Downrange Power & Data Distribution

300 METERS AND UNDER

Function

The section will explain in general terms, the basic design requirements for downrange power and data distribution to control Next Generation Army Target System (NGATS) range targetry and its associated equipment.

General Summary

For ranges 300m deep and under, each lane will be powered individually from the ROC-Tower Power Distribution Panel usually located underneath the tower, but may be located up to a minimum of 5m behind the firing lane. Lanes and targets on ranges greater than 300m deep will be powered from downrange power centers (PC) located on the range. 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) and standards. See Electrical Details in the Appendix of this document.

Targetry Power Requirements

EMPLACEMENT TYPE	POWER FEED TYPE	PEAK	STATIC LOAD	DESIGN LOAD
SIT with Thermal Target	120/240V, Single Phase	700VA while raising or lowering target. Add 260VA if Thermal Target is utilized.	50VA Thermal Target 260VA	960VA
SAT with Thermal Target	120/240V, Single Phase	2kW while raising or lowering target. Add 1kVA if Thermal Target is utilized.	100VA Thermal Target 1kVA	2.8kW
MIT	120/240V, Single Phase	2kVA during system charging	50VA	2kVA
MAT with Thermal Target	120/240V, Single Phase	3.8kVA during system charging	100VA	3.8kVA
Range Control System (RCS)*	120V, Single Phase	Associated Control Equipment		5.37kVA (ROC-Tower only)
* PEOSTRI / TACOM-RI supplied equipment, coordinate during design.				

General

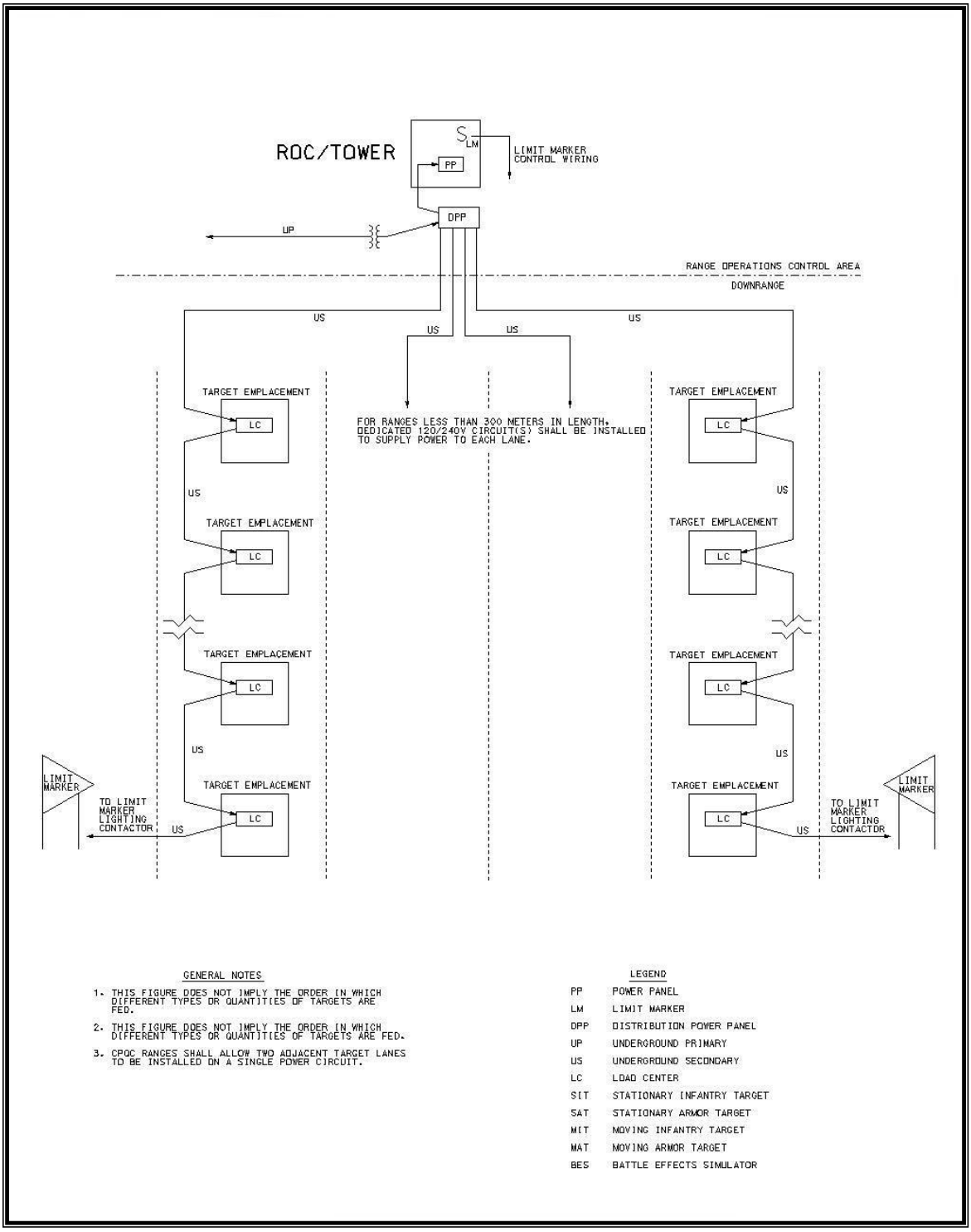
Electrical power distribution will conform to the Architectural Engineering Institute (AEI) and Technical Manual (TM) 5-811-1. Three phase or single phase primary power will be extended to the range site depending on range load. Voltage regulation and/or metering may be required. The voltage supplied must be maintained within 5% at a frequency of 60Hz, +/-0.5; the design agency will verify the power supply for each site.

All conduits and/or cables should enter and exit from the side or rear of the emplacements. This cable routing helps to minimize damage to the cables from range operations and maintenance crews performing berm repair.

Downrange Power Distribution

The downrange secondary power will be distributed from the ROC-Tower power panel (PP) via circuit breakers and a direct burial power cable. ROC-Tower details are discussed elsewhere in this manual. Each individual lane shall be powered with one or more circuits based on the number of targets located in each lane. Designing so that no two training lanes share a common power circuit should ensure continued range training in the event of electrical component failure. See Targetry Power Table for voltages and loads for determining the number of target emplacements per circuit. Operating voltage at the most distant emplacement should not be less that 95 percent of the supplied secondary voltage. The Load Center (LC) at the emplacement provides feed-thru capability for the secondary direct burial power cable to the next adjoining LC. The target emplacements in each lane will be “daisy-chained” or serially connected with the power cables continuing from emplacement to emplacement as required.

It is extremely important that detailed voltage drop calculations be performed on all target load center feeders from power center panels and ROC-Tower power panels prior to determining the feeder wire size. A diversity factor may be applied on these feeders as follows: 100% of the first target load, 75% of the second and third target load, and the static load for all remaining target loads on the feeder. If multiple target types are fed on the same feeder, the largest target load should be used with the highest diversity factor. A sample calculation has been provided for further clarification on how to apply the diversity factor. Additional a target feeder voltage drop calculator application, which includes all standard target loads and diversity factors, is included in the Navigation Pane of the Range Design Guide to assist with this calculation.


ROC/TOWER
PP
LM
LIMIT MARKER CONTROL WIRING
DPP
UP
RANGE OPERATIONS CONTROL AREA
DOWNRANGE
US
TARGET EMPLACEMENT
LC
FOR RANGES LESS THAN 300 METERS IN LENGTH, DEDICATED 120/240V CIRCUIT(S) SHALL BE INSTALLED TO SUPPLY POWER TO EACH LANE.
LIMIT MARKER
TO LIMIT MARKER LIGHTING CONTACTOR
GENERAL NOTES
1. THIS FIGURE DOES NOT IMPLY THE ORDER IN WHICH DIFFERENT TYPES OR QUANTITIES OF TARGETS ARE FED.
2. THIS FIGURE DOES NOT IMPLY THE ORDER IN WHICH DIFFERENT TYPES OR QUANTITIES OF TARGETS ARE FED.
3. CPOC RANGES SHALL ALLOW TWO ADJACENT TARGET LANES TO BE INSTALLED ON A SINGLE POWER CIRCUIT.
LEGEND
PP POWER PANEL
LM LIMIT MARKER
DPP DISTRIBUTION POWER PANEL
UP UNDERGROUND PRIMARY
US UNDERGROUND SECONDARY
LC LOAD CENTER
SIT STATIONARY INFANTRY TARGET
SAT STATIONARY ARMOR TARGET
MIT MOVING INFANTRY TARGET
MAT MOVING ARMOR TARGET
BES BATTLE EFFECTS SIMULATOR

Power Circuit Voltage Drop Example: (for downrange targetry only)

Number of SATs	1
Number of SITs	7
Number of MITs	1

		Thermal Blanket TB	Static
SAT (VA) ID #1	2800	1000	100
SIT (VA) ID #2	960	260	50
MIT (VA) ID #3	2000	0	50

$$\text{Current} = \frac{\text{Sum of target loads on circuit x diversity}}{\text{Voltage}}$$

$$\%\ \text{Voltage Drop} = \frac{\text{Distance x Volt Loss Number X Current}}{\text{Voltage}} \times 100\%$$

Volt Loss Number is taken from SPD Electrical Protection Handbook (Bussman) - Ampacity and Voltage Drop Table and multiplied by 10^{-6}.

The distance in the calculations is the distance from the current target to the previous target, power center, or power panel.

Voltage Drop Summary

ID	#1 Remain	Diversity #1	#2 Remain	Diversity #2	#3 Remain	Diversity #3	From	To	Distance-ft	Current	% V-drop
2	1	1.0	6	0.39360	1	0.75	PC	Sit 1	381	28.94	1.746
2	1	1.0	5	0.40538	1	0.75	Sit 1	Sit 2	23	22.96	0.082
2	1	1.0	4	0.42188	1	0.75	Sit 2	Sit 3	23	21.67	0.078
2	1	1.0	3	0.44661	1	0.75	Sit 3	Sit 4	23	20.38	0.073
2	1	1.0	2	0.48785	1	0.75	Sit 4	Sit 5	23	19.08	0.068
2	1	1.0	1	0.57031	1	0.75	Sit 5	Sit 6	23	17.80	0.064
2	1	1.0	0	0.81771	1	0.75	Sit 6	Sit 7	23	16.50	0.059
1	0	1.0	0	0	1	0.75	Sit 7	Sat 1	328	13.23	0.688
3	0	0	0	0	0	1	Sat 1	Mit 1	300	8.33	0.396
									Total Voltage Drop		3.254 %

The largest load is at 100% diversity, the next two largest loads are at 75% diversity. All other target loads are static. Thermal blanket (TB) load is considered a continuous load.

Diversity Example for the SIT: (all target types' diversity may be calculated similarly)

$$\frac{\text{100\%*(SIT load w/out TB[700VA])+75\%*(SIT load w/out TB[700VA])+75\%*(SIT load w/out TB[700VA])+ (all remaining \# of SITs)*(Static SIT load [50VA]) + (Total \# of SITs)*(TB load of SIT[260VA])}}{\text{(Total \# of SITs in circuit still)*(SIT load w/ TB[960va])}}$$

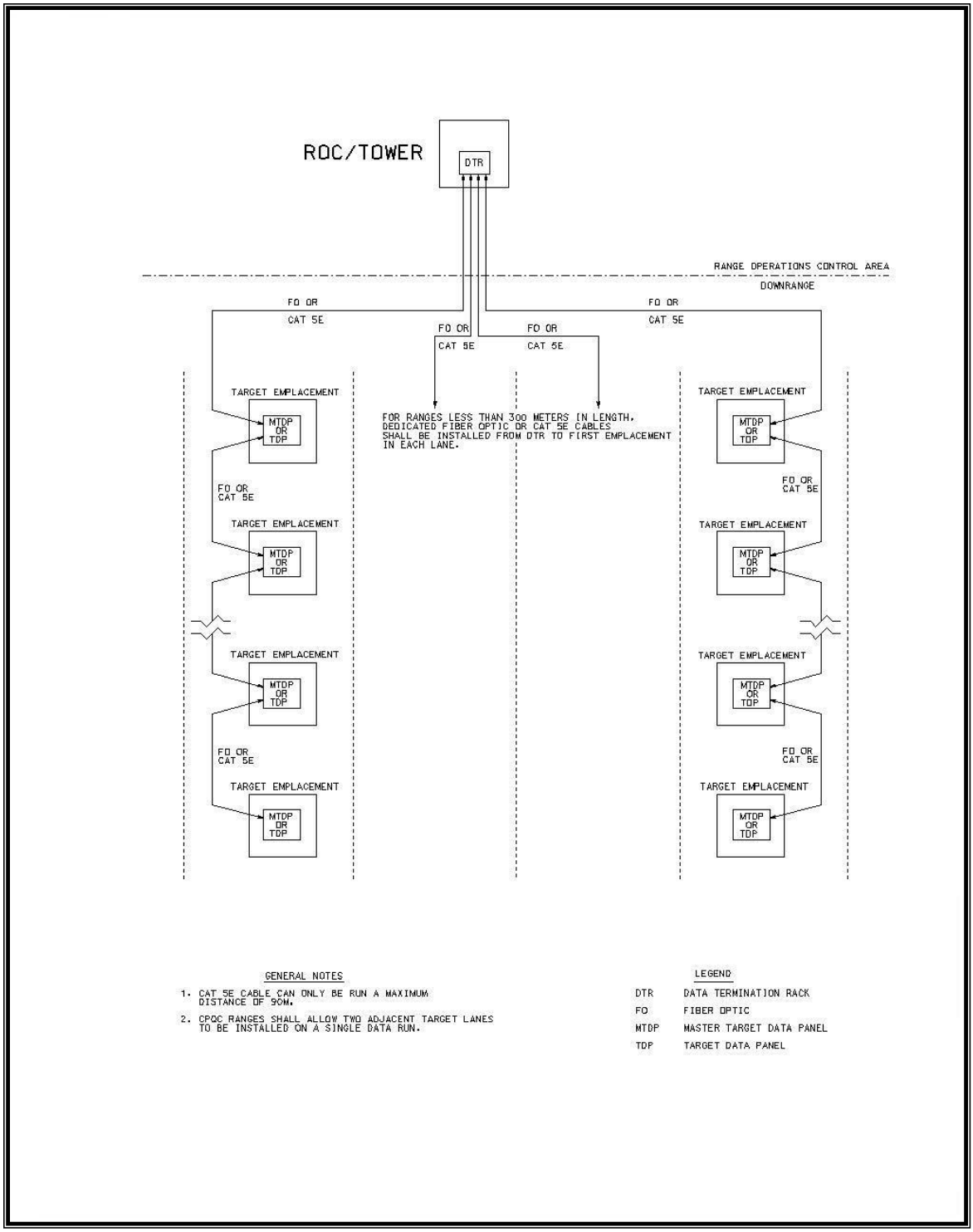
Per Example above: (100%*0+75%*0+75%*700+6*50+7*260)/(7*960)=**0.39360**

Targetry Data Requirements

RANGE TYPE	MEDIUM	SPEED	BANDWIDTH	WAVELENGTH/ FREQUENCY
Ranges 300 meters & under	Singlemode Fiber Optic Cable, 8.3 Micron.	Minimum 10Mbps	Unlimited	1310 to 1550nm
	CAT5E or better Cable	Minimum 10Mbps	200Mhz	200Mhz

Downrange Data Distribution

The data distribution originates in the ROC-Tower Data Termination Rack (DTR). ROC-Tower details are discussed elsewhere is this manual. Fiber optic or copper data cabling will extend from DTR the downrange target emplacement lanes. The design shall provide one data circuit for each individual lane of targets; no two training lanes will share a common data circuit. This will ensure continued range training in the event of an electronic component failure. Single mode fiber optic or shielded category 5E or better (copper data) cable will not exceed 30 targets per homerun. Contact the RTLP MCX at the US Army Engineering and Support Center, Huntsville, http://www.hnd.usace.army.mil/rtlp, if this limit needs to be exceeded. The target emplacements in each lane can be "daisy-chained" or serially connected with the copper and/or fiber optic data cables continuing from emplacement to emplacement Master Target Data Panel (MTDP) or the Target Data Panel (TDP) as long as the distance between emplacements does not exceed the 90 meter threshold. If the distance exceeds 90 meters then fiber optic cable must be used. CAT5E or better cables will not exceed 90 meters in total length between signal boosters (i.e., targets) with any application.


ROC/TOWER
DTR
RANGE OPERATIONS CONTROL AREA
DOWNRANGE
FO OR CAT 5E
FO OR CAT 5E
FO OR CAT 5E
FO OR CAT 5E
TARGET EMPLACEMENT
MTDP OR TDP
FO OR CAT 5E
FOR RANGES LESS THAN 300 METERS IN LENGTH, DEDICATED FIBER OPTIC OR CAT 5E CABLES SHALL BE INSTALLED FROM DTR TO FIRST EMPLACEMENT IN EACH LANE.
GENERAL NOTES
1. CAT 5E CABLE CAN ONLY BE RUN A MAXIMUM DISTANCE OF 90M.
2. CPOC RANGES SHALL ALLOW TWO ADJACENT TARGET LANES TO BE INSTALLED ON A SINGLE DATA RUN.
LEGEND
DTR DATA TERMINATION RACK
FO FIBER OPTIC
MTDP MASTER TARGET DATA PANEL
TDP TARGET DATA PANEL