# GOPHURRS—Grid Overhaul with Proactive, High-speed Undergrounding for Reliability, Resilience, and Security

## PROJECT DESCRIPTIONS

### GE Vernova Advanced Research – Niskayuna, NY

*SPEEDWORM: Swift, Portable, and Efficient Electrical undergrounDing using a Waterfree, cOmpact, and Reliable Machine - $3,674,998*

GE Vernova Advanced Research is developing a robotic worm tunneling construction tool that would dig and install conduit and cables for underground distribution powerlines in a single step. GE's SPEEDWORM would mimic the natural movement of earthworms and tree roots to install 1,000 feet of cable and conduit in two hours with unmatched flexibility. The tool could deploy from a standard pickup truck and would eliminate the cost, complexity, and surface disruption compared with conventional approaches.

### RTX Technology Research Center – East Hartford, CT

*UNderground Imaging with QUantum sEnsors (UnIQue) - $4,000,000*

RTX Technology Research Center (RTRC) is developing a mobile sensing platform using radar approaches based on quantum radio frequency sensing together with artificial intelligence to locate existing utility lines prior to installing underground power distribution lines. RTRC's quantum radio frequency atom vapor sensors offer unparalleled superior performance to that of traditional ground penetrating radar, and its artificial intelligence-assisted data processing method could boost the accuracy of 3D reconstructions of subsurface infrastructure by at least 95% compared with traditional data processing techniques.

### Prysmian Cables & Systems USA – Highland Heights, KY

*Error-Free Splicing Machine for Underground Power Cables - $4,500,000*

Prysmian Cables & Systems USA is developing a hands-free power cable splicing machine operating in underground vaults to reduce the share of splicing-caused medium-voltage network failures from 60-80% to less than 5% and dramatically improve the workforce safety by reducing the time the underground cable splicing crews spend in underground vaults. The proposed machine—which fits down a utility hole and is operated from above ground—would implement laser cutting and layer preparation, abrade cable layers, and complete the splice while a vision system augmented with machine learning would aid operators in maintaining quality control.

### Pacific Northwest National Laboratory – Richland, WA

*Subsurface Intelligence for Undergrounding Operations: Rapid AI-Based Geophysical Imaging and Advanced Visualization - $3,750,000*

Pacific Northwest National Laboratory is developing an artificial intelligence system for processing geophysical survey data into digital twin and augmented reality in order to identify existing utilities and other subsurface obstacles before installing underground power distribution lines. The system would autonomously process data from multiple types of geophysical sensors to detect and classify anomalies underground and create a digital representation of the subsurface for geographic information systems. Analysis, visualization, and reporting typically takes weeks or months after data

acquisition, but the proposed system could produce results within minutes, providing near real-time subsurface mapping and utility identification which will lead to cost savings and speed up the task of burying power lines.

## Virginia Polytechnic Institute and State University – Blacksburg, VA

*Multi-physics, Intelligent Sensing System (MISS) For Real-Time, Look-Ahead While Drilling - $2,500,000*

Virginia Polytechnic Institute and State University (Virginia Tech) will develop a look-ahead sensing system based on integrated electromagnetic and seismic sensors to guide and assist drilling to lower the cost and safety concerns of undergrounding power lines. The system's sensors, in the form of radar and accelerometers, would be mounted on and behind the drill head, with complimentary distributed acoustic sensing at the surface to detect obstructions within at least 10 feet of drilling operations. Artificial intelligence capabilities would interpret the geophysical data from the sensors and provide a real-time prediction of obstacles to operators within seconds.

## Sandia National Laboratories – Albuquerque, NM

*Advancing Horizontal Directional Drilling for Rapid Undergrounding of Electrical Utilities - $1,432,564*

Sandia National Laboratories is developing a real-time, drill-mounted, cross-bore detector using ground penetrating radar to reduce the risk of damaging existing utilities while installing new underground power lines. Unlike other drill-mounted ground penetrating radar sensors that measure broad frequency bands and produce large quantities of data that make real-time communication with surface systems difficult, the proposed sensor uses a narrow band frequency domain. The result is a system capable of detecting cross-bore events with high resolution within one foot, using directional drill rod integrated sensors and advanced communication channels to avoid collisions.

## Melni Technologies – Twin Falls, ID

*Enhancing Reliability and Resilience of Underground Distribution Systems Using Innovative Splicing - $2,000,000*

Melni Technologies is redesigning and developing novel medium-voltage power cable splice kits that require fewer steps and streamline connections to greatly reduce human errors and boost the reliability of underground electrical power distribution systems. The splice kits feature Melni's proprietary Dual Helix Spiral Technology, which expands and contracts as electrical currents and temperatures vary. The kit also contains an integrated housing system with medium-voltage insulation and components that require only basic hand tools for installation. Melni’s proposed kits could be installed in 10-15 minutes, which is 3-4 times faster than conventional kits, and would reduce failures and mistakes up to 90% by eliminating installation steps and potential human errors.

## Arizona State University – Tempe, AZ

*High Speed Installation of Buried Medium Voltage Electrical Distribution Lines Using a Single Pass System - $4,263,082*

Arizona State University is developing a water-jet underground construction tool that would deploy medium-voltage electrical cables and conduits simultaneously underground with a lower risk to existing utilities by eliminating the need for a hard drill bit. The proposed tool creates a borehole by passing high-pressure water through a steering drill head and then vacuuming the slurry back out of the borehole to clear a path for excavation. At the same time, the system installs conduit to reduce cost and schedule impacts from reaming and duct pulling tasks.

## Case Western Reserve University – Cleveland, OH

*Peristaltic Conduit with Stiff Structure and Compliant Skin - $2,072,952*

Case Western Reserve University is developing a worm-inspired construction tool that could cheaply and quickly install underground distribution powerlines in busy urban and suburban environments. The proposed robotic tool consists of a sleeve of expanding and contracting materials that digs underground like an earthworm while laying conduit as it goes. The goal for the peristaltic conduit is to be able to avoid existing infrastructure obstacles by turning more nimbly (with

potential turning radius of about 5 feet compared with conventional methods with turning radiuses larger than 1,000 feet). If successful tunneling would be possible in environments which are currently too risky for trenchless methods.

## Cornell University – Ithaca, NY

*Mini-Mole: Combustion Powered Tip Fracturing and Undulatory Locomotion Robot - $452,207*

Cornell University is developing a worm-inspired digging tool with a combustion-powered soil fracturing head to minimize environmental disruption, enhance efficiency, and reduce costs of undergrounding power cables. The Mini-Mole leverages soft robotics to allow for improved steering and movement compared with conventional approaches and would be capable of tunneling, laying conduit, and installing cables without damaging the surface. The Mini-Mole would be capable of digging as fast as 12 feet per hour, have a reach up to 1,000 feet, and lower costs of cable and conduit installation by over 50%.

## Arcbyt – San Francisco, CA

*Integrated Thermal Spallation Drill for Heterogeneous Ground Conditions - $1,749,634*

Arcbyt is developing a small-diameter ultrafast tunneling construction tool to underground power lines in heterogeneous soil conditions. The tool can operate in both hard rock and soft sediments and enable cost-effective undergrounding. Digging through hard rock typically requires higher-power, oversized machines, which complicates undergrounding in urban and suburban environments. Instead, Arcbyt seeks to tunnel through hard rock using thermal spallation drilling which breaks rock into small pieces via thermal shock without touching or melting any rock material. At the same time, the same tool will have a multi-modal drilling head that can interchange the drill head in situ as it encounters different types of geologic conditions without pulling back to switch the tool head, dramatically reducing the time and cost required for underground installations. The approach requires minimal thrust, takes a smaller surface footprint, and has lower power requirements than conventional approaches.

## Oceanit – Honolulu, HI

*Artificial Intelligence and Unmanned Aerial Vehicle Real-Time Advanced Look-Ahead Subsurface Sensor (AURALSS) - $3,276,836*

Oceanit is developing a look-ahead subsurface sensor system that would take advantage of unmanned aerial vehicles (UAV) and electromagnetic (EM) resistivity techniques to avoid damaging existing utilities when undergrounding powerlines. The proposed system pairs an EM sensor on an underground drill string and an antenna mounted to a UAV flying overhead to expand the distance and sensitivity of object identification underground. The system would use machine learning interpretation and high-resolution imaging capabilities to provide real-time guidance for the drill path.