CHAPTER 4
ELECTRICAL AND CONTROL REQUIREMENTS

4-1. WIRING CONFIGURATIONS. The physical size and electrical characteristics of the RETS equipment have been predetermined. With the exception of the items listed below, electrical design requirements are left to the discretion of the designer and the installation.

a. Data Distribution Configuration. See figure 4-1 for a typical block diagram. See table 4-1 for drawing numbers of each specific configuration for the ranges depicted in this manual.

b. Power Distribution Configuration. See figure 4-2 for a typical block diagram. See table 4-1 for drawing numbers of each specific configuration for the ranges depicted in this manual.

c. Control Tower Interface (Power and Data). See figure 4-3.

d. Power Center Interface (Data). See figure 4-4.

e. Target Emplacement Interface (Power and Data). See figure 4-5.

f. CJB Construction. See drawing E-03.

g. CJB Installation. See drawing E-04.

h. TJB Construction. See drawing E-05.

i. TJB Installation. See figure 4-3 and drawings E-12 and E-13.

j. DBB Construction. See drawing E-06.

k. DBB Installation. See drawings E-02 and E-10.

l. Power and Data Cable Construction and Installation. See paragraph 4-2 below.

4-2. POWER AND DATA DISTRIBUTION.

a. General Requirements. Electrical power distribution will conform to the AEI and TM 5-811-1. Three-phase primary electrical service will be extended to the range site. Voltage regulation and/or metering may be required. The voltage supplied must be maintained within 5 percent at a frequency of 60 Hz, ±0.5; the design agency will verify the power supply for each site.

b. Support Buildings: Primary Power Distribution. Primary distribution for service to the support buildings may be overhead or underground. The transformer supplying the control tower may also supply the range support buildings, depending on the physical separation between the control tower and the support buildings.

c. Support Buildings: Secondary Power Distribution and Electrical Criteria.

(1) Control Tower.

(a) Wiring. Electrical service to the control tower will be 120/240 volt, single phase, 3 wire, 60 Hz. Surge suppression devices will be provided at the service entrance for protection of the control tower distribution system. The control tower power distribution panel will have separate circuits for lighting, convenience outlets, control, and HVAC equipment. (See drawing E-24 for panel schedule examples.) Additionally, a dedicated 240-volt circuit must be provided for the SDA (see paragraph 4-5 below).

(b) Lighting. Fluorescent lighting and lights with red lamps or lenses for night operation will be provided.

*Table 4-1. Drawing numbers for wiring configurations for each range type**

Diagram Type	Tank Gunnery†	MPTR†	AATLF†	MPRC†	MPRC-LI†	AFF	ARF	MRF	Fire & Movement	Sniper Training	MPMG	CPQC	ISBC†	ISPC†	MOUT†
Power distribution single-line diagram	E-20 E-21	E-20 E-21	E-20 E-21	E-20 E-21	E-20 E-21	E-17	E-17	E-17	N/A	N/A	E-18	E-19	E-20 E-21	E-20 E-21	N/A
Secondary power circuit single-line diagram	E-22	E-22	E-22	E-22	E-22	N/A	N/A	N/A	N/A	N/A	N/A	N/A	E-22	E-22	N/A
Data single-line diagram	E-23	E-23	E-23	E-23	E-23	E-17	E-17	E-17	N/A	N/A	E-18	E-19	E-23	E-23	N/A

* Design drawing are in appendix F.

†These drawings show sample typical power & data wiring for an armor range. The targets shown may not be used on every range. Check requirements for range targetry type.

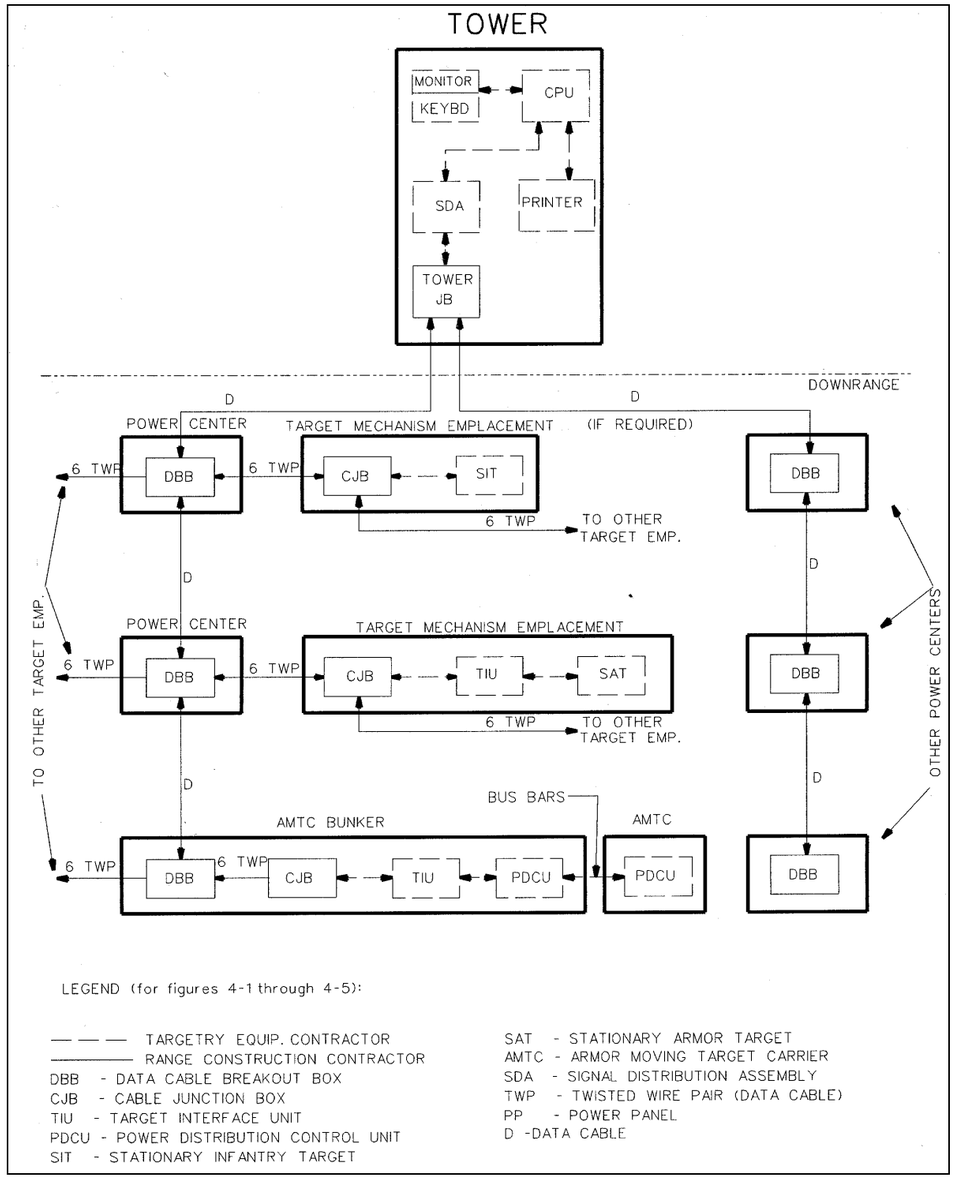

Figure 4-1. Data distribution block diagram

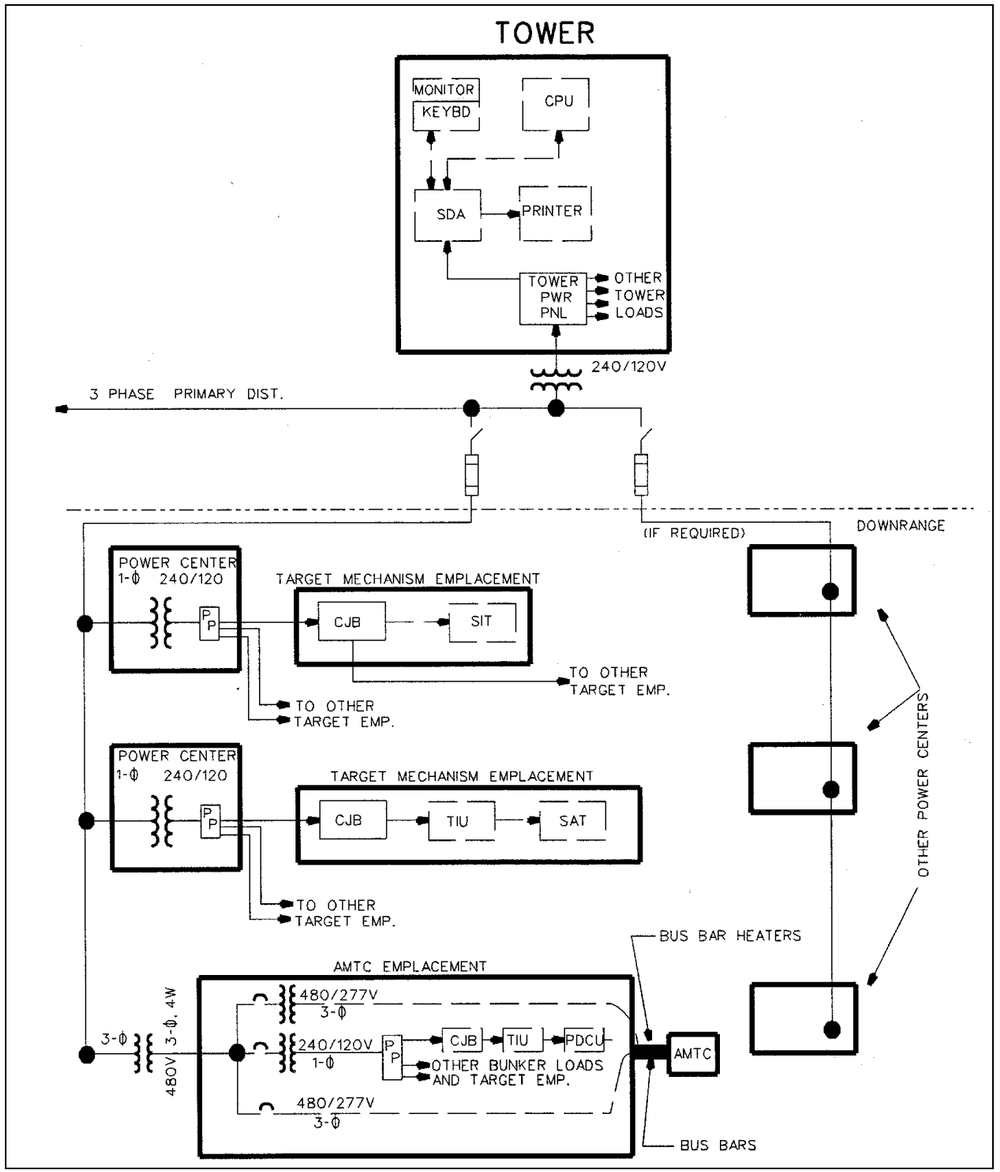

Figure 4-2. Power distribution block diagram

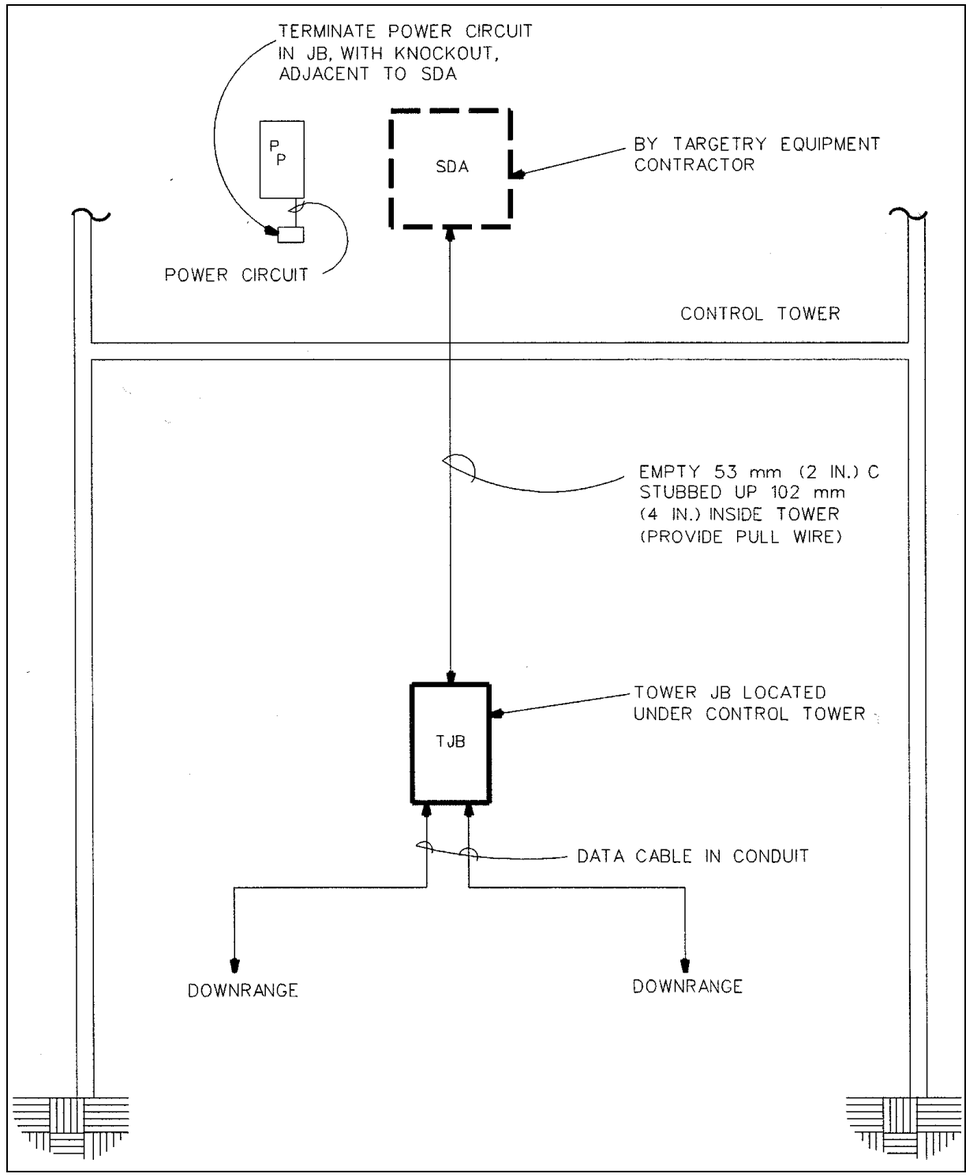

Figure 4-3. Control tower interface (power and data)

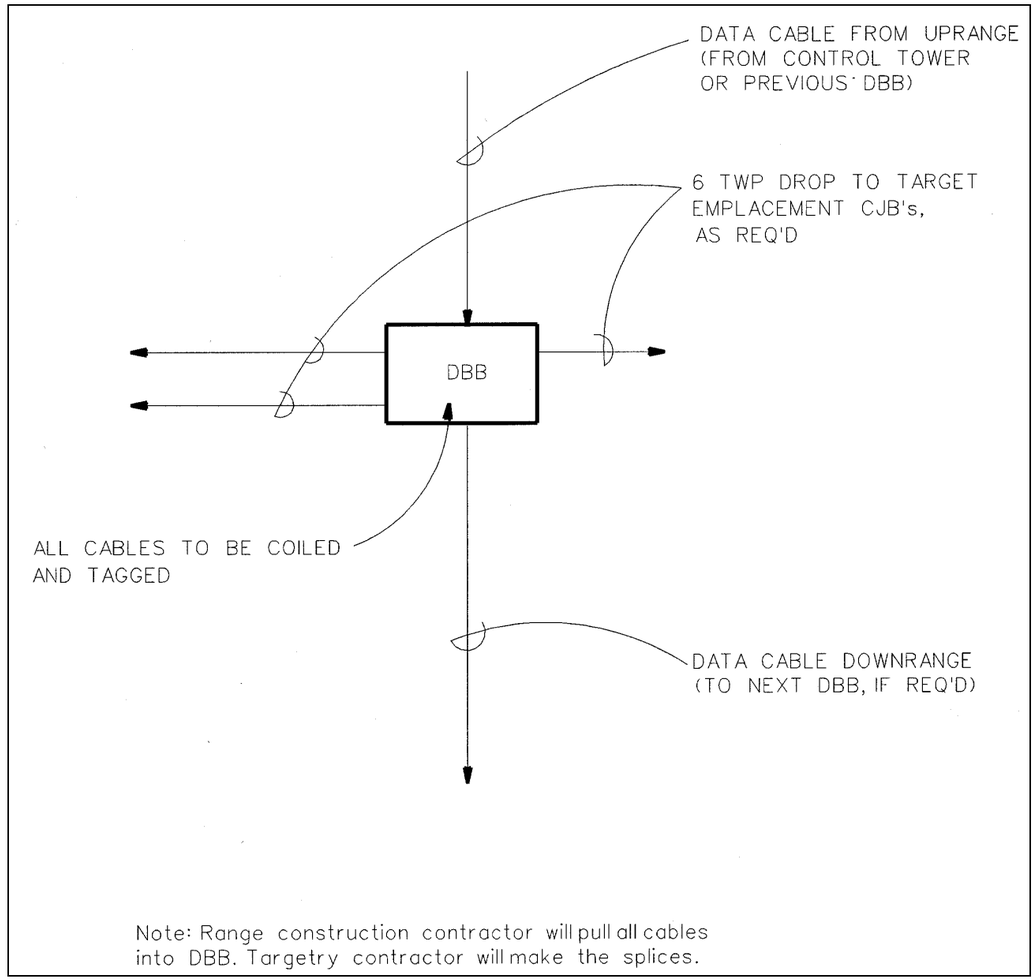

Figure 4-4. Power center interface (data)

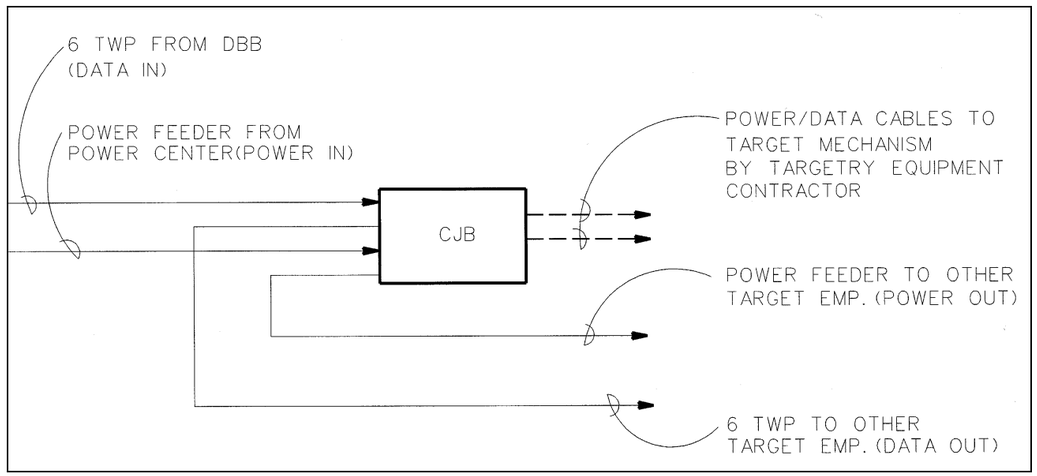

Figure 4-5. Target emplacement interface (power and data)

(c) Grounding. Grounding is required for safety and for lightning protection. The control tower ground system will consist of a buried, No. 4/0 AWG, stranded, copper conductor and ground rods all interconnected to yield an earth resistance of 25 ohms or less. The contractor must provide written certification that the tower ground grid provides a resistance of 25 ohms or less. The ground rods will be located near each tower leg. All air terminal down conductors will be run on the tower structural steel, or structural steel may be used as the down conductor. The tower roof and floor will be electrically interconnected by the structural members. Cable connections and connections to the ground rods and structural steel will be exothermically welded. The SDA and TJB ground points will be connected to a single ground point (SGP) with insulated, stranded, copper cables. The SGP will be connected to the ground system with at least a No. 4/0 AWG, bare, copper

cable. The insulated ground between the SGP and the SDA will be No. 1/0, and the insulated ground between the SGP and the TJB will be at least No. 6 AWG. See drawing E-11 for SGP detail.

(2) Other Support Buildings.

(a) Wiring. Electrical service to each support building will be 120/240 volt, single phase, 3 wire, 60Hz. Each building will be provided with a power distribution panel that has a main breaker. Separate circuits will be provided for lighting, convenience outlets, control, and HVAC equipment.

(b) Weatherproofing. All outlets located outdoors or in damp areas or exposed to weather will be rated for the application and will be ground-fault circuit-interrupter protected in accordance with NFPA 70. Weatherproof enclosures will be provided for electrical equipment in the covered mess.

(c) Grounding. Grounding is required for safety and for lightning protection. Building electrical system grounding will consist of one or more ground rods connected to the service panel in accordance with NFPA 70. Lightning protection system grounding is required for ammunition-handling facilities and for the covered mess and bleacher enclosures.

(d) Lighting. Incandescent lighting will be used for the covered mess, ammunition breakdown building, and latrine. Fluorescent lighting will be provided for the operations/storage building and the general instruction building. For night firing, lights with red lamps/lenses will be provided in addition to the normal lighting. Also, protected switching must be provided for white lights in order to prevent accidental use during night operations.

d. Downrange Primary Power and Data Distribution.

(1) Voltage. The primary distribution voltage for service downrange will depend on the available system primary voltage, capacity, circuit length, and voltage drop parameters; however, a distribution voltage of 4,160 volts is the minimum required.

(2) Burial Methods.

(a) Burial types and Requirements. Downrange primary distribution may be run underground in conduit or may be directly buried. Actual depth of the cables will be determined for each site and will be deep enough to prevent damage from vehicles traversing the range or projectile penetration. Minimum cover requirements of NFPA 70 and ANSI C2 must be met.

(b) Plastic Conduit. Cables installed in plastic conduit will be shielded, and a minimum 610-millimeter (2-foot) separation will be maintained between the primary power and data conduits. For nonmetallic conduit installations where data cables are also installed, the primary power cables must be shielded.

(c) Metallic Conduit. Primary distribution power cables installed in metallic conduit will be single conductors conforming to NEMA WC-7 or NEMA WC-8. Metallic conduit for the downrange distribution of power and data cables should be placed in a trench with a 205-millimeter (8-inch) separation between each conduit.

(d) Direct Burial. Direct-buried, primary distribution power cables will be 3 conductor (multiple-conductor-cable), with an overall shield and enclosing jacket conforming to NEMA WC-7 or NEMA WC-8. The use of direct burial distribution is recommended, since it is less costly than conduit. (See drawing E-09 for typical direct-buried cable configurations.)

(3) Manholes and Pullboxes. Both power and data cables may be run in conduit extending from manhole to manhole, pullbox to pullbox, or manhole to pullbox. Generally, the power cable will be routed through one manhole and the data cable through another. Maximum separation should be

maintained between power and data cables. Splices in primary distribution cables will be kept to a minimum and made only at power centers, in pullboxes, or in manholes. Data cables will not be cut or spliced in manholes or handholes but will be continuous between termination points. All manholes and their covers should be capable of withstanding the weight of any vehicles for which the range is designed.

(4) Data and Control Distribution System

(a) Cable. Downrange primary target control and data distribution cables must be multiple-conductor, shielded cable (No. 19 AWG, multiple TWP) conforming to 7CFR 1755.390, Bulletin 345-67. Design of the cable system must be as depicted in the drawings in appendix F. The recommended number of pairs for cables is 6, 12,18, and 25. Four data conductor pairs are usually required for communication with a DBB. However, if there are more than 45 targets connected to a DBB, four additional pair are required. Since two conductor pairs can serve up to 45 targets, the cable size between DBB's can be reduced as the cable progresses downrange. Spare conductor pairs should be provided between the TJB and the DBB's downrange.

(b) Modems. Modems are required for armor ranges. A modem system consists of 16 central modems located in the SDA and up to 2 remote modems located in each DBB. The maximum number of central modems that can be used is 16. One central modem serves one remote modem. Each remote modem will support 45 targets. If two remote modems are installed in a DBB, the DBB can serve a maximum of 90 targets (provided that the two remote modems are each served by a central modem). The designer will provide a power circuit to each DBB from the nearest power panel. The circuit must be 240 volts and 20 amp, with a 2-pole breaker. Each DBB requires approximately 120 watts. Power panels and DBB's will be collocated in power centers. All central modems, SDA enclosures, and remote modems are furnished by the RETS installer. The DBB enclosure and associated power circuits are provided by the range construction contractor.

e. Downrange Secondary Power and Data Distribution.

(1) Burial Methods. Secondary distribution cable (from the power center to the target emplacement) may be either directly buried or installed in conduit. The direct burial method is recommended because it is less costly. With the direct burial method, cables must be buried in a trench deep enough to protect them from possible damage; cables must also be encased in sand or select backfill, with an 205-millimeter (8-inch) separation between power and data cables (see drawing E-09). The minimum cover requirements of NFPA 70 and ANSI C2 must be met. If the secondary power and data cables are installed in metal or plastic conduit, the criteria for the installation are the same as for metal conduit in paragraph d(2) above.

(2) Cable Requirements.

(a) Power and Data. Secondary distribution cables will be run from power center to target emplacement or from emplacement to emplacement without intermediate splicing.

(b) Power. The size of the secondary 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 should not be less than 95 percent of the supplying transformer's secondary voltage. The secondary power cable will be a 600-volt-rated, multiconductor cable. It will consist of insulated, stranded, copper conductors and a bare, stranded, copper grounding conductor. The cable will be filled to round with nonwicking fillers, have an overall metallic shield, and be enclosed within a tight-fitting, heavy, nonmetallic jacket suitable for direct burial. The size of the conductors terminated in the CJB's will not exceed No. 2 AWG.

(c) Data. Secondary data cable will be 6 TWP, conforming to the cable requirements described in paragraph d(4) above. On infantry ranges, each data cable can serve a maximum of 15 targets.

f. Cable Separation Distances. The minimum separation distances for power and data cable described in paragraph d above are as follows:

(1) Primary Power and Data Cables.

(a) Installed in rigid galvanized steel conduit—205 millimeters (8 inches).

(b) Installed in plastic conduit—610 millimeters (24 inches).

(c) Installed in intermediate metal conduit—205 millimeters (8 inches).

(d) Directly buried—610 millimeters (24 inches).

(2) Secondary Power and Data Cables.

(a) Installed in rigid galvanized steel—205 millimeters (8 inches).

(b) Installed in intermediate metal conduit—205 millimeters (8 inches).

(c) Installed in plastic conduit—205 millimeters (8 inches).

(d) Directly buried—205 millimeters (8 inches).

4-3. TESTING. Described below are standardized test specifications for the power and data cables and ground resistance tests. Although some are required and some are only recommended, these are minimum tests. Other tests may be added at the contracting officer's discretion.

a. Power Cable Testing: Target Emplacement Feeder Cables.

(1) Requirement. All secondary power cables for targetry emplacement feeders will be tested by the contractor after installation in order to verify that the cables are functional and comply with construction contract requirements.

(2) Equipment. All testing will be performed with equipment approved by the contracting officer. The contractor will supply all equipment, labor, and materials needed for the tests.

(3) Tests and Data Submission. The contractor must record all test data and results and submit them to the contracting officer on a form similar to the Cable Test Report (figure 4-6). The submission will include information required on the Cable Test Report and data obtained from the tests listed below and from any other tests for secondary power cables required by the contract.

(a) Check continuity of each conductor (verify that conductors are not shorted and/or open).

(b) Megger each conductor to the shield and to each other.

(c) Megger the shield to the ground (earth).

b. Data Cable Testing.

(1) Required. These tests must be included in all contract specifications. All installed data cables will be tested by the contractor in order to verify that the cables are functional and comply with contract requirements. All testing will be performed with equipment approved by the contracting officer. The contractor will supply all equipment, labor, and materials needed for the tests. The contractor must submit all test results to the contracting officer on a form similar to the Cable Test Report (figure 4-6). The submission will include information required on the Cable Test Report, data obtained from the tests listed below, and data from any other data cable tests required in the contract:

(a) Check continuity of each pair. After each pair is tested, twist together the conductors that form the pair.

(b) Megger each conductor to the shield and to each other.

(c) Measure the resistance of a TWP. Twist wires at one end and measure resistance between the wires at the other end.

(d) Megger the shield to the ground (earth).

(2) Recommended. Performed before installation, these tests may be included at the discretion of the contracting officer:

(a) Test each reel at the job site for opens, shorts, and resistance.

(b) Check the continuity of each pair and of the shield.

(c) Megger each conductor to the shield and to each other.

Location				Date		
Contract No.				Temperature		
Cable Manufacturer						
Cable Length LF				Test Equipment		
Test Engineer				1.		
Witness				2.		
			TEST DATA			
Cable From				To		
Conductor or Pairs	Continuity		Megger Value		Measured Resistance of a Pair	Remarks
	open	shorted	to shield	of each pair		
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						
9.						
10.						
11.						
12.						
13.						
14.						
15.						
16.						
17.						
18.						
19.						
20.						
21.						
Shield			Ground			

Figure 4-6. Cable test report

(d) Measure the resistance of a TWP for each data cable. Twist the wires of a pair at one end and measure the resistance at the other end. Record resistance readings. See table 4-2 for required resistance value.

Table 4-2. Data cable conductor and shield resistance

CABLE SIZE	DIAMETER	DC SHIELD RESISTANCE OHMS/KILOFOOT AT 68 °F (20 °C)			
		5-mil copper	10-mil copper	8-mil aluminum	6-mil copper alloy or copper-steel
25-19	0.93	0.68	0.32	0.72	0.81
6-19	0.56	1.13	0.53	1.20	1.35
Note: The dc resistance of No. 19 AWG wire is 8.7 ohms/1,000 ft or 28.5 ohms/kM at 68 °F (20 °C).					

c. Ground Resistance Tests. The designer will ensure that the following requirements are included in the contract specifications:

(1) The tower and AMTC grounding systems must be tested by the contractor in order to verify that the required values are obtained.

(2) A ground resistance of 25 ohms or less must be obtained.

(3) The testing will be performed with equipment approved by the contracting officer.

(4) All data and measurements must be submitted to the contracting officer.

4-4. CJB's. Because installation of the CJB's has been a source of many problems in the construction of the range power and data interfaces, the following statement should be included in the contract specifications:

Before ordering all the cable junction boxes (CJB's), the contractor shall provide a sample CJB, complete with holes, connectors, and standoffs, for approval by the contracting officer.

4-5. ELECTRICAL INTERFACES. For this manual, interfaces are critical features of construction that the range construction contractor must provide in accordance with specific requirements so that the targetry contractor can properly install the targetry equipment. See the QAG, Part IV, appendix E, for the inspection checklist. The electrical interfaces listed below must be installed exactly as depicted on the appendix F drawings.

a. Control Tower Interface (Power).

(1) Interface Point. The SDA is the interface point for electrical power at the control tower (see figure 4-3 and drawings E-11, E-12, and E-13). The SDA provides power to the RETS RCS components (central processing unit (CPU), monitor, and printer) and distributes data to the CPU. Space, power, and supports are required for the SDA and will be provided by the range contractor.

(2) Space Required. Space for the SDA will be about 762 millimeters (30 inches) wide by 1,143 millimeters (45 inches) high by 305 millimeters (12 inches) deep (drawing E-11, appendix F, detail 2). The SDA weighs 115 kilograms (215 pounds).

(3) Mounting. Space will be provided in order to bolt the SDA to the wall (see drawing E-11, appendix F, detail 3). The SDA must be mounted with the top 1,676 millimeters (5 feet 6 inches) above the finished floor and located so that it can be interconnected with RCS equipment by standard 9.144-meter (30-foot) connector-ended power and data cables.

(4) Raceway. Six data cables (9.525 millmeters, 3/8-inch od) interconnect the SDA with the CPU, and three power cables (3/8-inch od), one each, interconnect the SDA with the CPU, printer, and monitor. A raceway must be provided between the SDA and RCS equipment, with the cables going through the floor near the SDA and up under the RCS equipment so that the cables do not pose a tripping hazard. A 105-millimeter by 105-millimeter (4-inch by 4-inch) raceway mounted below the floor is acceptable. The raceway must be designed to facilitate cable replacement.

(5) Power Circuit. A 240-volt, 2-pole, 20-amp power circuit must be provided from the power panel to the SDA. The circuit should be terminated in a junction box (with a knockout and cover) located within 3 feet of the SDA location (figure 4-3 and drawing E-11, appendix F, detail 3).

(6) Grounding. Grounding of the TJB, SDA, and lightning protection system are interface requirements. Although not a physical interface point, testing and certification of the grounding system is considered an interface requirement (drawing E-11, appendix F, detail 5).

b. Control Tower Interface (Data). The data cable interface point at the control tower is the TJB (see figure 4-3 and drawing E-05, appendix F). Cables will be tagged and neatly coiled with 1,850 millimeters (6 feet) excess cable provided for routing and termination. Cable tags should indicate cable destination. Enclosures will be NEMA type 4.

c. Power Center Interface (Power and Data). The power interface is a 240-volt circuit to the DBB from the power center panelboard. The data cable interface point at the power center is the DBB (see figure 4-4 and drawings E-02, E-06, and E-10). The DBB distributes data signals from the RCS to the target emplacements. DBB's are located at the power centers. Cables will be tagged and neatly coiled with 1,850 millimeters (6 feet) of extra cable provided for routing and termination. Cable tags should indicate cable destination. Enclosures will be NEMA type 4 and may have a maximum of 14 conduit penetrations.

d. Target Emplacement Interface (Power and Data). The CJB is the interface point for the power and data cables at each target emplacement (see figure 4-5 and drawings E-03 and E-04). The power and data cables are to be coiled and tagged with 407 millimeters (16 inches) excess cable in the

CJB. Labels should indicate source or destination target or feed and “out” or “in.” All target emplacements require a 240-volt, single-phase circuit.

e. AMTC Emplacement Interface (Power and Data).

(1) The CJB located inside the AMTC emplacement is an interface point for the data cables as described for target emplacements in paragraph d above, and requires the same power circuit (see drawing E-10).

(2) A 480-volt, 3-phase circuit breaker providing power to the AMTC bus bars is a power interface (see figure 4-2 and drawing E-10). The feeder from the circuit breaker to the AMTC bus bars will be provided by the targetry equipment contractor.

(3) A 120-volt, single-phase breaker in the 120/240-volt panelboard is an interface that provides power for the motor starter controller.

(4) The DBB (where included in the emplacement) is an interface item and includes the requirements of paragraph d above.

(5) The bus bar heater feeder circuit breaker is an interface item and must be fed by an isolation transformer as depicted on drawing E-10.

(6) The targetry space requirements shown in section A of drawing E-10 must be provided.

(7) Provision of a grounding conductor connected to the emplacement ground system is an interface requirement. Although not a physical interface point, testing and certification of the grounding system is considered an interface requirement.

4-6. AMTC VOLTAGE REQUIREMENTS. Each AMTC requires an isolated voltage source. Control signals are injected onto the 480-volt, 3-phase power bus bars and under certain conditions cross talk or control signal feedback will cause improper operation. Isolation through a transformer will clean up noise on the alternating current input and will reduce control signal transmission and improve operability. Two cost-effective methods of providing isolation are described as follows:

a. When each AMTC is served from its own power center transformer, it is more economical to provide isolation by installing a small isolation transformer in the bus bar heater feeder supply circuit as depicted on drawing E-10.

b. When two AMTC emplacements are served by the same power center transformer, it is more economical to provide isolation by installing an isolation transformer in each bus bar feeder supply circuit.

4-7. ENVIRONMENTAL LIMITS.

a. Indoor Equipment. The temperature and humidity limits for indoor electronic equipment are as follows:

(1) Operating temperature: +15.56 °C (+60 °F) to +26.67 °C (+80 °F).

(2) Nonoperating temperature: -34.44 °C (-30 °F) to +65.56 °C (+150 °F).

(3) Humidity: 5% to 95% (noncondensing).

b. Outdoor Equipment. The temperature and humidity limits for outdoor electronic equipment are as follows:

(1) Operating temperature: -33.33 °C (-28 °F) to +65.56 °C (+150 °F).

(2) Nonoperating temperature: -34.44 °C (-30 °F) to +65.56 °C (+150 °F).

(3) Humidity: 0% to 100% (condensing).

4-8. TARGET EQUIPMENT POWER REQUIREMENTS. The target equipment power requirements are summarized in table 4-3. Standard thermal targets are in the development stage; therefore, the designer must contact the user (range operations officer) in order to verify which thermal target system will be used, its characteristics, and the desired configuration.

4-9. MISCELLANEOUS ELECTRICAL AND CONTROL.

a. Grounding. Grounding is required for safety and lightning protection at each downrange equipment location. A 19-millimeter (3/4-inch) by 3,050-millimeter (10-foot) copper-clad steel ground rod will be driven to a depth of 305 millimeters (1 foot) below finished grade at each equipment location. Each piece of equipment (CBJ’s, target mechanisms, etc.) will be connected to the ground rod with a dedicated, bare, stranded, No. 6 AWG copper wire.

b. Bus Bar Heating. To prevent downtime caused by the accumulation of moisture on the AMTC bus bars, bus-bar heating should be provided. A 277/480-volt, 3-phase, 30-amp circuit is required at each AMTC bunker so that the targetry equipment contractor can connect the strip heater (see figure 4-2 and drawing E-10).

c. Telephone Communications. Telephone communications requirements will be coordinated with the local communications and/or electronics detachment.

d. Equipment Sizing. The electrical design must provide target feeder capacity so that the voltage drop to the most distant target is limited to 5 percent of the transformer output voltage. The designer must also consider load diversity when calculating demands for sizing the panelboards, transformers, and primary feeders. The loads should reflect the most demanding training scenario needed for the site-adapted range design. The thermal target loads may be served from the target feeder if capacity is provided and voltage drop limits are met (keeping in mind that the largest conductor that can be terminated in a CJB is No. 2 AWG). If these requirements are not met, the design must provide for separate circuits.

e. Range Markers. Consideration should be given to providing a power source for range boundary/limit markers. Marker configuration, size, and electrical loads will be coordinated with the

Table 4-3. RETS equipment power requirements

EMPLACEMENT TYPE	POWER FEED TYPE	PEAK	STATIC LOAD	DESIGN LOAD
ITM	120/240 V, single phase	700 VA while raising or lowering target and firing IHFS. Raising and lowering time is 500 milliseconds.	50 VA	700 VA
Thermal Target	120 V	150 VA	150 VA	150 VA
THMTG	120/240 V, single phase	2 kW; raising and lowering time is 6.1 seconds.	100 VA	1.8 kVA*
Thermal Target	120 V	650 VA	650 VA	650 VA
IMTC	120/240 V, single phase	2 kVA during movement. Full-length movement takes about 5.5 seconds.	50 VA	2 kVA
RCS	120/240 V, single phase	1 kVA while printer is active.	500 VA	1 kVA
AMTC	480 V, 3 phase, isolated	65 kVA** while moving at high speed. (Use 75 kVA transformer, minimum.)		
	480 V, 3 phase	20 kVA while bus bar heaters are on.	0 when heaters are off (seasonal)	20 kVA
	120/240 V, single phase	100 VA constant.	100 VA	100 kVA
Thermal Target	120 V	1,300 VA	1,300 VA	Included in 75 kVA
AMTC + Thermal Target + Bus Bar Heater				75 kVA

*Anticipated improved equipment demand load.

**Includes bus bar heater loads.

user (range operations officer) in order to determine design features. Power sources for boundary/limit markers must be placed on separate circuits from those serving RETS equipment.

f. Battlefield Simulation Device. Remotely controlled battlefield simulation devices (BSD's) include RETS target ATKS's, IHFS's, and NMFS's. The remotely controlled BSD's are automatically activated by the RCS computer as part of the programmed scenario. The IHFS, used in conjunction with an SIT emplacement, requires an emplacement located no more than 6 meters (20 feet) from the target emplacement. The ATKS may be used in conjunction with the AMTC and SAT emplacements. Use of the ATKS with the AMTC and SAT does not require any additional equipment or range feature. The NMFS can be used in conjunction with SIT emplacements and requires no special design considerations.

g. Range Lighting. 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.

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