DOWNRANGE POWER & DATA DISTRIBUTION

CACTF and MOUT CTF

General

This section explains the unique design requirements for the Combined Arms Collective Training Facility (CACTF) downrange power and data distribution to control Standard Army Target System and its associated equipment.

Power shall be distributed throughout the facilities via primary power cables connected to step-down transformers, sectionalizers, or switches and routed to power panels located in the electrical/communications rooms. The number of electrical/communications rooms is determined by the quantity of buildings and their proximity to each other. Communication cabling shall be distributed from the Range Operations Center (ROC) via fiber optical cabling to the zoned electrical/communication rooms central hubs. From the electrical/communications room the power and data shall be distributed to the buildings' target power and data outlets, cameras, lighting, and other systems as required. A network connection from the CACTF to the Installation backbone is not a requirement. The training rooms in the CACTF training buildings should be considered as wet locations.

Site Power Distribution

Primary power is run underground from the riser pole at the boundary of the range site to a pad-mounted transformer located inside the Range Operations and Control Area (ROCA) near the ROC. Secondary power shall be fed underground from the pad-mounted transformer to the After Action and Review Building AAR power panel and the ROC power panel. The other facilities in the ROCA may be fed underground from the AAR power panel and the ROC power panel. Underground primary power shall continue from the riser pole near the flagpole and run to the range site. If the distance between the ROCA and the range site is lengthy; overhead power line may need to be considered due to funding. If overhead power is used, care must be taken to ensure that lines are not exposed to vehicular traffic either near roadways or maneuver lanes. A mock overhead primary power line shall run within the CACTF to each range training facility. The actual primary power shall run underground from the range dead-end riser pole to pad-mounted switches and transformers. The range training facilities shall be supplied with 120/240V power from the nearest pad-mounted transformer or nearest available 120/240V power panel. All training building electrical service shall be provided with Transient Voltage Surge Suppression (TVSS) at the service entrance distribution panel board. The power transformers shall be of the low-profile design to reduce the impact on training. The power transformers should also be located in a remote area as much as possible to reduce chance of transformer damage and impeding training. Where transformers are located near training facilities, bollards shall be utilized to prevent the transformers from being inadvertently damaged by tactical vehicles during training exercises. Targets at each range training building shall be fed from the nearest power panel. Voltage available to each target shall be no less than 95 percent of the target's rated operating voltage. The secondary power cable is not required to follow the direct burial cabling requirements as stated in the general downrange section of this manual. A ductbank system is the preferred method for power and data cable distribution. All spare conduits shall be provided with pull wires.

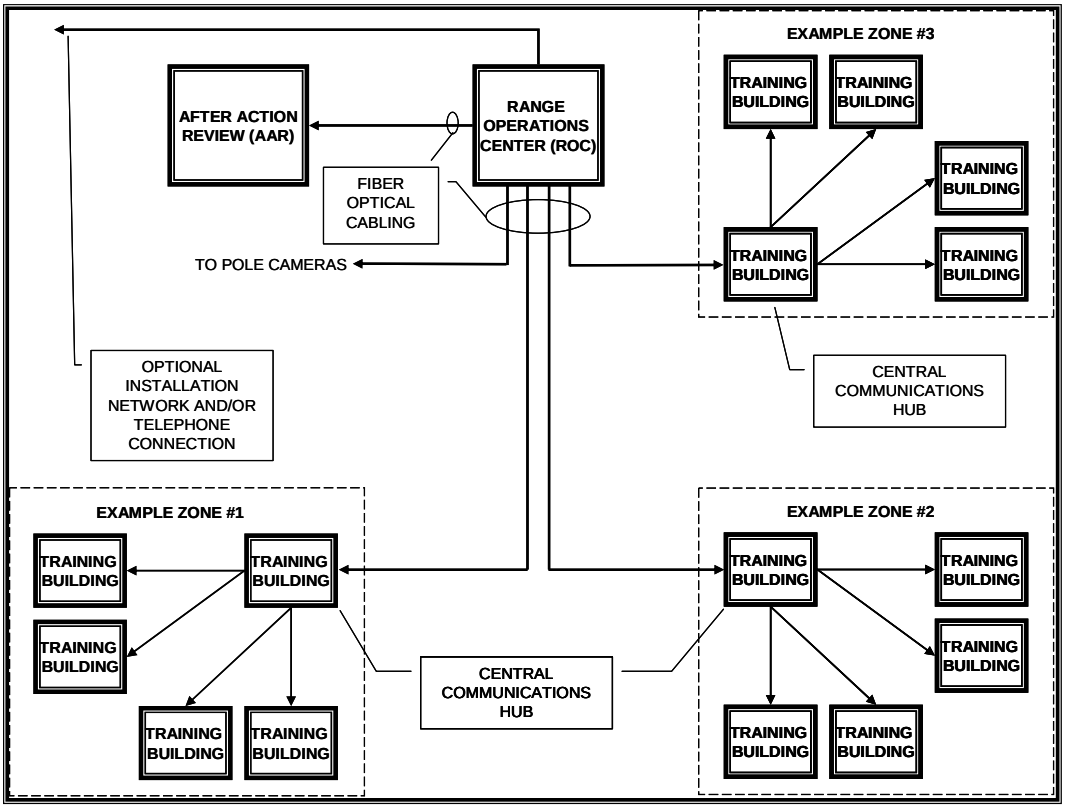
Site Data Distribution

Downrange fiber optic data distribution cables shall be installed underground from the ROC to each range training building that is designated as a central communications hub (See Representative Downrange Distribution). The cables shall be single mode fiber optic cables between facilities. The total number of "patches" or pass through terminations shall not exceed a total of three. At the electrical/communications room Data Termination Rack (DTR) the fiber optic cable shall be converted to Category 6 Unshielded Twisted Pair (UTP) cables and distributed to targets and other instrumentation components. Targets/Cameras/Speakers are controlled via an Ethernet based protocol network which means each individual data outlet connector shall have a dedicated network cable routed back to the communications rack and terminated. The network cable shall not exceed 90m in total length under any condition. All spare conduits shall be provided with pull wires.

Approximate fiber optical cable quantities for training buildings are based on 2 strands of fiber for every 24 data drops. A data drop is defined as each RJ-45 connector outlet that is available for data access inside the training building. For target outlets there are two data drops at each target outlet, for camera and speaker outlets there are one data drop per outlet. See the section for each type of outlet for more information on the outlet types. In addition, 30% spare capacity should be built into the fiber count for each training building.

For exterior cameras there should be 6 dedicated strands that homerun back to the ROC. The cables may pass through training buildings, but the total number of "patches" or pass through terminations shall not exceed a total of three.

When selecting the number of strands of fiber in each fiber optic cable the designer should use only standard numbers of strands from major manufactures of fiber optic cable. If the number of required strands calculated for a specific training buildings plus the 30% spare is not a standard cable then the number of strands should be rounded up to the next standard cable size.



REPRESENTATIVE DOWNRANGE DATA DISTRIBUTION (NOT TO SCALE)

Lighting

Interior illumination levels in the training rooms in the training buildings shall be designed for 15-30 Foot Candles at 2.5 feet ensuring safe movement within the building. The interior lighting will be fed thru a lighting contactor. The design shall provide a lighting schematic stating the size of the contactor and illustrating how the contactor controls the interior lights. Consideration should be taken in the fixture mounting design so that there is no swaying of the fixtures due to environmental forces (i.e. wind, concussions from training). If fluorescent fixtures are used they shall have a protective lens or guard in the training rooms. Lighting with local switch will be installed in the electrical room based on IES recommended lighting levels. Local training requirements and local environmental constraints should be considered in the training building lighting design.

Exterior illumination levels in the training area shall be designed in accordance with IES recommendations for the urban areas being represented by the training facilities. All lights shall be provided with photo cell control and be compliant with all applicable energy regulations. Provide an override for exterior light controls so that the lights may be turned off as dictated by training events. The lights shall be fed from lighting contactors that are located in the nearest training building electrical room. Types of fixtures shall be consistent with fixtures used on the local installation to permit operation within the local environmental constraints and allow for light fixture lamp replacement out of local installation maintenance inventories.

Interior and exterior lights shall be controlled by the automated training systems that control training events within the training buildings. The training software will communicate with the lighting contactors controlling the lights and will allow for remote operation of the lights. All lighting contactors serving the lights inside all training building training areas and all exterior lights in the training area shall be provided with one inch conduits from the contactor to the Data Termination Rack. A pull wire shall be provided inside this conduit. The wiring for the automated control will be included in the contract that provides the instrumentation of the training facilities. All lighting contactors shall include a hand-off-auto three position switch that will allow the lights to be fully controlled by the control system software, turned on, or turned off.

Training Building Electrical/Communications Room

Each training building shall have a minimum of one electrical/communications room, (except as noted on the Alternative Design discussed below). This room shall house all power and data equipment necessary to facilitate instrumented training equipment (power panels, DTRs, lighting contactors, target/camera instrumentation equipment…etc). All electrical/communications rooms shall be lockable and should open to the exterior of the training building if possible. If the door is to the interior of the training building it should be clearly labeled "Out of Play" so that it is not accessed during training exercises. The minimum size for an electrical/communication room should be sized to allow 914mm (3 ft) of access clearance to the front, rear, and one side of the communications rack(s) and to maintain the National Electrical Code (NEC) distance requirements for the power panel(s). The Communications Engineer should work closely with the Architect when sizing this room as some electrical/communication rooms will require multiple racks "ganged" together requiring a larger room to accommodate this equipment. All electrical/communications rooms should be water tight, and should be sealed to prevent rodents from entering to rooms.

Electrical/Communications rooms shall require one quadruplex power outlet with two independent power circuits per DTR to supply electronic equipment. The rooms shall also have a minimum of one maintenance outlet. All communication racks, power panels, cable trays, and conduits shall be bonded to ground. Electrical/communication rooms shall have a ladder type cable tray system encircling the perimeter of the room. Ladder type cable tray size and quantity should be according to the number of targets and camera circuits in the associated training building that shall be routed to the communication rack.

Training Building Electrical/Communications Room Ventilation

The CACTF training building communication equipment will have a rack mounted HVAC unit, equipped with an integral condensate evaporator. The rack mounted HVAC unit will be provided and installed by the OPA contractor. The only climate control to be provided by MCA is mechanical ventilation and is to be provided via a thermostatically controlled exhaust fan and a motorized damper/louver combination in the electrical room. The exhaust fan shall be sized to provide 15-20 air changes per hour and shall be activated by the thermostat, which is to be set at 90 degrees F. The exhaust fan and louver are to be installed to optimize cross ventilation in the room. Provide bird screens on all mechanical penetrations. Provide signage for all mechanical penetrations which clearly indicate that they are "Out of Play." The electrical design shall

incorporate the mechanical equipment loads and provide circuit breakers, conduit, conductor, and power receptacles applicable to the climate control equipment.

Training Building Power

Targets at each range training building shall be fed from the nearest power panel in the electrical/communications room. All electrical room power panels shall be installed as far as possible from the communication rack to help minimize electrical interference. Voltage available to each target shall be no less than 95 percent of the target's rated operating voltage. All target/camera/speaker power outlets shall not be provided with Ground Fault Interrupting (GFI) protection. When lighting control switches are provided in the training building area they shall be recess mounted in the wall. Maintenance outlets with GFI protection shall be provided in all training buildings in the optimum location as to allow for a 25 foot power cord to reach all training room areas as needed for maintenance purposes. All conduits, electrical devices, and target outlets shall not be installed on the interior walls below 2134mm (7 ft) A.F.F. (*exception: recessed lighting control switches and vertical conduit runs between floors located in rooms, hallways, or stairwell corners*). When vertical conduits are necessary between floors for the data or power they should be located in the corner of a room, hallway, or stairwell and mounted tight against the wall to prevent damage by training activity. Conduits to target/camera/other outlets shall be run tight along the ceiling as much as possible to maximize wall space for camera mounting flexibility. For conduits mounted on ceilings away from walls, conduits should be mounted flush to ceiling. Conduits shall be Intermediate Metallic Conduit in all training areas, and shall be secured with bolted style fasteners. Trapeze style hangers that allow conduits to suspend down from the ceiling shall not be utilized.

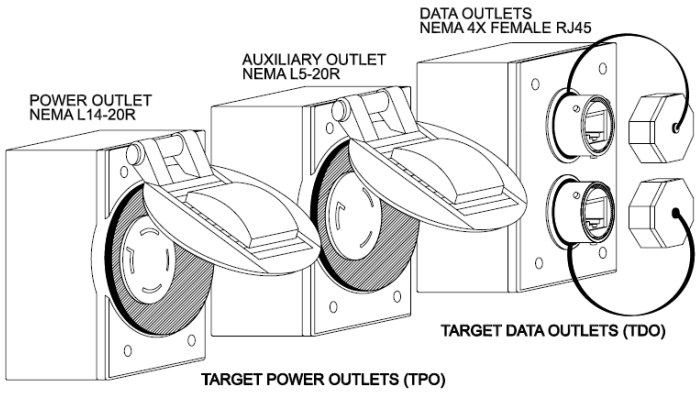
Training Building Data

From the electrical/communications room communication rack the fiber optic cable may be distributed to other building communication rooms when necessary. The fiber optic cable shall be terminated with "SC" type connectors at each electrical room in a standard communication rack patch panel. The minimum size for an electrical/communication room should be sized to allow 914mm (3 ft) of access clearance to the front, rear, and one side of the communications rack or racks with a minimum of 6 inches on the remaining side. Multiple racks will be "ganged" or joined together where more than one rack is required. Each individual RJ45 connector shall receive an individual network cable from the electrical communication rack supplied by Military Construction Defense (MILCON) and terminated with a Category 6, NEMA4X, female RJ45 connector utilizing TIA/EIA 568B wiring method for terminations. The outlets shall have minimum of 305mm (12in) of network cable slack. The target control, video, and audio cabling shall be installed in conduits from the electrical/communications room to the devices. All conduits, electrical devices, and target outlets shall not be installed on the interior walls below 2134mm (7 ft) A.F.F. (*exception: recessed lighting control switches and vertical conduit runs between floors located in rooms, hallways, or stairwell corners*). When vertical conduits are necessary between floors for the data or power they should be located in the corner of a room, hallway, or stairwell and mounted tight against the wall to prevent damage by training activity. Conduits to target/camera/other outlets shall be run tight along the ceiling as much as possible to maximize wall space for camera mounting flexibility. For conduits mounted on ceilings away from walls, conduits should be mounted flush to ceiling. Conduits shall be Intermediate Metallic Conduit in all training areas, and shall be secured with bolted style fasteners. Trapeze style

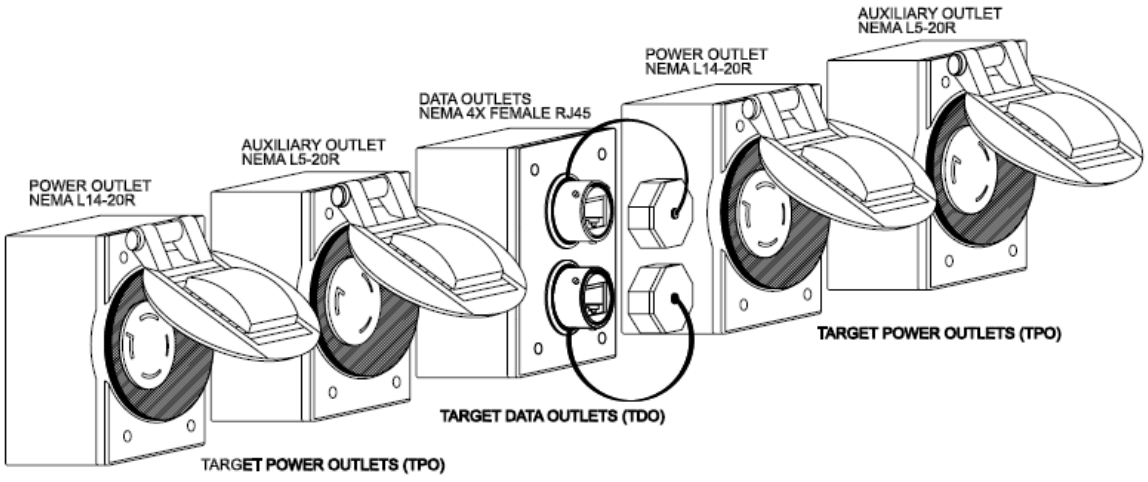
hangers that allow conduits to suspend down from the ceiling shall not be utilized. Provide permanent labels on all target/camera/speaker outlets that correspond to labels on patch panels in electrical/communications rooms.

Target Outlets

Each target outlet will have power outlets for target power and auxiliary power, and will have a set of data drops for data. The target power outlet shall be a NEMA L14-20R outlet. The target auxiliary outlet shall be a NEMA L5-20R outlet. Maximum of four single target outlets can be fed from one 120/240V, 20Amp circuit. All target outlets shall be mounted at a minimum 2134mm (7 ft) A.F.F. to the bottom of the outlet box. Conduits shall not be installed on the interior walls below 2134mm (7 ft) A.F.F. Target outlets can be either single or double in their configuration with single being the standard (See Representative Target Outlet Drawings in this document).



REPRESENTATIVE SINGLE TARGET OUTLET (NOT TO SCALE)



REPRESENTATIVE DOUBLE TARGET OUTLET (NOT TO SCALE)

Target power and data outlets shall be weatherproof when in use and when they are not in use. Target power outlets shall have weatherproof wet location covers with ethylene propylene rubber gaskets in the throat of the outlet to prevent the entrance of moisture and dirt with cover open and plug inserted. Target outlet covers shall be provided with spring loaded covers that will close when a plug is inserted into the outlet. Combining the target power and target auxiliary outlets into one double gang enclosure is not allowed.

The data outlet and enclosure shall be a harsh environment, industrial Ethernet outlet capable of supporting a CAT 5E connection per TIA/EIA 568 B. The Government will provide the MILCON contractor with harsh environmental industrial Ethernet outlet. The outlet will be an Amphenol RJ Field style outlet. The MILCON contractor shall install the Amphenol outlet seated with the Amphenol specific Code A keying sequence. The MILCON contractor shall terminate the data cable into the back of the Amphenol outlet with a standard male RJ-45 connector.

SAMPLES - POWER TARGET OUTLETS AND TARGET DATA OUTLETS (NOT TO SCALE)

EMPLACEMENT TYPE	POWER FEED TYPE	DESIGN LOAD
Single Target Outlet with Thermal Blanket	120/240V, Single Phase	960VA
		960VA

SINGLE TARGET OUTLET POWER TABLE

Camera Outlets (Speaker Outlets)

See "Cameras" section under "Primary Facilities" within the CEHNC design guide for Combined Arms Collective Training Facility (CACTF).

Data Termination Rack (DTR)

See "Data Termination Rack" section under "Primary Facilities" within the CEHNC design guide for Combined Arms Collective Training Facility (CACTF).

CACTF Alternative Design

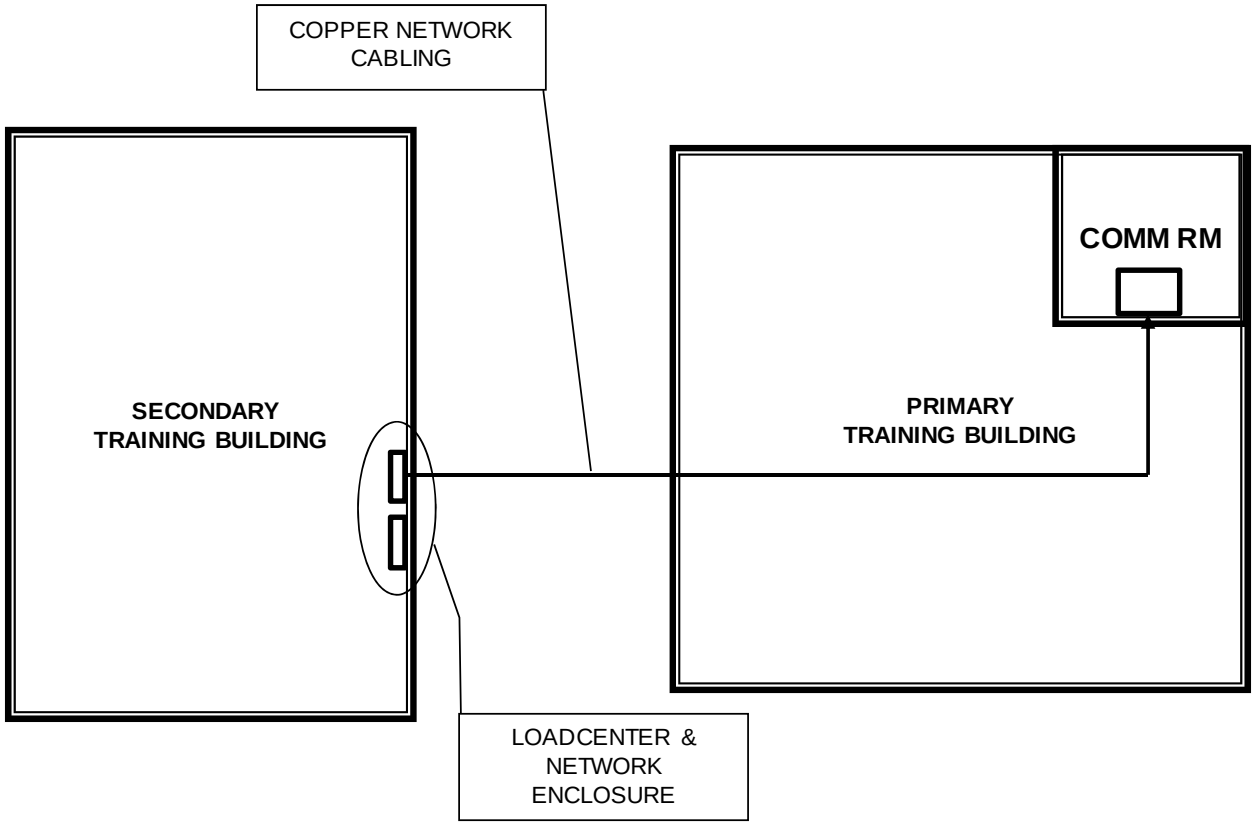
For CACTF training building layouts where there are small training buildings in close proximity to other training buildings, an alternative design technique may be used to eliminate the communication room in some of the training buildings. This alternative will allow the target, camera, and speaker outlets in one building to be served from a communication room in another building. Implementation of this alternative will only be allowed if all horizontal cabling to various device outlets does not exceed 90 meters (295 feet) in total length. The designer must coordinate this alternative with the MCX prior to incorporating any of these requirements into construction documents.

For this design alternative, a building containing a communications room that serves outlets and devices located in another building will be called the primary training building. A secondary training building is a building that has outlets and devices whose data is served from a communications room located in another training building. Secondary training buildings will not require a communication room. All power and data equipment will be provided in lockable enclosures inside secondary training buildings.

Data will be served via UTP cables from the primary training building communication room to a communication enclosure in the secondary training building. The design shall encompass physical protection for the data cables consistent with installation standards and local environmental conditions. Surge protection shall be provided at the point of entrance for the data cables into both the primary and secondary training buildings. The data cables shall be terminated in a communications enclosure inside the secondary training building sized for the number of data cables terminated inside the enclosure. The communication enclosure shall be

provided with a full metallic back plate and a ground lug mounted to the back plate. The ground lug shall be bonded to ground via a #6 AWG minimum size grounding conductor. All other requirements defined within this standard shall be applied to the data cabling and outlet device construction used in this design alternative.

Power will be provided via a 120/240 volt, single phase panel board in the secondary training building. Surge protection shall be provided on the panel board in the secondary training building. Power can be served through a separate service from a utility transformer or it can be served through a feeder supplied from a panel board in the primary training building. A separate lighting contactor shall be supplied to serve the lights in the secondary training building. Power for the lighting contactor shall originate in the secondary training building panel board. The lighting contactor must have H-O-A control. A conduit shall run from the contactor to the data enclosure in the secondary training building. Control wiring for the automatic control will be installed by the OPA contractor. All other requirements defined within this standard shall be applied to the secondary power wiring and outlet device construction used in this design alternative.



CACTF Design Alternative (Not To Scale)