Downrange Power & Data Distribution

General

RANGE AND TRAINING LAND PROGRAM – MANDATORY CENTER OF EXPERTISE
U.S. ARMY ENGINEERING AND SUPPORT CENTER, HUNTSVILLE
HUNTSVILLE, ALABAMA
256-895-1534
EMAIL RTLP

Function

This section shall explain the general design requirements for the downrange power and data distribution to control range targetry and its associated equipment.

General Summary

All targetry will be controlled over Ethernet based networks. These networks will be comprised of a combination of fiber optics and copper based systems maximizing the use of Commercial off the Shelf (COTS) electronic components and standards.

Power Requirements

Electrical power distribution shall conform to the Unified Facilities Criteria UFC 3-550-03FA. Voltage regulation and/or metering may be required. The voltage supplied must be maintained within 5% at a frequency of 60Hz, +/-0.5; the design agency shall verify the power supply for each site. Voltage available to each target shall be no less than 95 percent of the target's rated operating voltage.

Environmental Limits

The temperature and humidity limits for electronic equipment are as follows:

a. Indoor equipment operating temperature shall be: + 21.1°C (70°F) to +25.6°C (+78°F).). Non-operating temperature should be: -34.44°C (-30°F) to +65.56°C (+150°F). Humidity should be between 10% - 80% RH non-condensing.

b. Outdoor equipment non-operating and operating temperature shall be: -34.44°C (-30°F) to 60°C (140°F). Humidity: 5% to 95% RH (non-condensing).

Unexploded Ordinance (UXO)

The site UXO survey reconnaissance report shall be reviewed to identify all medium and high UXO risk areas coinciding with all down range electrical trenching layouts. The limits of these areas shall be delineated on electrical trenching plans and strict coordination shall be done with the UXO clearance design team to determine the method of UXO clearance for those areas, and the time at which it is anticipated to occur, i.e., prior to construction contractor mobilization or after. All special requirements shall be captured on the trenching plans such as but not limited to: the limits of construction for electrical corridors, UXO contract phasing information (if a phased approach is to be utilized), any standoff distances required from UXO clearance activities, and any special instructions that must be given to the trenching contractor that relate to UXO construction support. The electrical designer must coordinate with both the civil and UXO removal designers to determine the width of the construction corridors. The design must limit both the MCA construction costs as well as the UXO clearance costs. Design consideration should be given to reducing the amount of trenching required. This can be done by placing electrical trenches along course roads and maintenance roads and by combining trenches such that they fall into the same corridors.

For UXO low risk areas UXO construction support is normally provided and typically consists of UXO construction support personnel investigating suspect UXO items as they are discovered during normal construction activities. UXO construction support personnel will additionally be available to investigate any suspect items that may be found in any previously cleared area. The availability of construction support should be verified during the development of the construction documents. Any special instructions that must be given to the construction contractor related to UXO construction support should be included on the electrical trenching plans. The trenching contractor may be given flexibility to field route the trenches based on site conditions, but this should be verified with the UXO design team prior to incorporating this into the electrical trenching plans.

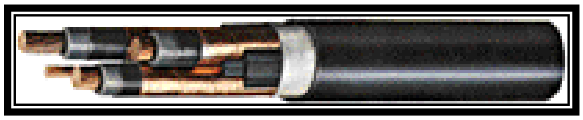
Burial Methods

Downrange power distribution and data cable shall be direct buried or run underground in conduit. Direct burial distribution is the recommended method since it is less costly than conduit methods. The direct burial cables must be encased in a bed of sand or select backfill. The method of "plowing" cables is not recommended. The power and data cables shall be installed in the same trench adhering to the Mandatory Center of Expertise (MCX) required separation distances as listed below. Unexploded Ordinance (UXO) and environmental issues should be considered to determine routes before trenching to minimize disturbance of effected areas. The designer should route trenches along access roads and maintenance trails as much as practical to minimize disturbance. Concrete encased duct banks must be used whenever trenching underneath road systems. Actual depth of the cables shall be deep enough to prevent damage from projectile penetration. Direct buried cables shall feed emplacements through conduit that is stubbed out 5 ft from the emplacement. Innerduct is not required at the emplacement, but is required to be installed in the Range Operations Center (ROC) entry conduits and in conduits placed in ductbank located beneath roadways and trails. Minimum cover requirements of National Fire Protection Agency 70 (NFPA 70) and Institute of Electrical & Electronics Engineers C2 (IEEE C2) must be met. See the Electrical Details in the Appendix of this document for details.

a. Direct burial data cables and secondary low voltage power cables must maintain a 102-millimeter (four inch) separation distance from other cable types.

b. Direct burial data and secondary low voltage power cables and medium voltage primary power cables must maintain a 305-millimeters (twelve inch) separation distance from other cable types.

Direct Burial Cabling Requirements



a. Power Cable The size of the power cables depends on the number of targets served, circuit voltage drop, and the circuit protective device rating. Operating voltage at the most distant emplacement or target should not be less than 95 percent of the supplying transformer's secondary voltage. The primary distribution power cable shall be either

single conductor or three conductor (multi-conductor) conforming to ICEA S-93-639/NEMA WC-74 Shielded Power Cable 5-46 KV or ANSI/ICEA S-94-649 Concentric Neutral Cables Rated 5-46KV. The secondary power cable shall be a 600-volt rated, multi-conductor cable. It shall consist of insulated, stranded, copper conductors and a bare, stranded, copper grounding conductor. Each cable shall be enclosed within a tight fitting, heavy, nonmetallic jacket suitable for direct burial. In instances where the secondary power cable enters a NEMA 4, NEMA 4X, or NEMA 6P rated enclosure, the power cable shall be a 600-volt rated multi-conductor cable filled until rounded with non-wicking fillers and be enclosed within a tight fitting, heavy, nonmetallic jacket suitable for direct burial. The size of the conductors terminated in the Load Center (LC) or Power Panel (PP) at the targetry emplacement shall not exceed No.2 AWG. Emplacements with larger size load centers/power panels than a Stationary Infantry Target (SIT) may use larger size conductors, not to exceed what is recommended by the manufacturer. No splicing of cables between emplacements is allowed.

b. Data Cable The type of data cable used depends on the range and network design. If metallic conduit is used the armored or shielded jacket is not required. The fiber optic data cable shall be multi-strand single mode, Outside Plant (OSP) direct burial, Ultraviolet (UV) resistant, single armored, water-blocking, gel-filled, loose-tube, double-jacketed cable. Only use single-mode fiber cabling to interconnect between the ROC and AAR and other ROCA buildings and training buildings and exterior cameras. The CAT5E or better data cable shall be Shielded Twisted Pair (STP), Outside Plant (OSP) direct burial, UV resistant, rodent proof, water-blocking. Splicing of either type of cable is allowed only within the emplacement Master Target Data Panel (MTDP), Target Data Panel (TDP), or and enclosures designed for such use. Fiber optic splices shall only be fusion type. CAT5E or better data cable splices shall have a low connection resistance, high insulation resistance, and resistance to moisture and corrosion.

c. Data Cable Terminations All cables shall be terminated with the appropriate connectors and tested. When terminating, fiber optic cables shall be terminated with "SC" type connectors. All fiber optic cable strands entering a target emplacement shall be terminated in the target emplacement. CAT5E or better data cable shall be terminated with a data surge protector terminal block. The finished installation of the data cable shall provide an RJ-45 female connector to allow future connection of others via RJ45 connector patch cables. All RJ-45 connectors shall be wired to the TIA/EIA 568-B standard.

d. Data Surge Protector Terminal Block Equipment Provide surge protection circuitry on both ends of CAT5E data cables installed between ROC and ARR, ROC and

target emplacements, between two target emplacements, and between control pedestals and remote communication enclosures (UAC). Most target emplacements will have two data surge protectors installed in the MTDP or TDP, one for each cable entering the emplacement. The device shall comply with UL 497 or UL 497B as applicable. Surge protection devices in target emplacements shall be auto-resettable and shall not contain fuses. The surge protection device shall have a clipping voltage between 12-20 volts. Surge protection devices in the master target data panel and the target data panel shall be limited in physical size such that they can be installed in a 5" wide X 6" long X 6" deep space. The finished installation of the data cable shall provide an RJ45 female connector to allow future connection of others via RJ45 connectors.

Interior Cabling Requirements

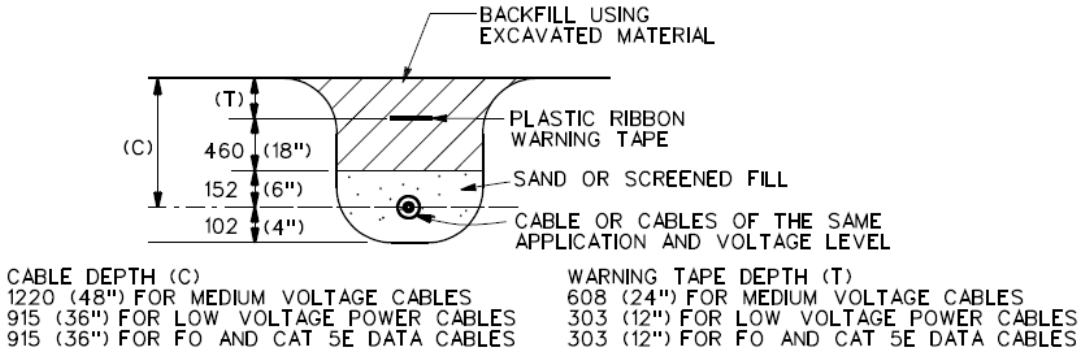
This pertains to the interior of any training building or facilities that is located downrange that is provided with an electrical service entrance and is grounded as required by the National Electrical Code.

a. Power Cable The size of the power cables depends on the number of outlets served, circuit voltage drop, and the circuit protective device rating. The secondary power cabling shall be suitable for interior wiring.
b. Data Cable Use CAT6 or approved interior data cable. The CAT6 cabling shall be unshielded twisted pair (UTP).

Trenching

Trenching Power and Data Cables

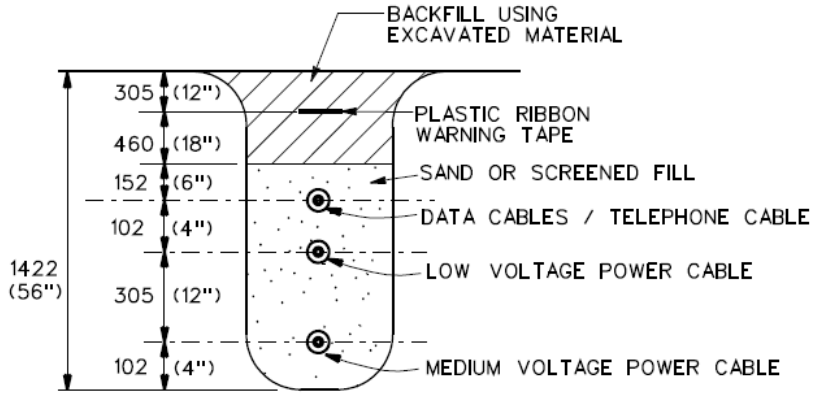
The National Electric Code has minimum requirements for trenching depths. These minimum NEC requirements are acceptable for the ROCA area. For the downrange portion of ranges, minimum recommendations are shown in the following TRENCH diagrams. Trenching depths, greater than RTLP recommended, may be required depending upon soil composition and density of the backfill material used. The cable depths must also be below the frost depth or local utility requirements of the geographic area. Concrete encased ductbank under downrange trails is recommended. For ranges without tank trails, rigid conduit to a depth of 6 feet may be used under trails.



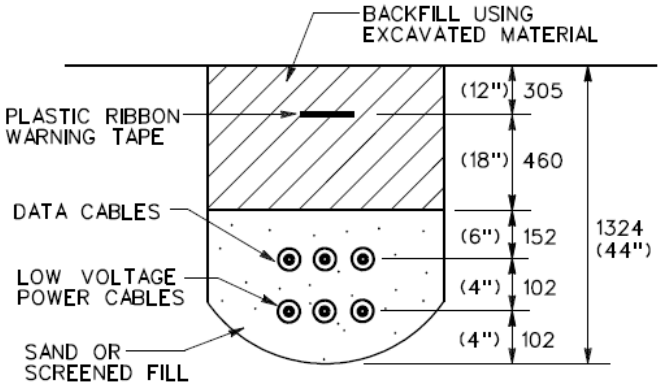
CABLE DEPTH (C)
1220 (48") FOR MEDIUM VOLTAGE CABLES
915 (36") FOR LOW VOLTAGE POWER CABLES
915 (36") FOR FO AND CAT 5E DATA CABLES

WARNING TAPE DEPTH (T)
608 (24") FOR MEDIUM VOLTAGE CABLES
303 (12") FOR LOW VOLTAGE POWER CABLES
303 (12") FOR FO AND CAT 5E DATA CABLES

TRENCH: SINGLE CABLE OR VOLTAGE



TRENCH: MEDIUM & LOW VOLTAGE POWER & DATA CABLES



TRENCH: LOW VOLTAGE POWER & DATA CABLE

DISTANCES SHOWN WITHOUT
PARENTHESES ARE IN MILLIMETERS

Note for TRENCH details above: The contractor may elect to install conductors in separate, parallel trenches as long as separation, minimum depth, and minimum cover criteria are met. Plowing in of cables is not acceptable. Diagrams above show typical configurations. For variance, space conductors according to NFPA 70.

Testing

Target Emplacement Power Cable

All secondary power cables for targetry emplacement feeders must be tested by the construction contractor after installation in order to verify that the cables are functional and comply with construction contract requirements. All testing must be performed with equipment approved by the contracting officer. The construction contractor is required to supply all equipment, labor, and materials needed for the tests. All test data and results shall be recorded and listed in the specifications as a submittal requiring Government approval. Examples of minimal tests to be recorded but not limited too, shall be:

a. Continuity of each conductor (shorted or open).
b. If power is shielded, megger each conductor to the shield and to each other.
c. If power is shielded, megger the shield to ground (earth).

Target Data (Fiber Optic/Copper) Cable

All data cables for targetry must be tested by the contractor after installation in order to verify that the cables are functional and comply with construction contract requirements. All testing must be performed with equipment approved by the contracting officer. The construction contractor shall supply all equipment, labor, and materials needed for the tests. All test data and results shall be recorded and listed in the specifications as a submittal requiring Government approval. Examples of minimal tests to be recorded, but not limited too shall be:

Fiber Optic:

a. Attenuation (End-to-End) One direction
b. Bandwidth

Copper:

a. Continuity
b. Shorts between two or more conductors
c. Transposed pairs.
d. Reversed pairs.
e. Split pair
f. Shield continuity
g. Grounded conductor

Grounding

Grounding is required for safety and lightning protection at each downrange equipment location. The communication rack ground points shall be connected to ground with at least a No.6 AWG, insulated, stranded, copper cable. Any additional communication racks should be bonded together with the same type and size copper ground. A 19mm (3/4inch) by 3,050mm (10feet) copper-clad steel ground rod shall be driven to a depth of 305mm (1 foot) below finished grade

at each equipment location. Each piece of equipment (MTDP, LC/PP, Target mechanism, etc.) shall be connected to the ground rod with a dedicated, bare, # 6 American Wire Gauge (AWG) copper wire. The armor of the fiber cables and the shield of the copper data cables shall be grounded when each enters an enclosure. The design shall ensure all existing or new underground mechanical systems are grounded according to the National Electric Code (NEC) guidelines. When targets are battery-powered and radio-controlled; ground the target mechanism using a ground rod and #6AWG bare copper ground to avoid a build up of static electricity.

Telephone

Telephone service is not required at ranges where two other forms of communication are available. Coordinate telephone service with the installation Directorate of Information Management (DOIM).

Range Lighting

There is not an Army standard for the lighting system, the designer will need to ensure that the customer's lighting requirements are met. Contact installation G3 for night operations range lighting requirements. Ranges required for night operations must be designed with red and white lighting in all facilities to be used at night. Protected switching must also be provided to prevent accidental illumination of white lights during night operations. Where necessary; low-level in-ground lights (similar to airfield markers) may be used for vehicle parking areas and walkways.