and how much time is spent traveling to the job, the actual route taken, and duration on job site. Experience indicates that these checks, balances and documentation, that were never before available, will help managers optimize field workload to get more work done with existing resources.

Fleet Management

4. Miles Driven Reduction

A key challenge in reducing fleet management costs is managing drivers' routes to decrease miles driven and associated fuel consumption. While some detours cannot be avoided, drivers who repeatedly diverge from pre-planned routes typically drive longer distances and therefore use excessive fuel.

5. Vehicle Maintenance Parts Savings

Traditionally, the information required to manage a fleet of vehicles was derived from observations made at the maintenance facility or by calendar. Today, advanced on-board diagnostic technology allows vehicles to

generate and store observations about itself. There are advanced mobile technologies that monitor and automatically report vehicle mileage and diagnostic information, which will enable your company to maintain fleet vehicles in a more proactive manner. The availability of better maintenance information will play a major role in reducing in-service breakdowns and the costs associated with parts for vehicle maintenance.

6. Vehicle Purchase / Lease Savings

By decrease speed and monitoring risky driving behavior you can reduce accidents. This will reduce the vehicle pool required. By monitoring diagnostic codes from the on-board computer you can fix problems early and extend the lifr of vehicles. Maintain a detailed list of each vehicle in use – number of vehicle leases purchased each year, cost per vehicle – to understand your total cost savings per year.

Fuel Costs

7. Engine Idle Time Reduction

Managing excessive engine idle without PTO time is also a key factor in reducing fleet management costs. While some idle time is authorized under State labor laws, excessive idling has a negative impact on fuel consumption as well engine performance.

8. State Fuel Tax Refund

In most States, your company is eligible for reimbursement for tax paid on fuel used for purposes other than operating motor vehicles upon the public highways of the state, and for fuel used to operate a power take-off (PTO) device.

9. Excessive Speed Reduction

Aggressive drivers are another factor contributing to excessive fleet management costs. A recent study from the U.S. Department of Energy states that following the speed limit can improve gas mileage up to 23 percent. Fleet managers can assume that each 5 mph driven over 60 mph is like paying an additional $0.21 per gallon for gas.

Risk Management

10. Vehicle Inspection Compliance

In some states certain vehicles types must be inspected every 90 days. For the first time, a prominent utility company missed a 100-foot bucket truck inspection due date because the vehicle could not be located in a timely manner. Implementing an advanced mobile resource management system will enable you to automatically track the location of all vehicles, reducing the risk of non-compliance with inspection regulations.

11. Air District Reporting Compliance

The State of California requires portable equipment usage to be reported by air quality district within five days or face penalties. Automatically tracking the usage of portable equipment helps reduce the risk of non-compliance in air quality reporting.

12. Driver Safety / Accident Reduction

Research indicates a strong correlation between speeding and accidents. Not only do accidents impact employee safety, they tarnish your company's public image and increase your operational costs with lower fuel economy and higher liability costs. By managing your fleets through GPS and other mobile means, you can set speeding thresholds and send alerts when thresholds are exceeded to proactively manage safety. It also provides you with an audit trail when incidents occur, which will help you identity the root cause of traffic incidents. Improved safety will have an added benefit of reduced fleet maintenance costs because fewer spare vehicles, which are more costly to maintain, will be back in circulation.

Mobile asset management can help you take business optimization to the next level. But be judicious in the way you use the information. Consider using information to reward rather than punish. Use the data to create a baseline of performance for your organization, and then set realistic goals for optimization. Finally, measure and monitor your performance using the data visualization techniques that have the most impact for your business.

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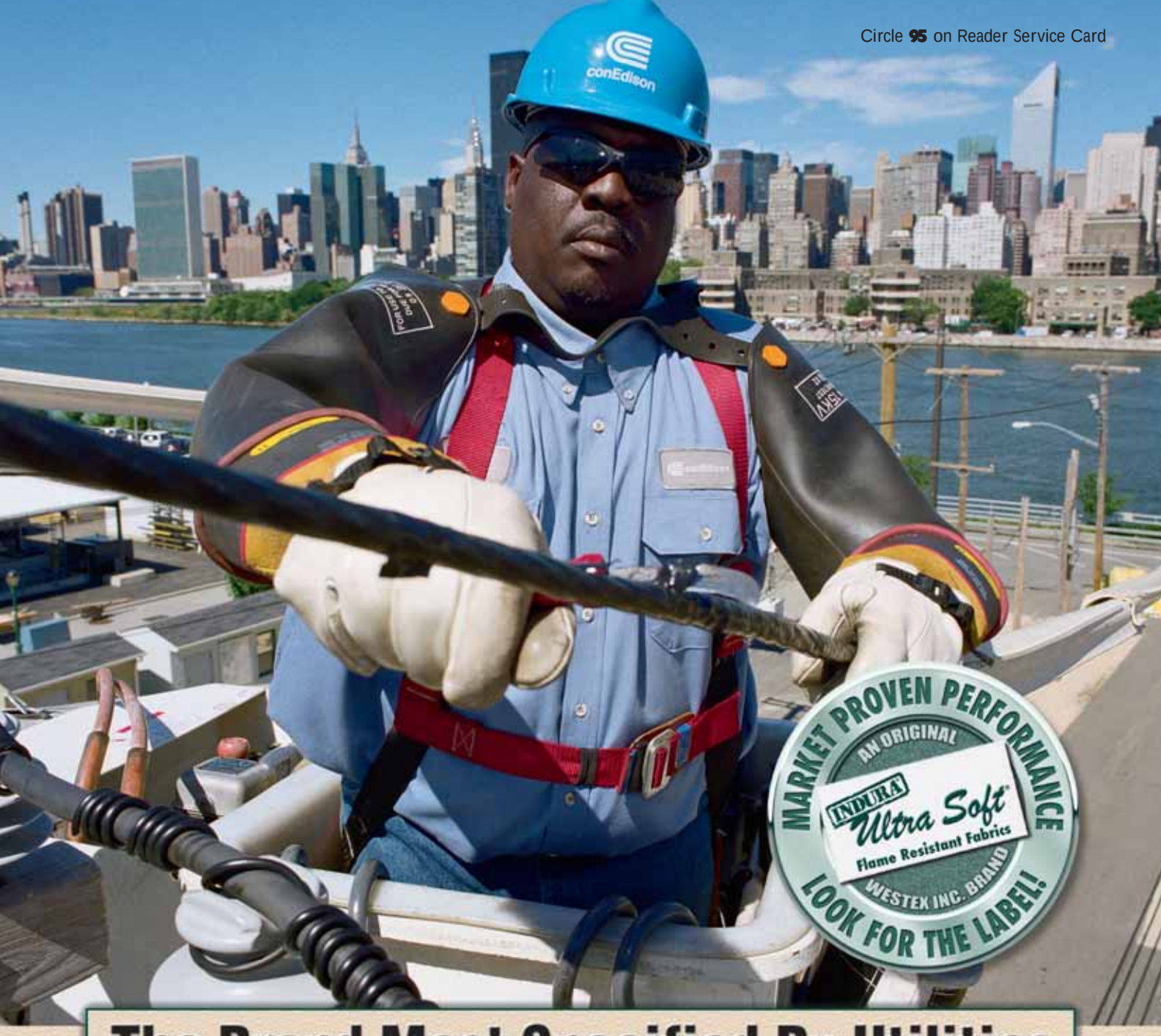

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By Michael A. Marullo, Contributing Editor

Truth or Consequences?

As you read this, Mardi Gras 2007 will be but a faint memory and our other annual event – the New Orleans Jazz & Heritage Festival – or "Jazz Fest" as it is now widely known – will be running its course before hundreds of thousands of visitors in late April and early May. Yes, despite the lingering devastation of Hurricane Katrina, the spirit and culture of this area has managed to rise above the fray with two of the biggest and most popular fun-fests on the planet going on as always. But, this isn't about those realities – it's about perceptions. As it is often said, perception is truth, and the older I get, the more cogent that cliché becomes.

If you're surprised to learn that anything is back to normal here, you're definitely not alone. The fact is, a lot of folks have developed perceptions about our situation without ever being here. Yet for them, it has become reality… their personal truth. But New Orleans has always been a study in contrasts, and post-Katrina, those contrasts are more pronounced than ever. Notably, some parts of the city appear untouched while other areas look pretty much just as they did on August 30th – the day after Katrina.

These days when people ask me about how the area is doing now, I usually say: "If you just land at the airport and take a cab directly to the French Quarter you would never guess that anything bad happened here. On the other hand, if you stray just a few blocks off that path, an entirely different scenario unfolds; you'll likely feel like you've wandered onto the set of a future-shock movie." But not everyone has the opportunity to see first hand what has happened here. Instead, many are left to their own perceptions.

Just the other night a spokesperson for the New Orleans Convention Center was being interviewed. When he was asked how the city was doing with regard to retaining and attracting conventions, the answer – like the city itself – was mixed. He said that whenever he could get a convention planner or their representatives to visit the city, they almost always sign up (or re-book) once they see the actual conditions and that the Convention Center, French Quarter and supporting businesses are mostly back up and running.

By contrast, those who refused to take a look themselves made their decisions based exclusively on their perceptions. In those cases, the events hanging in the balance are usually lost to other venues. And, although those negative perceptions are in many cases far off the mark, the outcome is still the same: Everybody loses something that could have had a positive outcome.

Then, just a few nights ago I was amazed to hear again (on national news!) that there remains a large group of people out there who think that the city is still under water! As anyone who has been here knows, that is definitely not the case and hasn't been for a very long time. But obviously that doesn't alter the perceptions that some people accept as the truth.

As I wrote in my last column (The Madison Avenue Factor; March/April 2007), our human propensity toward believing we can tell the difference between truth and perception is legendary. In reality, however, thinking that we are unaffected by the bending, shaping and molding of the truth into something entirely different often leads us to the wrong conclusions – and sometimes drawing the wrong conclusions has consequences.

Let me offer a few examples of what I mean…

- There's a seemingly widespread notion that we can keep on running utilities the way they always have and that automation is still a luxury. While it's certainly true that we don't need to replace everybody with computers, the perception is that we can just go on the way we always have; automating only when regulators require it or when there is no other alternative. (See what happens over the next 5-10 years as Baby Boomers leave the workforce and infrastructure with 35-50 year useful life expectancies continue to decline for lack of investment.)

- Trade shows are routinely judged by attendance – almost exclusively on a quantitative basis. That is, the success of a given event is usually determined by how many people register, without regard to the quality or classification of those attendees. The truth is that it only takes one really good product/service discovery to make attending a conference worthwhile or a few good contacts to more than pay for exhibiting; but the perception is that if the attendance isn't equal to or greater than last year's event, next year's participation should be re-evaluated and possibly nixed.

- A lot of suppliers perceive that because over 75% of annual automation/IT expenditures are made by the largest (mostly investor-owned) utilities, calling on the more than 3,000 smaller

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municipal and cooperative utilities is a waste of time and resources when in fact, expenditures by smaller utilities are rapidly increasing, both as a percentage of overall expenditures and especially in terms of average project values.

Catch my drift? Well, just to be sure, let me offer some additional detail that should help frame the issue.

In March of this year I attended the 30th Annual Conference of the Geospatial Information & Technology Association (GITA) in a warm and sunny San Antonio. I've been to a lot of these conferences since my first one in 1988, and while some things have changed, a lot has remained the same.

For one thing, this conference always puts on a stellar educational program. There's a good reason for that; education is – and has always been – the underlying fabric of the GITA membership and management. Education is the centerpiece of GITA's annual conference not just because of its status as a non-profit professional association, but also because that was the premise upon which GITA was founded – and they have remained true to that commitment for over 30 years.

However, even though education is a big draw for most utilities looking for tangible value from their attendance and support of conferences like this one, the numbers for Conference 30 in San Antonio were down from prior years. It was pretty easy for anyone who had been to previous conferences to see that several exhibitors' booths had been downsized and that the aisles weren't as crowded as they have been in the past. So, naturally the perception of some attendees was that the conference wasn't as good as last year. Some even questioned whether it would survive for another year. As I said, that was the perception.

The truth is that Conference 30 attendance was down to 1,520 from last year's 1,855 – a decline of 335 participants, which at first blush might seem like a relatively significant decline. However, when one digs into the numbers, we find that of that 335 fewer attendees, over 200 of them were vendor personnel. And, while GITA certainly values the participation of its exhibitors and their staffs at the conference, this decrease is directly attributable to vendors bringing smaller sales contingents to the conference and a corresponding reduction in booth size. The recent surge in supplier consolidations/ acquisitions has clearly led to fewer exhibits this year and, hence, a net reduction in booth personnel; no one should be surprised by that, but perceptions can be powerful.

GITA's leadership is aware of the situation and has definitive plans to do whatever it can to halt and hopefully reverse this industry-wide trend. "The industry is changing, and GITA is absolutely devoted to taking on the challenge of addressing these changes on behalf of our members and constituents to accommodate all of the exciting shifts in geospatial technology," said Bob Samborski, GITA's executive director. "We know we have work to do and we will be actively seeking the input of our exhibitors and conference attendees to help make this happen."

Another reality, however, is that despite GITA's best efforts and those of the many other conference managers and organizations serving the utility automation/IT market, some components of this trend may be largely irreversible. To be sure, supplier consolidation is likely to continue, utilities seem destined to keep on merging and reducing head counts, and budgets for conference attendance will continue to be squeezed as other educational and information sources – most notably the Internet and mobile data – will continue their inevitable proliferation.

While this spells trouble for the trade show community at large, corrective actions are being taken, albeit a slow process. In GITA's case, they are among the first organizations to take pro-active steps toward sharing future conference venues with those of other conferences having geospatial market relevancy. (Although GITA's initiative was not necessarily a direct result of our Jan/Feb 2007 Utility Horizons column, you may recall that co-location was a central theme of that editorial. - MM)

Moreover, GITA has initiated an extensive plan to revamp the 2008 event. Included in that plan is research to gauge exhibitor expectations and a detailed survey of attendees' reactions to this year's educational content. GITA staff and members of the Board of Directors plan to meet with Seattle area GIS, utility, public sector, transportation, emergency response, co-op, health care, and other organizations in May 2007 to build a 'circle of champions' for developing a top-notch, relevant educational program and spreading the word about the conference locally and regionally.

What I hope this illustrates to you, our readers, is that the difference between perception and truth can be profound. Whether it's the aftereffects of a hurricane or the future of an industry conference, it's worth taking the time to peel back the leaves of the onion to judge the facts for yourself before making any decisions you might regret later. Failure to test your perceptions and making decisions based on less than the true facts, can quickly turn Truth-or-Perceptions into Truth-or-Consequences.

- Mike ■

Behind the Byline

Mike Marullo has been active in the automation, controls and instrumentation field for more than 35 years and is a widely published author of numerous technical articles, industry directories and market research reports. An independent consultant since 1984, he is President and Director of Research & Consulting for InfoNetrix LLC, a New Orleans-based market intelligence firm focused on Utility Automation and IT markets. Inquiries or comments about this column may be directed to Mike at MAM@InfoNetrix.com.

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Highlights From The North American Study of Electric Power Utilities Protection and Control Management and Staff

By Charles W. Newton, President, Newton-Evans Research Company, Inc.

Overview

North American utilities participating in the 2006 study of protective relay usage and trends account for more than 30% of all North American electricity customers and industry revenues, exceeding the participation levels in four earlier studies conducted over the past decade.

The number of North American utility protection and control engineers and engineering managers participating in the Newton-Evans protective relay study series continued to increase from a total of 64 utilities in 1999, to 79 utilities in the 2002 study, to 102 utilities in the 2004 study and this year, up to 112 utilities.

Average Percentage of Digital Relays in Installed Base and Planned for New and Retrofit Applications Purchases:

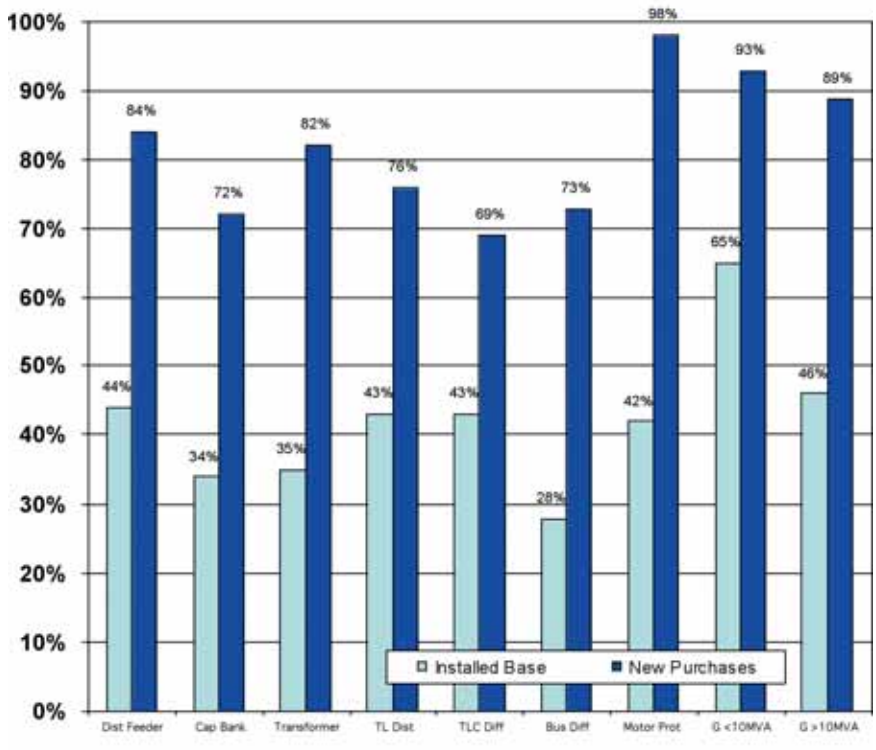
The 2006 survey has found that from 31% (bus differential relays) to 65% (small generator relays) of the installed base of protective relays in U.S. utilities is now comprised of digital relays. Percentages of new purchases tend to be dominated by digital purchases; however, significant opportunity exists in North America for electro-mechanical units, with from two percent to 18% of some units still being bought as electromechanical units. Almost all new motor protection relays planned for purchase (98%) are likely to be digital; this rate drops to only 82% for bus differential units.

Influence of Country of Manufacturing on Relay Purchasing Decisions:

A total of 111 utilities replied to the question: "Are your relay purchasing decisions influenced by the country of manufacture?"

Thirteen percent of the utilities indicated that they ONLY BUY from suppliers using North American manufacturing facilities. However, another 41% indicated that they prefer to buy from suppliers using North American production facilities. Forty-seven percent stated that the country of manufacture does not affect their purchasing decisions.

Figure 1b – North America
Percent of installed base and new purchases of digital relays by year end 2008



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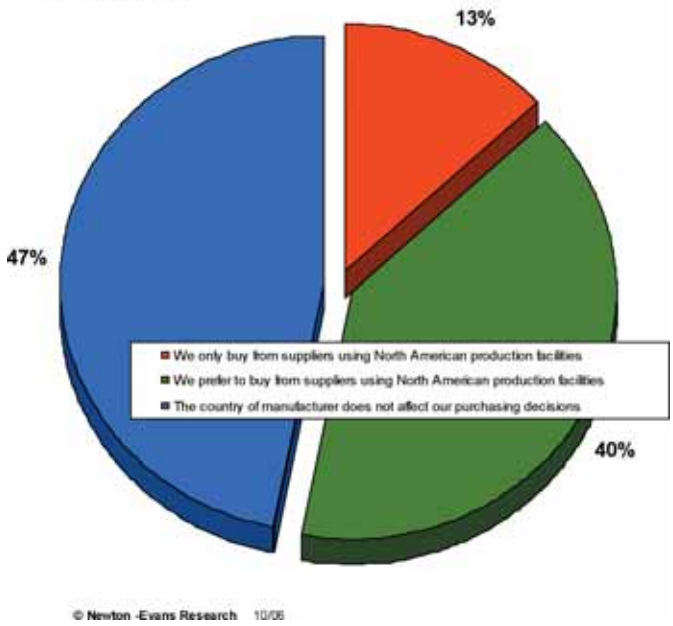
Importantly two-thirds of the cooperatives indicated strong preferences to purchase from suppliers using North American relay production facilities.

Figure 3 – North America
Influence of the country of manufacturer on relay purchasing decisions

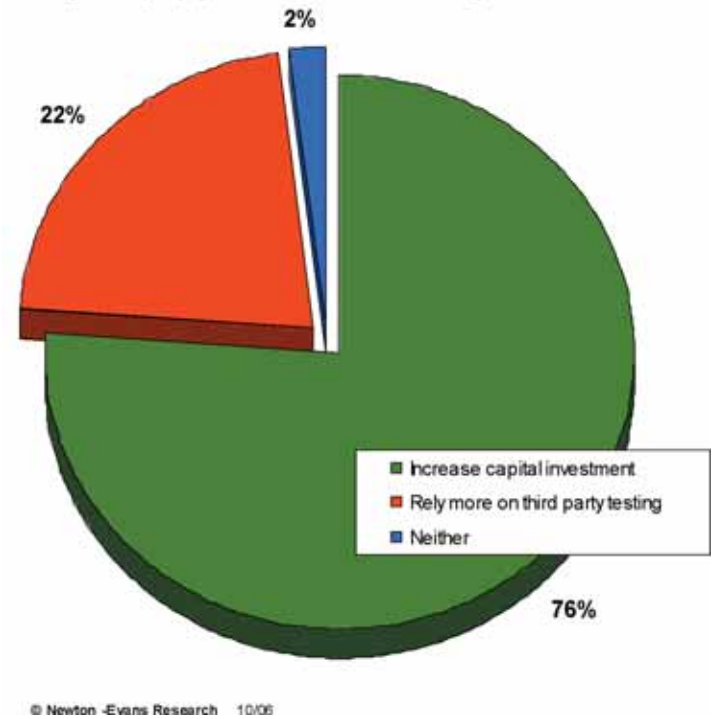


Plans to Increase Capital Investment for Relay Testing or to Increase O&M spending for Third Party Testing Services:

Respondents were requested to indicate whether they would likely be increasing capital investment for relay test equipment, or whether they would be more likely to increase spending for third party relay testing services or neither, in the 2006-2008 period.

About 75% of the responding protection engineering officials indicated that they would be likely increasing their capital investment in relay test equipment, software and training. Nearly a quarter of the survey group indicated that they would be likely to rely more heavily on third party relay testing services. Only two respondents indicated that neither approach was likely, and their was no need to increase such spending. Note that cooperative utilities were much more likely to be planning to relay more on third party testing services than were the IOU and public power utilities.

Figure 4 – North America
Percent of utilities planning to increase the capital budget for relay testing equipment, software, and training



Compliance with Loading Requirements Outlined in NERC Blackout Recommendation 8A. (Including the provisions of BZ3).

This question was expanded in the recent survey to include eight specific actions that could be taken to comply with NERC loading requirements per recommendations 8A and BZ3.

The optional responses included these: reset the zone x impedance relays; reset the transformer overload- overcurrent relays; install new

protection with an integral "load encroachment" function; eliminate the transformer overload/overcurrent relays; reset the transmission line "switch on to fault" relays; add separate load encroachment blinders; eliminate the transmission line "switch on to fault" relays; request exemption; or take some other action.

Responses from 93 utilities, including some who had selected multiple action being planned to attain compliance with NERC recommendations, were quite mixed with 50 respondents (54%) indicating they will comply by "re-setting the zone x impedance relays." Twenty-nine percent indicated they would "install new protection with an integral 'load encroachment' function." Twenty-two respondents (24%) stated that they would reset the transformer overload/overcurrent relays; Seventeen percent would "reset the transmission line "switch on to fault" relays.

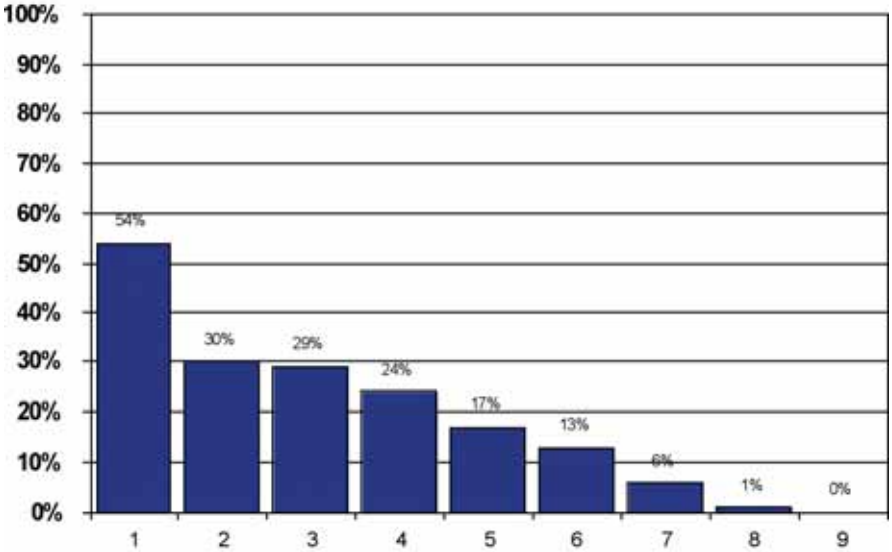
Only six percent stated that they would add separate load encroachment blinders while one utility would eliminate the transmission line "switch on to fault" relays. Officials at IOUs were much more likely to use a variety of methods to attain compliance with NERC recommendations. Cooperative utility officials were more likely to plan to request exemptions from the NERC loading requirements.

Requirements for Various Communications Media in Transmission of Relay Data:

A. Protection Communications:

The study has found that for transmission line applications the use of fiber is vital, and for line distance relays, power line carrier and microwave are also important media. Protection communications are not likely to be used for the majority of distribution feeder, transformer and capacitor bank types of relays.

Figure 5 – North America
Compliance with loading requirements outlined in NERC blackout recommendation 8A



Key
54% 1. Re-set the zone "x" impedance relays
30% 2. Other
29% 3. Install new protection w/integral load encroachment
24% 4. Re-set the transformer overload/ overcurrent relays
17% 5. Re-set the transmission line "switch on to fault" relays
13% 6. Request exemption
6% 7. Add separate load encroachment blinders
1% 8. Eliminate the transmission line "switch on to fault" relays
0% 9. Eliminate the transformer overload/ overcurrent relays

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The use of wireless communications is picking up, based on the findings reported in the current study, with 15 utilities now reporting some use of wireless approaches to provide protection communications for distribution feeder relays and for transmission line distance units. he majority of bus differential, motor protection, and generator relays also reportedly do not make use of protection communications media.

B. Physical Connections for Relays:

The mid-2006 study has found that copper remains the most important method of physical connection for protective relays. Note that fiber deployment continues to increase over earlier studies. The use of fiber for transmission line current differential relays has overtaken the use of copper among this survey group. Wireless connections are also on the upswing as reported by the utility respondents to this year's survey.

C. Relay Network Topology:

In the mid-2006 study, the use of STAR topology (RS 232) remains the more vital approach for most of the listed types of relays, however the use of multidrop (RS 485 and RS 422) appears to be increasing. At least 14 of the utilities were using both approaches for distribution feeder relays, and several using both network topologies for the other relays types as well.

D. Relay Protocols in Use:

By mid-2006, the use of DNP 3 had retained its top position as the current protocol "most likely" to be used for each of the nine relay types (by application) . Proprietary protocols were next in importance, followed by Modbus and Modbus Plus. There was MINIMAL USE of IEC 61850 by mid-2006 and NO USE of IEC 60870-5.

E. Mentions of Additional Protocols to be used in the Future:

Plans for protocol changes by year-end 2008 were minimal. Users of DNP plan to "hold onto this protocol" and for the protocol to remain dominant, with some migration expected over to IEC 61850 for a number of relay types..

In Newton-Evans' opinion, most of the changes are likely to occur at the expense of proprietary protocols, not from erosion of DNP use. These respondents will likely leapfrog from proprietary protocols directly to IEC 61850, but that is not yet clear. See Table 10E-1.

Plans to Embrace IEC 61850:

In the mid-2006 study, utility protection and control officials were requested to indicate whether their utility had already or was planning to embrace IEC 61850 in the near future. If not, the reasons for not moving to use of the IEC protocol was requested.

A total of 17 officials indicated that their utility had plans to embrace the IEC 61850 protocol in the near future, and seven others indicated that their utility had already done so. However, 86 officials indicated that they were not likely to embrace the IEC protocol for one or more reasons. The reasons given included: 37officials indicated that they would continue to use currently implemented protocols; 24 who stated that "the advantages of moving to IEC 61850 were "not that great." Twenty officials stated their belief that "some vendors have not implemented the protocol" and another 19 officials provided other reasons for not having plans to move to IEC 61850.

Reasons behind the Decision to Move to IEC 61850:

There were 24 eligible utilities to reply to this portion of question 11 combining users of IEC 61850 with those planning to migrate to IEC 61850. Seventeen of the 24 officials responded with the statement that the protocol simply offered "greater flexibility." Sixteen of the 23 replied that one reason for their decision to move to or plan to migrate to IEC

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61850 was premised on the "single protocol/tool to setup for multiple vendor products" while 12 cited the "cost reduction and faster substation configuration." Five others cited "ease of implementation of the protocol."

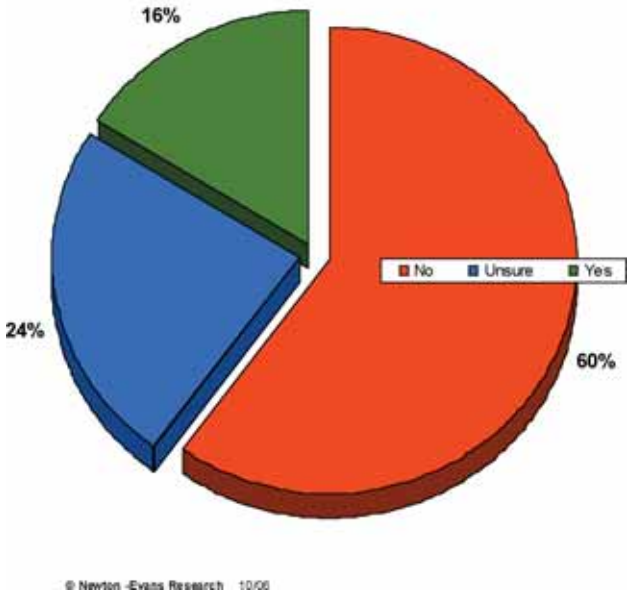
Application Plans for Wide Area Measurement Systems:

The mid-2006 study has found that there has been a significant increase in the percentage of utilities that either use or have plans to incorporate use for wide area measurement systems such as phasor measurement units (PMUs), remedial action schemes (RAS) or special protection systems (SPS).

Sixteen percent of the respondents indicated having plans for wide area measurement systems in the new study, and another 24% were uncertain about such plans. Fifty-nine percent have no use and no plans to use WAMS. A total of 43% of IOUs indicated having plans to include WAMS in their protection and control strategies. This compares with a lower respondent percentage from the 50 public power and cooperative utilities replying.

In 2004, plans for wide area measurement systems for use with phasor measurement units (PMUs) and remedial action schemes (RAS) had been somewhat limited. Nearly two-thirds of the 101 respondents to this question then indicated that they had no plans for use of wide area measurement systems.

Figure 13 – North America
Application plans for wide area measurement systems

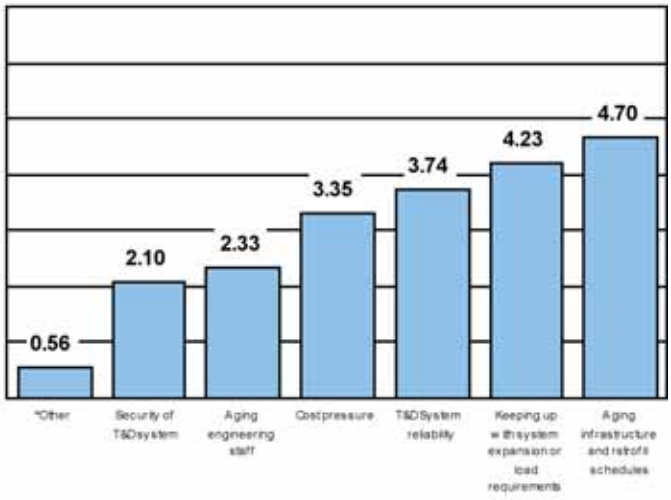


Ranking Present Day Challenges to Protection Engineering Organizations:

Senior protection and control managers and staff were asked to rank the current challenges of their utility in priority order. The optional responses included these:

Among this group of utility engineering officials, "aging infrastructure and retrofit schedules" posed the greatest present day challenge to their electric utility operations.

Figure 20 – North America
Ranking of present-day challenges at utilities
(1 = least challenging, 7 = most challenging)



***Other** challenges written in by respondents include 9 mentions of staffing issues (shortages, inexperience) and 1 mention each of the following: NERC requirements, short term investment views, availability of spare parts, keeping up with firmware upgrades in microprocessor relays, personnel safety, and records management.

"Keeping up with system expansion or load requirements was second in importance was next, "T&D system reliability" was third, followed by "cost pressure."

Despite the many recent articles published on this topic, "Aging engineering staff" was not highly ranked as an important present day challenge and neither was "security of the T&D system.". ■

About the Author

Charles W. Newton *is the President of Newton-Evans Research Company, a Maryland-based researcher of technology trends affecting the world's electric, gas and water utilities and energy pipelines. His company has been actively researching global power and energy automation and communications markets on a proprietary and multi-client basis for 28 years. Clients include major suppliers, utilities and consultants active in automation, instrumentation and real-time computer operations (EMS/SCADA/DMS) segments of electric power and gas/oil transmission and distribution. The company also researches T&D infrastructure markets on an ongoing, proprietary basis.*

Mr. Newton received an MBA in Marketing from Loyola College in Maryland and a BA degree in Economics from Fordham University in New York City. Chuck's professional memberships include CIGRE, IEEE Power Engineering Society, ENTELEC, UTC, AMRA, AWWA, AMA, CASRO and others.

The company's own newsletter, Market Trends Digest, is read by more than five thousand energy industry leaders each quarter.

Oracle: Guerry Waters

Guerry Waters
Vice President
Industry Strategy and
Marketing, Oracle Utilities
Global Business Unit

This marks the third installment in our 2007 Automation/IT Leadership Series featuring in depth interviews with senior executives of major suppliers to the utility marketplace. This month, my one-on-one interview is with Mr. Guerry Waters, Vice President - Industry Strategy and Marketing, Oracle Utilities Global Business Unit. In preparing for our discussion, I found myself feeling as though I'd known Guerry for a lot longer than I actually have. That's mainly because his views about the industry and mine have had almost uncanny parallels, both in timing and substance, over the past couple of years. (Refer to the Utility Horizons™ column and Guerry's AMI article in the Sep/Oct 2006 issue at http://www.electricenergyonline.com/magazine.asp?m=9&magid=37)

I had a chance to sit down with Guerry over a cup of coffee at the DistribuTech Conference in San Diego this past February, and it was immediately evident that Guerry is a man on a mission when it comes to articulating those views. Indeed, only a few short months after the merger of SPL WorldGroup into Oracle, he seems to have already figured out exactly where he wants to take this world-class company from a utility sector perspective. I'm sure you will find the visions and concepts he generously shares with us in this interview to be insightful and instructive.

- Mike Marullo,
Automation/IT Leadership Series Editor

EET&D: I think we can both readily agree that this is a time of sea change all across the utility industry, both for the utilities themselves as well as for suppliers. The recent acquisition of SPL WorldGroup – the company from which you came to Oracle – is arguably a part of that wave of change. How would you characterize the forces and incentives that brought these two companies together at this particular time?

Waters: The merger offers utilities what we describe as "the world's most complete suite of end-to-end information technology solutions for utilities." It brings together several different elements, including but not limited to Oracle's ERP (Enterprise Resource Planning), database and infrastructure software; Siebel's CRM (Customer Relationship Management) for larger competitive utilities' call centers and specialized contacts and sales; and SPL's utility-specific revenue and operations management applications.

EET&D: In your view, what should our readers expect the effects and benefits from this combination to be?

Waters: In bringing all these applications together, Oracle is responding to utilities' need to reduce costs and business complexity. Oracle now offers utilities the option to lower total cost of ownership through access to a single global vendor. Additionally, we offer pre-integrations that reduce implementation and maintenance costs. But because our applications are fundamentally stand-alone, utilities can be sure that going with Oracle doesn't lock them into an IT structure or suite that may not suit them in the long run or respond optimally to changing markets.

EET&D: What new developments might we see in the longer term?

Waters: Right now, the global utilities market is experiencing a great deal of change. We believe that, as applications advance to meet emerging needs, utilities will clearly see the advantages of choosing multiple applications from a single vendor. However, over the longer term, we will have the opportunity to demonstrate that Oracle has retained its commitment to compete head-to-head with single best-of-breed products.

EET&D: Will utilities still be able to take advantage of their own applications of choice as these products become more integrated?

Waters: Utilities will continue to get the features and functions that help them meet market challenges. But at the same time, as they choose two, three, or more of our solutions, they'll also begin to experience an added value when best-of-breed applications integrate out of the box to address cross-organizational business processes and best practices.

EET&D: How much of the applications spectrum can you readily address today?

Waters: Oracle utilities applications already address demand/response programs, increased grid efficiency, better scheduling of field crews, and new infrastructures to support advanced metering. And of course, Oracle offers an additional, complete suite of general business and CRM applications for utilities plus outstanding middleware and technology solutions.

EET&D: Is there one element or characteristic that you feel really sets you apart?

Waters: Our global network of partners and affiliates allows us to interact effectively with utilities and systems integrators around the globe to deploy worldwide best practices. There are very few companies that have the depth and breadth of global capabilities we can bring to bear quickly and comprehensively.

EET&D: That reminds me that I recently heard that Oracle has announced that it intends to become the #1 applications vendor to utilities worldwide; displacing SAP, which currently has almost twice as many utility applications customers as does Oracle. Can you offer some specifics about how you intend to achieve that objective?

Waters: Oracle sees utilities as requiring a core of mission-critical applications that, while they can all be used stand-alone, rest fundamentally on a common, standards-based architecture and a common vision to help utilities adapt to change and minimize its negative consequences. I cannot speak for SAP, of course, but my impression is that their vision of mission-critical utility applications is considerably narrower. For example, we offer network management as an integral part of the package and also a fully functional mobile workforce management system, where their solution relies on third-party technology from partners.

That doesn't mean we "do it all," of course. We have very important technology partnerships with companies like Twenty First Century for IVR and Cellnet for communications. We're working with several other technology companies in the Smart Energy Alliance to help utilities develop and implement the advanced metering packages designed to meet their goals.

At the same time, Oracle's vision is of a single-vendor core suite from which integrated business processes seamlessly rise.

EET&D: Turning now to the utility perspective, I recall your mentioning during our conversation in San Diego that Oracle had identified what you consider to be the top ten business requirements of utilities. ***(See Inset)*** Perhaps you could begin by briefly explaining what went into the analysis process and how you arrived at those conclusions.

Waters: Strategic analysis of industry trends and directions is fundamental to ensuring we provide the right applications to utilities at the right time. We're constantly talking about these issues with customers and potential customers as well as industry analysts. Publications like yours are vital in helping the utility community share understanding and direction. We also commission surveys that help us keep pace with customer thinking, like several we did over the past year on meter data management.

EET&D: I think it would be useful to hear your personal views and interpretation of how these requirements might relate to automation/IT solutions, whether they may be immediate or further down the road.

Waters: What's particularly important for IT is the way these trends interact to produce the need for new applications and combinations of applications.

Look, for instance, at requirements 2, 3, and 4. Today we face potentially cataclysmic environmental changes like global warming and the permanent destruction of our remaining wilderness. Electric utilities want to rise to that challenge and also want to add more renewables to the mix. They want to switch some power use to off-peak, when base generation essentially goes to waste.

But many are discovering that their metering structure can't handle net metering; nor can it handle interval metering or even time-of-use. Next, they find that even if they had the right metering infrastructure, the grid isn't robust enough to handle on-ramps for non-dispatchable renewables or the complexities of universal demand-response programs. And finally, even if all that were already in place, the vast majority of consumers don't have the devices in the home necessary to take full advantage of these programs.

This is where Oracle comes in. We have the resource depth to focus multiple applications on complex goals and to help utilities manage the individual applications and process changes that can result in positive environmental and economic outcomes.

EET&D: Are there things that you feel utilities must do or will do to change their traditionally conservative, slow-moving posture toward change?

Waters: I have to say that, with regard to issues like creating new services for customers and stepping up to the environmental plate, utilities today are moving forward smartly. Take advanced metering as an example. In March, Kema Consulting identified 12 utilities with an aggregated total of more than 39 million customers as issuing RFPs, RFIs, or otherwise signaling a direction toward advanced metering implementation.

Moreover, it appears that the majority of utilities electing advanced metering also elect to implement a relatively new concept: a meter data management application that's separate from the various data-using applications like billing and distribution management. UtiliPoint, for instance, reports that in just one year, 2005 to 2006, North American annual meter data management revenue quadrupled to more than $17 million. Moreover, it is anticipated that revenue will grow to more than $22 million, based on announced projects alone.

EET&D: What do you anticipate as far as what the utilities' expectations might be (i.e., from suppliers) for meeting those objectives?

Waters: To achieve that kind of posture and flexibility, we think that most utilities will be inclined to choose a strong, multi-faceted vendor that has specific abilities and characteristics. Key among those is the ability to address technology solutions holistically and exhibit a detailed and comprehensive understanding of the utility business.

EET&D: What else might they expect that would be consistent with these trends?

Waters: It will also be important that vendors use standards-based applications and architecture that will help utilities to innovate and that will ensure that the entire technology/application offering underpins coherent, cross-organizational business processes in order to keep pace with ongoing utility business and market changes.

EET&D: Let's get back to the role of automation/IT suppliers like Oracle; what should we expect from the supplier community as regards adapting to these changing expectations by the utilities?

Waters: Well, certainly there are huge implications for suppliers that we believe will transform their role – albeit in a very positive way. Specifically, there are ten elements that we aggregated from research conducted by several leading research organizations that I think fairly summarize the expectations many utilities have in this new era of challenges and changes. Those are:

1. Template-based solutions for common industry segments
2. Pre-integrated solutions for reduced project risk

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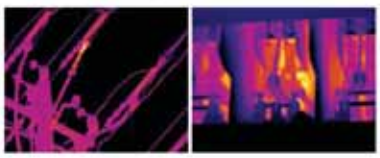

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TOP 10 BUSINESS REQUIREMENTS OF UTILITIES

1. Contain/remove costs in all business activities to meet expectations of all stakeholders (including investors, customers, and regulators).
2. Respond effectively to environmental requirements and challenges.
3. Maximize the value of advanced metering infrastructure.
4. Maximize grid efficiency, reliability, and resiliency
5. Determine and address the root causes of current business performance shortfalls.
6. Provide customer choice in areas such as:
   - Energy content ("green" /other electricity).
   - Rate structure (flat/time-of-use/interval).
   - Type of service (delivery-only, net metering).
   - Bill presentation and payment (on-line, third-party, direct debit, mail).
   - Value-add services (remote equipment control, outage notifications).
7. Adapt to workforce changes, including aging workforce, turnover, and use of contractors and outsourcers.
8. Respond to customer demand for improved service at the same or lower cost.
9. Attract and retain profitable customers.
10. Schedule the workforce effectively to ensure the right people, materials, and tools are at the right place at right time.

3. Proven technology with scalability and performance
4. Flexible, converged and open infrastructure
5. Support for new industry initiatives (e.g., AMI, green energy, etc.)
6. Expanded customer-service interactions (e.g., web, contact center, phone/PDAs, etc.)
7. Improved response for new and evolving market regulations
8. User interfaces that support business processes
9. Accommodation of existing (legacy) infrastructure
10. Integration to support third-party applications

EET&D: To sum things up, how long do you think it will take for suppliers to embrace these expectations?

Waters: I really can't speak for others, but I can tell you that we are committed to supplying all of these needs at the pace the market is prepared to accept them. There's no point in getting ahead of your market. That's just a prescription for financial losses that stymie long-run progress.

EET&D: Can you elaborate a little more on what you mean by that?

Waters: Let me give you an example from our Network Management product. To take full advantage of advanced metering, utilities need much closer integration across outage management, AMR, and mobile workforce applications. Keeping pace with the market means introducing those innovations now, neither before nor after utilities can use them. Similarly, the international focus on dealing with an aging grid has put a new focus on needs like Volt/VAR optimization and support for automated throw-over field devices. Now is the time to respond to these needs.

EET&D: It seems like staying in sync with the market can be a bit of a challenge since most utilities want progress, but they also want their legacy investments to be protected while the migrations to new products and platforms move forward. What can you suggest that might help assuage those very legitimate concerns?

Waters: Keeping pace with the market is the same approach we're using as we move toward increased application pre-integration. Many—possibly most—of our customers still seek the feature and function richness associated with stand-alone applications. That's why we will continue to supply, best-of-breed products.

EET&D: But won't those stand-alone applications be disappearing at some point soon?

Waters: No, we don't have any plans to narrow those choices, even when products might appear to overlap. But behind the scenes, we're working to make sure that as utilities start to experience the advantages of pre-integrated business processes, Oracle will be there with the combination they seek: A fully pre-integrated suite that retains all the best-of-breed functionality without sacrificing application richness and flexibility.

EET&D: Well, it sounds like you have everything under control. As you know, one of the primary objectives of these interviews is to afford our readers insights into what they can expect from their suppliers; I think we can safely label this one Mission Accomplished! Thanks again for sharing your thoughts and plans with us and hope that you will do so again, soon and often.

Power Utilities... It's A Whole NEW Ballgame

New Challenges – New Line of Thinking

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Substation Automation Basics - The Next Generation

By John McDonald, P.E.

There is an increased focus on transmission and distribution investments to address aging and distressed infrastructure. Previously voluntary reliability programs under the North American Electric Reliability Council (NERC) are transitioning to mandatory reliability standards, requiring self reporting and imposing penalties for non-compliance. Utilities are placing a greater emphasis on real time, enterprise wide information to secure the right information and the right time to enhance reliability and to better manage asset management and operations and management.

Intelligent electronic devices (IEDs) being implemented in substations today contain valuable information, both operational and non-operational, needed by many user groups within the utility. An IED is any device that incorporates one or more processors with the capability to receive or send data/control from or to an external source (e.g., electronic multi-function meters, digital relays, controllers). IED technology can help utilities improve reliability, gain operational efficiencies, and enable asset management programs including predictive maintenance, life extensions and improved planning.

IEDs are a key component of substation integration and automation technology. Substation integration involves integrating protection, control, and data acquisition functions into a minimal number of platforms to reduce capital and operating costs, reduce panel and control room space, and eliminate redundant equipment and databases. Automation involves the deployment of substation and feeder operating functions and applications ranging from supervisory control and data acquisition (SCADA) and alarm processing to integrated volt/var control in order to optimize the management of capital assets and enhance operation and maintenance (O&M) efficiencies with minimal human intervention.

IEDs facilitate the exchange of both operational and non-operational data. Operational data, also called supervisory control and data acquisition (SCADA) data, are instantaneous values of power system analog and status points such as volts, amps, MW, MVAR, circuit breaker status, switch position. This data is time critical and is used to monitor and control the power system (e.g., opening circuit breakers, changing tap settings, equipment failure indication, etc.). Non-operational data consists of files and waveforms such as event summaries, oscillographic event reports, or sequential events records, in addition to SCADA-like points (e.g., status and analog points) that have a logical state or a numerical value. This data is not needed by the SCADA dispatchers

to monitor and control the power system.

Utilities face the challenge of determining a standard integration architecture that meets its specific needs, can extract the desired operational and non-operational information, and deliver this information to the users who have applications to analyze the information. So how do utilities address this challenge? There have been many advances in substation integration and automation over the past 10 years. This article provides an overview of substation integration and automation fundamentals and a primer on best practices.

THE ABCS OF SUBSTATION AUTOMATION

Levels of Substation Automation - Substation integration and automation can be broken down into five levels. The lowest level is the power system equipment, such as transformers and circuit breakers. The middle three levels are IED implementation, IED integration, and substation automation applications. All electric utilities are implementing IEDs in their substations. The focus today is on the integration of the IEDs. Once this is done, the focus will shift to what automation applications should run at the substation level. The highest level is the utility enterprise, and there are multiple functional data paths from the substation to the utility enterprise.

Open systems - An open system is a computer system that embodies supplier-independent standards so that software may be applied on many different platforms and can interoperate with other applications on local and remote systems. An open system is an evolutionary means for a substation control system that is based on the use of non-proprietary, standard software and hardware interfaces. Open systems enable future upgrades available from multiple suppliers at lower cost to be integrated with relative ease and low risk.

Architecture Functional Data Paths - There are three primary functional data paths from the substation to the utility enterprise: operational data to SCADA systems, non-operational data to data warehouse, remote access to IED. The most common data path is conveying the operational data (e.g., volts, amps) to the utility's SCADA system every 2 to 4 s. This information is critical for the utility's dispatchers to monitor and control the power system. The most challenging data path is conveying the non-operational data to the utility's data warehouse.

Substation Integration and Automation System Functional Architecture - The functional architecture includes three functional data paths from the substation to the utility enterprise, as well as the SCADA system and the data warehouse - Data Concentrator, SCADA interface, Router. The operational data path to the SCADA system utilizes the communication protocol presently supported by the SCADA system. The non-operational data path to the data warehouse conveys the IED non-operational data from the substation automation (SA) system to the data warehouse, either being pulled by a data warehouse application from the SA system or being pushed from the SA system to the data warehouse based on an event trigger or time. The remote access path to the substation utilizes a dial-in telephone or network connection.

New vs. existing Substations - The design of new substations has the advantage of starting with a blank sheet of paper. The new substation will typically have many IEDs for different functions, and the majority of operational data for the SCADA system will come from these IEDs. The IEDs will be integrated with digital two-way communications. Typically, there are no conventional remote terminal units (RTUs) in new substations. The RTU functionality is addressed using IEDs, PLCs, and an integration network using digital communications.

In existing substations, there are several alternative approaches, depending on whether or not the substation has a conventional RTU installed. The utility has three choices for their existing conventional substation RTUs: integrate RTU with IEDs; integrate RTU as another IED; retire RTU and use IEDs and PLCs as with new substation.

Equipment Condition Monitoring - Many electric utilities have employed ECM to maintain electric equipment in top operating condition while minimizing the number of interruptions. With ECM, equipment-operating parameters are automatically tracked to detect the emergence of various abnormal operating conditions. This allows substation operations personnel to take timely action when needed to improve reliability and extend equipment life. This approach is applied most frequently to substation transformers and high voltage electric supply circuit breakers to minimize the maintenance costs of these devices, as well as improve their availability and extend their useful life.

SUBSTATION INTEGRATION AND AUTOMATION TECHNICAL ISSUES

• **System Responsibilities –** The system must interface with all of the IEDs in the substation. This includes polling the IEDs for readings and event notifications. The data from all the IEDs must be sent to the utility enterprise to populate the data warehouse or be sent to an appropriate location for storage of the substation data. The system processes data and control requests from users and from the data warehouse. The system must isolate supplier proprietary functionality by providing a generic interface to the IEDs. In other words, there should be a standard interface regardless of the IED supplier. The system should be updated with a report-by-exception scheme, where status-point changes and analog-point changes are reported only when they exceed their significant deadband.

• **System Architecture –** The types of data and control that the system will be expected to facilitate are dependent on the choice of IEDs and devices in the system. This must be addressed on a substation-by-substation basis. The primary requirement is that the analog readings be obtained in a way that provides an accurate representation of their values

• **Level 1 Field Devices –** Each electronic device (relay, meter, PLC, etc.) has internal

memory to store some or all of the following data: analog values, status changes, sequence of events, and power quality. These data are typically stored in a FIFO (first in, first out) queue and vary in the number of events, etc., maintained.

• **Level 2 Substation Data Concentrator –** The substation data concentrator should poll each device (both electronic and other) for analog values and status changes at data collection rates consistent with the utility's SCADA system (e.g., status points every 2 sec, tie-line and generator analogs every 2 sec, and remaining analog values every 2 to 10 sec). The substation data concentrator should maintain a local database.

• **Level 3 SCADA System/Data Warehouse -** All data required for operational purposes should be communicated to the SCADA system via a communication link from the data concentrator. All data required for non-operational purposes should be communicated to the data warehouse via a communication link from the data concentrator. A data warehouse is necessary to support a mainframe or client-server architecture of data exchange between the system and corporate users over the corporate WAN (wide area network). This setup provides users with up-to-date information and eliminates the need to wait for access using a single line of communications to the system, such as telephone dial-up through a modem.

• **Substation Host Processor -** The substation host processor must be based on industry standards and strong networking ability, such as Ethernet, TCP/IP, UNIX, Windows 2000 or XP, Linux, etc. It must also support an open architecture, with no proprietary interfaces or products. An industry-accepted relational database (RDB) with structured query language (SQL) capability and enterprise-wide computing must be supported. The RDB supplier must provide replication capabilities to support a redundant or backup database.

• **Substation LAN -** The substation LAN must meet industry standards to allow interoperability and the use of plug-and-play devices. Open-architecture principles should be followed, including the use of industry standard protocols (e.g., IEEE 802.x (Ethernet)). The LAN technology employed must be applicable to the substation environment and facilitate interfacing to process-level equipment (IEDs, PLCs) while providing immunity and isolation to substation noise.

• **User Interface –** The user interface in the substation must be an intuitive design to ensure effective use of the system with minimal confusion. An efficient display hierarchy will allow all essential activities to be performed from a few displays. It is critical to minimize or, better yet, eliminate the need for typing. There should be a common look and feel established for all displays. A library of standard symbols should be used to represent substation power apparatus on graphical displays. In fact, this library should be established and used in all substations and coordinated with other systems in the utility, such as the distribution SCADA system, the energy management system, the geographic information system (GIS), the trouble call management system, etc.

• **Communications Interfaces -** There are interfaces to substation IEDs to acquire data, determine the operating status of each IED, support all communication protocols used by the IEDs, and support standard protocols being developed. There may be an interface to the energy management system (EMS) that allows system operators to monitor and control each substation and the EMS to receive data from the substation integration and automation system at different periodicities. There may be an interface to the distribution management system with the same capabilities as the EMS interface.

• **Data Warehouse -** The corporate data warehouse enables users to access substation data while maintaining a firewall to substation control and operation functions. Both operational and non-operational data is needed in the data warehouse. To size the data warehouse, the utility must determine who the users of the substation automation system

data are, the nature of their application, the type of data needed, how often the data is needed, and the frequency of update required for each user.

Protocol Fundamentals - A communication protocol allows communication between two devices. The devices must have the same protocol (and version) implemented. Any protocol differences will result in communication errors. The substation integration and automation architecture must allow devices from different suppliers to communicate (interoperate) using an industry-standard protocol. The utility has the flexibility to choose the best devices for each application, provided the suppliers have designed their devices to achieve full functionality with the protocol.

Protocol Considerations - There are two capabilities a utility considers for an IED. The primary capability of an IED is its standalone capabilities, such as protecting the power system for a relay IED. The secondary capability of an IED is its integration capabilities, such as its physical interface (e.g., RS-232, RS-485, Ethernet) and its communication protocol (e.g., DNP3, Modbus, IEC 61850 MMS). Today utilities typically specify the IEDs they want to use in the substation rather than giving a supplier a turnkey contract to provide the supplier's IEDs only in the substation. However, utilities typically choose the IEDs based on the IED's standalone capabilities only, without considering the IED's integration capabilities.

• **Utility Communication Architecture -** The use of international protocol standards is now recognized throughout the electric utility industry as a key to successful integration of the various parts of the electric utility enterprise. One area addresses substation integration and automation protocol standardization efforts. These efforts have taken place within the framework provided by the Electric Power Research Institute's (EPRI's) UCA.

• **Merger of UCA with IEC 61850 -** In 1995 IEC TC 57 Working Groups 10, 11 and 12 began developing IEC 61850, Communication Networks and Systems in Substations, which defines a standard protocol for substation control and protection, including alternate communications stacks to be used with a standard substation-defined object-oriented user layer. The ten existing parts of 61850 have been issued as international standards, although future revisions are likely as field installations reveal issues and shortcomings. In 2001, the developers of 61850 and UCA agreed to merge the standards and get to one international standard, a critical objective for both standards projects.

• **IEC 61850 -** The continuing development of UCA2/MMS has ceased as suppliers refocus on implementing IEC 61850 versions of this LAN-based automation design. Meanwhile, supplier-utility demonstration projects of UCA2/MMS have been upgraded to IEC 61850 or were converted to DNP3. There are very few SA Systems in service today that

utilize UCA2/MMS. The trial UCA2/MMS installations included significant amounts of custom relay and IED programming and adaptation to make the sophisticated new technology work in its first practical installations.

• **Distributed Network Protocol -** The development of DNP was a comprehensive effort to achieve open, standards-based interoperability between substation computers, RTUs, IEDs, and master stations (except inter-master-station communications) for the electric utility industry. The short-term benefits of using DNP are: interoperability between multi-supplier devices; fewer protocols to support in the field; reduced software costs; no protocol translators needed; shorter delivery schedules; less testing, maintenance, and Training; improved documentation; independent conformance testing; support by independent user; group and third-party sources (e.g., test sets, source code). In the long term, further benefits can be derived from using DNP, including: easy system expansion; long product life; more value-added products from suppliers; faster adoption of new technology; major operations savings.

Choosing the Right Protocol - There are several factors to consider when choosing the right protocol for the application. First, determine the system area with which you are most concerned with, such as the protocol from a SCADA master station to the SCADA RTUs, a protocol from substation IEDs to an RTU or a PLC, or a LAN in the substation. Second, determine the timing of your installation, e.g., six months, 18 to 24 months, or three to five years. In some application areas, technology is changing so quickly that the timing of your installation can have a great impact on your protocol choice.

Communications Protocol Application Areas - There are various protocol choices depending on the protocol application area of your system. Protocol choices vary with the different application areas. Different application areas are in different stages of protocol development and industry efforts. The status of development efforts for different applications will help determine realistic plans and schedules for your specific projects.

• **Within the Substation -** The need for a standard IED protocol dates back to the late 1980s. IED suppliers acknowledge that their expertise is in the IED itself – not in two-way communications capability, the communications protocol, or added IED functionality from a remote user. Though the industry made some effort to add communications capability to the IEDs, each IED supplier was concerned that any increased functionality would compromise performance and drive the IED cost so high that no utility would buy it. Therefore, the industry vowed to keep costs competitive and performance high as standardization was incorporated into the IED.

• **Substation-to-Utility Enterprise -** This is the area of traditional SCADA communication protocols. The Data Acquisition, Processing and Control Systems Subcommittee of the IEEE PES Substations Committee began developing a recommended practice in the early 1980s in an attempt to standardize master/remote communications practices. At that time, each SCADA system supplier had developed a proprietary protocol based on technology of the time. These proprietary protocols exhibited varied message structures, terminal-to-data circuit terminating equipment (DCE) and DCE-to-channel interfaces, and error detection and recovery schemes.

Make Decisions with the Future in Mind - As we look to the future, it seems the time between the present and the future is shrinking. When a PC bought today is made obsolete in six months by a new model with twice the performance at less cost, how can you protect the investments in technology you make today? Obviously, there is no way you can keep up on a continuous basis with all the technology developments in all areas. You must rely on others to keep you informed, and who you select to keep you informed is critical. With every purchase, you must evaluate not only the supplier's present products but also its future product development plans.

- Does the supplier continuously enhance and upgrade products?
- Is the supplier developing new products to meet future needs?
- Do existing products have a migration path to enhanced and new products?

Selecting the right supplier will ensure you stay informed about new and future industry developments and trends and will allow you to access new technologies with the least impact on your current operation. ■

About the Author

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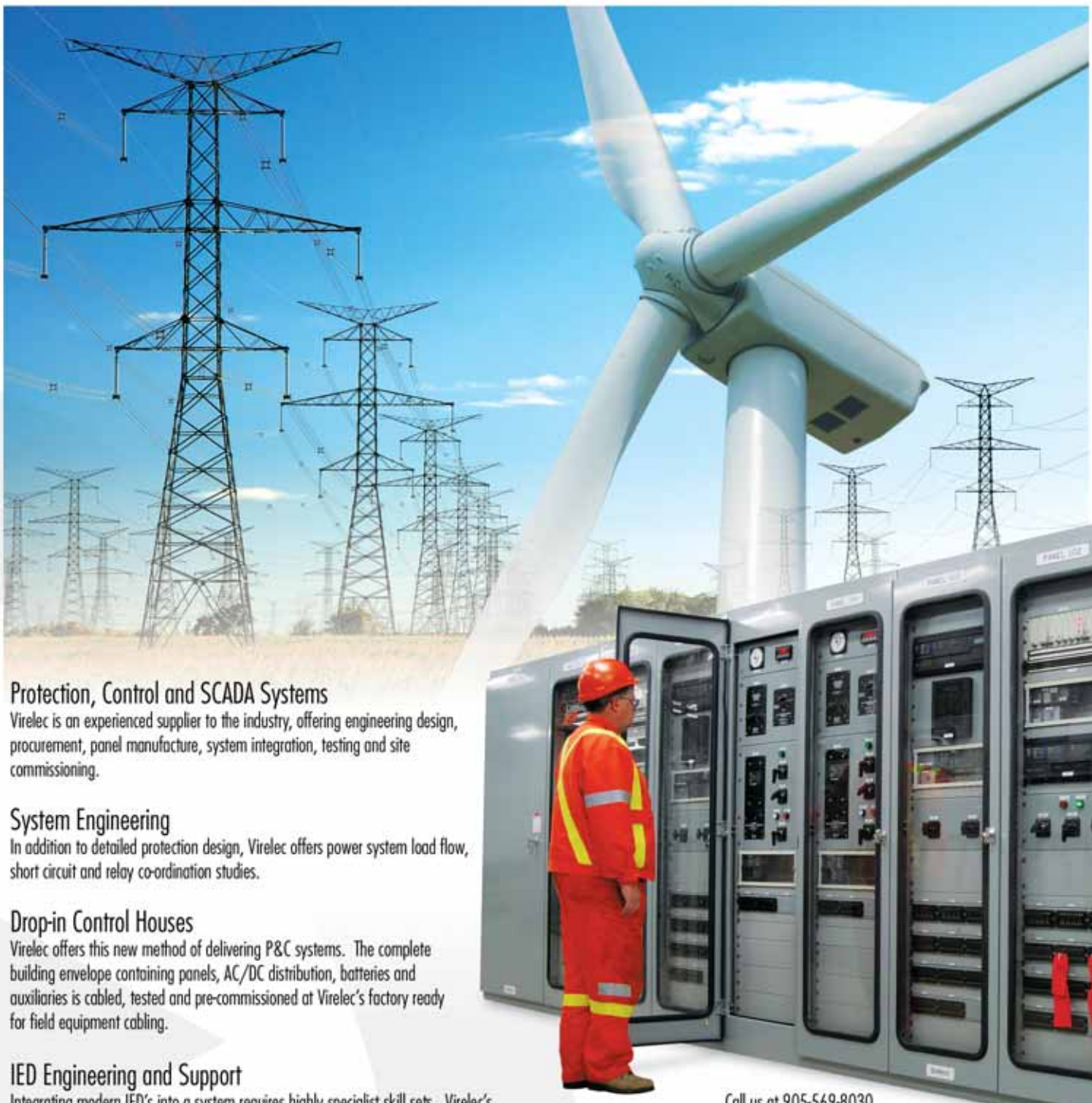

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Reliability Rolls On

by: Bob Fesmire, ABB Inc..

In November of last year, NERC issued its latest Long Term Reliability Assessment in which the recently anointed Electricity Reliability Organization (ERO) painted a rather grim picture. The report projected demand to increase by 19% over the next decade in the US (13% in Canada), and even warned of the potential for rolling blackouts in as little as five to ten years if transmission constraints are not addressed in the most congested areas. Capacity margins, currently averaging 17% nationally, will drop to just 7% by 2015.

Meanwhile, the cost of grid reliability continues to put a multi-billion dollar drag on the US and Canadian economies. The California ISO announced earlier this year it had "cut" reliability-related costs (e.g., reliability-must-run generation, out-of-sequence dispatch, etc.) to $476 million in 2006. If that sounds like a dubious cause for a press release, consider that the ISO spent $670 million in 2005 and a whopping $1.1 billion in 2004. The upside is that all that money flowing toward solving the congestion problem makes for a strong "price signal" to would-be investors in transmission projects, and there have been some big ones announced in recent months.

Hydro One will build a 500kV line from its Bruce nuclear facility to its Milton substation, a distance of 180 km, in order to facilitate two reactors returning to service as well as the development of 700 MW of wind resources in the area. The project, which will provide 3,000 MW of new transmission capacity, represents the largest expansion project at Hydro One in twenty years. Next door at Hydro Quebec, a 1250 MW back-to-back HVDC link announced in November will provide Ontario with more emissions-free hydro power as well as a new interconnection between the asynchronous Ontario and Quebec systems by 2009.

Other proposed projects, however, remain only "proposed." San Diego Gas and Electric (SDG&E) has plans for a transmission project that would run east-west across Southern California's Imperial Valley. The utility estimates the line would produce $57 million per year in savings in foregone congestion charges and increased access to low-cost generation from outside the state. The project would shave $1 million per year in avoided line losses alone.

Regulators and state-level authorities have also been busy. The California Energy Commission, for example, is now looking into designating transmission corridors in the state along the lines of the national corridors envisioned in the Energy Policy Act of 2005 (EPAct). A bill in the state senate would streamline the permitting process for projects in identified corridors. On March 27, Colorado governor Mark Ritter signed two bills into law, one expanding the state's commitment to obtaining more of its electricity from renewable sources and one introducing EPAct-style enhanced cost recovery for transmission projects within so-called "energy resource zones." The latter act is designed to facilitate reaching the goals of the former.

WHOSE JOB IS IT ANYWAY?

The legislative moves and the announced projects fall into a typical industry definition of "reliability," specifically, improving the capacity and resiliency of the high voltage transmission system. A more inclusive concept of reliability would extend to distribution and generation, but perhaps part of the reason we focus so much on transmission, aside from the much larger impact of an outage at that level, is because it's much harder to identify who is actually responsible for transmission-level reliability.

At the distribution level, the answer is simple: the local utility is responsible for the reliability of its network. Problems experienced within a given service territory are unlikely to affect neighboring systems, much less customers hundreds of miles away, so it's a fairly self-contained question. Transmission, obviously, affects more people over a wider area, but the really complicating factor is that there are many different entities that all play a material role in maintaining the grid's integrity. There is broad consensus on what the objective is (i.e., a reliable transmission system), but exactly how that goal is to be achieved is less obvious.

EPAct is a massive piece of legislation, and it includes a variety of measures aimed at improving the reliability of the US power system. Two elements, however, have received an inordinate amount of attention since the Act's passage: the establishment of mandatory reliability standards (and an accompanying enforcement regime), and the creation of National Interest Electric Transmission Corridors (NIETCs). A closer look at both of these components reveals potential fault lines, which to be fair, the entities involved are now in the process of addressing.

SETTING THE STANDARD(S)

Following the August 2003 blackout, the call for mandatory reliability standards reached a crescendo. Two years later, EPAct provided a response—national standards that would be backed by a rigorous enforcement regime with penalties reaching up to $1 million per day for non-compliance and administered by an independent Electricity Reliability Organization (ERO). NERC was certified as the ERO in July 2006, and since that time has worked hard to develop standards through its stakeholder process and get them approved by FERC.

On March 15, FERC approved 83 of the 107 standards submitted by NERC, but also sent 58 of those back for further clarification. The remaining 24 standards were deemed to be unenforceable, or applied only on a regional level. Subsequently, NERC submitted eight region-specific rules that will only apply to the WECC area, but FERC has not ruled on those as yet.

The development of the standards—which largely mirror the voluntary regime NERC presided over in its previous life—

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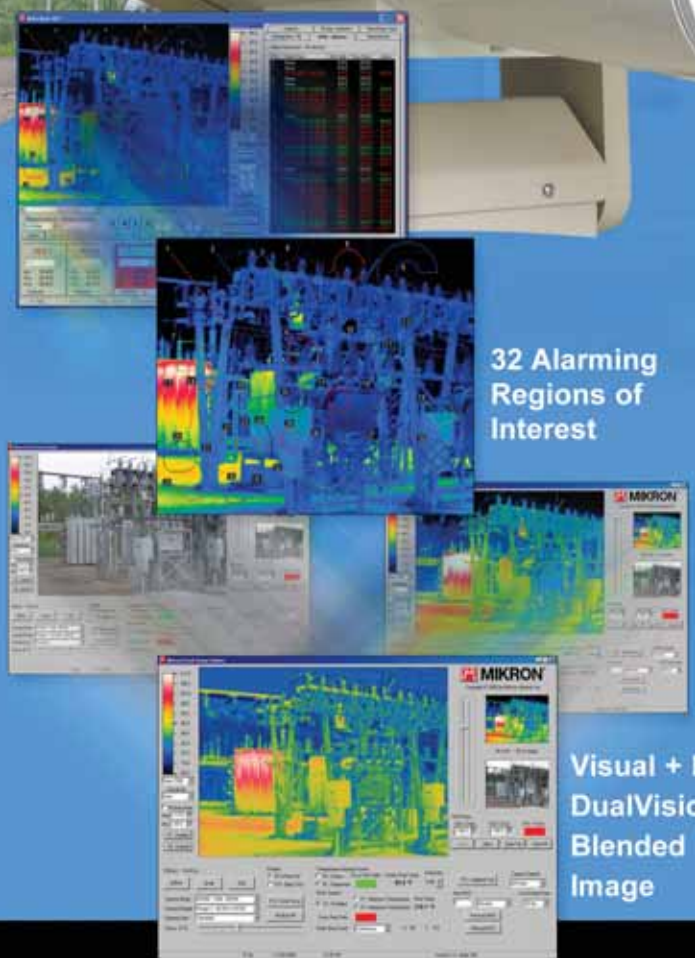

32 Alarming Regions of Interest

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is encouraging, but the big question remains as to who, exactly, these rules apply to. The standards themselves offer no definitive statement, and FERC has not ruled on the issue. The text of EPAct isn't much help. The law uses very broad language, defining the entities subject to ERO oversight as "users, owners and operators of the bulk transmission system" that are necessary to run the transmission grid. That includes generation, but not distribution.

So who does this definition include?

The answer hinges largely on how you define "bulk transmission". NERC's interpretation includes entities operating transmission facilities at 100kV or above, with further definition on a regional basis. However, FERC has stated that, while it will use NERC's definition, it reserves the right to re-interpret it to address any gaps FERC sees in the standards' coverage.

This is a curious state of affairs, and it could present a significant amount of uncertainty in how the industry's new reliability regime will function. NERC is set to begin enforcement of the standards on June 1, with enforcement focused mainly on the most serious violations. FERC has even suggested discretion in enforcement of penalties for those entities that have not been subject to reliability standards before such as public power agencies.

The Commission appears to be treading a fine line, though. While FERC seems to be OK with the kid glove treatment for the newcomers, Commission Chairman Joseph Kelliher was less accommodating in his response to calls for a delay in penalties across the board.

"They've had two years of field testing in 2004 and 2005," he said in reference to the utilities subject to the standards. "I'm focuses on the summer of '07. I think our job is to get as many standards that meet the statutory test enforceable before the summer of 2007."

CROSS-BORDER ENFORCEMENT

As if the wrangling within the US wasn't enough, there remains the question of how the newly certified ERO will fulfill its role with entities located in Canada. In April of 2006, NERC filed to be the ERO in each border province, but must still establish working agreements with each of them. That process is ongoing, sure to provide job security for a small army of lawyers, engineers and policy analysts.

Some provinces are further along than others, and the nature of the compliance requirement differs from one to another. Utilities in Alberta, Manitoba and Saskatchewan, for example, all currently operate under NERC standards by virtue of membership in WECC and the Midwest Reliability Organization. In New Brunswick and Ontario, NERC standards are "baked in" to the wholesale power market rules for those areas, so all market participants must comply with them to retain their right to buy and/or sell power. Layered on top of all this are the Memoranda of Understanding (MOUs) that NERC is seeking to establish with each of the provinces to formalize its authority.

Once the MOUs are in place, presumably all will be well. NERC will have the authority it needs under provincial law to carry out its role as ERO. But what will happen in the meantime if/when a Canadian provincial authority disagrees with NERC's assessment of a penalty against one of its resident utilities? Consider the following excerpt from NERC's comments in a recent FERC filing. The "body" in question is the ERO.

If a body mandated by the [Quebec] Régie under the agreement referred to above considers that an entity subject to a reliability standard does not comply with the standard, the body must give the entity the opportunity to submit observations, and report to the Régie on its findings and may recommend the application of a sanction. After giving the entity the opportunity to be heard, the Régie is responsible for determining if the entity has failed to comply with a reliability standard, and impose, if appropriate, a sanction that may not exceed 500,000 $CAN a day.

At current exchange rates, that maximum sanction comes to less than half the $1 million (USD) per day top end of NERC's penalty matrix. Further, the provincial regulator still retains final authority. It may be unlikely, but the possibility exists under this language for the Quebec Régie to nullify or greatly reduce a penalty assessed by NERC against a Quebec-based entity, or even to overturn the ERO's determination that a violation occurred.

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Of course, this is exactly the kind of situation parties on both sides are seeking to avoid with the establishment of an MOU. The key will be to get these agreements signed and in place before the "real" enforcement begins this summer.

THE CORRIDORS OF POWER

"Backstop siting authority" was perhaps the most talked about element of the entire electricity title in EPAct, and with good reason. Siting large transmission projects had become a regulatory odyssey stretching out to more than a decade in a few high-profile cases. Now, the US Department of Energy (DoE) has the authority under EPAct to designate National Interest Electric Transmission Corridors, and any project proposed within one of those corridors could receive siting approval from FERC if the local and state authorities fail to act within one year.

EPAct sought to speed up the siting process for transmission with the NIETC provision, but there are two important and interrelated gray areas in the statute. The first is the question of when that one-year clock starts to tick, and the second centers on what constitutes a "failure to act" on the part of the state regulator. Neither of these issues is likely to be settled in the near future, and either could provide the basis for a protracted court battle. Given that siting is perhaps the most contentious issue in the T&D business, it may be up to an administrative law judge to define what Congress intended.

DoE is expected to issue draft NIETC designations in June, based on its congestion study (also a product of EPAct) and the deluge of comments the agency received on the subject. Draft designations will be followed by a public comment period before the agency assigns final NIETC designations by August 8, 2007.

RELIABILITY THROUGH EFFICIENCY

While the need for increased transmission investment has been obvious for some time, the fact remains that even under favorable siting processes new lines take years to build. Even FACTS devices, which increase transfer capacity and stabilize voltage, can take a year or more to come online. The reality of the situation is that, in some locations, these options either are not technically feasible or may not have the impact in the short term that is required.

Perhaps that's why NERC President Rick Sergel at a recent conference in Washington, DC said that he sees demand response as the number one priority for enhancing grid reliability. His reasoning is simple: DR delivers an immediate impact with relatively little up-front investment (depending on the nature and scope of the given program, of course).

Sergel's suggestion is more than wishful thinking, too. There is historical precedent to support it. During the 2000-01 power crisis in California, customers in the state affected a 10% reduction in demand, and that was with the programs and communication processes in place at the time. Mostly, it was fear of rolling blackouts that drove consumer behavior, but the point was made. Demand response offered a very real alternative to adding supply from the spot market, if even possible, or reducing demand through less voluntary means.

Really, demand response is one form of efficiency, if you accept a broad definition of the term. It amounts to doing more with existing resources, and therein lies perhaps the greatest untapped potential in the quest for greater reliability because in a constrained system, a megawatt saved may well be better than a megawatt generated if you can't get the power where it needs to go.

DoE is pushing efficiency via standards for distribution transformers, and while the improvement on a per-unit basis is small (a few percentage points), the impact when multiplied across the entire installed base is significant. Figures for T&D losses are often cited in the 8% - 10% range, and if even a small fraction of those losses can be avoided, the savings go right to the economy's bottom line.

There are, of course, other ways to cut losses in the T&D system. HVDC transmission, for example, is being used today over much shorter distances thanks to the advent of a voltage source converter-based variety of the technology (e.g., the Cross-Sound Cable between Long Island and Connecticut). Even gas insulated substations contribute to grid efficiency by allowing power to come into a city center at higher voltage rather than incurring the losses associated with stepping

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The demand side, though, is where efficiency has the greatest potential. Compact fluorescent light bulbs are often cited as an example of technologies that present a win-win in the form of cost savings for the user and reduced demand for the utility. Now consider another example, variable speed drives. Motors power everything from compressors to assembly lines and consume more industrial power than any other single device. The vast majority of motors, though, run at full speed all the time, even when they don't have to, because they lack a variable speed drive to control them. With a VSD in place, a motor can be programmed to run only when needed and the difference in energy usage can be enormous. Savings of 60% are not uncommon, making for a very rapid return on investment.

The confluence of cost savings and energy efficiency is clearly the sweet spot for improving reliability on a system-wide basis. When a technology comes with a business case as compelling as that of a variable speed drive, the buyer doesn't need any further reason to implement it. The impact on reliability is merely a bonus, and an external one at that.

Residential and smaller commercial customers may not face choices as obvious as the plant owner looking to bring down his six-figure electricity bill, but the principle still applies under a more holistic idea of efficiency. For the residential customer, this concept of 'macro efficiency' might simply mean running the dishwasher at night. The appliance still uses the same amount of power, but the system as a whole is made more efficient, and more reliable, by shifting that usage to off-peak periods.

The last several years have seen significant changes in the way both the power industry and the grid itself function in North America. Most of the attention has focused on the restructuring of wholesale and especially retail energy markets, but now the industry faces perhaps an even greater challenge. Our electricity infrastructure is aging, even as we become ever more dependent upon it. Reliability is essential, but to make the transmission system as robust as we need it to be will require industry professionals, regulators and even customers to develop a more nuanced understanding of just what that term, "reliability," means when placed into a societal context.

In technologies like FACTS and variable speed drives, we have the means to improve efficiency and in turn, reliability. In EPAct, we have a legal framework for defining and ensuring reliability at a national, and even international, level. And we have regulatory mechanisms in place like cost recovery during construction to encourage reliability-enhancing projects. All the pieces are on the table. Now it's up to us to put them together. ■

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Raise Your Expectations – Unlock Your Data for Improved Asset Management

By: Debra Henderson and Ann Moore, Business Development Executives, OSIsoft (www.osisoft.com)

Every company is dependent on some type of asset that keeps the business in business – be it a computer, a centrifuge, or a power transformer. In a large enterprise, reducing costs related to asset maintenance, repair, and ultimate replacement is at the top of management concerns. Downtime in any network, manufacturing, or computer system ultimately results not only in high repair costs, but in customer dissatisfaction and lower revenues. Real-time Condition-based Maintenance (CBM) provides a unique solution to the age old question—how to better plan and monitor critical maintenance processes and assets.

Reliability and uninterrupted service to customers are the goals of any T&D organization, but keeping systems up and running is no small task. Electricity must be produced, transmitted and distributed – almost instantaneously – to the point of consumer consumption.

Imagine a typical transmission scenario where a circuit breaker trips. The first action the operator will take is to close the breaker. The breaker trips again. Suspecting contact chatter, the operator attempts to close it again. Testing into a fault – open, close, open, close – is very stressful on a breaker.

What if that operator had all the historical data – past wear and tear, operating history, past failures – as well as real-time data about that piece of equipment? In this case, data about the asset can translate to improved decision making. If he had that information at his fingertips, he could take action with more confidence, while eliminating the stress that blind trial and error puts on equipment.

Multiply this by hundreds of such situations occurring with remote assets on a daily basis and you've got a problem: a hit to your bottom line. Change the approach by bringing consistent, real-time data to your operations, and you've just positively impacted your reliability and productivity.

Companies using real-time data in their SCADA and EMS systems are just scratching the surface of the amounts of data available to them. Today, only 10% of all operational data is collected (but not always stored permanently) through real-time control systems. The remaining 90% comprises data that is not being used to its full advantage.

By gathering all dynamic data in one repository, then monitoring and analyzing data from the perspectives of both operations and engineering, utilities can transform this wealth of data into actionable information, directly affecting bottom-line measures like efficiency and productivity.

OUT WITH THE OLD

Unplanned downtime can be costly and highly disruptive if not managed properly. Due to the highly integrated nature of modern power systems in North America, local disturbances can have a widespread impact on reliability.

In a move to more effectively manage assets and integrate real-time data into viable processes, utilities must take into consideration the combination of an aging infrastructure and a workforce with a diminishing availability of technical experience and subject matter expertise.

While utilities are jumping through hoops to get rate cases through their PUCs to support massive infrastructure improvements and lobbying Congress for the same, real-time enterprise historians can ensure that costly old assets, like transformers, will run for a longer period of time, and safely.

Additionally, as the age profile of the workforce changes, utilities need to maximize the use of their real-time data, which provides the mechanism for capturing "tribal knowledge" and applying it throughout the organization.

THE COMPETITIVE EDGE...WITH CONDITION-BASED MAINTENANCE (CBM)

How do utilities keep their edge and run traditional regulated business in today's more competitive market? The answer is by reducing maintenance costs and managing investments and assets more strategically.

Maintenance processes and systems have evolved dramatically over the years. In the early years, maintenance consisted of reacting to mechanical breakdowns. As technology progressed, the solution gradually evolved from a time-based model to a condition-based one.

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Today, effective maintenance systems are expected to detect early forms of degradation in predictive maintenance practices in tandem with CBM.

Predictive maintenance defines methods to predict or diagnose problems in a piece of equipment based on trending of test results. These methods use non-intrusive testing techniques to measure and compute equipment performance trends.

CBM is a methodology that combines predictive and preventive maintenance with real-time monitoring. CBM systems detect fault sources well in advance of failure, making maintenance a proactive process.

CBM accurately detects the current state of mechanical systems and predicts the systems' ability to perform without failure. It uses the stressor levels created during the machinery design process, measures suitable parameters to quantify the existing stressor levels, and corrects operating environments to make these levels compatible with economic production versus equipment lifetimes.

IMPROVING ASSET MANAGEMENT WITH CBM

CBM adds two important dimensions to classical predictive maintenance solutions.

First, CBM looks at the entire system and all of its assets. This holistic approach to maintenance represents a major shift from the fragmented technologies of the past. While CBM can be implemented in single steps, its greatest potential is realized when it is applied consistently and evenly across an entire asset class, employing the full range of maintenance concepts.

The second added dimension is the concept of extending maintenance intervals. CBM replaces arbitrarily timed maintenance with scheduled maintenance warranted by the equipment condition. It advocates the analysis of equipment condition data to allow planning and scheduling of maintenance activities or repairs before functional failure.

Comprehensive use of data across the organization can help organizations prevent disruptions. The critical piece is data: a combination of real-time, on-demand data, in addition to the less time-sensitive information. By automatically analyzing data before disseminating it to all responsible parties, utilities will turn the mounds of data into actionable information.

With this information, organizations can take preventative steps and prioritize action with confidence, while concurrently capturing utility "tribal knowledge" in the form of abstracted algorithms, analyses and business rules so that this information can be applied to similar classes of utility assets or networks.

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With CBM, organizations perform maintenance only when needed to prevent operational deficiencies or failures, to eliminate costly periodic maintenance, and to significantly reduce the likelihood of mechanical failures.

Today, a proactive approach that can identify and act on maintenance problems makes good business sense.

As manufacturing and utility companies become more competitive in a global market, increased availability becomes an issue. Companies need to run traditional regulated businesses competitively, reduce maintenance costs, and manage investment and assets strategically and efficiently.

Likewise, in an unregulated market, customer service and resulting customer satisfaction are essential. Utility companies strive to maximize performance at the lowest lifecycle cost, while improving system reliability by eliminating catastrophic equipment failures. CBM strives to identify incipient faults before they become critical.

CBM – YOUR IMPLEMENTATION GUIDE

By putting valuable information – such as analytics, notifications and event alerts, and intuitive visualizations – around real-time data, utilities can address a myriad of challenges from the aging workforce, proactive management of an increasing number of assets, and the growing compliance demands.

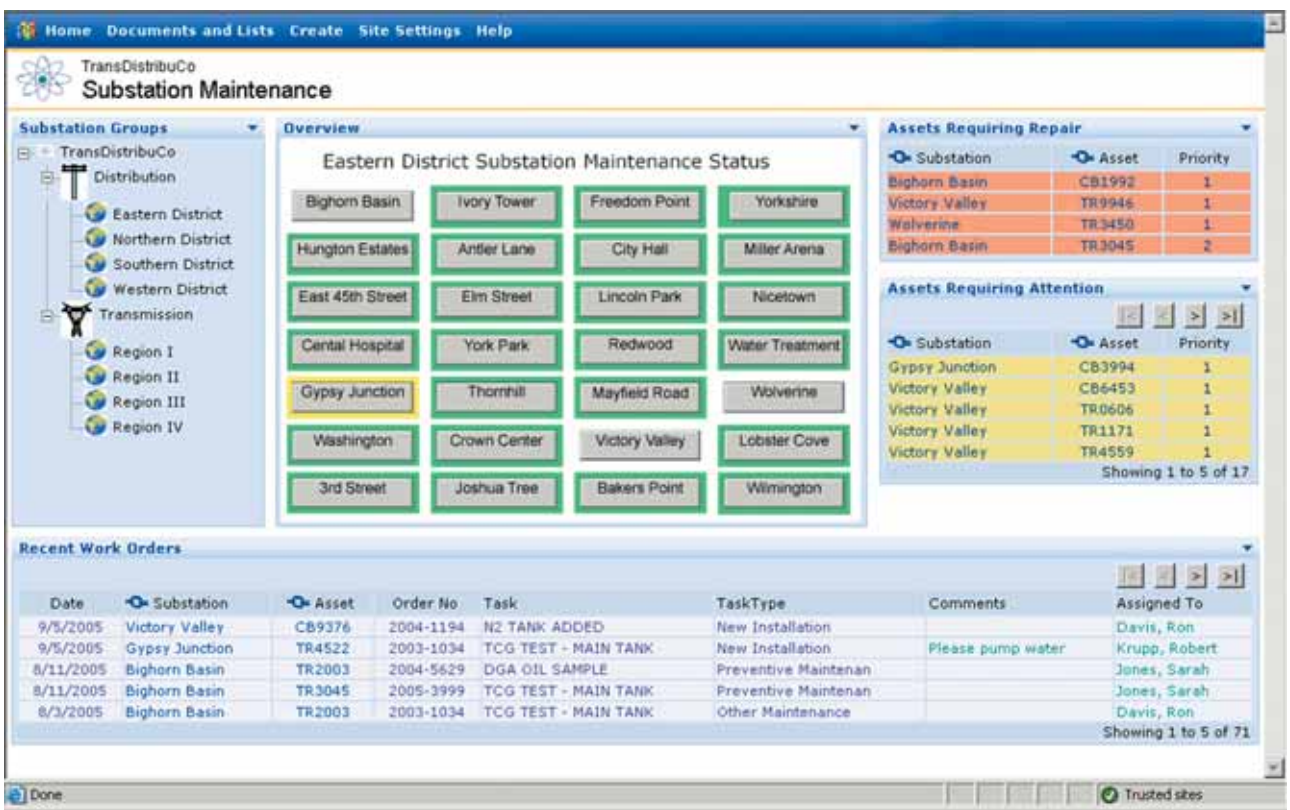
Providing access to mounds of operational data in and of itself does not guarantee that an operator or engineer will detect the underlying event or emerging condition. A CBM approach depends upon:

- Being able to easily configure the calculation or notification that will prompt operators or engineers into action;
- Real-time trending combined with analytics to apply intelligence to make the data actionable, to spot trends and system anomalies (this is central to the effective management of assets, especially those that are remote or highly distributed);
- On-demand visualization and alerting, which is imperative for success – the visualization must be intuitive, crisp, and easily navigable.

Utilities must formulate a long range strategy to replace – on a proactive and risk-adjusted basis – the aging transmission line and T&D substation infrastructure to improve reliability and control

equipment operation and maintenance costs. They must also develop a spending plan to support replacement of aging infrastructure, including provisions for adequate spares and inventory.

By moving away from the confines of a calendar-based maintenance and towards more dynamic asset management, utilities will better predict equipment failures before they occur, minimizing costly failures, automatically triggering maintenance tasks and extending the life of aging equipment through more efficient performance monitoring.



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TIP LIST: COLLECTING AND MODELING DATA FOR CONDITION-BASED MAINTENANCE

The CBM methodology involves the following steps:

1. Collect all relevant data needed to monitor and analyze all maintenance units, systems, and devices and ensure that it can be accessed in real-time.
2. Structure the real-time data for calculations, computation, analysis, visualization, service-reuse, and scalability.
3. Create a portal site to visualize the real-time data, to create reports, and to report and act on problems as they occur or alarm/alert and early warning.

TIP LIST: YOUR CBM TECHNOLOGY CHECKLIST

The best source of aggregating and analyzing real-time data for a condition-based maintenance strategy is an enterprise-class data historian. Be sure to consider the following, critical factors when integrating a new technology solution:

- Integration with legacy environments that allows users to access data from older systems in order to extend the life of operational assets
- Configurable analytics and notification support
- Ability to implement a 'Manage by Exception' management framework, which is the foundation on which CBM is built
- Ability to support extremely large volumes of dynamic data with original fidelity and high performance
- Intuitive, powerful visualization, including high fidelity, real-time trending, prioritization of KPIs

TRUST YOUR DATA FOR IMPROVED CONFIDENCE IN DECISION MAKING

It's time to raise the expectation of what utilities can control and what they can deliver. With strategic CBM best practices in place, interrupted service can be avoided and downtime can be better managed.

As technology improves, data frequency will grow exponentially, and utilities will demand an infrastructure that can handle it. As you head down the path to preparing for the Intelligent Grid and Automatic Metering Infrastructure (AMI), consider that real benefits will come from combining and reconciling new sources, such as AMI data (usage and event data), with operational data from SCADA and other sources.

This will provide real-time visibility downstream of the breaker and enable real-time – or in some cases, near real-time – operational capabilities, including:

- Dispatch of load for grid management
- Management of distributed energy resources
- Situational data in near real-time
- Outage & service condition information at the customer level
- Support rate option innovations

Utilities need data that delivers trusted results – data that can be reconciled, be combined with distribution automation and AMI meter reads and provide audit trails.

An enterprise-class data historian will distribute intelligent information to people and systems, such as distribution engineers, operators, outage management systems (OMS) and circuit analysis tools. Ultimately, it will enable the intelligent grid, in which the grid automatically "heals itself" as a result of effective analysis, notification systems and visualization of real-time data.

By allowing technology to work for you, your T&D organization will be able to efficiently collect data and provide a means for advanced analysis, creating an environment where all levels of the organization will be better informed about the health of critical equipment. And with this level of understanding, confidence and visibility into the operations, your organization will realize immediate benefits, which only increase over time. ■

About the Authors

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Debra Henderson is a 26-year veteran of the energy industry, primarily in transmission and distribution operations and engineering. Debra's employment experience includes PG&E Corporation, CellNet Data Systems, Silicon Energy and Itron. She holds a degree in electrical engineering from California Polytechnic University, San Luis Obispo and an MBA from California State University, East Bay. She is a registered electrical engineer in California.

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Ann Moore joined OSIsoft last year as a Business Development Executive, focusing on expanding OSIsoft's business in China. Prior to this she had worked for San Diego Gas & Electric for 17 years. She was in charge of the software development and support for SDG&E's Grid Operations real-time control Energy Management System (EMS). In this capacity, she also managed all EMS system-related projects, including PI. She graduated from the University of Michigan-Ann Arbor, with an MS degree in Computer Engineering.

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Make/Break Contacts

In Power Circuit Breakers

PREFACE

The interruption of electric power circuits has always been an essential function, especially in cases of overloads or short circuits when immediate interruption of the current flow becomes necessary as a protective measure.

In earliest times, circuits could be broken only by separation of contacts in air followed by drawing the resulting electric arc out to such a length that it can no longer be maintained.

This means of interruption soon became inadequate and special devices called circuit breakers had to be developed.

The basic problem has been to control and quench or extinguish the high power arc, which necessarily occurs at the separating contacts of a breaker when opening high current circuits.

Since arcs generate a great deal of heat energy, most often destructive for the breaker's contacts, technology had to find ways to limit the arc duration and develop contacts that can withstand the arc effect time after time.

Fig 1 Arcing representation, showing arc plasma column, and contact wear

In the present article you will find a summarized description of the different designs of make/break contacts found in the modern power circuit breakers and the key factors influencing their architecture and material choice.

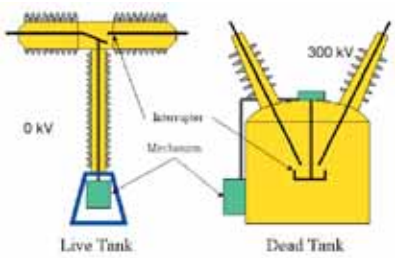

Fig 2 Representation of Live tank and dead tank Circuit breaker

INTRODUCTION

Since the beginning, scientists based their research on exploring the capabilities of the available quenching mediums. Hence the breakers are classified accordingly.

The arc quenching ambients are numerous.

Historically, it should be mentioned that pure water has had some use in Europe. The arc produced gases, steam and hydrogen, which are as effective as the vapor and hydrogen from oil in quenching the arcs, but insulation problems have limited the use of this medium and at present no breakers are being built that use this technique.

For the purpose of the present article, we will limit our quest to those most popular: Oil, Compressed air, SF6 and Vacuum.

BREAKER CATEGORIES

Breaker development research has explored the available mediums and has come up with a lot of breaker designs but most of them fall into four major categories:

OIL CIRCUIT BREAKER

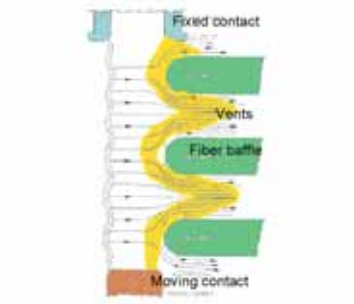

Fig 3 Representation of electric arc in oil circuit breaker

In oil circuit breakers, the arc is drawn in oil inside a special compartment of the interrupting chamber called the explosion pot. The intense heat of the arc decomposes the oil and produces gases, mainly composed of hydrogen, generating high pressure that produces a fluid flow through the arc and out of the explosion pot through vents situated on its walls. Thus extending the arc's column and carrying its energy away until its total extension see Fig 3.

At transmission voltages below 345 kV, oil breakers used to be popular. They are increasingly losing ground to gas-blast circuit breakers such as air-blast breakers and SF6 circuit breakers.

AIR-BLAST CIRCUIT BREAKER

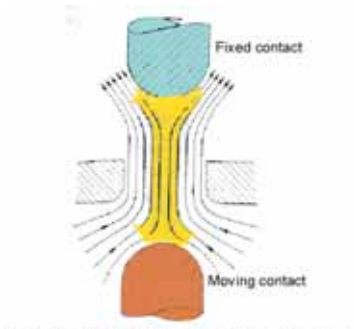

Fig 4 Representation of electric arc in air-blast circuit breaker

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In air-blast circuit breakers, air is compressed to high pressures. When the contacts part, a blast valve is opened to discharge the high-pressure air to the ambient, thus creating a very-high-velocity flow near the arc to dissipate the energy.

SF6 CIRCUIT BREAKER

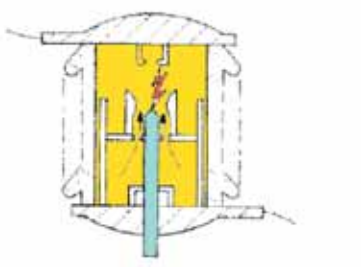

Fig 5 Representation of SF6 interrupter chamber in puffer type SF6 circuit breaker

In SF6 circuit breakers, the same principle is employed, with SF6 as the medium instead of air. In the "puffer" SF6 breaker, the motion of the contacts compresses the gas and forces it to flow through an orifice into the neighborhood of the arc. Both types of SF6 breakers have been developed for EHV (extra high voltage) transmission systems.

VACUUM CIRCUIT BREAKER

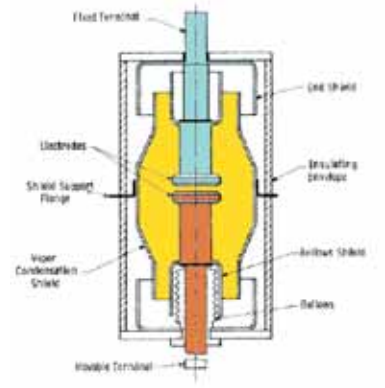

Fig 6 Representation of vacuum interrupter chamber in vacuum circuit breaker

The vacuum breaker uses the rapid dielectric recovery and high dielectric strength of vacuum. A pair of contacts is hermetically sealed in a vacuum envelope.

Actuating motion is transmitted through bellows to the movable contact. When the contacts are parted, an arc is produced and supported by metallic vapor boiled from the electrodes. Vapor particles expand into the vacuum and condense on solid surfaces. At a natural current zero the vapor particles disappear, and the arc is extinguished. Vacuum breakers of up to 242 kV have been built.

MAKE/BREAK CONTACTS

The breaker's heart is the switching element. It is where the arc quenching takes place. It mainly contains the make/break contacts and the interrupting medium. The make/break contacts' functions can be reduced to:

- Conduct the electric current when the breaker is closed.
- Withstand the arc's destructive effect while interrupting.

Generally, the make/break contacts have a stationary part and a moving part. By bringing the moving part to touch the stationary one, electric current flows and the breaker is closed.

By driving the moving contact away from the stationary contact the electric arc develops and by quenching it the current stops flowing and the breaker is open.

Contact design and choice of materials are greatly affected by the arc's energy, duration and the chemical reactions that may occur with the ambient medium under the arc's effect.

To understand these crucial elements, it is necessary to review the electric arc's characteristics.

ELECTRIC ARC

The electric arc is a natural phenomenon. Despite its destructive nature it is of great use to current switching in circuit breakers. It acts as variable impedance from zero value when the breaker is closed to infinity when the breaker is open.

HIGH-PRESSURE ARC

Found in blast type circuit breakers (air-blast, SF6 and oil circuit breakers). Great heat generation and relative long durations characterize them. They also generate deposition of solid by-products that may affect the conductivity of the contacts.

VACUUM ARC

Found in vacuum circuit breakers. They are limited and of short duration. They cause no deposition of by-products.

CONTACT ARCHITECTURE

FOR HIGH-PRESSURE ARCS:

The contacts have to withstand the arc's heat without excessive damage. They also need to have good conduction properties.

Tungsten and tungsten alloys have good resistance-to-arc properties but less conductivity. Copper and silver have great conductivity but relatively poor resistance-to-arc properties.

The contacts have also to overcome the deposition of by-products that may become a problem if not wiped off before an insulating layer is built.

The type of contacts that are commonly found in these types of devices are:

SLIDING CONTACTS

As their name indicates, the moving contact and the stationary contact touch on closing and slide into each other to a certain distance before stopping at closed position. On opening, they slide out until their separation and the arc's ignition. The sliding action helps to wipe off the deposited by-products, to make better contact on closing.

This type of contact usually separates the resistance-to-arc role from the current carrying role, by using tungsten alloy based contacts called arcing contacts that are meant to close first on closing and separate last on opening and are submitted to the arc. The current carrying role is attributed to copper or silver plated copper contacts called main contacts. These contacts are not subjected to the arc and therefore not eroded by it.

DESIGN EXAMPLES

Designers worked hard to reach effective designs exploit these principles.

In the KSO type **oil circuit breaker** by the General Electric company, the stationary contact is a ring of sprung copper (or sliver plated) contact fingers where two of them have a tungsten tip (see Fig 7).

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Fig 7 **Tulip contact in oil circuit breaker**

The moving contact is a solid rod of copper (or silver-plated) with the upper part made of tungsten (see Fig 7a)

Fig 7a Rod contact in oil circuit breaker

In the Dell-Alsthom, PKV type **air-blast** circuit

Fig 8 PKV air-blast breaker module

breaker, the stationary contact is a tulip contact made of sliver plated copper contact fingers where two of these contacts are arcing contact fingers made of tungsten. The moving contact is a tube of silver-plated copper with the upper part made of tungsten (see Fig 8a).

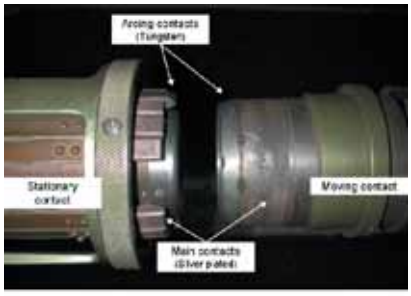

Fig 8a Tulip contacts in air-blast breaker

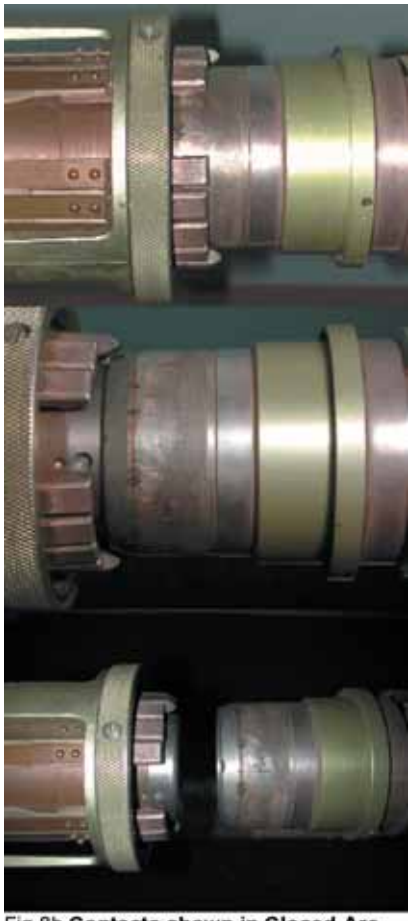

Fig 8b **Contacts shown in Closed-Arc starting step-Opened position**

The ABB, DLF Type **air-blast** circuit breaker uses butt contacts which are particularly shaped to achieve these goals.

Fig 9 DLF air-blast breaker module

Fig 9a Contacts showed in Closed-Arc starting step-Opened position

In **SF6** ABB, HPL Type circuit breaker,

Fig 10 HPL SF6 circuit breaker

For main contacts the stationary contact is a tulip contact made of sliver plated copper contact fingers, the moving contact is silver-plated copper tube The arcing contact is completely separate from the main contact. The stationary contact is a tungsten rod and the moving one is a tulip consisting of tungsten contact fingers.(see Fig 10a)

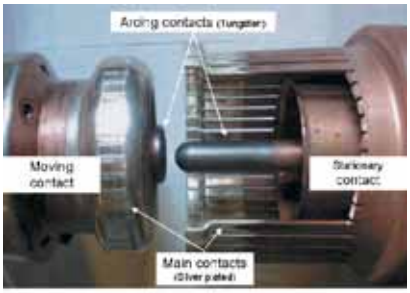

Fig 10a Tulip contacts in SF6 circuit breaker

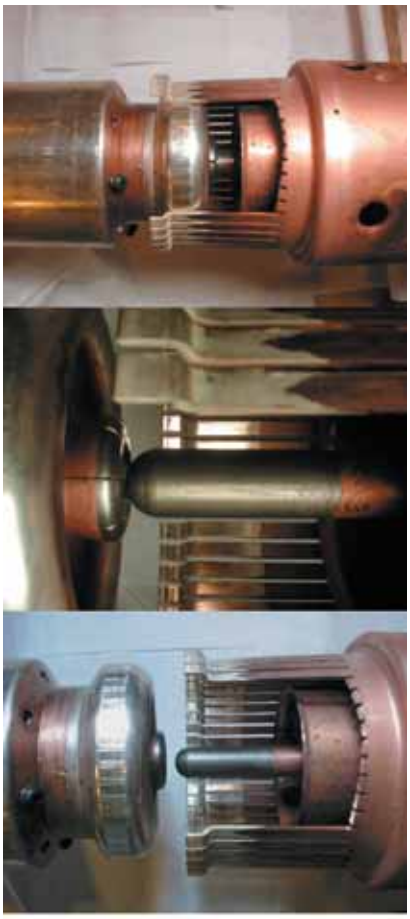

Fig 10b Contacts showed in Closed-Arc starting step-Opened position

All of these contacts use a wiping action when the moving contact gets inserted in the stationary contact as we see the traces of this action in Fig 11.

Fig 11 Wiping traces shown on SF6 contacts

FOR VACUUM ARCS: none of the above conditions are present. Two plates of conductive material can constitute the moving and the stationary contacts. Generally we need to separate them to a short distance (3mm to 20mm).

In a vacuum circuit breaker, vacuum interrupters are used for breaking and making load and fault currents. When the contacts in vacuum interrupter separate, the current to be interrupted initiates a metal vapor arc discharge and flows through the plasma until the next current zero. The arc is then extinguished and the conductive metal vapour condenses on the metal surfaces within a matter of microseconds. As a result the dielectric strength in the breaker builds up very rapidly.

The properties of a vacuum interrupter depend largely on the material and form of the contacts.

Over the period of their development, various types of contact material have been used. At the moment it is accepted that an oxygen free copper chromium alloy is the best material for high voltage circuit breakers. In this alloy, chromium is distributed through copper in the form of fine grains. This material combines good arc extinguishing characteristic with a reduced tendency to contact welding and low chopping current when switching inductive current. The use of this special material is that the current chopping is limited to 4 to 5 Amps.

At currents under 10kA, the vacuum arc burns as a diffuse discharge. At high current values the arc changes to a constricted form with an anode spot. A constricted arc that remains on one spot for too long can thermally overstress the contacts to such a degree that the deionization of the contact zone at current zero can no longer be guaranteed.

To overcome this problem, the arc root must be made to move over the contact surface.

Fig 12 Butt contacts short distance 9.5 mm used in vacuum interrupter in vacuum circuit breaker

In order to achieve this, contacts are so shaped, as in Fig 12, that the current flow through them results in a magnetic field being established which is at right angles to the arc axis. This radial field causes the arc root to rotate rapidly around the contact resulting in a uniform distribution of the heat over its surface. Contacts of this type are called radial magnetic field electrodes and they are used in the majority of circuit breakers for medium voltage applications.

A new design has come in vacuum interrupters, in which switching the arc from diffusion to constricted state is done by subjecting the arc to an axial magnetic field. Such a field can be provided by leading the arc current through a coil suitably arranged outside the vacuum chamber. Alternatively the field can be provided by designing the contact to give the required contact path. Such contacts are called axial magnetic field electrodes.

This principle has advantages when the short circuit current is in excess of 31.5 kA.

TESTING

Make/break contacts as presented need to be tested periodically to assess their condition. These contacts have to keep their good conductive properties when the contacts are fully closed. The conductive properties may be affected by the mechanical wear due to friction on operation or electrical wear caused by the electrical arc.

CONTACT RESISTANCE MEASUREMENT:

The best method for testing contact resistance is to put in application Ohm's law. It consists of applying a current, usually 100

Amps, and to measure the voltage drop in volts across the closed contacts. The resistance is then calculated in dividing the voltage by the current. The resulting value is read in micro-ohms, 1 micro-ohm= 10-6 ohms.

This measurement is used on all types of contacts.

DYNAMIC CONTACT RESISTANCE:

For some breakers, especially those that use an arcing nozzle to drive the flow of the quenching medium (puffer type SF6 breakers for example, see fig 10b), the wear of arcing contacts, if excessive, may affect the arc quenching capability of the interrupter, resulting in its destruction.

So the assessment of the arcing contact cannot be done by simply measuring the contact resistance in the classic way as described previously. A new method is developed called the dynamic contact resistance. It consists of measuring the contact resistance as described above but continuously while the contact is moving from the first contact touch until the fully closed position. This method permits to measure the length of the arcing contact and by comparing it to a value measured when new, helps determine its state of erosion.

It is important to state that this method does not apply to butt-type contacts.

SUMMARY

The electric arc plays an important role in the choice of material and shape of the make/break contacts.

In high-pressure arcs, intense heat is generated, which the contacts have to resist and keep their conductive properties. This is achieved by using tungsten alloys and copper or silver-plated copper and tulip contacts shape.

In vacuum arcs, the choice of materials is crucial to limit vapor emissions and favor their condensation within microseconds otherwise the contacts are destroyed. Oxygen-free copper chromium alloy is the best material for high voltage circuit breakers and butt contact shape is commonly used . ■

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***Dr. Fouad Brikci** is the president of Zensol Automation Inc. He was the first to introduce the concept of truly-computerized test equipment in the field of circuit breaker analyzers. As a former university teacher in Ecole Polytechnique — Algiers and CNRS - LAAS researcher in France, Dr. Brikci has developed experience in the fields of electronics, automation, and computer science. Most activities were focused on the industrial application of computers. Among his achievements are the development of fully comput¬erized measuring systems for quality control in circuit breaker manufacturing, laboratories, and maintenance services of electric utilities. Dr. Brikci holds a PhD in Electronics and a Master in Sci¬ences in EEA (electronics, electrotechnics, and automation) from the University of Bordeaux, France.*

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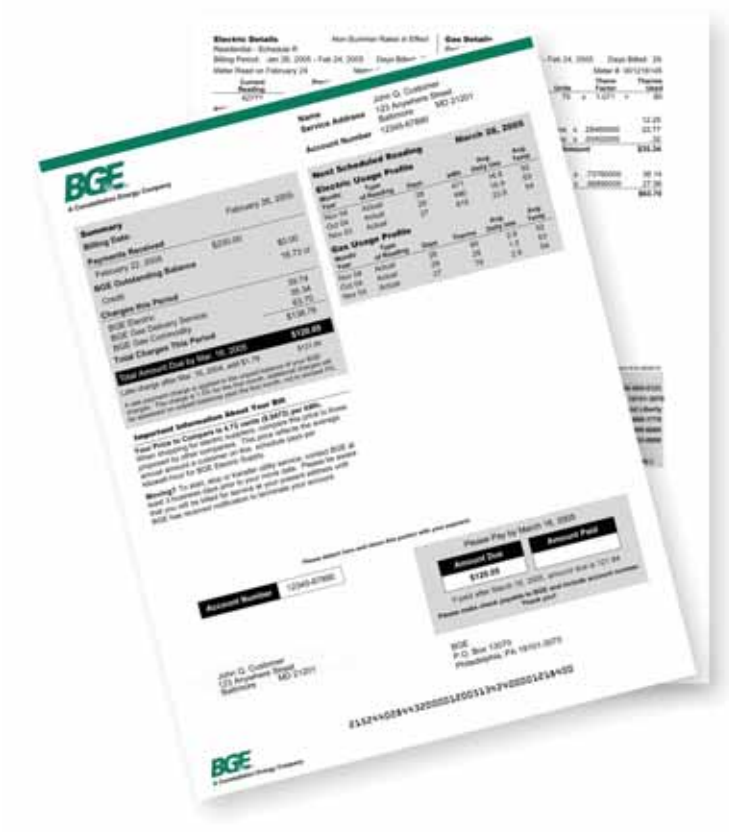
Developing a Solid Infrastructure for Flexible Customer Communications

by: Jim Norton, Vice President of Utilities Practice, Exstream Software



Electrical utilities today are facing a variety of new challenges, including cultivating more positive relationships with both their commercial and consumer customers. Deregulation, industry consolidation, and increasing environmental concerns are only a few of the issues fueling the drive for improved public relations. And these are on top of the ongoing requirements to respond to routine billing and service questions, while managing crisis situations like power outages due to natural causes or other unexpected service interruptions. Yet, customer expectations are on the rise and many electric utilities are frustrated by the unrelenting pressure and perceived costly effort needed to solve these challenges.

The customer relationship management (CRM) challenges energy companies confront today differ from those of other industries, though they are similar to the issues now-competitive financial services and telecommunications companies faced many years ago. Few utilities have a "lock" on being irreplaceable as the regional provider of electricity. The privileges utilities may enjoy as suppliers of indispensable resources come with heavy compliance requirements and the obligation to prove diligence in fulfilling their mission. Similar to companies in highly competitive industries, utilities today must be compelled to differentiate themselves by offering and communicating customer-relevant products and services, and implementing state-of-the-art systems to meet or exceed customer service expectations.

Utilities' IT focus has traditionally been dedicated to customer information systems solely to meet billing needs. In order to improve the customer experience, however, it is imperative that utilities leverage this critical system to capture relevant information about the customer in order to deliver more relevant and quality communications. The next step is actually using that information to most effectively impact the business.

THE CENTRAL CHALLENGE

Typically, a utility operates siloed customer content and communication systems built upon the needs of specialized business units: sales, marketing, billing, and customer service. Each unit may have its own back-end systems and processes, as well as different output requirements—including printed and electronic invoices, printed direct mail or other marketing pieces, and both printed and online correspondence for customers and the call center. Consistency and content accuracy are nearly impossible to achieve if the communication systems aren't integrated. Additionally, in order for communications to be corporate compliant and created relevantly for each customer and with the most up-to-date information, the system(s) must be able to interact in real time with centralized content management and other corporate systems. Many of the systems that exist in utilities today do not support these integrated capabilities.

Mergers and acquisitions just magnify the complexity of this situation. While an acquisition expands a utility's service area capabilities and number of customers, a newly-acquired operating facility has its own legacy and CIS systems that may or may not be compatible with the acquiring organization's IT infrastructure.

In a 2004 survey conducted by UtiliPoint International, Inc., more than 20 percent of the 300 participating utilities identified "flexibility" as the one feature they would change in their current customer communication system. Another top choice was "user friendliness." At the bottom of the list was "price"—chosen by less than 5 percent of those responding. This was especially true of utilities serving more than 500,000 customers. More than 45 percent of

these larger organizations wanted communications systems with the flexibility to interface with all corporate systems so information could be shared across both geographic and organizational boundaries. They also wanted more flexibility and "user friendliness" to be able to respond faster to changing demands as their businesses evolved.

Based on this feedback, what utilities need is an enterprise document automation software solution that provides a wide range of capabilities, supports multiple platforms, and integrates easily with existing applications and legacy systems.

ENTERPRISE DOCUMENT AUTOMATION

Baltimore Gas & Electric (BGE) implemented an enterprise document automation solution to achieve this type of flexibility. In a move to divest itself of non-core operations, the utility decided to shut down its in-house printing facility and partner with an outside print provider. At the same time, BGE wanted to retain control over the content, formatting, ongoing changes, and required regulatory information that went into its customer communications.

The technology selected provides the design independence BGE wanted, allowing its in-house staff to build applications without having to learn specialized programming code or skills. It also allows for simultaneous retrieval and dynamic processing of variable data and content from multiple information sources—from comma-delimited files and other formats to its CIS, CRM, and ERP systems.

BGE initially implemented its enterprise document automation solution to redesign and update its customer invoices. Based on surveys, they deleted information customers indicated they no longer needed, modified the font size, and printed the new bills on both sides of the page, which significantly reduced printing and postage costs. BGE's new system pulls relevant data from several different sources and assembles it according to specified design rules. Apart from promoting increased customer comprehension and satisfaction, these relatively simple changes in invoice design have saved BGE $297,000 per year in printing and postage costs alone.

Other utilities are also leveraging the capabilities of this enterprise document automation solution to develop invoices specifically targeted for their consumer or commercial clients, showing different types of usage data through charts and highlighting other information so customers can more easily track and plan their activities for improved cost savings and efficient energy use. The technology's ability to construct customized tables and charts from customer data is a highly effective tool many organizations have used to clarify hard-to-understand usage data.

A MONTHLY MEETING WITH CUSTOMERS

Most utilities already recognize the value of the monthly statement as a communications tool on several levels. The bill is the one mail item that customers are likely to open and read carefully. Innovative utilities incorporate useful information on their monthly statements, such as tips for conserving energy to help customers control their usage and costs. But with the right enterprise document automation solution, the bill itself can be tailored and customized to meet specific needs of the individual customer.

Most utilities offer some type of "complex billing" product with favorable pricing to customers who are willing to vary the amount and frequency of their payments according to wholesale market changes. The monthly invoice can be an effective vehicle for announcing incentives to encourage use of these programs for both businesses and consumers, even if the programs are available only seasonally or on relatively short notice. Utilities need an enterprise document automation solution that can collect and process information from many different systems and data sources on-the-fly to make this possible.

Another important way of ensuring that customers thoroughly understand their bills, as well as a highly effective way to establish more positive customer relationships, is to speak to customers in their own language. The nation's Hispanic population has risen by 60 percent over the last 10 years—a trend that is expected to continue in certain geographic areas. The right enterprise document automation solution will allow utilities to produce invoices and other communications in any language and, using contextual settings and business rules, format dates, currencies, and other language-dependent invoice information accordingly. The solution should also provide a spell checker for foreign languages.

MULTI-CHANNEL DELIVERY

Migrating paper billing to electronic channels is a current trend among innovative utilities, allowing them to speed delivery of accurate information while saving costs in printing and mailing. The shift to electronic bill presentment and payment is being deployed in a variety of ways, often by sending an email notification to the customer that the electronic invoice is ready for download. Some utilities have achieved higher levels of customer acceptance by delivering both hard copy and electronic invoices for a limited "trial period" before moving exclusively to electronic channels. It is vital to implement a software solution that supports output for multiple print and electronic channels from a single design. The right solution will also accommodate multi-channel delivery based on both business and customer preferences.

CALL CENTER SUPPORT

Of course, the right enterprise document automation solution must also support call centers' online retrieval needs for the most current customer bills and information. The right solution will impact the call center in two important ways. First, bills that are clearer and easier to understand will reduce the number of calls from customers requesting explanations of their bill. Second, call center employees will be better equipped to provide quality customer care because of their improved ability to access current bills and the relevant information they need. Additionally, the right provider for automated document solutions will allow representatives to print duplicate bills on the spot, or instantly send the customer a copy in PDF format.

CUSTOMIZED MARKETING

Though utilities have traditionally been given a bad rap with regard to customer service and acquisition initiatives, the more marketing-savvy ones are using the monthly invoice and other customer communications as a way to update their image, re-create themselves as customer-centered, and inspire customer loyalty. Cleaner, more effective design supports this effort, along with personalized and relevant marketing messages incorporated directly into the bill and other communications.

Personalization is no longer confined to name and address, units of energy consumed, and geographic area based on zip code. Smart marketers—and utilities seeking to differentiate themselves—are using customer data to develop new products targeted for specific buyers. As in the case of the complex billing programs

mentioned above, invoices can convey marketing information crafted to appeal to the requirements of a specific audience, including an audience of one.

With the right enterprise document automation solution, marketers should be able to define rules that trigger personalized messages and images to be incorporated into communications based on the recipient—whether a large or small energy user, a business or consumer, a homeowner or renter, or a community institution, non-profit organization, school or university. The marketer should also be able to ensure corporate branding standards are maintained across communications sent out by the utility.

REGULATORY COMPLIANCE

Utilities face daily challenges to comply with changing state and local regulations they are required to communicate to all or some of their customers. Here too, it is important that utilities implement an enterprise document automation platform that supports these shifting requirements easily and automatically. It should be easy to modify compliance content, including effective dates, for dynamic insertion into documents at the time of processing. The right enterprise document automation solution will house the compliant content centrally and automate changes on all the documents in which the content must appear.

IN SUMMARY

Although the idea behind automation is to make life a little easier, we all know that isn't always the case—at least initially. Utilities are strapped with traditional systems and processes to support a large number of customers, ensuring uninterrupted billing and service. Unfortunately, this has fostered siloed systems and data sources for customer communications that make it very difficult for utilities to achieve increased internal productivity while improving the customer experience. And, of course, mergers and acquisitions just complicate the situation.

Implementing the right enterprise document automation solution will allow utilities to leverage existing systems and data sources eliminating point solutions and streamlining document related processes, while generating significant cost savings, streamlined operations, and happier customers.

Exstream Software helps organizations of all sizes connect with their customers through higher quality, fully personalized communications. Exstream is on the web at www.exstream.com. ■

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Jim Norton *is vice president of utilities practice for Exstream Software. Jim Norton's responsibilities include planning, strategy, new customer acquisition and partnerships. Prior to joining Exstream Software, he was EVP and General Manager of Covast Corporation and Senior Vice President of Sales for Derivion (an Electronic Bill Presentment and Payment company). Mr. Norton has a BA in computer science and mathematics. He began his career with EDS and Texas Instruments.*

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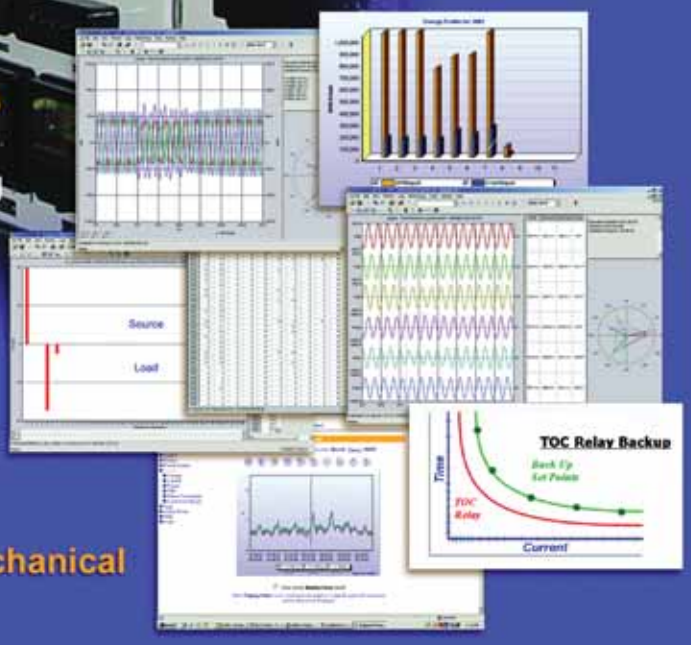

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