KETCHIKAN PUBLIC UTILITIES FINDS SOLUTIONS TO OUTDATED, PROPRIETARY RTUS

OVERCOMING PROPRIETARY SCADA PROTOCOL IS KEY

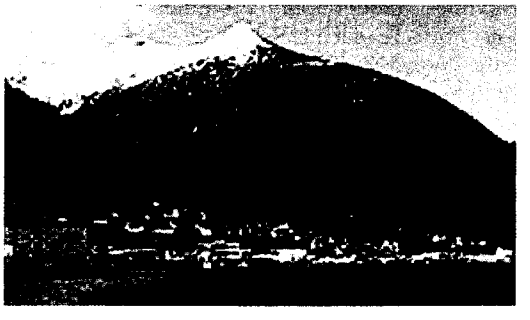
By Harvey Hansen, P.Eng. and John, McDonald, P.Eng.

In the 1990s, Ketchikan Public Utilities (KPU) of Alaska found itself in a position that many utilities dread. Wismer-Becker, the vendor that had sold KPU a SCADA master station and RTUs in 1983, had gone out of business and left no support for its products. Making matters worse, the system operated using a data communications protocol that was proprietary to the defunct vendor.

Maintaining the aging system was difficult enough, but the problem exacerbated in 1999 when KPU decided to expand the data collection capacity in its substations by replacing RTUs with Modicon programmable logic controllers (PLCs) from NovaTech. The decision to use PLC technology was a good one because these devices can handle analog and status inputs and control outputs, and provide a platform for possible future substation automation. PLCs are far superior to RTUs at supporting ladder logic automation applications.

The challenge, however, was that Wismer-Becker had installed the RTUs, which communicated with the SCADA system using Wismer-Becker's proprietary protocol. The PLCs would have to do the same. Fortunately, KPU contracted NovaTech LLC of Kansas City, Kansas, an experienced integrator of substation automation components. NovaTech agreed to decipher the Wismer-Becker protocol and program the NovaTech Orion communication processor box, designed specifically for IED integration and substation automation, to emulate the SCADA protocol. In this configuration, the Orion became a slave unit responding to commands from the SCADA master station, and a master station to the PLCs to send commands or retrieve data from them and transmit the data back to the SCADA system.

The PLC replacement strategy proved effective, but costly, due primarily to the continued use of a large amount of hardwired input/output points and little use of intelligent electronic devices (IEDs) to gather much of the same information via digital communications. Due to budget restraints, KPU implemented the new devices at six of thirteen substations over the next five years. In the midst of this program, however, the utility decided it was time to replace the SCADA master station.



Ketchikan is located in far southeastern Alaska about 200 miles south of Juneau and 650 miles north of Seattle. The town is located on a small island that is home to 8,000 people, most of whom have electric service provided by KPU. The utility generates power from one oil-fired diesel unit and five hydroelectric plants. Thirteen substations are spread throughout the service territory. Some of these plants and substations are located as far as 20 miles from the town. The distances belie the importance of automated technology for remote collection of data and control of equipment. Automation and reliable communication are a necessity because some of these facilities, though only 20 miles away, take hours to reach by truck. One of them is only approachable by floatplane. Its crews live on site with their families and fly to Ketchikan every week for groceries.

"The old SCADA was getting too difficult to maintain and support, and it had no data points left, so there was a limit to the data we could acquire," said Jay Hansen, KPU Electric Division Manager. "KPU expects to expand in the future, and we needed to upgrade our capabilities."

Without a particular product in

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mind, KPU took a studious approach to its SCADA system search and began scouring the industry literature on SCADA and substation automation technology. KPU sent personnel to the 2003 DistribuTECH Conference in Las Vegas to get a first-hand look at new SCADA and substation automation products and to inquire about emerging technology that might reduce the cost of the RTU replacement program. In terms of finding answers to their questions, KPU hit the jackpot in Vegas.

POWER IN A REMOTE LOCATION

Ketchikan is located in far southeastern Alaska about 200 miles south of Juneau and 650 miles north of Seattle. The town is located on a small island that is home to 8,000 people, most of whom have electric service provided by KPU. The utility generates power from one oil-fired diesel unit and five hydroelectric plants. Thirteen substations are spread throughout the service territory. Some of these plants and substations are located as far as 20 miles from the town.

The distances belie the importance of automated technology for remote collection of data and control of equipment. Automation and reliable communication are a necessity because some of these facilities, though only 20 miles away, take hours to reach by truck. One of them - the Swan Lake Plant - is only approachable by floatplane. Its crews live on site with their families and fly to Ketchikan every week for groceries.

"We spent $350,000 last year to upgrade our microwave system to ensure that our SCADA system can talk to the substations and plants," said Jay Hansen.

KPU's average load is 22 megawatts during the summer and 27 megawatts in winter. Total generation capacity is 57 megawatts with a historical peak of 29 megawatts. The potential expansion project referred to by Jay Hansen could involve connecting Ketchikan with another power grid system operating to the north. This line, known as the Swan Lake -Tyee Interconnect, would connect Ketchikan to the Tyee Project, which provides power to the Alaskan towns of Wrangell and Petersburg.

Most years, Ketchikan's hydro projects don't have enough water to supply all of the electric needs of the community. In addition to providing this 15 gigawatt hour shortfall, the interconnect could bring energy to KPU, which could be sold to the cruise ships that dock in Ketchikan. As many as seven ships per day make port calls at Ketchikan in summer months, nearly doubling the town's population. Currently, the town has no capacity to provide the ships with electric power while in port, which means they must keep their diesel engines running. Supplying the ships with land power would not only be lucrative for KPU, but it would reduce local pollution from the massive engines.

If KPU connects to the Swan Lake network, the entire grid would most efficiently be operated from a central location. With some automation already in place, Ketchikan could be a likely choice for the control center site, but KPU realized its outdated SCADA system did not even have the capacity to adequately meet the data demands of KPU's existing power grid. Expansion would have been out of the question without a new or upgraded SCADA system.

INSTALLING IEDS

At DistribuTECH, KPU's engineering manager and senior SCADA technician attended workshops and seminars and talked to exhibitors, gaining a complete overview of options for both the SCADA master station replacement purchase and PLC installation to replace existing RTUs. Also at the show, KPU met and hired KEMA Inc., a Burlington, Mass.-based consulting firm that specializes in utility automation projects.

"It's pretty easy to get tunnel vision when approaching a project like this, and we felt that having a consultant would help us maintain a global perspective of what [technology] was available," said Jay Hansen. "Hiring a consultant who was not selling any products gave us confidence that we would get the best solution."

KEMA made a site visit to Ketchikan in 2003 and toured each facility with KPU SCADA technicians to analyze existing equipment and determine the most effective configuration for the replacement master station. During this review, the participants also considered viable options for cutting PLC installation costs. After conferring with NovaTech, the project participants quickly devised a workable scheme that had not been available five years before when the RTU replacement began.

In a substation, an RTU is installed to provide control outputs and acquire data from multiple points including analog, digital and accumulator inputs. In the past, before digital communication became common in substations, the RTUs were hardwired to these data points. In more recent automation projects, many hardwired inputs are replaced by points acquired digitally from IEDs. These microprocessor-based IEDs can collect data from hundreds of input points and transmit them digitally to a data concentrator in the substation, replacing the conventional RTU.

Unfortunately, IEDs were not commonly used when the original SCADA vendor installed the RTUs in the KPU facilities. When the time came to upgrade the RTUs with PLCs, the existing hardwired points were wired into the new PLCs with no use of new IEDs, making for a one-to-one RTU/PLC replacement. This installation was more than twice as expensive as it would have been if IEDs were already in place or were implemented with the new PLCs.

KPU, KEMA and NovaTech personnel spent a week reviewing every data point in the power plants and the seven substations that had not been upgraded. The goal was to identify existing hardwired points where IEDs could be used instead. Many were found in the generation protection equipment of the power plants and in the over-current protective devices in the substations. At a cost of $5,000 each, the IED was a very attractive alternative to $150,000 PLCs with a large number of analog and status input modules. Many PLC input modules could be replaced by a small number of IEDs at a much lower cost and with more effective data processing capabilities.

NovaTech then re-engineered its PLC replacement plans to include minimization of hardwired points and maximization of IED implementation. It used this procedure in automating the seventh KPU substation in 2003.

DEALING WITH PROTOCOLS

While the PLC/IED situation was being resolved, the consultant was writing specifications for the new SCADA master station. This contract was ultimately awarded to Open Systems International, Inc. (OSI) of Minneapolis, but not until after a technical challenge stemming from the proprietary Wismer-Becker protocol at the existing Wismer-

Becker RTUs could be overcome.

In considering a new SCADA master station, KPU wanted nothing to do with proprietary equipment and was adamant that the new master station utilize the popular DNP3 communications protocol, a de facto industry standard. The problem was that the NovaTech Orion communications processors in seven substations had already been modified, at significant expense, to emulate the proprietary Wismer-Becker SCADA protocol.

Discussions with NovaTech revealed the Orion boxes could be converted relatively easily back to the DNP3 protocol for which they were originally designed. But the next problem was the Wismer-Becker RTUs in the remaining six substations. KPU's budget still dictated that upgrading or automating these facilities would occur over a period of years, so the question of how to allow the new SCADA master station to communicate with them utilizing the DNP3 protocol in the meantime remained a hurdle.

NovaTech devised a plan to decipher the master version of the old protocol and build a converter into its Orion communication processor that would allow it to receive DNP3 commands from the new SCADA master station and convert them to the unique protocol required by the RTUs. The converter would also work in reverse to send responses and data back to the SCADA master station. These customized boxes will be installed at each of the six substations during implementation of the OSI master station. The beauty of this solution is that the communications processors can be kept and switched back to the DNP3 protocol when KPU's budget can support replacing the RTUs in the future.

Completion of the OSI SCADA master station installation and six Orion implementations will start in March 2004 and should be completed by the end of the year.

READY FOR EXPANSION

KPU made the right decision in investing resources to carefully examine all of the technical options now available regarding substation automation and replacing conventional RTUs. The utility estimates that it will reduce the cost of RTU replacements by 70 percent thanks to the IED program, and that does not include anticipated operational savings.

"The change in technology is remarkable," said Terry Rose, the senior SCADA technician. "We are replacing a SCADA system that cost $1.5 million 20 years ago with one that costs $500,000 today and gaining much more capability at the same time."

The tangible benefits of the new technologies are expected to play out for years to come in terms of greater enterprise efficiency and the capability to meet the needs of possible expansion projects.

"The biggest single benefit is the long-term survivability of this SCADA system because of the open architecture we chose. It is expandable beyond anything we could ever need," said Rose. "The volume and speed with which data will become available to us will make our decision-making processes better and more effective than ever before."

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