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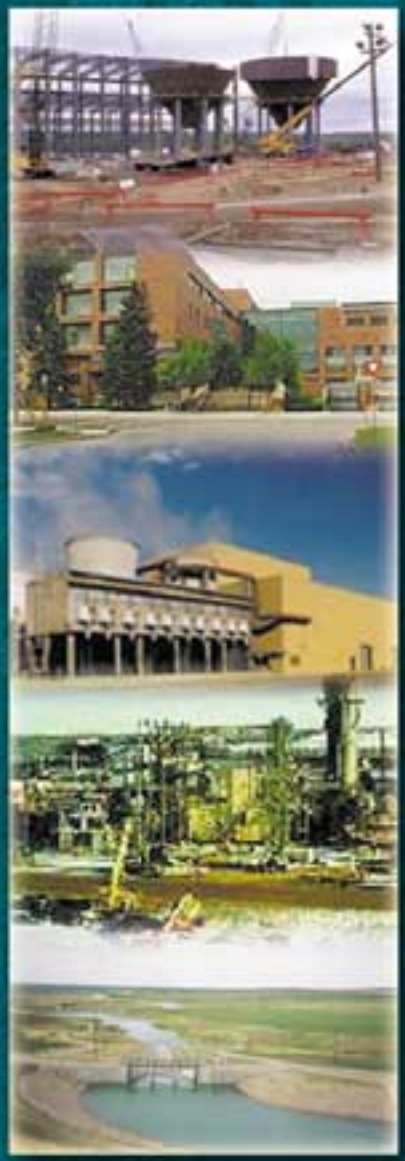
ISSUE 2, 2001

HV Engineering, Operations, Construction & Maintenance

ELECTRICITY TODAY

Power Generation, Transmission & Distribution, Utilization

CANADIAN ELECTRICITY FORUM



ALBERTA ELECTRICITY REPORT

Klein Seeks Industry Input on Alberta's Long -Term Deregulation Policy

Proposed Genesee 400 MW Unit Example of World-Class Technology

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POWER QUALITY

Utility Reliability Metrics for New "E-conomy" Processes

PLUS

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Klein Seeks Industry Input On Alberta's Long-Term Deregulation Policy

Alberta Premier Ralph Klein has announced plans to create an external committee that will advise government on longer-term issues surrounding electrical deregulation.

"The government is providing rebates for residential and industrial users, plus a commercial market transition credit throughout 2001 to ease the initial transition period to a competitive market, and substantial new generation is on the horizon to address the supply shortage. The advisory committee will provide a longer-term outlook that will enhance stability and confidence in the provinceís energy future," the premier said.

The mandate of the advisory committee on electricity will be to provide policy recommendations and analysis to government. A diverse group of stakeholders will be invited to participate on the council, including the Industrial Power Consumers and Co-generators Association of Alberta, the Independent Power Society of Alberta, the Consumers Association of Alberta, power companies, rural electrification associations, the Alberta Urban Municipalities Association, the Alberta Association of Municipal Districts and Counties, the Environmental Resource Centre, and other business and community organizations.

Leonard Bolger, currently co-chair of the Alberta Energy Research Institute, has agreed to chair the advisory council. Mr. Bolger is also a member of the board of directors of the Alberta Science and Research Authority, and is retired from Shell Canada Ltd., where he served as vice-president.

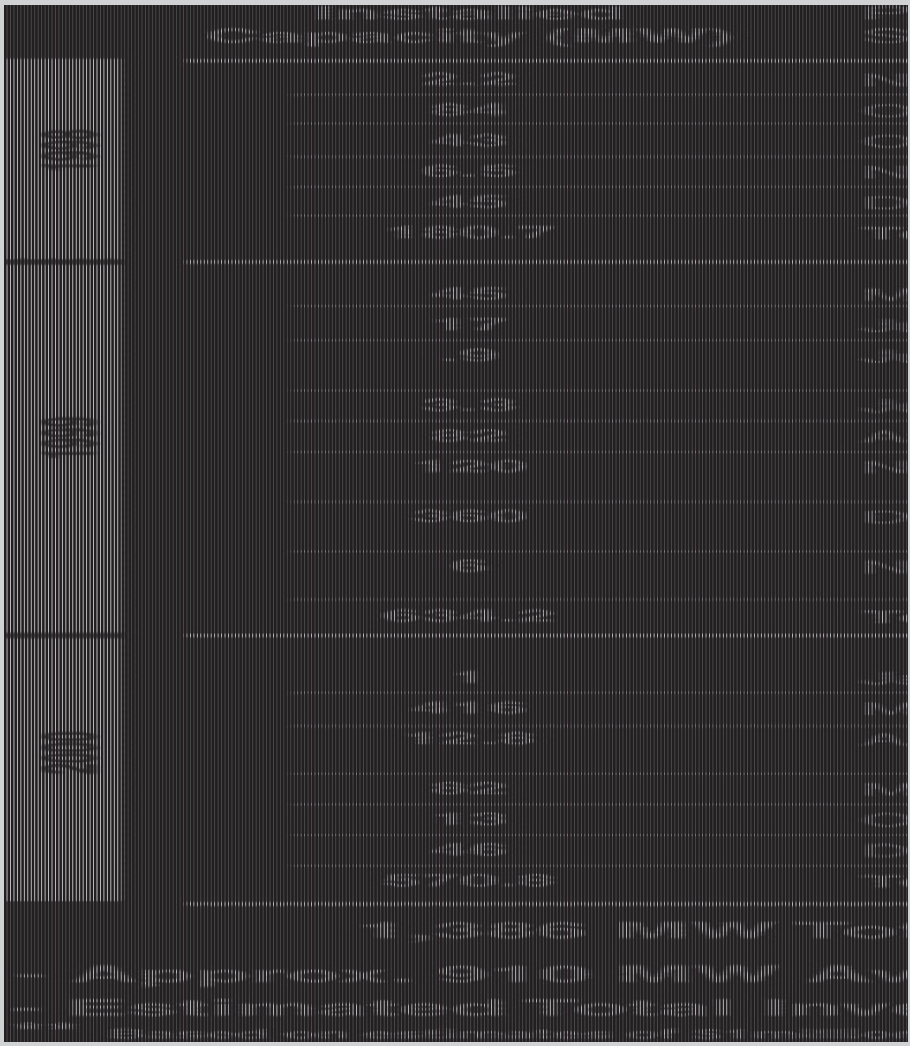
"There are a range of issues to be explored, and the council will work with stakeholders to see that consumersí concerns are addressed," Mr. Bolger said. "Our primary concern will be to help ensure a reliable, ample and competitively priced supply of electrical energy for Albertans."

"Electrical deregulation is underway in Alberta and investor confidence in the Alberta electrical market is strong, with firm commitments made to new power generation projects," the Premier said. "We will look to the advisory group to help us deal with issues in the market as they arise, with a focus on consumer issues and priorities. We want their input on how to resolve problems and how to ensure stability for consumers. We look forward to the ideas and critical analysis such groups can bring to the table," he said.

Continued on page 7

Alberta Premier Ralph Klein (photo right) has announced plans to create an external committee that will advise government on longer-term issues surrounding electrical deregulation in the province.

Recent Generation Developments



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Power failures are expensive and can significantly impact the bottom line of an organization. Electrical engineering and maintenance personnel have long been aware that identifying, monitoring and correcting power quality problems is vital to keeping facilities and processes running smoothly. This forum offers electrical professionals the opportunity to keep abreast of the latest technologies and techniques available in this area. It also offers an excellent opportunity for delegates to ask specific questions and exchange ideas relating to their own applications. This is designed to be an interactive, problem-solving, learning environment for delegates of all disciplines.

Program Highlights

- Power Quality in the Real World: An indepth session using actual case histories to illustrate power quality problems and solutions.
- Recent developments in power quality monitoring equipment, software and applications.
- Transient voltage surge suppression solutions for sensitive microprocessor-based applications
- Utility Power Quality Solutions Service
- Power system harmonics analysis, standards and mitigation
- The economics of power quality monitoring
- Evaluation, isolation and correction of grounding and power quality factors
- Improve power quality, save money and help the environment

Continued from page 5

Alberta's Electricity Supply

Alberta's deregulated electricity market has helped to encourage additional new generation. The new, competitive system enables the market to be more responsive to changes in supply and demand by allowing anyone to build new generation, not just the province's traditional utilities.

New generation of about 1,400 Megawatts (MW) was added to the Alberta power suppyly by the end of 2000. An additional 4,400 MW is under development over the next few years (see Table)

At present, installed capacity exceeds 10,000 Megawatts, however, all that capacity is not continuously available to meet electricity demand. This winter's current peak demand is reported by the Power Pool to be 7,785 Megawatts — up from 7,408 Megawatts in 1999. Of the installed capacity, there is currently over 9,300 Megawatts available to the Alberta System, including capacity that may be available from imports.

What is the Outlook for Energy Prices?

Although prices are high, independent experts expect that Alberta may see downward pressure on both natural gas and electricity prices.

Private sector forecasters say natural gas prices should drop to around $5 or $6 per gigajoule in 2002, with the trend continuing downward in the following years. The government reports that electricity prices are expected to go down. For example, in the November electricity auction, the market purchased power for 2001 at 12¢ per kilowatt-hour (kWh), year 2002 power at 6.8¢ per kWh, and year 2003 power at 6¢ per kWh.

These forecasts are based on new supplies of natural gas and electricity coming on line.

Natural gas prices are determined by the competitive natural gas market. Because prices are high right now, gas producers are drilling wells at record levels. In Alberta, the number of wells drilled set a record in 2000, jumping almost 40 per cent in just one year.

At the same time, direct employment in the drilling industry increased 15 per cent over the last year, creating spin-off employment in various other sectors.

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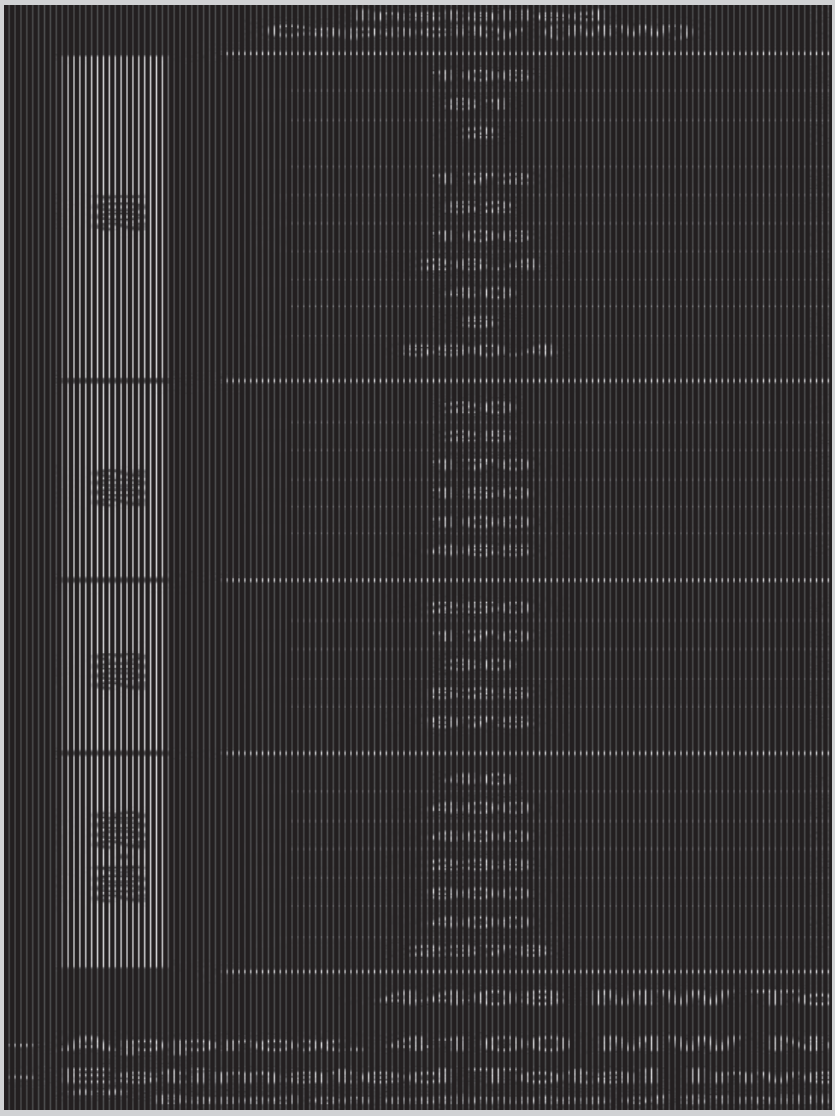
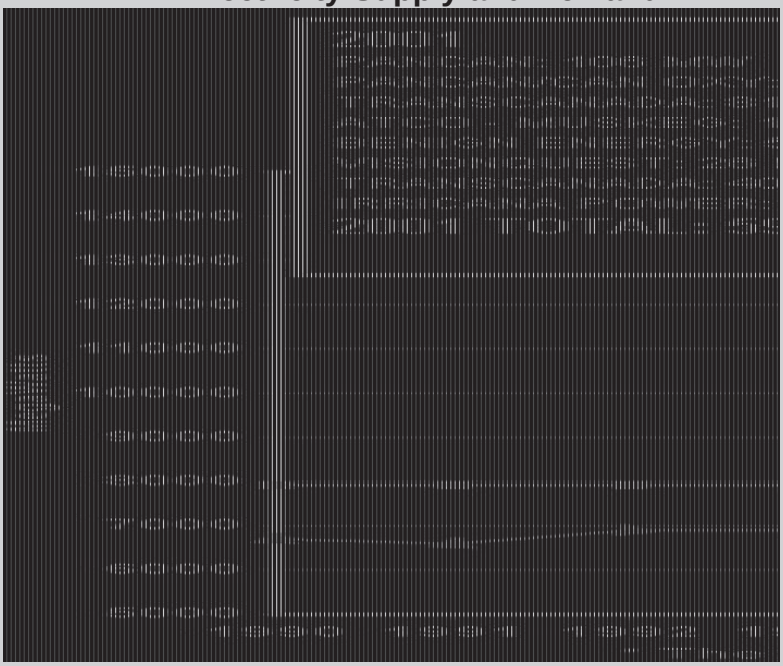
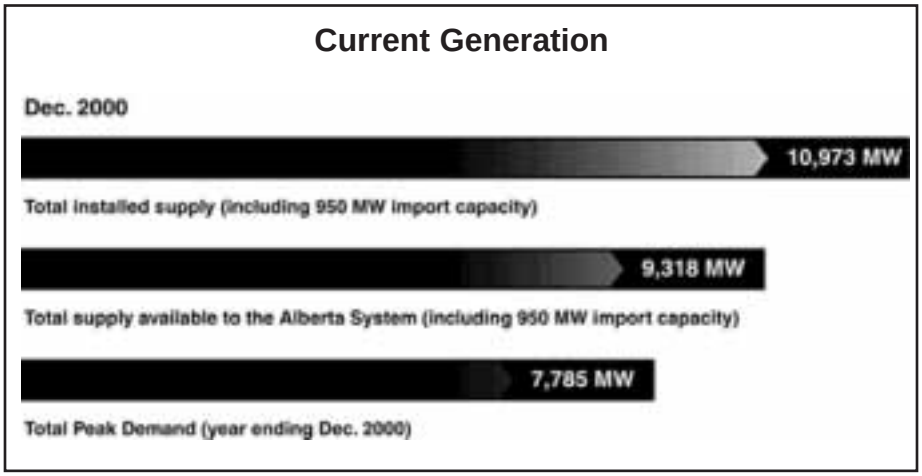
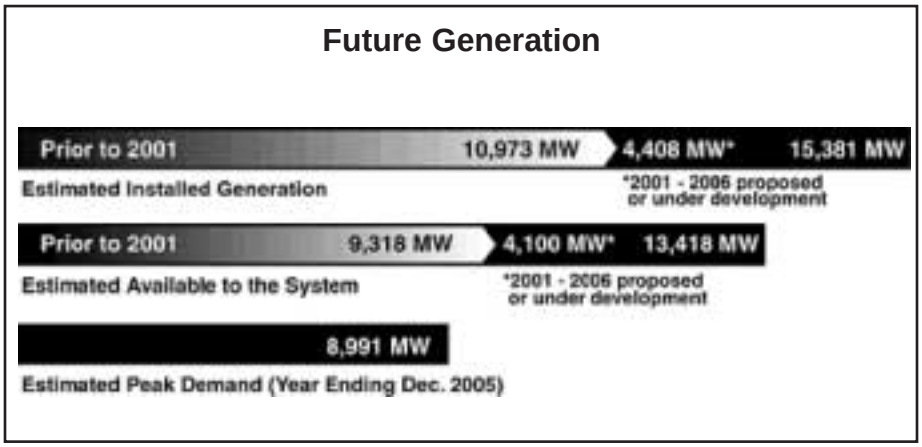
Proposed Alberta Generation



Electricity Supply and Demand







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On the electricity side, Alberta's new deregulated market is encouraging investor confidence. With close to 3,000 MW of new electricity generation coming on line or planned by the year 2005, this represents about $3 billion in new investment from the private sector. That's enough power to light up 30 cities the size of Red Deer. About 500 megawatts of that power is expected to come on line in 2001. In December alone, companies announced more than 1,300 MW of new generation.

TransAlta Also Expanding

TransAlta announced plans for a 900-megawatt (MW) expansion of their coal-fired Keephills power plant located near Edmonton, Alberta. The company also announced a new $5-million Cdn investment in Vision Quest Windelectric Inc. of Calgary, Alberta and plans to switch their Calgary-based corporate head office to wind power.

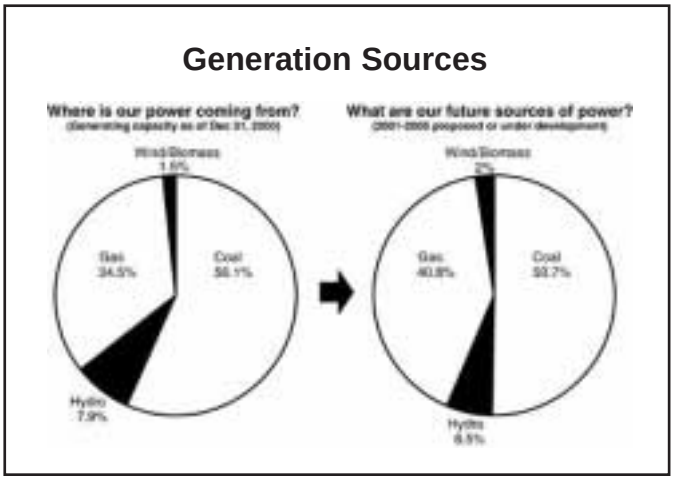
"These projects represent another major step in TransAlta's strategy to increase its generation capacity to 10,000 megawatts by 2002," said Steve Snyder, TransAlta's president and CEO. "Low-cost generation using a diverse range of fuels is what we do best. We are moving ahead to grow our business in the competitive markets of Alberta and Washington State. Both of these growing economies need more low-cost power."

"We anticipate a rigorous regulatory and environmental assessment of our plans and look forward to working with interested stakeholders," added Mr. Snyder.

Pending regulatory approval, the $1.8-billion Cdn ($1.2-billion US) expansion of the coal-fired Keephills plant will see the addition of two 450-MW generating units, bringing the plant's capacity to a total of 1,654 MW. The 900-MW Keephills expansion will meet all the environmental standards required of a new plant of its kind. TransAlta expects to commission the new units in early 2005.

TransAlta is investing $5 million Cdn ($3.3 million US) in Vision Quest to purchase 40 new Vestas V47 wind turbines. These turbines can generate 26.4 MW of electricity.

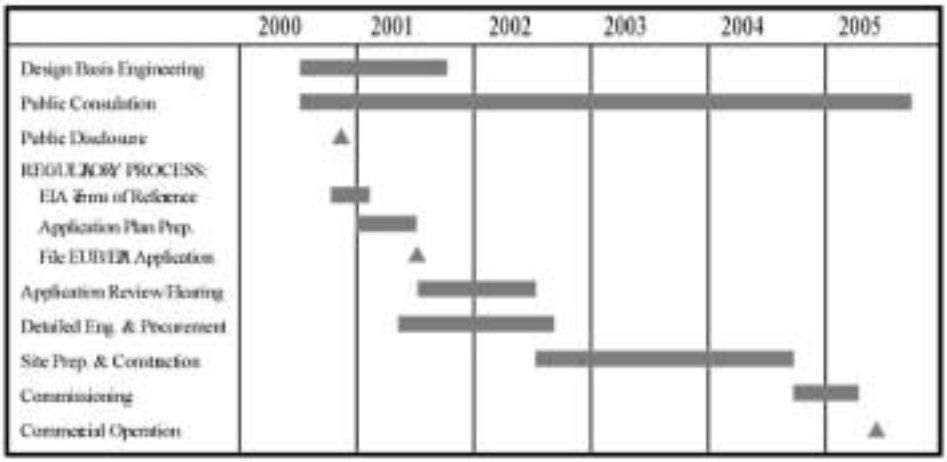
Graphics courtesy of Alberta Department of Energy. ET



Proposed Genesee 400 MW Unit Example of World-Class Technology

EPCOR's proposed expansion of its Genesee coal fired generating station will be a world-class example of generation and emissions control technology. Scheduled for completion in 2005, the utility believes that the 400MW project can be implemented with acceptable environmental, technical, social, and economic results.

According to a recently released Public Disclosure document intended to inform government regulatory authorities, stakeholders and the general public about the utility's intention to expand the existing facility, EPCOR claims the third unit is needed to keep pace with the province's continued economic expansion.



Proposed Time Line

Electricity Supply and Demand in Alberta

The need for a third unit is because of demand, and demand for electricity is being driven by Alberta's expanding economy - as it will be for the next several years. Historically, demand has grown at approximately three per cent annually. In the first six months of 2000, the Alberta Power Pool reported a five per cent increase over 1999 requirements. In the past three years, the provincial population has grown by 110,000 people to a total of three million. Increased industrial requirements for additional power are led by major expansions in oil sands mining and upgrading operations, in-situ bitumen projects, and petrochemical facilities. Business and residential consumption, particularly related to powering a growing number of highly sophisticated computers and appliances, places further stress on the existing power supply.

EPCOR expects that the future demand for electricity will continue to grow and that new supply must be added to meet that demand. Recently announced generation projects in the province are insufficient to meet large-scale demand. The majority are being built to provide on-site industrial generation, which means that only a limited amount of surplus power is available to the provincial market. Overall, growth will exceed the capabilities of currently proposed new generating capacity. This will substantially reduce the reserve power available and increase reliance on expensive imported energy, primarily from British Columbia where pricing is set by more lucrative markets in California. In 1999, Alberta paid $135.5 million for imported energy. In the first nine months of 2000, more than $183 million had been expended on energy imports from British Columbia and Saskatchewan. Increased natural gas prices have also contributed to higher electricity prices. Current Alberta Power Pool reports, detailing provincial supply and demand as well as future projections of electricity requirements, can be accessed on the Internet at www.power-pool.ab.ca.

With this in mind, coal-fired generation from the proposed Genesee Phase 3 project would provide a large-scale source of base load energy dedicated to the Alberta Interconnected Electric System. This would reduce dependence on high cost import power and exposure to the price volatility of natural gas.

Genesee Generating Station and Mine

The existing Genesee Generating Station consists of two coal-fired thermal electric generating units, ancillary support facilities and a cooling pond. The first unit began commercial operation in 1989.

The second came on stream in 1994, and is the newest coal-fired generation plant in Canada. Genesee functions with consistently high in-service ratings, and is one of the most efficient and reliable pulverized coal-fired power plants in Canada. The major operating design parameters for each unit include:

- generating capacity - 410 MW gross, 381 MW net;
- coal burning rate - 216 tonnes per hour;
- steam temperature - 540°C;
- steam pressure - 16.2 MPa;
- ash production - 39 tonnes per hour; and
- live coal storage - 40,000 tonnes (total).

Project Scope

The proposed additional Genesee unit consists of a 400 MW net base load electric generation facility. It would be constructed immediately adjacent to and east of the existing Genesee units, wholly within the existing site boundaries. Coal would be obtained from the adjacent Genesee surface mine. The existing

Continued on page 10

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cooling pond and coal-handling facilities are already sized to accommodate the capacity addition.

Genesee Phase 3 will use a single supercritical boiler and a high efficiency turbine. Approximately 25 per cent of the world's thermal electric power plants use this advanced technology. This will be the first unit of its kind in Canada.

In addition to a high efficiency boiler and turbine, the third unit will include:

- a dry flue gas desulphurization (FGD) unit for removing sulphur dioxide (SO 2) from flue gas;
- low nitrogen oxides (NO x) burners;
- a high-efficiency dust-collection system, using fabric filters to reduce particulate and associated mercury emissions;
- a stack;
- condensing and cooling water equipment to minimize back pressure; and
- a generator transformer.

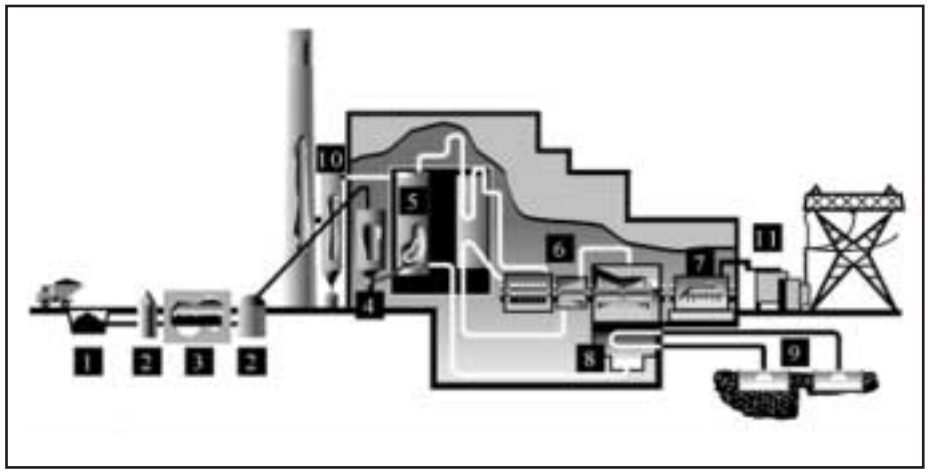
The major design parameters for Genesee Phase 3 include:

- generating capacity - 440 MW gross, 400 MW net;
- coal burning rate - 207 tonnes per hour;
- steam temperature - 540°C;
- reheat steam temperature - 565°C;
- steam pressure - 24.1 MPa; and
- ash production - 37 tonnes per hour.

Under the mine permit issued by the Alberta Energy and Utilities Board, there are sufficient mineable coal reserves in the Genesee development area to supply both the existing units and the proposed new unit for the next 40 years. Estimated coal reserves in the Genesee Coal Deposit, mineable from the surface, exceed 370 million tonnes. Currently, coal is mined at a rate of 3.4 to 3.6 million tonnes per year. Genesee Phase 3 would require approximately 1.6 million tonnes annually. The mine plan would be adjusted to reflect the increased rate of removal. The existing large-scale mining equipment and mobile fleet would be supplemented to handle the increased volumes of coal.

Supercritical Coal Combustion

The process of Supercritical Coal Combustion can be followed using the numerical references indicated in Figure 1: Coal to Electricity Process Diagram. Crushed coal is moved mechanically from the existing handling area to coal storage bunkers in the new plant (1-4). It is then pulverized and blown directly into the boiler where it is burned to produce heat (5). At supercritical pressures, water does not boil in the conventional sense. Instead, it gradually turns to steam with no sudden expansion. Water is passed through tubes in the boiler to absorb the heat from the burning coal. As the temperature of the water rises, the boiler produces steam at a rate of about 1.3 million kilograms per hour (kg/h). Steam is directed to the turbine and generation equipment (6-7).



Fgiure 1: Coal to Electricity Process Diagram

During the combustion process, carbon and hydrogen in the coal are converted to carbon dioxide and water. Flue gas formed in the burning process travels through the boiler, where it cools from 1500°C to 140°C. After leaving the boiler, it enters a flue gas desulphurization (FGD) unit where sulphur dioxide is removed (10). The flue gas contains small non-combustible particles called fly ash. Solid particles of fly ash are filtered out of the cooled flue gas through a fabric filter before being released into the atmosphere (10). The filter removes more than 99.8 per cent of this particulate matter and reduces associated mercury emissions. Heavier ash falls to the bottom of the boiler where it is extracted as bottom ash.

Electrical Power Generation

The power generation process uses the steam produced in the boiler to drive a multistage turbine that generates electricity (6). The exhaust steam from the turbines is routed through a condenser, where it is cooled by fresh water from the cooling pond to become boiler water (8). Cooling water is pumped out of the pond and through the condenser and returns to the pond without coming into direct contact with the steam or boiler water (9). The recycled steam is returned as water to the boiler to repeat the cycle. The multistage turbine is connected to the electrical generator (7). The electricity produced by the generator is then increased to 240 kilovolts (kV) through a transformer at the plant (11). This high voltage electricity is transmitted into the Alberta Interconnected Electric System, and is distributed throughout the province. EPCOR has consulted with the Transmission Administrator regarding transmission capacity. The preliminary assessment indicates that, subject to minor modifications, the existing transmission infrastructure is capable of supporting the addition of Genesee Phase 3 generation into the Alberta grid.

Regulated Emissions

EPCOR's proposed additional third coal-fired electric generation at its existing Genesee Generating Station in Leduc will use supercritical pulverized coal combustion technology. Recognized as the best available commercial technology for this project, the third unit will increase efficiency by an estimated eight to 10 per cent, compared to the existing units.

One of the key considerations for the new plant design is emissions control. The third unit will be designed to comply with the applicable guidelines for NO x and SO 2 emissions, and particulates. It is recognized that air quality issues relating to particulate matter (PM 10 & 2.5) and mercury are under review in the Canada-wide Standards Process.

The Genesee Generating Station is one of the most efficient coal-fired power generation facilities in Canada. Technology selection will result in reduced emission rates for Genesee Phase 3 compared to the existing units. Low NO x burners reduce NO x by at least 20 per cent. The FGD unit will enable Genesee Phase 3 to achieve up to 60 per cent sulphur removal even if coal with unusually high sulphur content levels is burned. Particulate emissions will be controlled by installing a fabric filter.

Fabric filter efficiencies exceeding 99.9 per cent are reported by plants burning coal with similar properties to that mined at Genesee. This would represent a 60 per cent improvement over the performance of existing units.

Greenhouse Gases

Genesee Phase 3 will have six per cent higher capacity than each of the other two units, and at the same time generate lower greenhouse gas emissions per unit of electrical output and on a tonnes-per-hour basis. Based on the amount of carbon dioxide emitted per unit of electrical output (kg/kWh), carbon dioxide output will be eight to 10 per cent lower at the addition than at the existing plant, and 18 per cent lower than at the average coal-fired power plant in Alberta.

At commercial start-up of Genesee Phase 3, EPCOR's goal is that net incremental GHG emissions will be equal to or lower than those from comparable combined-cycle, natural gas-fueled electrical generation. The utility is pursuing a diverse mix of programs such as landfill gas recovery, fly ash sales, water efficiency, customer conservation, wood pole recycling, tree planting, Green Power generation and emissions trading.

Socio-Economic Benefits

The expected capital cost of Genesee Phase 3 is estimated at approximately $500 million. The project will create employment opportunities during the environmental review, planning, design, site preparation, construction and operating stages.

EPCOR anticipates that as much as half of the total cost could accrue to Alberta businesses, many of which represent national and international firms, for a wide variety of goods and services. In-house expertise will be supplemented by engineering and other technical resources. Service and construction contracts will be awarded on a competitive basis to Alberta firms that have the required capacity and skills. Specialist requirements will be sourced nationally and internationally. Most of the large-scale equipment, including turbines, the supercritical boiler, and mining equipment are expected to be purchased from U.S. or overseas manufacturers, as none currently exist in Canada.

The project will create approximately 750 person years of direct and indirect employment during the 30-month period of site preparation and construction. Genesee Phase 3 will create up to 60 new full-time staff positions in the plant, in addition to the 130 current operating positions. About 65 new positions will be created at the coal mine resulting in a total estimated mine staff of 140. The construction and operation of Genesee Phase 3 will provide significant direct and indirect economic benefits to the local and regional economies. The project will strengthen the property and industrial tax base of Leduc County, as well as increase taxes or royalties for all levels of government.

From a provincial perspective, the project will provide a large, reliable source of electricity and allow the province to make use of its abundant reserves of low-sulphur thermal coal.

About EPCOR

EPCOR Utilities Inc. is a holding company with wholly-owned subsidiaries that provide electricity, water and natural gas services to customers in Alberta and technology services to markets across Canada.

EPCOR currently has assets of $2.8 billion and annual revenues of $1 billion. It employs about 2,000 people in its various business units.

EPCOR Generation Inc. currently operates three generating stations which supply a total of 1,615 MW into the power grid-approximately 20 per cent of Alberta's electricity:

- Genesee Generating Station, coal-fired - 762 MW;
- Clover Bar Generating Station, natural gas-and landfill gas-fired - 632 MW; and
- Rossdale Generating Station, natural gas-fired - 221 MW.

EPCOR Power Development Corporation (EPDC) is responsible for the non-regulated generating portion of EPCOR's business. It is the proponent of the Genesee Phase 3 project, and the 170 MW natural gas re-powering of the Rossdale Generating Station in Edmonton, Alberta. EPDC is currently a partner in the 416 MW natural gas-fired cogeneration plant near Joffre, Alberta; the 249 MW natural gas-fired plant at Frederickson, Washington; the 12.75 MW Taylor Coolee Hydroelectric plant near Magrath, Alberta; and the 7 MW small hydro project at Brown Lake, British Columbia. ET

AUTOMATION ISSUES

Reliability of Power Supplies – A Theoretical Reflection

By Andreas Sobotta

Most automation applications require a DC power supply. If the power supply fails, the whole control panel will not work and valued production time is lost because of just one failing device.

The reliability is therefore a critical parameter when choosing a power supply. However, there are uncertainties and irritations about the important keywords like MTBF-time, lifetime and reliability. The following article will try to explain these expressions and help to choose the right power supply.

Mean Time Between Failure

One key to the consideration of reliability is the MTBF-time, which stands for Mean Time Between Failures (not Mean Time Before Failure). The MTBF represents the reciprocal value of the failure rate:

$$MTBF = \frac{1}{-\lambda}$$

The failure rate of a power supply is similar to the one of electronic components and can be shown with the bathtub life curve (see Figure 1).

The failure of a device can be subdivided into three sections.

(a) Early failures of defective components
(b) Low fault rate during the normal lifetime
(c) Increasing fault rate due to ageing components

Section (a) is usually covered by a run-in testing which however, is not performed by every power supply manufacturer. During the normal lifetime, the reliability of a device is expressed by the MTBF-time and only refers to Section (b) b).

The calculation of the MTBF is performed by a statistical evaluation of operating hours of as many devices as possible.

This calculation takes into consideration every single part of the device, the temperature, and the load. The world-wide accepted standard for such a calculation is IEC 1709.

The reliability of a device is strongly related to the MTBF and is defined as:

$$R_{(t)} = e^{-\frac{t}{MTBF}}$$

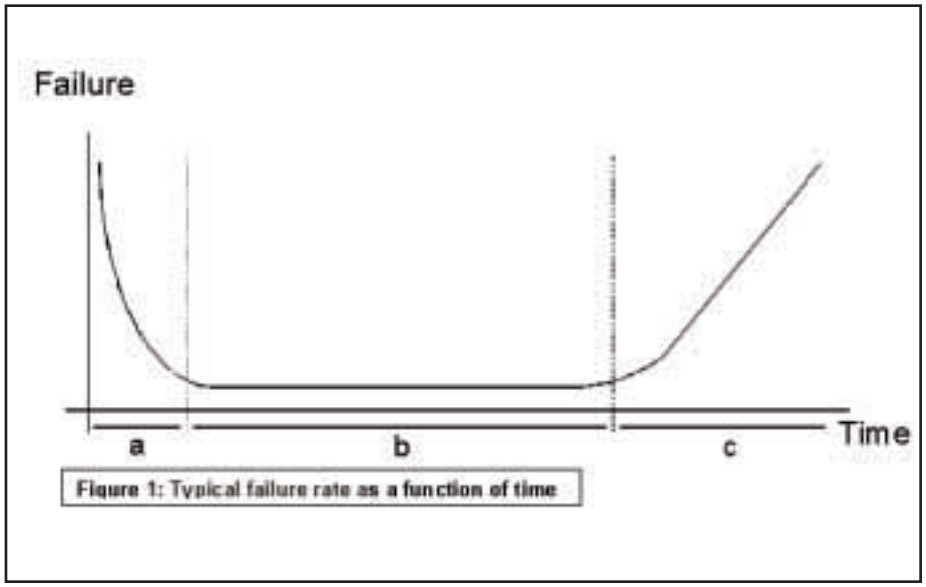


Figure 1: The failure rate of a power supply is similar to the one of electronic components and can be shown with the bathtub life curve above.

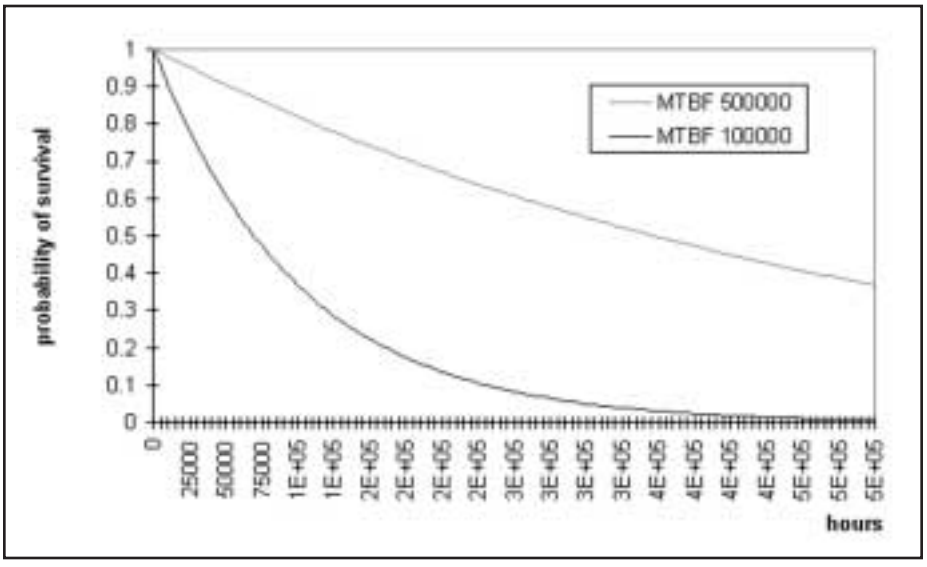


Figure 2: The probability of survival for a device with MTBF 100,000 h and 500,000 h is compared. After 25,000 h (or less than three years) the probability of survival of the device with an MTBF of 100,000 h is less than 78 per cent. That means the likelihood of a failure is over 22 per cent, whereas the power supply with an MTBF of 500,000 h has a survival probability of more than 95 per cent!

An example of a power supply with a MTBF of over 500,000 h is the QUINT series of Phoenix Contact (shown above). Large industrial companies in the automotive industry, process industry or automation industry are all using these types of units.

In other words, it is the probability of surviving a defined number of operating hours. Therefore a higher MTBF corresponds with a longer lifetime.

If the device is operated for a period equal to its MTBF, the probability of survival is 0,37. If it is only operated for a period of 10 per cent of its MTBF, the probability of survival is 0,9.

Comparing Devices Using MTBF

Therefore, the MTBF value is suitable for comparing devices. However, if you apply the MTBF value for one single device, it can be assumed that the probability of survival to be expected in practice is much better than the actual calculated MTBF values.

In Figure 2 we compared the probability of survival for a device with MTBF 100,000 h and 500,000 h. After 25,000 h (or less than three years) the probability of survival of the device with an MTBF of 100,000 h is less than 78 per cent. That means the likelihood of a failure is over 22 per cent, whereas the power supply with an MTBF of 500,000 h has a survival probability of more than 95 per cent!

Due to the exponential functionality, it gets even worse for devices with a lower MTBF, if we take into consideration a longer operating time.

After 100,000 h for example, the likelihood of a failure of devices with an MTBF of 100,000 h is about 63 per cent, whereas the likelihood of failure for a device with a MTBF of 500,000 h is only 18 per cent.

Critical Power Supply Components

The most critical parts of a power supply are the capacitors. They are usually the first parts to fail, especially at higher temperatures. If a manufacturer fails to use higher quality capacitors, the lifetime will be shorter.

High quality power supplies are therefore using special long-life capacitors that are rated for temperatures of 105 degrees C or higer. At ambient temperatures of 70 degrees the internal temperature may be over 100 degrees. Even if the ambient temperature in the application is not that high, a higher rated capacitor assures a longer lifetime.

An example of a power supply with a MTBF of over 500,000 h is the QUINT series of Phoenix Contact (Figure 3). Large industrial companies in the automotive industry (General Motors, Ford, Daimler-Chrysler, Volkswagen, Audi), process industry (Dupont, Shell, Imperial Oil, Suncor, Fisher Rosemount) or automation industry (ABB, Siemens, GE) are all using these units.

In particular, if installations require availability and long lifetime, an investment in reliable components is especially meaningful from a technical, and economical point of view.

Andreas Sobotta is the Product Marketing Manager for Phoenix Contact Ltd. ET

POWER MONITORING AND CONTROL

Application of a Power Management System at Wescast Industries' Plants

By T. Thoma and L.E. Crossley, P.Eng.

Power management systems are installed at four of Wescast Industries Inc.'s plants at Brantford and Wingham, Ontario.

Wescast Industries is the world's largest supplier of cast exhaust manifolds for passenger cars and light trucks. They design, develop, manufacture and machine, high-quality iron and steel exhaust manifolds for automotive OEMs. Wescast operates seven production facilities in North America and three sales and design offices in North America and Europe. The company is recognized worldwide for its quality products and innovative design solutions.

Their power management system is a real-time management system allowing Wescast plant management to reduce operating costs through the automatic control of plant furnace loads with minimum interference to production levels. Experience with this system has proven that the overall energy cost can be reduced while improving productivity and energy consumption efficiency. The system is fully integrated with the Wescast local and wide area networks permitting multiple users to access the system's real-time and historical data from their existing desktop computers.

There are four Wescast plants that have management systems installed.

Brantford Installation

The Brantford plant was built in 1991 and covers approximately 168,000 square feet. The plant produces Ferritic Ductile Iron and High Silicon Molybdenum Ductile iron cast as exhaust manifolds. The plant has an installed potential load of 20 MW, the major loads being comprised of 5 furnaces and one holding furnace. The plant is supplied by one 27.6kV line and is billed by the utility on the Ontario RTPll rate structure. The E2MS RealTime system monitors the main incoming utility meters and the sub-meters installed on each of the furnaces and the plant substation transformers. The E2MS system is complete with a fully automatic load control software

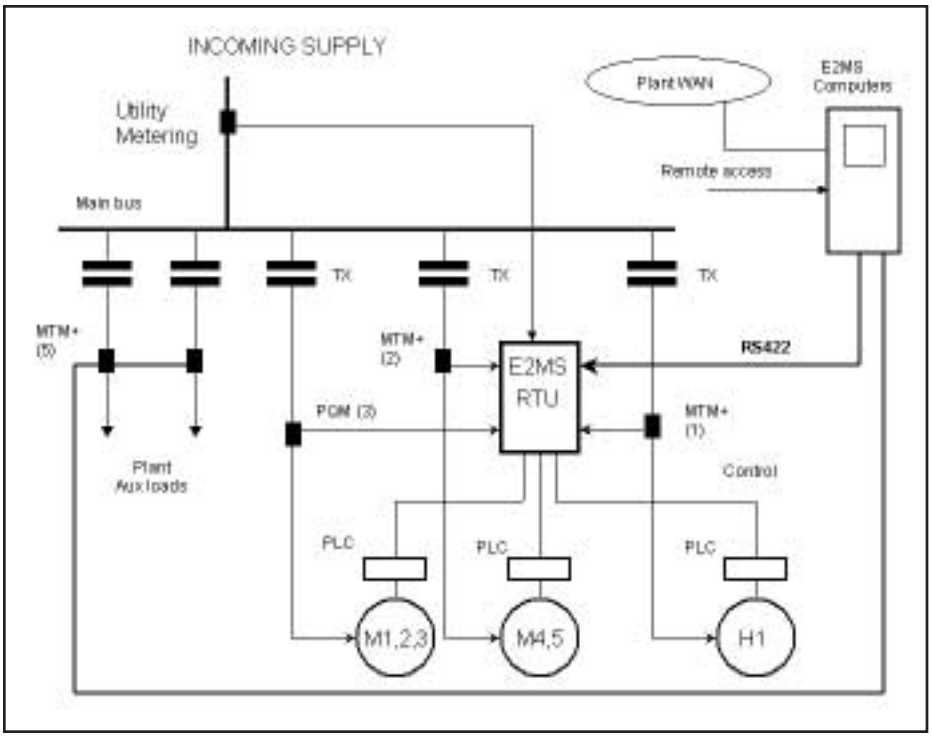


Figure 1

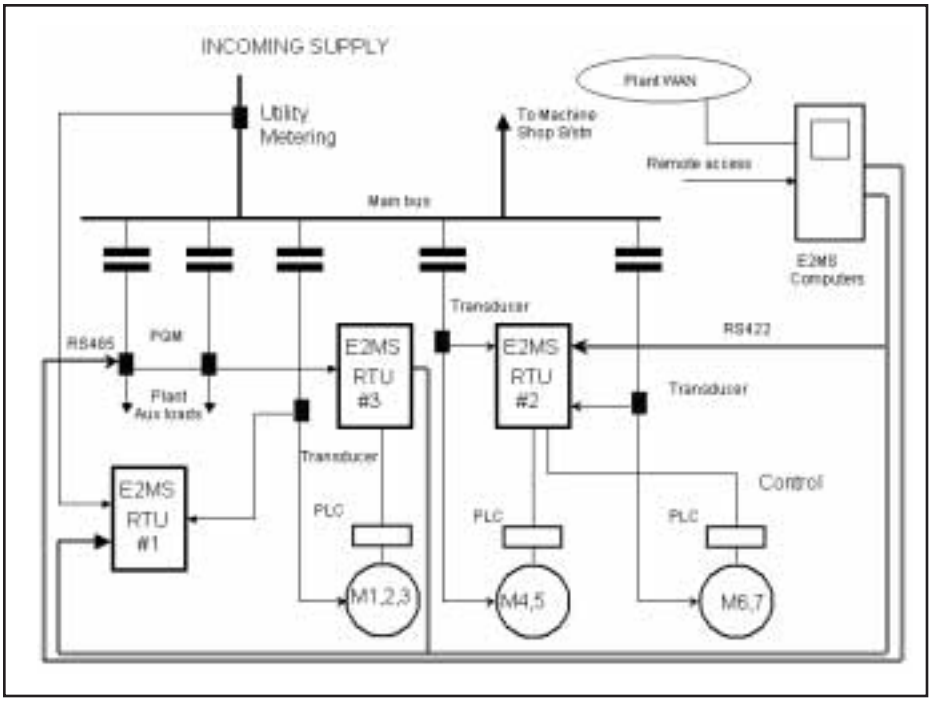


Figure 2

module which issues raise and lower load signals to the furnaces. The control signals are issued in accordance with a calculation of the plant's predicted load and its difference to an operator set target. The control output signals turn on or off optically isolated output modules which are interfaced to the individual furnace controls via the plant's PLC equipment. The system is shown in Figure 1.

The RTU panel contains the data acquisition equipment and is mounted alongside the computer cabinet. The data acquisition equipment is manufactured by Opto22 and provides optically isolated input and output modular interfaces. KWh, kVARh and time synchronizing pulses from the utility metering are connected to the input modules together with kWh and kVARh pulse signals from Multilin PQM transducers on each of furnaces 1,2 and 3. Furnaces 4 and 5 are equipped with Multilin MTM+ transducers which are mounted on each furnace power supply equipment and provide local readout of electrical parameters. The PQM and MTM+ units supply kWh and kVARh energy data and are interrogated by the data acquisition computer via an RS485 two wire communication highway.

An additional 5 MTM+ units, mounted on a panel in the plant's main substation are also monitored on this highway. Control outputs on the Opto22 data acquisition equipment are connected as inputs into the plant's PLC system. These outputs signal the PLC to raise or lower individual furnace loads in accordance with the plant's predicted load and desired hourly target. The operators can select the order of furnace control through their PLC logic pushbutton interface.

Wingham Castings Plant Installation

The Wingham Castings plant was built in 1901 and covers approx. 165,000 square feet. The plant produces Ferritic Ductile Iron and High Silicon Molybdenum Ductile iron cast as exhaust manifolds. The plant has an installed potential load of 20 MW, the major loads being comprised of 7 furnaces. The plant is supplied by one 44 kV line and is billed by the utility on the Ontario RTPll rate structure. The E2MS RealTime system monitors the main incoming utility meters, the transducers installed on each of the furnaces and the plant substation transformer loads through Multilin PQM sub-meters. The system is complete with a fully automatic load control software module which issues raise and lower load signals to the furnaces. The control signals are issued in accordance with a calculation of the plant's predicted load and its difference to an operator set target. The control output signals turn on or off optically isolated output modules which are interfaced to the individual furnace controls via the plant;s PLC equipment (see figure 2).

There are three RTU panels containing the data acquisition equipment at the Wingham Castings plant. RTU panels 1 and 3 are located beneath the control room while RTU #2 is mounted on the far side of the plant. The equipment in the panels has to operate under high electrical noise conditions and is subjected to high temperatures and vibration. The computer equipment is mounted in a cabinet located in a controlled environment.

Continued on page 16

Continued from page 15

The data acquisition equipment is manufactured by Opto22 and provides optically isolated input and output modular interfaces. KWh, kVARh and time synchronizing pulses from the utility metering are connected to the input modules in RTU panel #1 together with kWh and kVARh pulse signals from the transducers on each of furnaces 1, 2 and 3. The kWh signals from transducers on furnaces 4, 5, 6, and 7 are connected to RTU panel #2. RTU panel # 3 is equipped with the output modules to control furnaces 1, 2 and 3 while RTU panel #2 has the output modules for furnaces 4, 5, 6, and 7. Multilin PQM meters supply kWh and kVARh energy data for the plants auxilliary loads and are interrogated by the E2MS data acquisition computer via an RS485 two wire communication highway.

Control outputs on the Opto22 data acquisition equipment are connected as inputs into the plant's individual furnace control systems. These outputs raise or lower individual furnace loads in accordance with the plant's predicted load and desired hourly target. The operators can select the order of furnace control through the E2MS control configuration.

Wingham Machine Shop Installation

The Wingham Machine Shop was built in 1991 and covers 103,000 square feet. The plant has an installed potential load of 2 MW and machines product produced by the Wingham Castings plant. This plant is sub-metered from the Wingham castings plant and is also billed on the RTPll rate. The machine shop substation load is monitored by a Multilin PQM meter which is interrogated by the E2MS system located at the Wingham Castings plant, using the plant's wide area network. From the data supplied by this sub-meter the plant can allocate the machine shop portion of the overall bill. The system is shown in figure 3.

A Multilin PQM meter is installed on the secondary side of the machine shop substation incoming supply. This meter provides kWh and kVARh aux pulses which are connected to Opto22 input modules contained in an E2MS RTU mounted in the substation. The PQM internal registers can also be interrogated by the E2MS computers using an RS485 connection.

An IP addressed, dual channel, Ethernet to serial interface, is mounted in the RTU panel and provides a transparent serial connection through the use of TCP/IP. The E2MS computer software,

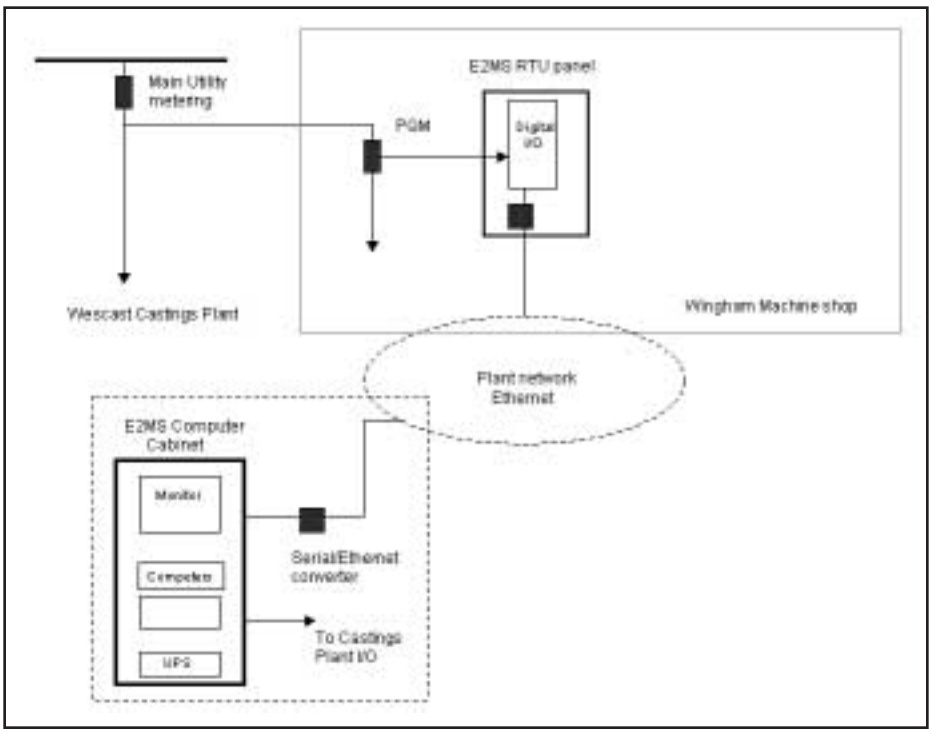


Figure 3

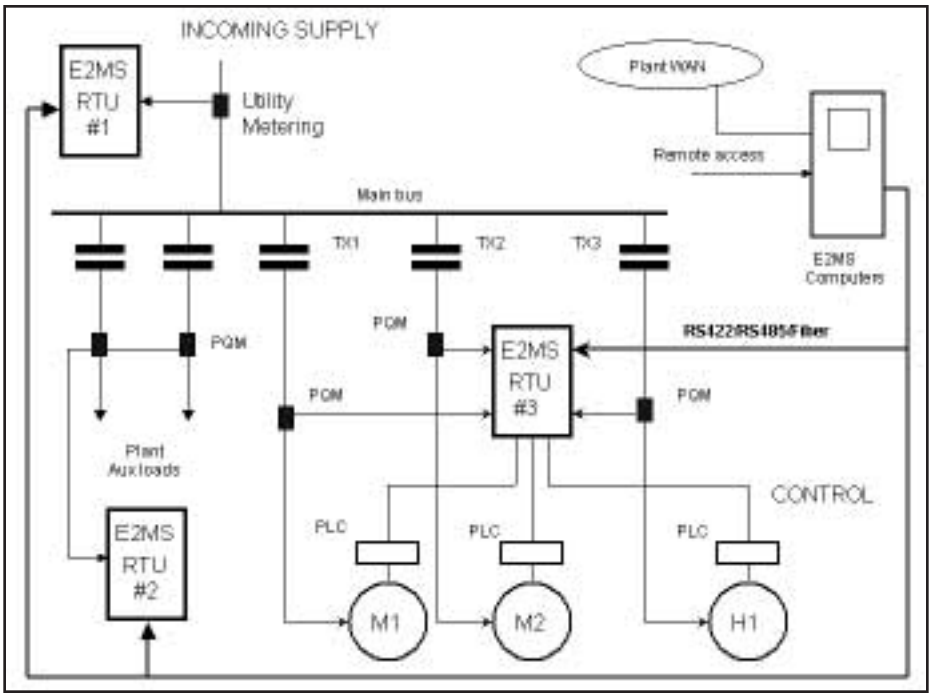


Figure 4

in the Wingham Castings plant, uses the data obtained from the PQM in the machine shop as a sub-metered load and tracks the energy used by the machine shop along with the energy used in the Wingham Castings plant.

North Huron Castings Plant Installation

The Wescast North Huron Castings plant was built in 1999, covers an area of 105,000 square feet and produces SiMo Iron which it casts into exhaust manifolds. The plant has an installed load of 20 MW and is on the large user Time of Use rate (TOU) with on-peak demand penalties.

The E2MS RealTime system monitors the main incoming utility meter, the Multilin PQM sub-meters installed on each of the furnaces and the plant substation transformer loads through Multilin PQM sub-meters. The E2MS system also issues raise and lower load signals to the two furnaces and holding furnace in

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Continued from page 16

accordance with an E2MS calculation of the plants predicted demand and its difference to an operator set target. The E2MS output control signals are interfaced to the individual furnace controls via the plants PLC equipment. The system is shown in figure 4.

There are three RTU panels containing the data acquisition equipment at the North Huron Castings plant. RTU panel #1 is located at the end of the plant closest to the utility metering location. RTU panel #2 is located at the opposite end of the plant in the plant's substation and RTU panel #3 is located close to the variable frequency power supplies for the two furnaces and holding furnaces. The equipment in RTU #3 has to operate under high electrical noise conditions and is subjected to high temperatures and vibration. The computer equipment is mounted in a cabinet located in a controlled environment in the plant's server room. All the data acquisition equipment is manufactured by Opto22 and provides optically isolated input and output modular interfaces. KWh, kVARh and time synchronizing pulses from the utility metering are connected to the input modules in RTU panel #1.

Multilin PQM meters supply kWh and kVARh energy data for the plants aux loads and for each furnace and holding furnace. The RTU panels are interrogated by the E2MS data acquisition computer via a dual fiber optic highway using RS485 and RS422 serial communications. Control outputs on the Opto22 data acquisition equipment in RTU panel # 3 are connected as inputs into the plants individual furnace PLC control systems. These outputs raise or lower individual furnace loads in accordance with the plants predicted load and desired demand target. The operators can select the order of furnace control through the control configuration.

Overview of the systems

Figure 5 shows an overview of the plant application as described in the previous sections. The present system allows an authorized user to view real-time and historical data from all plants from anywhere on the network. The existing system as installed can also be extended to provide aggregation of each of the plant's profiles, and real-time data, into a format suitable for purchasing power under a deregulated market.

System Operation

The following description is applicable to each of the Wescast Castings plants using the E2MS system.

The computer system continuously obtains electrical information from the plant's main utility meters, and from the transducers and meters on the furnaces and aux loads. At each plant the E2MS control software module monitors the energy being used at the plant and forecasts the plant's demand in accordance with the power utility billing algorithm used at the plant.

For the North Huron plant, on Time of Use rates, the control program compares the forecast demand with the desired set point demand, as determined by plant management, and issues control commands to raise or lower furnace loads.

For the Brantford and Wingham Castings plants, on RTPII rates, the control program operates slightly differently. The plant management sets the desired hourly demand target in accordance with the hourly kWh rate, issued daily by OPGI, and with the desired production schedule. The melt department shift leader enters the prices into the software and sets the hourly targets based on the production schedule. The system control module automatically changes the target each hour in accordance with the preset requirements. As the hourly pricing is generally lower at night and on weekends, the melt department will melt as much as possible during the night and build an inventory of molten iron in the holding furnace. The plants will then run at a lower load during the daytime when costs are higher, the load being restricted by the control program.

In all plants the output signals are sent to the appropriate RTU panels where they operate digital output modules which in turn signal the process control PLCs to make the appropriate adjustments in load.

The system operators are provided with a real-time graph of overall plant load versus time, with the set target load displayed, together with full analysis tools for historical and cost analysis. In addition to the overall plant total, the load on each individual furnace is also shown. The control of demand is smooth and is applied in stages to the furnaces in a set order in accordance with the plant production requirements. Reloading of the furnaces is automatic after the load has fallen to the restart level as defined in the system configuration. Every time a control operation takes place, the activity is written into a control log together with the time, date and demand at that time.

The load target is password protected and may be changed at any time by authorized users when on the control screen. The output control levels are computed on a minute by minute basis using the utility metering signals. The system has several major communication routines. These routines are:

(a) The one minute read, on the minute, of all RTU metering counter registers. This information is used for real-time load prediction calculations and for load control and is saved for future analysis.
(b) The five minute read and filing of all RTU metering

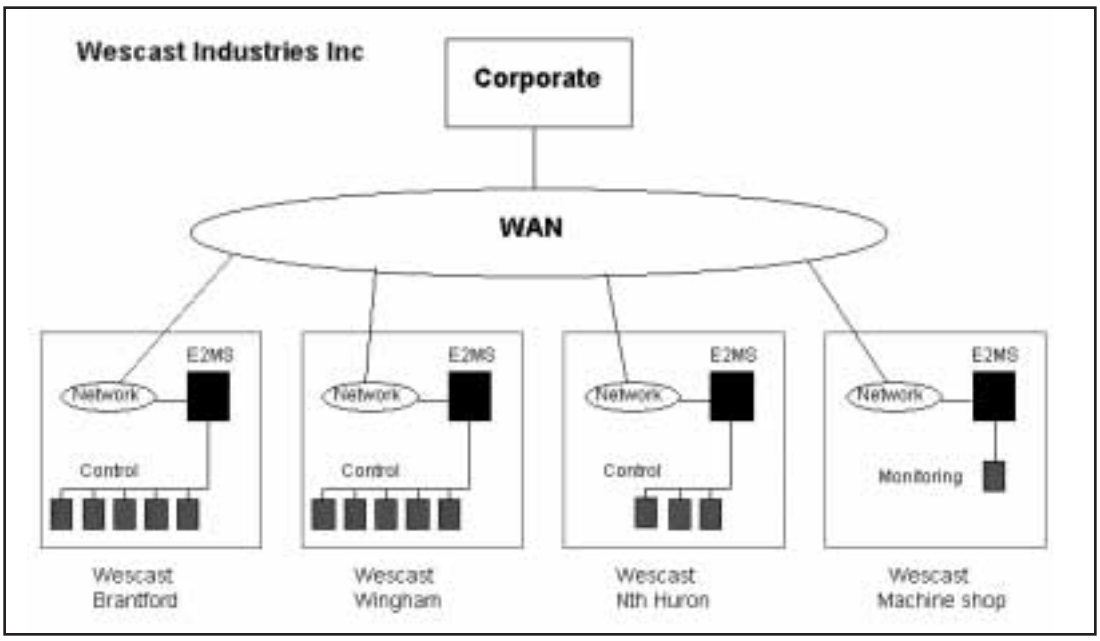


Figure 5

counter registers. This 5 minute information is used for bill verification purposes in the deregulated markets.

(c) The 15 minute read and clear, on the 15 minute mark, of all RTU metering counter registers. This information is filed in a database using Access, Oracle or SQL and is used for historical billing analysis purposes.

(d) The one minute control signal to update the outputs in the various RTU panels in accordance with the load forecasts.

Menu driven routines provide access to the stored data and logs for analysis purposes. All E2MS systems are network enabled allowing authorized multiple users to access data from across the Wescast network.

System Software

The SYSTEM software, as installed at Wescast industries, consists of the following major modules.

(a) Communications module: This module provides the data acquisition functions and interface with the control equipment via the plant RTU.

(b) Display module: Provides the user interface with the system both in graphical and spreadsheet format using Windows 98/NT system software.

(c) Analysis module: Provides graphical and spreadsheet analysis of the stored data including maximums, minimums, coincident demand data, energy use and load factors.

(d) Report module: Provides reports on power use and plant running costs including bill verification by generating utility bill.

(e) Database filer: Stores the data and configuration parameters in ODBC compliant database.

(f) System and cost configuration module: This module allows the number of points to be entered, identified and utility metering algorithms assigned together with energy and demand costs. Both RTPII and Time of Use (TOU) rates are provided.

(g) Automatic demand control module: This module uses the E2MS load prediction calculation to determine the demand and rate of energy use in accordance with the rate setup in the system configuration.

Plant experience with the system

The systems at Brantford and Wingham Castings were first introduced in the mid 1990's. Over the years modifications and enhancements were made to cater to advances in computer technology and changes in billing tariffs.

The introduction of the RTPII tariff was a challenge to the system programmers as the tariff was very complex and required a great deal of development and testing. There have been savings made with the system through the limiting of demand and identification of operating opportunities.

Current work involves enhancements to the products to make them ready for the deregulated market. In this respect hourly prices will be downloaded directly from the IMO into the E2MS software without the need to enter them manually.

T. Thoma is Director of Technology, Wescast Industries Inc. and L. E. Crossley P.Eng, is Executive Vice President, Engineering, E2MS Inc. ET

POWER QUALITY

Utility Reliability Metrics for New E-conomy Processes

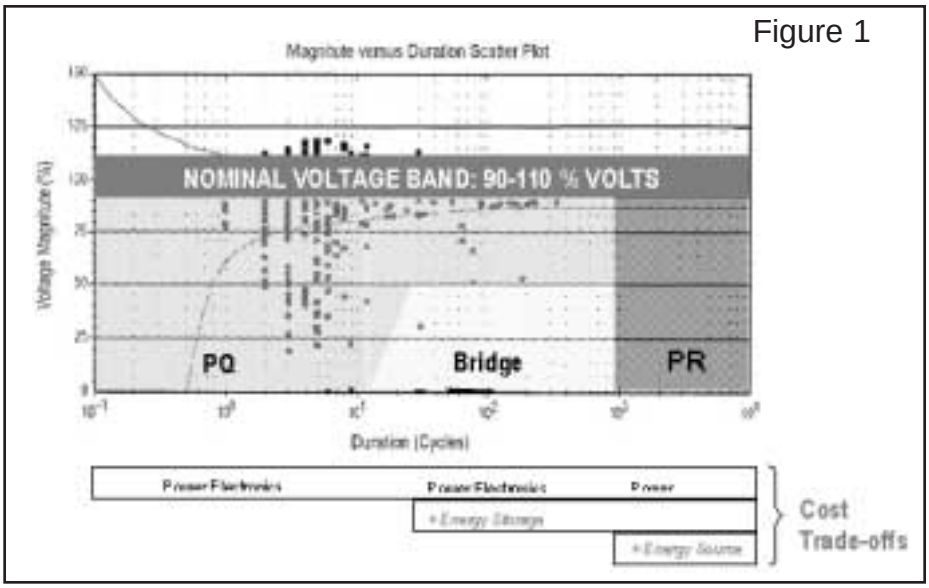
By Dr. Deepak Divan, Fellow IEEE

The North American industrial economy has been powered by the electric grid for the past 100 years. The quality of electrical power has been key to economic growth and improving industrial productivity levels. In the industrial economy, power reliability (PR) was the important metric and was measured by the frequency of power interruptions, typically 2-3 per year. In the new digital economy, this definition is very limited and does not adequately address equipment and process sensitivity. Microprocessors, communications, and industrial process control equipment, the building blocks of the new digital and Internet E-conomy, are often disrupted by very short duration voltage dips and sags which occur 20-30 times per year. This leads to more frequent and costly process and economic disruptions, even as the 'lights stay on'. These short duration power quality (PQ) 'events' cost the US economy over $150 billion every year due to lost productivity [1].

The term 'power quality' has recently achieved a high level of visibility due to the needs of the digital economy. The distinction between power reliability and power quality is often blurred. Power reliability solutions, such as back-up generators and microturbines, often claim to be power quality devices, and vice-versa. A popular measure of utility reliability, as proposed by Mark Mills and Peter Huber of The Gilder Group, uses the percentage of time that the utility voltage is within nominal spec as a direct measure of reliability [2]. For instance, a utility voltage out of spec for 2000 seconds per year implies a 'utility reliability level' (URL) of 99.99 per cent (or 4 nines). This reliability metric also fails to distinguish between power reliability and power quality; it fails to distinguish the impact that each has on processes in the New E-conomy.

This article suggests a segmentation of the power quality and power reliability markets based on a simple metric,the Downtime Amplification Factor (DAF), which provides valuable insight into the selection of appropriate solutions. An alternate measure of 'effective' and perceived utility reliability, the 'Process Utility Reliability Level' (PURL) is also proposed and more accurately reflects the impact that power quality events and solutions have on sensitive equipment and processes. Effective solutions, meeting the needs of power reliability and power quality, are also discussed. Solutions such as SoftSwitching's Dynamic Sag Corrector™ are shown to provide unique value for protecting sensitive processes.

Figure 1



Utility Reliability Metrics

Utilities attempt to deliver a voltage, typically within +/-10 per cent of a 'nominal' value, to their customers at all times. A power reliability event occurs when a power outage occurs, typically lasting for 2 seconds to several hours. A power quality 'event' occurs whenever the voltage deviates from this 'nominal' band, typically for a very short time. Computers, digital controllers, and sophisticated industrial processes are at the heart of the New E-conomyand can shut down when the voltage fluctuates from the nominal band for as little as 0.02 seconds. Such short duration 'events' are often referred to as voltage sags. The old industrial economy used less sophisticated electromechanical devices that were sensitive to long outages, but not sensitive to voltage sags. New E-conomy equipment and processes tend to be very sensitive to voltage sags.

Process sensitivity to voltage sags abounds in virtually every industry sector. Examples include:

A plastic extruder experiences a shut down of its 14 extrusion lines between 10-15 times a year. Each shutdown entails a 4-6 hour restart process and generates a mountain of scrap. Monitoring the incoming power with the help of the local utility revealed that voltage sags of less than 1/4 second duration, primarily a result of nearby thunderstorms, caused virtually all the plant shutdowns. ·

A major auto manufacturer loses anywhere from 10-30 cars when production is interrupted by a voltage sag at an assembly plant. Such 'events' occur 10-20 times per year at each plant for all auto manufacturers.

Fiber optic cable bundles, at the heart of the telecom revolution, can snap when a voltage sag is encountered during the manufacturing process, costing cable manufacturers millions of dollars every year.

Semiconductor fabrication houses

lose millions of dollars a year in chips due to voltage sags. As a result, the semiconductor industry is the first industry group to formulate and to enforce a voltage sag susceptibility standard, SEMI F-47, which will specifically protect equipment and processes from voltage sags [3]. This trend is sure to be followed by other industry groups. Most power quality 'events' are caused by factors outside a utility's control and thus can never be totally eliminated. Causes include lightning storms, squirrels in transformers, damage to utility poles, and faults in industrial plants or on the utility grid. The occurrence of such an 'event' causes a line fault resulting in the tripping of utility-protective switchgear on the specific utility line where the 'fault' occurs. However, until the fault clears (typically less than 0.15 seconds), very high currents flow in the utility system causing a short duration voltage dip or voltage sag as far as 50 to 100 miles from the location of the fault. As there could be hundreds of electric lines in that 50 to 100 mile radius, and only one faulted line which possibly suffers an actual outage, the number of voltage sag 'events' at any location vastly outnumbers longer duration outage type of 'events'. Several studies, including the EPRI Distribution Power Quality Study, have confirmed that a typical utility customer in a radial distribution system may experience 2-3 outages per year, but may experience as many as 25-30 short duration voltage sags and momentary loss of power 'events' per year [4].

It is well known that many 'high-tech' industrial customers, such as semiconductor chip and automobile manufacturers, require higher levels of 'reliability' than available from typical utility grids. The high voltage transmission grid (>138 kV), independent dual distribution feeds, or highly meshed distribution grids (such as in New York City), are three distinct approaches that utilities use to improve power reliability and provide 'premium'grade utility power. For instance, the transmission grid in most utilities or the grid in New York has not suffered an outage in over 30 years, showing extremely high reliability levels (greater than 8 nines). By way of contrast, frequent short duration voltage sags can occur, even on the 'premium' grade power grids. If a 1/4 second voltage sag shuts down a sensitive process for 1/2 hour, the effective power reliability for the industrial customer is similar to a power loss for 1/2 hour. The 'down-time' for the process is amplified from 1/4 second to 1800 seconds, a downtime amplification factor (DAF) of 7,200. By way of contrast, a load such as an incandescent lamp, would suffer a downtime equal to the time that the utility was out of spec, essentially a DAF of 1.

Table 1 shows how utility reliability is likely to be perceived by typical industrial customers. An example of typical power quality and power reliability events for both a 'normal' and a 'premium' utility feed for a representative utility customer is shown. It can be seen that for the event scenario shown, the normal utility customer experiences 2107.5 seconds of 'event' time per year, compared with 5.5 seconds per year for the premium utility customer. For a load with DAF=1; this would give a URL of 4 nines for the normal utility feed and 6 nines for the premium utility feed. For most old economy customers with low DAF processes, a premium power feed would thus provide adequate reliability levels.

The impact on New E-conomy customers is captured in terms of effective process downtime. If a process has a high DAF and suffers, say 1/2 hour of downtime for every power quality or power reliability 'event', it would suffer an annual downtime of 45,000 seconds for the normal utility case (2 nines) and 39,600 for the premium utility case (2 nines). The

Continued on page 22

	# of events Normal utility	Time utility out of spec	Time Process is down (sec)*	DAF	# of events Premium Utility	Time utility out of spec	Time Process is down (sec)*	DAF
<1/4 sec duration	22	5.5 sec	39,600 s	7,200	22	5.5 sec	39,600 s	7,200
¼ sec to 2 sec	1	2 sec	1,800 s	900	0	0 s	0 s	-
2 sec to 5 minutes	1	300 s	1,800 s	6	0	0 s	0 s	-
>5 min (1/2 hour typ)	1	1800 s	1800 s	1	0	0 s	0 s	-
Total for all events	25	2107.5 s	45,000 s	21.35	22	5.5 s	39,600 s	7,200
Process Utility Reliability Level (PURL)	-	4 nines	2 nines	-	-	6 nines	2 nines	-

Table 1

Continued from page 21

'Process Utility Reliability Level (PURL)' of '2 nines', for both the above cases, is thus much worse than the URL value would indicate, particularly for high DAF loads.

It should be noted that for sensitive equipment and processes (i.e., high DAF processes), the higher power reliability afforded by premium power has had virtually no impact on reducing process downtime! In fact, the downtime amplification factor (DAF) has gone from 21.3 for the 'normal' utility case, to 7200 for the 'premium' utility case. It is also clear from Table 1 that the use of a 'backup' solution, such as a generator, fuel cell, or microturbine, can substantially reduce the downtime of 2107.5 seconds per year, thus improving reliability. However, the slow response speed of these solutions makes them ineffective against the 1/4 second voltage sags, even with a 'premium' utility feed. Power quality solutions are required to dramatically improve the 'process utility reliability level' (PURL).

Existing Power Quality Solutions

Existing solutions tend to fall into two primary categories: power reliability (PR) and power quality (PQ). Figure 1 segments the familiar magnitude-duration (mag-dur) plot into three regions: PQ, PR, and Bridge. Figure 1also shows an 'event' profile monitored at an industrial facility with a normal utility feed over 2 1/2 years during the EPRI DPQ Study. Table 1and this data show similar trends and confirm that the PQ region covers 92 per cent of the events by count (23/25), while the PR region covers 85 per cent of the time that the utility is out of spec (1800/2107.5). The Bridge region covers only a small portion of the events by time or by count. However, it bridges the gap between PQ and PR solutions, making possible integrated solutions that protect against 100 per cent of the 'events' shown in Figure 1.

All three regions (PQ, Bridge, and PR) place unique demands on solutions needed to cover the respective spaces. The PR region, due to its need for sustained operation without the utility, requires a continuous energy source. PR solutions include back-up generators, microturbines, and fuel cells. This is also the region that most distributed resource (DR) needs map over to.

The Bridge region, with its need to operate for a short period of time (typically 1/4 second to 60 seconds), requires significant energy storage in the form of batteries, flywheels, ultracompacitors, or superconducting coils. In addition, power electronics is required to condition and convert the stored energy to a utility compatible voltage.

For the PQ region, the required fast response necessitates the use of power electronics. Units such as SoftSwitching's Dynamic Sag Corrector™, (DySC™) for instance, protect against deep voltage sags, as well as momentary loss of power, using only power electronics and minimal energy storage [5].

Other solutions, such as uninterruptible power supplies (UPS), use power electronics and one of the energy storage media from the 'Bridge' region. If we assume that the three technology components (i.e., energy source, energy storage, and power electronics) have similar cost on a mature product basis, we can deduce the cost effectiveness of the various types of solutions, as summarized in Figure 1.

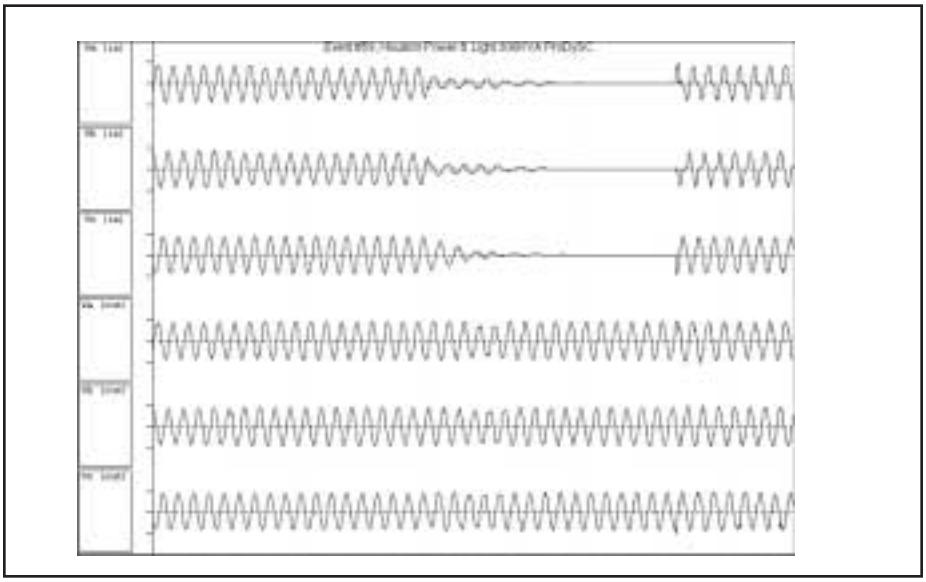


Figure 2

For a 'premium' utility feed, it is clear that all 'events' fall into the PQ region. Virtually 100 per cent of all 'events' would be covered by a lower cost PQ solution such as SoftSwitching's Dynamic Sag Corrector™, giving an effective PURL of 8 or 9 nines. This reliability level would not be significantly improved even with fully integrated solutions. Even with 'normal' utility feeds, the unit can improve process utility reliability levels (PURL).

Figure 2 shows recorded input and output waveforms for a 300 kVA DySC™ operating at an industrial computer facility in Texas. The utility waveform shows a momentary loss of power for approximately 10 cycles, including a complex ring-down voltage. As can be seen, the DySC™ was able to keep the load functioning through this event.

Summary

Awareness of voltage sags as the

dominant power quality problem is growing slowly. The DPQ study and magazines play an important role in this education. As specific information on power quality events becomes more widely available, end use customers who own and operate sensitive processes will be empowered to select cost-effective solutions to minimize process downtime and associated costs. The semiconductor industry, with its recently introduced F-47 standard, has clearly validated the importance of voltage sag susceptibility for an industry with high DAF factors and possibly the highest costs of downtime. As costs of the PQ solutions migrate down, this trend will be duplicated in other industry sectors.

This article has presented new metrics for evaluating utility power quality and its impact on processes. The proposed 'downtime amplification factor' (DAF) and 'process utility reliability level' (PURL) provide a very simple and intuitive means to distinguish between various power quality solutions and their appropriateness for a given type of utility feed and process. It also provides a means to reduce some of the confusion between what constitutes a power quality or power reliability solution, and clarifies under what conditions each one is appropriate. Finally, it provides a simple but meaningful linkage between the cost of a solution and its effectiveness.

As electricity demand increases and the utility grid reaches capacity limits, there will be a need for substantial additional generation resources — the opportunity for the distributed resources market. New technologies, such as fuel cells and microturbines, will have to compete with existing generation technologies. Key technical, cost, and commercial issues remain, but the prognosis is good. There is also a tremendous synergy between the power quality and distributed resources market. Power electronics companies, such as SoftSwitching, are well positioned to take the value they are creating for customers in the power quality arena and extend the same power electronics building blocks to distributed generation markets.

References:

1. Sandia report showing $150 billion loss
2. Gilder group report
3. SEMI F-47 standard
4. EPRI DPQ Study
5. SST PQA Paper

Deepak Divan is President and CEO of SoftSwitching Technologies. ET

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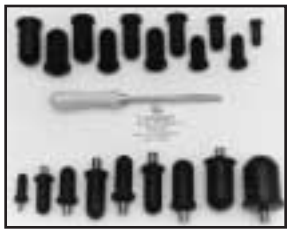

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DISTRIBUTION AUTOMATION

Wireless Monitor Helps Cut Service Downtime from 60 to 5 Minutes

Enhancing a distribution automation system with wireless monitoring technology helps an electric utility reduce the time required to restore partial service after an outage from 60 to 5 minutes in areas served by manual switches. Cobb Electric Membership Corporation in Kennesaw, Georgia, has over 350 gang operated disconnect switches with fault detection capability. In the past, an outage meant the entire feeder line went down and it took an hour or so to field a crew, locate the outage, and restore power to everyone except those on the affected section.

Now, the new wireless monitors, located at intervals along the feeder, send a signal within a few minutes of the fault, allowing the control center to easily determine its location and restore power without sending out a crew. The Cellemetry two way communications option used by Cobb is very economical, utilizing mass produced cellular modems and the existing cellular network.

This combination provides two way communications service for only a few dollars per month while adding only a fraction of the normal communications hardware costs to the RTU.

Challenge of locating the fault

Formed in 1938, Cobb Electric Membership Corporation (EMC) started as an electric utility with 489 residential members and 14 commercial accounts. With over 150,000 members and growing, Cobb EMC is the largest of Georgia's 42 EMCs, the second largest retail supplier of electricity in Georgia, and the second largest of the nation's approximately 900 EMCs. As a not-for-profit, customer-owned corporation, Cobb EMC is dedicated to providing its member/owners with the best service at the lowest possible price. The challenge has always been pinpointing the location of outages so they can be quickly bypassed by the distribution system. The company has installed automated disconnect switches in some locations but economics dictated manual switches for others. These switches make it possible to redistribute power and quickly restore service to the great majority of customers affected by an outage.

The utility has fault indicators arrayed strategically throughout most feeder lines with visual indicators that flash from the time of the faults until they are reset. In the past, as soon as the outage occurred, the manager in the control center would assign a field crew to locate the outage. It could take 20 or 25 minutes to scramble the crew during the day or perhaps 45 minutes during off hours. The crew then drove down the length of the affected feeder line for the purpose of visually inspecting the fault detectors. Normally, every detector would trip and provide a visual signal up to the point of the fault, while detectors located after the fault would not trip. This made it possible for the crew, typically within 20 to 30 minutes, to isolate the affected section and report back so the automation system could bypass it. Because Cobb EMC is located in a congested suburb of Atlanta, slow traffic sometimes substantially delayed the visual line survey.

Finding an economical solution

Of course, this approach leaves the company's customers without power for an hour or so. Cobb EMC engineers considered a variety of remote monitoring systems but each of them was quite expensive. A 900 MHz two-way wireless system adds costs in the neighborhood of $700 to $1200 to each monitor's cost and the company would also have been faced either with the very high cost of constructing its own base system or the hefty monthly charges involved in using an existing network. Any solution that involved installation of a telephone line would have required a minimum monthly line charge of $40 or so for each monitoring point. At these prices, the cost of monitoring the entire network would have been too high to make it economical. The engineers continued their search for a less expensive yet still reliable monitoring method.

Corbitt Clift, Manager of Special Projects for Cobb EMC, led the team assigned to develop a low cost monitoring solution. "I was interested when I heard about the Fisher Pierce system because it was a totally unique approach to low-cost

Continued on page 28

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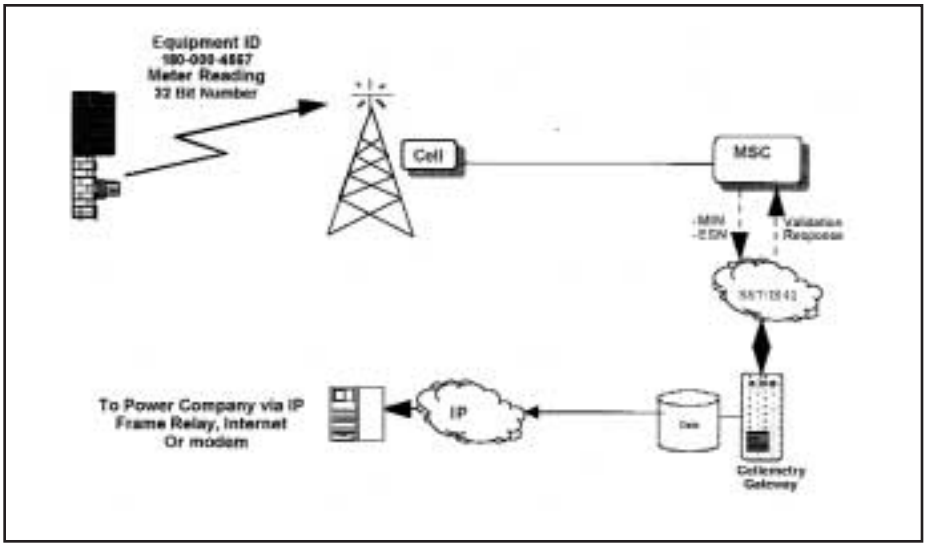


Cellemetry Data Service, the wireless network used by the SmartLink monitor, works by mimicking a roaming cellular telephone. A person turning on a cellular phone outside the local service area causes the phone to register on the local cellular network before obtaining service. This process is called roaming registration and is transparent to the user. During the roaming setup sequence, the cellular system verifies that the phone attempting to make calls is valid. During the process, the system transmits a short message over the cellular control channel typically taking less then 30 seconds and never tying up the voice channel of the cellular system. Like a roaming registration, SmartLink messages are sent to a Cellemetry Gateway that provides immediate transmission of data to the Cellemetry Data Service customer. In the above illustration, an electrical utility meter is shown.

Continued from page 26

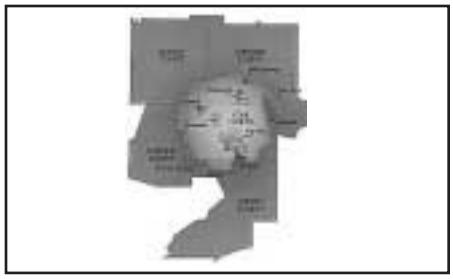
monitoring," Clift said. Fisher Pierce, a division of Danaher Corporation located in Weymouth, Massachusetts specializes in the development of electronic sensing and control equipment for the electric utility industry. "Basically, they use the control system of the every-day analog cellular network. Because they send very small data packets, they never have to intrude on the voice channel. The result is that the cost per monitoring point is very low, only about $5 per month. Their SmartLink monitoring package, which is specially designed for feeder automation applications, only costs about $150 to allow two-way communications. I had to be convinced that a solution that was this inexpensive would really work so I asked them to set up a trial device and put it on in the field for a few months. It passed with flying colors. We now have 13 devices out in the field and have never had any serious problems."

Mimicking a roaming cellular phone

Cellemetry Data Service, the wireless network used by the SmartLink monitor, works by mimicking a roaming cellular telephone. A person turning on a cellular phone outside the local service area causes the phone to register on the local cellular network before obtaining service. This process is called roaming registration and is transparent to the user. During the roaming setup sequence, the cellular system verifies that the phone attempting to make calls is valid. During the process, the system transmits a short message over the cellular control channel typically taking less then 30 seconds and never tying up the voice channel of the cellular system. Like a roaming registration, SmartLink messages are sent to a Cellemetry Gateway that provides immediate transmission of data to the Cellemetry Data Service customer.

This unique data channel technology has several major advantages over the alternatives of wireline, conventional cellular and satellite data services, particularly for applications whose data size requirements are small. First, the costs are considerably lower than the alternatives yet the reliability and reach of the service virtually covers North America. Additionally, the small size of the data packets provides a robustness that extends the range of the service considerably beyond conventional cellular networks.

For example, these data transmissions can penetrate multiple building walls without difficulty and can typically communicate with a cellular transceiver at a distance far beyond that of cellular voice capability, making it possible to easily cover remote facilities.



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Integrating with control center

Cobb EMC uses several versions of the SmartLink monitor, which is available in different models for feeder fault monitoring, capacitor or sectionalizing switch control and status or end of feeder voltage monitoring. The device is powered from the distribution line via a step down transformer. Battery backup is provided and a fully solar powered version will be available soon. When a fault occurs, the device's transmitter reports the faulted phase through the cellular system to a base station operated by Cellemetry Data Service.

The alarm is immediately routed to Fisher Pierce's network that dials into a PC located in Cobb's control center. Every indicator up to the point of the fault sends an alarm and the PC, which runs an application developed by Fisher Pierce, flashes red to provide a visual alert while a text message indicates the location of the fault. This entire process can be completed within 35 seconds to one minute of fault occurrence.

Within a few minutes, the Cobb EMC control center can restore power through its switching system and dispatch a crew to fix the fault. Eliminating the time previously required to visually inspect the line more than pays for the cost of the monitors.

Clift said, after validating the concept, Cobb EMC has begun to utilize it extensively in conjunction with its other automation equipment. "We use the SmartLink for fault protection at major taps or underground risers that don't have automated switches. Basically, they allow us to provide the performance of an automated switch at a much lower cost. In the new deregulated utility market, the bottom line is providing better customer service than competitors, while keeping costs low.

These monitors help us restore power much more quickly than we were able to do in the past while actually reducing our operating costs. So it shouldn't come as any surprise that we are planning to add a considerable number of these units in the near future."

Cobb EMC's distribution system covers approximately 415 square miles. The physical plant consists of over 7,300 miles of line located within Bartow, Cherokee, Cobb, Fulton, and Paulding Counties.

In 1999, Cobb EMC sold 2.8 billion kilowatt hours of electricity with revenue exceeding $228 million. Cobb EMC's customer base is 92 percent residential and 8 percent commercial/industrial. Based on total kilowatt hour sales, revenue is approximately 30 percent commercial/industrial and 70 percent residential. Cobb EMC's total utility plant is valued at over $371 million, with assets of over $447 million. ET

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Monday March 19, 2001: 07:00 — 16:35

Tuesday March 20, 2001: 07:00 — 15:30

Conference Highlights

Monday, March 19, 2001:
08:00 — 08:30
Opening Keynote Speaker:
Seabron Adamson, President, Frontier Economics Inc.
Topic: Making Dollars and Sense from Understanding the Fundamentals (and other factors) Behind Alberta's Electricity Prices.

13:00 - 13:30
Keynote Speaker:
Professor Robert Michaels, California State University, Fullerton, USA
Topic: California's Electrical Disaster and the Future of Competitive Power.

Tuesday, March 20, 2001:
08:00 - 08:30
Keynote Speaker:
Dr. Per Christer Lund, General Manager,
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Topic: Power Trading and Risk Management in Competitive Enegy Markets

13:00 - 14:15
Keynote Speaker:
David Baxter, Executive Director, Urban Futures Institute
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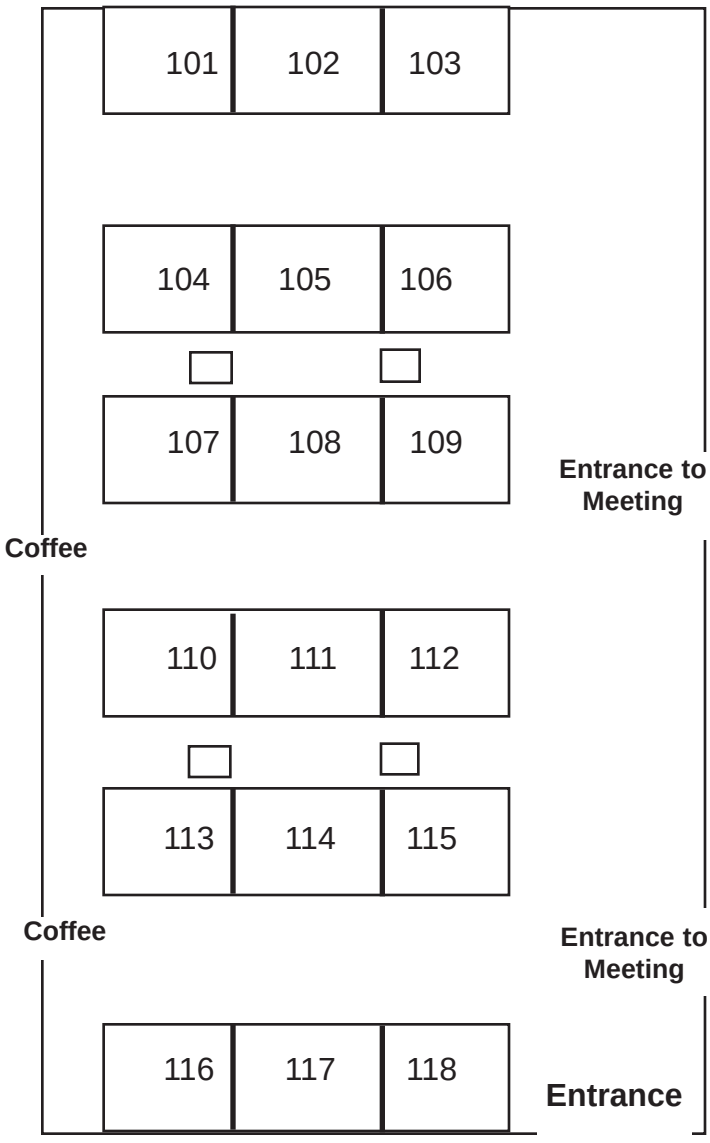

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IPPSA 7TH ANNUAL CONFERENCE

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NEWS

Transalta Announces Intention to Purchase Shares

TransAlta Corporation announced today that it has received regulatory approval to purchase for cancellation up to three million of its common shares through a normal course issuer bid program. The shares represent approximately 1.8 per cent of TransAlta's approximately 168.5 million issued and outstanding common shares. This is coincident with the expiration of TransAlta's existing normal course issuer bid program, which terminates Feb. 20, 2001.

The program will commence on Feb. 21, 2001 and will terminate Feb. 20, 2002, or when TransAlta completes the purchase of three million shares, whichever is earlier. Purchases will be made on the open market through The Toronto Stock Exchange at the market price of such shares at the time of acquisition. TransAlta may also issue put options to facilitate the purchase of common shares pursuant to the normal course issuer bid program.

TransAlta will use the normal course issuer bid to offset any dilution that may occur as a result of the issuance of common shares pursuant to various employee, director and officer compensation programs. In the past 12 months, TransAlta has purchased for cancellation 1,631,200 of its common shares at an average price of $15.68 through a previously announced normal course issuer bid.

TransAlta is an international electric energy company with more than $7.0 billion in assets. The company is focused on achieving strong earnings growth and enhancing its competitive edge as a low-cost operator of generation and transmission assets, and a successful developer of gas-fired independent power projects. The company is concentrating its growth in Canada, the United States, Australia and Mexico. TransAlta owns and operates more than 8,000 megawatts of generation plus significant transmission assets in Alberta.

NB Power and AECL Reach Agreement on Point Lepreau

New Brunswick Power Corporation (NB Power) and Atomic Energy of Canada Ltd. (AECL) have reached an agreement on the refurbishment assessment program at the Point Lepreau Generating Station.

The assessment program will define the technical scope for the potential refurbishment of the station. It consists of preliminary engineering for fuel channel replacement and a comprehensive plant condition appraisal. Under the agreement, AECL will act as the general contractor and will utilize NB Power resources. The preliminary engineering and assessment program represents an investment of up to $40 million by NB Power.

NB Power's Board of Directors will make a decision on whether to support refurbishment and life extension of Point Lepreau in 2002.

A technical and economic review of Point Lepreau by consultant Hagler Bailly in 1998 determined that refurbishment in the 2006-2008 period may be desirable based on refurbishment costs and the achievement of a high capacity factor over the station's extended life. Following completion of the AECL assessment, the costs and benefits of refurbishment will be compared with other development opportunities to determine the most viable option for NB Power. Refurbishment would require the replacement of fuel channels, the calandria tubes and other plant components to extend the station's operating life by 25 years.

"This agreement is the beginning of a new business relationship between NB Power and AECL," said NB Power President and CEO James Hankinson. If the decision is made to refurbish Point Lepreau, NB Power intends to appoint AECL as project manager and implement a risk and benefits sharing arrangement with AECL based on the station's future operating performance.

"Our companies have complementary strengths that will help achieve the best operational and financial value from Point Lepreau," added Mr. Hankinson.

"As the designer and original supplier of the CANDU 6 reactor at Point Lepreau, AECL is a technology leader capable of delivering complete project management and engineering services," said R. Allen Kilpatrick, President and CEO of AECL.

"We have tremendous confidence in the capability of the CANDU design. This strategic relationship will help develop a design framework for life extension of the CANDU 6," Kilpatrick said.

"The operators of nuclear generating stations in the United States have markedly improved the performance of their plants and many are looking for life extensions. NB Power will be the leader in refurbishing CANDU 6 power reactors," Kilpatrick added.

NB Power's CANDU 6, 635 MW unit at Point Lepreau began operation in 1982 and supplies up to 30% of the utility's generation. After hydro, nuclear is the lowest cost generator on NB Power's system. It is also an important component of the utility's climate change and sulphur dioxide management initiatives because it does not contribute to these emissions.

Over the past three years, Point Lepreau has instituted performance improvement initiatives to achieve more consistent, predictable operations. Since 1996, the station has achieved capacity factors of 72% (1999/00), 84% (1998/99) and 66% (1997/98).

New Energy Conservation Initiatives from Manitoba Hydro

Manitoba Hydro is introducing a series of new energy conservation initiatives under its Power Smart® Program to help alleviate the impact of rising natural gas costs, Greg Selinger, minister responsible for Manitoba Hydro, and Bob Brennan, president and CEO of Manitoba Hydro, announced today.

"It has been 10 years since Manitobans have had access to a comprehensive loan and energy audit program that will help homeowners make the improvements needed to reduce the amount of energy they consume," Selinger said. "I would like to congratulate Manitoba Hydro on its efforts to help Manitobans address the rising cost of home heating."

The initiatives—which include assisting homeowners conduct home audits and providing low-interest financing for those interested in retrofitting their homes—are designed to provide residential and commercial customers with the information, expertise, and financial support needed to reduce their energy costs through conservation.

"Through our Power Smart Program, we've proven time and time again that conservation is a powerful tool for lowering energy costs. Now, we're proud to use this program to offer Manitobans some exciting new ways to reduce their energy consumption and consequently, their energy bills", said Bob Brennan, President and CEO of Manitoba Hydro.

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- Phase and Ground Fault Protection
- AC Induction Motor Protection
- Motor TCC Curves
- Thermal Overload Protection

AND MORE!!

NEWS

Continued from page 38

Brennan added that he expects one of the most popular of the new initiatives will be a convenient, low-interest financing program for residential customers. Under this initiative, customers will be eligible to receive a $5,000 loan toward renovation projects undertaken to increase the energy efficiency of their homes. These loans will be provided at an interest rate of 8.5% and will be repayable on their Hydro bill over a five year term. Loans will be available to homeowners wanting to perform their own renovations and those who wish to hire a contractor to complete their retrofitting projects.

Another initiative which is certain to prove popular offers an array of three home energy audit options. Customers wishing to perform their own audits will be provided with a free energy checklist to help them determine what measures they can take to improve their home's energy efficiency.

Customers wanting to undertake a more detailed audit can take advantage of a low-cost, on-line audit. Through the on-line audit, household data obtained from customers will be reviewed by Manitoba Hydro energy efficiency experts who will, in turn, provide a report outlining recommendations for retrofitting, along with the costs and savings related to those recommendations.

Finally, customers who would prefer a detailed and personalized home energy report will be able to arrange for an in-home audit to be conducted by Manitoba Hydro specialists at a nominal $100 fee. After conducting a comprehensive audit, these specialists will provide a detailed retrofit plan designed specifically for the customer's home.

Another initiative to be introduced especially with the homeowner and residential contractors in mind is an information line which will handle requests for energy efficiency resource materials, provide simple energy tips and allow customers with specific or complicated questions to access energy experts. Energy efficiency resource materials to be made available include comprehensive booklets on a variety of energy saving topics and specialized topic expert sheets. The number to call is 1-888-MBHYDRO.

Commercial customers too, will benefit from these new initiatives, through Manitoba Hydro's Power Smart Energy Manager Program. Under this program, dedicated Energy Managers will provide commercial customers with innovative solutions for integrating continuous energy efficiency improvements in their businesses, to reduce their energy consumption and to maximize the use of their energy dollars.

Hydropower Can Play a Key Role in Meeting Commitment to Reduce Greenhouse Gases

Hydropower can play a key role in helping Canada meet its international commitments in reducing the greenhouse gases that contribute to global warming, according to the Canadian Hydropower Association.

Greenhouse gas (GHG) emissions, which contribute to air pollution, urban smog, and acid rain, are also seen as the cause of global warming. The burning of fossil fuels such as gas, coal and petrol is the main source of GHG emissions around the world, and three sectors — transportation, industry and electricity-generation — produce most of these GHGs. For example, the burning of fossil fuels to produce electricity is responsible for 17% of GHG emissions in Canada and approximately 40% in the United States.

At an international conference in Kyoto, Japan, in 1997, Canada committed to reducing GHG emissions by 6% below 1990 levels by the years 2008-2012, while the United States agreed to reduce their emissions by 7%. However, emissions have continued to increase significantly since 1990; hence, Canada and the United States must significantly increase their reductions if they are to meet the Kyoto objectives.

Given the heavy use of electricity in our society, decreasing our dependence on carbon-intensive fossil fuels for our energy supply is essential to reducing GHG emissions. This could be done, for example, by replacing fossil-fuel generated electricity with clean, renewable sources of energy such as solar, wind, and hydropower. Renewable technologies like solar and wind power are still relatively expensive, cannot provide large amounts of electricity, and, because they are intermittent sources, are dependent on other energy sources. Hydropower, on the other hand, is competitively priced and can meet increasing electricity demand. Moreover, hydropower produces very few GHGs, 60% less than coal-fired power plants and 18% less than natural gas power plants.

Exporting hydropower to the United States also reduces GHG emissions by displacing electricity that would have been generated using fossil fuels. Hydro-Quebec, Manitoba Hydro and BC Hydro, three of the largest producers of hydropower in Canada, have contributed to reducing GHG emissions in the U.S. by hundreds of millions of tons over the past 20 years.

Hydropower is presently the only renewable source of energy that can replace fossil-fuel electricity production while satisfying growing energy needs. Hydropower production can be increased either by reconditioning existing facilities or by developing new sites. Canada offers many opportunities for new hydropower projects that could be developed with respect for the environment and within a context of sustainable development. And while it may take several years to construct large projects such as Ste-Marguerite-3 in Quebec or Churchill Falls in Labrador, run-of-river projects can be developed fairly rapidly.

By replacing forms of energy that cause high levels of GHG emissions, hydropower can contribute to the reduction of air pollution, smog, acid rain, and global warming. The continued and increased use of hydropower can help us meet the Kyoto objectives.

Founded in 1998, the Canadian Hydropower Association (CHA) is the national association dedicated to representing the interests of the hydropower industry. Its principal mandate is to promote hydropower nationally and internationally as a source of renewable and sustainable energy, to make the economic and environmental advantages of hydropower better known and to publicize the benefits of hydropower.

Ontario Power Generation Posts Strong Results

Ontario Power Generation Inc. (OPG) announced its financial and operating results for the year ended December 31, 2000. Earnings for the 12 months ended December 31, 2000 increased 36 per cent to $605 million or $2.36 earnings per share, as compared with 1999 pro forma earnings of $446 million or $1.74 earnings per share. The increase in earnings was primarily driven by cost reductions and a two per cent increase in sales volume.

"Our results indicate that we are on the right track and will permit us to pursue our strategy to improve generation and environmental performance and ensure market readiness," said President and CEO, Ron Osborne.

OPG is a major North American electricity generating company with a total available generating capacity of approximately 25,800 megawatts (MW), consisting of 7,300 MW of hydro-

electric capacity, 9,700 MW of fossil-fueled capacity and 8,800 MW of nuclear capacity, plus a further 5,100 MW of nuclear capacity that is currently laid-up.

OPG's nuclear stations made significant performance gains over the past three years towards achieving the Company's long-term goal of top quartile nuclear performance. Nuclear energy accounts for almost half of OPG's electricity production. OPG's competitive position will be further strengthened by the planned return to service of the four unit, 2,060 MW, Pickering A nuclear station. Subject to regulatory approvals, these units will be returned to service at approximately six-month intervals beginning in early 2002. The performance of its fossil and hydroelectric fleet, along with its nuclear stations, enabled OPG to reliably meet Ontario's electricity demand and contributed to the Company's improved financial results.

OPG has been mandated to reduce its control of the generating capacity available to the Province of Ontario to no more than 35 per cent within 10 years of open market access. "While this requirement effectively limits OPG's Ontario market share in terms of generating capacity, it does allow for OPG to grow its business through energy trading arrangements and selective growth opportunities. OPG expects to meet these decontrol requirements through asset sales, long-term leases, asset or energy swaps, or other arrangements, well in advance of the established deadlines," said Osborne.

In July 2000, OPG entered into an agreement to lease its Bruce A and Bruce B generating stations to Bruce Power L.P., an entity controlled by British Energy plc. The operating lease will have an initial term of approximately 18 years and will include options for Bruce Power to extend the lease for up to another 25 years. The completion of the transaction, which is expected to take place in mid-2001, is subject to usual closing conditions, including the necessary licences from the Canadian Nuclear Safety Commission.

In early 2000, OPG announced its intent to decontrol its 2,140 MW oil/natural gas-fueled Lennox generating station and its 1,140 MW coal-fired Lakeview generating station. At the provincial government's request, decontrol of these plants is on hold pending a review of environmental regulations on fossil-fueled electricity generation.

OPG is committed to environmental leadership. At present, almost 75 per cent of the Company's generation portfolio has virtually no smog-producing emissions. In 2000, OPG's performance improved over 1999 in its six key corporate environmental areas. OPG has completed and is maintaining ISO 14001 certification for the environmental management systems at all generating stations. To improve air quality, OPG made significant investments in clean-air technologies, participated in emissions-reduction credit trading and announced an expansion of its green energy portfolio to approximately 500 MW from the current 115 MW.

During 2000, OPG made significant progress in building a high-performance, customer-focused and commercially oriented culture through the expansion of a groundbreaking Partnership Agreement with its unions and the introduction of a GoalSharing incentive program that has contributed to improvements in employee safety performance.

The company attained investment grade (A) debt ratings from Canadian rating agencies and successfully launched a $600 million commercial paper program during 2000. OPG also partnered with major third-party providers to more effectively leverage its research and development and information technology resources. These partnerships will enable OPG to better concentrate on its core operations and market readiness activities and will provide employees with growth opportunities in a new competitive market.

As part of the restructuring of Ontario Hydro and the related restructuring of Ontario's electricity industry, OPG purchased the generation business of Ontario Hydro on April 1, 1999 and commenced operations on that date.

ENMAX Energy Provides Energy Saving Tips to Customers

ENMAX Corporation announced today that tips on ways to save energy will be delivered to residential customers of ENMAX Energy Corporation, ENMAX's wholly owned unregulated retail service provider.

Starting immediately, all ENMAX Energy residential customers across Alberta will receive a brochure in their mailbox that outlines 20 energy management tips, identifies what the average appliance costs to operate and includes a contest for residential customers to receive a $500 credit on their electricity bill.

The contest is open to all current ENMAX Energy residential customers in Calgary, Red Deer, Lethbridge, Crowsnest Pass, Cardston and Fort Macleod. Four winners will be chosen and each will receive a $500 credit against their electricity bill.

"We know customers are concerned about electricity prices and that's why we continue to add to our energy conservation campaign, said Sean Durfy, ENMAX Energy vice-president and chief operating officer.

ENMAX Energy launched its conservation campaign in October 2000. Through newspaper ads and information on the ENMAX website, the campaign showed what typical appliances cost to operate, outlined ways customers can reduce consumption and identified tools customers can use to cut costs.

One of the most popular tools has been the interactive "cost calculator" available on the ENMAX website at enmax.com. It allows customers to estimate the amount of time they use a particular appliance and the cost calculator will show approximately how many kilowatts the appliance uses and what it costs to operate. Knowing what appliances cost to operate is the first step in reducing costs.

ENMAX Corporation is a wholly owned subsidiary of The City of Calgary. Through its subsidiaries, ENMAX provides electricity and value-added services to more than 400,000 residential and commercial customers throughout Alberta. Primary markets are Calgary, Red Deer, Lethbridge, Cardston, Crowsnest Pass and Fort Macleod.

BC Hydro Issues Request for Proposals for 5.5 million Tonnes of Greenhouse Gas Offsets

BC Hydro has issued a formal request for proposals for 5.5 million

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NEWS, Continued from page 41

tonnes of greenhouse gas offsets in order to identify quality greenhouse gas mitigation projects that can help BC Hydro meet its aggressive greenhouse gas offsets commitment. The request for proposals can be viewed at BC Hydro's web site at www.bchydro.com/environment

"BC Hydro is serious about managing its environmental impact," said BC Hydro's senior environmental coordinator of greenhouse gas management, John Duffy. "With this request for proposals, we're publicly stating that we are open to all options when it comes to reducing greenhouse gas emissions."

The request for proposals supports BC Hydro's plan to offset 50 per cent of the increase in greenhouse gas emissions from two new natural gas-fired electricity generation plants planned for Port Alberni and Campbell River on Vancouver Island, through to 2010.

A greenhouse gas offset is a reduction in emissions at one location that compensates for emissions at another location. BC Hydro invested in a greenhouse gas offset project in Surrey, B.C. in March 2000 where, in cooperation with Delta-based Norseman Engineering Limited, BC Hydro is buying up to 33,400 tonnes GHG emission reductions over the next 14 years. Norseman engineering collects and refines methane gas from the Port Mann landfill in Surrey and delivers it to the Georgia Pacific wallboard plant in Surrey, where it is blended with natural gas and used to fuel its boilers.

Duffy added, "By investing in greenhouse gas offsets, BC Hydro will reduce its net impact on climate change, while continuing to provide British Columbians with low-cost, reliable electricity. We recognize the important role we can play in voluntarily taking action to reduce GHG emissions through our aggressive offsets plan."

BC Hydro Begins Phase Two of the Creekside Capacitor Station Life Extension Project

BC Hydro is resuming work on its Creekside Capacitor Station life extension project February 19, 2001. The work will mark the beginning of the second and final phase of the upgrade and is expected to wrap up in August, 2001.

The upgrade of the capacitor station, located north of Mount Currie on Portage Road, is designed to increase electricity reliability. The $12.8 million project will improve operational communication links, extend the service life of the station and eliminate the use of equipment containing polychlorinated biphenyls (PCBs) and stored PCB waste material. The first phase of this project is now complete. New microwave radio equipment at Creekside and Black Tusk and a new mountaintop passive reflector station have been installed to improve communications. As part of this work, the station yard was expanded within the boundaries of the existing BC Hydro property to incorporate additions to the communications and control building.

Phase two will include new capacitors and control equipment installed to extend the service life of the station for another 20 years. All PCB-contaminated equipment and waste will be removed from the station and disposed of at a licenced facility.

PCB removal will take place from February 26 to early March. All PCB materials will be transported off the site using reliable, licenced transportation services. They will be taken to a waste management facility in Swan Hills, Alberta where they will be destroyed using safe, environmentally sound techniques. ET

Electricity Today Literature Review

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Products and Services Catalog
Eaton's Cutler-Hammer Products and Services Catalog 2001 provides product descriptions, detailed specification and pricing. You can also learn about the broad spectrum of solutions offered from Cutler-Hammer Engineering Services and Systems (C-H ESS). These catalogs are easy to use and are the most complete industrial resources currently available. Call 1-800-957-7050 to order yours today!

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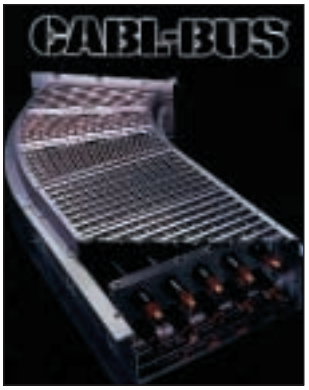

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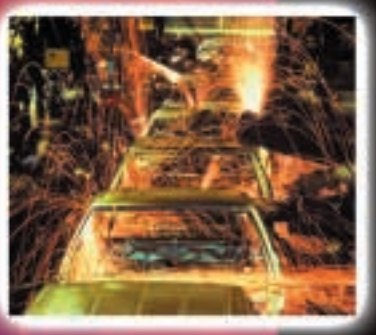

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