CENTRAL PLANTS AND UTILITY INFRASTRUCTURE

CAMPUS CENTRAL PLANT PROJECTS DEMONSTRATE A/E INTEGRATION
GLHN COVERS MASTER PLANNING TO COMMISSIONING

Integration of architectural and engineering components is GLHN’s key to success in designing underground infrastructure and central plant facilities. From roadways and site development to buried pipe and construction of energy efficient plants, GLHN’s integrated, multi-discipline capabilities provide a significant advantage in project scheduling and coordination.

GLHN was Engineer of Record for the $50 million University of New Mexico Utilities Infrastructure Renewal project at the University of New Mexico, completed in 2005, that included work at two central chilled water plants, totaling 12,000 Tons of capacity. The project involved replacement of steam turbine chillers with high efficiency electric units, installation of water tube boilers with feedwater economizers, gas turbine cogeneration, and significant thermal energy storage, steam piping improvements. Campus utility costs have since seen significant improvement.

GLHN also designed an 8,000 Ton chilled water upgrade project at the University of Arkansas in 2006, following development of a Strategic Energy Management and Infrastructure Plan in 2002. The plan examined steam generation improvements, installation of an electric motor on the North Plant Chiller, and steam and gas turbine driven cogeneration options, along with various utility voltage buy up, transportation gas opportunities, and chilled water loop improvements. The Strategic Plan provided the basis for several projects, including conversion of the campus chilled water loop to a higher dT primary flow configuration, improvements to building chilled water controls, and tunnel capacity enhancements.

In 2005, GLHN assisted the University of Alaska, Fairbanks (UAF) with preparation of a Utility Development Plan that would address major infrastructure improvements to their 45-year-old coal fired steam turbine driven cogeneration system. A thorough analysis of the thermodynamic cycle efficiencies within their system allowed economic projection of the long term dollar and carbon costs of converting from very inexpensive local low sulfur coal fired cogeneration to liquid fuel heat with purchased electricity.

Between 2004 and 2008 GLHN completed design, construction, and commissioning on a large multi-phase, multi-plant ice thermal storage system at the University of Arizona (UA). The 36,000 Ton hour system that uses multiple banks of Calmat ice-on-coil tanks has proven remarkably reliable and simple to automate. Electric energy savings from reduction of peak demand have exceeded expectation.

GLHN is Mechanical Engineer of Record on a 6 million gallon chilled water thermal storage system at the University of Illinois Urbana-Champaign at its “Petascale” supercomputer facility. GLHN provided economic and hydraulic calculations used in optimizing the size of the system, then went on to prepare construction drawings and specifications for the piping and controls in a new control valve/pump house.

Other campus projects include a Utility Development Plan and subsequent Campus Chilled Water Utility Improvements at New Mexico State University, major improvements to the central refrigeration and steam plant at Northern Arizona University, and replacement of 12,000 Tons of cooling towers and 2,500 Tons of water chillers at the University of Arizona.
Three projects that highlight design/function integration (and true architectural and engineering integration) are the Northern Arizona University South Campus Central Plant, completed in 2006, North Campus Central Plant, completed in 2012, and University of Arizona Central Heating and Refrigeration Plant (CHRP), completed in 2009.

GLHN carefully studied building orientation, the visual and acoustic effects of the building on its context, and educational opportunities. The NAU South Campus Central Plant (top) was designed with a creative approach that presents a routinely unattractive building type in a unique manner that opens it up visually to the surrounding campus community. The north wall of the plant is glass, and the major equipment assets and piping are color-coded and illuminated to showcase the functions of the plant. The building can thus be enjoyed as a work of mechanical art by students and passers-by. The project has been enormously successful in unifying that quad of campus. The design concept introduced with the NAU South Campus Central Plant is currently being developed further by GLHN on the North Campus Central Plant Renovation (middle). In addition to opening the plant up to embrace its context, educational components are being incorporated. The goal of the architectural renovation is to make the building a contributing piece of the campus environment in which it is located. Views into the facility and educational courtyards that showcase information about plant operations help integrate the structure with its campus surroundings. A similar approach was used in the design of the UA CHRP plant (bottom). GLHN's approach is to celebrate the plant's presence rather than attempt to make it invisible. The architecture is creatively designed to allow passers-by audio and visual peaks at the cooling towers and other mechanical functions while at the same time match the plant to its contextual surroundings by adopting the building materials, colors, and textures of the surrounding residence halls. With the addition of creative lighting techniques, the plant is truly connected to its context. The university uses the site as a teaching tool and holds tours of the facility for engineering courses.
UNDERGROUND UTILITY INFRASTRUCTURE
USING MECHANICAL AND CIVIL ENGINEERING SKILL SETS

GLHN’s expertise in underground utility infrastructure includes the study, design, and construction administration of major extensions and improvements to domestic water distribution, steam and condensate, high temperature hot water, chilled water, water and gas distribution, and wastewater conveyance systems. Conceptual design of a distribution system is done as a part of the mechanical engineering effort, and relies on coupling cooling load (and load growth) estimates to building heat transfer characteristics (flow and delta T), then developing, running and re-running hydronic models of alternatives to develop a concept that optimizes capital and operating costs under the constraints of a growth or phasing plan. From concept design forward, GLHN has learned that subterranean utility infrastructure is best done using the skillset of civil engineering. Thorough examination of existing drawings, detailed ground survey, utility location, integration with existing GIS, and coordination with local agencies where necessary are all essential to the success of the final design. An understanding of the extent and potential magnitude of disruption to existing activities needs to be considered in final alignment and specification of traffic plans, haul routes, surface repair, and construction phasing. The efforts of GLHN’s Civil Utilities Group are acclaimed by clients across the country.

UNDERGROUND UTILITY PROJECTS
BURIED PIPE DISTRIBUTION

GLHN has been working at the University of Arizona in Tucson continuously since 1966 and has designed the majority of the main campus underground utility distribution systems over the past twenty years, totaling well over $20 million in extensions and expansions.

Phase IV Utilities (right), connected two campus chilled water systems on the main campus involving 4,500 LF of 24-36” chilled water mains and 2,200 LF of 8” water mains, coordination with utility companies and municipalities, and west campus interconnect with 2,700 LF of paired 24” insulated pipe.

Phase V Utilities involved extensions to the north campus chilled water and reclaimed water systems involving over 12,000 LF of 20-30” chilled water mains and 4,000 LF of 8-12” mains for reclaimed water. The central campus chilled water and reclaimed water lines completed the central distribution loop, involving over 1,800 LF of 24” chilled water mains.

Phase VI Utilities included over a mile of new tunnels, steam/condensate piping, potable water, reverse osmosis water and compressed air piping systems. The project incorporated a major augmentation of Pima County Wastewater Management’s public sanitary sewer system to serve the initial construction phase and future campus build out. The project also included the design of storm sewers, water harvesting facilities, and stormwater retention basins.
GLHN has been working at the University of New Mexico in Albuquerque since 1999. Projects total over $50 million in utility construction.

The Utilities Infrastructure Renewal included expansion and extension of water, sanitary sewer, stormwater, natural gas, steam, chilled water, reuse water, electrical power, and telecommunications systems. The water component included a 2,000 FT, 2,000/gpm well, 1.8 million gallon water storage reservoir, numerous water distribution mains ranging from 8-16”, and pumping facilities.

Main campus chilled water distribution involved upgrades to two central plants and construction of 6,500 ft of 24” supply and return chilled water piping and 12” water main. The channel crossing (upper right) was a challenging component of the project, involving the design of infrastructure passing underneath Lomas Boulevard, a major arterial roadway dividing the campus.

GLHN also provided design and construction period services for the UNM North Campus Utility Extensions, Phases I and II (right). The project addressed major renovations, relocations, and upgrade of campus sanitary sewer, potable water, steam, chilled water, electric power, and telecommunications distribution systems. The sanitary sewer component of the project consisted primarily of 12” and 10” gravity sewers. In effort to meet the Owner’s requirement to minimize sewage ejectors (lift stations) within the building basements, the sewer mains were installed at depths approaching 20 feet. To economically construct the system, protect existing utilities, and maintain the required site circulation, the sewers were installed by micro-tunneling techniques. The vertical and horizontal alignments were controlled by a laser theodolite projecting through the bore. The water and chilled water piping system is a fully restrained 6” to 20” ductile iron piping system.

Campus Chilled Water Improvements, including new Satellite Chilled Water Plant, New Mexico State University. 8,000 LF of new underground piping ranging from 16” to 36” in diameter. Intricate multi-modal coordination is required as the distribution line cuts directly through the main campus circulation corridor.

North Campus Research Infrastructure, Northern Arizona University. Distribution system extensions for new campus research buildings included chilled water, potable water, reclaimed water, natural gas, sanitary sewer, storm sewer, steam, and electrical power. The piping system was a fully restrained PVC piping system, ranging from 6” to 12” in diameter. Steam and pumped condensate distribution system upgrades were constructed of welded steel piping installed in the existing tunnel system. The sanitary sewer and storm sewer system included system extension, rerouting of the lines, and building service lines. The sewer system was constructed of PVC piping systems ranging from 6” to 24” in diameter.

Chilled Water Plant, Yavapai College, Prescott Campus. Design and installation of 2200 LF of 6”, 8” and 16” chilled water distribution and 2450 LF 4” and 8” hot water distribution lines on the Yavapai College Prescott Campus.