Downrange Power & Data Distribution

300 METERS AND OVER

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

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

Lanes and targets on ranges greater than 300m deep from the firing line to the end of the training area 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) electronic components and standard designs. Downrange infrastructure hardware (i.e., switches, routers, media converters, etc.) is avoided where possible due to extreme weather conditions, a high potential for damage due to the nature of live fire ranges and the avoidance of specialized maintenance activities.

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 American Electrical 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.

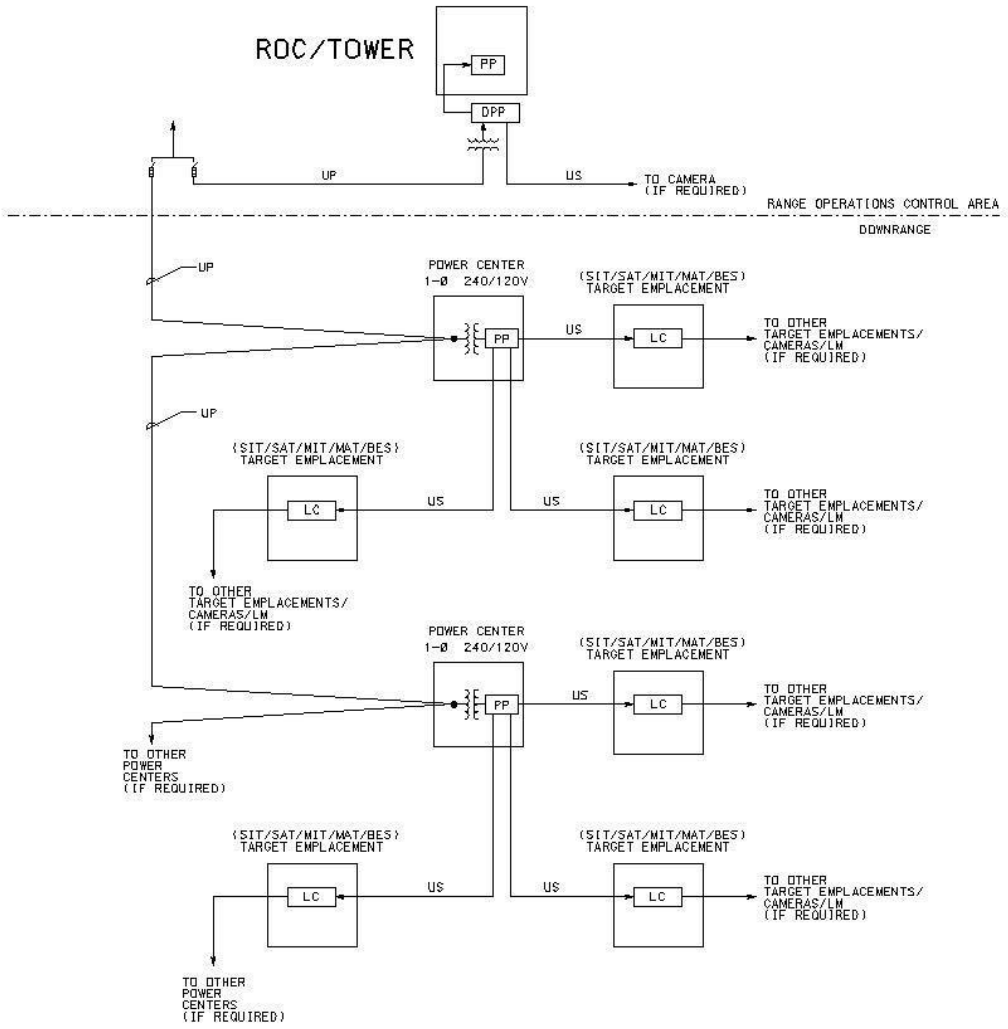
All conduits and/or cables should enter and exit from the side or rear of the emplacements. This cable routing helps to minimize damage to the cables from range operations and maintenance crews performing berm repair.

Downrange Power Distribution

Ranges over 300m shall distribute single phase, primary power downrange via Power Centers (PC). PC's can contain primary switches, sectionalizers, transformers, and Power Panel's (PP). From the PP located inside the PC, power cables shall be distributed to the Load Center's (LC) at the emplacement and shall continue to the next emplacement or cluster if required. The LC at the emplacement provides feed-thru capability for the secondary direct burial power cable to the next adjoining LC. Also fed from the PP's shall be limit markers, camera enclosures, and defilade position emplacements as required. Operating voltage at the most distant emplacement shall not be less that 95 percent of the supplied secondary voltage. SIT Cluster detailed information is discussed elsewhere in this manual.

On large ranges it is advantageous to run multiple primary feeders down range. The designer should provide the means to back feed targets everywhere practical. The designer should consider phase imbalance on utility system when selecting phases to run down range, and the primary feeders should be sized such that each feeder can carry the load of the entire range if one feeder must back feed targets on other ranges.

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.



GENERAL NOTES

1. POWER CENTERS MAY BE LOCATED IN MAT OR SAT EMPLACEMENTS.
2. THIS FIGURE DOES NOT IMPLY THE ORDER IN WHICH DIFFERENT TYPES OR QUANTITIES OF TARGETS ARE FED.

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)

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

Per Example above: (100%*0+75%*0+75%*700+6*50+7*260)/(7*960)=**0.393**

Targetry Data Requirements

RANGE TYPE	MEDIUM	SPEED	BANDWIDTH	WAVELENGTH/ FREQUENCY
Ranges Over 300 meters	Singlemode Fiber Optic Cable, 8.3 Micron.	Minimum 10Mbps Maximum Unlimited	Unlimited	1310 to 1550nm
	CAT 5E or better Cable	Minimum 10Mbps	200Mhz	200Mhz

Downrange Data Distribution

The data distribution originates in the ROC Data Termination Rack (DTR). The ROC-Tower, ROC-Small, ROC-Large, and the DTR details are discussed elsewhere in this manual. Fiber optic cabling shall extend from the DTR downrange to the target emplacements or data enclosures. The target emplacements in each area 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). All 6-strand fiber optic cables / single copper data cables will serve a maximum of 30 single targets per homerun with a SIT cluster being recognized as one single SIT target emplacement. SIT Clusters require special network considerations and are discussed elsewhere in this manual. Copper data cables can on be used when the distance between emplacements does not exceed the 90 meter threshold. All fiber optic cables shall be single mode.

The fiber optic backbone cable leaving the ROC will run to data enclosures installed in power centers, SAT emplacements, MAT emplacements, and MIT emplacements. The back bone cable will be spliced at these locations to break out the 6-strand fiber optic cables that serve targets. The number of strands in the fiber optic backbone cable will be determined by the number of 6-strand cables at the data enclosure and the other downrange fiber optic backbone cable requirements serving data enclosures further down range. The maximum attenuation shall be 20 dB between targets and the ROC. It should be assumed that there is a .4 dB/Km loss for the fiber optic cable, 0.75 dB loss per connector pair, and a 0.1 dB loss at each splice. All splices shall be fusion splices, and shall be made above grade inside the data enclosures.

Moving Armor Targets (MATS)

Consideration should be given to the use and operation of MATS in the training events when developing the downrange power and distribution plan. Power and data are used to supply charging stations which charge batteries used to propel the target mechanisms down the tracks. Careful coordination should occur between the designer and TCM-L, Range Control, and the A/E Master Gunner consultants to verify the charging stations are located on the end of the MAT where the Target first presents itself during training exercises. The cost of installing the

equipment on one end of the MAT versus the other should also be a considered and included in this coordination.