SECTION I

GENERAL DESCRIPTION

1-1. INTRODUCTION.

1-2. The SM68 Missile Weapon System consists of a radio inertially guided, liquid fueled missile and the associated ground equipment necessary to maintain and launch the missile. The weapon system is capable of destroying enemy targets over 5500 nautical miles distant. The missile complex is designed to maintain an operational readiness condition with no outside support after sustaining an attack that destroys all nonhardened facilities. For maximum safety and effectiveness, individual launch sites are widely separated. All in-commission missiles are maintained in a constant alert condition and may be counted down individually or simultaneously.

1-3. SM68 MISSILE.

1-4. LEADING PARTICULARS.

1-5. The SM68 missile consists of three sections: Stage I and Stage II, both powered by rocket engines, and a re-entry vehicle. Provisions are included for inflight separation (staging) of Stage II from Stage I and separation of the re-entry vehicle from Stage II. The Stage I and Stage II vehicles each contain a rocket engine and hydraulic equipment; the two stages together contain flight control equipment and electrical equipment; Stage II contains guidance equipment. Figure 1-1 outlines the external missile configuration and identifies the major parts of the SM68 missile. Figure 1-2 provides a table of leading particulars.

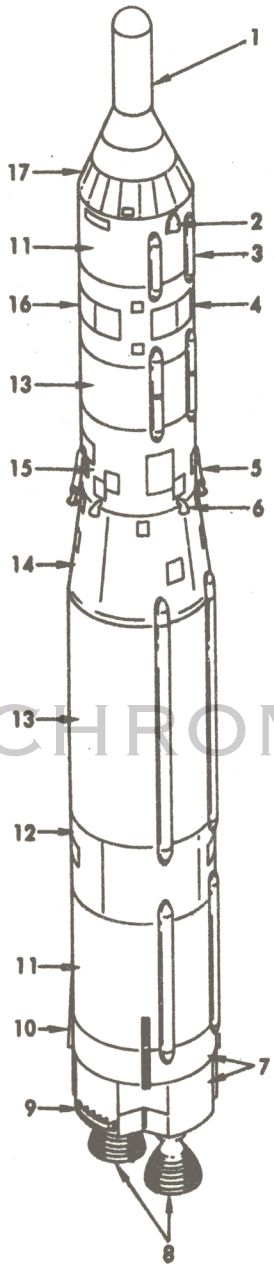
1-6. COUNTDOWNS.

1-7. Basically the SM68 missile countdown capability can be limited to EWO launch and exercise countdowns.

1-8. The EWO launch countdown may be initiated within a matter of minutes on any missile that is on EWO alert, provided that a valid execution order is received by the missile combat crews. Prompt and efficient reaction to this order is the primary responsibility of a missile combat crew.

1-9. Combined systems exercise (CSE) countdown is an integrated weapon system operation wherein a missile countdown in a non-launch mode parallels a guidance system countdown in an exercise mode. The CSE countdowns are basically identical to an actual launch type countdown. The receipt of a launch exercise enable signal is indicated by the START LCH EXERCISE indicator on the missile guidance console. Pressing of the LAUNCH EXERCISE pushbutton indicator on the missile guidance console enables the ground guidance system and the launch system to perform a combined systems exercise. The CSE countdown proceeds from start countdown through the simulated function of missile liftoff to the end of guidance. A series of steering orders and discrete commands, generated by a CSE guidance program in the computer, are transmitted from the ground guidance system to the missile during the plus time portion of the CSE countdown.

1-10. Three modes of CSE can be accomplished: dry CSE, fuel CSE, and lox CSE. These modes of operation will accomplish a weapon system checkout through functional use of the missile facility and aerospace operating equipment (AOE).



1. RE-ENTRY VEHICLE
2. GUIDANCE ANTENNA
3. EXTERNAL CONDUIT (TYPICAL)
4. ACCESS PANEL (TYPICAL)
5. STAGING ROCKET (2 PLACES)
6. VERNIER NOZZLE (4 PLACES)
7. TAIL SKIRT AND TAIL FAIRING ASSEMBLIES (STAGE I ENGINE COMPARTMENT)
8. THRUST CHAMBERS
9. AIR SCOOP (2 PLACES)
10. MAIN LONGERON (4 PLACES)
11. FUEL TANK
12. STAGE I BETWEEN TANKS STRUCTURE (STAGE I BETWEEN TANKS COMPARTMENT)
13. LIQUID OXYGEN TANK
14. STAGE I SUPPORT STRUCTURE (STAGE I TRANSITION COMPARTMENT)
15. STAGE II AFT SKIRT ASSEMBLY (STAGE II ENGINE COMPARTMENT)
16. STAGE II BETWEEN TANKS STRUCTURE (STAGE II BETWEEN TANKS COMPARTMENT)
17. FORWARD SUPPORT STRUCTURE (STAGE II TRANSITION COMPARTMENT)

500L34C

Figure 1-1. Missile Configuration

FACILITIES OR EQUIPMENT	PARTICULARS
SM-68 MISSILE	
Length	Overall, including air frame and component extensions, 98 feet, 10 inches. Stage I - 10 feet, Stage II - 8 feet, R/V - 2 feet 9 inches.
PROPELLANT	
Fuel	Rocket propellant number one (RP-1)
Oxidizer	Liquid oxygen (lox)
PROPELLANT CAPACITIES: (Approximately)	
Fuel tank	Stage I - 7750 Gallons, Stage II - 2027 Gallons Total - 9,777 Gallons.
Liquid oxygen tank	Stage I - 12,400 Gallons, Stage II - 2985 Gallons Total - 15,385 Gallons.
PROPULSION:	
Stage I engine	300,000 pounds thrust at sea level.
Stage II engine	80,000 pounds thrust at 250,000 feet altitude.
Vernier thrust	900 pounds at 250,000 feet altitude.
GUIDANCE SYSTEM	Radio inertial guidance
RANGE	5,500 nautical miles.

Figure 1-2. Table of Leading Particulars.

1-11. DRY CSE. The purpose of the dry CSE mode is to exercise the applicable subsystems during a countdown without transfer of propellants or gases. This is done with a minimum of preparation and can be performed and recycled on short notice. Dry CSE is performed with no launcher movement, with or without fuel aboard the missile. The entire exercise can be performed with the complex in the hardened condition.

1-12. FUEL CSE. The fuel CSE mode enables the weapon system to be exercised through a countdown and simulated nose cone release without transferring propellants or helium gases. The fuel mode is performed with only fuel loaded and with launcher movement. During countdown the fuel tanks are pressurized with N_2 while the lox and helium pressure switches are simulated. The launcher platform is raised and guidance is initiated. Shutdown occurs after simulated nose cone release.

1-13. LOX CSE. The lox CSE mode enables the weapon system to be exercised through a countdown and simulated re-entry vehicle release. The lox and helium systems are pressurized and the fuel pressure switches are simulated. The launcher platform is raised and guidance is initiated. Shutdown occurs after simulated nose cone release.

1-14. POST LAUNCH AND SHUTDOWN OPERATIONS.

1-15. Post launch and shutdown operations return the missile complex to a hardened configuration. Missiles and facilities are safed and any shutdown missiles are recycled to a readiness condition.

1-16. PROPELLANTS.

1-17. Liquid oxygen (lox) and RP-1 (processed kerosene) are the propellants used by the rocket engines. The walls of the tanks in which the propellants are stored serve also as skin for the missile.

1-18. EXTERNAL CABLE CONDUITS.

1-19. External cable conduits on the exterior of each propellant tank wall provide for the routing of electrical cables and pressurization lines. At VAFB these conduits also provide routing for the range safety system, consisting of instrumentation cables and primacord lines.

1-20. ACCESS PANELS.

1-21. Access panels provide missile entrances for inspection, replacement, and repair of systems and equipment. Access panels are (figure 1-3) are located in the between-tanks, support, engine, and transition areas. There are no external access panels on the propellant tanks. Manholes on tank domes are provided in order to enter the propellant tanks for repair or cleaning.

1-22. ORDNANCE

1-23. STAGING ROCKETS. The two staging rockets are mounted 180 degrees apart on the outside of the Stage II engine compartment. At separation, they provide 9600 pounds of thrust for approximately 3 seconds, producing a minimum separation distance of 10 feet between the first and second stages.

1-24. STAGING SEPARATION BOLTS. The four staging separation bolts are located at four restraining points around the missile. They are used to secure Stage II to

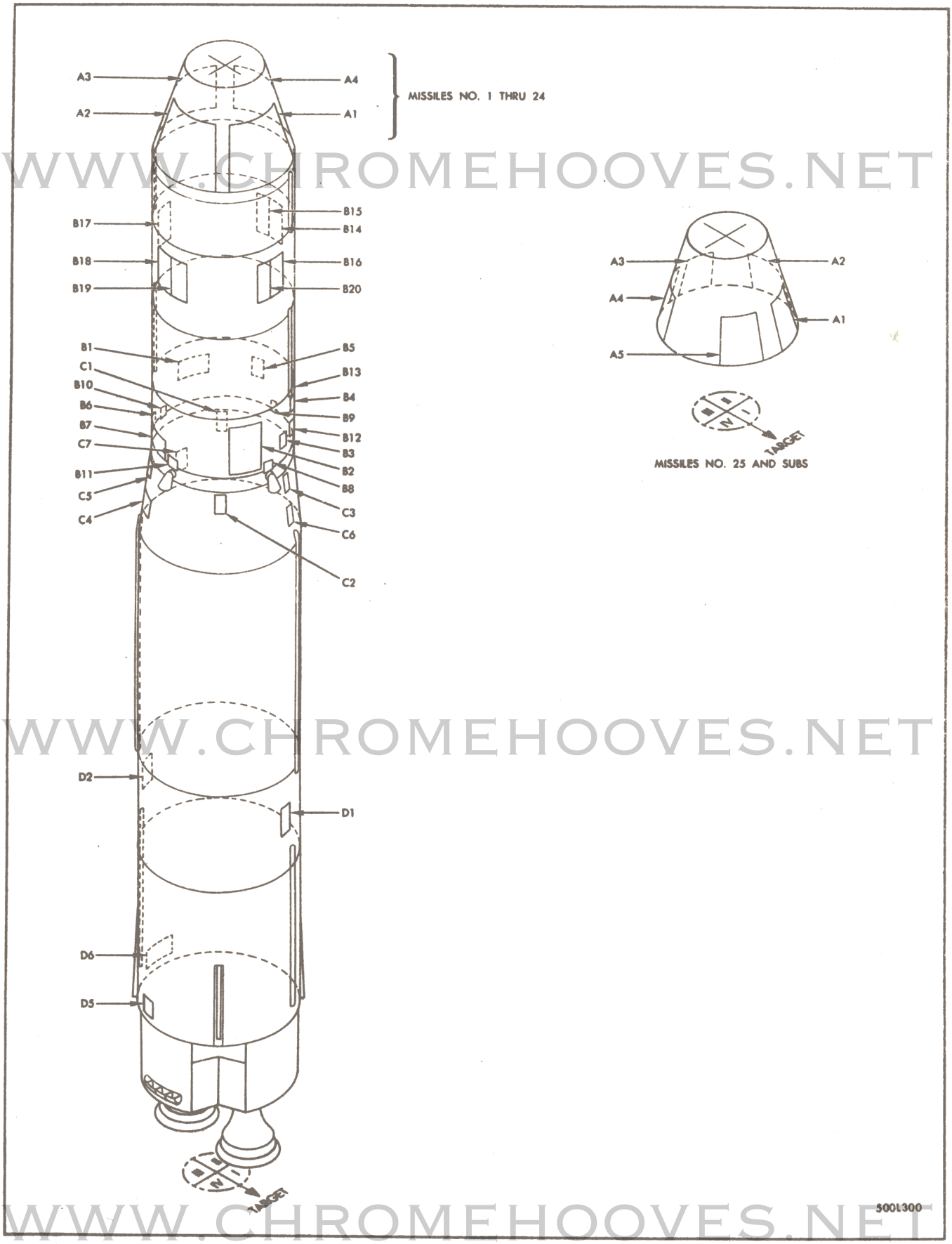


Figure 1-3. Access Panels

Stage I. Each staging separation bolt consists of one stud, two nuts, and two nut squibs. At separation, the squibs disengage the nuts from the studs, allowing Stage I and Stage II to separate.

1-25. STAGING ROCKET RELEASE SQUIBS. One staging rocket release squib is mounted in each of the two piston and cylinder assemblies at the forward end of the staging rockets. After the staging rockets have burned out, the release squibs fire to jettison the staging rockets.

1-26. IGNITERS. Two pyrotechnic igniters are used to start fuel and lox burning in the combustion chamber. Power to the igniters is supplied by the engine control system (ECS) aerospace operating equipment, and applied to the igniters through the thrust chamber valve switch. Each thrust chamber igniter assembly consists of a cluster of 8 single pyrotechnic igniters mounted on an igniter holder.

1-27. MISSILE RELEASE BOLTS. Hold-down clamps, secured by explosive bolts, hold the missile to the launcher until sufficient engine thrust is attained for missile launching. The explosive bolts are electrically detonated to release the missile hold-down clamps, and explosive bolts within the umbilical tower are fired to enable tower retraction. The electrical system arms and fires the explosive bolts.

1-28. VERNIER NOZZLES.

1-29. The four vernier nozzles are small uncooled thrust chambers on Stage II that control Stage II attitude during staging and assist in controlling Stage II powered flight. After Stage II sustainer engine shutdown, the nozzles make final trajectory and velocity corrections before the re-entry vehicle is released. The nozzles are spaced 90 degrees apart around the aft end of Stage II.

1-30. LAUNCH COMPLEX.

1-31. LEADING PARTICULARS.

1-32. The launch complex consists of three missile launchers, a power house, antenna terminal and antenna silo, fuel terminal, portal, tunnels, and local control stations. Each launcher contains a missile silo, equipment terminal, and propellant terminal. At VAFB, the launch complex also contains a pump house.

1-33. The launch complexes are similar in function and physical layout. Differences between certain areas at VAFB and the operational bases are shown in figures 1-4 and 1-5. All of the structures are of reinforced concrete construction and have structural grounding networks, ventilation systems, drainage systems, weather protection, and complete utilities such as water, heat, sewage disposal, and electric power. All structures at the operational bases are underground; at VAFB, the structures are combination underground and reinforced surface structures. Equipment is designed to provide maximum accessibility of components and to allow repair of malfunctioning equipment by removal and replacement of components with a minumum of calibration and adjustment.

1-34. MISSILE SILO.

1-35. The missile silo (figure 1-6) stores and protects the missile underground. A launcher platform in the silo supports the missile and raises it above ground for launching.

(Text continued on page 1-13.)

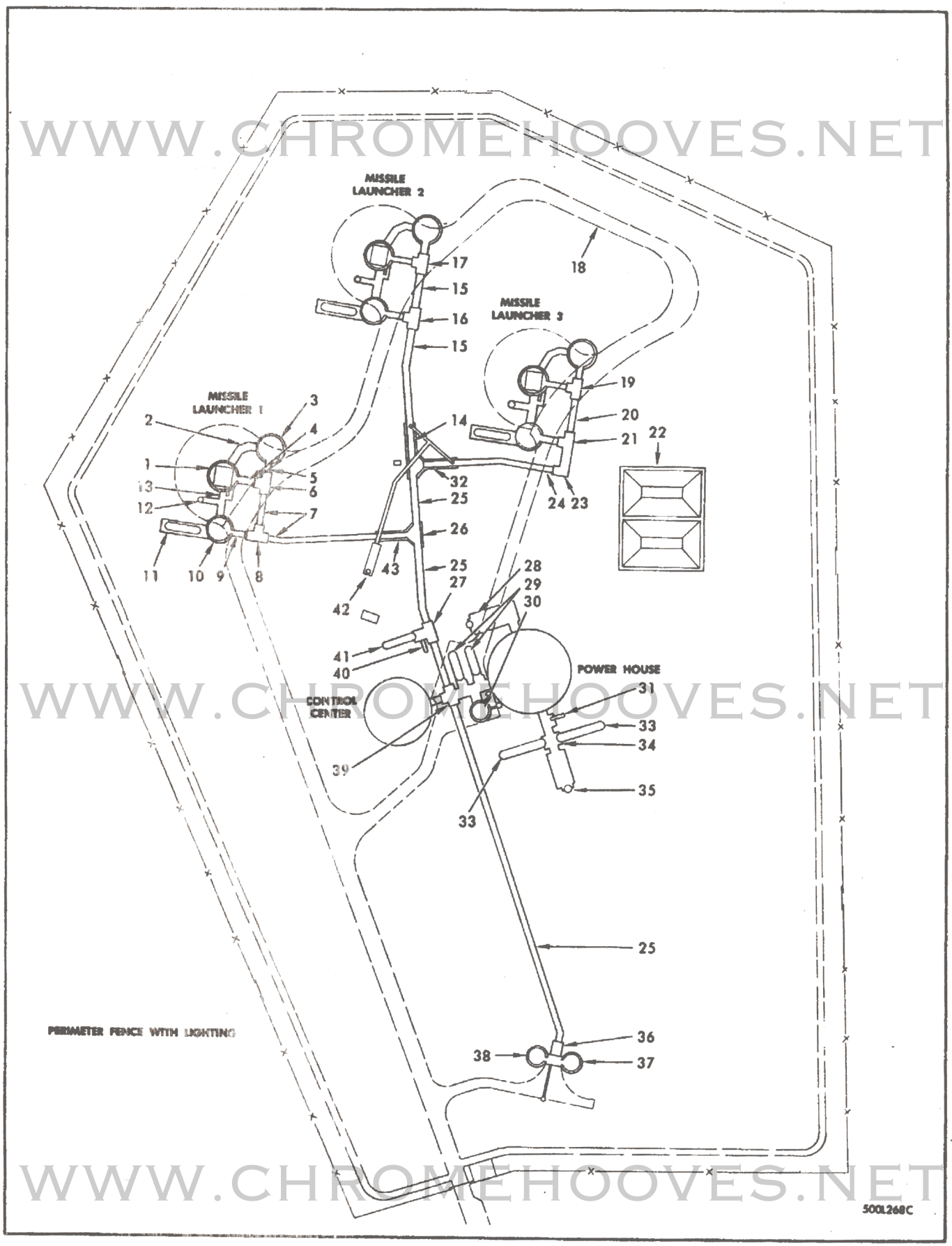


Figure 1-4. Operational Base Launch Complex (Sheet 1 of 3)

1. Missile Silo
2. Utilities Tunnel
3. Equipment Terminal
4. Missile Silo Branch Tunnel
5. Equipment Terminal Branch Tunnel
6. Tunnel Junction 1
7. Missile Launcher 1 Branch Tunnel
8. Tunnel Junction 2
9. Propellant Terminal Branch Tunnel
10. Propellant Terminal
11. Lox Storage Area
12. Lox Fill and Vent Shaft
13. Lox Tunnel
14. Blast Lock 2
15. Missile Launcher 2 Branch Tunnel
16. Tunnel Junction 5
17. Tunnel Junction 4
18. Service Road
19. Tunnel Junction 7
20. Missile Launcher 3 Branch Tunnel
21. Tunnel Junction 9
22. Sewage Stabilization Pond
23. Tunnel Junction 8
24. Missile Launcher 3 Branch Tunnel
25. Main Tunnel
26. Tunnel Junction 13
27. Tunnel Junction 12
28. Power House Air Filtration Facility
29. Water Storage Tanks
30. Portal
31. NO. 2 Diesel Oil Tank
32. Blast Lock 3
33. NO. 4 Diesel Oil Tank
34. Tunnel Junction 11
35. Power House Exhaust
36. Antenna Terminal
37. Antenna Silo 2
38. Antenna Silo 1
39. Tunnel Junction 10
40. Nitrogen Blanket Tank
41. Missile Fuel Storage Tank
42. Launcher Area Air Filtration Facility
43. Blast Lock 1

Figure 1-4. Operational Base Launch Complex (Sheet 2 of 3)

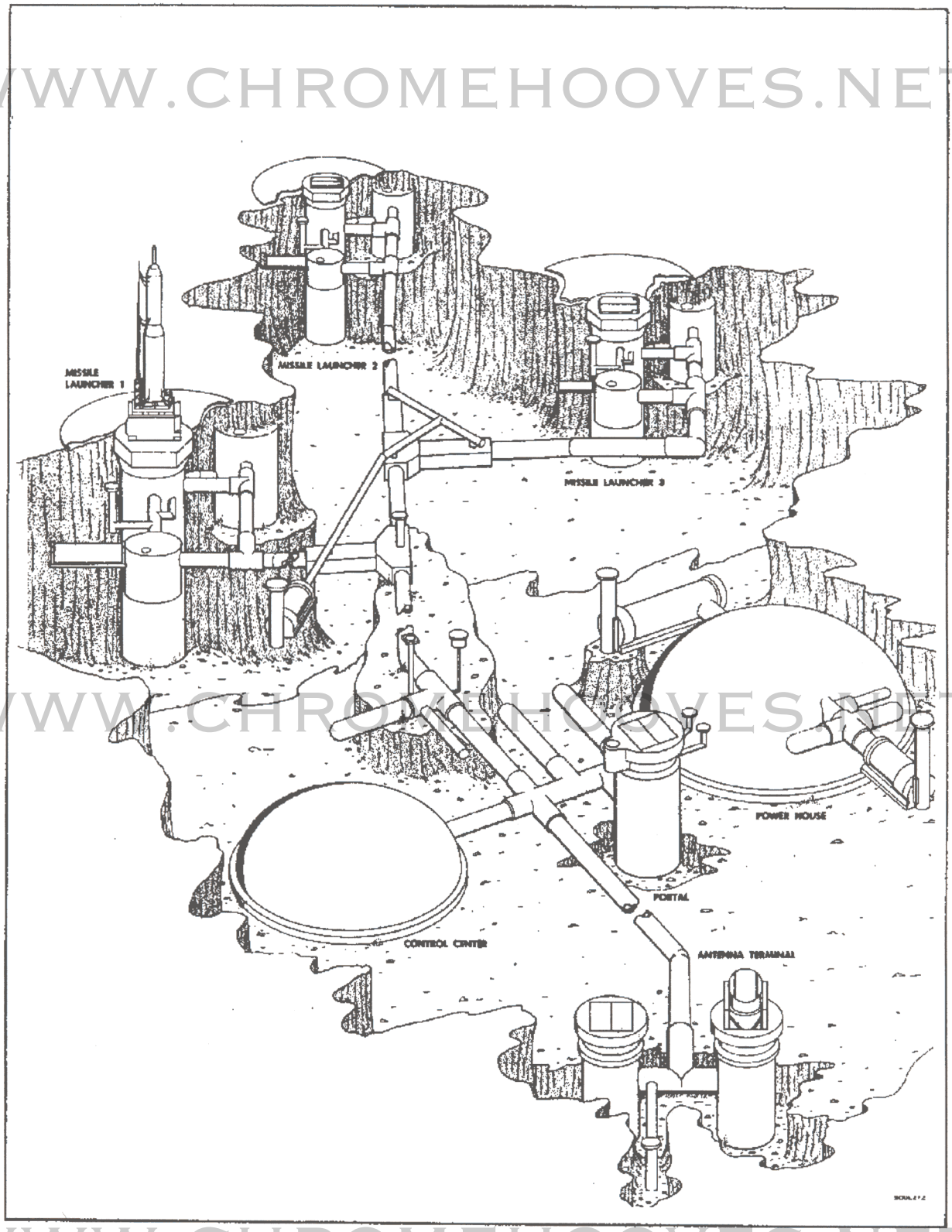


Figure 1-4. Operational Base Launch Complex (Sheet 3 of 3)

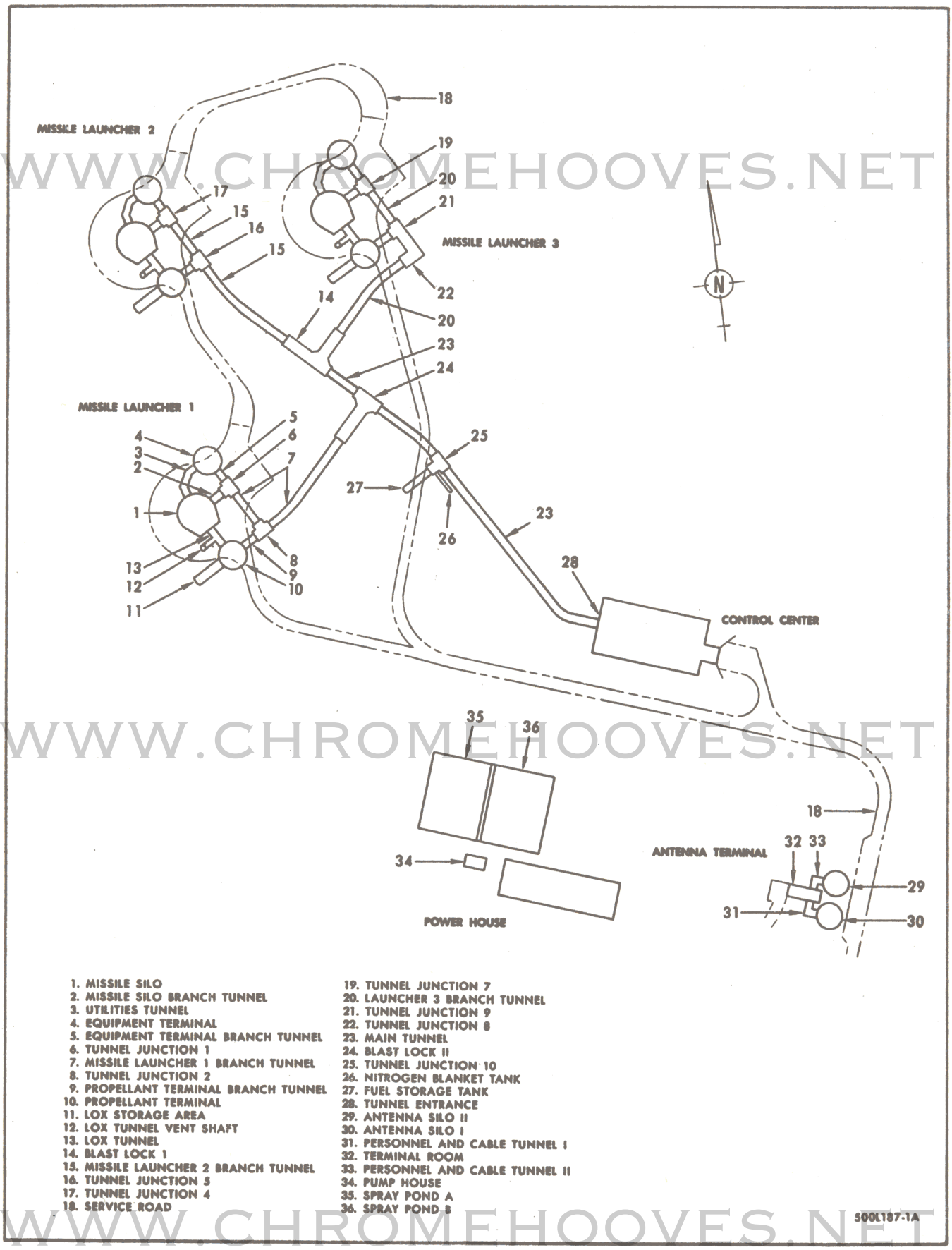


Figure 1-5. VAFB Launch Complex (Sheet 1 of 2)

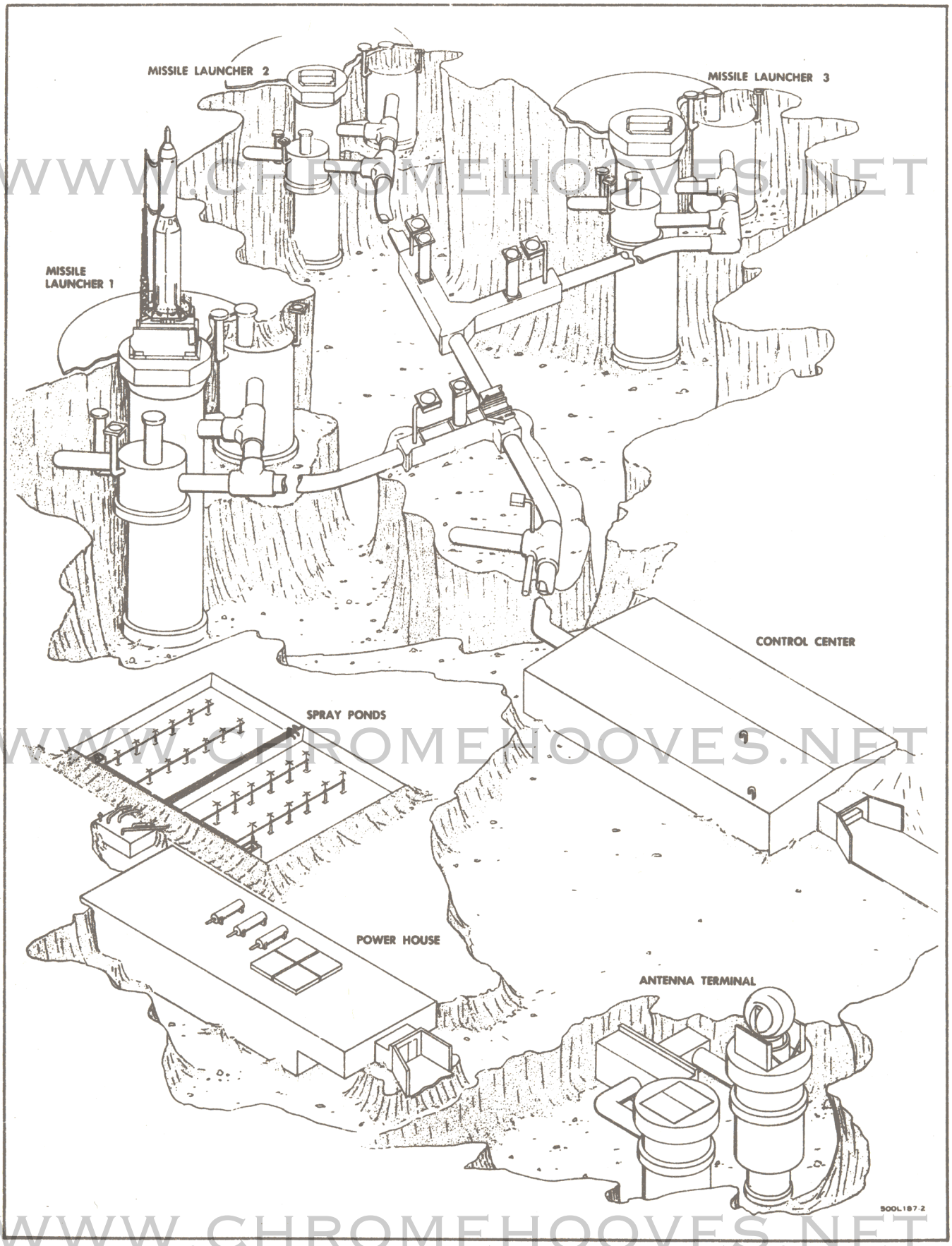


Figure 1-5. VAFB Launch Complex (Sheet 2 of 2)

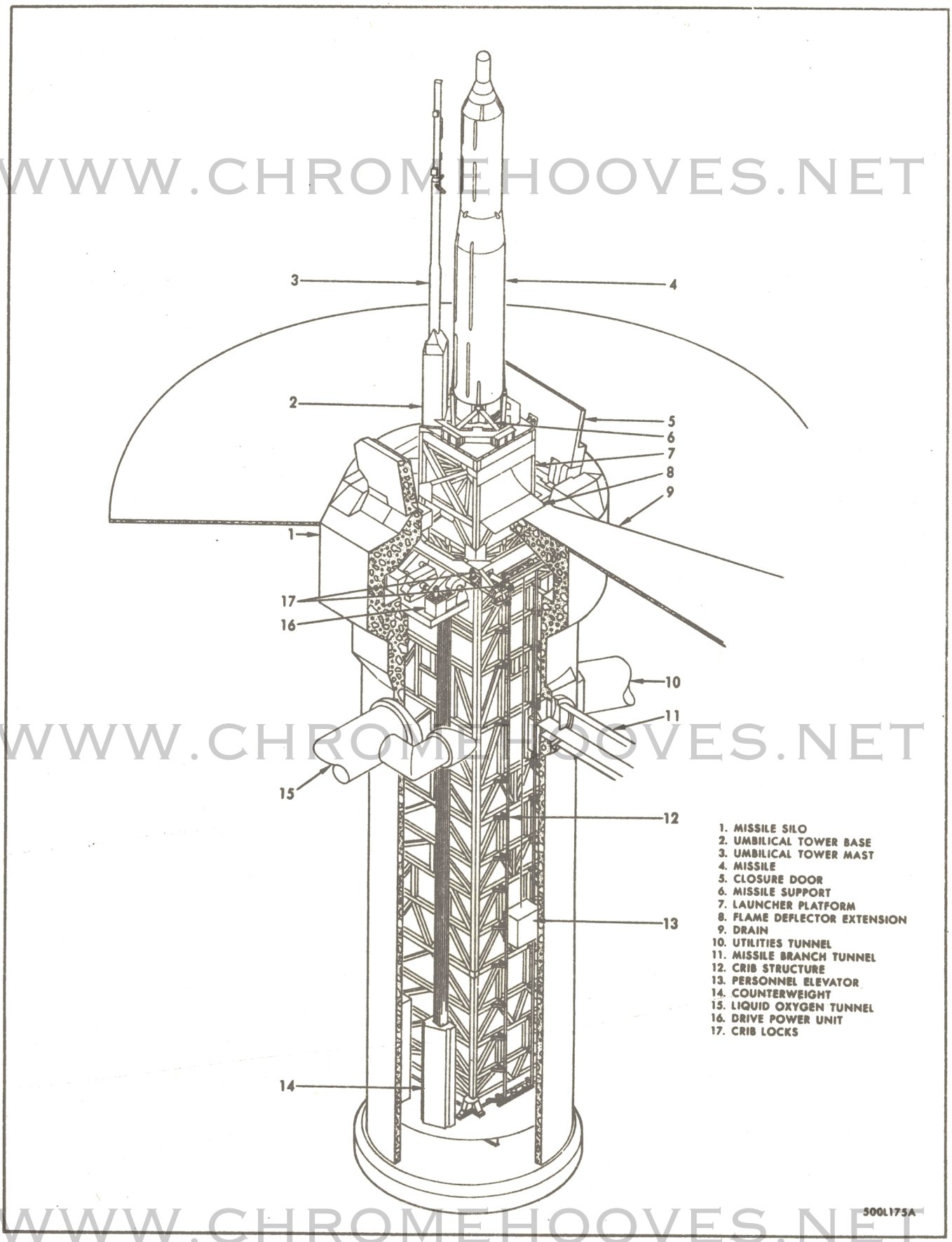


Figure 1-6. Missile Silo

(Text continued from page 1-6.)

1-36. The missile silo, including the door foundation, forms a cylindrical reinforced concrete structure approximately 158 feet in depth and 40 feet in diameter. A pair of reinforced concrete silo doors (figure 1-7), each weighing about 230,000 pounds, cover the silo mouth. The silo doors protect the missile from weather, overpressures due to nuclear blast, and contamination from nuclear attack. Structural isolation of the door foundation minimizes the transmission of surface shock to the missile silo. The doors are opened hydraulically by double-acting actuating cylinders.

1-37. Equipment in the silo includes the crib structure, launcher platform, launch platform drive system, umbilical lines and their support mechanisms, hydraulic plumbing, water plumbing, electrical circuitry, fire fighting, and sensing devices.

1-38. CRIB STRUCTURE. The crib structure (figure 1-8) is constructed of vertical steel framework which functions as a support frame for maintenance, protection, and launch of the missile. The crib structure is suspended by spring supports within the silo, which protect the missile against violent ground shocks. The crib supports all the maintenance platforms and control stations. The maintenance platforms provide work areas at various heights within the silo. The crib structure also supports the personnel elevator as well as ladders and stairways. Personnel safety devices, such as eyewash and shower stations, railings, and nets, are positioned about the crib. Hydraulic and electrical lines are routed along the crib structure for the actuation and control of crib mechanisms and maintenance equipment.

1-39. The personnel elevator, supported by the crib structure, carries personnel and equipment to the five maintenance platforms, the missile service platform, the rail access platform, and crib bottom. The elevator is driven by an electric hoist and is controlled from a self-service panel inside the car. There are call stations located at each elevator stop and at the self-service panel inside the car.

1-40. Five maintenance platforms are mounted on the crib. The main platform sections at each level are extended and retracted hydraulically. Platform sideleaves are extended manually to provide a continuous walkway and working area completely encircling the missile, except at the fifth level. The platforms are retractable to allow the launcher platform to pass without interference. Work platforms at each level may be controlled from the personnel elevator when it is at that level.

1-41. A crib-to-silo bridge is provided at the end of the missile silo branch tunnel to bridge the space between the silo wall and the crib structure and is the primary elevator stop. A gate protects personnel on the bridge.

1-42. LAUNCHER PLATFORM. The launcher platform (figure 1-9) is a shell structure that supports the missile in the silo during storage and launch operation. The launcher platform consists of the missile support structure (A-frame mounts), flame deflector, water spray equipment, umbilical tower base, guide rollers, platform-to-crib locks, platform-to-crib seal, and service platform.

1-43. The launcher platform converts the tension of the wire ropes into vertical movement of the missile within the crib structure. Vertical and lateral platform-to-crib locks secure the launcher platform in the launching position. At the silo-mouth, the support structure provides a level, stable platform from which the missile is released when engine thrust is sufficient for lift off. Engine exhaust is deflected by the flame deflector, and the water spray equipment protects the

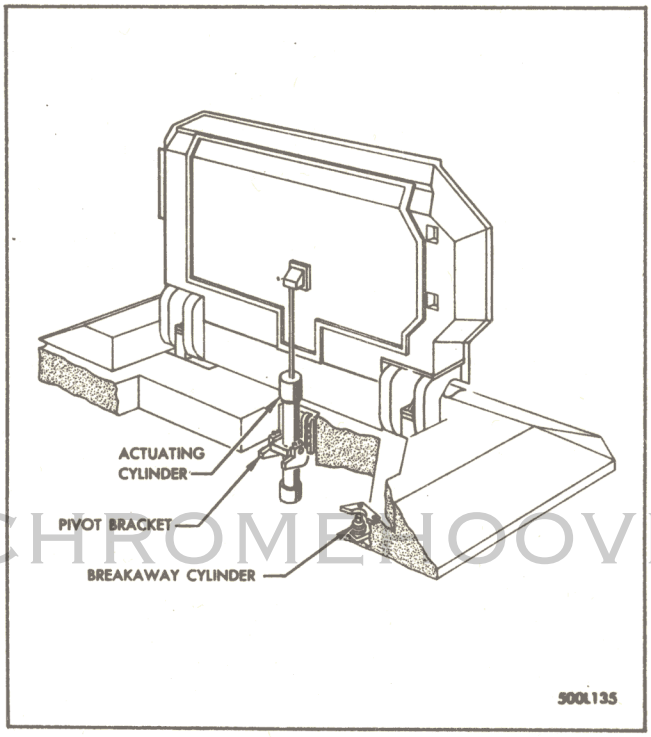


Figure 1-7. Silo Doors

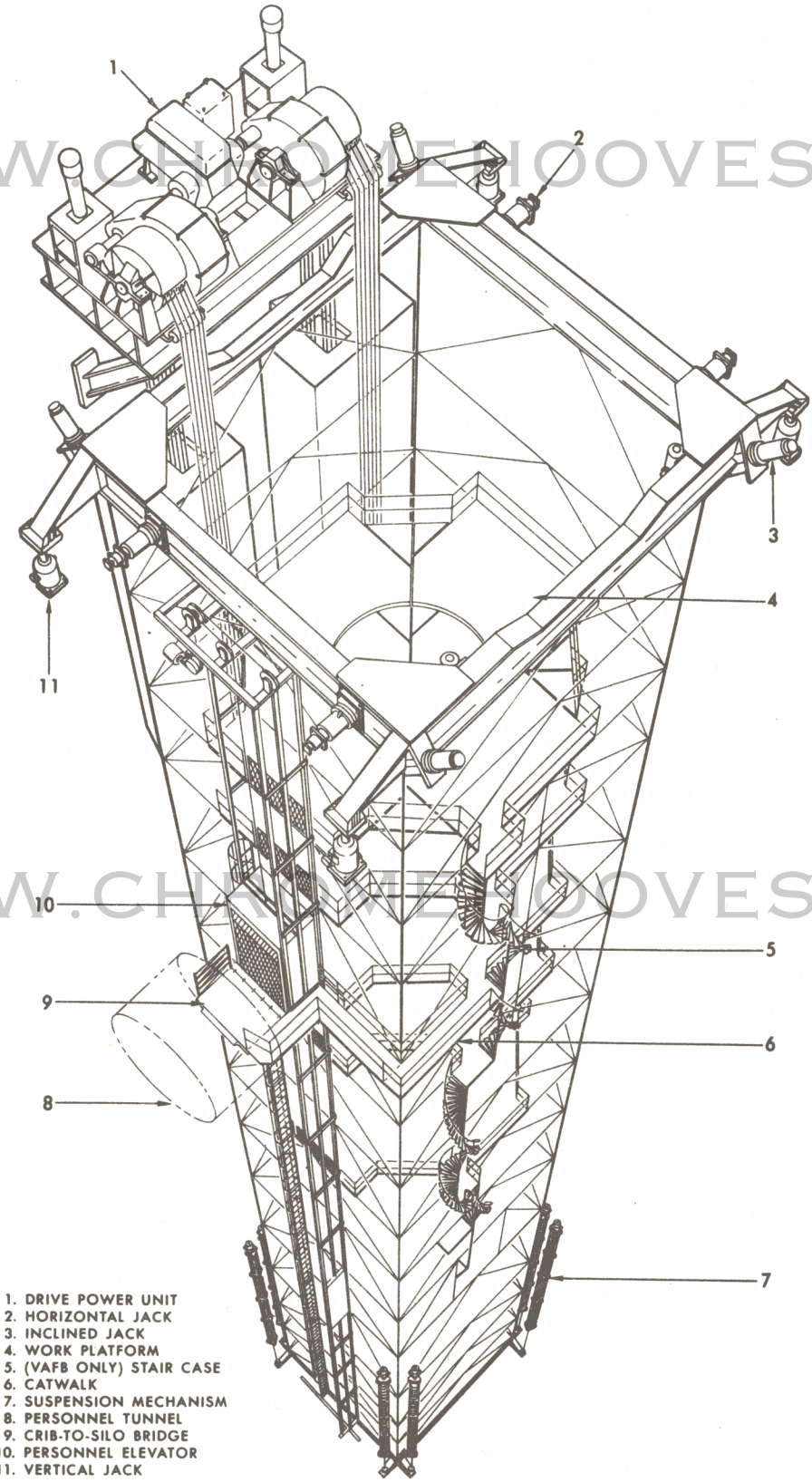


Figure 1-8. Crib Structure

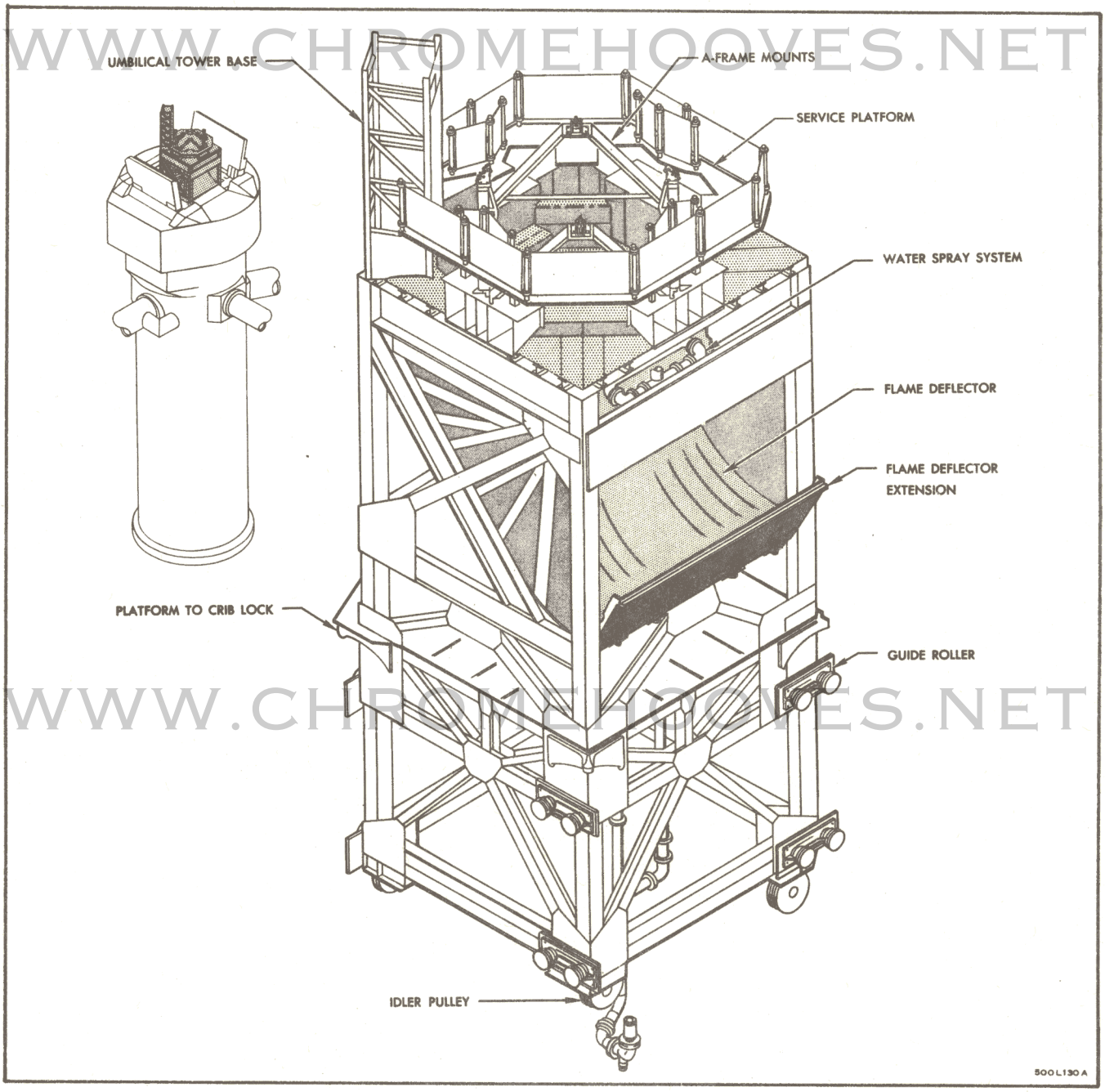


Figure 1-9. Launcher Platform

missile and launcher platform from engine exhaust heat damage. The platform-to-crib seals prevent the entrance of engine exhaust, water, fuel, or liquid oxygen into the silo.

1-44. The umbilical tower (figure 1-10) is located at one corner of the launcher platform and consists of a pivoting boom and stationary tower base. The tower supports three groups of umbilical lines: group one, Stage I engine compartment; group two, Stage II engine compartment; and group three, Stage II transition compartment. At launch, the umbilical tower is tilted away from the missile by detonating explosive bolts. The tower tilt disconnects all umbilical connectors mechanically by lanyards.

1-45. The service platform provides a work area for personnel performing maintenance on the missile support system and the Stage I engine. The service platform is covered with metal decking and has removable guard rails.

1-46. LAUNCHER PLATFORM DRIVE SYSTEM. The launcher platform drive system (figure 1-11) raises and lowers the launcher platform and can hold it at any level in the silo. Two sets of wire ropes are attached to tension equalizers and are routed over idler pulleys located under the launcher platform. Tension equalizers mounted on the crib structure maintain tension on the wire ropes to keep the platform level and to minimize rope damage from unequal loading. The tension equalizers slacken a portion of the wire ropes, and allow the crib to move freely in the event of ground shock.

1-47. UMBILICAL LINES AND SUPPORT MECHANISM. Umbilical lines with associated support mechanism (figure 1-12) connect service and power facilities to the missile when it is on the launcher platform. The umbilical lines not required for missile launching are routed within the silo and connected to the crib. These lines extend from the crib to the missile-mounted umbilical connectors and are disconnected prior to the raising of the launcher platform.

1-48. (Prior to incorporation of TCTO 21-SM68-763.) Upon receipt of a signal from the logic circuitry an electrically controlled umbilical retraction mechanism pivots the umbilical lines away from the missile. When the umbilicals are fully retracted a retracted-and-latched signal is received by the logic circuitry from each retraction mechanism. (After incorporation of TCTO 21-SM68-763.) The crib umbilicals will be disconnected by lanyard upon positive launcher movement.

1-49. EQUIPMENT TERMINAL.

1-50. The equipment terminal is composed of four levels containing aerospace operating equipment (AOE) and aerospace ground equipment (AGE) termination racks, and amplification equipment for the missile and facility systems as follows: Level I, launcher control floor; Level II, air conditioning and hydraulic floor; Level III, checkout and launch floor; and Level IV, power floor. At operational bases all levels are serviced by an elevator. Actual layouts vary at different bases.

1-51. LEVEL I. Level I of the equipment terminal (figure 1-13) is divided into a power pack room and an electrical room. The power pack room contains the cycling control station and power pack equipment which supplies hydraulic pressure for operating the launcher system. The electrical room contains the motor control center and the logic racks for the launcher hydraulic equipment.

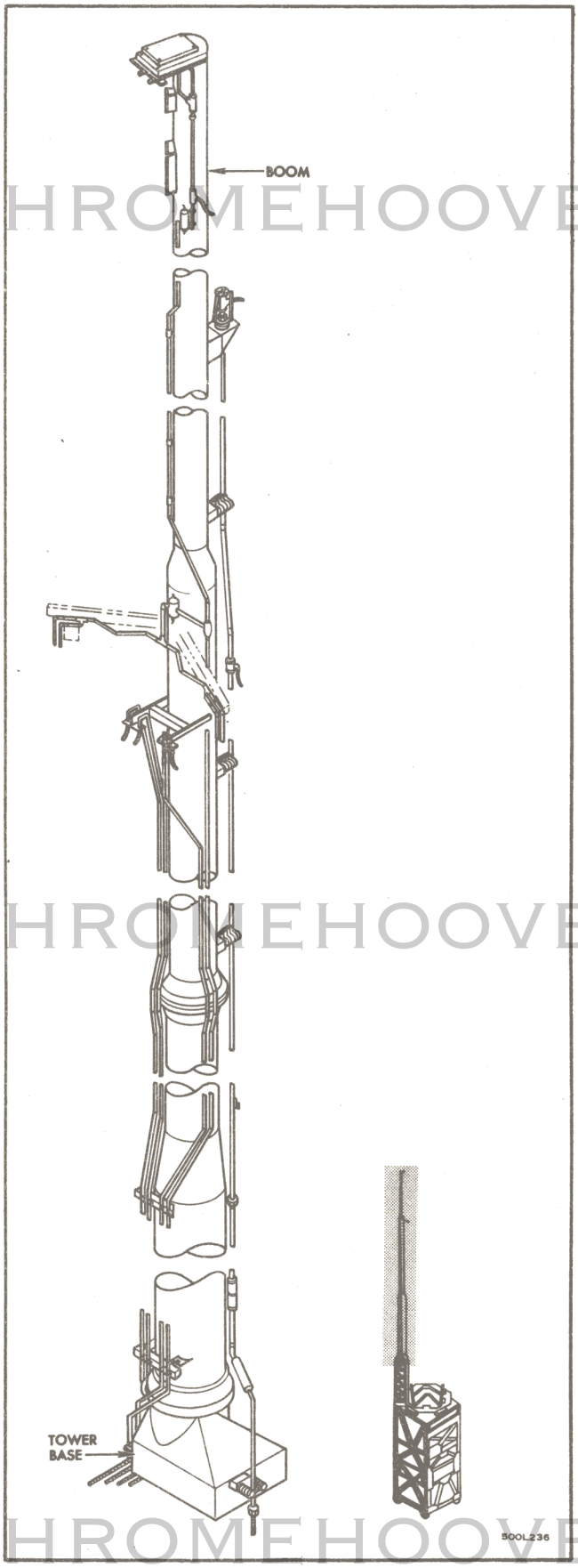


Figure 1-10. Umbilical Tower

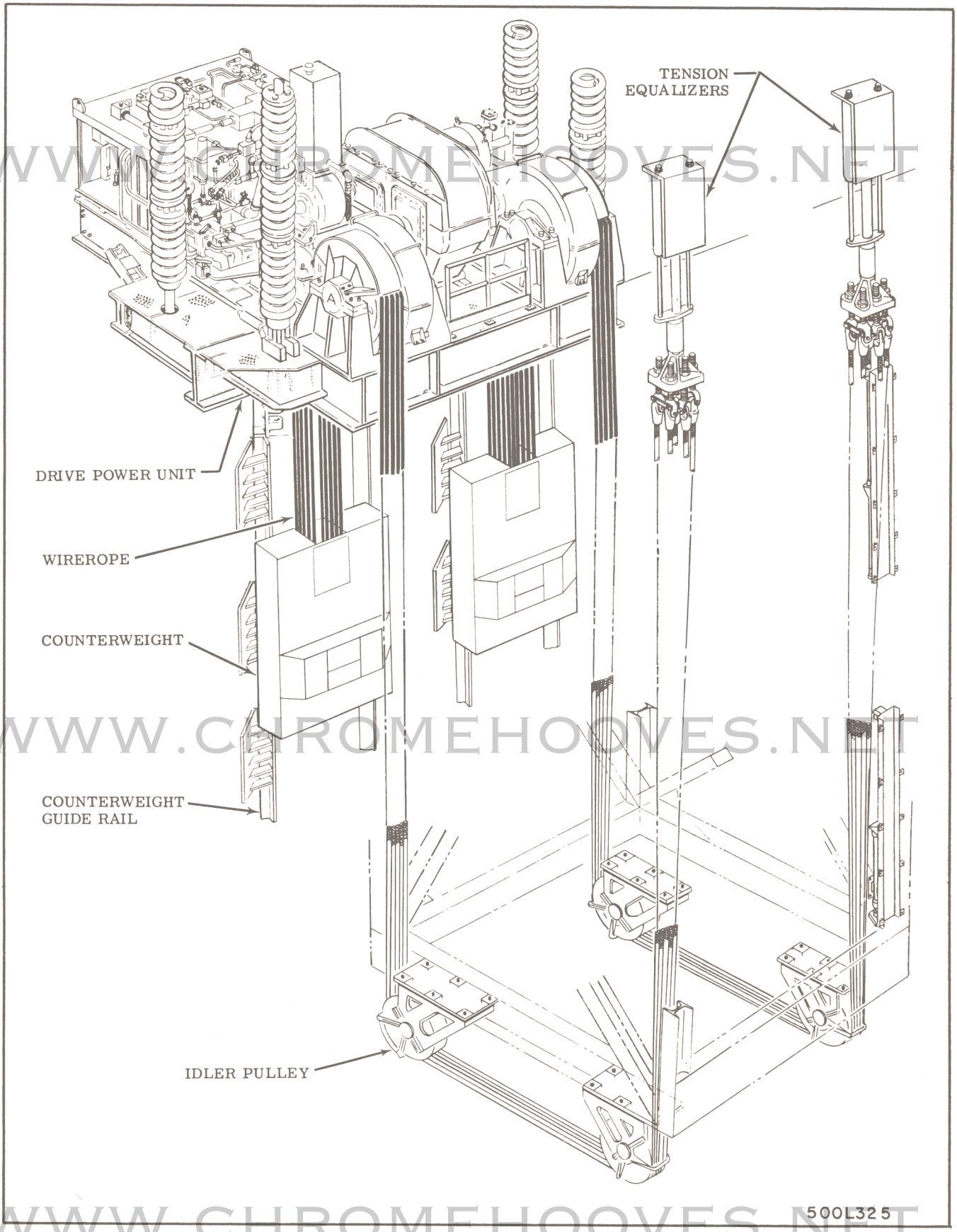


Figure 1-11. Launcher Platform Drive System (Operational Bases)

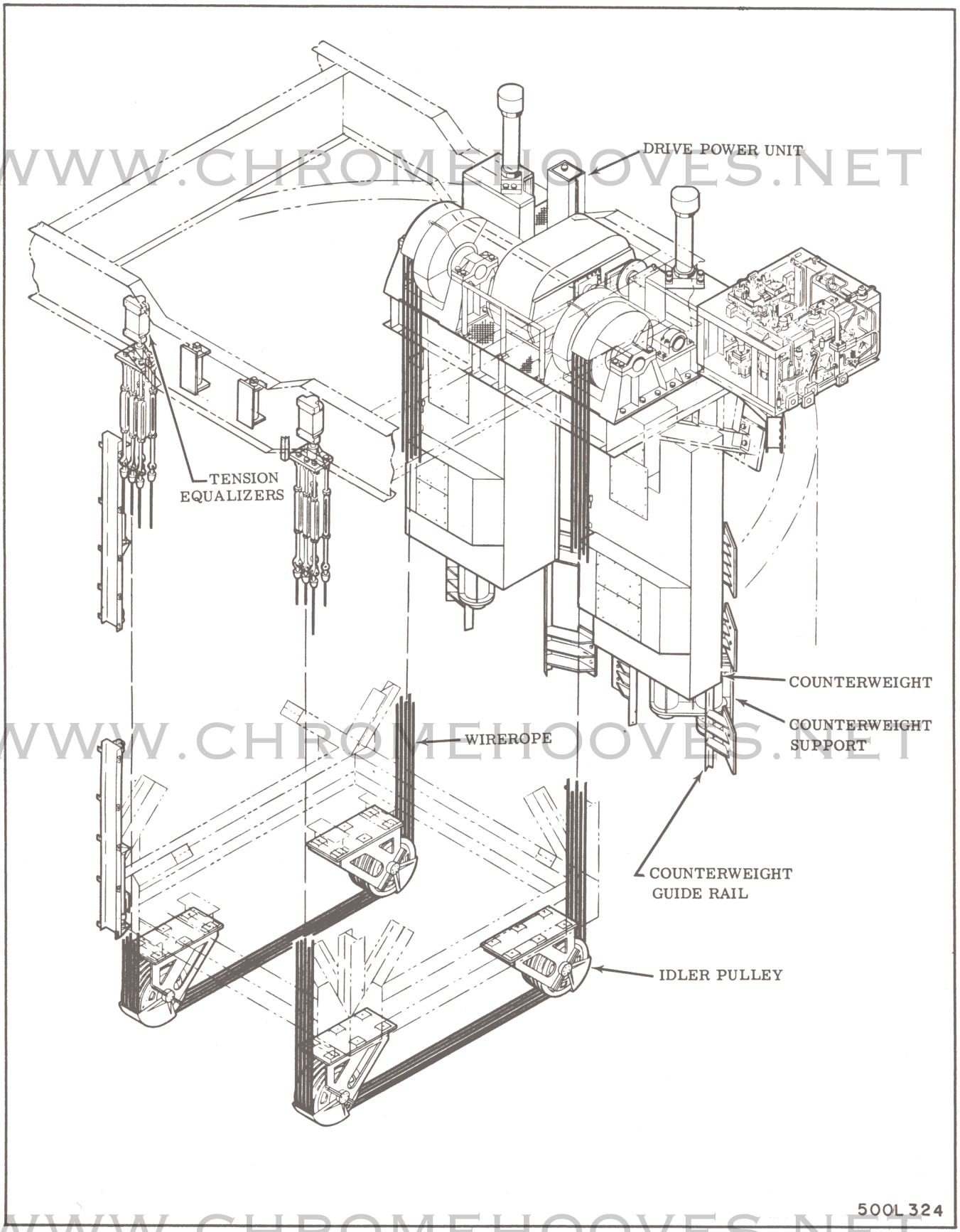


Figure 1-11A. Launcher Platform Drive System (VAFB)

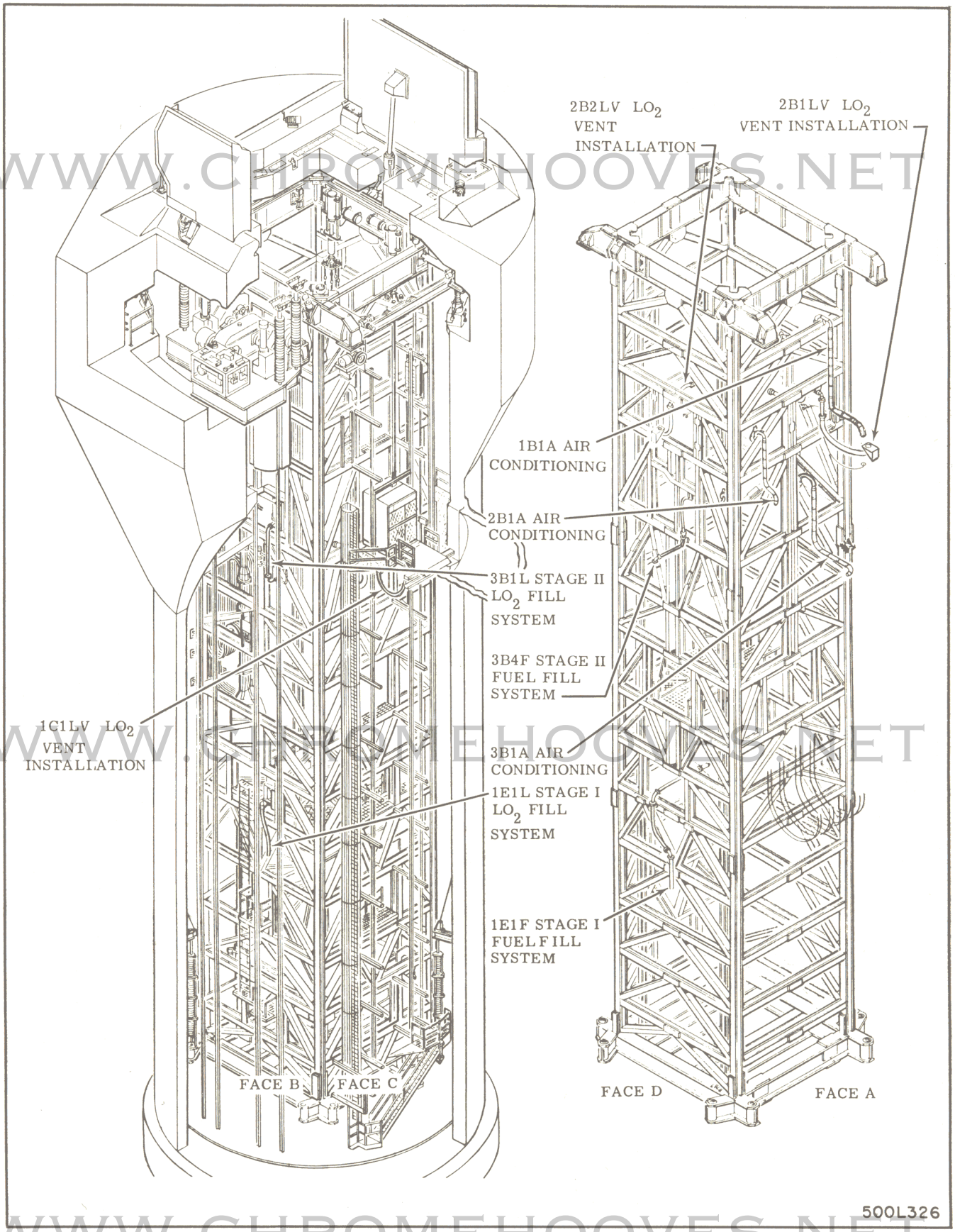


Figure 1-12. Umbilical Lines and Support Mechanism

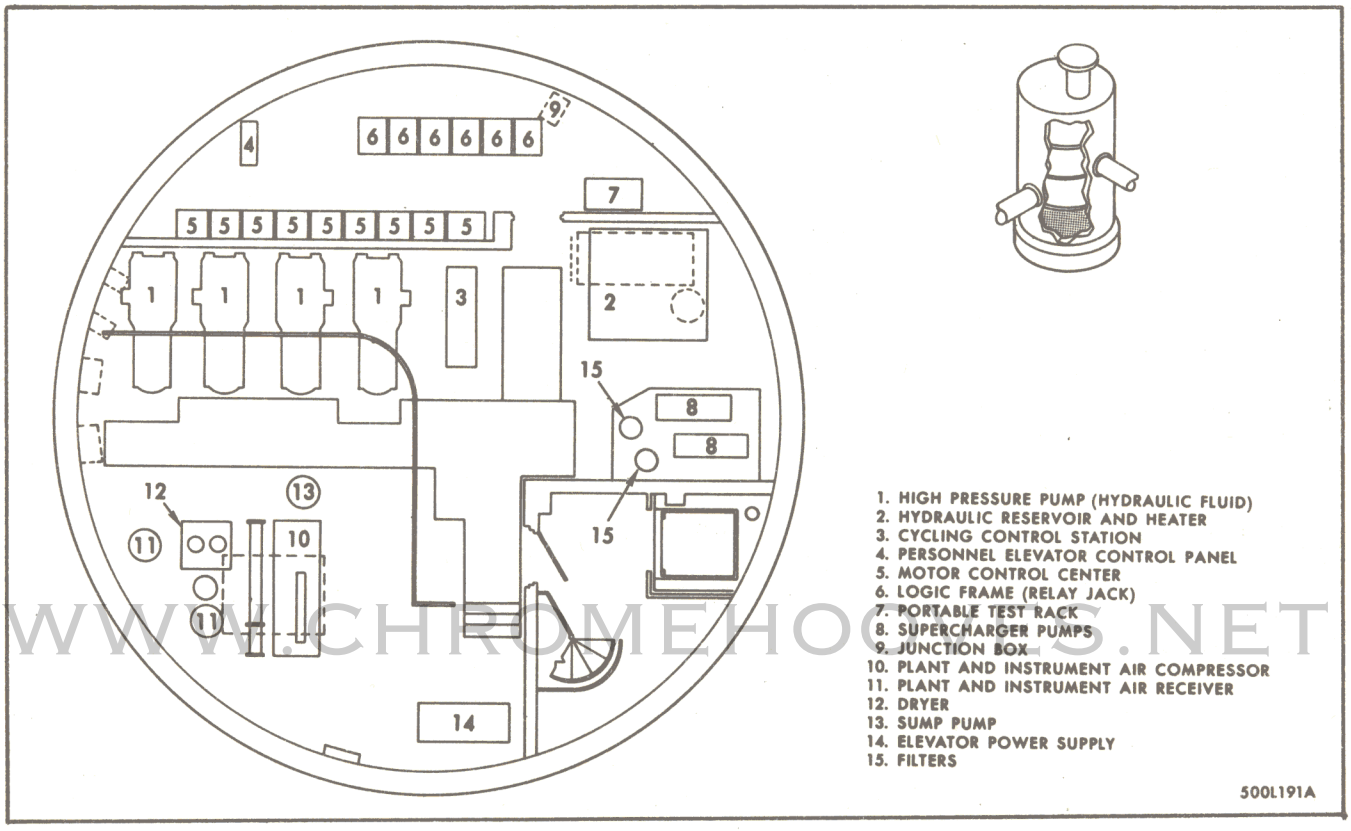


Figure 1-13. Equipment Terminal, Level I

1-52. A typical power pack room and electrical room are shown in figure 1-14. The power pack consists of a storage reservoir, supercharger pumps, high pressure pumps, heating facilities and heat exchangers, a filter system, and a cycling control station with shutoff valves permitting sectional isolation of the system during checkout and maintenance. The power pack consists of two major circuits: the main power pack and the auxiliary standby system. The hydraulic reservoir stores system fluid and maintains it at the required temperature for proper operation by means of an integral heating system. Sludge and contaminants are removed by the filtering system to prevent foreign objects from clogging the launcher mechanism.

1-53. The cycling control station provides manual control of the hydraulic power pack for purposes of checkout. It contains gages and an annunciator circuit. The annunciator circuit sounds a warning horn and lights the appropriate indicator on the annunciator panel when a loss of pressure in either the main line or the return line, or abnormally high temperature in the hydraulic storage reservoir occur.

1-54. The motor control center receives 480 V 60 CPS from the launcher unit substation and provides a centralized power supply and control station for the launcher system motors and heaters.

1-55. The launcher logic circuitry within the logic racks determines the status of the launcher system and controls the operation of various drives and actuators. The launcher logic circuitry is so arranged that the operation of the actuators of each launcher component is in proper sequence to perform a complete function. Groups of these functions, performed in proper sequence for missile firing, are sequenced by logic circuitry. These groups of functions are initiated upon receipt of a command signal from either the launch controller for automatic operation, or by maintenance personnel for local operation or equipment checkout.

1-56. LEVEL II. Level II of the equipment terminal (figure 1-15) contains the missile air conditioner and the missile silo air conditioning equipment. The missile air conditioner supplies heated or cooled air to maintain the proper temperature in the Stage II transition compartment, between-tanks compartment, and Stage II engine compartment. The missile silo air conditioning equipment supplies conditioned air to the missile silo. Level II also contains a hydraulic pumping unit that supplies hydraulic fluid to fill, bleed, and pressurize the hydraulic equipment in both missile stages.

1-57. LEVEL III. Level III of the equipment terminal (figure 1-16) contains launch and checkout equipment necessary to launch a missile or perform checkout of the following subsystems: engine control, flight control, launch sequencer, re-entry vehicle, electrical, missile guidance, and propellant loading and pressurization systems.

1-58. LEVEL IV. Level IV of the equipment terminal (figure 1-17) contains the equipment that supplies and distributes electrical power to the launcher area. This level contains motor control centers, a power switchboard, a 400 CPS motor-generator, two 28 VDC power supplies, a battery power supply, a 9 KVA transformer, and transformer substations.

1-59. The motor control centers and power switchboard distribute electrical power from the generator and power transformer substations to the equipment in the missile silo and launcher. The 400 CPS motor-generator supplies regulated power for missile systems until the airborne power supplies are used. A transformer rectifier furnishes the 28 VDC power supply for the ground checkout and launch control equipment.

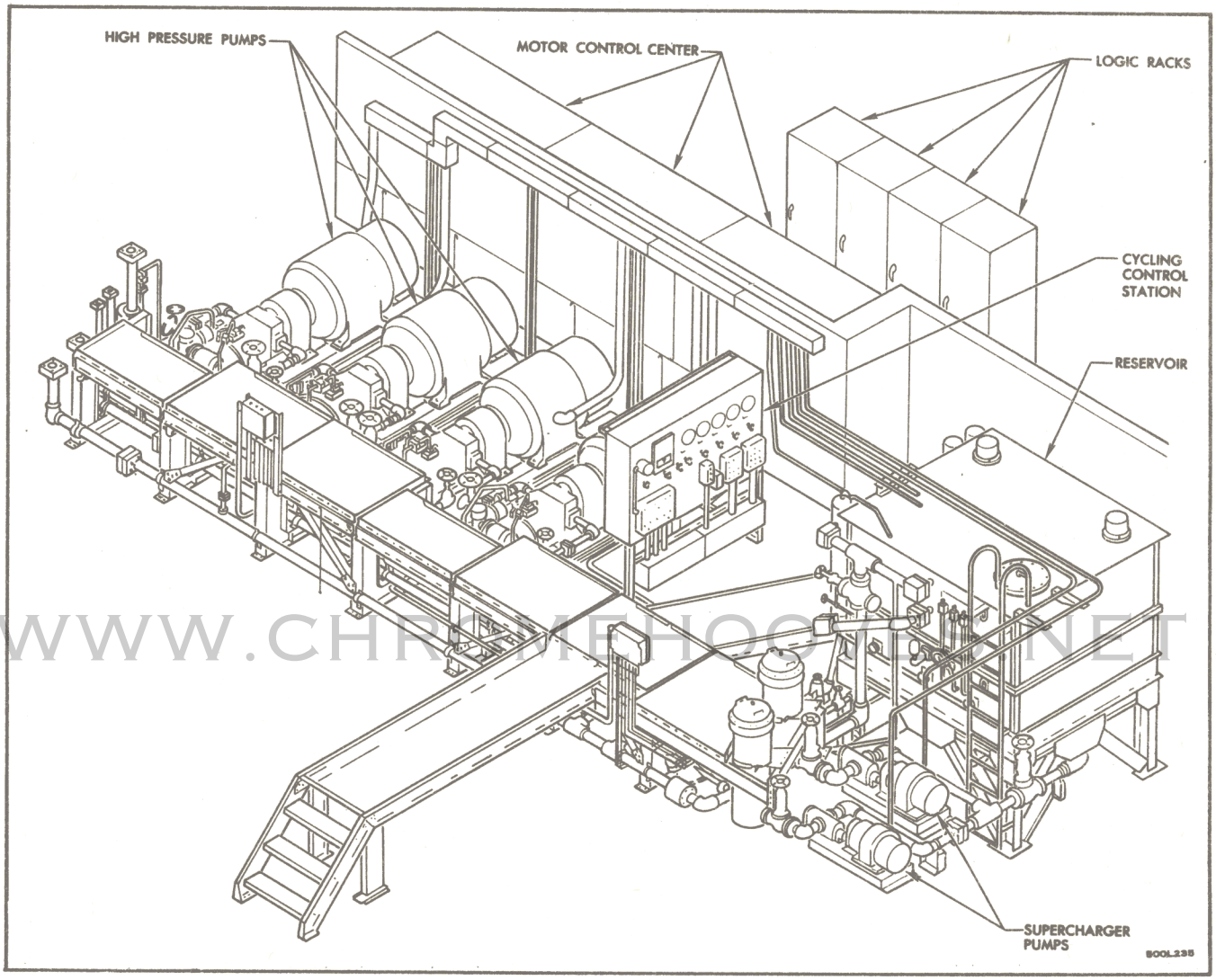


Figure 1-14. Typical Power Pack Room and Electrical Room

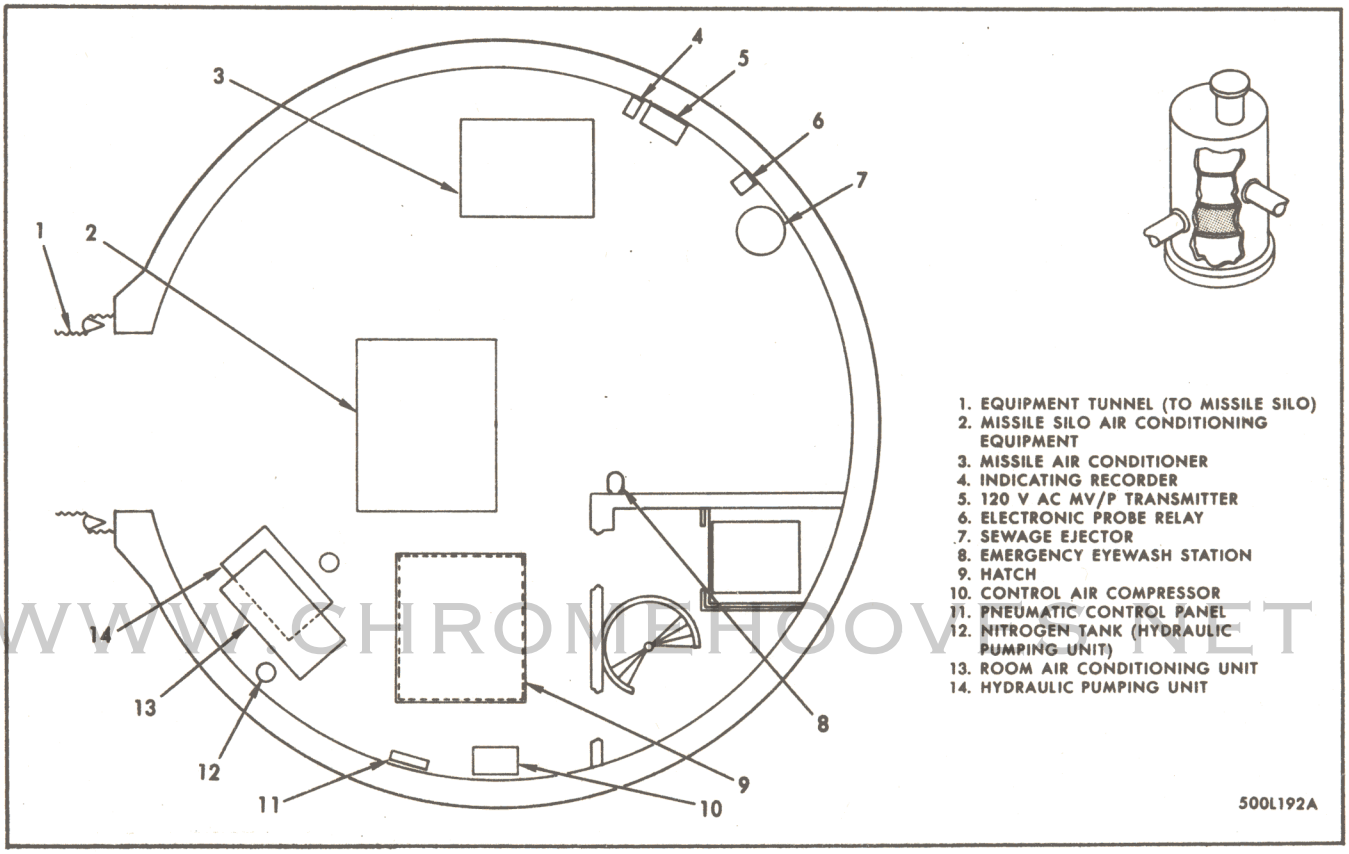


Figure 1-15. Equipment Terminal, Level II

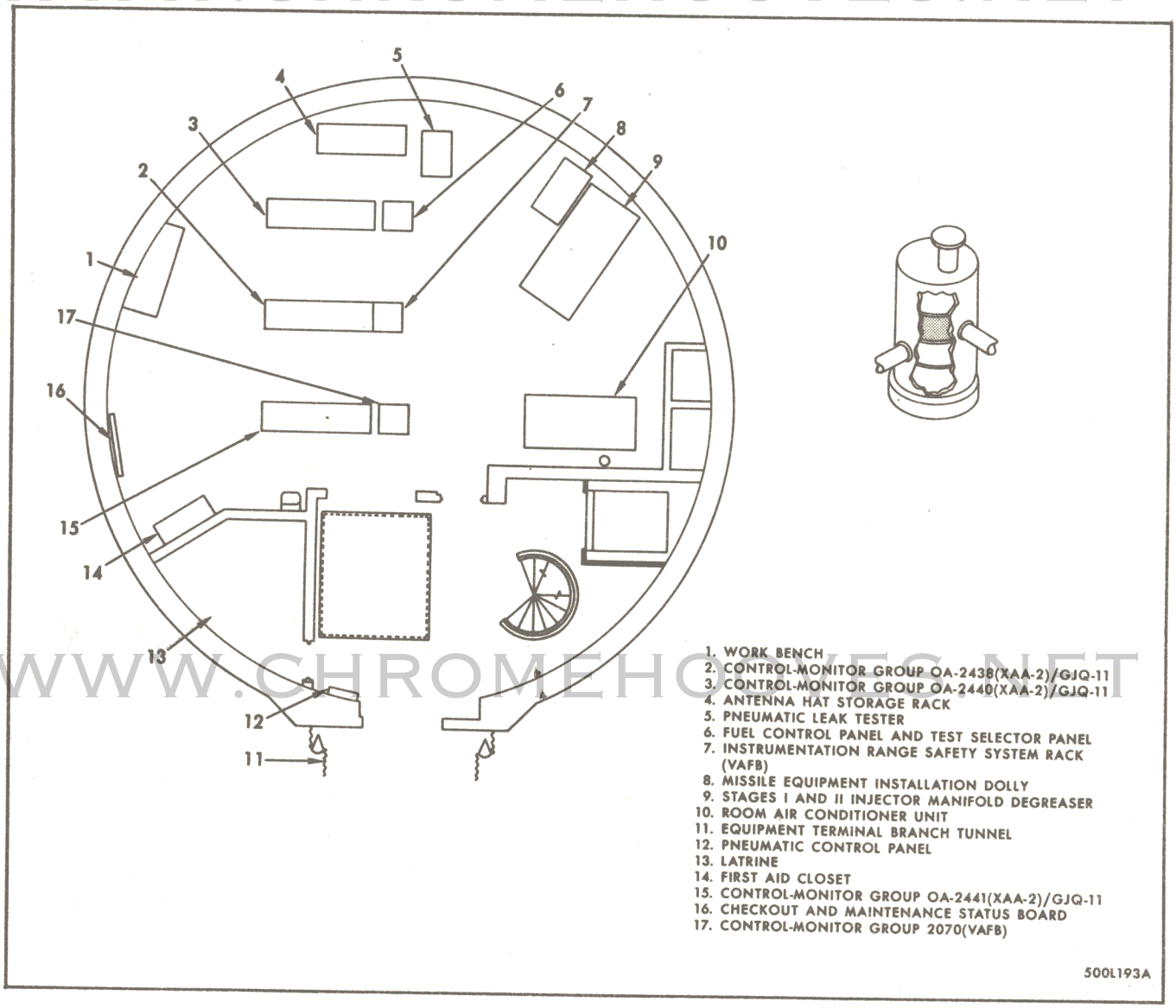


Figure 1-16. Equipment Terminal, Level III

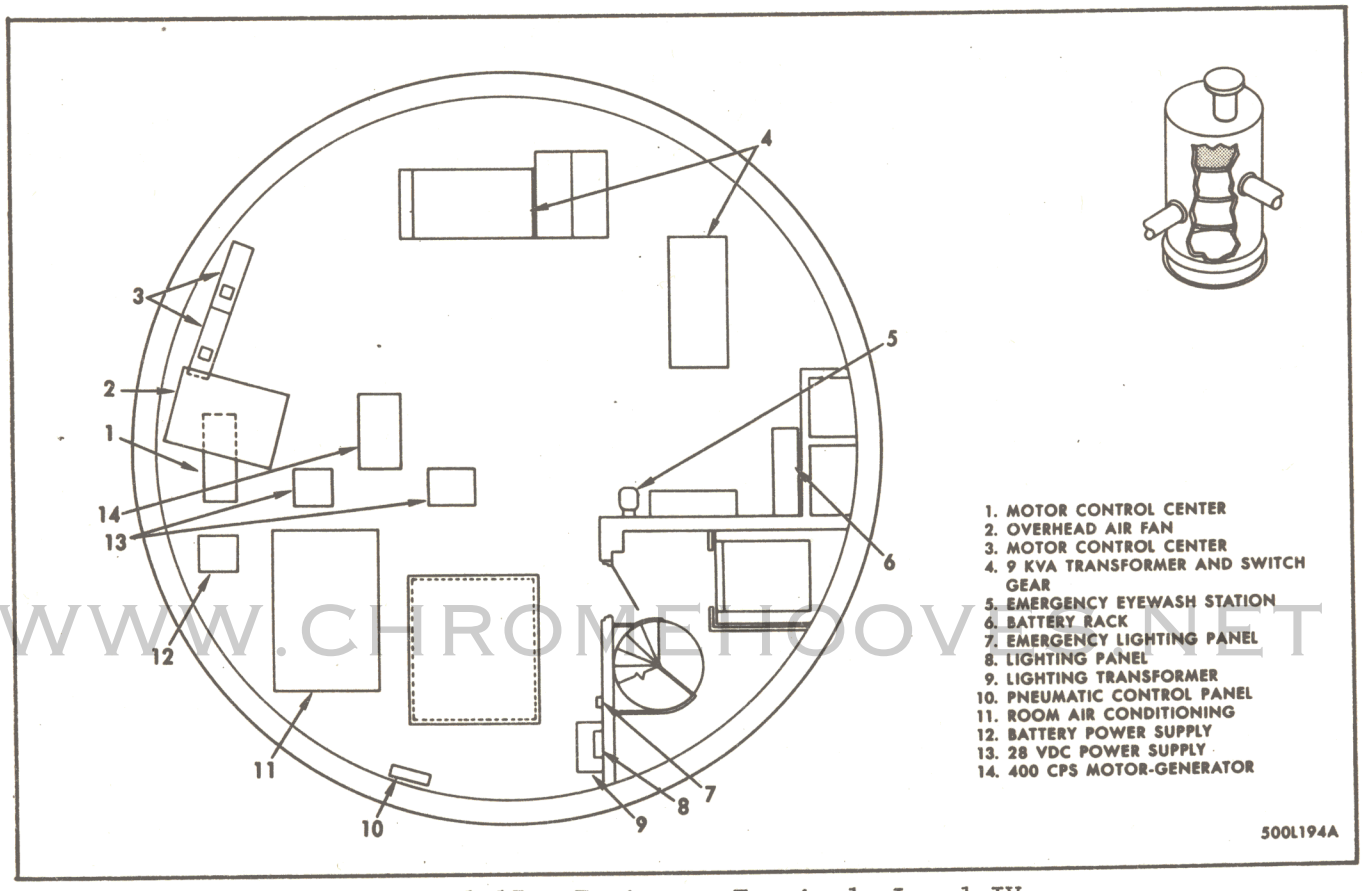


Figure 1-17. Equipment Terminal, Level IV

The battery power supply permits a safe shutdown of checkout and launch control equipment if a malfunction occurs in the 28 VDC power supply. The 9 KVA transformer supplies electrical power to the substations for distribution to the motor control centers and the power switchboard.

1-60. PROPELLANT TERMINAL.

1-61. The propellant terminal contains storage tanks for liquid oxygen, liquid nitrogen, gaseous nitrogen, and helium. Equipment and plumbing associated with the transfer of the liquids and fluids are also contained in the propellant terminals and in the liquid oxygen vent shaft tunnels that connect the propellant terminals to the missile silos. The propellant terminal has two levels; a lower level (figure 1-18), with an entrance to the liquid oxygen tunnel, and an upper level (figure 1-19), connecting the liquid oxygen storage tank access room with the propellant terminal branch tunnel.

1-62. LOWER LEVEL. The lower level of the propellant terminal (figure 1-18) contains helium storage tanks, nitrogen storage tanks, a helium cooler, a liquid oxygen subcooler, vacuum pumps, and an emergency eyewash and shower station. A liquid oxygen catchpot is provided to catch liquid oxygen spillage during transfer operations.

1-63. UPPER LEVEL. The upper level of the propellant terminal (figure 1-19) contains an emergency eyewash and shower station and the propellant transfer panels. The propellant transfer panels consist of the following: a liquid oxygen transfer panel, a nitrogen transfer panel, and a helium transfer panel. These panels provide a central location for pressure and level indicators that display liquid levels, storage bottle pressures, and system pressures. These panels also consist of pressure switches that relay status information to the launch control and checkout equipment in the equipment terminal.

1-64. CONTROL CENTER.

1-65. The control center contains the launch control console (LCC), missile guidance console, launch complex facility console (LCFC), display equipment, guidance computer, and radar equipment. The equipment and consoles monitor the status of the missile systems, and control the launcher equipment, the guidance antennas, and the missile during standby activities and launch operations. The control center at VAFB is shown in figure 1-20. At the operational bases, the control center is an underground, dome-shaped structure divided into an upper level and a lower level (figure 1-21). The two levels are divided into 14 rooms.

1-66. The control center operations room (figure 1-22) contains the equipment necessary to monitor the weapon system. The equipment initiates the launching of the missiles and includes components of the launch control and status system, and guidance system.

1-67. LAUNCH CONTROL CONSOLE (LCC). The launch control console (figure 1-23 and 1-24) (control-monitor group OA-2437) is a desk type console with a base and a combined control-display panel. The console serves as the primary center for initiating and monitoring an actual launch or exercise countdown for any one of the three missile launchers in the launch complex. The launch console base contains a working surface for the operator, two equipment drawers, a telephone dial, and two telephone jacks for the console operator's headset. Launch console operation is controlled

(Text continued on page 1-36)

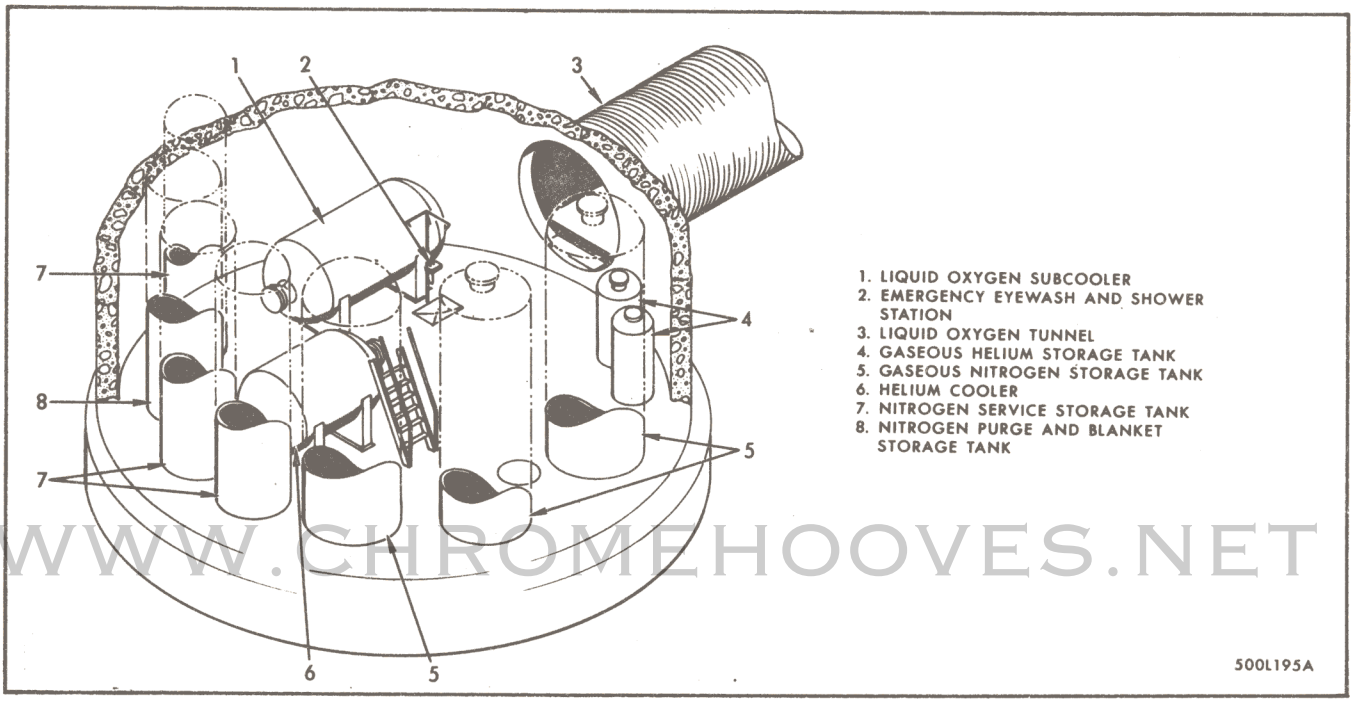


Figure 1-18. Propellant Terminal Lower Level

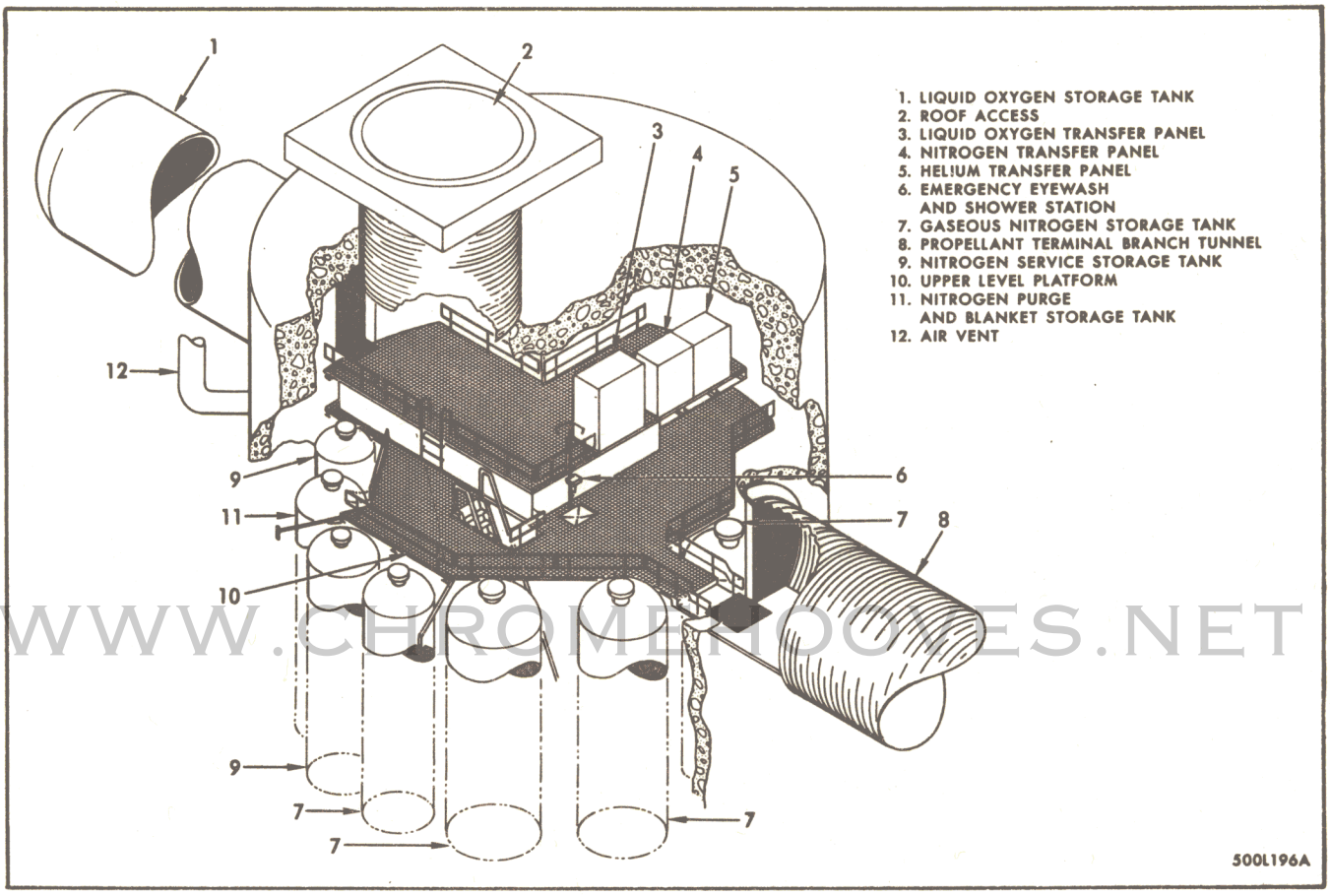


Figure 1-19. Propellant Terminal Upper Level

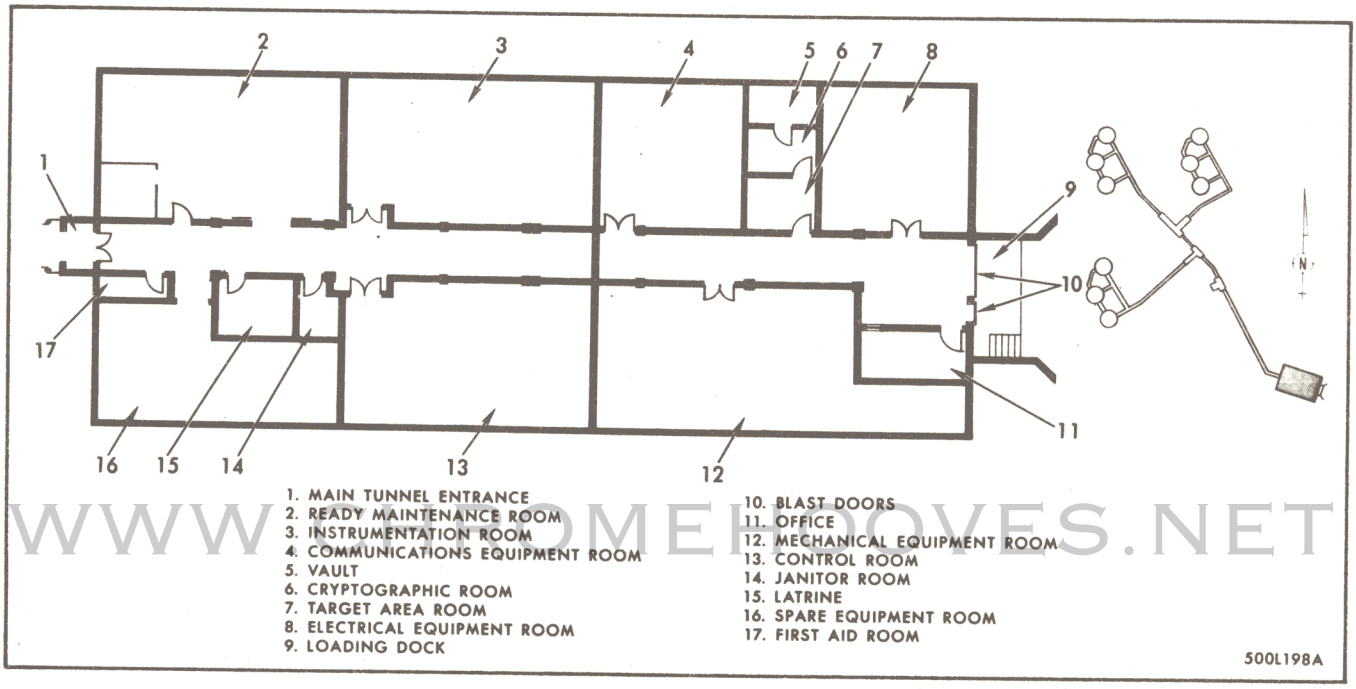


Figure 1-20. Control Center (VAFB)

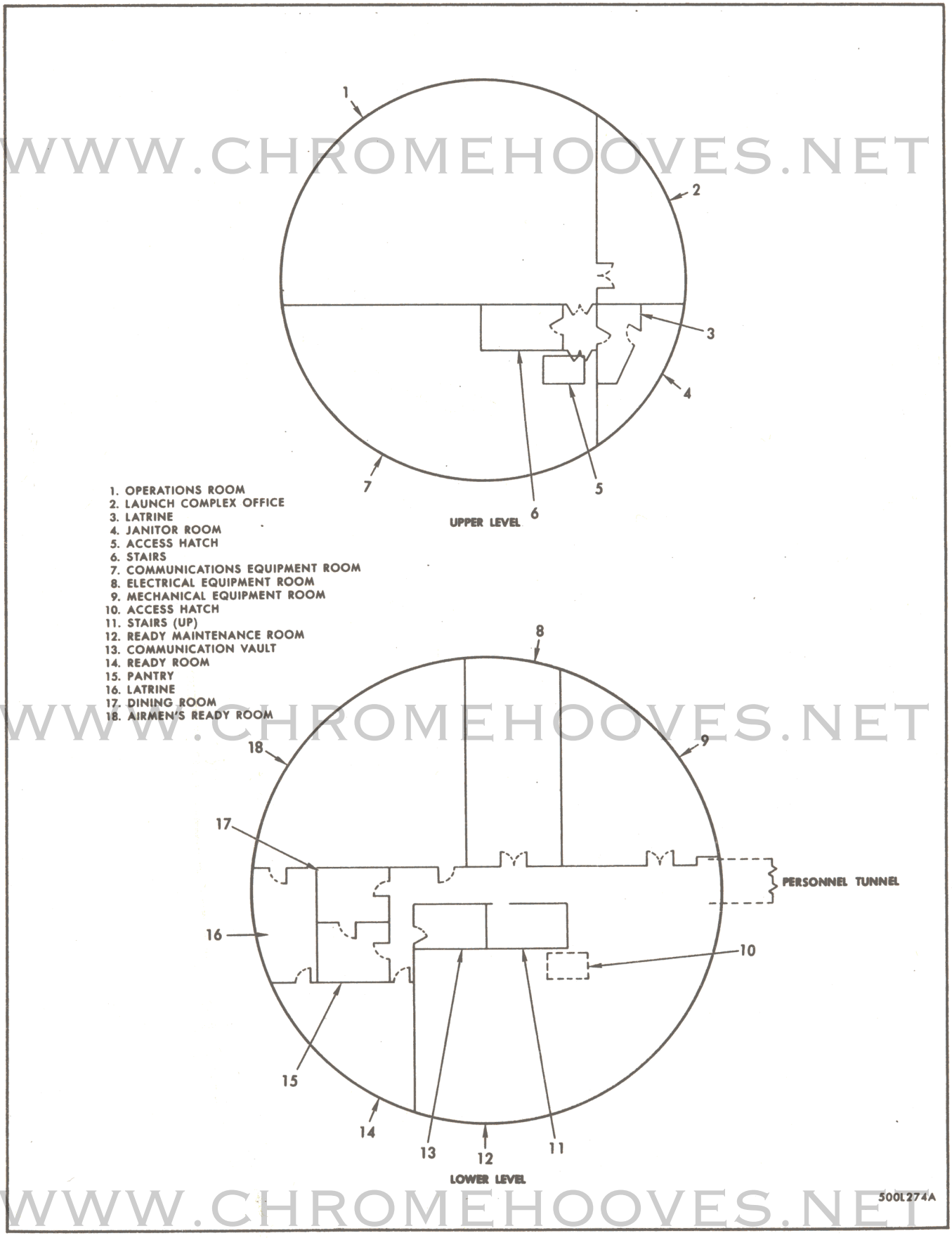


Figure 1-21. Control Center (Operational Bases)

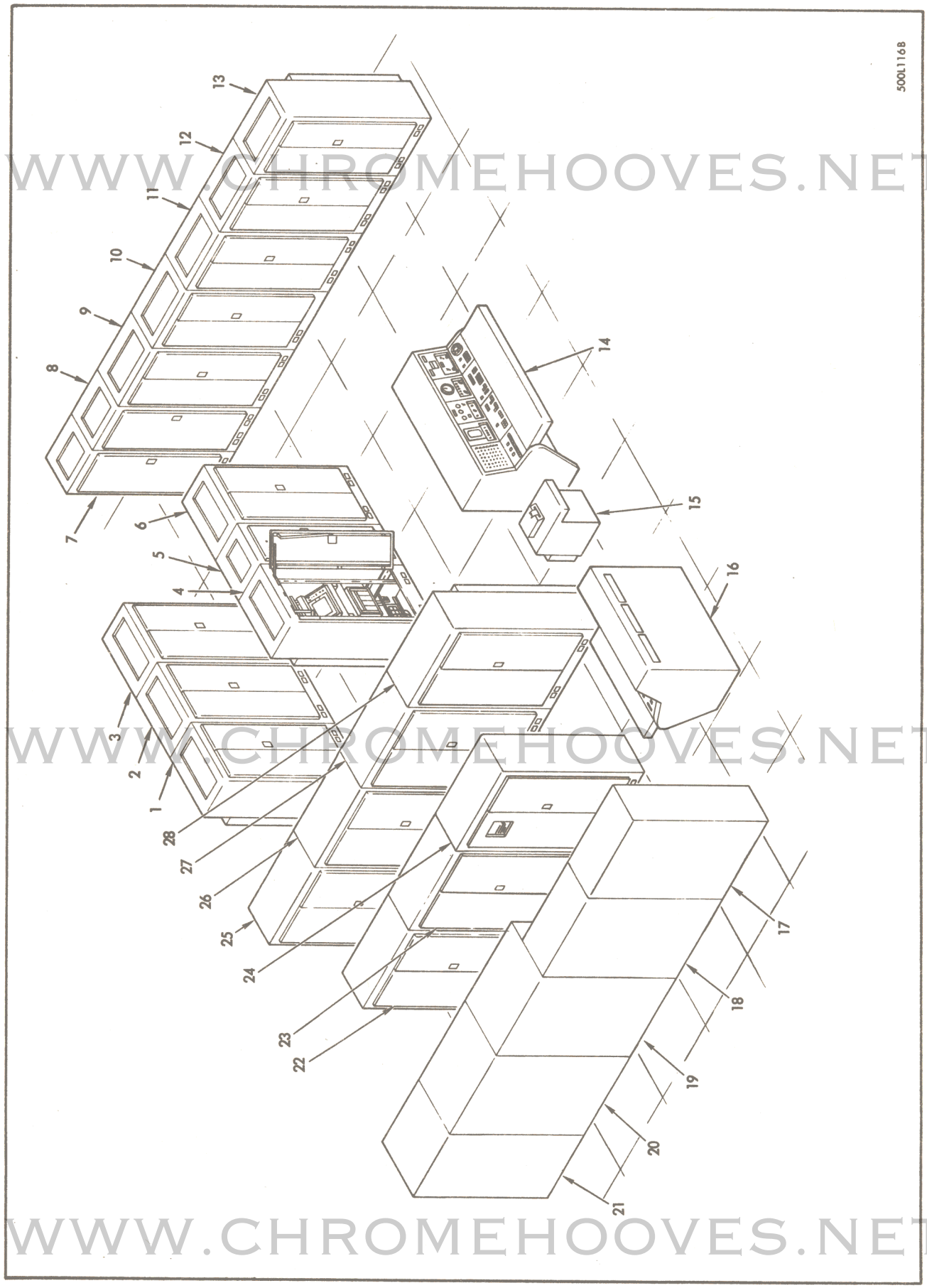


Figure 1-22. Control Center Operations Room Equipment Location (Sheet 1 of 2)

MISSILE GUIDANCE SET AN/GRW-5

1. Power supply set OA-2902C/GRM-40
2. Signal data converter CV-968B/GRM-40
3. Computer-signal data generator CP-561B/GRM-40
4. Signal data recorder RO-146/GRW-5
5. Power switchboard SB-1168/GRW-5
6. Power supply set OA-2898/GRW-5
7. Command signals decoder KY-344A/GRW-5
8. Reference signal generator TD-409A/GRW-5
9. Signal data converter CV-967C/GRW-5
10. Range computer CP-560A/GRW-5
11. Antenna Control C-3360C/GRW-5
12. Receiver group OA-3034B/GRW-5
13. Antenna position programmer C-3362B/GRW-5
14. Missile guidance console OA-3101/GRW-5 or OA-2897/GRW-5

MISSILE GUIDANCE COMPUTER SET AN/GSK-1

15. Digital data printer RO-144/GSK-1
16. Computer set console OA-2656/GSK-1
17. Signal data recorder group OA-2660/GSH-4 (VAFB)
18. Simulator-verifier SM-203/GSK-1
19. Signal data reproducer group OA-2658/GSK-1
20. Power distribution group OA-2655/GSK-1
21. Power supply group OA-2656/GSK-1
22. Data storage magnetic drum MU-422/GSK-1
23. Data input processor-verifier CM-166/GSK-1
24. Recording set control C-3206/GSH-4 (VAFB)
25. Core memory unit MU-423/GSK-1
26. Computer control C-3205/GSK-1
27. Computer arithmetic unit CP-539/GSK-1
28. Digital to digital converter CV-929/GSK-1

Figure 1-22. Control Center Operations Room Equipment Location (Sheet 2 of 2)

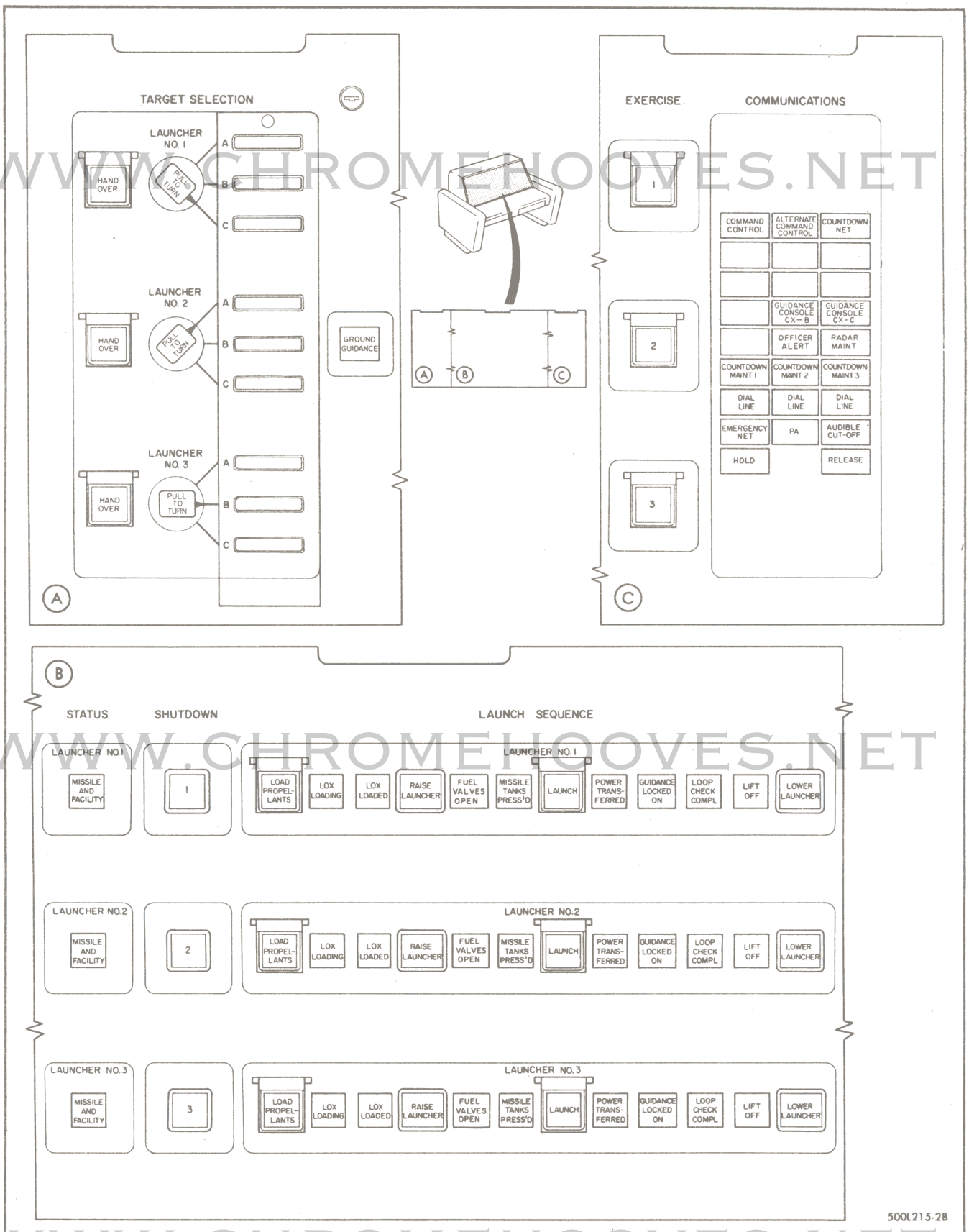


Figure 1-23. Launch Control Console (Operational Bases)

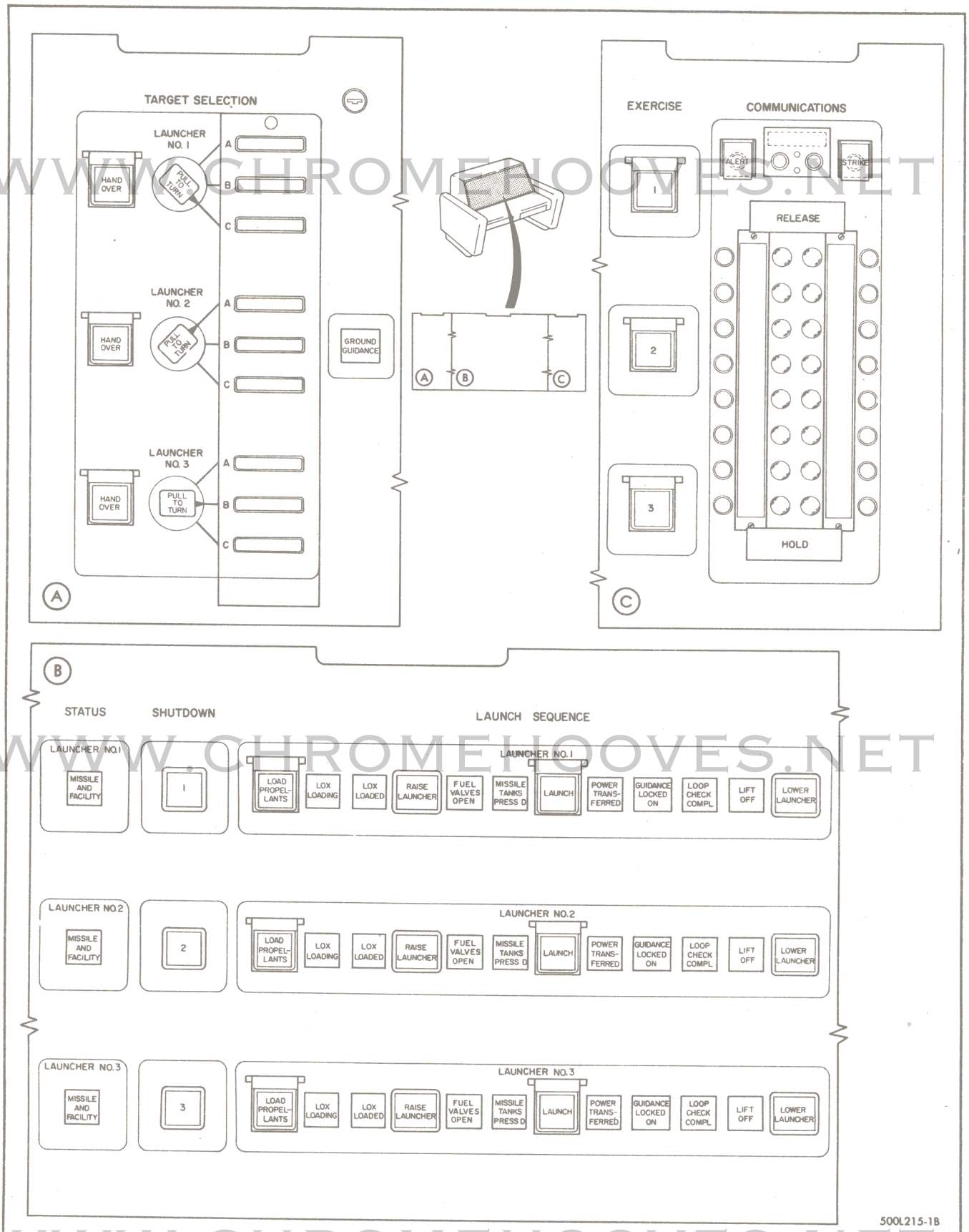


Figure 1-24. Launch Control Console (VAFB)

(Text continued from page 1-27.)
from the control-display panel, which contains three rows of controls and indicators (one row for each launcher). The controls consist of pushbutton indicators that are actuated manually by the missile launch officer to start the semiautomatic sequenced events of a countdown. The indicators provide visual monitoring of the ground guidance station, the three missile launchers, and the major sequenced events that occur during countdown. Transparent guards over the HANDOVER, LOAD PROPELLANTS, LAUNCH, and EXERCISE pushbutton indicators prevent the accidental pressing of these pushbuttons. The guards are hinged and must be raised before the pushbuttons can be pressed. The launch console panel is divided into six sections: TARGET SELECTION, STATUS, SHUTDOWN, LAUNCH SEQUENCE, EXERCISE, COMMUNICATIONS.

1-68. The TARGET SELECTION section of the LCC contains three HANDOVER push-pushbutton indicators, which select missile guidance control for each of the three missile launchers. When the HANDOVER pushbutton indicator is pressed, the indicator lights white, indicating the guidance control has been transferred to another launch complex. The indicator remains lighted white until the HANDOVER pushbutton indicator is pressed a second time to return guidance control to the original launch complex. The TARGET SELECTION section also contains three rotary switches (one for each launcher) and nine target identification display windows (three windows for each switch). When the switch is rotated to the desired target, the target identification display window lights green, indicating the proper target has been selected by the aerospace operating equipment (AOE). At T-80 the target identification display window changes from green to white, indicating the target selection is locked in the target card reader and logic assemblies of control-monitor group OA-2439. The target display windows are mounted on a hinged panel that allows access to the back of each window for the insertion of an eight digit target identification tab. To prevent unauthorized access to the target identification tabs, the hinged panel is secured with a lock.

1-69. The STATUS section of the LCC contains one GROUND GUIDANCE and three MISSILE AND FACILITY indicators that display the alert status of the ground guidance and of the missile and facility systems prior to and during a countdown. After launch, these indicators display the status of the ground guidance, aerospace operating equipment, and facility systems. For the ground guidance system, green indicates ready, red indicates not ready, and white indicates the station is operating and is locked on the desired missile. For the missile and faciliy systems, green indicates ready, and red indicates not ready for the corresponding missile launcher.

1-70. The SHUTDOWN section of the LCC contains three pushbutton indicators that initiate and indicate a shutdown. Pressing the 1, 2, or 3 pushbutton indicator terminates the countdown for the corresponding missile launcher and lights the indicator red. The indicator also lights red when the countdown is shut down automatically. Manual shutdown is possible throughout the countdown. If a malfunction should occur after the RAISE LAUNCHER pushbutton indicator is pressed, the countdown is automatically stopped.

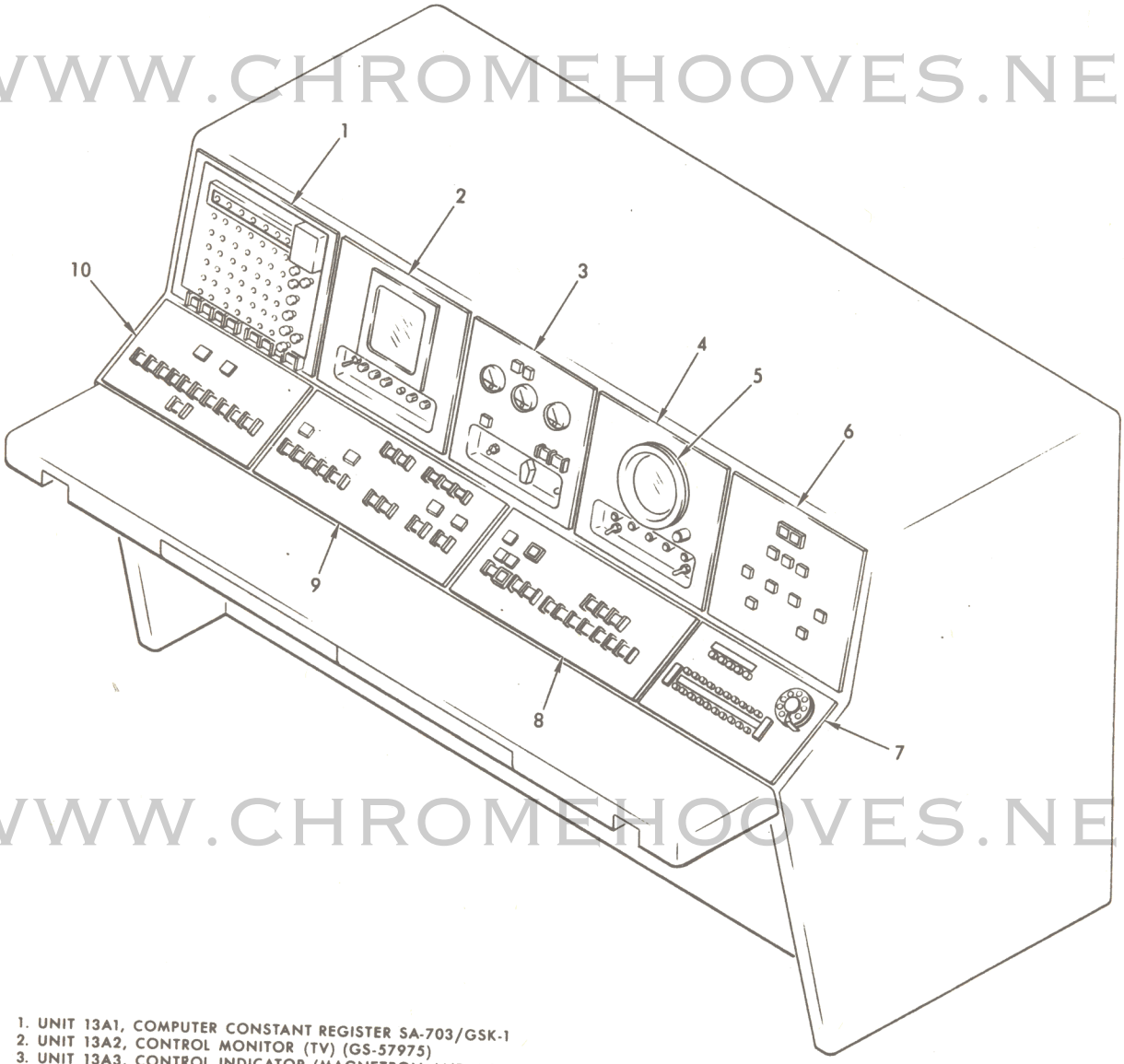
1-71. The LAUNCH SEQUENCE section of the LCC contains three rows (one for each launcher) of three pushbutton indicators and eight status indicators that initiate and display the sequenced events of a countdown for each of the three missile launchers. To control countdown, the pushbutton indicators are pressed in the following order: LOAD PROPELLANTS, RAISE LAUNCHER, and LAUNCH. When the pushbutton indicators are pressed, the indicators light as each automatic operation initiated by the pushbutton indicators starts. The progress of each automatic operation is displayed by the eight status indicators. The completion of each automatic

operation is displayed by a green lamp in the pushbutton indicator that controls the next sequence of events. The LAUNCH SEQUENCE section also contains three LOWER LAUNCHER pushbutton indicators (one for each missile launcher) that display and initiate the lower-launcher phase after completion of the launch or shutdown phases. The LOWER LAUNCHER pushbutton indicator lights green when the launch phase is completed or if a shutdown is initiated after T-41. Pressing the pushbutton indicator changes the indication from green to white, indicating that the launcher platform is being lowered. When the missile launcher is returned to a hardened condition, the white lamp in the pushbutton indicator goes out.

1-72. The EXERCISE section of the LCC contains pushbutton indicators 1, 2, and 3 that are used to perform launch control system checkout for each of the corresponding missile launchers. During an exercise countdown, the sequenced events occur in the same order as for an actual launch with the following exceptions: fuel prevalves are not opened, batteries are not activiated, power from the ground power source is not transferred to the airborne power supplies, Stage I rocket engine is not ignited, and explosive bolts for the missile release mechanism are not detonated. When an exercise is initiated by pressing LOAD PROPELLANTS, the EXERCISE indicator changes from green to white indicating that the exercise countdown is in progress. At the completion of the exercise, the indicator changes from white to green. (The pushbutton indicator will change from white to red if the exercise is not completed successfully.) If the EXERCISE pushbutton indicator is pressed again, the green light will go out. At this time, the launch control system is returned to launch capability.

1-73. The COMMUNICATIONS section of the LCC enables the missile launch officer to communicate by telephone or public address to all areas of the launch complex. A direct line to COMMAND CONTROL and DIAL LINE for off-site calls is also provided. The communication section for the operational bases is shown in figure 1-23 and the section for VAFB is shown in figure 1-24. Although the physical layouts of the two sections differ, the actual operation of each is similar. Pressing of any COMMUNICATIONS pushbutton indicator will connect the launch control console to the called station and simultaneously light the pressed pushbutton indicator. The RELEASE pushbutton indicator will break the circuit to the called station and return the indicator to not lighted. Once a station is connected and a hold is desired in order to connect another station, the HOLD pushbutton indicator is pressed; then by pressing the new station pushbutton indicator, the new station is connected. To break a station that has been held, the station pushbutton indicator must be re-pressed; then pressing of the RELEASE pushbutton indicator breaks the circuit and returns the indicator to not lighted. Line circuits are indicated by a white light and hold circuits are indicated by a yellow light. The DIAL LINE incoming signal is indicated by a flashing white light. The EMERGENCY NET indicates flashing red. By pressing this pushbutton indicator, any other network in use is automatically placed in HOLD and the EMERGENCY NET is connected.

1-74. MISSILE GUIDANCE CONSOLE. (Figure 1-25) Launch countdown operations of the guidance radar and computer in the launch complex are effected from the missile guidance console OA-3101G/GRW-5 or OA-2897G/GRW-5. Three rows of indicators and pushbutton indicators located on the two middle sloping panels are used to control the guidance system during countdown. The color coding of the pushbutton indicators is used to identify the following conditions: white, information or function in progress; green, function completed; yellow, caution; and red, warning. The lower or countdown row of pushbutton indicators is used for initiating the countdown function. Pressing a lower row pushbutton indicator initiates a function and a white indication that signifies the particular function is in progress. Completion of the



1. UNIT 13A1, COMPUTER CONSTANT REGISTER SA-703/GSK-1
2. UNIT 13A2, CONTROL MONITOR (TV) (GS-57975)
3. UNIT 13A3, CONTROL INDICATOR (MAGNETRON AND AGC) (GS-65990)
4. UNIT 13A4, RANGE INDICATOR (GS-65927)
5. UNIT 13A4A2, PULSE GENERATOR VIDEO AMPLIFIER (GS-57985)
6. UNIT 13A5, CONTROL-INDICATOR (CONSOLE ANTENNA SELECT) (GS-65907)
7. UNIT 13A9, TELEPHONE CONNECTING STATION (COMM. CONTROL PANEL) (GS-57996)
8. UNIT 13A8, CONTROL-INDICATOR (COUNT DOWN RIGHT) (GS-57981A)
9. UNIT 13A7, CONTROL-INDICATOR (COUNT DOWN LEFT) (GS-67571)
10. UNIT 13A6, CONTROL-INDICATOR (TARGET SELECT AND COMPUTER FAULT) (GS-57979)

Note

UNIT 13A9 SHOW MAY NOT BE THE SAME AT ALL TITAN I SITES.

500L301

Figure 1-25. Missile Guidance Console

function is signified by the change in indication from white to green. Pushbutton indicators in the lower row may not be pressed to initiate a countdown phase until the associated indicator in the middle row is lighted white. The indicators and pushbutton indicators in the upper row indicate abnormal or emergency conditions when lighted yellow or red. The console panel to the far left is associated with the target selected and computer fault function and the panel to the far right contains the telephone communication controls. The upper panels are primarily indicators with associated controls. A constants register at the extreme left is used to introduce azimuth, elevation, and range data, and index of refraction into the computer. The adjoining panel contains the television monitor with kinescope and camera controls. The camera, mounted on the antenna, relays to the kinescope a view of the missile as it is launched and started on its flight. Meters and controls for the high frequency transmitter and receiver are located on the center panel. The fourth panel contains a cathode-ray tube range indicator and associated controls. During a missile flight, the cathode-ray tube displays a visual indication of the return pulse from the missile as gated by the range unit. The panel at the extreme right contains pushbutton indicators that indicate handover mode and antenna status, and also permit switching of handover mode and of antennas.

1-75. LAUNCH COMPLEX FACILITIES CONSOLE (LCFC). The launch complex facilities console (figures 1-26 and 1-27) (control-monitor group OA-2436) is a desk type console consisting of a base and display panel. The facilities console indicates the status of the airborne equipment, aerospace operating equipment (AOE), and aerospace ground equipment (AGE) at each of the three missile launchers. The console also displays guidance system status and monitors the launch complex damage control system. The facilities console base contains a working surface for the operator, two equipment drawers, a telephone dial, two telephone jacks for the console operator's headset, and a hazard-alert buzzer for the launch complex damage control system. The display panel contains indicators for the visual indications of the equipment status and facility status, and pushbutton controls that initiate or terminate corrective functions of the launch complex damage control system. The display panel is divided into three sections: EQUIPMENT STATUS, FACILITY STATUS & CONTROL, and COMMUNICATIONS.

1-76. The EQUIPMENT STATUS section of the LCFC indicates the alert status of the ground guidance system, missile equipment, and AOE. The status of the launch complex ground guidance station is indicated by one GROUND GUIDANCE indicator that lights green for ready, white for in-operation (guidance locked on the desired missile), and red for malfunction or hold. The functional status of the missile and associated facilities for each missile launcher is indicated by three MISSILE AND FACILITY pushbutton indicators. These pushbutton indicators (one for each missile launcher) are lighted green when normal conditions prevail within the launch complex. During a countdown, the MISSILE AND FACILITY pushbutton indicator that corresponds to the operating launcher lights green for ready and red for malfunction. During a checkout, the pushbutton indicator is lighted red. When pressed, the pushbutton indicator initiates a no-go signal to the launch control and checkout equipment at the corresponding missile launcher. The other indicators in the equipment status section present the status of the placarded equipment or system for each missile launcher as follows: not lighted for ready, amber for in-checkout, and red for malfunction. The status of the complex security fence gate (operational bases) is initiated and indicated by a FENCE GATE pushbutton indicator which is lighted green for locked and red for unlocked. The PORTAL ACCESS blast door status is indicated by two pushbutton indicators, green for LOCK and red for UNLOCK.

1-77. The FACILITY STATUS & CONTROL section of the LCFC indicates conditions or hazards in the launch complex, grouped by major areas. Hazards such as fire,

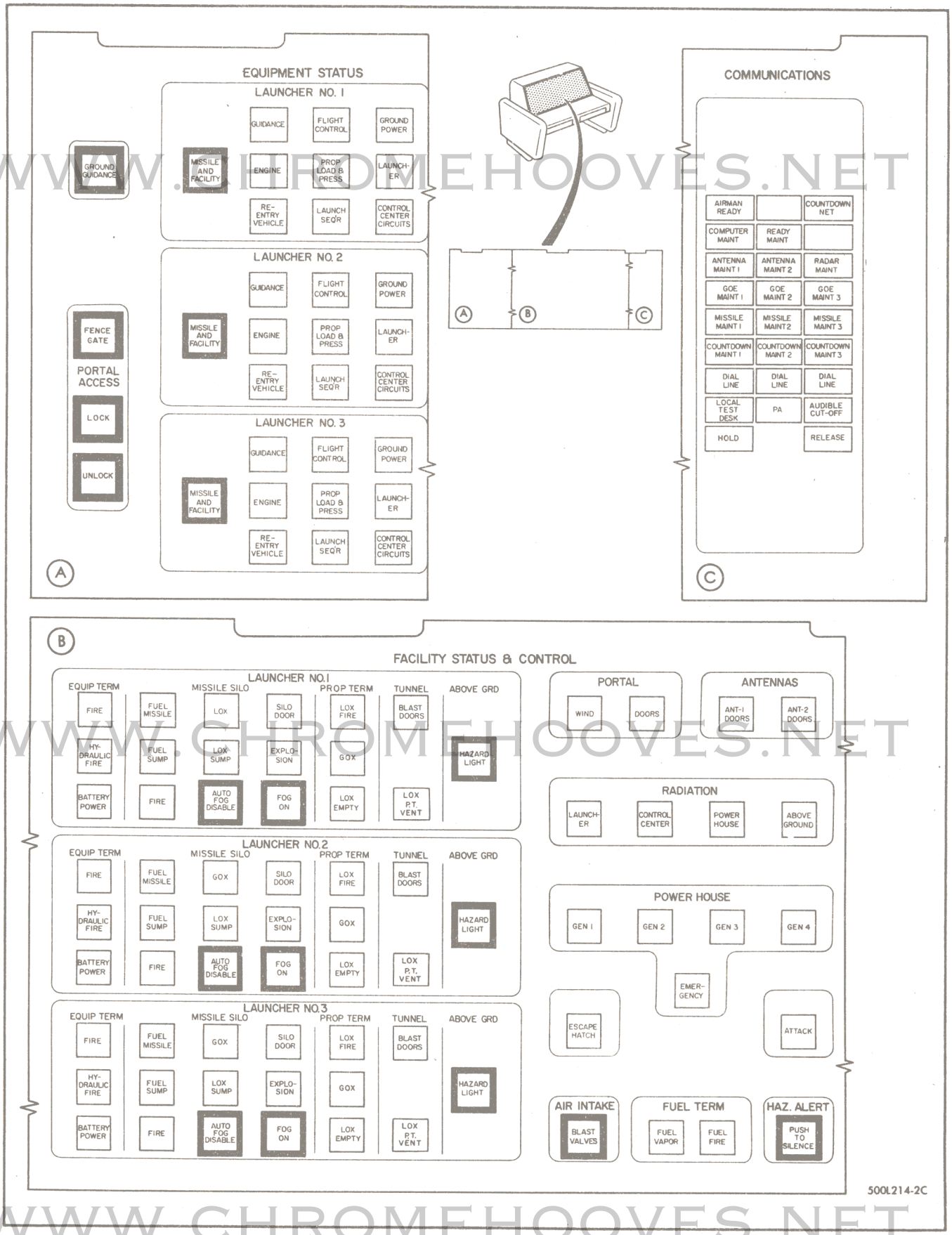


Figure 1-26. Launch Complex Facilities Console (Operational Bases)

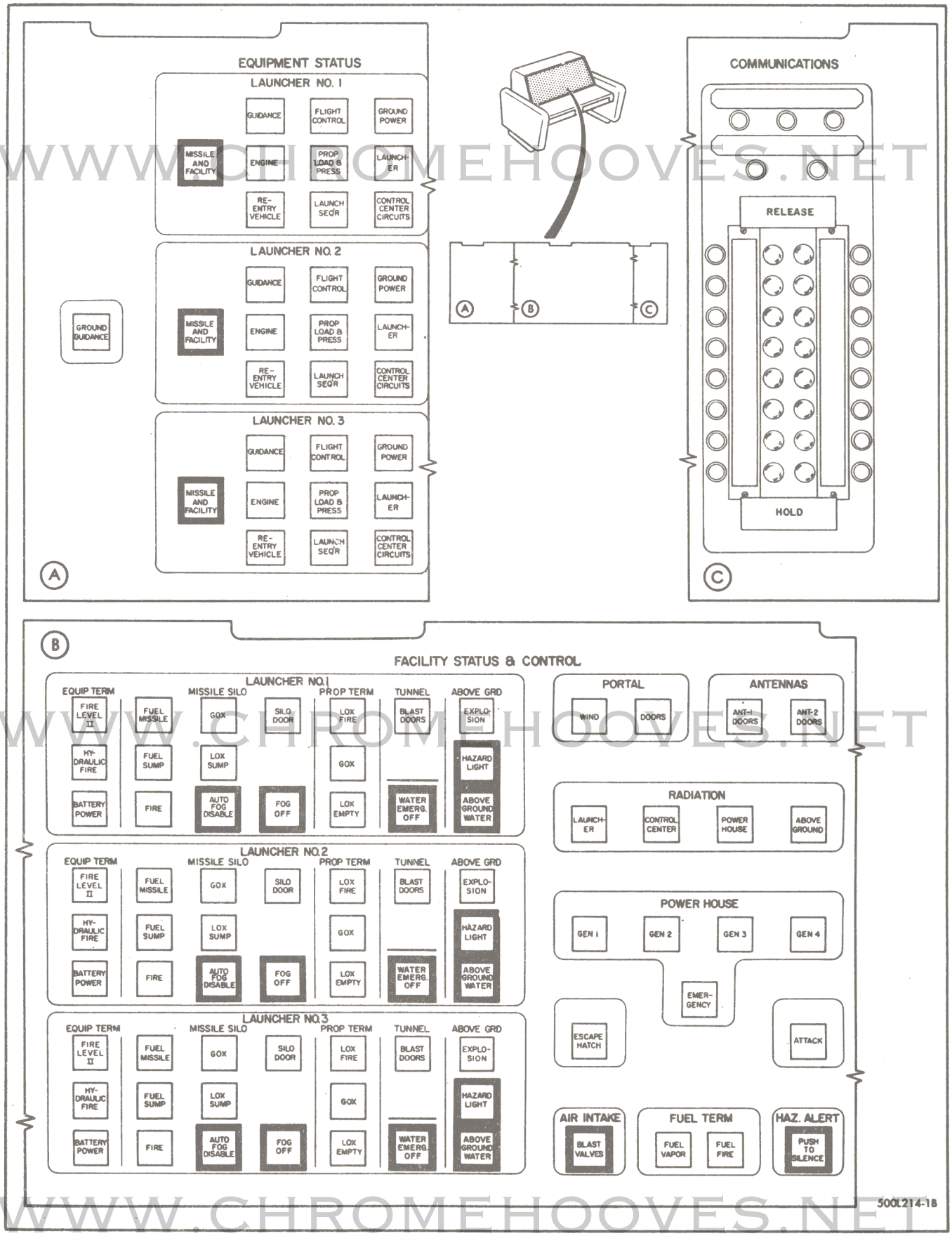


Figure 1-27. Launch Complex Facilities Console (VAFB)

radiation, and liquid oxygen vapors are indicated by flashing red lights. Corrective actions are initiated automatically by sensors in the launch complex damage control system or are controlled from the console. Corrective action in progress is indicated by a flashing white light that alternates with a flashing red light. Pushbutton indicators in the FACILITY STATUS & CONTROL section provide each launcher with manual control of the missile silo water fog equipment, the above ground hazard lights, and the hazard-alert buzzer on the facilities console. At VAFB, the above ground water equipment and the main water valve are also manually controlled at the facilities console by ABOVE GROUND WATER and WATER EMERG. OFF pushbutton indicators.

1-78. The COMMUNICATIONS section of the LCFC enables the console operator to communicate by telephone or public address to all areas of the launch complex.

1-79. POWER HOUSE.

1-80. The power house is the electrical power generating and distribution center for the launch complex. The power house contains generating equipment, transformers, electrical power distribution equipment, and water treatment equipment for the launch complex. The power house at VAFB (figure 1-28) is a two level subsurface structure. The roof of the power house supports the exhaust mufflers for the diesel generators and has four removable precast concrete covers over the generator room. Personnel and trucks enter the power house through a blast door located on the upper level at the south end of the structure. The blast door opens onto a loading dock next to the generator room. A stairwell next to the loading dock provides access to the lower level. In addition to the loading dock and generator room the power house contains a transformer room, pump room, compressor room, boiler room, office, storage area, and a shop area. The operational base power house (figures 1-29 and 1-30) is an underground, dome-shaped structure. The illustrations in this section concerning the power house show a typical layout for the equipment although the actual layout of the equipment from base to base may vary. Entry into the power house is through the personnel tunnel which opens into the power house through the launch complex main tunnel. Large diesel fuel storage tanks are located on each side of exhaust tunnel. Two water storage tanks are located adjacent to the portal entrance tunnel to the power house. The power house supplies all utilities, electrical power, water, and heat, for operation of the launch complex.

1-81. The power house mezzanine (figure 1-30) provides access to the air intake and exhaust tunnels. A water chlorinator, water pumps, water tanks, back wash tank, air receivers, air compressors, fuel oil day tanks, lube oil storage tanks, compression tanks, and a motor control center are located on the mezzanine. The power house lower level (figure 1-29) consists of an office, a shop area, a latrine, and a generator room. The equipment located in the generator room consists of four generators, ice banks, switch gear, water chillers, pumps of various types, heat exchangers, and motor control centers.

1-82. ANTENNA TERMINAL.

1-83. The antenna terminal is a subsurface structure and is composed of a terminal room and two silos. Entrance to the VAFB antenna terminal (figure 1-31) is through a blast door on the exposed side of the terminal room. The terminal room is connected to the two silos by tunnels. Entrance to the operational bases antenna terminal (figure 1-32) is through a personnel passage tunnel. The terminal room is connected directly to the silos. The silos are entered through blast doors.

(Text continued on page 1-48.)

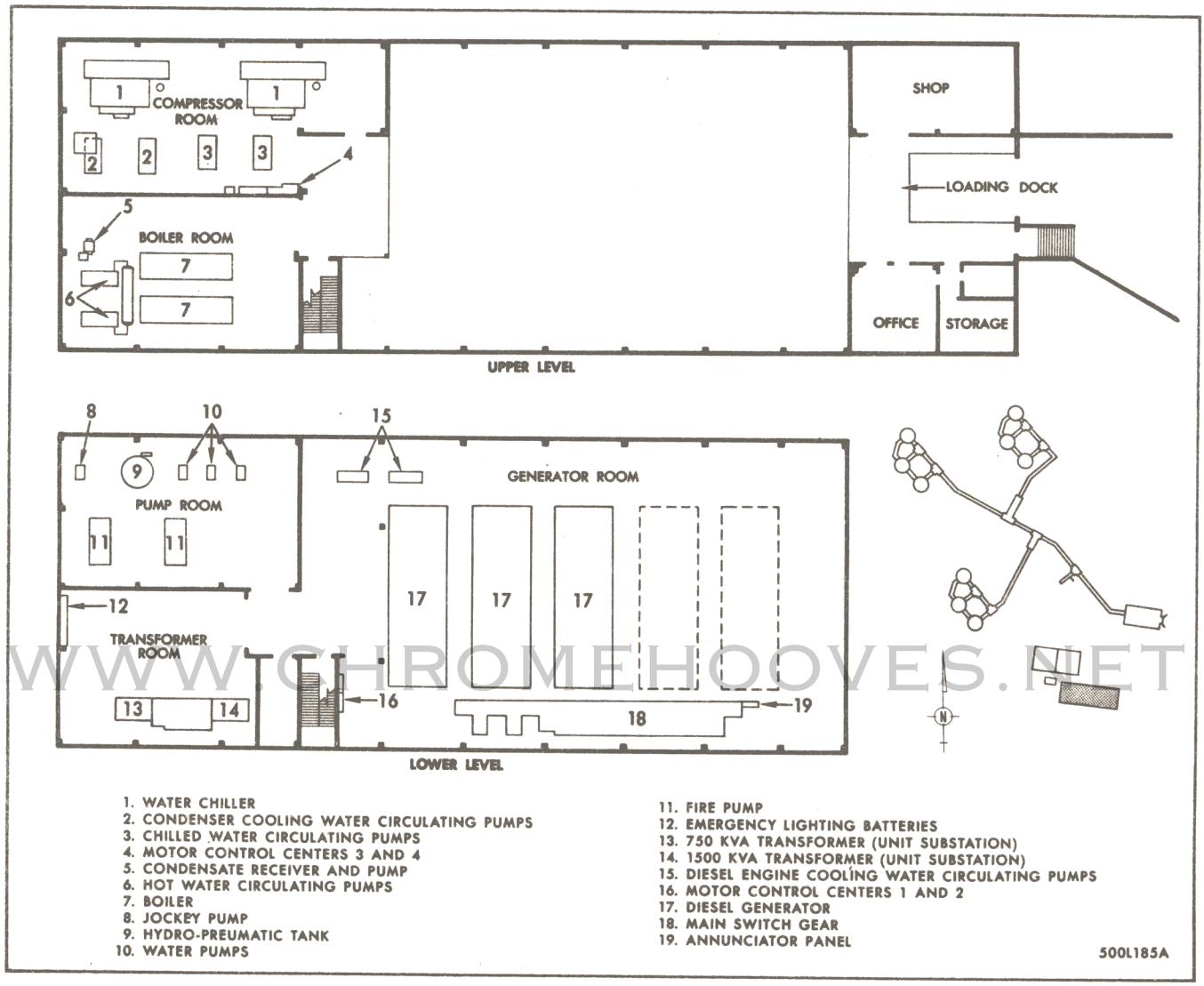


Figure 1-28. Power House (VAFB)