CHAPTER 2
REMOTED TARGET SYSTEM (RETS) EQUIPMENT AND RANGE STRUCTURES

2-1. RETS-EQUIPPED RANGE. RETS provides a computer-operated and -controlled facility that uses both stationary and moving target devices. The system consists of target mechanisms, moving target carriers, night muzzle flash simulators (NMFS), infantry hostile fire simulators (IHFS), armor target kill simulators (ATKS), data links, and a computer control console. RETS software controls target activation in programmed scenarios, records hit information, and provides the trainer with individual scores on a printout. RETS uses standard stationary infantry silhouette targets and vehicle frontal/flank targets, which pop up and down and move back and forth while operating in an environment of convincing sound and sight effects ranging from hostile gunfire to simulated muzzle flashes at night. The modular design of RETS enables equipment interchangeability so that various range configurations can meet current training standards. Except for the MOUT complex, all the ranges addressed in this guidance are RETS-equipped.

2-2. RETS TARGET TYPES AND ASSOCIATED CONTROL AND SIMULATION EQUIPMENT. This paragraph provides a description of the various targets and equipment used on the armor ranges. See drawings C-1 through C-10 for design information about RETS simulation equipment emplacements.

a. Infantry Targets.

(1) Stationary Infantry Targets. SIT's are located in permanent emplacements throughout the downrange area. Each SIT emplacement consists of an infantry target mechanism (ITM), a target, and a CJB. NMFS's and IHFS's are also used on some ranges.

(2) Infantry Moving Targets. IMT's are located in permanent emplacements. Each IMT emplacement includes an IMT, a target carrier, a target, and a CJB.

b. Armor Targets.

(1) Armor Moving Targets. The armor moving target carrier (AMTC) is a training device that supports tank, antitank, Bradley Fighting Vehicle (BFV), and aerial gunnery training. The AMTC consists of three major subassemblies: the track system, the target carrier, and the target elevating mechanism. Each track is approximately 350 meters long and is protected from direct fire or crossfire by berms or trenches. Associated equipment includes an ATKS, a target interface unit (TIU), and a CJB (see the paragraph c, Associated Equipment, below). When used, the optional storage bunker for a moving target emplacement must be located at the end of the track providing the best protection from engagement positions (see paragraph 5-3).

(2) Stationary Armor Targets (SAT's). The target-holding mechanism, tank gunnery (THMTG) is a major subassembly of the SAT emplacement. The THMTG is used to raise and lower an armor target. Necessary controls for the THMTG are provided by the TIU through an interconnecting cable. Control signals provided by the TIU include "raise target" and "lower target." The hit/kill information is also transmitted by the TIU.

c. Associated Equipment.

(1) ITM. The ITM is an environmentally sealed unit that raises and lowers infantry targets.

(2) CJB. Junction boxes provide the interface between the range control station (RCS) and the target equipment. The CJB enclosure will be provided by the construction contractor and must comply with the requirements set forth in chapter 4 of this manual. The internal components will be provided as Government-furnished equipment (GFE) and installed by the targetry equipment contractor.

(3) NMFS. The NMFS is a device that simulates the muzzle flash associated with night firing of small arms weapons. The NMFS will be provided as GFE and installed by the targetry equipment contractor.

(4) TIU. The TIU is environmentally sealed electronic equipment that processes RETS data and control signals to the AMTC and the THMTG. The TIU is provided as GFE and installed by the targetry equipment contractor.

(5) ATKS. The ATKS is a pyrotechnic device that simulates the burning of killed moving and stationary armor targets. The ATKS will be provided as GFE and installed by the targetry equipment contractor.

(6) IHFS. The IHFS is an oxygen propane device for the ITM that uses gas ignition to produce a white smoke cloud and sound to simulate the firing of small arms. The IHFS will be provided as GFE and installed by the targetry equipment contractor. See drawing C-04 for a typical IHFS emplacement.

(7) THMTG. The THMTG is an environmentally sealed unit that raises and lowers armor targets.

2-3. RANGE OPERATIONS AND CONTROL AREA. The range operations and control area is the center for overall control and coordination of the range, training exercises, and administrative services. From the range operations and control area, downrange target and simulation equipment is operated, downrange movement and activity is monitored, and scoring and performance data are collected and distributed. The control tower and support facilities are located in this area. Support facilities at a typical range include an operations/storage building, a general instruction building, an

ammunition breakdown building, latrines, a covered mess, and a bleacher enclosure. The exterior finish of the building will be compatible with the surrounding structures and environment.

a. Control Tower.

(1) Design Drawings. See drawings A-2 through A-4, E-11 through E-13, S-1 through S-6, and M1 for standard control tower architectural, electrical, structural, and mechanical design.

(2) Siting Criteria. The range control tower will be located approximately 15 to 50 meters behind the baseline in an area offering an unobstructed view of all of the baseline and visibility of as much of the downrange area that is economically practical. Only the vegetation obstructing the console operator view of downrange activity needs to be cleared.

(3) Functional Requirements. The control tower houses the RETS RCS. The RCS must have a minimum of 24 square meters (256 square feet) of interior space in order to accommodate the control console, SDA, scoring and recording equipment, communications equipment, and range operations personnel (a console operator, a range operations officer, and a range safety officer). See drawing A-2 for required dimensions.

(4) Architectural Requirements.

(a) Observation Platform. An open observation platform located directly below the control room is an option for all towers. See drawings A-2 and A-3.

(b) Reducing Glare. The control tower has been designed with deep roof overhangs in order to reduce solar glare and enhance visibility from the control tower to the firing line. Tinted, transparent pull-down shades can also be used to reduce glare further. Avoid tinted glass for facilities that are used to conduct night exercises, since the mirroring effect of tinted glass under low background light levels may impair vision from the control tower at night.

(c) Windows. Window size and placement have been chosen to create an unobstructed field of vision for the console operator observing the firing line. Operable windows are required to facilitate cleaning (not for ventilation). See drawings A-3 and A-4.

(d) Stairways. Each flight of stairs having four or more risers will be provided with standard stair railings designed in accordance with Occupational Safety and Health Standards, Title 29, Code of Federal Regulations, Part 1910. Platforms and stairway landings will be provided with standard railings and toeboards also designed in accordance with Occupational Safety and Health Standards, Title 29, Code of Federal Regulations, Part 1910.

b. Environmental Control Equipment. Environmental control equipment for the control tower will consist of a wall-mounted package terminal heating, ventilating, and air-conditioning (HVAC) unit meeting the requirements of TM 5-810-1 and Architectural and Engineering Instructions (AEI): Design Criteria. For most sites, the unit selected will be a heat pump. The ambient control must maintain an equipment-operating temperature of 16 °C to 27 °C (+60 °F to +80 °F). When the computer equipment is not operating, the temperature range may vary from -35 °C to 65 °C (-30 °F to +150 °F) without damaging the equipment. However, when the control tower is occupied, the temperature must be maintained for the comfort of the occupants in accordance with the requirements of TM 5-810-1. The U-factor requirements will be based on local climatic conditions in accordance with the AEI.

c. Structural Requirements.

(1) Material. The control tower superstructure is of structural steel.

(2) Height. The control tower may be varied in height by 2,700-millimeter (9-foot) increments from a minimum height of 2,700-millimeter (9-foot) to a maximum height of 13,500 millimeters (45 feet). Actual tower height will be determined by site conditions and range requirements. The structural adequacy must be rechecked for different heights.

(3) Design Criteria. The standard tower design conforms to EI 01S010, ASCE 7-95, TM 5-809-10, and the following structural criteria:

(a) Roof live load: 1 kPa (20 psf) (site-specific).

(b) Floor live load: 5 kPa (60 psf).

(c) Walkway and stair live load: 5 kPa (100 psf).

(d) Wind speed: 185 kPa (115 mph), exposure C (site-specific).

(e) Seismic: Zone 3 (site-specific).

(f) Structural steel: ASTM A36.

(g) Pipe: ASTM A53.

(h) Structural tubing: ASTM A500.

(i) Concrete: f’c = 28 MPa (4,000 psi).

(j) Reinforcing steel: ASTM A615, grade 60.

(k) Allowable soil-bearing pressure: 100 kPa (2,000 psf) (site-specific).

(l) Minimum safety factor against overturning: 1.5.

The criteria used for roof live load, wind speed, seismic load, and soil-bearing pressure should be sufficient for the majority of site locations. At locations where more stringent design criteria or codes are required, however, the tower design must be analyzed and modified by the designer. Because foundation criteria are site specific, the designer must adapt the standard control tower design to the site. See drawings S-1 through S-6.

d. Operations/Storage Building.

(1) Design Drawings. The operations/storage building accommodates range personnel and stores supplies, spare parts, and tools. See drawings A-6, AX-01, and AX-02 for metal construction; A-11, AX-03, and AX-05 for masonry construction; and drawing E-14 for electrical requirements. The configuration of the operations/storage building depicted in the drawings in appendix F may be modified by the designer, based on the functional requirements of the building designated use.

(2) Metal Construction. Typically, this building will have a thickened-edge concrete slab-on-grade foundation with a self-framing or a rigid-frame steel structural system. The metal walls and roof panels will have metal liner panels with insulation designed to meet the requirements specified in the AEI.

(3) Masonry Construction. This building will have a thickened-edge concrete slab-on-grade foundation. Wall construction will be structurally reinforced concrete masonry units. Walls will be insulated with loose fill insulation, and the ceiling with blanket insulation. The roof will have wood framing, plywood decking, and standing seam metal roof (SSMR).

(4) Size. The size of the building depends on the volume of operations at the range. Typically, the office and storage areas will each require 30 to 40 square meters (300 to 400 square feet).

(5) Doors and Windows. The storage area will have a pair of 900-millimeter by 2,100-millimeter (3-foot by 7-foot) exterior service doors. The personnel area will have a 3-foot by 7-foot exterior door. All doors will be heavy-duty metal doors. Exterior doors will be insulated and equipped with locks, closures, and fixed-pin hinges. Operable windows with security grills or polycarbonate glazing will furnish natural light and ventilation.

(6) HVAC. The office area will be provided with mechanical ventilation and may be provided with heating and/or cooling. Mechanical ventilation will provide air exchange as indicated in TM 5-810-1 and the AEI. If cooling is required, a packaged HVAC unit meeting the requirements of TM 5-810-1 and the AEI will be provided. For most sites, the unit selected will be a heat pump (see drawing M-3). The heating/cooling unit will conform to the requirements of TM 5-810-1 and the AEI. The use of electrical resistance heating must be justified by a life cycle cost analysis. When the operations/storage building is occupied, the temperature must be maintained for the comfort of the occupants in accordance with the requirements of TM 5-810-1.

e. General Instruction Building.

(1) Design Drawings. This building is for troop instruction before or following a training exercise. See drawings A-5, AX-01, and AX-02 for metal construction; A-12, drawings AX-03, and AX-05 for masonry construction; and drawing E-14 for electrical requirements. The configuration of the general instruction building shown in the drawings in appendix F may be modified by the designer, based on the functional requirements of the building's designated use.

(2) Metal Construction. This building will have a thickened-edge concrete slab-on-grade foundation with a self-framing or a rigid-frame steel structural system. The walls and roof will have metal liner panels with insulation designed to meet the requirements specified in the AEI.

(3) Masonry Construction. Typically, this building will have a thickened-edge concrete slab-on-grade foundation. Wall construction will be structurally reinforced concrete masonry units. Walls will be insulated with loose fill insulation, and the ceiling with blanket insulation. The roof will have wood framing, plywood decking, and SSMR.

(4) Size. The building will provide interior space for 40 desks, a lecture platform, audiovisual equipment, and coat storage, plus approximately 1 square meter (10 square feet) per person for circulation.

(5) Location. The general instruction building will be located in the training area in order to provide easy troop access.

(6) Doors and Windows. The general instruction building will have a pair of 900-millimeter by 2,100-millimeter (3-foot by 7-foot) exterior personnel service doors and a single 900-millimeter by 2,100-millimeter (3-foot by 7-foot) exterior personnel door. All doors will be heavy-duty metal doors. Exterior doors will be insulated and equipped with locks, closures, and fixed-pin hinges. Operable windows with security grills or polycarbonate glazing will furnish natural light and ventilation.

(7) HVAC. The general instruction building will be provided with mechanical ventilation and may be provided with heating and/or cooling. Mechanical ventilation will provide air exchange as indicated in TM 5-810-1 and the AEI. If cooling is required, a packaged HVAC unit meeting the requirements of TM 5-810-1 and the AEI will be provided. For most sites, the unit selected will be a heat pump (see drawing M-2). The heating/cooling unit will conform to the requirements of TM 5-810-1 and the AEI. The use of electrical resistance heating must be justified by a life cycle cost analysis. When the operations/storage building is occupied, the temperature must be maintained for the comfort of the occupants in accordance with the requirements of TM 5-810-1. The U-factor requirements will be based on local climatic conditions in accordance with the AEI.

f. Latrines.

(1) Design Drawings. See drawings A-07 and A-08 for metal construction; A-13, A-14, and A-15 for masonry construction; and drawing E-15 for electrical requirements.

(2) Location. Latrines will be located near the major range facilities; however, they must be a minimum of 30 meters (100 feet) from the mess area.

(3) Single-Sex Latrine Design. The latrine design shown in drawing A-07 accommodates males or females in separate facilities. This latrine has 6 waterless closets and approximately 2,500 millimeters (8 feet) of urinal trough that will accommodate a training unit of up to 270 men. To accommodate a unit of up to 150 in a women-only latrine, delete the urinal trough and drain line.

Latrine capacity shown in table 2-1 below was derived from Occupational Safety and Health Standards, Title 29, Code of Federal Regulations, Part 1910.141, table J-1.

Table 2-1. Latrine Capacity

Number of Personnel	Number of Toilets
1 to 15	1
16 to 35	2
36 to 55	3
56 to 80	4
81 to 110	5
111 to 150	6
over 150	1 additional for each additional 40 personnel

(4) Dual-Sex Latrine Design. The latrine designs shown in drawings A-08, A-13, A-14, A-15, AX-03, and AX-05, appendix F, will accommodate both males and females in the same facility. In the aerated vault design (drawing A-08 for metal and drawing A-15 for masonry), the male side has 4 waterless closets and approximately 1,800 millimeters (6 feet) of urinal trough; the female side has 2 waterless closets. In the design for water (drawings A-13 and A-14), the male side has four water closets and three urinals; the female side has 2 water closets. These latrines will accommodate a training unit of up to 190 men and 35 women. Latrine capacity shown in table 2-1 above was derived from Occupational Safety and Health Standards, Title 29, Code of Federal Regulations, Part 1910.141, table J-1.

(5) Toilet Types.

(a) Water Closets. If a water supply and sanitary sewers or septic tank system are available at the range, standard water closets and urinals may be used. Drawings A-13 and A-14 show the design for water. For locations where freezing temperatures may be encountered, provide freeze protection (heated to maintain 5 °C/40 °F). The heating unit must conform to the requirements of TM 5-810-1 and the AEI. The use of electrical resistance heating must be justified by a life cycle cost analysis.

(b) Aerated Vault Latrines. If a water supply is not available, an aerated vault latrine may be used, or in remote areas, a composting toilet. Drawings S-09 and M-05, appendix F, show details. In the aerated vault latrine, the water level must be maintained at least 150 millimeters (6 inches) above the aerators.

(c) Ventilation. For natural ventilation, use operable windows with security grills or polycarbonate glazing. Mechanical ventilation must conform to TM 5-810-1. See drawings M-4 and M-5.

(d) Disposal Prohibitions. In the past, soldiers have used latrines for disposal of toxic chemicals such as cleaning agents. Such chemicals can kill the aerobic organisms that decompose sewage, resulting in odor problems and inadequate sewage disposal. To help prevent such problems, a sign stating the following should be posted in each latrine:

Disposal of chemical or foreign substances in latrines is prohibited.

g. Ammunition Breakdown Building.

(1) Design Drawings. The ammunition breakdown building is to be used for breaking down and issuing ammunition to the personnel involved in range training exercises. See drawings A-09, AX-01, and AX-02 for metal construction; drawings A-16, AX-03, AX-04, and AX-05 for masonry construction; and drawing E-16 for electrical requirements.

(2) Siting Criteria. In accordance with DA PAM 385-64, siting will be based on the quantity and classification of the ammunition items that will be involved. The building must be sited not less than intraline distance from the range firing line, range support facilities, and other exposed sites associated with the range. See also paragraph 2-5 below.

(3) Lightning Protection. The ammunition breakdown building must have lightning protection conforming to NFPA 780.

h. Miscellaneous Range Support Facilities. In addition to the range support facilities described above, design data and information for the following buildings and support facilities are included in this manual.

(1) Covered Mess. See drawings A-17 and A-18 for architectural requirements, and drawing E-16 for electrical requirements.

(2) Bleacher Enclosure. See drawings A-19, AX-04, S-17, and S-18. The designer must ensure that the size of the enclosure will accommodate the capacity of the bleachers.

(3) Ammunition Loading Dock. See drawing S-10 for dock design and drawing E-07 for lightning protection.

(4) Lightning Protection. If the covered mess and the bleacher enclosure are to be used as protection during thunderstorms, a lightning protection mast system or overhead wire system must be installed (see drawing E-07, appendix F).

2-4. FACILITY ARCHITECTURAL AND STRUCTURAL GUIDELINES.

a. Functional Criteria.

(1) Facilities in this manual have not been designed for site-specific applications; therefore, the designer must modify the designs in order to meet site-specific needs.

(2) Siting of the control tower and support buildings must be coordinated with the user in order to provide optimum flexibility without compromising tactical and maneuver areas.

(3) Range support buildings will be durable, easily constructed and maintained, and relatively inexpensive.

b. Standardization. Metal panels, their structural components, flashings, and connection systems will be standard with those of the metal building industry.

c. Flexibility of Facility Systems. To accommodate local conditions and equipment, requirements for design modifications and revisions will be determined by the designer. For example, modifications may include the addition or deletion of insulation or the change of window sizes and types.

d. Security. Vandalism and theft will be deterred by metal doors, security grills or polycarbonate glazing, windows, and hardware. All buildings require those security measures, except windows in the control tower.

e. Foundations. Foundation criteria, such as allowable soil-bearing pressures, frost depth, lateral earth pressure, etc., are site-specific data to which the designer must adapt the recommended designs in accordance with foundation reports prepared for each proposed facility site. Turned down slab footings may have to be replaced with foundation walls in areas with a deep frost depth.

2-5. SAFETY REQUIREMENTS.

a. Support Facilities. Range support facilities will be designed and sited to comply with:

(1) AR 385-63.

(2) DA PAM-64.

(3) Occupational Safety and Health Standards, Title 29, Code of Federal Regulations, Part 1910.

(4) DA PAM 40-501.

b. Quantity-Distance Siting Requirements. Siting for the ammunition breakdown building must meet DA PAM 385-64 requirements and be based on the quantity and classification of the ammunition items involved. For example, DA PAM 385-64 shows that 20-mm ammunition without explosive projectiles is classified as class/division 1.4, and the intraline distance is 15 meters (50 feet) for any quantity of ammunition. Once the quantity-distance is known, the ammunition breakdown building must be sited as follows:

(1) Not less than intraline distance from the range firing line, range support facilities, and other exposed sites associated with the range.

(2) Not less than inhabited building distance from exposed sites of the range, including the installation boundary.

(3) Not less than public traffic route distance from any navigable stream, passenger railway, or public street, road, or highway (including roads on military reservations that are used routinely by the general public for through traffic).

(4) Beyond the quantity-distance arcs from existing potential explosives sites on an installation.

c. Hazardous Noise. DA PAM 40-501 defines hazardous noise as a steady state exposure of 85 dBa or more, regardless of duration, and impulse exposure exceeding 140 dBp. Because weapons used on training ranges create hazardous noise, range support facilities must be sited so that personnel will not be exposed to the hazardous noise during range activities.

(1) Hazardous Impulse Noise Contours. The primary factor for the siting of support facilities is the hazardous impulse noise resulting from weapons firing. For each weapons system to be used on a range, the 140 dBp noise contours will be drawn from each firing position. The support facilities will be sited beyond the hazardous impulse noise contours.

(2) Control Tower Siting. The control tower is the only structure that, if it is not possible to do otherwise, may be located within the hazardous noise contours created by range activities. If the control tower is located within the hazardous noise contour, it must be designed to provide adequate sound attenuation in order to protect personnel from hazardous noise exposure or the personnel must wear suitable hearing protective devices.