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ELECTRICITY Transmission & Distribution TODAY

THE ELECTRICITY FORUM

ISSUE 9 Volume 17, 2005

2006 EDIST Conference & Exhibition

Composite pole an award winner

- EDIST conference is positioned for the future
- Smart Metering: Tacoma Washington, America's most wired city

Smart sensors enable a smarter grid

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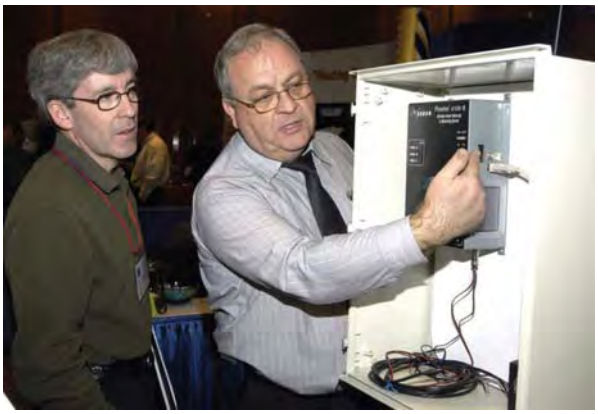
EDIST CONFERENCE IS POSITIONED FOR THE FUTURE

By Don Horne



The fourth annual EDIST Conference and Exhibition in January brings together engineers, operation professionals, IT professionals, financial and management staff from Ontario's Local Distribution Companies (LDCs), as well as organizations representing the supply, manufacturing and service sectors of the energy industry.

EDIST (Electricity Distribution Information Systems & Technology) will feature more than 250 industry people at the two-and-a-half day event in Markham, Ontario from January 25-27, with such companies as ABB, Bell Canada, Cooper Power Systems, Kinectrics, G.E. Energy and Panasonic having participated in previous years.

The theme for 2006, "Positioning Local Distribution Companies for the Future", is targeted for engineers, operational, IT and financial professionals, financial and management staff from Ontario's LDCs., in addition to the commercial members representing the supply, manufacturing and service sectors of the energy industry.

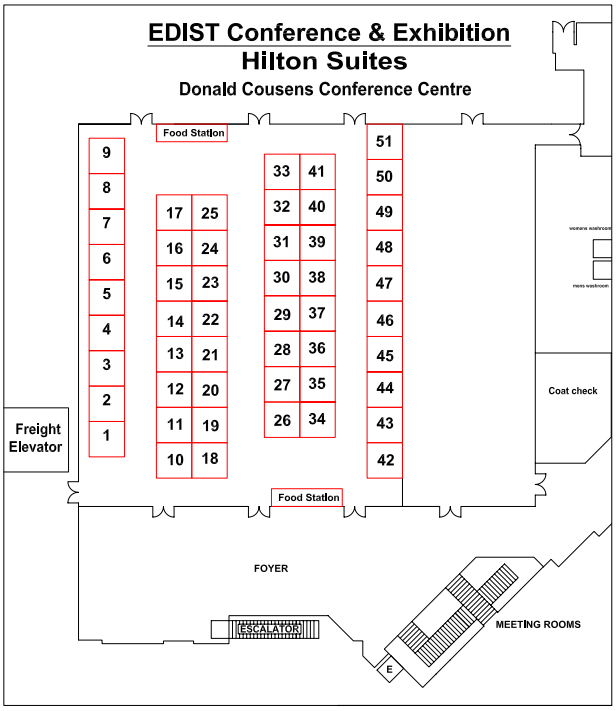
The program includes a number of plenary and concurrent sessions dealing with the most current topics in engineering, finance, technology and operations, including smart metering, CDM best practices, revenue assurance and more.

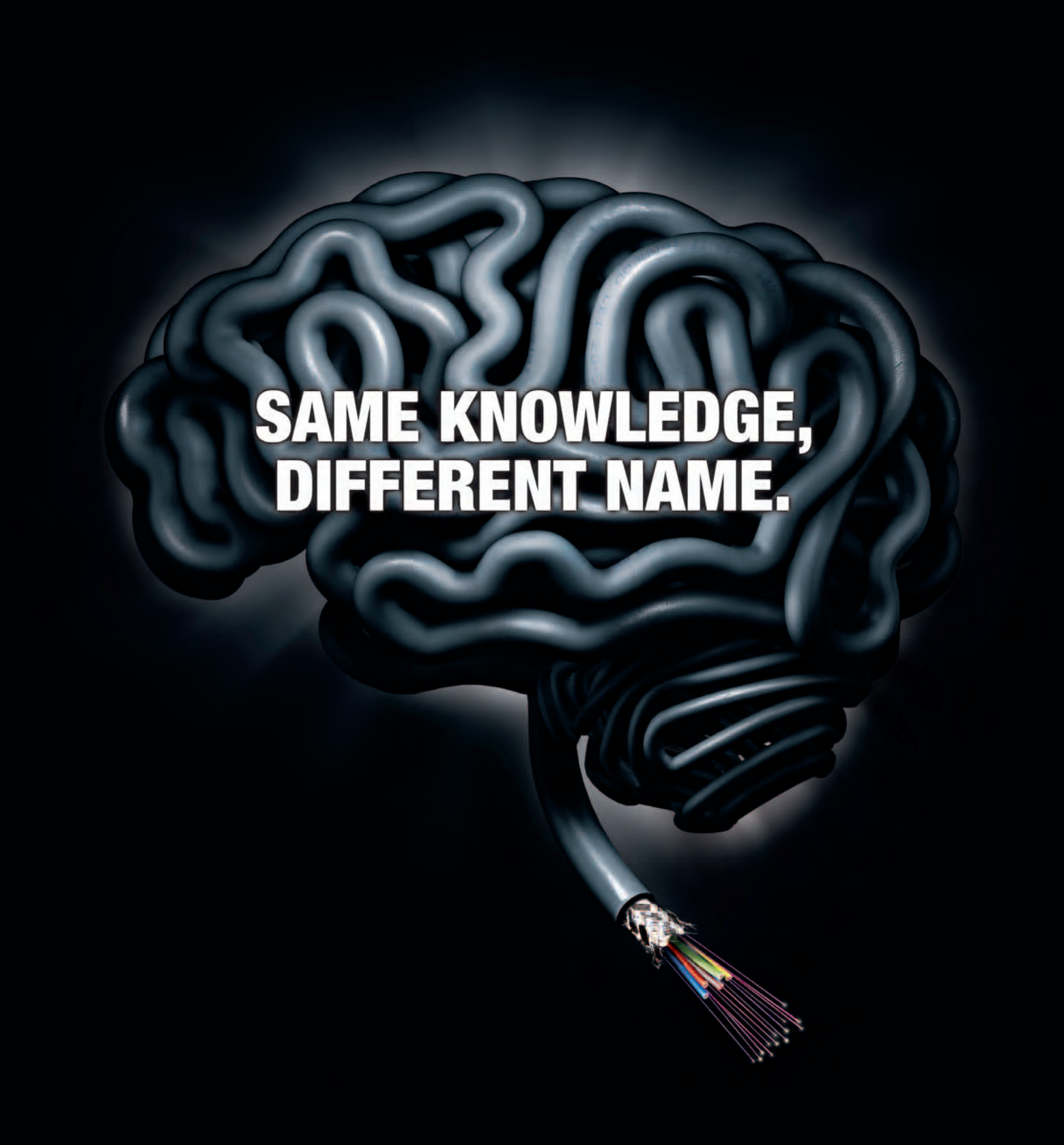
Attendees will be getting the latest updates on information technology, smart metering, CDM best practices, the future of technical skills training, revenue assurance and more.

Sponsored by the Electricity Distributors Association, EDIST also offers great exhibition and sponsorship packages for participating companies who want to display their products and services directly to their target markets.

Located at the Hilton Suites Conference Centre at Highway 7 and Warden, you can get more information on EDIST by going to their website, www.edist.ca

Photos from last year's EDIST conference





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TACOMA WASHINGTON, AMERICA'S MOST WIRED CITY

By Regan Stewart

Tacoma boasts one of the largest publicly owned telecommunications infrastructure systems in the nation, offering more fiber optic connectivity than any other city in the country. Today, Tacoma Public Utilities (TPU) is taking the city's technology assets to a new level by establishing one of the first "smart metering" systems in the country. Using the city's wired assets, TPU's new technology will allow customers to remotely monitor power reliability and usage, control their utility environments from anywhere in the world, and set up pay-as-you-go payments via the web. With 10,000 Smart Meters ready for use more than 2,200 miles of distribution lines, Tacoma is still leading the nation in telecommunication connectivity.

Randy Karr, Gateway Project Manager at Tacoma Public Utilities, says there are two reasons why Tacoma was prompted to undergo the smart meter project.

"First, customer service," he says. "We wanted more up-to-the-minute information about outages and signal quality. We hope to detect and even fix problems before the customer notices. And second, efficiency – by eliminating manual meter reads, we can reduce manpower requirements." With remote disconnects and reconnects, TPU can reduce truck rolls, thereby saving money for their customers.

Deployment Challenges

One of the biggest technical challenges was finding a meter manufacturer compatible with their hybrid coax fiber system HFC. "We have been the first large system to utilize this approach and we have encountered start-up bugs along the way," he says. "We also underestimated the back-office systems complexity and especially the details involved with interfacing to our SAP billing system."

Professionals in the electrical industry – specifically those building apartment complexes and industrial developments – can learn from TPU's experience. "We initially missed the fact that multi-dwellings sometimes use different meters than residential customers," says Karr. "Our initial meters were 2S meters and our system has about 50 percent 12S meters in multi-dwellings. We also had to work with space limitations since multi-dwellings stack meters closer together." AMR systems that switch power off remotely are fairly new and still in debugging stages of deployment. Dedicated staff to work the issues of maturing the products is a necessity, Karr added.

Now that the meters are in place, the next step for Tacoma is to finalize their 10-year plan to convert all their meter plants to smart meters, as well as work on a "pay as you go."

Network Transport

Tacoma Power's Click! Network was conceived in 1992, as Congress began considering electricity deregulation. To remain viable in the potential new environment, the utility recognized it would need to upgrade its service reliability. Rather than rely on paper maps and push-pins to locate outages, Tacoma Power would need a state-of-the-art telecommunications system to monitor its distribution network in realtime and automatically reroute power when faults occurred. In 1997, after four years of detailed research and consideration of numerous alternatives –including unsuccessful attempts of leasing capacity from the phone or cable companies – Tacoma Power began building its own telecommunications infrastructure.

The utility's use of the network includes fiber connections from substations throughout Tacoma Power's service area to the utility's energy control center

Continued on Page 10

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Wired

Continued from Page 8

for monitoring and load management visibility. The telecommunications network is integral in the utility's smart meter project. Tacoma Power is currently deploying residential meters which incorporate both communications and control features in a single, integrated meter.

These "smart meters" are capable of highly granular remote meter reads, remote electric service connects and disconnects, remote telecommunication service connects and disconnects, meter tampering detection, and micro-outage detection. These devices enable prepaid residential billing, provide access to accurate and timely information about energy use and should enable the opening and closing of accounts with a single phone call, saving the utility operational costs.

The biggest challenges of constructing the network included building a massive fiber and coaxial cable system hundreds of miles long from the ground up. Tacoma Power crews had to make room on the utility poles to accommodate another telecom provider – Click. Click is now an operating section of Tacoma Power. Diane Lachel, Government Relations Manager, Click! Network/Tacoma Power explains, "During that time we experienced political challenges from a handful of vocal business leaders who did not initially think the government should be in a competitive business. Telecom and cable franchise negotiations took a year to complete and were required prior to deploying services." The Telecom Act of 1996 requires cities to treat all service providers the same.

Other challenges, Lachel adds, included the often sluggish bureaucracy of being a public entity, receiving necessary equipment as a small operator (with the largest operator in the country as a direct competitor), stalls in negotiating contracts with program suppliers who were owned by our competitor as well as vandalism in the field.

Click capitalized on the fact that neither wire line competitor had upgraded their infrastructure in decades. They designed a robust and fully redundant infrastructure and built a state-of-the art network capable of multiple applications. The company even asked the utility's customers' what they wanted to see on their TVs as well as what were they willing to pay for it.

"We've constructed Tacoma Power's telecommunications network and deployed commercial services in approximately 60 percent of Tacoma Power's total 180 square miles of service area," Lachel says. "The smart meter project is in its early stages with slightly more than 3,500 smart meters deployed." Tacoma Power has 155,000 total customers.

Prior to Tacoma Power's investment in Click! Network, businesses spent 12 to 18 months to install telephone lines. The Tacoma/Pierce County area was underserved because the phone company and cable company had limited capital. Residents only had access to a 25-year-old cable plant with 33 channels and no interactive services.

Regan Stewart is a freelance writer based out of Texas.

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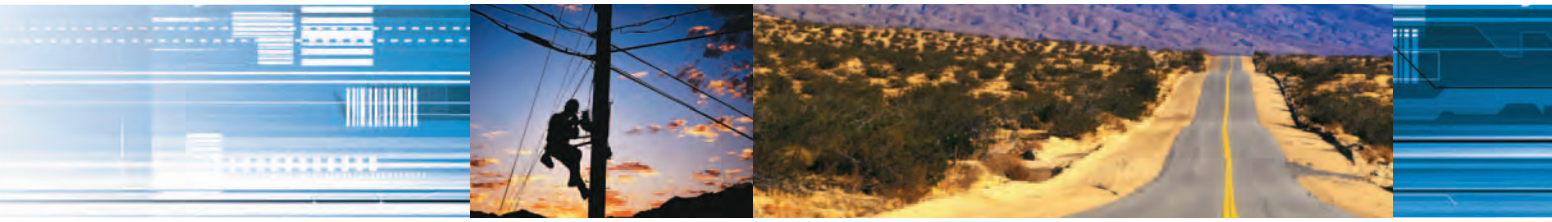

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QUEBEC'S BIG WIND PLAY

By Bob Fesmire, ABB

Recently, the University of Quebec's Rimouski campus played host to a conference on wind power. Falling immediately after the Canadian Wind Energy Association's (CANWEA) annual meeting, and located in Quebec's remote Magdalen Islands, the meeting was anticipated to be a relatively small event with around 150 attendees. Nearly 250 showed up.

The surprising boom in attendance is indicative of the buzz being generated about wind power in Quebec these days, and with good reason. Quebec is blessed with an abundance of wind resources — as much as 100,000 MW within 25 kilometers of existing transmission lines according to a recent study. It is further estimated that up to 4,000 MW of wind could be added to Hydro Quebec's network by 2015 without causing significant system constraints.

The provincial government has taken bold steps in recent years to boost the development of wind power in Quebec, mandating in 2003 that state-owned Hydro Quebec (HQ) acquire 1,000 MW of new wind generation capacity, and recently issuing a second decree for an additional 2,000 MW. Quebec is already poised to overtake Alberta as the Canadian leader in wind energy, and with these new initiatives the region is looking to become a major player in the global wind industry. But the motivating force behind these moves has as much to do with local economics as it does with fuel diversity and environmental concerns.

Quebec sees wind power as a means to multiple ends. It provides the province with new sources of emissions-free generation to support economic growth, but it also stimulates that growth directly. Unlike other areas where "jobs" and "emissions" usually involve an unhappy tradeoff (think coal mining), Quebec has used local content provisions in the requests for proposals (RFPs) issued by HQ to ensure that the development of the area's wind resources will also create local jobs.

This is especially meaningful for the Gaspe region, a windswept peninsula in the Gulf of St. Lawrence that has fallen on hard times in the wake of downturns in the mining and fishing industries on which it relied for many years. Hydro Quebec's first RFP stipulated that 40-60% (depending on timing) of the costs associated with the turbines themselves must be incurred within the Gaspe itself, while 60% of the project costs in total be spent in Quebec. A stringent requirement, to be sure, but it didn't stop a swarm of developers and manufacturers from going after the business. In fact, the first RFP precipitated more responses, and lower prices, than anticipated with eight projects being awarded for a total of 990 MW of power to be sold at 6.5 cents per kWh. And yes, that's 6.5 cents Canadian.

Will wind-related manufacturing jobs be enough to turn the Gaspe's economy around? Probably not, but the idea that wind can have a positive impact on a local economy is one that deserves more attention, especially in manufacturing centers like the "rust belt" of the US.

Still, if the Gaspe — and Quebec in general — is to become a Mecca for the wind industry, the companies that set up shop there will have to stay after the work for HQ's initiative is complete. For that to make sense, they will have to export, and that means competing successfully in the world market.

That's the position of various industry observers, including CANWEA. While praising Quebec for its forward thinking approach to wind power, the organization was also concerned that the local content provisions would be too much of a good thing. The provincial government seems to have taken this into account in the second RFP by reducing the Gaspe-specific requirement to 30% of turbine costs. The province-wide requirement, however, remains at 60%.

However, towers, turbines and blades are not the only export Quebec has to offer when it comes to wind energy. HQ's extensive experience with hydroelectricity — and now its expertise in integrating wind with a large hydro system — could pay dividends down the line as well.

Aggregation of wind farms can do much to mitigate intermittency, but the fact remains that wind is an inherently variable power source. Conversely, hydro resources are extremely predictable, and they can provide a perfect compliment to wind generation. Hydro plants can be controlled precisely to follow the small variations in wind output while still avoiding the emissions and volatile fuel costs associated with gas-fired plants. As wind energy continues to grow, the use of hydro power to facilitate its integration to existing grids is likely to grow with it. This will require specialized expertise, a niche that Quebec is positioning itself to fill today.

If the current initiative can be parlayed into sustained businesses that continue on after the province has brought its next 2,000 MW online, then it seems safe to declare the approach a success. At what point, though, does the benefit of local content requirements become a liability for global competition? Manufacturers on their way to eastern Canada now to supply the eight projects awarded under the first RFP will soon have to start looking at how to make money in the export market. Otherwise, the last rotor blade shipped for RFP2 could be the last one shipped, period. Clearly, Quebec's play for wind jobs is a gamble, but the benefits of 3,000 MW of wind generated power will accrue for many years after that last blade rolls out of the factory.

The views expressed by Bob Fesmire are not necessarily those of ABB.

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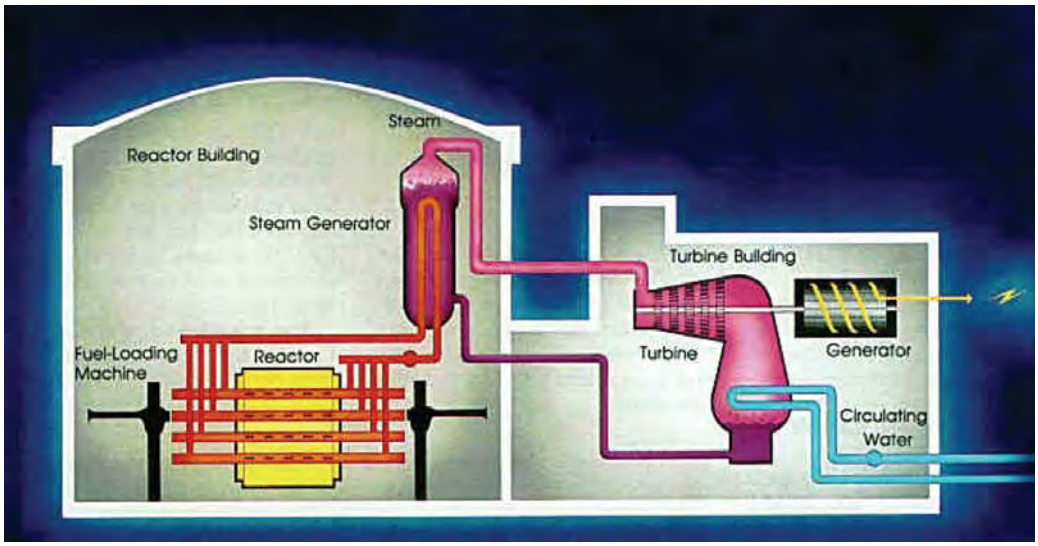
AMEC GOING INTO BRUCE POWER PROJECT WITH EYES WIDE OPEN

By Don Horne



The announced restart of Bruce A Units 1 and 2 in October really began in April of 2003 when Bruce Power AMEC began taking a hard look at the feasibility of refurbishing these mothballed reactors.

"It's been two years in the preparation, and over 18 months since we we got involved in some of the preliminary work, looking at different project models," says Kevin Routledge, Project Director and President of AMEC NNC Canada Limited (AMEC NCL). "It has been very demanding, but also is very exciting to be involved in such a challenging project."

AMEC, an international project management and services company, has been was selected by Bruce Power LP as the project manager to restart two of Bruce A nuclear reactor units that were shutdown in the mid-1990s.

As the project leader, Mr. Routledge brings a wealth of experience to the job.

"I have 32 years (experience) in the nuclear industry with a UK (United Kingdom) company known as NNC (now AMEC NNC), and we built all the reactors in the UK and ones for Italy and Japan.

"We've been involved in a number of reactor refurbishment projects over the years in Russia, Lithuania and the Ukraine, and I've worked on just about every reactor type in the world."

The $4.25 billion investment program for Bruce Power is being conducted under the auspices of Bruce A LPOntario Power Generation.

The total investment includes $2.75 billion to restore Units 1 and 2, which have been down since the mid-1990s.

"We will be working on them in parallel, and expect them to be back on the bars by 2009," he says.

The remaining $1.5 billion will be spent on refurbishment of Unit 3, and with $350 million of that allocated to replace the steam generators on Unit 4.

AMEC was hired to manage the project and keep costs under control, and has invested a half-billion dollars of its own money. Major investors in the project are Calgary-based TransCanada and OMERS, one of the country's largest pension plans, both shareholders in Bruce A LP.

As part of this contract worth up to $510 million, AMEC is mobilizing a team onsite to undertake project management, contract management and construction management, on behalf of Bruce Power, as well as to provide critical services for the contractors undertaking modification work on the plant. In addition to the project management service, AMEC's proprietary project management system Convero will be used on this project.

Although the capital cost for the refurbishments will be covered by Bruce Power, a "risk and reward sharing schedule" will have taxpayers liable for 50 per cent of cost overruns of up to $618 million on the project and a 25 per cent share beyond that.

And AMEC is all too aware of the need to keep a handle on cost overruns.

"It is a very legitimate concern, cost overruns," says Mr. Routledge. "They (the nuclear industry) haven't been very good at keeping delivering projects of this type to budget and schedule costs down. The industry is good at sharing information, and the information we've been studying from previous projects makes us confident of getting the outcome we need."

The cost to build the province's controversial Darlington nuclear station nearly tripled during the 1980s to $14 billion, and Ontario Power Generation's efforts to restore Unit 4 at the Pickering A facility cost $1.25 billion, almost three times the original projected cost.

"Some of the restarts were beguan without the preparation being done; the contracts hadn't been put in place," he says. "We have done a great deal of due diligence in putting the contracts in place.

"There is always a degree of uncertainty," admits Mr. Routledge. "We won't really know everything until we begin opening up the reactors and seeing what is in there."

Once completed, the refurbished units will earn Bruce 6.3 cents per kilowatt-hour, well above the 4.9 cents per kWh OPG received for its nuclear power

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Continued from Page 16

this summer, but less than the average electricity costs this year of 6.8 cents per kilowatt-hour.

Canada generates 12.5 per cent of its electricity from nuclear. Its last reactor came on-line in 1993. Ontario is the largest nuclear market, with 20 of Canada's 22 reactors. There is a growing market to bring mothballed reactors back into service in order to meet demand for energy and the provincial government's commitment to phasing out coal-fired stations. All of its operating reactors will have to undergo life extension/refurbishment and it is estimated that $20 billion could be spent over the next 15 years.

"The Candu reactor is a good one, and in the early days it was the top performer in the world bar none," says Mr. Routledge. "But it has run into life issues, specifically the horizontal pressure tubes that require replacement every 25 years."

In comparison, he cites the recent technological improvements made in the United States, especially in the field of light water technology, are dramatically improving reactor life by upwards of 60 years.

"The ACR (Advanced Candu Reactor) has moved away from heavy water and uranium to enriched fuel and light water - like the new American reactors," he points out. "But the existing Candus are still solid performers."

In terms of funding, the majority of Canada's reactors are owned by provincial utilities. Eight of the reactors in Ontario are leased to Bruce Powera private company and the cost of bringing two of these laid up reactors back online will be funded by its shareholders. It will also be necessary to extending the operating lease it has with Ontario Power Generation by 25 years, which could be a model for the future. New Brunswick Power has decided to retain ownership and management of its reactor in the public sector, and is proceeding with its refurbishment.

The AECL is currently making a decision whether to lease its nuclear power station to a private company so it can be refurbished, or close it down and replace it with a new nuclear or conventional plant.

As Mr. Routledge sees it, the options of meeting demand and abiding by the Kyoto Protocol leave few options.

"Essentially there are only two ways to do it, and only nuclear offers a large impact in meeting electricity generation requirements, while reducing carbon dioxide emissions," he says. "And the other way to significantly eliminate emissions is to put an end to traffic - and no one is going to stop driving."

The refurbishments will boost Bruce's total nuclear contribution in Ontario to 6,200 megawatts - enough to power about 25 per cent of the province on a typical day.

The plan is designed to help address potential shortages of electricity. The province needs to fix or replace some 25,000 megawatts of electricity generation by 2020.

ET

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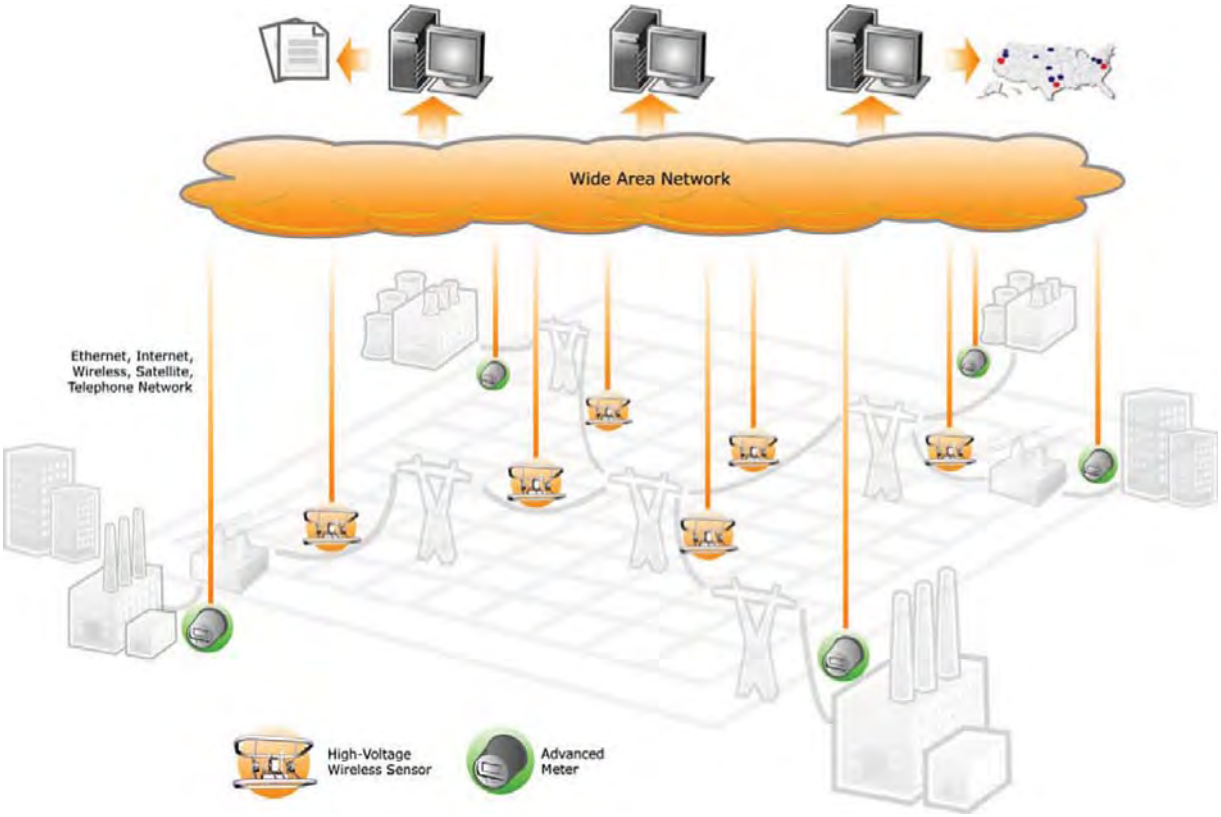

Fig. 1. Wide Area Monitoring System (WAMS) offering a hybrid system of existing conventional monitoring and innovative new HV Sensors.

SMART SENSORS ENABLE A SMARTER GRID

By Paul Doig, Power Measurement

As the demand for electricity increases, the electric utility industry is faced with many challenges to supply the high quality, reliable energy demanded by the sophisticated industrial and consumer markets. After the recent blackouts, the industry is even more aware that the aging transmission system requires huge capital investments, which puts large financial burdens on the public and private energy suppliers.

However, innovative technologies are emerging to help the grid evolve in a cost-effective manner in order to meet the power consumption needs of modern society. Efforts put forth by the United States Department of Energy and the US congress have led to the formation of coalitions, such as the GridWise Alliance. These groups are visionary, creating the architecture for the new smarter power grid. Investment into long-term R&D has proven fruitful, producing immediate technological benefits to the utility industry. This article investigates the innovative technologies developed by Power Measurement, a subsidiary of Schneider Electric, that directly address the requirement for increased visibility and monitoring on the grid through the use of easily deployed smart sensors.

The technology focuses on the ability for utilities to deploy, cost effective, high-accuracy, wireless high voltage sensors that increase grid observability and enable true wide area monitoring systems (WAMS).

NEW PARADIGM FOR WIDE AREA MONITORING SYSTEMS

Increased reliability is directly affected by the amount of visibility and monitoring within the power system. Near real-time collaboration between utilities interconnected on the same grid has historically been challenging. After the effects of the blackout in the western United States in 1996 and, more recently, after the blackout in the northeast in August 2003, utilities and system opera-

Continued on Page 19

Continued from Page 18

tors realize the importance of wide area monitoring systems (WAMS). These systems are still in their infancy with relatively few sensors placed across various regions in the US and Canada. The existing sensors monitor voltage stability and provide this information to systems responsible for the reliability of the interconnected utility grids. Increased funding from the utilities and government has spawned a reawakening of these types of systems. As the requirement for system reliability increases, utilities are under pressure to increase their monitoring capabilities and need to install many more sensors.

A concept, known as synchronized phasor measurement, is based on collecting GPS time-synchronized data from multiple points on a wide area grid to provide real-time visibility of voltage stability on the power network. The IEEE 1344 Synchrophasor standard provides technical details on the methodology to achieve highly-accurate, GPS time-synchronized phasor information. This system relies on the synchronized phasor measurements to be transmitted in real-time to head-end system control centers that can process and analyze the information to make mission critical decisions to improve system reliability.

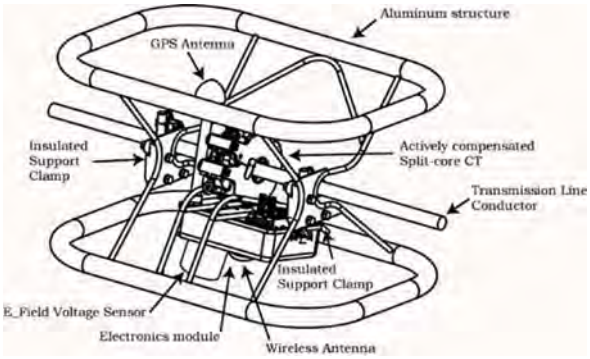

Fig. 2. HV Sensor.

The existing synchrophasor measurement solution is based on embedding this monitoring capability in conventional advanced metering, digital relaying equipment or specially designed phasor measurement units (PMU). This solution uses existing instrument transformer infrastructure or requires that new equipment be installed to provide monitoring at these key monitoring points.

The technology from Power Measurement is a unique paradigm offering a hybrid of existing metering points with new high-voltage (HV) sensors, as shown in Fig.1. The new HV sensors provide cost-effective, easy, clamp-on installation and wireless integration for previously unmonitored points on the grid.

Having the ability to quickly install a sensor on an HV transmission line or within an HV substation greatly enhances visibility of network monitoring. The HV sensor provides high accuracy GPS time-synchronized phasor measurements that are wirelessly transmitted, via satellite, cellular, or licensed RF radio back to a central information system controlling the real-time operations of the grid.

Fig. 2 shows the various components of the HV sensor. This technology is self powered and designed to be installed live on HV systems up to 765 kV. Its highly accurate, actively compensated split-core CT and its electric field voltage sensor provide RMS phase and magnitude data over the wireless link back to the control center. The type of accuracy from this HV sensor is not achievable through the conventional instrument transformers –based methodology.

The industry standard for synchronized phasor measurements calls for accuracy of 0.1 degree, however, the

Continued on Page 20

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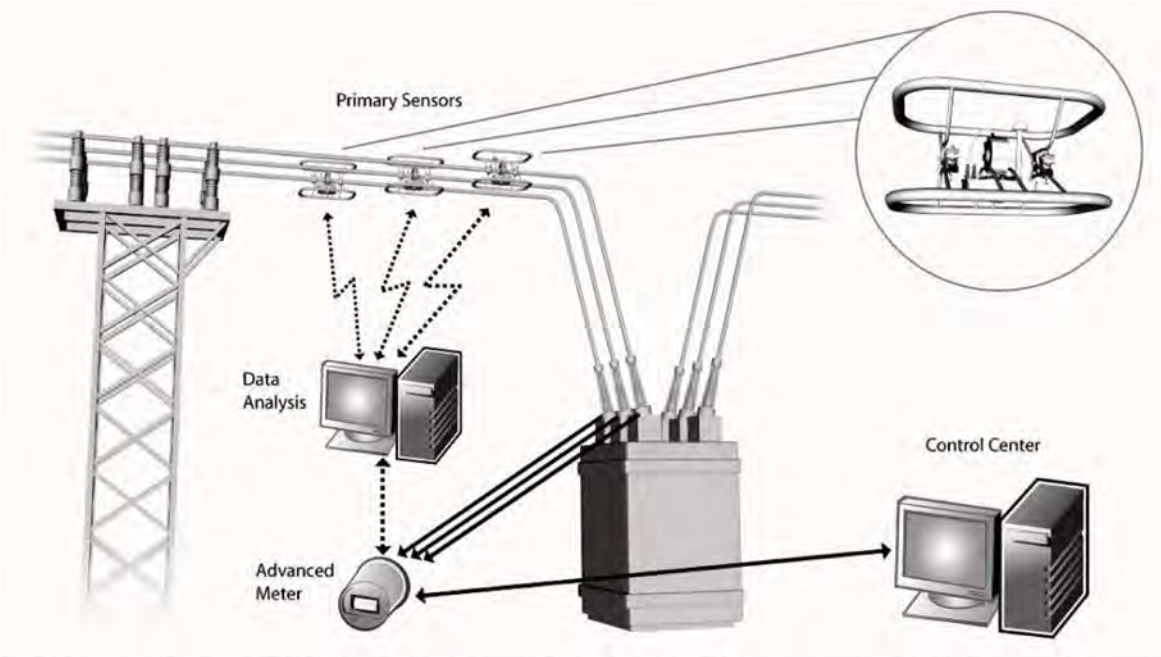

Fig. 3. Accuracy verification and CT reclassification system to increase the overall accuracy of the monitoring point on the grid. Improvements in accuracy provide more reliable data by which operators can effectively improve the control and reliability of the entire power grid.

Sensors

Continued from Page 19

instrumentation currently providing this data is connected to the secondary wiring of instrument transformers that are manufactured to be no better than 1-2% accuracy. By using a sensor that bypasses the existing infrastructure and is mounted directly and easily at the desired monitoring point, this provides a leap forward in technology that immediately contributes to the ability to improve the overall reliability of the power grid.

SYSTEM ACCURACY VERIFICATION AND RECLASSIFICATION

As mentioned earlier, the conventional systems for grid reliability monitoring rely on advanced metering, digital relays and dedicated PMUs to provide time synchronized phasor data. However, the weak link is typically the performance of the current transformers (CTs) and potential transformers (PTs) that are providing the analog signals to the high accuracy instrumentation. Without knowing the true accuracy of the entire system, system operators cannot reliably depend on these existing WAMS to make mission critical decisions.

Power Measurement has developed a system, based on the HV sensor technology, that can accurately verify and reclassify existing instrument-class current transformers while installed and operating in the field. Inherent errors in phase angle and ratio lead to overall system errors when calculating synchronized phasor data. For those sites where existing systems already provide data, it is critical to understand the entire accuracy of the system. Fig.3 illustrates the system that is being deployed in substations in British Columbia, Georgia and New York.

The HV sensor acts as the high accuracy reference sensor, known as the primary sensor, that is traceable to NIST standards. The primary sensors are mounted live, one on each phase, on the high voltage bus within a substation. The CT under test that is providing analog signals for the instrumentation is connected to a highly accurate advanced meter. The measurements from the primary sensors are wirelessly streamed and collected by a PC that is simultaneously collecting data from the meter connected to the secondary wiring of the CT under test.

The PC compares the GPS time-synchronized data from both the primary sensor and the meter and calculates the error in phase angle and ratio for the CT under test. Having this error information provides insight into the true accuracy of the overall measurements used for grid reliability monitoring. With this information, the accuracy of the CT can be dynamically corrected by programming the advanced meter with the necessary error characteristic curves. In realtime, the meter corrects for inherent errors in the CT and simultaneously provides time-synchronized data to the control center to provide information to ensure the reliability of the grid is maintained.

This unique system completes the hybrid model for wide area monitoring. The ability to verify and reclassify instrument transformers while operational in the field minimizes system downtime, increases system accuracy and improves the overall reliability of the grid.

CONCLUSION

The combination of the highly-accurate HV sensor and the ability to improve the overall accuracy of existing monitoring sites provides a solution that increases the visibility for operators controlling the grid. By providing the industry with the ability to increase observability of the power system, the smart sensors enable a smarter grid and accelerate improvements in overall grid reliability.

HOW INFRARED THERMOGRAPHY HELPS SOUTHERN CALIFORNIA EDISON IMPROVE GRID RELIABILITY

By Bob Turnbull and Steve McConnell, Southern California Edison

The Infrared Thermography Inspection program at Southern California Edison has been fully integrated into their predictive maintenance protocol at all their facilities. This article will provide an overview of the program.

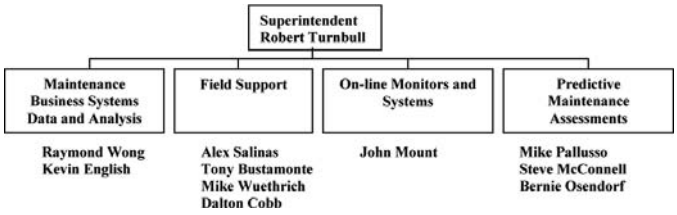

Figure 1. Our organization chart

A BRIEF OVERVIEW OF SOUTHERN CALIFORNIA EDISON

SoCal Edison services more than 4.1 million customers in a 50,000 square mile service territory in Southern California with a peak demand of 21GVA. Our 80 GVA installed capacity is delivered through 858 substations in which the equipment complement includes:

- 900 substation busses
- 3,300 power transformers
- 10,800 circuit breakers rated from 500 to 2,400 Volts

OVERVIEW OF THE SUBSTATION CONSTRUCTION AND MAINTENANCE DEPARTMENT

Figure 1 is a structural chart of our

Continued on Page 23

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organization headed by Mr. Bob Turnbull, Technical Supervisor of Substation Construction and Maintenance Support Services. The heart of our controlled PdM program is the computer-based PassPort, which is the name for our Work Management System.

Maintenance Business Systems data and analysis personnel provide:

- Substation Construction and Maintenance web-site technical lead and development
- PassPort Work Management System maintenance data
- Real-time KPI (key performance indicators) status
- Transporting and management of data
- Data communications systems architecture and database structure

Technical Field Support personnel provide:

- Installation, operation and maintenance recommendations, equipment failure analysis and reports and on-line oil filtering and Morgan Schaffer monitoring for transformers, reactors LTCs (load tap changers) and oil-filled CT/PTs (current transformers/voltage transformers).
- Installation, operation and maintenance recommendations for power circuit breakers and GIS (gas insulating systems).
- Maintenance cost factors provided by the equipment specification team member
- Capital replacement strategy provided by the transformer resource management team member
- Equipment problem resolution and supplier performance tracking by the ABB (Asea-Brown-Boveri) circuit breaker team member
- Resource manual, SF6 residual credit and new gas processing equipment provided by the SF-6 sulfur hexafluoride insulating gas) gas resources team member

On-line Monitoring personnel provide:

- On-line monitor links to our PassPort Work Management System
- Development of response time recorder replacement
- On-line equipment monitoring technical lead analysis and on-line monitor data

OUR PREDICTIVE MAINTENANCE ASSESSMENT PROGRAM

The mission of our PdM assessment (PMA) program is to improve and optimize grid reliability through the deployment of a multidisciplinary diagnostic program of equipment monitoring. With all these elements in place, and by means of our Predictive Maintenance Assessment (PMA) reports we have consistently demonstrated and documented failure avoidance and cost avoidance. The Infrared Thermography Inspection program in particular has been most dramatic in this regard, as shall be demonstrated by examples given later.

The elements of a PMA program are:

- PdM technical lead
- Maintenance initiatives
- Infrared diagnostics
- Acoustical diagnostics
- Vibration analysis
- Technical reporting
- Technical recommendations

The importance of "selling" the program to team members as well as to management cannot be emphasized enough. While management's major concerns involve meeting business goals and maintaining profitability, the goals of the team members revolve more around job satisfaction, recognition of contribution by management and personal enrichment and advancement.

Field personnel also benefit by the success of the program. Frequent systematic inspections, meaningful findings and timely maintenance and repair optimize personnel and facility safety, minimize down time and enhance the job satisfaction of field operating personnel.

Most critical to our program is emphasizing the concept of a "team effort". Effective communication among team members is essential. The need to "close the loop" on any finding must remain foremost in the minds of all team members.

THE PMA PROCESS – CLOSING THE LOOP

The PMA process begins with regularly scheduled inspections at locations designated by the program managers and supplemented, on occasion, by special requests from the field. The technical specialists, such as the IR thermographers, perform the station inspections and determine the criticality of each finding, assigning a severity level to each detected abnormality. These levels, in the case of infrared thermography, are determined, for the most part, by the maximum detected temperature rise over a predetermined reference temperature, with Level 1 being the most critical and requiring the most immediate attention. The severity levels are defined as follows:

Critical problem-priority level 1

Any problem that is identified as a safety hazard, or an immediate threat to grid reliability.

Identified through the use of diagnostic analysis and inspections.

Action required: repair immediately.

Foreman/electrician to make decision and take immediate corrective action to relieve the problem. Notify superintendent and program manager as soon as possible.

Note: the corrective action may be in the form of switching to relieve load, jumper out a disconnect switch, repair or remove equipment from service, etc.

Serious problem-priority level 2

A problem that has the potential to develop into a hazardous condition and affect grid reliability. Identified through the use of diagnostic analysis and inspections.

Action required: repair in the immediate future.

Foreman/technical specialist shall periodically monitor until repaired. Technical specialist notifies supervision and submits a written report. Foreman/program manager to establish priorities and schedule at monthly foremen's planning meeting.

Note: this type of problem will progressively worsen.

Intermediate problem-priority level 3

A problem that is identified as no immediate threat to personnel or grid reliability.

Identified through the use of diagnostic analysis and inspections.

Action required: schedule the repair.

Foreman/program manager to establish priorities and schedule at monthly foremen's planning meetings.

Continued on Page 26

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3' – 6"	Limited Approach
1' – 0"	Restricted Approach – Class 00 Voltage Gloves
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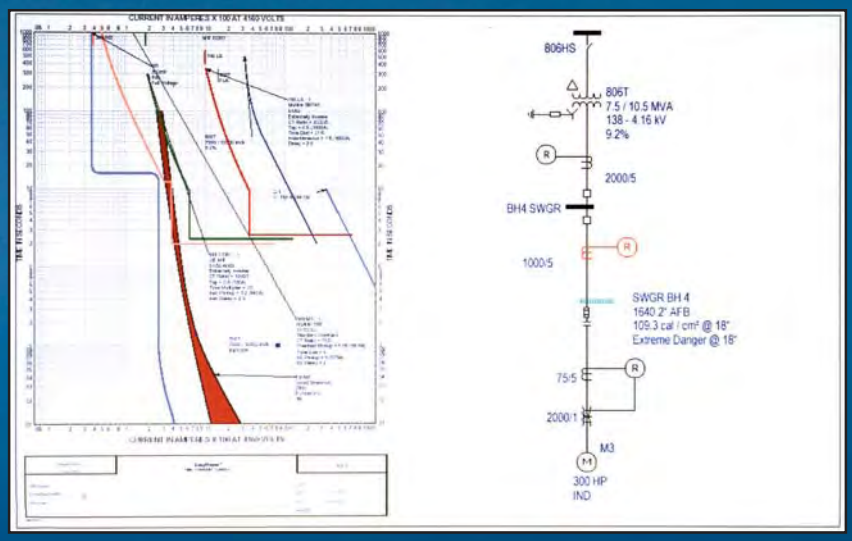

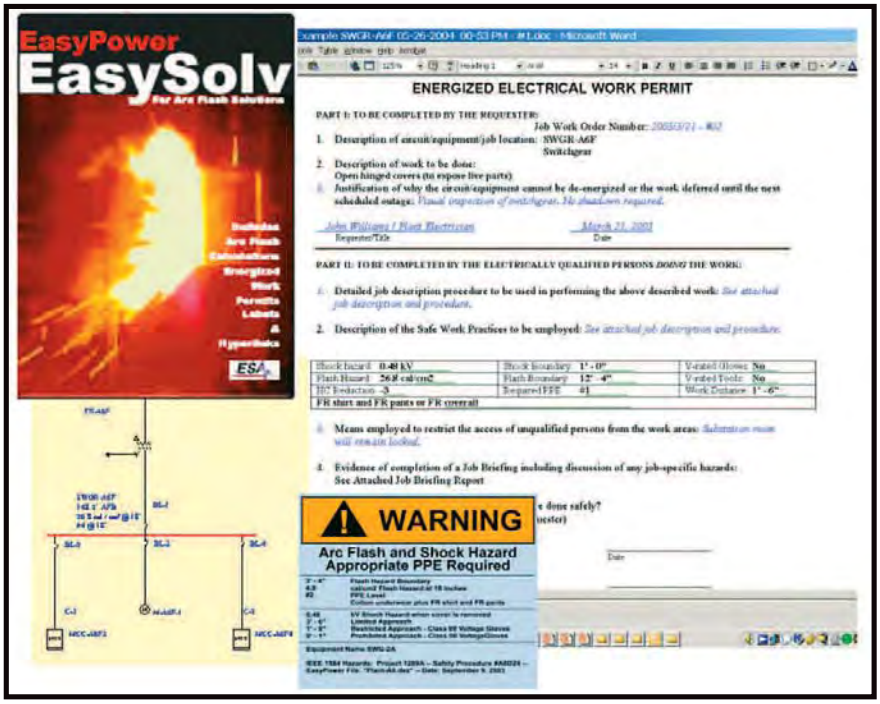

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Continued from Page 23

Note: this type of problem is less likely to be immediately detrimental to personnel or to the grid.

Minor problem-priority level 4

A problem that is identified as requiring routine attention or maintenance. Little probability of physical damage. Identified through the use of diagnostic analysis and inspections.

Action required: repair as part of regular maintenance.

Foreman to establish priorities and complete repairs as time permits.

Note: this type of problem is very unlikely to be detrimental to personnel or to the grid.

The technical specialist then inputs the data into the WMS for the creation of field reports and maintenance repair work orders and the WMS generates the formal reports and work orders. The technical specialist also notifies the field maintenance crews directly when there are any severity Level 1 abnormalities detected.

Acting on the severity Level I abnormality report, the appropriate foreman generates and releases validation sheets directing repair crew (electricians) to perform the indicated repairs. The crew completes and documents the repairs, the site is reinspected and the foreman closes the work order and enters the repair data in the WMS.

All PMA findings are discussed during regularly scheduled monthly workload meetings attended by team personnel from all groups. Cost avoidance reports generated for all Level 1 abnormalities and repairs are discussed at these meetings.

Information for reporting trends to management is derived by querying the WMS database. In this way reports are prepared from the PMA process for assuring continuing management support.

EXAMPLES OF FINDINGS USING IR THERMOGRAPHY

We are currently using an Inframatrics model PM 295 uncooled-microbolometer based infrared camera. We employ three (3) Level II certified infrared thermographers. A fourth thermographer is currently in training.

We inspect a wide variety of operating equipment in our substations, including transformers, circuit breakers, bushings, disconnects, fuses, roto-switches, secondary current terminations, potheads, station batteries and relays. The following are illustrations of some of the abnormalities detected.

1. Hot battery terminal

A hot connection was detected on a battery terminal at our Anita Substation as illustrated in Figure 2. A rise of greater than 1°C is considered extraordinary in this type of equipment and required immediate attention.

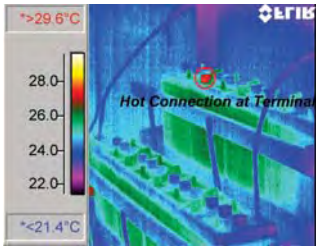

Figure 2 Hot connection at battery terminal (top)

2. Overheated fan control circuit terminals

At our San Bernadino Substation, the 1AA bank fan control circuit exhibited 2 overheated terminals, as shown in the thermogram of Figure 3. The terminal at the left exhibited a rise of 135°C and the one at the right exhibited a rise of 153.6°C.

3. No oil flowing through transformer radiator

The thermogram of Figure 4., taken of a transformer bank at our Center Substation, illustrates the effect of the oil flow being shut off from the radiator at the right, resulting in a ΔT of greater than 20°C.

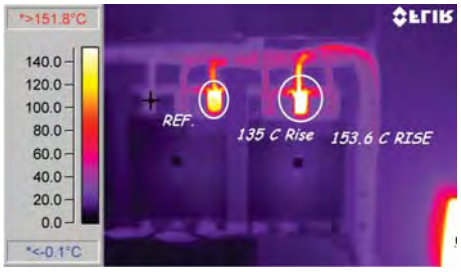

Figure 3. Fan bank control circuit with 2 overheated terminals

4. Overheated tap changer

The tap changer shown at the center of the thermogram of Figure 5, taken at our Elsinore Substation, was measured to be more than 7°C hotter than the main tank (shown at the left).

5. Hot bushing rod

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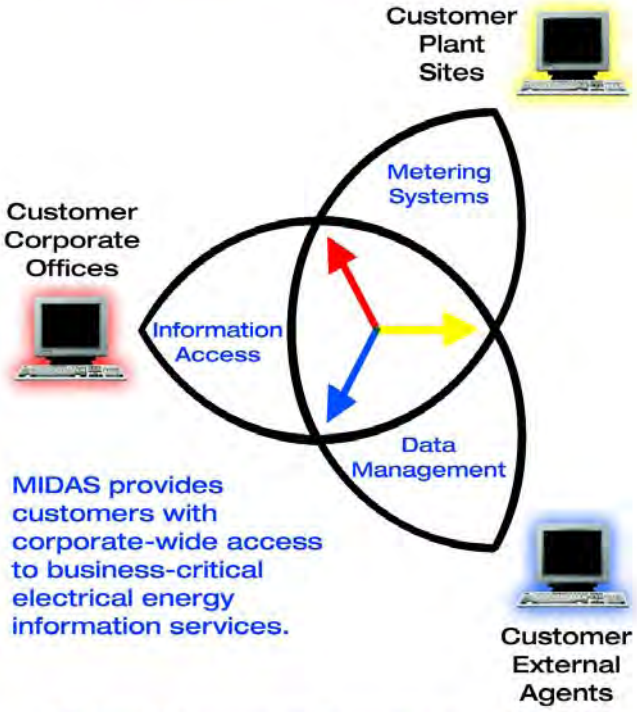

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Continued from Page 26

A hot bushing rod, detected at our Santiago Substation, is shown in the thermogram of Figure 6. This bushing rod (lower center) had a measured temperature of 93.7°C, which was more than 60°C hotter than the reference point shown at the upper left.

6. Low oil level indication

A measured temperature difference of greater than 10°C resulted from the low oil level in the radiator at the left of the thermogram of Figure 7, taken at our Sierra Madre Substation. The radiator at the right, with normal oil flow is at a measured temperature of 31.6°C compared to the 18.9°C reading taken on the left-hand bank.

7. Hot fuse clips

Several hot fuse clips appeared on the thermogram of Figure 8, taken on the main DC fuse panel at our Anita Substation. As indicated in the thermogram, the clips marked from left to right exhibited ΔTs of 7.2°C, 4.6°C and 3.9°C respectively above the 28.0°C reference.

Figure 4. The effect of oil being shut off from the radiator at the right

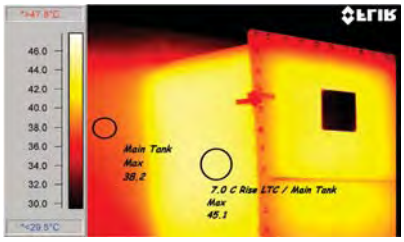

Figure 5. Tap changer (center) measured to be more than 7°C hotter than the main tank (left)

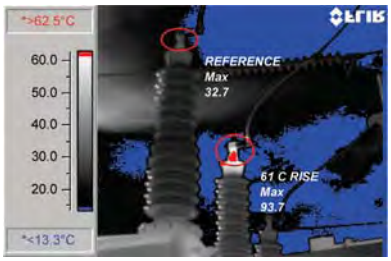

Figure 6. Hot bushing rod (center) measured to be more than 60°C hotter than reference bushing

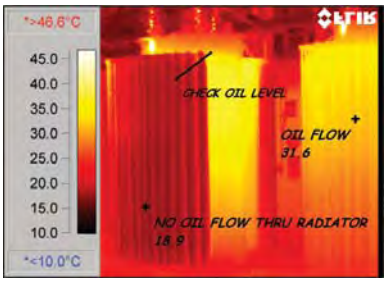

Figure 7. The low oil level in the left hand transformer bank results in no oil flow through the radiator

SUMMARY: WHAT WE HAVE DONE TO DATE AND WHERE WE GO FROM HERE

1. Cost avoidance benefits

The "bottom line" in any PdM program resides in the cost avoidance results. From 1998 to the present we have inspected 450 substations with our multidisciplinary assessment program. Of the more than 3000 real anomalies detected and corrected over this period, more than 1500 (about 50%) were detected by means of infrared thermography. Table 2 illustrates the results by severity criteria over this testing period.

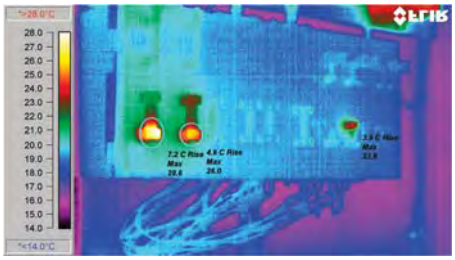

Figure 8. Hot fuse the clips exhibited ΔTs of 7.2°C, 4.6°C and 3.9°C respectively above the 28.0°C reference

Estimated savings in cost avoidance are in the millions of dollars per year from the IR thermography program alone, far exceeding the cost of the equipment and the training of our thermographers. Clearly, in terms of "bang for the buck" IR comes out way ahead.

2. Where we go from here?

It has become apparent that the combination of incorporating infrared imaging cameras into the PMA, and meticulously training our personnel in their operation has paid off in terms of avoided down time, avoided repair costs and enhanced safety for our operating personnel and equipment.

Severity Level Classification	Total Anomalies Found	Total Anomalies Found by Infrared Thermography
Level I	299	159
Level II	1529	846
Level III	1449	503
Total	**3277**	**1508**

Table 2. Anomalies detected from 1998 to the present in 450 substations inspected

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CHECK POWER QUALITY AND PROTECT UTILITY REVENUES

In a competitive environment, electric utilities are finding that power quality testing can be a key part of their customer satisfaction strategy. A utility that offers comprehensive power quality analysis can improve safety, customer service and revenues.

Fortunately, there are high-accuracy power quality test tools now available that make the task simple and straightforward. The three-phase analyzers that technicians use to measure power factor and trend power quality now offer user-settable ratios for displaying readings as if measuring at the primary side of PTs and CTs. They also verify revenue meters.

This alone represents a substantial revenue opportunity. Enough revenue meters are out of tolerance that a 2001 Electric Power Research Institute study estimated meter-related losses at $5 million to $20 million per year for a medium sized U.S. utility.

Using a multi-purpose analyzer such as the Fluke 430 Series, for example, allows utility technicians to offer more customer services in less time and quickly audit revenue meters during each site visit.

STOP GIVING AWAY POWER

A simple test can verify that the customer meter is reading correctly. This is important in heavy use environments (shopping malls, industrial users, etc.) and in any areas where the power quality might be poor. Energy meters are optimized to work under certain conditions. Any change in those conditions can cause the meter to work incorrectly, resulting in the customer paying for more than he uses (poor customer service) or less (lost revenue to the utility).

Verification with the new breed of power quality tester is similar to a hand-switch verification and can quickly uncover tolerance problems. On new analyzers, technicians use a softkey to conduct the test, with no configuration or accessories needed. The verification can be performed on any electromechanical meter or electronic meter that has an indicator or rotating disk. "Using this energy feature takes about 30 seconds with just five button presses," says Fluke Electronics Canada product manager, Colin Plastow.

STOP POWER POLLUTION AND BUILD REVENUES WITH PRE-EMPTIVE TROUBLESHOOTING

Large industrial/commercial users often cause poor power on the grid, resulting in complaints from their neighbors. Using power quality testing on the front line can identify the culprit and allow you to correct problems quickly and improve your reputation with other users.

There's no reason why a utility cannot pre-empt such problems by performing power quality analysis as a customer service. Many already send power quality specialists to a customer site, where they monitor power at the meter, analyze the data, write a report

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and make recommendations. Utilities that offer this service have identified a new revenue source – installing the recommended solution.

RESOLVE DISPUTES BEFORE THEY HAPPEN

Good power quality testing programs are good insurance. Utilities have standards for minimum power quality on the grid. Customers can hold them to these standards through a written agreement. Power quality analysis can verify that a customer's power is meeting the minimum standard as soon as you receive a complaint, but before is obviously better.

Taking a snap shot of power quality before and after connecting a new customer to the grid provides useful data in the event of a dispute. Keep the information on file and you will be able to present an accurate record of what the power looked like at the time of connection.

If a customer is having a problem with electronic equipment, the power quality analyzer can quickly show whether or not the utility is causing the problem.

POWER QUALITY ANALYSIS MADE EASY

Some handheld three-phase power quality analyzers are rated for use at the service entrance and will trend data easily, without setup. To support detailed yet efficient assessments of substations and customers' power, new analyzers:

- Measure voltage, current, frequency, power, power factor, power consumption (energy), unbalance and flicker, harmonics and inter-harmonics on all three phases and neutral
- Log events like dips, swells and interruptions
- Trend all measurements onscreen, with automatic scaling
- Check conformity to EN50160 limits or to custom limits
- Capture 40 waveforms showing detailed dips, swells, interruptions or transients
- Meet 600 V CAT IV, 1000 V CAT III safety standard required for measurements at the service entrance
- Transfer stored measurements to the PC

Flexible connections for current and potential transformers

Some of these new tools can be connected directly to low voltage services, including 120 V/240 V, 480 V, and 600 V. The analyzer can also connect in parallels with primary metering using PT or CT loops and a set of precision 5 A current clamps. Technicians can set custom scale factors to display readings in primary units. The analyzers support all standard power configurations:

- Single-phase
- Split-phase
- Three-phase grounded wye
- Three-phase delta
- Three-phase high leg delta
- Three-phase open leg delta
- Single-phase and 3-phase IT

IS A KILOWATT SAVED REALLY A KILOWATT SAVED?

By Stephen Heins, VP of Corporate Communication, Orion Energy Services

In spite of advice to the contrary, I have decided to apply a "best practices" analysis to the sacred cow of "free-ridership" as it relates to public benefits and utility energy efficiency programs.

This analysis is all the more important, because energy efficiency – with a measurement, verification and sustainability protocol – is emerging as the single best investment option for economic development and emission reduction in such diverse economies as the European Union, Canada, China, New England and the far western states of the U.S.

In relationship to public benefits and utility energy efficiency programs, one of the most vexing problems surrounding the issues of free-ridership is definitional. To the economic purist, the textbook definition of free-ridership is as follows: "A free rider is a person who consumes a good without paying for it." However, for a variety of reasons, the working definition of free-ridership as it pertains to public benefits and a utility energy efficiency program is significantly different. In this case, "a free-rider is someone who would install an energy efficiency measure without any program incentives because of the return on investment of the measure, but is able to receive a financial incentive or rebate anyway."

While it is true that utilities and regulators need a way to distinguish the actual impact of their energy efficiency programs on the market, employing the concept of free-ridership to do this is both confusing and inappropriate.

This definition has become the accepted language, as used by utilities, program directors and regulatory bodies, to discuss energy efficiency programs.

It is immediately clear that these two usages have very little to do with each other. In fact, this is another case of a useful economic concept being appropriated and re-interpreted for the needs of policy-makers. While it is true that utilities and regulators need a way to distinguish the actual impact of their energy efficiency programs on the market, employing the concept of free-ridership to do this is both confusing and inappropriate.

Then, there is the matter of public and political perception. In a previous era, "energy efficiency programs" were just a fancy way of describing a social program or corporate welfare. These prejudices are slowly disappearing, thanks, in part, to better measurement technology and an understanding of the relationship between the cost of building new power plants and employing energy efficiency programs as a new source of energy.

In a recent news release from California's Flex Your Power, they stated that, properly done, energy efficiency is one/fifth the cost of building new power plants. In a more recent study implemented for the Northeast Energy Efficiency Partnership, Inc. (NEEP), investment in energy efficiency was 67% cheaper than the avoided cost of electric supply. In other words, the cost/benefit analysis of the two approaches to new sources of electricity suggests that energy efficiency programs are 33% the cost of the new power.

Another source of concern for regulators and administrators are the externalities (i.e. a cost or benefit that falls on peo-

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ple who do not participate in the transaction), of any public benefits or mandated utility energy efficiency program. In this case, administrators accrue the cost of issuing the rebate and the benefit of the reduced consumption on the electric system. Some people argue that energy efficiency programs that are funded by system-benefits charges constitute a negative externality for consumers, since public benefits charges are added to all customers' electric bills; and then used to fund public-purpose energy efficiency and renewables programs.

Contrary to that argument, the reduction of the electricity demand has a profound effect on the future of adequate supplies of electricity and the overall costs of generating and transmitting electricity, especially when demand has been going up 2.2% per year for years and the average age of our current fleet of power plants is 39.5 years.

Therefore, the economic and social value of energy efficiency to customers is that it reduces the need for new power plant construction with its accompanying production of new emissions. Therefore, it benefits all customers regardless of their participation in the energy efficiency program in their home or business. For these reasons, it should be clear that free-ridership issues for energy efficiency programs do not arise out of externality concerns.

So, if energy efficiency programs do not create free-riders from public good or externality concerns, what is the source of concern for utilities, regulators and/or program administrators? In the early years of energy efficiency programs, when most programs were administered by utilities, their focus was on resource acquisition. In the mid-1990s when market restructuring became a major initiative of the utility industry, the goal of energy efficiency often became "market transformation".

However, a major component of this out-dated philosophy was to employ energy efficiency rebates and incentives to get customers to purchase products and services which would otherwise be prohibitively expensive for consumers, or did not provide a reasonable rate of return for businesses. These market transformation programs, in other words, sought to pick winners among energy efficiency products; moreover, they typically focused on large-ticket items, boilers, air-conditioning systems, etc., which had large up-front costs and limited returns.

This approach forced program administrators to develop a program rationale, which justified this approach. To this end, program administrators often created payback standards for efficiency funding, which penalized lower-cost projects or projects with over-sized benefits. In addition, the standards were based on the belief that businesses should implement measures that meet a certain arbitrary payback standard without any incentive, and often, the payback standards were set too high.

For example, the dividing line for energy efficiency incentives in Oregon is one year, which means any project with a better return on investment than one

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year does not qualify for program monies. On the other hand, Wisconsin has established a 50% return on investment rule which will not fund projects with a two year payback.

In the business world, the decision-making process for capital expenditures is much different than some program directors think. Energy efficiency projects have to compete with all other capital initiatives, including investments in new production assets or processes, which are usually given first priority. Under this scenario, incentives are often required for energy efficiency products and services, even those with significant benefits, to be chosen by businesses. "I suspect that time horizons are a major culprit in sustaining the dichotomy of 'free ridership' definitions as applied to EE market transformation programs," stated Christopher Russell, Director of Industry Sector for the Alliance to Save Energy. "We are all aware of the business community's need to earn MORE, and earn it NOW."

As utilities and states move out of the restructuring period and increasingly turn to energy efficiency as another source of new energy, it should be remembered that a resource cannot be counted until it's purchased and installed by a consumer. By writing a purchase order and a cheque, no customer is getting anything for free. According to Jon Wellinghoff, longtime energy efficiency advocate, "Energy Efficiency is viewed by both utilities and regulatory commissions very differently than supply side measures. And it shouldn't be. Utilities should be required to acquire demand side measures in the same manner as they acquire those on the supply side if the demand measures can be provided as 'utility grade' (i.e. reliable and predictable and persistent) for a specified period of time."

The Minnesota Public Service Commission has adopted a very sane approach to the free-rider issue. They assume that "free drivers" – people or companies that install the energy efficiency measure as a result of the indirect effects of the energy efficiency program but never collect a rebate or incentive – offset each other.

Ultimately, the whole free-rider issue hinges on the fact that it is notoriously difficult to measure.

Does anyone actually think that General Motors or Ford spent much time worrying about the "free-riders" of their Employee Discount Sale this summer once they decided to offer it? It was just a part of increasing overall auto sales.

Finally, the best measurement of the program's effectiveness, other than money spent, is the total of electricity saved. In the 21st Century, we have the technology and the available energy efficiency expertise to stem the growth of electricity consumption and the need for new power plants.

We cannot allow the inappropriate use of the concept of free-ridership to impede the progress of thoughtful deployment of energy efficiency throughout the U.S. After all, every kilowatt saved is another kilowatt available for economic development with all of the benefits of cost savings and emission reductions.

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MANITOBA HYDRO EXPANDS COMMUNICATIONS, INFORMATION SHARING WITH EMPLOYEES

By Don Horne

When Manitoba Hydro needed to improve and expand communications and information sharing for its 5,500 employees, its customers and its business partners, it turned to a collaborative software to address their needs.

Already familiar with SAP system technology in 1992 and '93, Dan Lohr, Manager of Integrated Systems at Manitoba Hydro, decided to move ahead with mySAP Business Suite technology.

"We had home-developed systems from 25 years ago," says Mr. Lohr, "and from the financial side (accounting and materials management), SAP met our requirements."

The need for greater accountability was also a driving force to incorporate the new technology at Manitoba Hydro.

"By 2003 there was a tremendous amount of pressure to have better management reporting," says Mr. Lohr. "We looked at everyone and chose SAP."

"NetWeaver is the technology on which it rests," points our Mark Mandzik, Executive Assistant to the Vice President of Corporate Relations at Manitoba Hydro.

"We did evaluations of the different systems that are out there, and the Business Warehouse of NetWeaver had great integration application.

"We can interface with the other systems and manage the traffic."

According to the literature, the technology that is mySAP Business Suite provides complete integration, industry-specific functionality, unlimited scalability, and easy collaboration over the Internet .

In the case of Manitoba Hydro (Canada's fourth largest utility), by standardizing its integrated system, the utility eliminated disconnects between its systems and its people, helping to achieve the company's goal of maximizing revenues from export power sales and in turn maintaining its low rates for its customers.

In addition, the SAP Enterprise Resource Planning software provides diverse opportunities to accountants in areas such as Corporate Accounting, Capital and Operating Budgeting, Financial Planning and Regulatory Affairs, and Internal Audit.

A comprehensive integration and application platform, SAP NetWeaver works with the existing IT infrastructure to enable and manage change. With SAP NetWeaver, you can flexibly and rapidly design, build, implement, and execute new business strategies and processes. You can also combine existing systems while maintaining a sustainable cost structure.

"From an HR (human resources) point of view, there are a lot of benefits,

> "The work flow is that much smoother.
>
> "When we get requests for training courses and forums, a request can go automatically to the supervisor for approval. No paper means much faster."

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as we were able to create a two-way system between manager and employee," says Rob Lanyon, System Development Supervisor with Manitoba Hydro. "When we went live (with the HR and R3 systems) in June of 2003, we had employee pay stub info all online. The information was right at their fingertips; and no more paper."

In addition, the human resources department at the utility is faced with the challenge of replacing an aging workforce with fresh faces. The new technology makes it that much easier.

Artist's rendition of Manitoba Hydro's new headquarters.

"We can post (new jobs and job openings) both internally and externally through the new system," says Mr. Lohr.

The new technology is also that much more user-friendly, which is necessary for some workers who aren't that comfortable with computer technology.

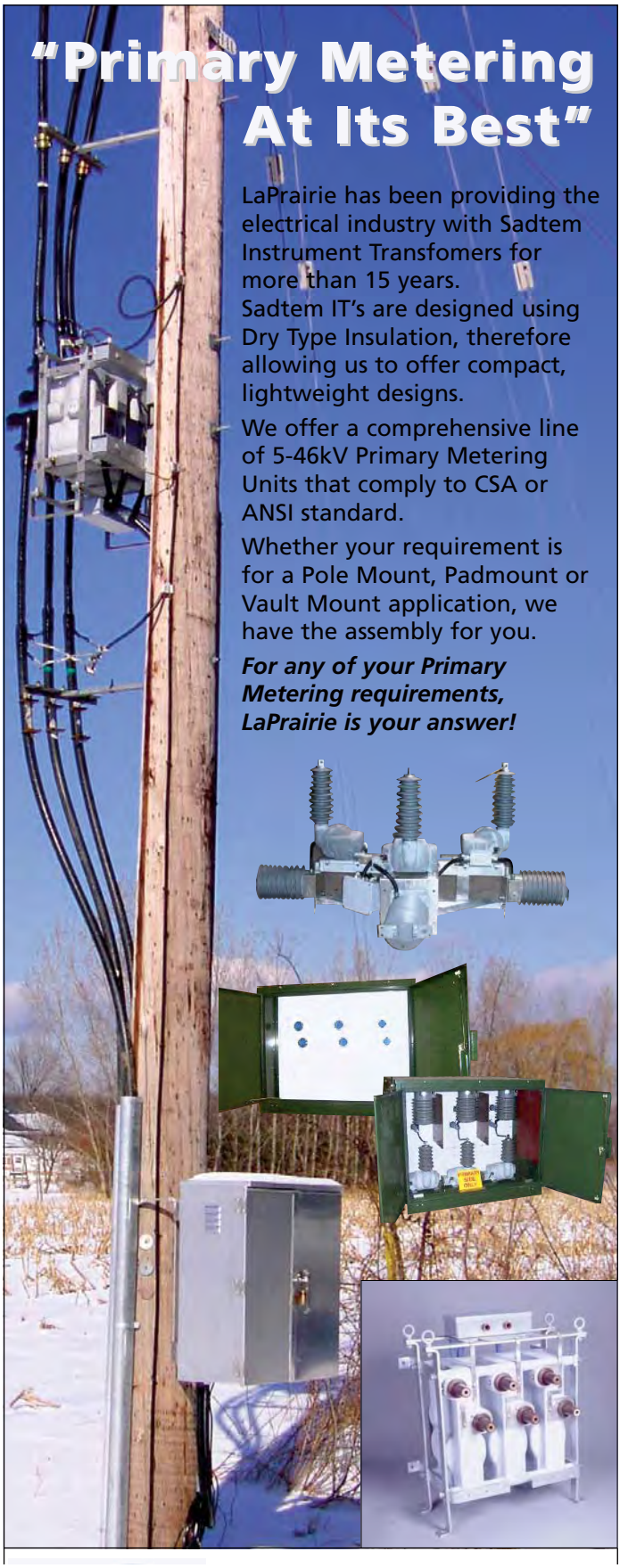
"The older system was too complex for some people," says Mr. Lohr. "We have a strong, loyal older workforce here, and there's been a lot of change recently. There was some resistance initially, but they are finding that this new system works well."

Mr. Lanyon adds that replacing the archaic paper trail with an interactive computer system allows for faster, more responsive employer/employee communication.

"The work flow is that much smoother," he says. "When we get requests for training courses and forums, a request can go automatically to the supervisor for approval. No paper means much faster."

SAP NetWeaver embraces Internet standards such as HTTP, XML, and Web services. Ensuring openness and interoperability with Microsoft .NET and Java 2 Platform Enterprise Edition (J2EE) environments such as IBM WebSphere.

SAP NetWeaver is the technical foundation of mySAP Business Suite solutions, SAP xApps composite applications, partner solutions, and customer custom-built applications. It also enables Enterprise Services Architecture, SAP's blueprint for service-oriented business solutions.



THE CASE FOR ADVANCED ELECTRICITY METERING IN TEXAS - PART 1

The restructuring of the Texas electricity market brought with it visions of sweeping change in how customers purchase and consume energy. Competition among providers was seen as the way to bring lower prices and new products and services to customers, and new levels of efficiency to the operations of the electrical grid.

Following the recent launch of the new market, competition is clearly benefiting many customers. But crucial parts of the restructuring vision are on hold as market participants continue to struggle to meet the challenges of executing in the new environment. Many of the promising new products and services envisioned during the restructuring debate have been slow to develop, especially for smaller customers.

Meanwhile, global advancements in technology have given rise to a number of exciting new "Smart Energy" innovations that can transform the way customers use energy: enabling efficiency, adding convenience, and managing usage to take advantage of lower, off-peak energy prices. For residential and small commercial customers in Texas, however, these products and services still face a number of barriers — the largest and most important of which is the absence of detailed meter data.

More granular meter data can empower customers to save money, help the restructured electricity market to function, and promote energy efficiency. By measuring consumption over intervals or time blocks, advanced meters can provide customers with detailed views of their energy usage, enabling electricity providers to offer pricing plans that reflect the changing costs of energy, and bringing the proven value of demand elasticity to the new market.

Wholesale electricity prices spike when supply struggles to meet surges in demand. At these times, inefficient "peaking plants" are fired up, and transmission lines become congested.

This drives up costs and puts the system at risk for brownouts and blackouts. The overall cost of electricity also spikes when the transmission and distribution system (the grid) becomes overloaded, forcing operators to purchase more expensive power to relieve congestion. Empowering customers to reduce their demand during these peaks can decrease overall wholesale prices and improve system reliability.

Today, the vast majority of Texas customers — all but the largest industrials — are still served by traditional electromechanical meters, which deliver single monthly kilowatt-hour readings when directly observed. These customers therefore must be served by average kilowatt pricing. Advanced meter data would expand the competitive playing field for retail electric providers in the restructured market, allowing them to offer rate plans tailored to customers' lifestyles and their ability to respond to price signals. This can help insure the long-term success of the market, by rewarding creative providers and reducing the inherent advantages of size and incumbency.

Advanced meters create market incentives for targeted energy efficiency technologies and services, and thus are a source of clean energy and a solution for heavily congested transmission areas. Demand reductions prompted by a more

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Texas

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granular knowledge of consumption patterns, in combination with price signals, provide new capacity to the system with zero emissions of air pollutants by encouraging investment in new, smart energy technology, as well as cost effective behavioral changes. And customers with the incentives and tools to reduce peak use almost invariably reduce their overall consumption as well.

Meters have traditionally been owned, installed, maintained, and read by the regulated utilities. When the Texas Legislature restructured the electricity industry with Senate Bill 7 in 1999, it included a provision stating that "metering services… shall be provided on a competitive basis," beginning in 2004 with commercial and industrial customers.

Competitive metering was viewed as a means to create a market for upgrades in metering services, which in turn would enhance competition by increasing the availability of detailed consumption data. At the time, competitive metering was a fledgling concept that had not yet been implemented fully in any other state. Since then, in every state where it has been tried, competitive metering has failed to result in meter upgrades for all but the most sophisticated commercial and industrial customers.

In order to comply with the law's January 1, 2004 deadline, the Public Utility Commission of Texas (PUCT) approved a rule allowing commercial and industrial customers, or a Retail Electric Provider (REP) or third party authorized by the customer, to own their meters. No customers had formally applied for competitive meter ownership during the first three months of eligibility.

These experiences, in addition to the information discussed in this paper, strongly suggest that in order to achieve the legislative intent, metering services should remain a utility function at least for smaller customers.

This document is intended to assist policymakers, market participants, and interested parties in considering both the value of mass market demand participation and how to stimulate deployment of advanced meters as the enabling infrastructure.

THE RESTRUCTURED TEXAS ELECTRICITY MARKET

Electricity deregulation nationally has produced uneven results, with some notable negative experiences providing headlines and coloring the national perspective on the issue. In this environment, proponents' eyes remain fixed on Texas, which opened its market to retail competition on January 1, 2002. There is much to praise about the Texas model, as virtually all customers in the restructured areas of the state now have a choice of providers and are paying less for their electricity than they did before.

Observers frequently attribute Texas's success, in part, to the surplus of available electricity.

Unlike California, which deregulated its market when supplies were particularly vulnerable, Texas is awash in generation capacity, much of it from plants constructed in the past few years. Combining this with the relatively low natural gas prices that existed at that time has helped to keep both wholesale and retail prices down during the startup of competition.

The Texas market has attracted numerous competitive Retail Electric Providers (REPs), and a promising percentage of the overall supply is now being purchased from non-incumbent suppliers. While this is inarguably a sign of success, much of the competition to date has been concentrated in the mid- to large commercial customer categories. For the majority of customers, the successes of restructuring have been less evident:

- Fewer than 12 percent of residential customers in any eligible utility service area switched from their incumbents during the first two years of competition, and a long-term growth trend in provider switching has yet to emerge. Competitive REP market share has actually decreased in some months.
- The difference has narrowed dramatically between competitive REPs' residential rate offerings and the rates required to be charged by REPs affiliated with the former vertical utilities (known as the Price to Beat).
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Texas

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and small commercial customers, New Power Company, declared bankruptcy in 2002 and exited the Texas market.

• A detailed analysis in 2002 cast doubt on the ability of competitive REPs to make a profit selling to smaller customers under the Price-to-Beat structure, raising concerns about the market's long-term ability to ensure a strong level of competitive choice for these consumers. The majority of REPs in the market are limiting their offerings to commercial & industrial customers.

• The Price to Beat is scheduled to be phased out in 2007, after five years, at which time competitive REPs will be forced to compete head to head with the incumbents.

In the absence of advanced meters, that playing field would be limited to flat-rate price offerings, under which the advantages of incumbency and existing market share could become even more pronounced.

Other problems lurk beneath the surface. While there is unanimous consent that the market launched at a fortuitous time, evidence is emerging that the surplus of supply has not stopped aggressive traders from manipulating the market to win artificially higher prices.

The market price of natural gas, the dominant fuel source for marginal Texas electricity generation, has risen significantly in recent years. At the same time, policymakers concede that their ability to regulate reserve power margins has been significantly reduced. Only time will tell how the restructured market will respond to spikes in peak demand during the inevitable boom-bust cycles of generation construction to come.

While there is unanimous consent that the market launched at a fortuitous time, evidence is emerging that the surplus of supply has not stopped aggressive traders from manipulating the market to win artificially higher prices.

Look for Part 2 of "The Case for Advanced Electricity Metering in Texas" in the next issue of Electricity Today.

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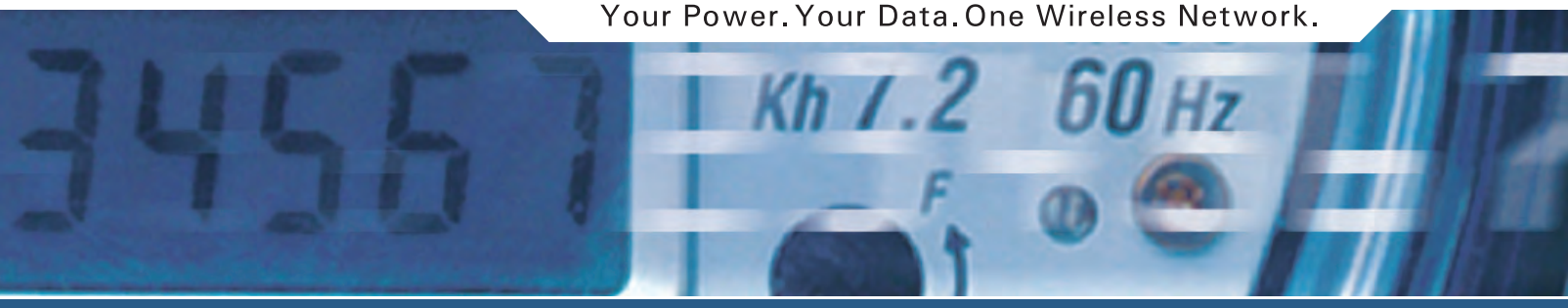

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