*The ultimate build-out of the new Cloud View substation contains a 230-kV H-bus rated for 3000 A; three sets of transformers, each including a 230-kV live-tank breaker; a 41-MVA 230 x 115/13.8-kV transformer; and a six-bay distribution structure.*

SUBSTATIONS

# The Need for Speed Drives Progressive Design-Build

*When extraordinary load growth demanded a faster way to build, Grant County PUD found one.*

Russ Seiler , Mark Milacek | Dec 14, 2017

Pushed by a decade of extraordinary industrial load growth, Grant County Public Utility District (PUD) was facing a five-year backlog of needed substation upgrades, including two brand-new substations, expansion of two existing substations and ground-up rebuilds of three more — all within a tight 24-month time frame. The traditional design-bid-build procurement process for public utilities would have added at least two years to the ambitious schedule. Big customers were impatiently awaiting more capacity. System upgrades were critical to handle the anticipated growth and to ensure reliability of service.

That pent-up need for speed was a product of both timing and circumstance for this rural PUD with a 2800-sq mile (7250-sq km) service area that includes small cities, expanses of irrigated farmland, homes, businesses and industry in the high-desert country of central Washington, U.S. Grant County PUD generates its own power from two federally licensed Columbia River dams and delivers power to 49,000 electric meters connected by more than 4000 miles (6437 km) of transmission and distribution lines.

## Major Load Growth

A decade ago, some of the biggest names in the internet discovered that Grant County had the perfect mix of cheap land and electricity, low seismic activity and an ideal climate to site their sprawling, energy-intense data centers — super-wired warehouses filled with thousands of high-capacity computers. Data centers are the earthbound technology that floats the intangible data cloud. They process the massive amount of data flowing over the internet every day, all year, nonstop. Microsoft, Yahoo!, Intuit and others decided to relocate to Grant County, and the energy demand soared.

Over the 10-year period ending in 2015, Grant PUD's load grew 63.5% to average 590 MW. An average annual growth of 5.04% was more than 19 times the national average of 0.26% during the same period, according to historical data from Grant PUD and the U.S. Department of Energy. PUD forecasters are predicting similar levels of load growth for at least the next five years.

Data centers today account for about 20% of the county's total load. That is up from virtually zero in 2005. Other big industrial customers include vegetable processing plants, agricultural irrigators and new manufacturing, also drawn to Grant County for its land and power benefits.

The Central Ephrata substation was added to the design-build roster after an arc-flash fire destroyed the substation in February 2017. Work was complete by late October 2017.

## A New Option

Grant PUD's US$40 million in pent-up substation work could not wait, but the upgrade project could not sacrifice quality, consistency or worker safety. The utility found its solution when it became the first PUD in Washington to take advantage of a 2013 state law that gave public entities a progressive design-build procurement option — one that has proven both flexible and efficient, producing work virtually on time with outstanding quality and an excellent record of safety.

PUD engineers learned of the option when attending a seminar in 2015 on the benefits of alternative public works procurement methods available in Washington state. Like its more widely known design-build predecessor, progressive design-build enables project owners to hire a project designer and contractor under a single contract with a guaranteed maximum price for multiple construction projects. The progressive version goes further by allowing project owners to choose their

contractors based almost entirely on qualifications, although not without a competitive-price component.

According to Robyn Parkinson, the Mercer Island, Washington, attorney who helped draft Washington's 2013 design-build legislation, the process gets the three key players — project owner, designer and builder — together early in the process to develop a scope of work; refine designs, materials and time frames; and, together, determine a maximum project cost. The project's ultimate success depends on the ability of these three key players to work together, Parkinson said.

Kenneth Hamelin, foreman for Wilson Construction, in the midst of a 12-day project to wire the marshalling cabinet at Quincy's Cloud View substation.

## Getting It Done

The progressive design-build alternative sounded perfect for Grant PUD's substation projects. Coworkers and management liked what they heard, and they started

putting together the required owner's project-management team, made up of both Grant PUD staff and hired consultants, including Parkinson, Vanir Construction Management Inc. and POWER Engineers of Hailey, Idaho, U.S. These consultants were skilled in the design-build process.

The team created the initial scope of work and applied to the state project review committee to see if the Grant PUD substations project would qualify for the progressive design-build option. The consultants' contribution was valuable at this stage. The state board needed to see that the PUD had enough experience on its team to ensure a successful project and preserve the reputation of the design-build alternative. The project qualified.

Throughout the scoping and approval process, the team kept the PUD's elected board of commissioners informed of the progressive design-build process and its advantages. PUD board members agreed in October 2015 to hire the design firm of HDR Engineering Inc. and builder Wilson Construction Co. under a single contract with a maximum cost of $24 million. Both of these companies had a good deal of prior experience doing design-build substation and transmission work.

HDR's Deputy Project Manager Jake Van Houten described the interaction with Grant PUD as "free-flowing and continuous to be sure everyone is on the same page about expected outcomes and delivery dates." HDR and Wilson led the project under a single team that included the same project managers, procurement managers, controllers, design manager and construction managers for all seven substation projects. Notable subcontractors on this project were Tommer Construction Co. , Specialty Engineering and KVA Electric .

Work began on the first of the seven substations in June 2016. As work progressed, the PUD team, together with HDR and Wilson, got to work on the design and logistics of the next substation. The team gained efficiencies with each stage of construction as they learned lessons from the last.

"It was a real go for a few months; a real scramble," said Patrick Smith, site superintendent for Wilson. "Of all the design-build projects, this is the largest number of sites I've worked on that are contained within one project. It brought challenges of complexity and speed."


Early construction at Cloud View substation shows the crew at work. One of the data centers driving the need for system expansion can be seen in the background.

## Significant Dates

The timeline and scope of the project looked like this:

• Oct. 22, 2016: For the Nelson Road substation in Moses Lake — Grant County's largest city, with a population of 22,080, and a center for manufacturing — the work included building a second transformer lineup with a six-bay distribution structure and adding a circuit switcher, a new 25-MVA, 115/13.8-kV transformer and five distribution breakers. It also involved adding a motor operator to a 115-kV line switch, removing an associated ground switch and upgrading the existing communications system for a new IP SCADA system, with relays to each existing breaker.

• Nov. 15, 2016: For the Babcock substation in Quincy, Washington — a farm community with a population of 7358 that has become a center for computer data center operation — the work included replacing existing transformer and switchgear with an open-air distribution structure; replacing all existing equipment with a 115-kV circuit switcher, a 41-MVA, 230 x 115/13.8-kV transformer and five distribution breakers; adding room for future transformer lineup, including below-grade work; installing a new control house and all-new relaying; and installing an oil-containment system to protect a nearby irrigation system from potential spills.

• Dec. 23, 2016: For the Peninsula substation in Moses Lake, the work included replacing existing switchgear with an open-air distribution structure and replacing a circuit switcher with a higher-rated unit.

• April 30, 2017: For the Winchester substation in Quincy, the work included replacing aging equipment to increase capacity. New equipment included a 115-kV circuit switcher and a 25-MVA, 115/13.8-kV transformer, including new and reused distribution breakers. Relays were added to existing breakers to provide communications for the IP SCADA system. A mobile substation tap, two new transmission poles for the mobile substation tap, a takeoff point for future line extension and a new control house —upgraded for relaying and communications — were all installed.

• June 15, 2017: For the Coulee City substation in Coulee City, Washington — a small agricultural community with a population of 569 — the work included removing

aging equipment as well as leveling and regrading the site. New equipment was installed, including a 115-kV circuit switcher and 41-MVA, 230 x 115/13.8-kV transformer. All of the existing breakers were replaced. A new control house was installed for upgraded relaying and communications.

• July 31, 2017: The Quincy Plains substation in Quincy was a new construction. The build-out included a 230-kV H-bus rated for 3000 A, a 230-kV live-tank breaker, a 41-MVA 230 x 115/13.8-kV transformer and an eight-bay distribution structure. The substation's foundation and conduit were built for the future addition of 230-kV transmission breakers and one additional full transformer lineup with a 230-kV live-tank breaker. The control house was designed for the ultimate build-out.

• Aug. 31, 2017: The Cloud View substation in Quincy is also new construction. The ultimate build-out includes a 230-kV H-bus rated for 3000 A; three sets of transformers, each including a 230-kV live-tank breaker; a 41-MVA 230 x 115/13.8-kV transformer; and a six-bay distribution structure. The current build-out includes a 230-kV H-bus with 230-kV transmission breakers to be installed in the future, one full transformer lineup and 230-kV live-tank breakers for the other two lineups. Two of the 230-kV breaker isolation switches have line-break ability until the 230-kV transmission breakers are installed. Two of the distribution breakers operate in parallel to provide a 2000-A circuit to an industrial client. The control house will accommodate the ultimate build-out.

The new Quincy Plains substation includes a 230-kV H-bus rated for 3000 A, a 230-kV live-tank breaker, a 41-MVA 230 x 115/13.8-kV transformer and an eight-bay distribution structure. The new Quincy Plains 230-kV tap will connect the area's new or expanded substations.

## On Schedule

In February 2017, an arc-flash fire caused extensive damage to Grant PUD's Central substation in the city of Ephrata, population 8032. PUD officials added the rebuild of the damaged substation to its ongoing progressive design-build project. This brought the total number of project substations to eight.

Work has progressed on schedule and with good results. The unseasonably cold winter of 2016-2017 caused some delays and required schedule shuffling, but the

overall project — including the additional substation — was finished by late October 2017, only three months longer than planned and with an excellent safety record.

HDR's Van Houten said his crew logged 60,000 hours on the project with zero lost-time incidents. Worksites passed multiple surprise inspections from state labor officials. "Safety was huge," Van Houten said.


Updated with new equipment that includes a 115-kV circuit switcher and 25-MVA, 115/13.8-kV transformer, with new and reused distribution breakers, the Winchester substation is now ready for future area residential, commercial and industrial growth.

## Lessons Learned

Grant PUD's internal team is conducting a series of lessons-learned exercises. Here are some of their initial findings.

With design, procurement and construction happening in parallel, design-build requires the three key participants — the project owner, designer and builder — to work closely and collaboratively. The attitude of the key players is critical. The success of the project depends on establishing a culture of trust and collaboration.

With multiple phases of the project underway at any given time, the project owner should expect to assign more than one staffer to manage the project. Work happens fast. The owner has to be very involved. It can be too much for a single project

manager or engineer to handle. Operations folks also should be included throughout the process. They bring a critical perspective. The contractor wants to give the owner what it wants. Every utility has its own stamp. The utility must work with the contractor to reach that goal.

It's important to get everyone to the table as early as possible. Spending effort and resources on a well-coordinated, organized start is a huge benefit. When the unexpected comes up in the heat of battle, it can stress relations on the team. Catch problems and address them early to bring the team closer together. Sometimes, as the saying goes, "You have to slow down to go fast."

Bundling the work really had a positive impact on quality. Builders fought through the learning curve early in the build to meet PUD expectations. By the time crews had finished the first three substations, both quality and speed improved. For example, control house wiring took 12 weeks on the first two substations. Crews cut that time in half by the third substation.

Grant PUD wanted each of the eight substations to look, feel and even smell just like every other substation in the PUD system. When crews go to troubleshoot, it is a big help to have everything be the same as much as possible.

Grant PUD also partnered with two professors from Washington State University to conduct independent research and interviews to compile a formal lessons-learned report. The effort supports the utility's drive to develop a culture of continuous learning and innovation.

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