July 2004

water, sewer, gas & cable

underground construction

...nstruction, rehabilitation
...rofessional

undergroundconstructiononline.com

Rehabilitation Selection Guides

Aggressive Maintenance Nets Results

Pigging Benefits Boost Sewer/Water

Remediation Wells Are Complex, Viable Market

Vertical Lining Rehabs Historic Church

Government Facility

Optimizes Underground Location Accuracy For Safety, Efficiency

Lawrence Livermore National Laboratory (LLNL) is a U.S. Department of Energy laboratory operated by the University of California. Founded in September 1952, LLNL has become one of the world's premier scientific centers for cutting-edge science in areas of national importance including energy, biomedicine, homeland security and environmental science.

This laboratory consists of a one square-mile campus located at a former naval air station in Livermore, CA. Bruce Fritschy, damage prevention manager for LLNL, explains that the site has all of the complexities of a municipality, and more.

"Because of the nature of our operations, we have more varied underground facilities than a typical city," Fritschy explains. "These include low conductivity (process) water supply and return, city water, deionized water, sanitary sewer, storm drains, telecommunications, natural gas, low and high voltage electrical power, special waste disposal systems, compressed air and various gases."

To complicate matters, Fritschy notes, the former naval air base is criss-crossed with abandoned facilities of various types, and also includes remnants of concrete runways. Unlike normal municipal locating, where applications could involve just one utility, an LLNL locate assignment may entail as many as 13 separate utilities on one ticket, and workers must also contend with abandoned or unknown underground components.

Zero tolerance

Because of the nature of the work conducted at LLNL, the organization has zero tolerance for damage to under-

Top inset: *Lawrence Livermore National Laboratories' Damage Prevention Manager Bruce Fritschy (left) discusses marker ball programming with certified LLNL locator Maxine Lawson, using the 3M Dynatel 2200M id Series locating and marking system.*
Top: *3M 1400 Series EMS iD Ball Markers identify the location of hot and chilled water supply and return lines. Markers are kept a minimum of three feet apart, and programmed with details including type of service, depth, date of placement, permit number and map coordinates.*
Bottom: *LLNL services in this trench include compressed air, natural gas and fire suppression lines, as well as an alarm conduit, each marked with 3M 1400 Series EMS iD ball markers.*

A new double-wall toxic waste line has been installed in this excavated trench. Tracer wire and ball markers identify the pipe route.

ground facilities, the damage prevention manager explains, both for safety and to protect the status of critical laboratory work. The LLNL Technical Administration Group, located within Plant Engineering's Facilities Maintenance Management Division, has its own one-call center and rigorous procedures governing installation and maintenance of underground facilities, both inside structures and across the campus. A 30-inch dig restriction zone around buried facilities is enforced at LLNL, in contrast to California's 24-inch rule.

"In the past, we relied on outside contract locators, some with substandard training and poor record-keeping capabilities, and their work details were not recorded in a database. As site complexity grew, LLNL suffered damage problems related to locator accuracy and incomplete records," Fritschy said.

"To improve results, an in-house locating program was organized, complete with centralized records and advanced mapping capabilities. We established a permit procedure based on the national One-Call System and the Department of Transportation's one-call study, with enhancements to meet our specialized needs. Today, the One-Call Permit Office handles five different permit categories related to locating work both inside buildings and outside as part of our 'Safety through Damage Prevention Program."

He explained that when locating is arranged by an outside contractor today, the work must be assigned to a locator that is on the LLNL approved list and has been third-party certified. Only third-party certified individuals, and not companies, are allowed to perform work on the site, and LLNL's five staff locators must meet the same high certification standards.

One of the first major tasks taken on by the LLNL location organization was videotaping and mapping all sewer and drain facilities in the complex. This condition assessment allowed an accurate determination of underground conditions, and provided for cost-effective planning of repair and replacement work, which included lining of some pipe. The sewer/drain survey and repair process involved five years of effort, Fritschy notes, and resulted in fully mapped sewers and drains and a dramatically improved ability to deal with major spills or other emergencies.

Gaining data

In the late 1990s, LLNL began placing passive underground markers to denote the locations of various utility points. These markers were put in the ground during construction or when trenching for repair or changes, and the marked points were recorded for future reference. Passive markers greatly improved a locator's ability to return to a specific point, but provided little information about the underground setting, particularly in cases where records were incomplete or inaccurate.

In early 2003, LLNL switched to active underground markers, using the new 3M Dynatel 2200MiD Series Locating and Marking System for field mapping and facilities maintenance. This marking approach makes it possible to find a location and confirm details of the buried feature before excavation begins, and workers know in advance what to expect (i.e., power line, gas valve, telephone stub or point where a utility has been repaired, as well as when it was placed and who did the work.

Each active marker comes with a unique preset identification number, and is programmed with point-specific information by the placement crew, including the utility in question, depth below grade, size of the structure, the LLNL permit number associated with the work, the grid point on the campus map and the year the work was done. The precision of this marking method now makes it possible for a crew to go back at a later date, quickly find the marker, verify underground details, and then excavate with confidence using a tool as small as a post-hole digger.

Active markers come in a series of colors, each intended for a specific underground utility per industry standards. However, LLNL has opted to use the purple general purpose marker only. Fritschy explains, "We decided to use general purpose 3M 1400 Series EMS iD Ball Markers throughout rather than the more common municipal practice of placing distinctly colored models with specific frequencies for each underground utility. This makes it possible for our locators to find and read every marker (and all marked utilities) that are found at a given point using a single marker ball frequency.

The active underground marker practice ties in well with LLNL's Open Trench Policy – a practice governing all outside excavation work. Per this policy, the first step is to request a permit for work based on the intended locate. Then when a trench has been opened, Fritschy's office is notified by the individual responsible for pulling the permit that the utility has been exposed. This triggers a series of actions including a site survey to pinpoint the location on the LLNL grid, followed by placing and programming a marker ball. A digital photograph of the trench and exposed utility is taken for database records, and finally a compliance coordinator verifies that all work has been done properly. The next time it is necessary to open that location, the crew will know exactly what to expect based on the programmed marker, documentation and site photos. This underground information will help ensure safety as well as efficient underground facilities management.

Heavy locate duty

According to Fritschy, LLNL crews do a substantial amount of excavating because of ongoing construction as well as maintenance and modification work, and marker placement is now a standard operating procedure. The Department of Energy periodically audits the process,

looking for accuracy in configuration management, infrastructure and mapping. Fritschy estimates that LLNL's in-house and contract locators combined do an average of 850 locates annually. Given the multiple utilities located at many points and the zero tolerance for damage, each locate can take 4 to 5 hours.

Another responsibility of the Damage Prevention group is mapping of rebar and other embedded utilities in LLNL buildings. Concrete work during building changes can lead to unacceptable safety risks since workers may inadvertently saw or jackhammer into live electrical circuits. The group uses specialized equipment to analyze and mark concrete before work begins. They also check outdoor asphalt sections for buried electrical lighting conduit before any road work is conducted. Ground penetrating radar now makes it possible to check for buried or concrete-encapsulated elements to a depth of three feet.

LLNL is currently in the process of implementing a global positioning system (GPS) adjunct to marker placement and programming to further compliment the open trench program, Fritschy reports. GPS will help document map accuracy, and global coordinates will record each ball marker, on spreadsheet records and AutoCAD drawings of the site. This will involve an on-site transmitter signal coordinated with satellite information to give field positioning with centimeter accuracy. Fritschy expects that in the future, crews will use GPS equipment to zero in on marker locations, and then read and collect data using a marker locator. It is anticipated that in future locating systems, GPS and marker locator/reader functions will communicate seamlessly.

An internal audit shows that the cost of paperwork and documentation related to a damage event could run in excess of $100,000, apart from the cost of repairs, lost service expenses, safety issues or the threat to critical laboratory activities. The use of active markers and strict locating procedures along with detailed record-keeping has resulted in a clear value proposition, the LLNL damage prevention manager added.

"Based on the Department of Energy policy and commercial One Call studies, we always come down on the side of caution, and take the most extreme safety measures to protect employees and LLNL operations," Fritschy said. "New location technologies are constantly coming on line, and it is our policy to adopt the latest and most effective methods. We anticipate that emerging options such as active markers, high resolution global positioning and ultra-sound underground detection will be of increasing importance to LLNL in the future."

Fritschy and his staff work closely with the surrounding municipality on facilities management for the periphery of the laboratory campus, and LLNL is an active member of NULCA, the Common Ground Alliance and the One-Call System (USA North).