Potlatch's Hybrid Poplar Project Application Paper

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The world's largest contiguous automated drip irrigation tree farm is located in the high desert of eastern Oregon and is controlled by one of the most advanced SCADA systems in the agriculture industry. Potlatch Corporation's Hybrid Poplar Project grows "super desert trees" for solid wood and wood chips outside Boardman, Oregon. More than 117 remote irrigation manifolds are controlled through a Supervisory Control and Data Acquisition (SCADA) system reporting to a single Control Room on the farm. This automated irrigation system allows the 17,000-acre tree farm to operate 24 hours a day, 7 days a week with a staff of less than 18.

Figure 1: Boardman Poplar Project

Figure 2: Two Generations of Trees

Founded in 1903 at Potlatch, Idaho, Potlatch Corporation is a diversified forest products company manufacturing lumber and panels, bleached pulp, paperboard and consumer tissue. Potlatch owns approximately 1.5 million acres of timberland in three states: Idaho, Arkansas and Minnesota. This land now provides about half of the company's total fiber requirements. This level of self-sufficiency is unique in the forest products industry and provides a distinct advantage for Potlatch. Best of all, self-sufficiency will improve the benefits of modern forest management practices reflected in increased growth.

As part of the its self-sufficient forest management project, Potlatch operates a 17,000 acre Hybrid Poplar Project near Boardman, Oregon. Since 1992, Potlatch has been growing hybrid poplar trees in northeastern Oregon to supplement regional fiber needs in the future. These fast-growing hybrids, also known as cottonwoods, grow 10 - 12 feet in a single growing season and Potlatch expects to harvest them after 11-13 growing seasons. Hybrid poplars produce short, lighter-colored fiber that has potential applications in many wood and paper products. Potlatch is continuing to research appropriate value-added uses for hybrid poplars and is currently planning to market the hardwood lumber for nonstructural uses such as furniture framing. Although unsuited for many structural lumber products, hybrid poplars may also be used in engineered wood products. Potlatch's 17,000-acre hybrid poplar plantation is managed as an agricultural crop. At the heart of this project is a computerized and automated drip irrigation system feeding

Figure 3: Remote Manifold Site

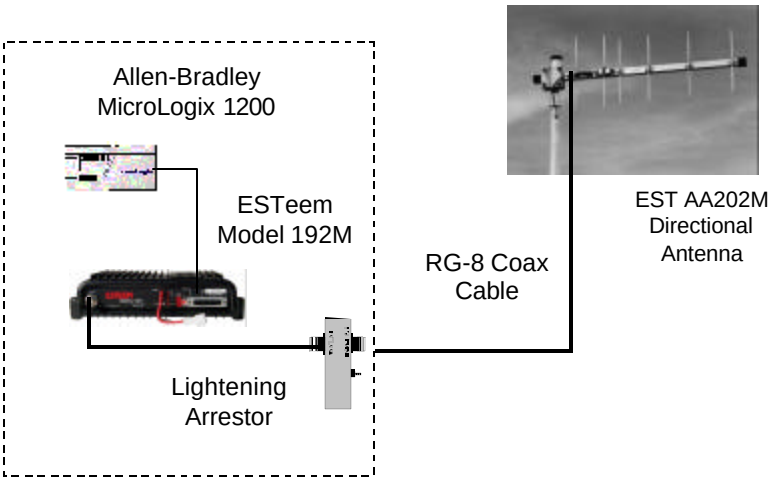

Figure 4: Remote Manifold Diagram

each tree individually according to its needs, conserving water and nutrients and reducing pumping times to reduce electricity costs. The control of this irrigation system is provided by an advanced SCADA system consisting of 117 remote terminal units (RTU) (Figure 3) reporting to either a Primary or Backup Master PLC in the Control Room. This Master PLC, an Allen-Bradley PLC 5/80E, controls the data collection polling to the remote locations and also stores the data for use in the Human-Machine Interface (HMI) computer. The HMI computer provides the operations and maintenance personnel a single point of access to the 62 pumps, 370 irrigation blocks (40-70 areas each), 105 flow meters, 315 pressure transducers, 940 automatic valves, 100 fertilizer pumps, 70 primary and secondary screen filters and 47 irrigation center pivots.

All remote irrigation manifolds, manifold clusters and pivot sites are controlled by a local Allen-Bradley SLC 5/03 or Allen-Bradley MicroLogix 1200 processor (Figure 4). This processor can make autonomous decisions for the manifold to open or close based upon flow rates or other I/O input, but can also be overridden by SCADA computer by personnel at the control room. The RTU reports the local status, flow rates and I/O status tables to the Master PLC in the control room on the each communication poll.

The Control Room's Master PLC collects the data from the remote locations and provides data to the HMI computer system. The data is collected through the DF1 serial communication port (Channel 0) on the processor and reports to the HMI computer through its Ethernet connection (Figure 5). The Master PLC will send any changes to a remote RTU, either manually input into the HMI computer system or from changes to the overall watering schedules based upon the crop's maturity and seasonal changes. The HMI computer software is Rockwell Software's RSView and RSSQL software packages. The HMI screens programmed for this project provide the operators and maintenance personnel a single point of information for the entire system. By selecting a single manifold in the system, all information and functions that are controlled by the local RTU are available for change.

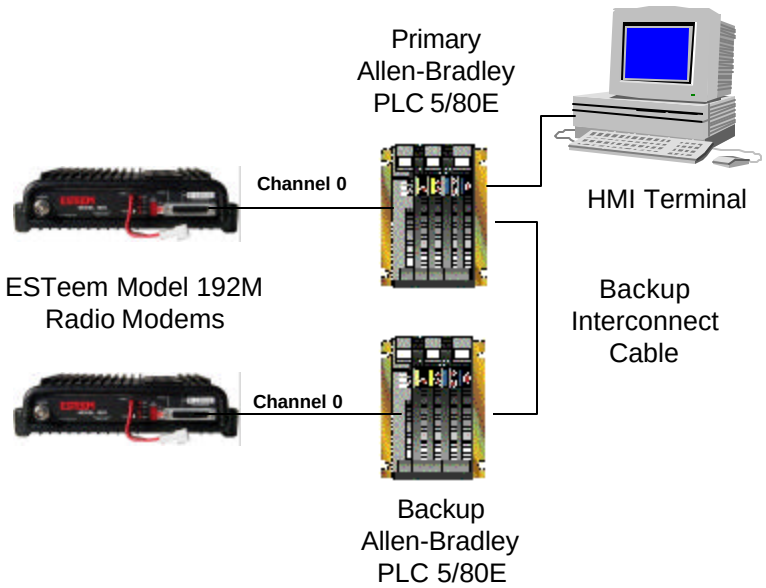

Figure 5: Remote Manifold Diagram

As with any SCADA network, reliable communication is the key. When the SCADA system was first designed in 1993, the consideration of a wired

Figure 6: Control Room

communication network was quickly abandoned because of the vast area covered by the system and the constant digging in an agricultural environment. It was determined in a preliminary radio analysis that the most reliable communication in this environment would be a wireless network operating in the mid-band VHF (150-174 MHz) frequency band. A licensed radio frequency in mid-band VHF would provide exclusive use for that frequency in the area and excellent radio propagation over the large distance of the tree farm. The first wireless system installed communicated directly from the Control Room to each one of the remote RTUs. This type of network provided communication for 10 years, but as the trees have matured and been harvested, there are now several generations of trees on the farm ranging from 2 feet to 70 feet in height. As trees began to grow above the height of the antennas, the signal strength was reduced to the further remote sites and they began to loose communication. This problem continued to get worse until 2001 when over 60% of the farm had lost communication.

Electronic Systems Technology, Inc. was hired to evaluate the existing RF network and make recommendation on its improvement. An on-site radio analysis of the existing radio network was conducted and found that reliable communication could only be established by raising the antenna from 20 feet to over 100 feet at the remote sites. Another option would be to install repeater sites throughout the farm to allow for the higher than originally planned tree height. The installed radio modems did not support multiple repeater sites and raising the remote site antennas to 100 feet was cost prohibitive. The solution proposed was to change the existing radio modems to a more modern radio system that allowed any remote site to act as a repeater while concurrently providing communication to a remote RTU. This type of radio modem would solve the current communication problem and also provide the flexibility for any future expansion.

The ESTeem Model 192M (150-174 MHz radio modem) was selected as a replacement for the current radio system. The ESTeem products are part of Rockwell Automation's Encompass program as a referenced third part solution and provide direct access to both the Master PLC and all remote RTUs. The ESTeem wireless modem has an integral Allen-Bradley DF1 driver that allows any remote site in the network to function as a repeater for any other site. The on-site analysis was continued with the ESTeem Model 192M radio modem and found that using three remote sites as repeaters provided reliable communication to the whole system without changing any of the installed remote hardware (antennas, coax cable, lightning arrestors or power supplies).

The ESTeem Model 192M proved to be an excellent choice for the system upgrade. The modems were a "drop-in" replacement for the older radio system and with minimal changes to the existing code at remote RTU. The code in the Master PLC and HMI computer system was changed to utilize the higher RF data rate (19,200 bps) and faster response times. The model 192M also provides flexibility to the system by allowing future additions or changes to the radio network through simple software commands. The reliability of the entire SCADA network went from 40% to 100% as soon as the hardware was installed and programmed.

The use of an advanced SCADA network in typically "low-tech" agricultural system showed a level of commitment to modernizing forest management where Potlatch excels. The change to ESTeem wireless modems was a further commitment to the modernization project that allowed improved system performance while planning for the future. The Hybrid Poplar Program is an excellent example of how forward thinking companies can improve their product base and better use the existing natural resources.