SNL Subsurface Engineering and Excavation Safety Program

Infrastructure Operations

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NNSA National Nuclear Security Administration

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SNL Subsurface Engineering and Excavation Safety Program Overview

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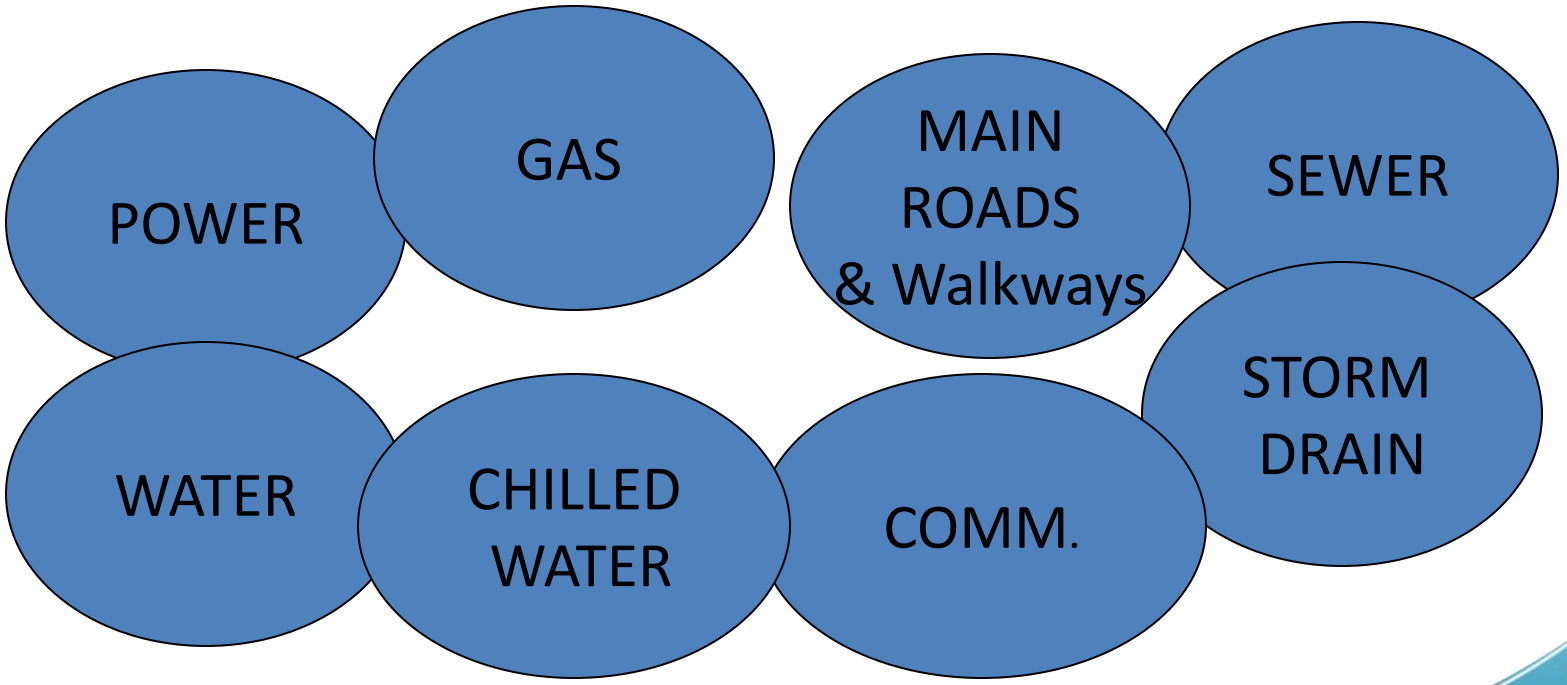
SNL / NM INFRASTRUCTURE SYSTEM QUANTITIES

High Voltage	**115kV – 7.5 miles, 46kV 9.7 miles, 115kV/12.47kV subs – 5, 46kV/5kV subs 9, 115kV/46kV switching station 1, 5kV/15kV underground distribution 55 miles, 4 each 600kW emergency generators**
Water / Fire Protect	**70 miles of water line, 325 fire hydrants, 1000 gate valves, 300 PIVs, 3 tanks, and a pumping station**
Sanitary Sewer	**46 miles of U/G pipe and 520 manholes. Three City of Albuquerque Permit Monitoring Stations**
Chilled Water	**Includes all chilled water systems that support multiple buildings. Approximately 17,670 tons of cooling and 10 miles of U/G pipe**
Gas	**23 miles of distribution line and 250 valves**
Roads	**263 acres of paved surfaces**
Communications	**33 miles of duct bank and 257 manholes**
Storm	**21 miles of pipe and channel, 275 manholes, 560 catch basins, 7 detention basins**

MISSION-DEPENDENT INFRASTRUCTURE

- **Utilities are considered to be mission-essential infrastructure and must provide consistent, reliable service and sufficient capacity to meet mission requirements.**
- **Current replacement plant value of these 8 systems: $842,000,000**
- **Annual Utility Costs: $13,500,000**



Our Program Elements Include

- Sub-Surface Engineering
- Surveying
- Civil Design
- Facilities Geographic Information System (FGIS)
- Construction Safety
- Excavation / Penetration Permitting, Processes, and Procedures
- As-Built and related support programs

Safety-Driven Program

Everyone Goes Home Safe

All excavation-related activities are governed by applicable DOE Orders, SNL Corporate Policies, and most specifically their flow down into the SNL Integrated Laboratory Management System. The SNL Facilities Management and Operations Center (FMOC) Construction Safety Program is the basis of the SNL Subsurface Utility Program.

DOE/NNSA holds SNL principally accountable for compliant execution of all construction activities on its SNL mission assignments and on its sites regardless of who performs them. All applicable requirements imposed on SNL and all SNL-specific requirements must flow contractually to all tiers of SNL subcontractors, and they must be enforced.

Construction Safety and Program Work Key Elements

- Plan Work
- Analyze Risks
- Implement Controls
- Perform Work
- Improve the Process

The SNL Subsurface Utility Program is based on the core values of the Sandia Corporation and the FMOC Construction Safety Program.

Program Hierarchy

- We are a process-driven organization. All excavations are authorized before breaking ground.

- Excavation activities are directed by our Operations Engineering and Project Teams. Most projects require a design or direction from Operations Engineering before excavation is considered.

- Each excavation begins with the completion of several processes related to work planning, risk analysis, environmental compliance, and safety review before any excavation activities.

- The excavation and penetration permitting process is the key entry point into our compliance processes for all excavations.

Facilities Geographic Information System (FGIS)

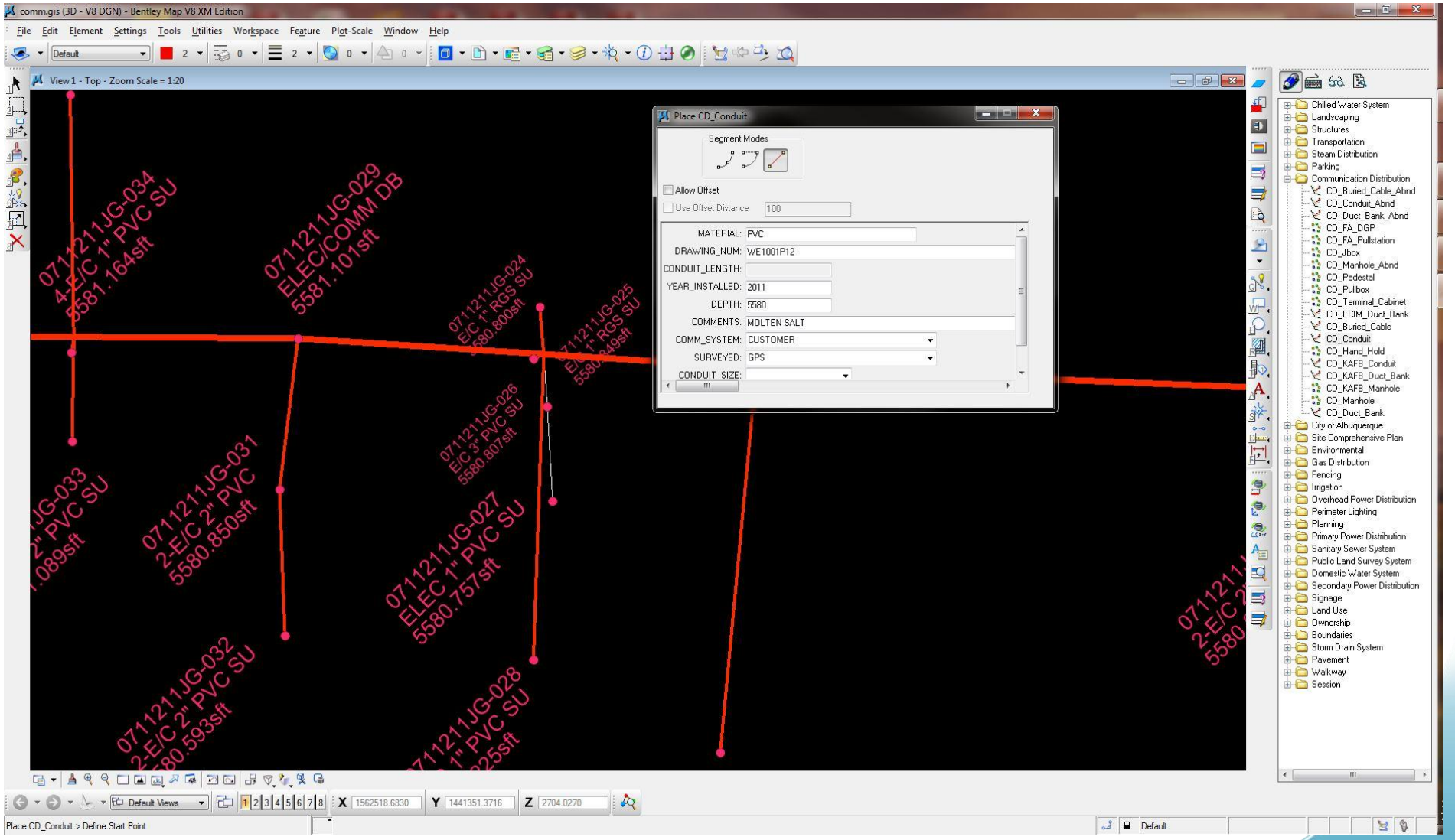
- The FGIS is the data warehouse for all mapping and underground utility information.
- FGIS files are managed and stored in Bentley® ProjectWise.
- SNL uses Bentley Map to maintain our utility mapping and information.
- Utility-specific MicroStation files, linked to an Oracle Spatial Database, are used to map and manage key utility information.
- GPS surveys and topographical information are stored in ProjectWise.

FGIS Process

The process is real-time. GIS Files Stored in PW are updated as information comes in from the field.

- GPS activities are logged in Visual Project Analysis and Tracking (VPAT).
- GPS Data is downloaded and processed using Trimble Geomatics Office™ Software, and then input into the SNL ProjectWise System.
- GPS Information and contract drawings are used to update the FGIS.
- FGIS files are updated by the GIS Technician and then reviewed by operations engineers.
- Completed updates are logged and tracked in the Bentley Map Design History tool.
- The GIS technician compares the FGIS information with the As-Built Redlines and/or As-Built record drawings at the completion of the project.

Facilities Geographic Information System



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Civil Design Process

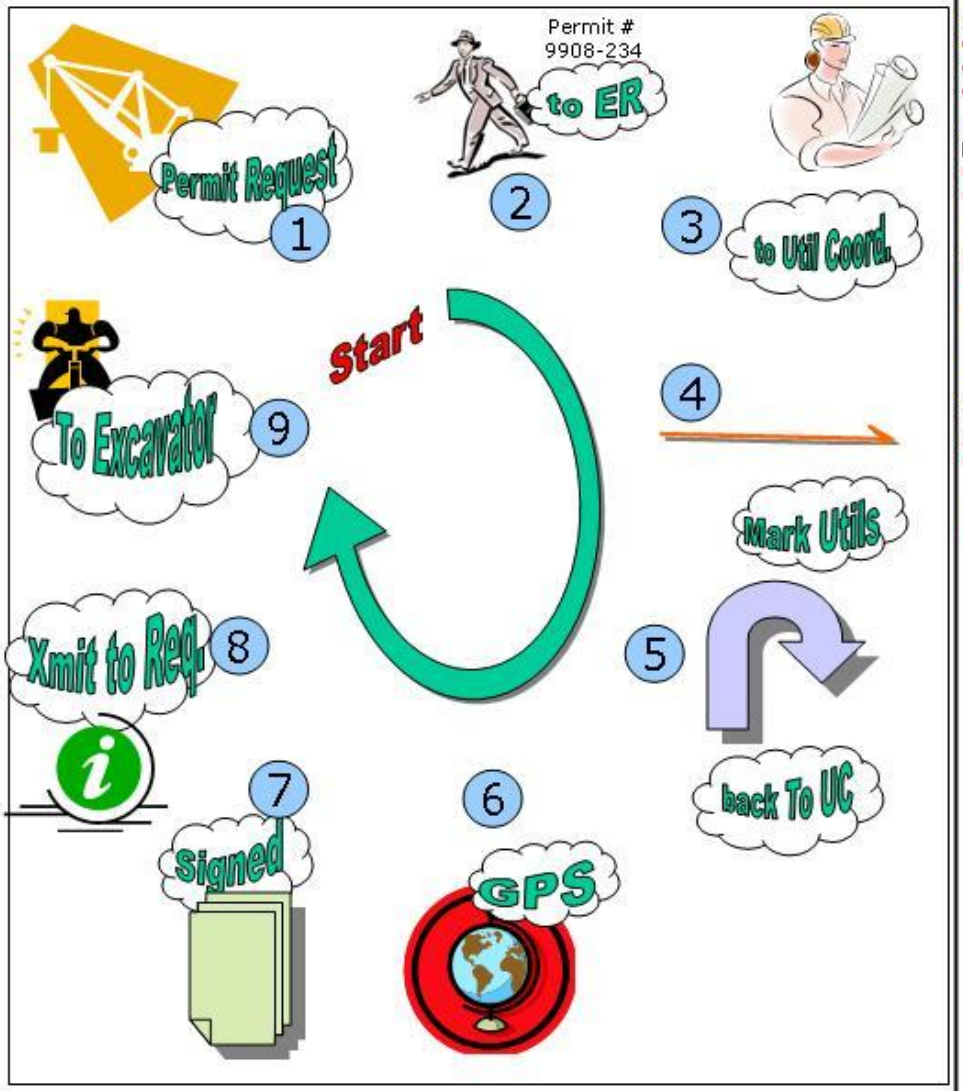
- Project development
- Utility system alignments and corridors
- Perform survey along alignments
- Compare to FGIS Mapping
- Review Alignment
- Develop a Pothole Plan to support utility verification
- Survey potholes and locations
- Complete Utility Plans and Profiles based on available information
- Determine high-risk areas that should be vacuum excavated
- Complete contract documents
- Provide all pothole data to Contractor in the Contract Documents
- **Note:** Plans must include requirements for contractor to verify all pothole data. No assumptions or added risk. We have found the data helps in the bidding and work planning process.

Excavation- and Penetration-Permitting Process

The Procedure (PCD) applies to FMOC excavation and penetration construction, service and maintenance operations, and all FMOC employees and contractors performing penetration or excavation activities. The purposes of this PCD are to:

- Minimize the potential of injury or death to workers from excavating/penetrating into hidden utility hazards that may be found in soil, concrete pads, floors, walls, ceilings and roofs.
- Protect the environment from disturbance of Environmental Restoration/Historical/Archeological (ER) sites and protect property and personnel from hazards found at these sites.
- Prevent damage to government utilities and property, and minimize unplanned utility outages.
- Define the requirements for FMOC personnel engaged in excavation or penetration activities; and
- Facilitate the update of site utility and building drawings to reflect the actual configuration of utilities.

Excavation Permit Instruction Map



Reference: Visuals: pictures, sketches, pictorials, cartoons....etc.

Step 1 Excavation Permit Requested
- Sandian Reviews Excavation Permit Process (AP-004)
- White Lines area for Excavation and submits w/description and drawings
- Project Technologist submits permit for contractor

Step 2 Permit goes to ER for review
- ER gives requirements
- ER submits permit #
- ER signs

Step 3 Permit goes to Utility Coordinator (FGIS, Exc/Pen, and Site Modifications Coordinator)
- Reviews Drawings and descriptions
- Creates Drawings for Electrical, Mechanical & Communication in color

Step 4 Utility Spotter (member of FMOC Utilities Maintenance Dept or Communication Dept.) Marks Utilities
- Planner creates work order

Step 5 Utility Spotters send back to Utility Coordinator

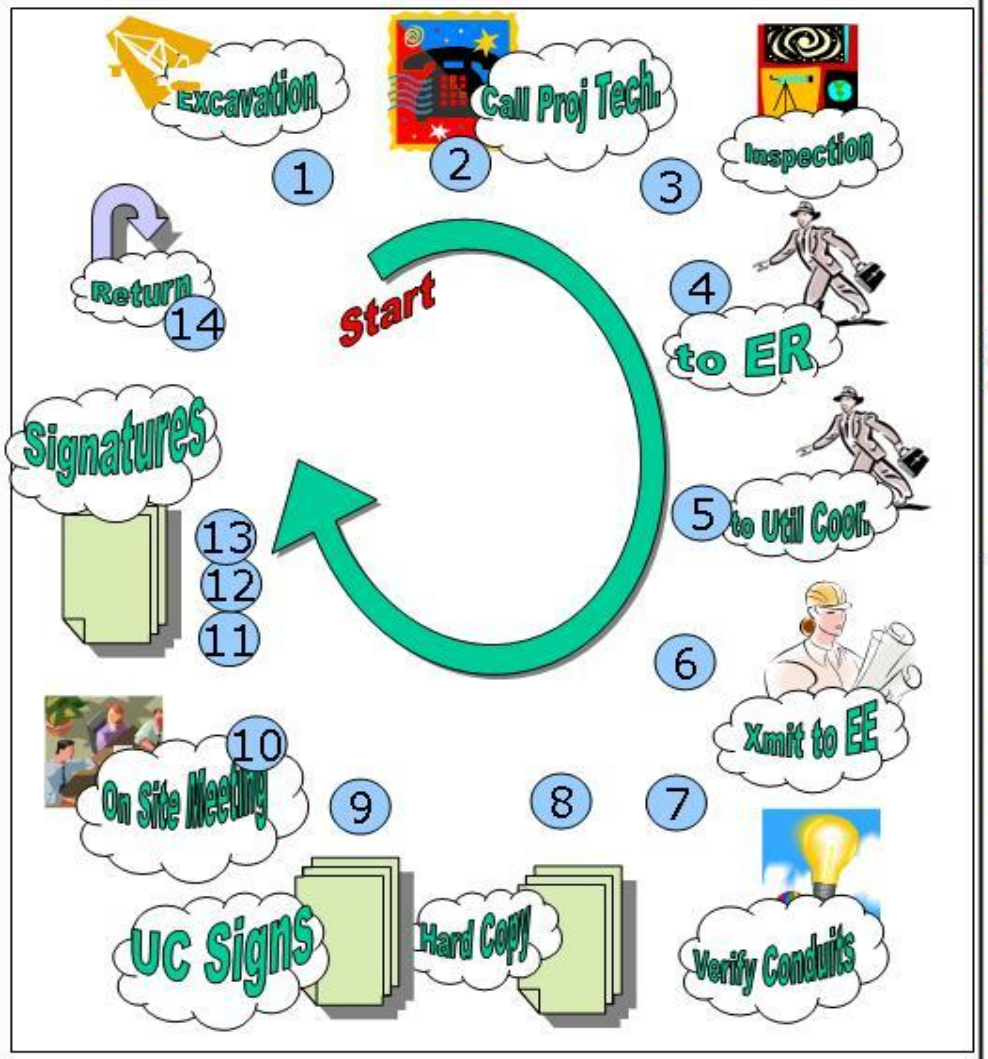
Step 6 FGIS/GPS Technologist will GPS utilities, as needed

Step 7 All comments are consolidated and permit is signed

Step 8 Transmit permit back to the Requestor/Coordinator
- Utility Coordinator returns to Construction Observer

Step 9 Requestor gives permit to Excavator
- Project Technologist signs permit and gives to contractor to sign
- Contractor signs permit

Concrete or Non-Concrete Encased Conduit Penetration Permit Instruction Map



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Step 1 Contractor excavates and exposes utilities

Step 2 Call Project Technologist (Penetration Coordinator) when conduit is exposed
- PT will evaluate
- If necessary PT will request spotting support
- PT will attend evaluation

Step 3 Project Technologist and High Voltage Rep to determine if Penetration Permit is required.

Step 4 Permit goes to ER
- ER assigns # and signs permit

Step 5 Permit goes to Utility Coordinator
- Utility Coordinator Enters Information Electronically

Step 6 Utilities Coordinator transmits to Electrical Engineer
- Electrical Engineer Conducts Field Investigation
- Electrical Engineer add comments electronically and sends to Utility Coordinator

Step 7 Utility Spotters Verify if conduits are de-energized and electric

Step 8 Utility Coordinator generates hard copy for Electrical Engineer signature

Step 9 Utility Coordinator signs permit and transmits to Project Technologist

Step 10 Project Technologist Coordinates task specific hazard analysis meeting with Contractor

Step 11 Spotter signs permit and returns to Project Technologist

Step 12 Project Technologist signs Permit

Step 13 Contractor signs Permit

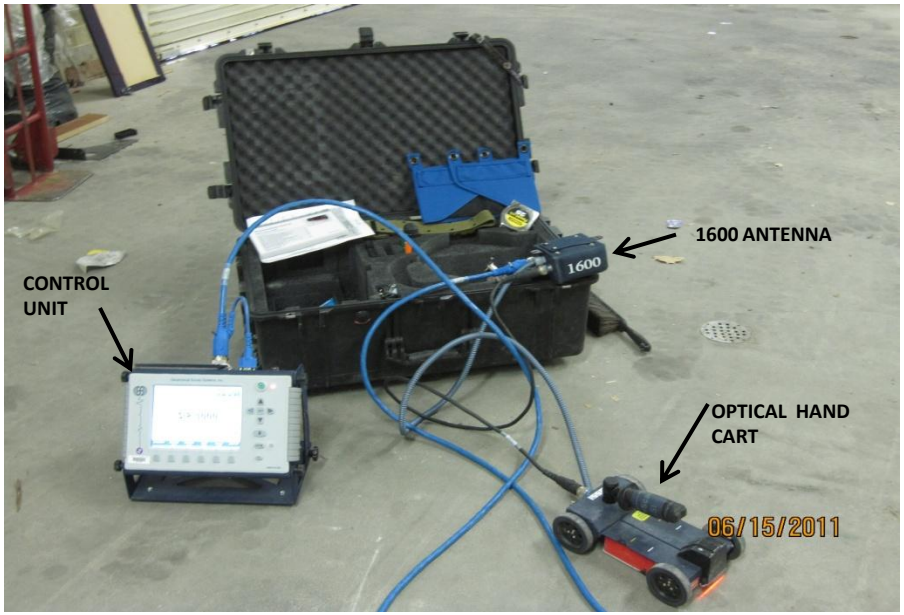
Step 14 Copy of Permit is returned to Utility Coordinator

Penetration Permitting and use of GPR

GPR at SNL

- GPR currently supports penetration activities.
- SNL modeled our GPR Program on careful study of LANL's program.
- LANL has a successful GPR Program and were helpful in showing their processes and equipment.
- LANL shared their lessons learned to help jump start the SNL program.
- At SNL we are using GPR to enhance our existing penetration process.
- Notable tracking differences:
  - LANL's process requires submitting a penetration permit for each single penetration.
  - SNL's process allows one permit to be submitted for multiple penetrations within the same project area.
- The soil conditions at SNL/NM are not conducive to locating underground utilities using GPR.

Equipment Information



- Geophysical Survey Systems, Inc. (GSSI) Model 5100B with a 1600MHz antenna, which is capable of scanning to a depth of 18”(Depending on type of concrete)
- Can locate rebar, tension cables, conduits (PVC and metal). Cannot determine that targets (items found in the scan) are electrical or have an electrical charge.
- Does not introduce site hazards or require work areas to be closed off as with radiography (X-Ray)
- Capable of scanning objects in 3D.

SNL GPR Program Recommendations

- **Modify current penetration processes to allow our GSSI equipment to be used to assist in interior penetrations and help determine whether an electrical outage is required.**
  - **Process modifications considered include where this tool is not to be used:**
    - *Within 6” of walls*
    - *On rough surfaces*
    - *Tight spaces*
    - *Congested areas*
  - **As a safety factor, no penetrations will be allowed within 1” of the center of the anomaly mark.**
  - **Palm Antenna allows closer proximity to walls and ability to work in tighter spaces**

Utilities Spotting Process

Utilities Spotting Process is a subprocess to the excavation and penetration process. In this process all excavators – SNL, FMOC and Contractor personnel, are required to submit a permit request for all excavation or penetrations.

- The process follows industry best practices.
- The excavator/requestor white-lines the area and submits an Excavation Request.
- This triggers an ER Review of the request.
- The permit is also routed to the Utility Coordinator.
- The Utility Coordinator receives the permit request and creates drawings. The permit request is sent to organizations as Spotting Requests.

Utilities Spotting Process (continued)

Line Spotting

- SNL Maintenance and Communications contractor schedules the spotting activities
- The assigned Utility Spotters perform the line spotting and note any areas of concern or other field issues on the permit.
- The Utility Spotter returns the completed form to the Utility Coordinator.
- The Utility Coordinator compiles the package and issues the permit to the requestor.
- The permit requestor reviews the approved excavation permit with the inspector or supervisor and both sign the approved permit.
- They are now allowed to follow the permit requirements and begin excavation.

Spotting Tools

- PipeHorn® 800 – Utility Spotting Wand
- Heath Surlock – Utility Spotting Wand
- Ridgid® SeeSnake® Plus Color Camera
- Radiodetection RD8000
- Trimble GPS receiver and Trimble S6 Total Station utilizing Trimble Geometrics Office
- SNL FGIS Mapping

PipeHorn 800

- **Superior high frequency** (480 kHz) performance. Pipehorn is the best tool in the industry when direct connect is not possible, and on the toughest conductors: coated iron pipes with insulated joints, unenergized power (street/parking lot lights), worn-out tracer tape and wire, short side services and stub-outs, concentric neutrals, and fiber.
- **Simultaneous conductive** transmission of both high (480 kHz) and low (9 kHz) frequencies for congested areas and for long distance locates (800-HL). Check either signal with the flick of a switch.

No more air broadcast on high frequency conduction. Better signals on the worst conductors!

Fast-response signal strength meter and sharp audio tone for precise pinpointing.

Watertight reinforced receiver wand. More durable than ever.

Heath Surlock

- **Product Features**
- Multi-jacking
- Simple two-button operation with continuous depth reading
- Phase locked loop technology reduces bleed off
- Weather resistant, durable, rugged

Ridgid SeeSnake Plus Color Camera

- 325' Color reel with camera.
- 2" to 12" Lines
- Designed and constructed for the most rugged environments, these high performance, durable camera/transmitter systems are the best video inspection systems on the market.

  Excellent for Inspecting Lines 2" and larger (3" and larger for P-traps)

  Durable Construction 100% hardened Steel Camera Head, Scratch-resistant sapphire lens.

  Proven components tested to over 1 million cycles
- Smallest, most durable camera heads.
- Ease of Use - One button power on, One touch recording, highly maneuverable camera heads

Trimble Equipment

- Both instruments can collect data from the same survey controller to combine GPS and Optical techniques in the field.
- SNL utilizes Trimble TSC2 Survey Controllers.
- Trimble S6 supports reflectorless range (dist. Measurements), so hard-to-reach and unsafe targets are no obstacle to field performance

General Excavation Requirements

- Supervisor and Excavator must have approved traffic control and barricades in place prior to beginning excavation activities.

- Excavator shall locate identified underground utilities by hand-digging or pot-holing / vacuum excavation within five feet of the identified location. Once all known utilities have been located, normal excavation methods may be used.

- Excavator shall exercise caution to ensure located utilities are not damaged during normal excavation or penetration activities. Further hand digging or vacuum excavation may be required.

Excavation Best Practices

Required vacuum excavation – during construction.

SNL often requires high-risk areas to be vacuum-excavated as a best practice. The contractor will vacuum excavate a narrow trench to the specified trench depth prior to performing other mechanical excavation.

These locations are specified in the contract documents by the design engineers with input form SNL Operations Engineers.

Use pothole utility markers to mark potholes

Place marker in pothole to prevent future dig-in contact with previously excavated utilities. Specify requirements for congested work areas in the contract documents. These devices are inserted into the pothole to help identify the location as construction progresses.

Swimming noodles have been successfully used on some of our Decontamination and Demolition projects to help prevent dig-ins.

Utility Position Survey /GPS Process

SNL Construction Standard Specification Section 01701, *Subgrade Utilities As-Built Requirements,* is an administrative specification that sets the procedural requirements for the General Construction Contractor to perform the as-built redline process and coordinate with the SNL GPS Team for a Utility Position Survey.

- GPS support requests are initiated through a pager system.
- All utilities are surveyed before backfill.
- All support request are tied to the Project Service Order and logged by the Team.
- Compliance is monitored by the construction inspection team.
- Progress is monitored at construction meetings by the Project Management Team.

GPS Process

SNL GPS Technicians perform work in accordance with the Contractor's approved Safety Plan.
We use Trimble GPS Receivers and a Remote Control Trimble Total station to collect Survey information.

Calibration of the GPS system is critical.

Enforcement - If the contractor backfills prior to coordination of the survey, they must vacuum-excavate or hand-dig the utility at various locations so SNL can GPS the utility.

GPS Process

Questions