# FINAL PRELIMINARY ASSESSMENT REPORT
# FORMER WALKER AIR FORCE BASE
# ATLAS "F" MISSILE SILO 8
# CHAVES COUNTY, NEW MEXICO
# PROPERTY NO. K06NM0486

**Prepared for**

**U.S. Army Corps of Engineers**
**Albuquerque District**

**Purchase Order No. 42236 QP**

**October 24, 2005**

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**Prepared for**


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**Purchase Order No. 42236 QP**

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# TABLE OF CONTENTS

**Section** **Page**

## LIST OF FIGURES



## LIST OF TABLES

# APPENDICES

## ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| amsl | above mean sea level |
| AOI | Area of Interest |
| BaP | benzo(a)pyrene |
| BD/DR | Building Demolition and Debris Removal |
| bgs | below ground surface |
| BMAT | Ballistic Missile Analyst Technician |
| CON/HTRW | Containerized Hazardous, Toxic, and Radioactive Waste |
| DCCC | Deputy Combat Crew Commander |
| DERP | Defense Environmental Restoration Program |
| DHEW | Department of Health, Education, and Welfare |
| DOD | Department of Defense |
| EPA | U.S. Environmental Protection Agency |
| EPPT | Electric Power Production Technician |
| °F | Degrees Fahrenheit |
| FUDS | Formerly Used Defense Site |
| $GN_2$ | gaseous nitrogen |
| HGL | HydroGeoLogic, Inc. |
| HTRW | Hazardous, Toxic, and Radioactive Waste |
| LAWCC | Lake Arthur Water Cooperative Corporation |
| LCC | Launch Control Center |
| $LN_2$ | liquid nitrogen |
| $LO_2$ | liquid oxygen |
| LP | launch platform |
| MAMS | Missile Assembly and Maintenance Service |
| MEK | methyl ethyl ketone |
| MFT | Missile Facility Technician |
| mg/kg | milligrams per kilogram |
| mg/L | milligrams per liter |
| MMRP | Military Munitions Response Program |
| NMED | New Mexico Environment Department |
| PA | Preliminary Assessment |
| PAH | polynuclear aromatic hydrocarbons |
| PRP | Potentially Responsible Party |
| Shaw | Shaw Environmental, Inc. |
| silo | underground missile silo |
| site | Former Walker Air Force Base Atlas "F" Missile Silo 8 |
| SMS | Strategic Missile Squadron |
| SVOCs | semi-volatile organic compound |
| TAL | target analyte list |
| TCE | trichloroethene |

**ACRONYMS AND ABBREVIATIONS** (continued)

| | |
|---|---|
| TDL | target distance limit |
| TIC | tentatively identified compound |
| USACE | U.S. Army Corps of Engineers |
| USAF | United States Air Force |
| UST | underground storage tank |
| VOCs | volatile organic compound |
| WAFB | Former Walker Air Force Base |
| μg/kg | micrograms per kilogram |

# FINAL PRELIMINARY ASSESSMENT REPORT
# FORMER WALKER AIR FORCE BASE
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## 1.0 INTRODUCTION

On July 16, 2004, HydroGeoLogic, Inc. (HGL) received Purchase Order No. 42236 QP from Shaw Environmental, Inc. (Shaw) to conduct a preliminary assessment (PA) for the former Walker Air Force Base (WAFB) Atlas "F" Missile Silo 8 (site) under the authority of the Comprehensive Environmental Response, Compensation and Liability Act, as amended by the Superfund Amendments and Reauthorization Act of 1986. This work is being conducted on behalf of the U.S. Army Corps of Engineers (USACE), Albuquerque District. The site is located in Chaves County, New Mexico, and has been assigned Formerly Used Defense Site (FUDS) Property Identification Number K06NM0486 (Figure 1). The site is located in New Mexico's 2nd Congressional District.

This PA was conducted in accordance with U.S. Environmental Protection Agency (EPA) Guidance Document EPA/540/G-91/013 to determine if an immediate or potential threat to human health and the environment exists as a result of Department of Defense (DOD) activities at the site and to determine if further action is warranted. The scope of work included performing a review of the DOD activities within the 500-foot by 500-foot alert area of the silo property (area of interest or AOI), identifying potential restoration projects to be accomplished under the Defense Environmental Restoration Program (DERP)-FUDS program, and identifying post-DOD activities at the site. Tasks performed in conducting this PA included: on-site and off-site reconnaissance, archival and regulatory research; interviews; title research; aerial photographic analysis; and comprehensive pathway and target research.

In 1990, the USACE made an evaluation of potential projects at the site. As part of this scope of work, HGL was tasked to identify any other potential projects not previously identified by the USACE based on the analysis of material obtained through the PA. The types of projects to be evaluated include: Hazardous, Toxic, and Radioactive Waste (HTRW), Containerized/HTRW (CON/HTRW), Military Munitions Response Program (MMRP), Building Demolition and Debris Removal (BD/DR), and Potentially Responsible Party (PRP).

Section 2.0 below describes the site location and physical characteristics, explains the DOD's activities at the site, and identifies the post-DOD owner. Section 3 provides details on the pathways of concern and potential targets. Projects are addressed in Sections 4, 5, 6, 7, and 8 for HTRW and CON/HTRW, MMRP, Petroleum Storage Tank (CON/HTRW), BD/DR, and PRP, respectively. Section 9 contains a summary of findings from the PA. Appendices A through D are HGL's field logbook, photograph log, historical aerial photograph analysis report, and references, respectively. Appendix D appears as a separate volume.

# 2.0 SITE DESCRIPTION AND OPERATIONAL HISTORY

## 2.1 SITE LOCATION

The site consists of 249.58 acres in southern Chaves County, New Mexico and is located in Township 15 South, Range 26 East, Section 21 (Ref. 1, pp. 6, 8). The geographical coordinates for the center of the AOI are approximately E 539,453 and N 729,164 (Ref. 2, p. 28). The site is approximately five miles east of U.S. Highway 285 near the town of Lake Arthur, New Mexico and sits at an elevation of 3,375 feet above mean sea level (amsl) (Ref. 3, p. 2; Ref. 4). The AOI is surrounded by a 7-foot chain link fence with a gate. The land use surrounding the AOI is primarily ranch land for cattle, except for a single family residence just south and outside of the AOI.

The regional climate for the site is mild. From January 1914 to September 2004, the average total annual precipitation in the region was 11.9 inches, with most of the precipitation occurring May through October (Ref. 5). The average total annual snowfall for the same period is 6.2 inches, with most of the snowfall occurring December through February (Ref. 5). June, July, and August are the hottest months with average daily high temperatures of 94 degrees Fahrenheit (° F). December, January, and February are the coldest months with temperatures ranging from an average daily low of 24° F to 28° F (Ref. 5).

## 2.2 SITE DESCRIPTION

The DOD acquired the site property in 1960 through the following means: 14.62 acres fee simple by condemnation and 234.96 acres in easement (Ref. 1, p. 8). The site was 1 of 12 locations purchased by the DOD in the vicinity of WAFB in Roswell, New Mexico to construct an Atlas "F" missile launching facility (Ref. 1, p. 14; Ref. 6, p. 21).

A joint venture consisting of Macco Corporation, Raymond International, Inc., The Kaiser Co., and Puget Sound Bridge and Dry Dock Co. was awarded the contract to build the missile launching facilities (Ref. 6, p. 20). Construction on the site began in June 1960 and was completed on November 13, 1961 (Ref. 6, pp. 20, 42). Features constructed at the site included an underground missile silo (silo) and launch control center (LCC), water wells, water treatment building, two Quonset huts, septic system, and underground storage tanks for fuel and water (Ref. 1, p. 8). All of these features are within the AOI except the Quonset huts.

On May 16, 1964, the DOD announced that the Atlas "F" missile program was to be phased-out, and on February 4, 1965 the last Atlas "F" missile was removed from alert readiness (Ref. 7, p. 10). On June 30, 1965, the site was declared excess to the General Services Administration (Ref. 8, p. 1). On September 26, 1966, the Department of Health, Education, and Welfare (DHEW) conveyed the 14.62 acres fee simple and 2.01 acres of easement to the Lake Arthur Water Cooperative Corporation (LAWCC). On June 29, 1966, the remaining easements expired following non-use for a period exceeding one year as stipulated in the acquisition documents (Ref. 1, p. 8; Ref. 9). The LAWCC is the current owner of the AOI and uses two of the former DOD water wells for municipal water supply (Ref. 10).

## 2.3 SITE PHYSICAL CHARACTERISTICS

The silo complex consisted of above and belowground structures within the AOI. Figure 2 depicts the typical surface and underground features of a silo complex, and Figure 3 illustrates the layout of the underground silo complex. Typical aboveground features included: two silo doors; silo air intake; silo air exhaust; fill and vent shaft; silo sump discharge; the LCC entrance; LCC sewer vent; LCC air exhaust; LCC escape hatch; LCC air intake; tile field for LCC sump; three communication boxes; two blast detection optical sensors; collimator site tube opening; RP-1 fuel manual shut off valve; dirty lube oil drain line; clean oil fill line; and horizontal crib locks. Fill stubs and vents were located above the ground for gaseous nitrogen ($GN_2$), liquid nitrogen ($LN_2$), liquid oxygen ($LO_2$), helium, and RP-1 (Ref. 11, pp. 3-7).

The AOI also contained a water treatment building, a cooling water tower for the diesel generators, a raw water storage tank, and a processed water storage tank. The water treatment building contained two water wells and pumps, and demineralization, filtration, and softening equipment (Ref. 11, pp. 3-7; Ref. 7, p. 2). A third water well was located just north of the other two water wells (Ref. 2, p. 14). Figure 4 depicts the layout of the site.

Wastewater from the LCC sump was pumped to a septic tank and leachfield located southwest of the silo (Ref. 6, p. 60; Ref. 11, pp. 3, 7; Ref. 2, p. 14). Wastewater from the sump at the bottom of the silo was pumped to the surface and disposed of through a 6-inch pipe into a drainage ditch. The outfall for the silo sump was located directly south of the silo (Ref. 6, p. 60; Ref. 11, pp. 3, 7; Ref. 2, p. 14).

Belowground features within the AOI included: the LCC; the missile silo; a 15,300-gallon diesel underground storage tank (UST) and a 15,000-gallon catchment tank, both typically residing east of the silo; and four utility water tanks with a 91,000-gallon combined capacity (Ref. 11, pp. 3-7). An Atlas "F" missile and the launch platform (LP) for the missile resided within the silo. Descriptions of the LCC, silo, LP, and missile are detailed below along with associated equipment and/or components.

The LCC was approximately 27 feet in height and 40 feet in diameter (Ref. 12, p. 17). Entrance into the LCC was through a stairway that began at ground level. The stairway shaft contained an entrapment area, two blast doors, connecting tunnel, a stairwell to the LCC levels and a utility tunnel that connected the LCC to the missile silo (Ref. 11, p. 10).

The LCC was a suspended, two-story steel structure (Ref. 11, p. 10). The suspension system was designed to absorb the ground shock of a near nuclear blast through four air cylinder spring supports (Ref. 12, p. 17; Ref. 13, p. 2). The air cylinder spring supports were attached from the ceiling of the structure to the first floor level and four level-detecting devices were mounted between the second floor level and the concrete base (Ref. 13, p. 2). The upper floor of the LCC (Level 1) contained the ready room and storage area, janitor room, latrine and shower room, kitchen and dining area, heat-vent and air conditioning room, and medical supply room. The lower floor of the LCC (Level 2) was the work area that contained the missile launch console and associated equipment. Rooms contained on Level 2 included the launch control room, office, battery room, and communications and equipment room (Ref. 11, p. 10). Figure 5 provides an illustration of the monitoring, electrical, and launch equipment installed on Level 2 of the LCC (Ref. 13, p. 3).

Outside the stairwell entrance to the lower level of the LCC was a utility tunnel that connected to the missile silo. The tunnel was approximately 54 feet in length and 8 feet in diameter and provided personnel access to the silo and also served as a conduit for electrical and communications cabling (Ref. 12, p. 10).

The silo, which housed the missile and most of the equipment needed for its maintenance and launching, was a concrete cylindrical hole 52 feet in diameter and approximately 174 feet in depth (Ref. 12, p. 10; Ref. 14, p. 3). The concrete walls of the silo were 2 feet, 6 inches thick up to 55 feet below ground surface (bgs), at which point the thickness flared out to a total thickness of 9 feet (Ref. 15, p. 2). In the silo roof, which is flush with ground level, was a square opening sealed by two blast-resistant silo doors (Ref. 12, p. 13). The missile was installed, raised, and lowered into the silo through these doors via the LP.

Inside the silo was an octagonal structural steel crib. The crib was suspended from the silo walls on spring-loaded shock struts designed to cushion the crib and its contents against the shock of a near nuclear blast (Figure 6). Within the crib were two square shafts of different dimensions. The larger shaft was for the LP. The smaller shaft contained a utility elevator (Ref. 12, p. 13).

The crib contained eight levels which housed the equipment necessary to launch the missile and maintain the missile support systems, which included heating, ventilation, and air conditioning equipment (Ref. 14, p. 3). Figures 7 to 14 layout the configuration of each silo level and also list the equipment on each level. Additional information on specific equipment listed in the figures is provided below by silo level.

<u>Silo Level 1</u>: contained a 345-gallon demineralized water tank (Ref. 11, p. 21).

<u>Silo Level 2</u>: contained a hydraulic pump and 275-gallon hydraulic oil reservoir unit, a 30 KVA transformer, and eight accumulators and five $GN_2$ bottles mounted in a support rack (Ref. 11, p. 25-26; Ref. 16, pp. 2-3).

<u>Silo Level 3</u>: had a 30 KVA transformer, a transformer rectifier, an MD-2 motor generator, and an emergency missile power battery backup unit that consisted of 21 nickel-cadmium alkaline cells (Ref. 11, pp. 33-34).

<u>Silo Level 5</u>: contained a 348-gallon dirty lube oil tank, a 348-gallon clean lube oil tank, and a 665-gallon diesel fuel storage tank. The diesel fuel storage tank was kept full through a continuous topping process from the 15,300-gallon diesel UST. A model 40, heavy duty, vertical, multi-cylinder, solid injection full diesel generator was supplied fuel and oil from this equipment. The dirty lube oil from the diesel generator was pumped into the dirty lube oil tank (Ref. 11, p. 38).

<u>Silo Level 6</u>: contained a model 40, heavy duty, vertical, multi-cylinder, solid injection full diesel generator and a dirty lube oil pump. The dirty lube oil pump transferred dirty lube oil

from the diesel generators on Levels 5 and 6 to the dirty lube oil tank on Level 5, and from there it was transferred to the top of the silo through a drain line when the tank was pumped-out. The pump had a capacity of 20 gallons per minute (Ref. 11, pp. 4, 42).

Silo Level 7: contained components for the propellant loading system and vapor detection equipment (Ref. 11, pp. 47-49).

Silo Level 8: contained a fuel loading prefab unit with a storage capacity of 630-gallon for RP-1, two 1,870-gallon tanks used to store high pressure helium, a 4,000-gallon $LN_2$ storage tank, a 3,600-gallon $LO_2$ topping tank, a 23,000-gallon $LO_2$ storage tank, three 13,000-gallon combined $GN_2$ storage tanks. The level also contained an evaporator tank for any overflow of $GN_2$ and $LN_2$ from the $LN_2$/helium shrouds during countdown (Ref. 11, pp. 52-55; Ref. 14, p. 8).

Beneath Level 8 at the bottom of the silo was the sump level, which contained a sump with two explosion-proof submersion 7.5-horsepower pumps with a capacity of 100 gallons per minute. Liquids that were discharged from the sump were routed up the silo wall through a discharge line. The discharge line was routed up to Level 2 where the liquids were released through a 6-inch line into a catch basin outside the silo at grade level (Ref. 11, pp. 7, 57).

The LP was an open cage-type, four-level elevator on which the missile was lowered into and raised out of the silo. The platform was 16 feet square and 49 feet high (Ref. 12, p. 15).

The first level of the LP, which was aboveground when the platform was raised, contained the missile launcher and flame deflector. The second level held the launcher platform locking system, which anchored the platform to the silo walls when it was raised and to the crib structure when it was lowered. The third and fourth levels contained equipment for servicing the missile while the LP was rising during a countdown (Ref. 12, pp. 15-16). Figure 15 details the equipment on the LP.

The Atlas "F" missile was 75 feet long, and had a 10-foot diameter that flared to 16 feet at the nacelles (Ref. 17, p. 2). The missile could be fitted with one of two different nuclear warheads (Ref. 7, p. 2). The main shaft of the missile was made of thousandths of an inch stainless steel, which was molded into a cylindrical tank structure that had no supporting framework. Rigidity of the missile was maintained through constant application of pneumatic pressure to the interior of the two missile propellant tanks. Missile pressure was maintained during transportation and standby using gaseous nitrogen. When the missile was in flight, helium was used to maintain pressure (Ref. 17, p. 2). Electrical, instrumentation, flight control, and guidance equipment were mounted on the outside of the missile (Ref. 17, p. 4). Figure 16 illustrates the components of the missile.

The missile contained a $LO_2$ tank with a capacity of 18,725 gallons, but 18,500 gallons of $LO_2$ was loaded into the tank during launch or propellant loading exercises. The missile also had an RP-1 tank on the missile with a capacity of 11,653 gallons, but only 11,200 gallons of RP-1 was stored inside the tank (Ref. 17, pp. 4-5).

During a 1990 site visit, the USACE noted that all openings to underground structures were closed off with concrete or mounded dirt. The diesel tank and the aboveground water storage tanks had been removed (Ref. 18, p. 1). The representative for the LAWCC stated that the septic tanks at the site were still present, but had been filled in (Ref. 19, p. 1).

## 2.4 SITE OPERATIONAL HISTORY

### 2.4.1 DOD Operations

The majority of information regarding DOD operations at the missile silos was obtained from interviews with six former Atlas "F" missile crewmen and maintenance personnel of the 579th Strategic Missile Squadron (SMS) stationed at WAFB. Formal interviews were conducted with these individuals regarding their knowledge of operations and maintenance activities in the AOI. With the exception of one individual, the interviewees were stationed with the 579th SMS during the entire activation period of the Atlas "F" missile program. It should be noted that the interviewees referred to the liquid oxygen at the silos as "LOX." Since the historical site documents use the acronym $LO_2$ for liquid oxygen, $LO_2$ will be used instead of LOX for standardization purposes.

All the interviewees reported to duty in late 1961 or 1962 while the silos were being constructed (Ref. 20, pp. 4, 9, 12, 16, 18). The Site Activation Task Force, under the Air Force Systems Command, was charged with overseeing the construction contractors. The USACE was also involved in the construction of the silos (Ref. 20, p. 12). During the construction phase, the interviewees worked out of the 579th SMS headquarters at WAFB. Several of the interviewees were sent to missile school where they received instruction on missile operations and the maintenance of the silos and support equipment (Ref. 20, pp. 9, 12, 18).

Once the United States Air Force (USAF) took custody of the silos, an inventory of the silo equipment was conducted. The missiles were then transferred to the silos, and the silos went to alert status (Ref. 20, p. 4).

The missile crew at each silo consisted of five crewmen. The crew included the Combat Crew Commander, Deputy Combat Crew Commander (DCCC), Ballistic Missile Analyst Technician (BMAT), Missile Facility Technician (MFT), and the Electric Power Production Technician (EPPT) (Ref. 20, pp. 6, 9). Both Crew Commanders had to have a rank of Captain or higher, and each wore the launch code for the missile n a sealed, plastic case around their necks. The launch code changed frequently, even during the course of a shift. Both Crew Commanders also carried a firearm to protect the launch code (Ref. 20, pp. 6, 12). In addition, two guards were stationed on top of the silo at all times (Ref. 20, p. 9). The missile crew worked a 24-hour shift and had 2- or 3-day break between shifts. During the course of a shift, crew members conducted about two or three inspections within the silo. The crewmen would record instrument readings and verify that the instrument lights in the silo were green, indicating that everything was operational (Ref. 20, p. 16).

Strategic Air Command required the crewmen to become certified prior to being assigned to a missile crew. This certification involved performing drills associated with missile operations.

Approximately once a year, the crewmen had to be recertified, which typically involved conducting propellant loading exercises (Ref. 20, p. 6). It should be noted that during propellant loading exercises, the nuclear warhead was removed from the missile and replaced with a dummy warhead of the same weight (Ref. 20, p. 10).

Each silo had a library containing about 10 to 12 feet of books, including technical orders and prints, referred to as "Tucker Prints," depicting the electrical and plumbing lines throughout the silo. The maintenance shops in the Missile Assembly and Maintenance Service (MAMS) building at WAFB also had a library containing similar material (Ref. 20, pp. 10, 18).

Silo operations relied on diesel generator power during normal operations, but commercial power was also available. The diesel generators were relied on totally during missile exercises (Ref. 20, pp. 16, 18). The silo contained two diesel generators. Diesel fuel was pumped from the UST into a "day tank" inside the silo. The "day tank" contained a day's worth of diesel to operate the generators. The generators also had cooling towers at the silos (Ref. 20, pp. 10, 13).

In addition to diesel fuel, other material stored on-site included $LO_2$, RP-1 fuel, $LN_2$, helium, and hydraulic fluid. $LO_2$, one of the fuel sources for the missile, was stored in large amounts in an oxidizing tank inside the silo. The $LO_2$ was loaded into the missile during launch or propellant loading exercises. After the exercise, the $LO_2$ was vented off the missile into the atmosphere. RP-1, a high-grade form of kerosene, was stored in a fuel tank on the missile (Ref. 20, pp. 5, 7, 10, 13). While the $LO_2$ was vented off the missile after an exercise, the RP-1 stayed on the missile and did not need to be replenished (Ref. 20, pp. 5, 10, 13).

Other material located in the silo included helium and hydraulic fluid. The hydraulic fluid was used to operate the silo doors, crib locks, and elevators. Because the hydraulic fluid was under great pressure, it had to be occasionally refilled due to leaks. A small tank was present inside the silo to store extra hydraulic fluid (Ref. 20, pp. 5, 13). Two gallons of hydraulic fluid were stored at the silo for back-up purposes (Ref. 20, p. 5).

Each interviewee was asked about general solvent use at the silos. The Maintenance Control Officer, who was responsible for overall maintenance operations at the silos, stated that small amounts of methyl ethyl ketone (MEK) may have been used at the silos to clean parts and remove grease. However, he did not believe trichloroethene (TCE) was used in the silos for maintenance or cleaning operations (Ref. 20, p. 5). Another interviewee, a DCCC, suggested that TCE may have been used (Ref. 20, p. 13). It is noted, however, that the DCCC did not oversee or conduct maintenance activities in the silos; rather, during maintenance operations, the DCCC remained in the LCC to monitor the support systems (Ref. 20, p. 10). Other interviewees did not know of any solvent use on the silo property. One interviewee stated that hydrocarbon solvents were incompatible with $LO_2$, and the USAF was reluctant to use hydrocarbon solvents in the silos (Ref. 20, pp. 7, 11, 13, 16, 18).

The maintenance squadron for the 579$^{th}$ SMS, located in the MAMS building at WAFB, performed the majority of the maintenance at the silo (Ref. 20, pp. 7, 13, 16, 18). Interviewees stated that the maintenance crew was out at the silo on a daily basis performing scheduled maintenance or responding to maintenance requests. Scheduled maintenance, which included tasks such as replacing filters, was performed at the silo every 30, 60, 90, and 120 days, as well as annually (Ref. 20, pp. 4, 10).

According to historical documents, the maintenance squadron was responsible for the following maintenance tasks on the missiles and support equipment: pre-launch, daily, and storage inspections; routine launch site servicing and preventive maintenance; removal and replacement of specific components; bench maintenance; assembly of missiles; periodic inspections; recycle maintenance; technical order compliance; and reclamation and repair of components and parts (Ref. 21, p. 3). Bench maintenance was performed at the squadron maintenance area, located at the MAMS building (Ref. 21, p. 6). Maintenance on the weapon system that was beyond the capability of the maintenance squadron was performed at contractor facilities, "AMAs", or at the squadron with Air Material Command mobile maintenance teams (Ref. 21, p. 7).[1] Depending on the level of service required, maintenance on the missile and support equipment would be conducted within the launch complex, WAFB, AMAs, or contractor facilities (Ref. 21, pp. 5-7). An interviewee recalled that any maintenance on the Atlas "F" warhead was conducted at WAFB (Ref. 20, p. 16).

Maintenance activities within the silo generally involved components of the support equipment, such as vacuum pumps, valves, and motors (Ref. 20, pp. 6-7). The Maintenance Control Officer described typical maintenance issues within the silo as malfunctioning equipment, door problems and facility problems. He added that much of the maintenance involved "R & R," also known as "Remove & Replace" (Ref. 20, p. 4). According to two members of the maintenance squadron, maintenance on the diesel generators occurred on a regular basis because the generators occasionally dripped fluid and were located above the $LO_2$ tanks. To resolve the potential hazard of the fluid coming into contact with the $LO_2$, a 4-inch-deep drip pan was placed beneath the generators (Ref. 20, pp. 4, 18).

A MFT and another crewman were always in the silo to observe the maintenance crew's activities (Ref. 20, pp. 7, 10). According to one Maintenance Squadron personnel, the maintenance crew strictly adhered to the technical orders when conducting any silo maintenance or cleaning (Ref. 20, p. 18). Occasionally, maintenance inside the LCC occurred and typically involved electronic issues (Ref. 20, p. 4).

The missile crew performed minor adjustments to silo equipment during its "walk around." This maintenance entailed adjusting equipment to keep the temperature within a certain range, adding oil to the vacuum pumps, and wiping down equipment (Ref. 20, p. 7). According to historical documents, the missile crew was responsible for performing preventive maintenance on the launcher, ground support equipment, facilities, and communications and ground guidance equipment within the launch enclosure (Ref. 21, p. 4).

The interviewees did not recall if the $LO_2$ lines were flushed while out at the silo; however, one of these interviewees recalled that the $LO_2$ had to be replaced once and, as part of that process, a non-hydrocarbon cleaner was use to clean out the line. The $LO_2$ lines were extremely sanitary and remained sealed at all times (Ref. 20, pp. 7, 13). A technical manual stated that the cleaning

[1] Although the referenced document does not define "AMA," the acronym is believed to stand for Air Material Area.

of components and systems of the Atlas F weapon system was to be conducted in the MAMS building, and indicated that the propellant loading system was cleaned with nitrogen gas (Ref. 22, pp. 2-5).

Very little material was stored at the silo itself. The maintenance crew brought any necessary material needed to conduct repairs or perform maintenance checks with them from WAFB (Ref. 20, p. 5). The maintenance squadron was also responsible for supplying diesel fuel and hydraulic fluid to the silos. A tanker delivered diesel to the silos once a month (Ref. 20, p. 5). The crewmen interviewed recalled that spills or leaks in the silos mostly involved hydraulic fluid, diesel, and occasionally lubricating oil (Ref. 20, pp. 7, 11, 13). Typically, the leaks involved mostly seepage and did not constitute large spills. If a larger leak of diesel occurred, it usually resulted from personnel forgetting to turn off the switch when filling the "day tank" on the generator (Ref. 20, p. 13).

Water frequently leaked into the silos and collected in the sumps at the bottom of the silos (Ref. 20, p. 7). Hydraulic oil that had leaked would occasionally flow into the sump as well (Ref. 20, p. 11).

The deactivation of the missile silos was conducted in three phases. Phase one included removing the missile, re-entry vehicle, and classified components, removing mobile equipment and equipment for reutilization, and disposing of missile propellants and gases. The second phase included protection and preservation of equipment, removal of organizational material and equipment, communications-electronics-meteorological equipment, and real property installed equipment. Phase three consisted of reporting the site as excess to the General Services Administration and providing care and custody of the sites (Ref. 23, p. 2).

After removal from the sites, the missiles were transported to Norton Air Force Base and stored near Mira Loma (Ref. 23, pp. 3-4). Between the time when the sites were deactivated and when the equipment was dismantled and removed, the DOD took measures to preserve and maintain equipment in optimum condition for later reutilization (Ref. 23, pp. 5-6).

The USAF determined what equipment it could reutilize from the silos, and then other services and federal agencies were allowed to request remaining equipment. The USAF marked 42% of the equipment in the silos for reutilization (Ref. 23, pp. 7-9). General dismantling began after July 31, 1965 (Ref. 23, p. 13). The diesel generators and air conditioning units were removed from the silos and distributed within the USAF (Ref. 23, pp. 10-12). As part of the equipment removal procedure, the diesel fuel was drained from the generators prior to removal, the silo hydraulic system was drained, and $GN_2$ and helium were vented off. The diesel generators were removed from the silo along with equipment on Levels 1 through 8, including all the storage containers. The launch platform was used as an elevator for the removal. The launch platform and its drive mechanisms were then removed (Ref. 16, p. 4).

The remaining dismantling work was managed through service and salvage contracts where the contractor removed all required equipment and was granted the salvage rights to the residual equipment and material (Ref. 23, pp. 13-14). Open bidding on the service and salvage contracts began in August 1965 (Ref. 23, p. 16). On June 30, 1965, the site was declared excess to the

General Services Administration (Ref. 8, p. 1). On September 26, 1966, the DHEW conveyed the 14.62 acres fee simple and 2.01 acres of easement to the LAWCC (Ref. 1, p. 8; Ref. 9).

Although not within the AOI, information on the Quonset huts was researched to determine their purpose. None of the interviewees had direct knowledge of the purpose of or the activities conducted in the Quonset huts, and their accounts varied on whether the huts were taken down when the construction phase was completed. One interviewee believed that the huts contained various shops, possibly plumbing and electrical shops. Other interviewees suggested that equipment and spare parts were stored in the huts (Ref. 20, pp. 5, 7, 10, 14, 17, 19).

Historical DOD documents indicated that one Quonset hut was an administration office and the other was used as a supply and equipment warehouse (Ref. 8, p. 7; Ref. 7, p. 2). No site related documents specifically listed what was stored in the Quonset huts or described the activities conducted inside the huts. A missile phase-out document listed Atlas "F" maintenance ground equipment and distinguished what equipment was kept in the MAMS building at WAFB. Given the distinction of what equipment was kept in the MAMS, it is likely that the other equipment was stored at the site in the Quonset huts. Equipment that may have been stored in the huts included: "MAPCHE" checkout equipment, re-entry vehicle checkout equipment, guidance maintenance equipment, communications equipment, gas and propellant servicing equipment, miscellaneous tools and test equipment, pneumatic checkout equipment, calibration equipment, work platforms (Ref. 24).[2]

### 2.4.2 Post-DOD Operations

On September 26, 1966, the Department of Health, Education, and Welfare conveyed the 14.62 acres fee simple and 2.01 acres of easement to the LAWCC (Ref. 1, p. 8). The LAWCC is the current owner of the AOI and uses two of the former DOD water wells for municipal water supply (Ref. 10). The site is not used for any other purpose, such as storage. A representative of LAWCC stated during a 1990 site visit that he was unaware of any hazards at the site (Ref. 18, pp. 1-2).

# 3.0 PHYSIOGRAPHIC AND ENVIRONMENTAL SETTING

## 3.1 GROUNDWATER PATHWAYS

### 3.1.1 Hydrogeologic Setting

The site is located in the southern part of the Roswell Artesian Basin approximately one mile west and over one-half mile north of the Pecos River. Two distinct, but closely related, water systems within the upper carbonate-evaporite member of the San Andres Formation lie within the Roswell Artesian Basin. The first is a shallow aquifer, composed in part from alluvial fill, and the second is an artesian aquifer. Quaternary unconsolidated gravel, sand, silt, and clay form alluvium that lies unconformably above the Permian rocks in the Roswell Artesian Basin. The artesian aquifer occurs beneath an aquitard formed by the Queen Formation in faulted eastward-

[2] Although the referenced document does not define "MAPCHE," the acronym is believed to stand for mobile automatic programmed checkout equipment.

dipping rocks at the northwestern edge of a large depositional basin of Permian age. It is believed that the on-site wells were drilled to the San Andres Formation. In general, groundwater flows in a southeasterly direction across the basin (Ref. 2, pp. 19-20).

Drilling logs from three on-site wells drilled during construction of the site to depths of 1,040 feet, 1,046 feet, and 1,020 feet indicated that there are between 770 to 825 feet of very low permeability strata between the ground surface and the deep aquifer that exists at approximately 1,040 feet bgs (Ref. 25). Only one of the 1960 drilling logs noted the presence of a shallow groundwater zone at 250 to 260 feet bgs, but recent environmental work at the site indicated the presence of groundwater units at 40 to 55 feet bgs, 89 to 105 feet bgs, 120 feet bgs, and possibly 190 feet bgs (Ref. 25, p. 1; Ref. 2, p. 48). The groundwater flow direction in the zone between 89 to 105 feet bgs is to the southeast, and the groundwater gradient across the site is approximately 0.0025 feet/foot (Ref. 2, p. 48).

### 3.1.2 Hydrogeologic Targets

Two of the water wells drilled at the site by the DOD are currently being used for municipal water supply for the town of Lake Arthur by the owner, LAWCC (Ref. 1, p. 8; Ref. 10). The 2000 U.S. Census listed the population of Lake Arthur as 432 (Ref. 26, p. 1). The wells are subject to both state and federal water quality standards and are frequently tested. Water samples from the wells have never shown contaminant levels in excess of federal drinking water standards (Ref. 1, p. 10). Figure 17 identifies the location of the two municipal wells within the AOI. According to a representative of the LAWCC, the LAWCC does not have a wellhead protection plan in place (Ref. 27).

A significant number of residents are located within a 4-mile radius of the AOI, but are not located within the town of Lake Arthur. These residents obtain their drinking water from domestic wells. A search was conducted in the New Mexico Office of the State Engineer W.A.T.E.R.S. database to identify the registered domestic wells within the following target distance limits from the AOI: 0 to ¼ mile, ¼ to ½ mile, ½ to one mile, one mile to two miles, two miles to three miles, and three miles to four miles. The search identified 88 registered domestic wells within four miles of the AOI (Ref. 28). The number of people using domestic wells within each target distance limit (TDL) was determined by multiplying the number of domestic wells within each TDL by 2.66, the average number of people per household in Chaves County, according to the 2000 Census (Ref. 29, p. 2). Figure 18 identifies the municipal and domestic wells within each TDL. Table 1 shows the number of private and municipal drinking water wells and receptors within each TDL. It should be noted that the residence located just south and outside of the AOI receives water from the LAWCC (Ref. 30).

## 3.2 SURFACE WATER PATHWAYS

### 3.2.1 Hydrology Setting

The site lies in the Pecos River Basin and is one mile west and over one-half mile north of the Pecos River. The Pecos River is the only major surface water within two miles of the site (Ref.31, Ref. 4). Figure 19 depicts the location of the Pecos River in relation to the site.

### 3.2.2 Surface Water Targets

The site is outside the 100-year floodplain of the Pecos River (Ref. 32). As of March 30, 2005, the flow rate of the Pecos River at Artesia, approximately 18 miles downstream from the site, was 89 cubic feet per second (Ref. 33). It is unlikely that runoff from the site would reach the Pecos River given that the area has a low annual precipitation of 11.9 inches, the topography of the site is flat, and there are roads to the south and east of the site that separate the river from the site (Ref. 4, 5). There are no wetlands or surface water intakes for domestic use within 15 miles downstream from the site (Ref. 34).

## 3.3 SOIL EXPOSURE AND AIR PATHWAYS

### 3.3.1 Physical Conditions

The site is located in the Pecos River Valley, a north-south trending topographic feature situated along the southwestern boundary of the Great Plains physiographic province. The geologic setting for the site is the Roswell Artesian Basin north of the western edge of the Guadalupian reef complex of the Permian Basin. The Roswell Artesian Basin is bounded by the Capitan, Sacramento, and Guadalupe Mountains to the west, the Seven Rivers Hills to the south, and the scarp of the east bank of the Pecos River to the east. The northern boundary of the basin is indefinite, but probably coincides with the main stem of Arroyo del Macho. Regional stratigraphy consists of quaternary valley-fill alluvium overlying Permian marine clastic, carbonate, and evaporite rocks (Ref. 2, p. 19).

Shallow subsurface geology at the site consists of unconsolidated silty sand and fill from ground surface to a depth of approximately 8 to 15 feet bgs. In a borehole recently drilled in the former UST area of the site, a red silty clay with moderate plasticity was present to 45 feet bgs; evaporite deposits with weathered quartz conglomerate were present from 45 to 70 feet bgs; and a dark-red silty clay was present from 70 to 96 feet bgs with a 3-foot-thick limestone bed from 90 to 93 feet bgs. In two deep boreholes recently drilled to the west of the silo, a grey to red clay with varying amounts of quartz conglomerate was encountered from 32 to 105 feet bgs, and a limestone unit of unknown thickness was encountered at depths of 102 feet and 105 feet. In a deep borehole recently drilled north of the former UST area, silty sands and clays with occasional cobbles were present from 15 to 100 feet bgs; anhydrite with thinly bedded clay and limestone was present up to 247 feet bgs; and two limestone beds were encountered from 100 to 120 feet bgs and 130 to 140 feet bgs (Ref. 2, pp. 28, 39).

Primary vegetation at the site is salt cedar and native grasses.

### 3.3.2 Soil and Air Targets

On the average, approximately 31 people live within the one-mile TDL of the site and 929 people live within the four-mile TDL. These figures were calculated by determining the population per square mile of both the town of Lake Arthur and Chaves County and then multiplying the population per square mile by the number of square miles for each entity within both TDLs. The number of square miles for the town of Lake Arthur and Chaves County within each TDL was determined using ESRI ArcMap™. ESRI ArcMap™ was also used to determine the total square miles of the town of Lake Arthur. Data from the 2000 U.S. Census was used for the total population of both entities (Ref. 26, p. 1; Ref. 29, p.1). The closest residence identified during the site visit was one home located just south of the fenced-in area containing approximately three residents.

Chaves County encompasses 6,071 square miles and has a total population of 60,591 people (60,591/6,071 = 10 people/square mile) (Ref. 29, pp. 1-2). There are 3.14 square miles of Chaves County within the one-mile TDL (10 people x 3.14 square miles = 31 people). The four-mile TDL included the total population of the town of Lake Arthur (432 people), and 49.65 square miles of Chaves County (10 people x 49.65 square miles = 497 people). Table 2 shows the population tabulations for each TDL.

No schools or daycare centers are located within 200 feet of the site. Terrestrial habitat may exist near the site for the Sand Dune Lizard (sceloporus arenicolus), a New Mexico Wildlife Conservation Act threatened species (Ref. 35).

# 4.0 HTRW AND CON/HTRW PROJECTS

## 4.1 PRIOR AREAS INVESTIGATED FOR POTENTIAL PROJECTS

In 1990, the USACE identified four potential sources of hazardous or toxic waste contamination at the site: the area where the diesel fuel UST was located; the evaporative ponds associated with the water treatment system; the main missile silo; and the septic system and leach field (Ref. 1, p. 10).

The USACE is currently performing a site investigation at the site. The areas being investigated and preliminary sampling results are detailed below. Soil samples taken during the site investigation were analyzed for volatile organic compounds (VOCs) (EPA 8260B), semi-volatile organic compounds (SVOCs) (EPA 8270C), polynuclear aromatic hydrocarbons (PAH) (EPA 8270C-modified for low level PAH), and target analyte list metals (TAL) (EPA 6010B/6020/7470A/7471A). The laboratory also performed searches of mass spectra library files and reported the top ten tentatively identified compounds (TICs) for each VOC and SVOC analysis (Ref. 2, p. 32). The soil sample results were compared against the more conservative standards of either the New Mexico Environment Department (NMED) Soil Screening Levels or the EPA, Region 6, Human Health Medium-Specific Screening Levels for residential exposure (Ref. 2, p. 33).

The analytical procedures outlined above were also performed on groundwater samples taken from installed monitoring wells and one of the two active production wells at the site and samples of water from the silo. In addition to these methods, four groundwater samples were also analyzed for total dissolved solids (Method 160.1) (Ref. 2, pp. 51, 53). The groundwater and silo water results were compared against the more conservative standards of either the New Mexico Water Quality Control Commission groundwater standards or the EPA's National Primary and Secondary Drinking Water Regulations Maximum Contaminant Levels.

### 4.1.1 Septic Leachfield

Four soil borings were advanced to 9 to 14 feet bgs within and across the slope of the septic leachfield at the site. Soil samples were collected from the bottom of each soil boring. No organic vapors were detected within field-screening methods and no discolored soil was observed in the drill cuttings (Ref. 2, p. 22).

One of the soil samples collected from the leachfield had an arsenic concentration of 4.71 milligrams per kilogram (mg/kg), exceeding the evaluation criteria of 3.9 mg/kg. No other TAL metals, VOCs, or SVOCs were detected above evaluation criteria in soil samples collected from the leachfield (Ref. 2, p. 34).

### 4.1.2 Sump Outfall

A total of seven soil samples were collected in the vicinity of the sump outfall pipe, which was located approximately 80 feet south of the silo. A 16-square-foot area downgradient of the outfall pipe was excavated to the same elevation as the bottom of the pipe. Three soil samples were collected from directly below the outfall pipe, 1 foot downgradient of the pipe, and from the organic-rich soil material inside the clay pipe. After these samples were collected, the area downgradient of the pipe was excavated to 4 feet bgs and four more soil samples were collected. Organic vapors were not detected in any of the sump outfall samples (Ref. 2, pp. 22, 29).

Benzo(a)pyrene (BaP) was detected at an estimated concentration of 63 micrograms per kilogram (μg/kg) in one field duplicate sample from the sump outfall area. The original sample did not contain a BaP concentration above the evaluation criteria. VOCs and TAL metals were not detected above evaluation criteria in soil samples collected from the sump outfall area (Ref. 2, p. 34).

The following TICs were identified in two of the sump outfall soil samples: 2-propenoic acid, 2-methyl-, decyl; 2-propenoic acid, 2-methyl-, dodec; and benzo[j]fluoranthene. In accordance with the site investigation quality assurance plan, no further action was necessary regarding the TICs (Ref. 2, pp. 35-36, 39).

### 4.1.3 Former UST Area

One soil sample was collected 45 feet bgs in the former UST area at the site. Organic vapors were not detected with field-screening methods (Ref. 2, pp. 29, 32). The analytical results from the soil sample did not exceed the evaluation criteria (Ref. 2, p. 33).

The TIC ethyl acetate was identified in the soil sample. In accordance with the site investigation quality assurance plan, no further action was necessary regarding the TIC (Ref. 2, pp. 35-36, 39).

### 4.1.4 Additional Soil Sampling

Soil samples were collected 45 feet bgs from two deep boreholes drilled to the west of the concrete silo pad. No organic vapors were detected with field-screening methods (Ref. 2, pp. 28-29).

Arsenic was detected at a concentration of 13.4 mg/kg in one of the soil samples. No other TAL metals, VOCs, or SVOCs were detected above evaluation criteria in the soil samples collected from the deep boreholes (Ref. 2, p. 33).

### 4.1.5 Groundwater and Silo Water Sampling

Six monitoring wells were installed in the four deep boreholes at the site. The borehole in the former UST area had nested wells completed within groundwater zones at 57 feet bgs and 92 feet bgs. Nested wells were also completed in groundwater zones in the borehole immediately north of the former UST area at 145 feet bgs and 242 feet bgs. One well was completed at 103 feet bgs northwest of the former UST area and another well was completed at 105 feet bgs southwest of the former UST area (Ref. 2, pp. 45-46).

The well at 57 feet bgs in the former UST area had concentrations of lead at 0.0503 milligrams per liter (mg/L) and antimony at 0.0585 mg/L in the unfiltered sample, which exceeded the evaluation criteria of 0.015 and 0.006 mg/L, respectively. Lead and antimony did not exceed evaluation criteria in the filtered groundwater sample. Manganese and aluminum were detected above evaluation criteria in all groundwater samples collected at the site. VOCs, SVOCs, and PAH were not detected above evaluation criteria in any groundwater samples collected from the site (Ref. 2, p. 53).

The established evaluation criteria are not applicable to the standing water in the silo, but silo water sample results were compared to the evaluation criteria. Manganese and aluminum concentrations were detected above evaluation criteria in the two silo water samples at 0.244 mg/L and 0.383 mg/L, but VOCs, SVOCs, and PAH were not detected above evaluation criteria. It should be noted that the silo water is not considered a domestic water supply (Ref. 2, p. 58).

## 4.2 PROPOSED PROJECTS

No additional HTRW and CON/HTRW projects are proposed.

# 5.0 MMRP PROJECTS

## 5.1 PRIOR AREAS INVESTIGATED FOR POTENTIAL PROJECTS

No prior MMRP projects have been identified.

## 5.2 PROPOSED PROJECTS

No MMRP projects are proposed.

# 6.0 PETROLEUM STORAGE TANKS (CON/HTRW)

## 6.1 PRIOR AREAS INVESTIGATED FOR POTENTIAL PROJECTS

No prior CON/HTRW projects associated with petroleum storage tanks have been identified.

## 6.2 PROPOSED PROJECTS

No CON/HTRW projects associated with petroleum storage tanks are proposed.

# 7.0 BD/DR PROJECTS

## 7.1 PRIOR AREAS INVESTIGATED FOR POTENTIAL PROJECTS

No prior BD/DR projects have been identified.

## 7.2 PROPOSED PROJECTS

The USACE's *Environmental Formerly Used Defense Site (FUDS) Program Policy, ER 200-3-1, May 2004* does not permit BD/DR projects at sites that have been owned since DOD usage by one or more private interests, unless the title transfer documents specifically require the U.S. Government to restore the site. In addition, the conveyance to LAWCC contained a hold harmless clause that releases the United States from liability for claims of personal injury or property damage resulting from the government's use of the land (Ref. 1, pp. 4, 8).

# 8.0 PRP PROJECTS

## 8.1 PRIOR AREAS INVESTIGATED FOR POTENTIAL PROJECTS

No prior PRP projects have been identified.

## 8.2 PROPOSED PROJECTS

No PRP projects are proposed.

# 9.0 SUMMARY AND CONCLUSIONS

## 9.1 SUMMARY OF OPERATIONS

In 1960, the DOD acquired 249.58 acres in southern Chaves County, New Mexico to construct an Atlas "F" Missile Silo 8. Silo construction was completed by the Fall of 1961, and the silo was placed on alert status in 1962. The underground silo complex consisted of the LCC and the silo, where the Atlas "F" missile and its support equipment were located. The silo complex included water wells, water treatment building, two Quonset huts, septic system, and underground storage tanks for fuel and water.

In May 1964, the DOD announced plans to phase-out the Atlas "F" missile program. In 1965, Silo 8 was declared excess to the GSA. The DHEW conveyed the AOI to LAWCC in September 1968. The LAWCC remains the owner of the property and uses two of the former DOD water wells as a municipal water supply for the town of Lake Arthur.

## 9.2 SUMMARY OF AREAS PREVIOUSLY INVESTIGATED

Areas in which the USACE conducted prior investigations include the following HTRW projects:

- Septic Leachfield
- Sump Outfall
- Former UST Area
- Groundwater
- Silo water

## 9.3 PROPOSED PROJECTS

Based on a review of historical DOD operations at the site, a site reconnaissance trip, analysis of migration pathways and receptors, and a review of environmental work performed at the site, no projects are recommended for the site.

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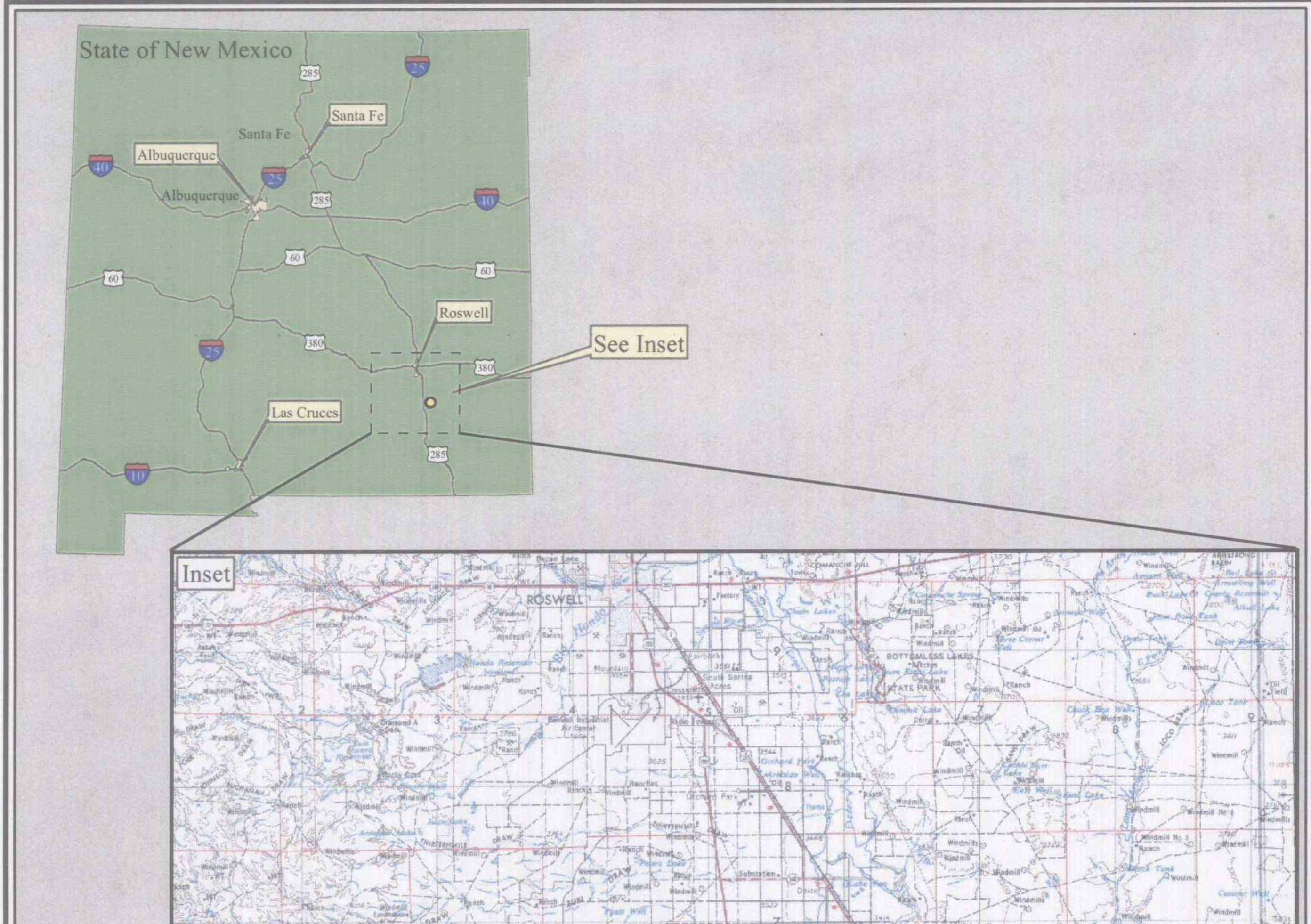


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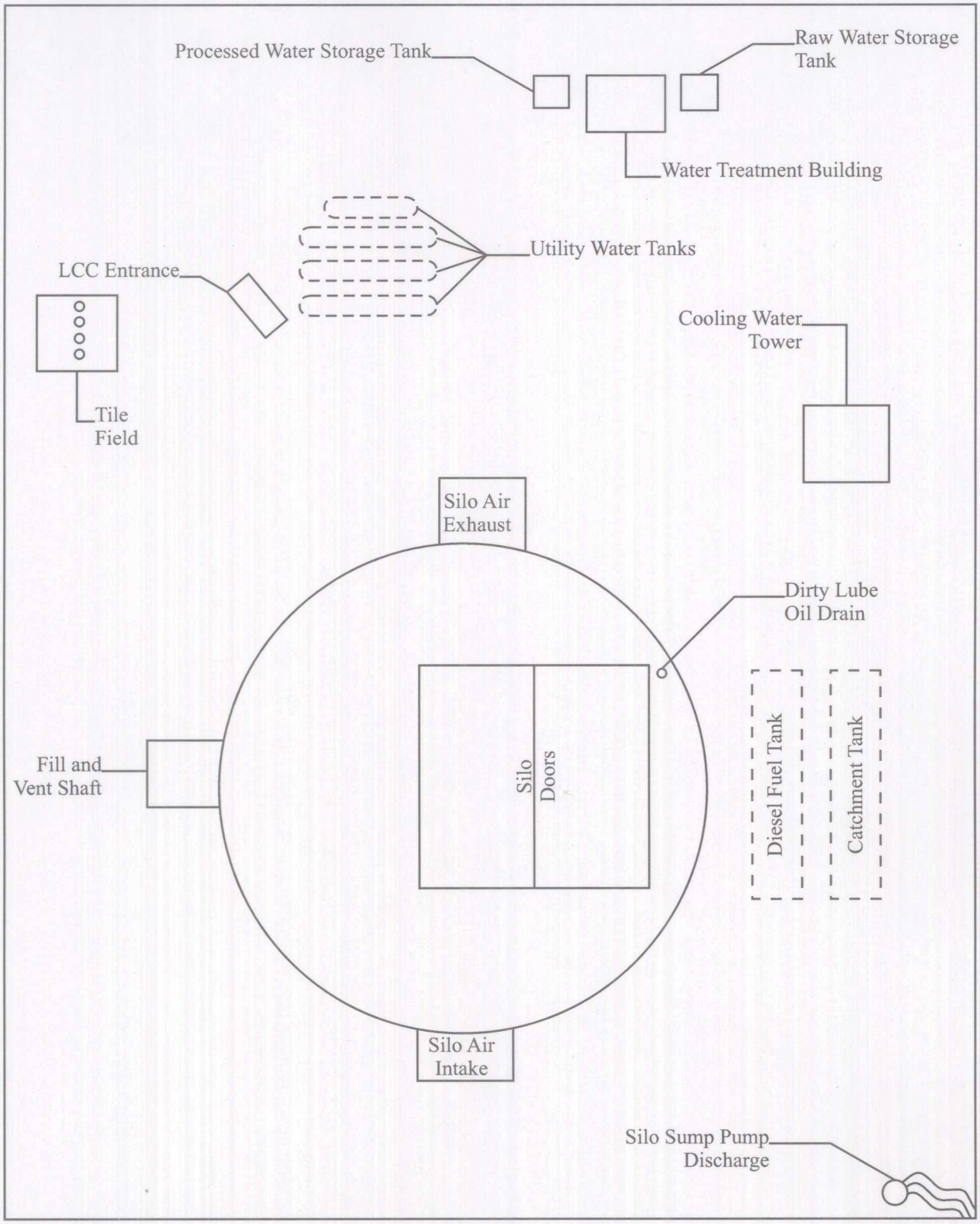
**Legend**

Former WAFB Atlas "F" Missile Silo 8

**Figure 1**
**Former WAFB**
**Atlas "F" Missile Silo 8**
**Site Location Map**

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**Legend**

Above-Ground Features

Underground Features

**Figure 2**
**Typical Silo**
**Surface and Underground**
**Features**

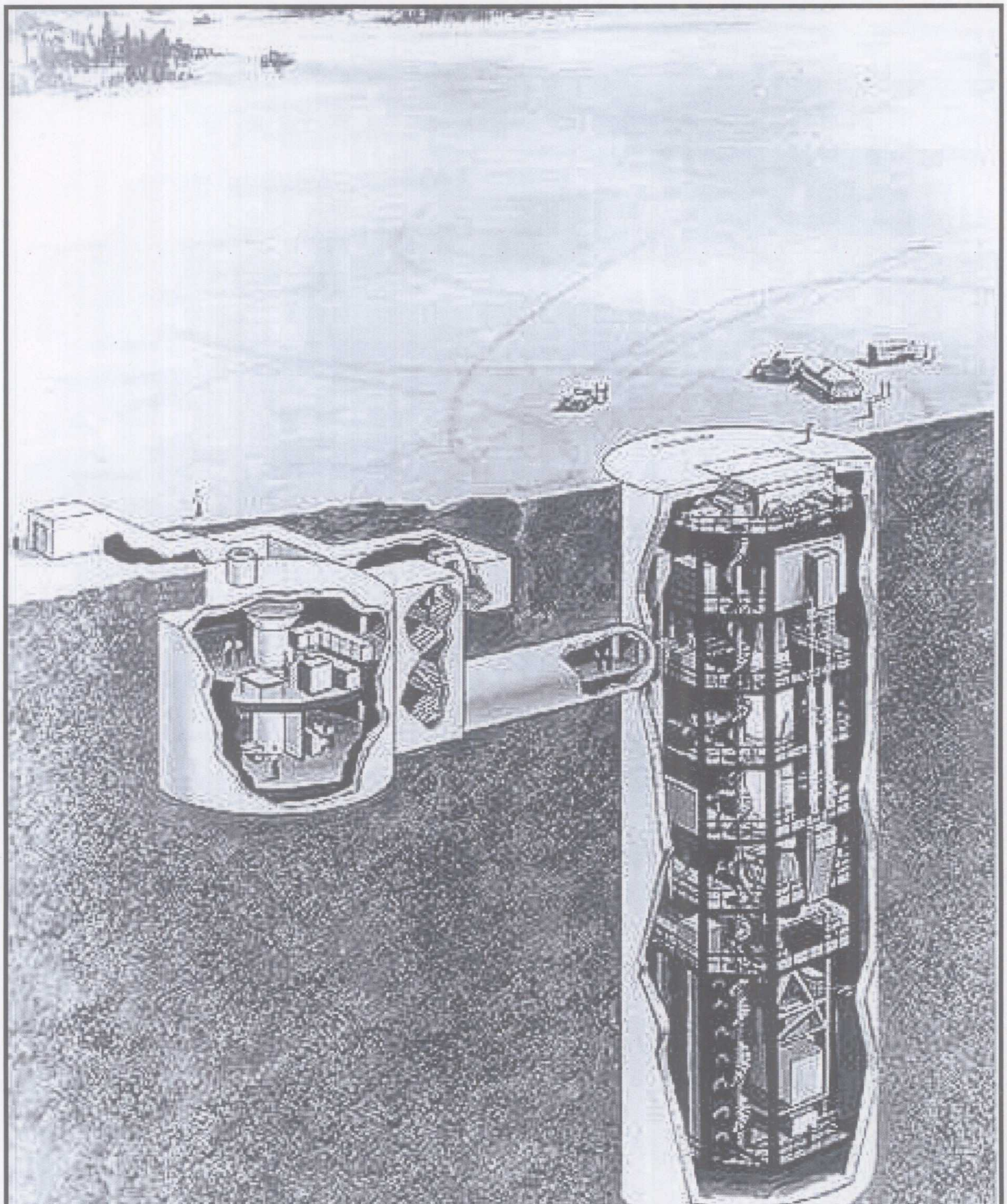

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**Figure 3**
**LCC and Missile Silo Cross-Section Diagram**

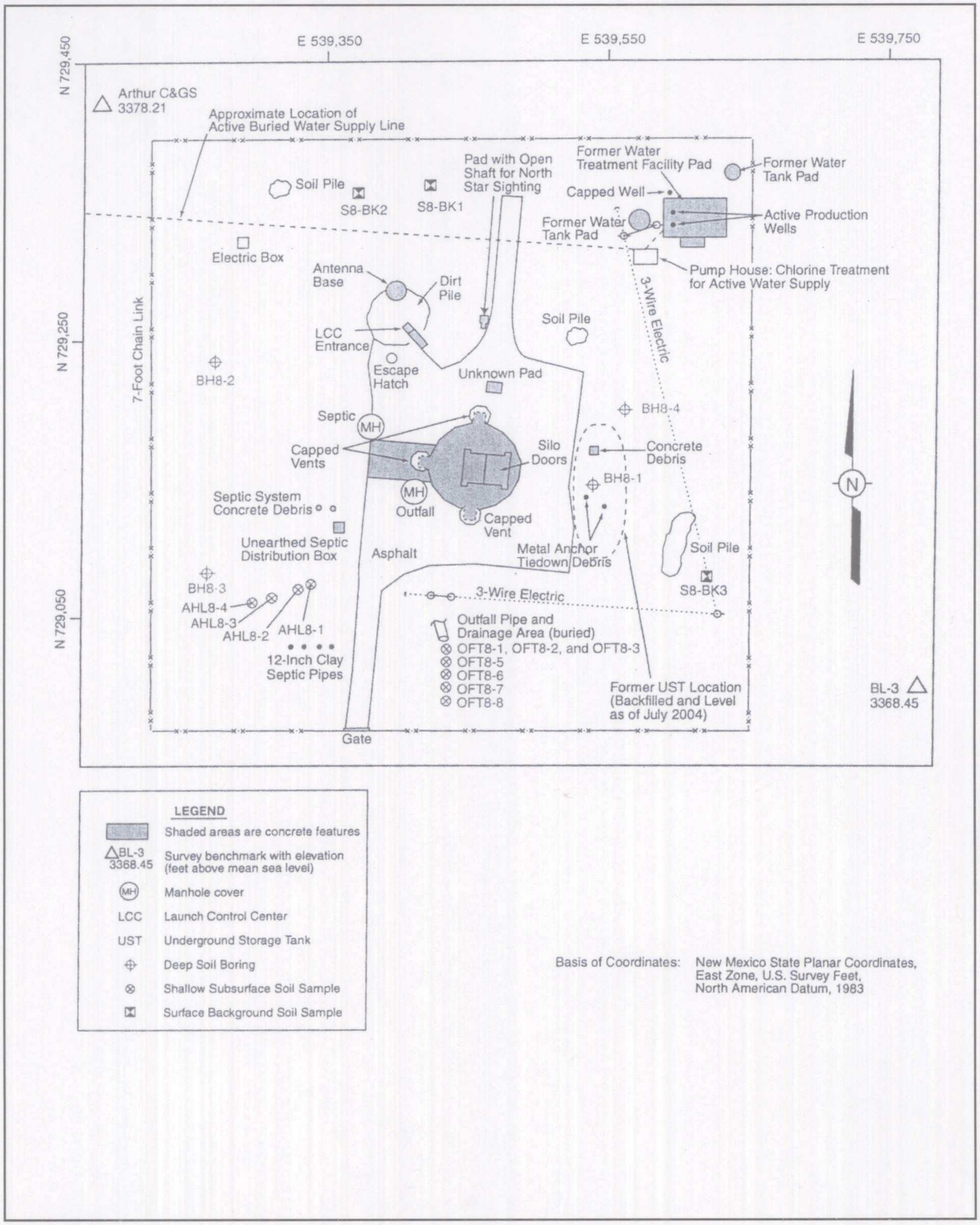


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**Figure 4**
**Former WAFB**
**Atlas "F" Missile**
**Silo 8 Site Layout Map**

1 TELEPHONE TERMINAL CABINET
2 SIGNALLING SYSTEM CABINET
3 MAIN DISTRIBUTION FRAME
4 INTERIM PA BAY & LES CONTROL BOX
5 L/M BAY
6 D/L BAY
7 COMM RACKS
8 COMMUNICATIONS PANEL C
9 LES "J" BOX
10 ANNUNCIATOR PANEL
11 UHF AND VHF SYSTEMS
12 JUNCTION BOX
13 BLAST DETECTION CABINET
14 COMMUNICATIONS CONSOLE
15 FIRE ALARM BATTERY BOX
16 FIRE ALARM PANEL
17 NOTIFIER PANEL
18 COMM ANNUNCIATOR
19 FRCP
20 COMMUNICATIONS DISCONNECT PANEL
21 PRCP
22 $LO_2$ TANKING PANELS 1 & 2
23 LC CONSOLE
24 CSMOL
25 TV MONITOR
26 ENTRAPMENT TV MONITOR
27 GATE AND DOOR CONTROL PANEL
28 DISTRIBUTION PANEL "A"
29 480-VOLT CONTROL CENTER
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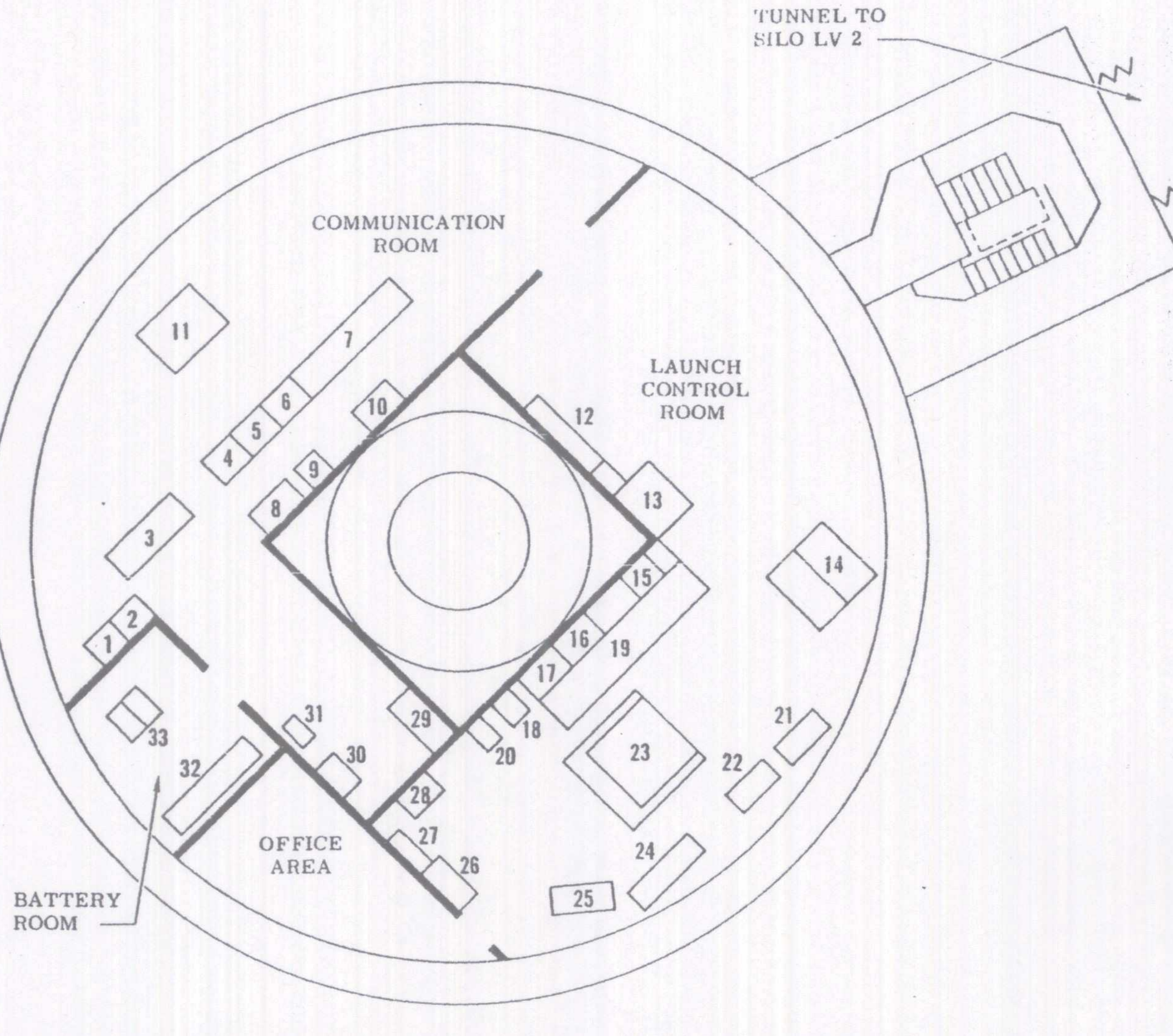
31 440-VOLT TRANSFORMER
32 BATTERY BANK
33 CHARGER BAY

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*Created: CLimoges 04/01/05*
*Revised: CLimoges 10/21/05*
*Source: Ref. 13, p.3*

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**Figure 5**
**Launch Control Center**
**Level 2 Diagram**

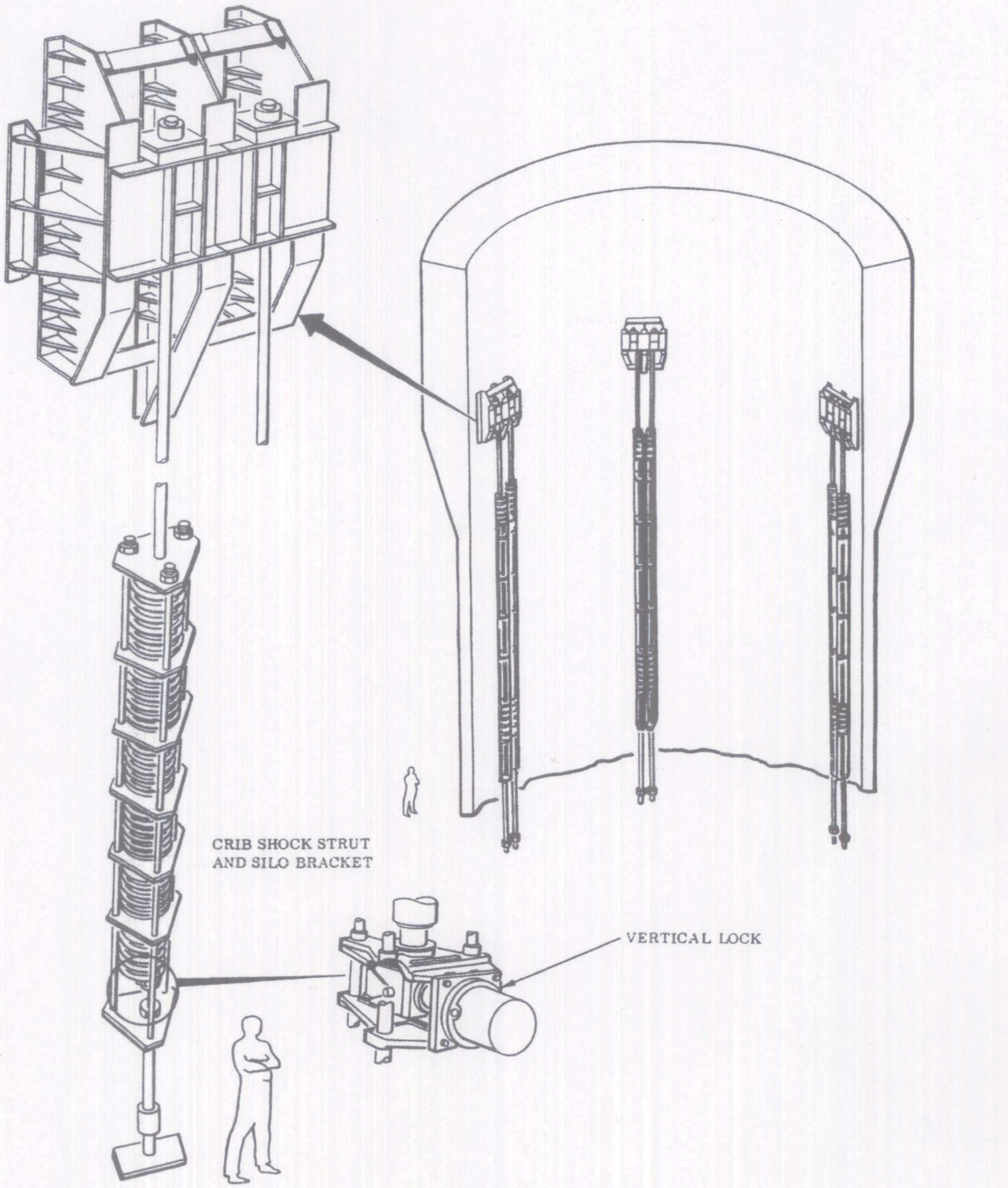


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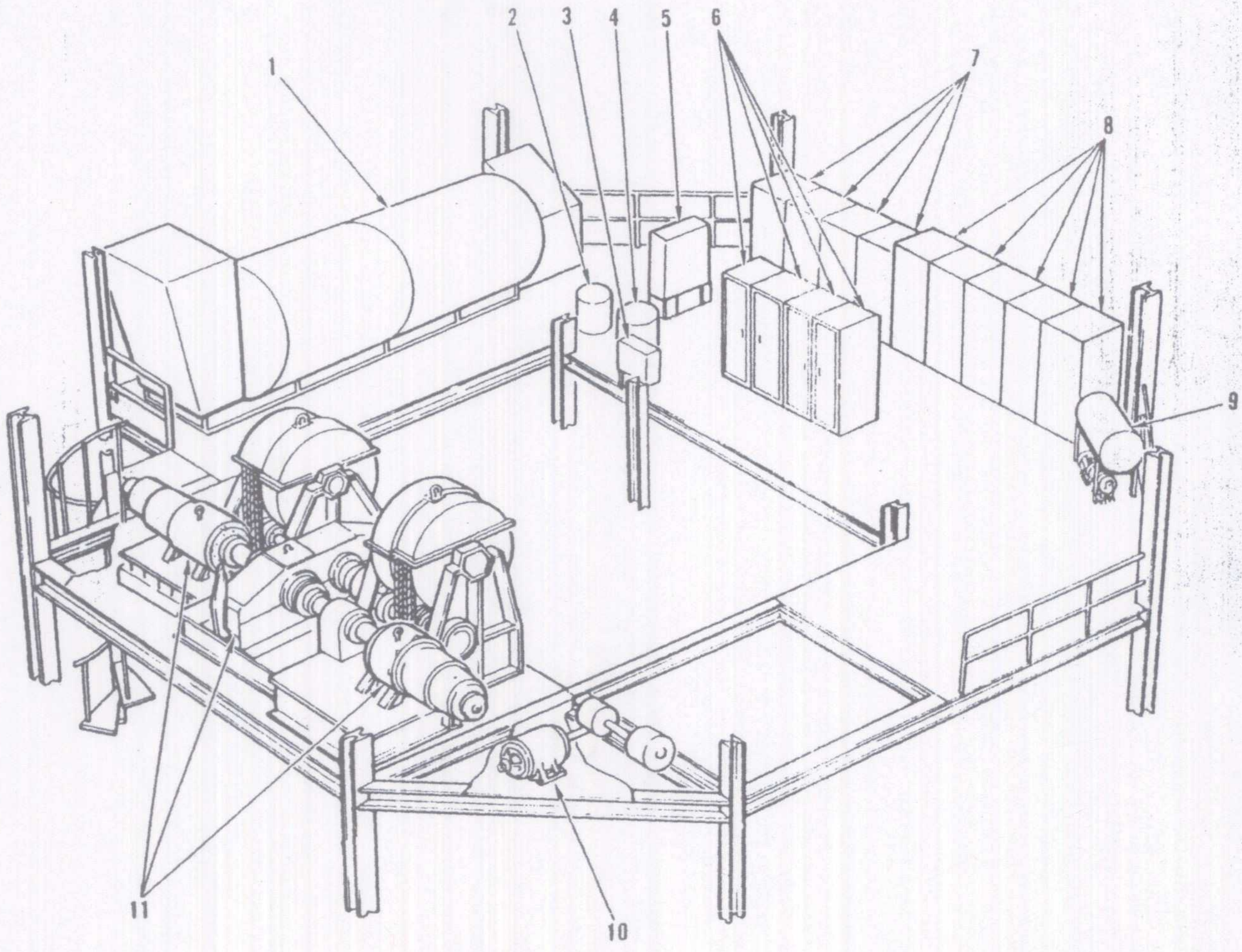
**Figure 6**
**Silo Crib Suspension System Diagram**




LEVEL 1

1 FRESH AIR DUST COLLECTOR, PUMP, AND WASHER
2 DUST COLLECTOR WATER MAKEUP TANK
3 OVERSPEED CONTROL BOX
4 CHILLED WATER EXPANSION TANK
5 INTERCONNECTING JUNCTION BOX
6 ELECTRICAL MISSILE LIFTING CONTROL SYSTEM
7 MISSILE LIFT SYSTEM MOTOR CONTROL CENTER
8 LAUNCH PLATFORM MISSILE LIFTING DRIVE ASSEMBLY CABINETS
9 DEMINERALIZED WATER STORAGE TANK AND PUMP P-90
10 FACILITY ELEVATOR DRIVE
11 MISSILE LIFTING LAUNCH PLATFORM DRIVE ASSEMBLY

*X:\Phoenix\Graphics\Atlas (SHA002)\Figures\Silo8\2.3-Figures-8.cdr*
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*Revised: CLimoges 10/21/05*
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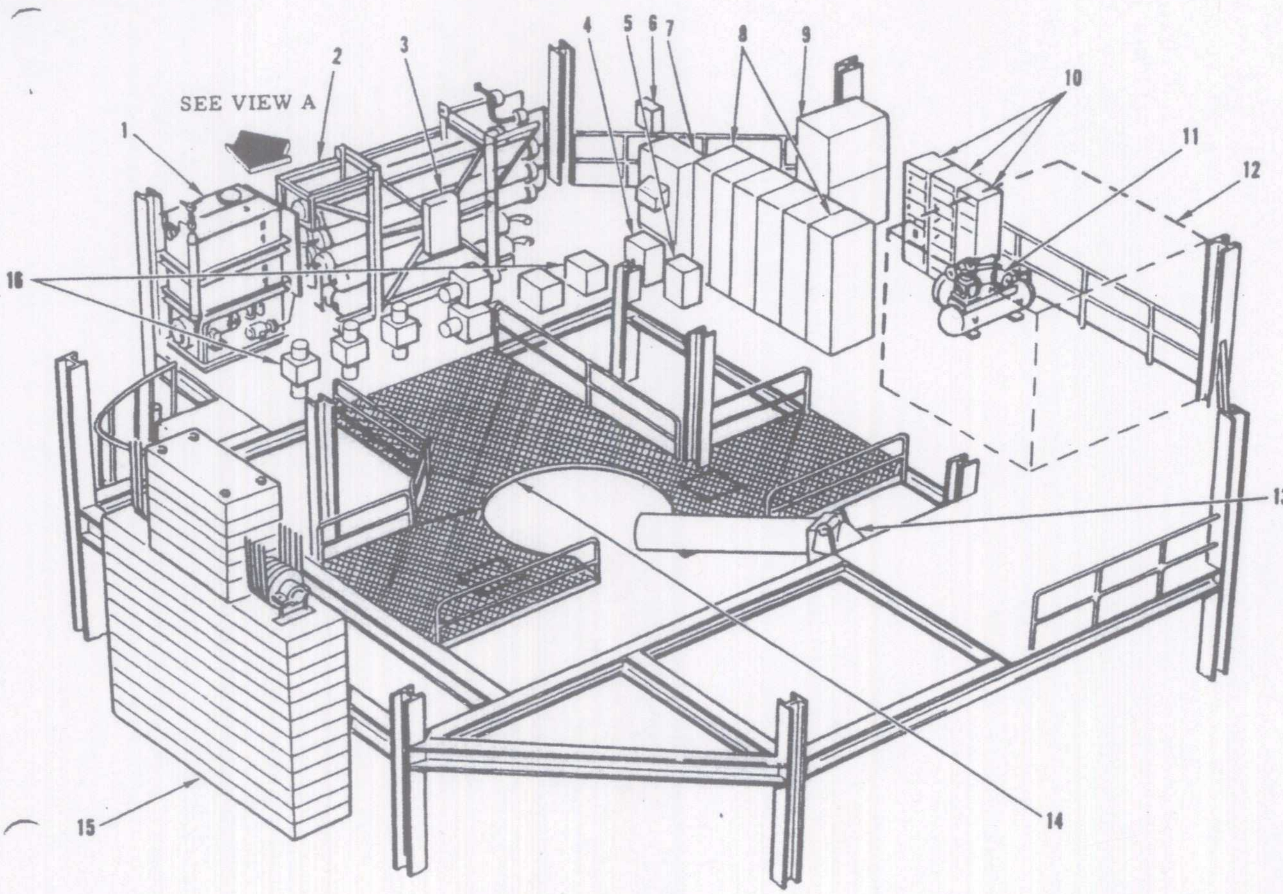
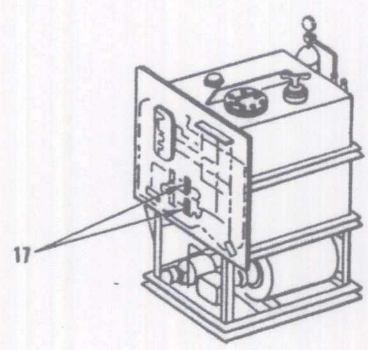
**Figure 7**
**Silo Level 1 Equipment Location Diagram**




LEVEL 2

1 HYDRAULIC PUMP AND RESERVOIR
2 HYDRAULIC ACCUMULATOR AND GASEOUS NITROGEN PRESSURE TANKS
3 INTERCONNECTING JUNCTION BOX
4 LIGHTING PANEL LA
5 LIGHTING PANEL LD
6 30 KVA TRANSFORMER
7 LOCAL CONTROL HYDRAULIC PANEL
8 NONESSENTIAL MOTOR CONTROL CENTER
9 COMPRESSED AIR SYSTEM REGULATOR PANEL
10 ESSENTIAL MOTOR CONTROL CENTER
11 EXHAUST FAN BLAST CLOSURE AIR COMPRESSOR
12 SILO EXHAUST FAN AND PLENUM
13 GASEOUS OXYGEN VENT
14 WORK PLATFORM 1
15 LAUNCH PLATFORM COUNTERWEIGHT
16 MANIFOLD ASSEMBLY WORK PLATFORMS CRIB LOCKS SILO OVERHEAD DOORS
17 FILTERS

VIEW A

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Revised: CLimoges 10/21/05
Source: Ref. 11, p. 24

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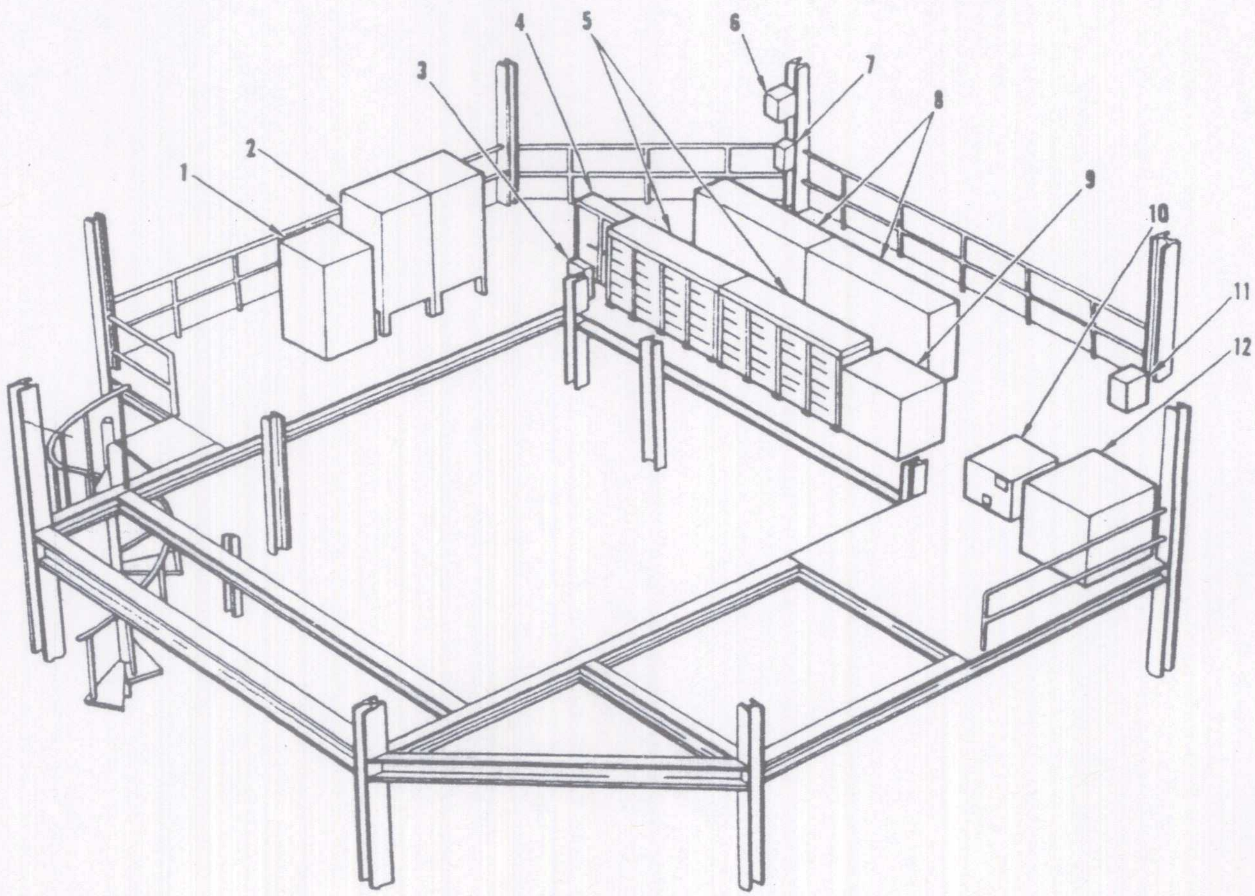
**Figure 8**
**Silo Level 2 Equipment Location Diagram**




LEVEL 3

1 RE-ENTRY VEHICLE PRELAUNCH MONITOR AND CONTROL UNIT
2 COUNTDOWN GROUP
3 LIGHTING PANEL
4 FACILITIES INTERFACE CABINET
5 CONTROL MONITOR GROUP 1 OF 4 AND 2 OF 4
6 480-VOLT 30-KVA TRANSFORMER
7 LAUNCH CONTROL POWER PANEL
8 CONTROL MONITOR GROUP 3 OF 4 AND 4 OF 4
9 28 VDC BATTERY
10 400 CYCLE SKID MOUNTED MOTOR-GENERATOR TYPE MD-2
11 DISTRIBUTION BOX
12 POWER SUPPLY - DISTRIBUTION SET

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*Created: CLimoges 04/01/05*
*Revised: CLimoges 10/21/05*
*Source: Ref. 11, p. 31*

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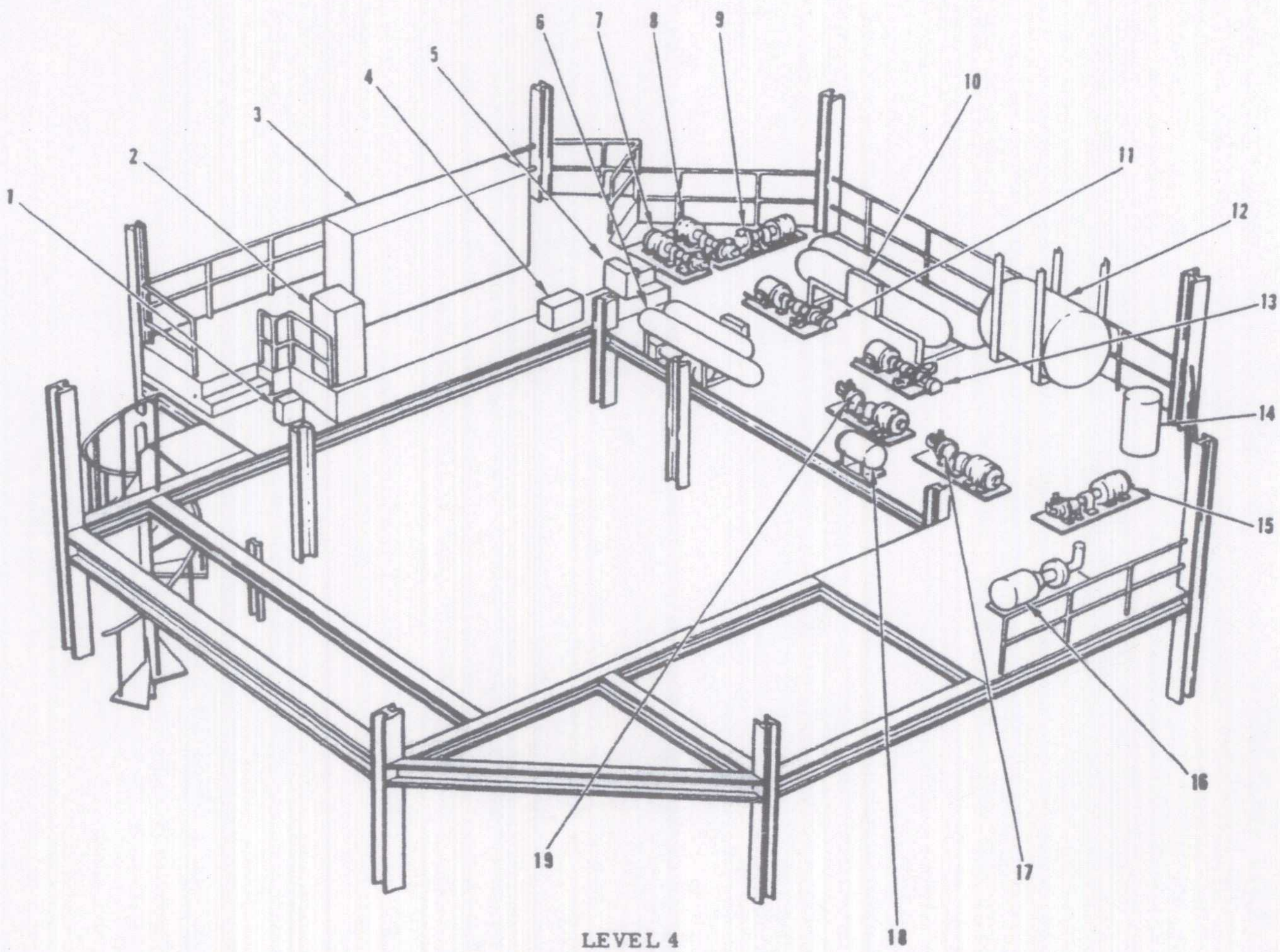
**Figure 9**
**Silo Level 3 Equipment Location Diagram**




1 JUNCTION BOX ASSY IR56 SILO CHECKS (576 AND OSTF-2)
2 INSTRUMENTATION CABINET (OSTF-2)
3 INSTRUMENTATION CABINET (OSTF-2)
4 LIGHTING PANEL LB
5 LIGHTING PANEL LB
6 CONDENSER, WATER CHILLER, AND REFRIGERATIONN COMPRESSOR
7 CHILLED WATER PUMP P-51 (P-50 FOR OSTF-2)
8 CHILLED WATER PUMP P-50 (P-51 FOR OSTF-2)
9 EMERGENCY WATER PUMP P-32
10 CONDENSER, WATER CHILLER, AND REFRIGERATION COMPRESSOR
11 CONDENSER WATER PUMP P-31
12 HYDROPNEUMATIC UTILITY WATER TANK 50
13 CONDENSER WATER PUMP P-30
14 AIR TANK (OSTF-2)
15 WATER PUMP P-80
16 UTILITY WATER PUMP P-81
17 HOT WATER PUMP P-61
18 HOT WATER EXPANSION TANK 63
19 HOT WATER PUMP P-60

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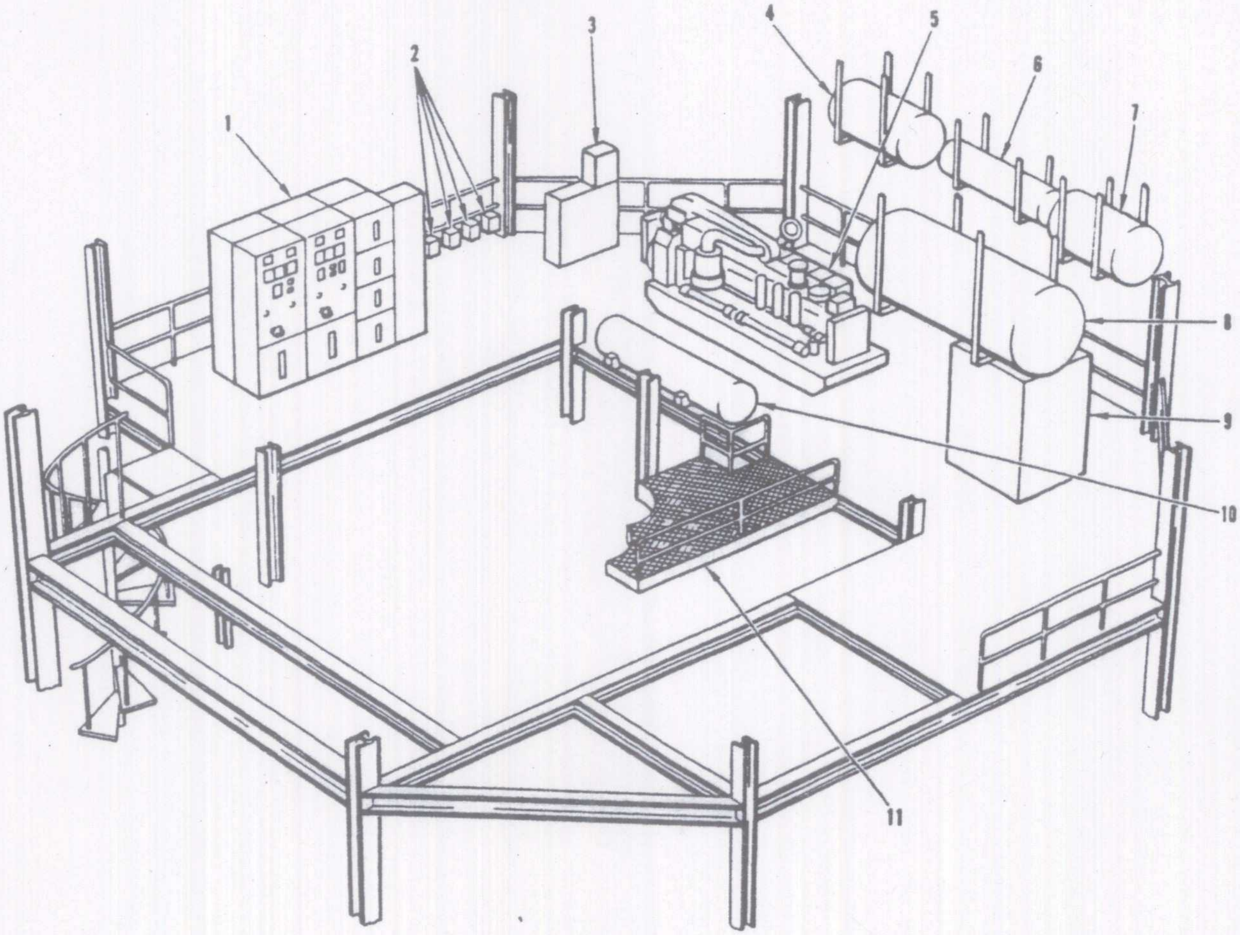
*Created: CLimoges 04/01/05*
*Revised: CLimoges 10/21/05*
*Source: Ref. 11, p. 78*

**Figure 10**
**Silo Level 4 Equipment Location Diagram**




LEVEL 5

| | |
|---|---|
| 1 480-VOLT SWITCHGEAR | 7 CLEAN LUBE OIL TANK |
| 2 INSTRUMENTATION BOXES (OSTF-2) | 8 HEAT RECOVERY SILENCER |
| 3 SURGE PROTECTION PANEL (EXCEPT OSTF-2) | 9 WATER HEATER (OSTF-2) |
| 4 DIRTY LUBE OIL TANK | 10 DIESEL DAY TANK |
| 5 500 KW DIESEL GENERATOR | 11 WORK PLATFORM 2 |
| 6 AIR RECEIVER (OSTF-2) | |

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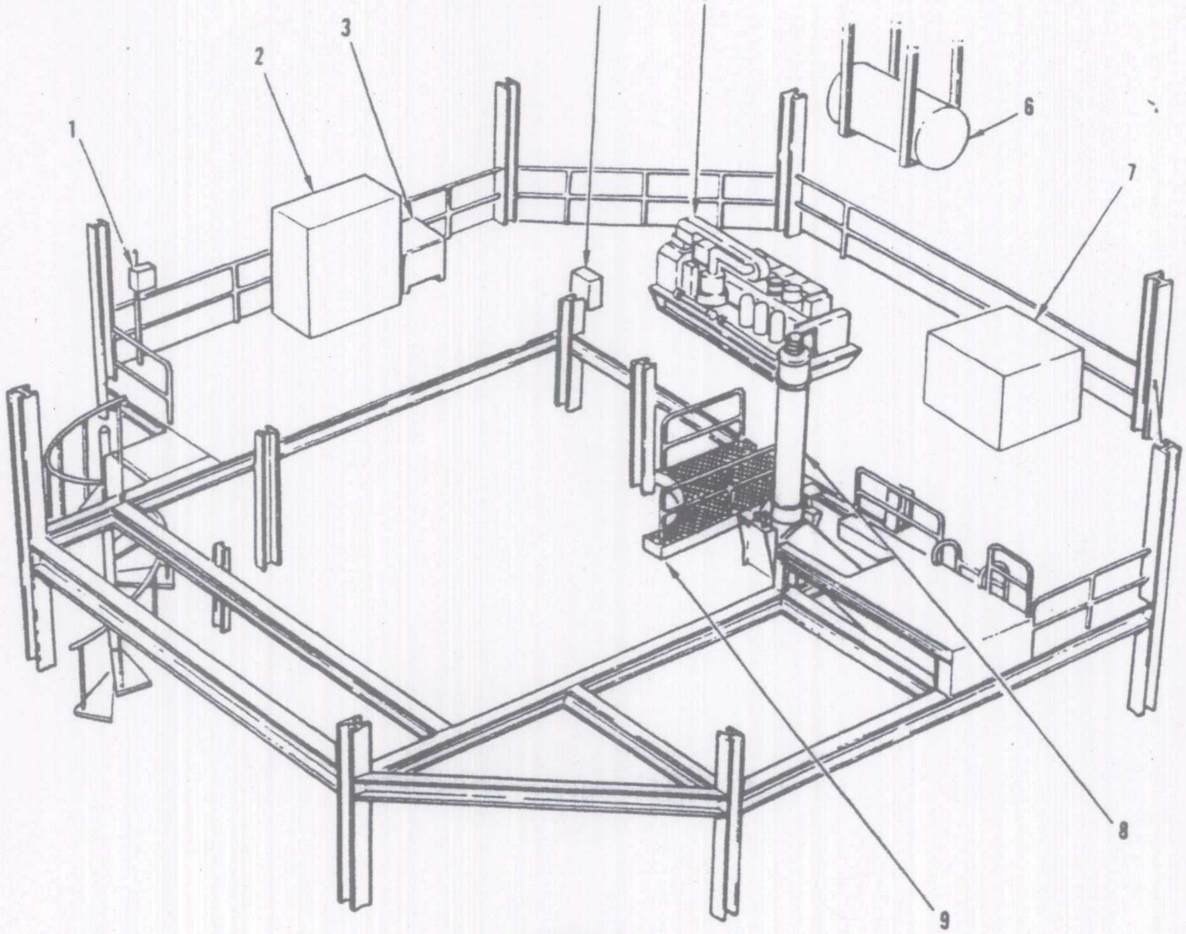
**Figure 11**
**Silo Level 5 Equipment Location Diagram**




LEVEL 6

1 48-VOLT DC DISTRIBUTION PANEL
2 48-VOLT BATTERY RACK
3 48-VOLT BATTERY CHARGER
4 INTERCONNECTING JUNCTION BOX (VAFB)
5 500 KW DIESEL GENERATOR
6 AIR RECEIVER
7 WATER HEATER
8 ALIGNMENT GROUP SIGHT TUBE
9 WORK PLATFORM

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*Created: CLimoges 04/01/05*
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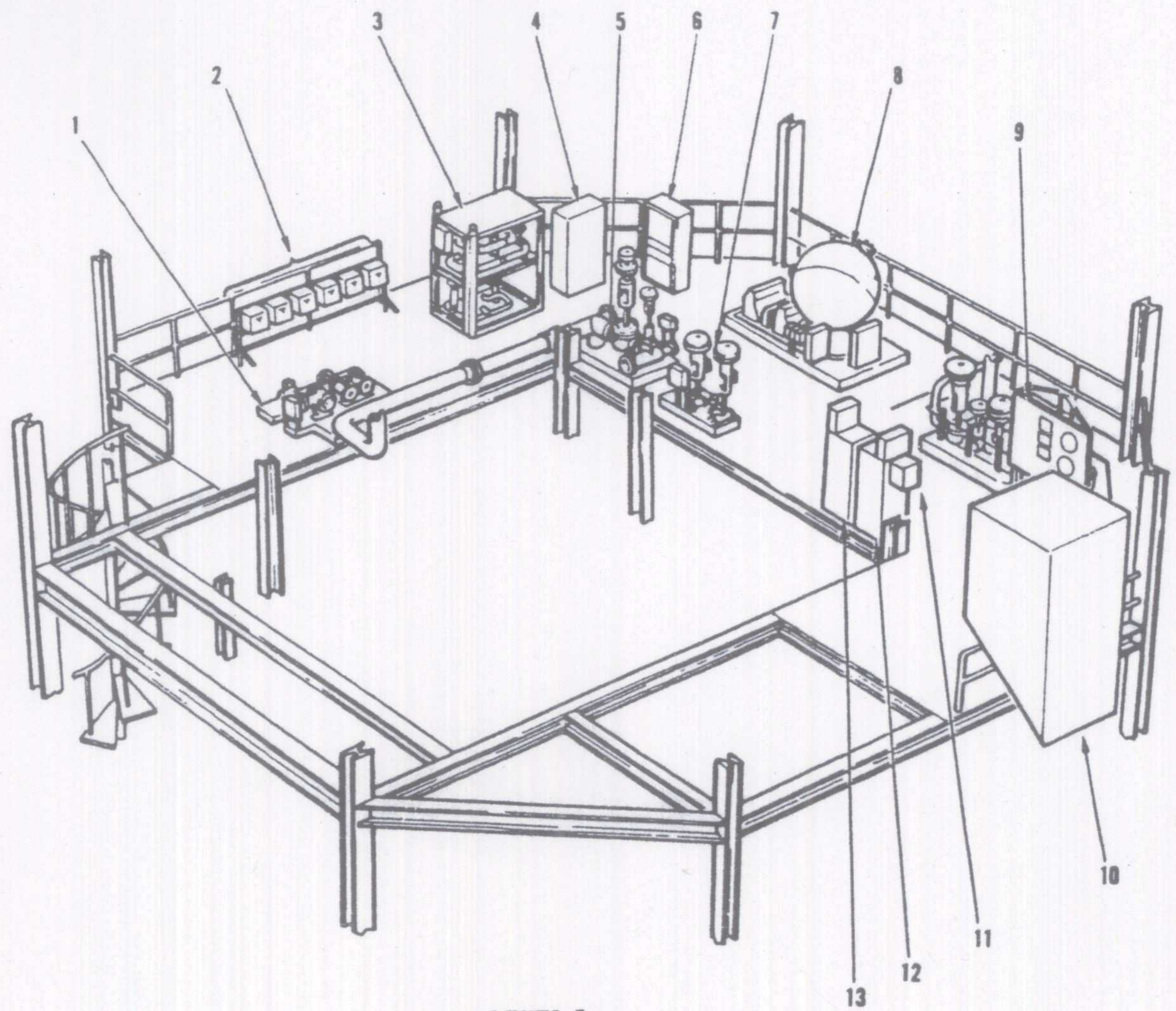
*Source: Ref. 11, p. 41*

**Figure 12**
**Silo Level 6 Equipment Location Diagram**




LEVEL 7

1 $LO_2$ TOPPING CONTROL UNIT
2 INSTRUMENTATION BOXES (OSTF-2)
3 $LN_2$ PREFAB
4 GASEOUS OXYGEN DETECTOR
5 $LO_2$ CONTROL PREFAB
6 GASEOUS OXYGEN DETECTOR
7 $LO_2$ FILL PREFAB
8 INSTRUMENT AIR PREFAB
9 PRESSURIZATION PREFAB
10 ALIGNMENT GROUP ENCLOSURE
ALIGNMENT GROUP
BENCH MARKS
11 FIRE X CONTROL PANEL (VAFB)
12 DIESEL FUEL VAPOR DETECTOR
13 RP-1 DETECTOR

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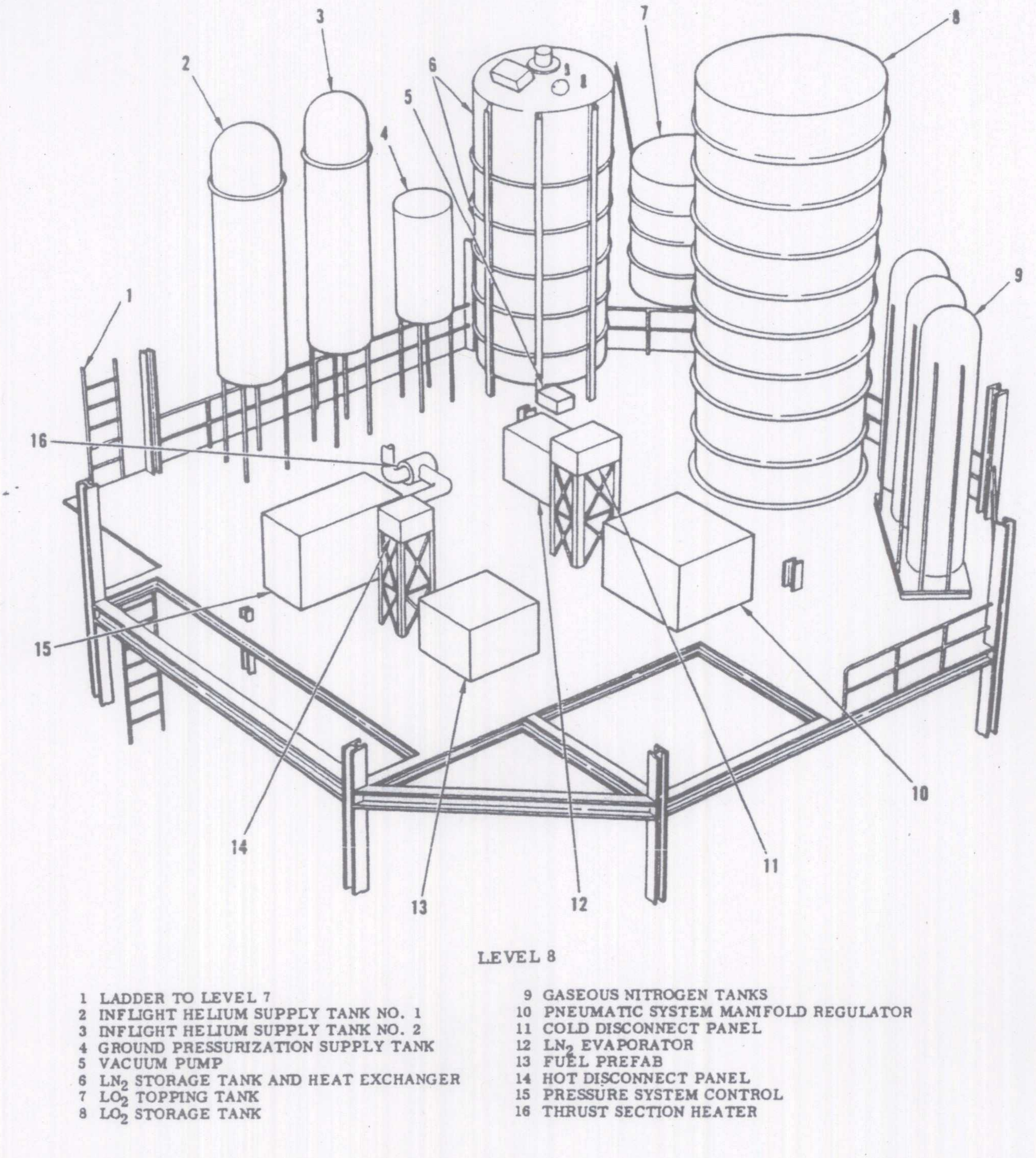
*Created: CLimoges 04/01/05*
*Revised: CLimoges 10/21/05*
*Source: Ref. 11, p. 46*

**Figure 13**
**Silo Level 7 Equipment Location Diagram**




LEVEL 8

1 LADDER TO LEVEL 7
2 INFLIGHT HELIUM SUPPLY TANK NO. 1
3 INFLIGHT HELIUM SUPPLY TANK NO. 2
4 GROUND PRESSURIZATION SUPPLY TANK
5 VACUUM PUMP
6 $LN_2$ STORAGE TANK AND HEAT EXCHANGER
7 $LO_2$ TOPPING TANK
8 $LO_2$ STORAGE TANK
9 GASEOUS NITROGEN TANKS
10 PNEUMATIC SYSTEM MANIFOLD REGULATOR
11 COLD DISCONNECT PANEL
12 $LN_2$ EVAPORATOR
13 FUEL PREFAB
14 HOT DISCONNECT PANEL
15 PRESSURE SYSTEM CONTROL
16 THRUST SECTION HEATER

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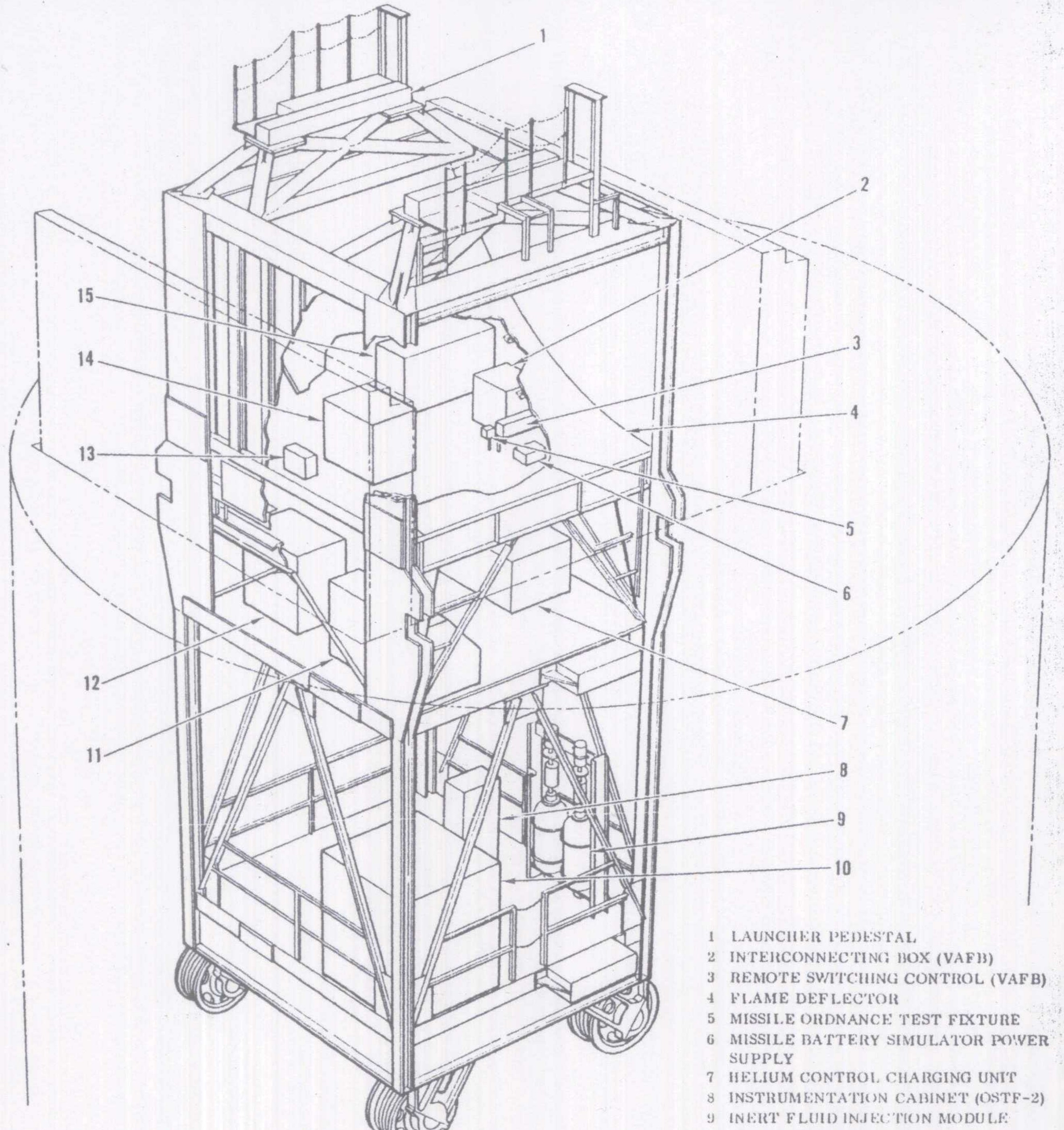
*Created: CLimoges 04/01/05*
*Revised: CLimoges 10/21/05*
*Source: Ref. 11, p. 51*

**Figure 14**
**Silo Level 8 Equipment Location Diagram**




1 LAUNCHER PEDESTAL
2 INTERCONNECTING BOX (VAFB)
3 REMOTE SWITCHING CONTROL (VAFB)
4 FLAME DEFLECTOR
5 MISSILE ORDNANCE TEST FIXTURE
6 MISSILE BATTERY SIMULATOR POWER SUPPLY
7 HELIUM CONTROL CHARGING UNIT
8 INSTRUMENTATION CABINET (OSTF-2)
9 INERT FLUID INJECTION MODULE
10 AIR CONDITIONER
11 HYDRAULIC PUMPING UNIT
12 NITROGEN CONTROL UNIT
13 INTERCONNECTING BOX
14 INSTRUMENTATION CABINET (OSTF-2)
15 INTERCONNECTING BOX

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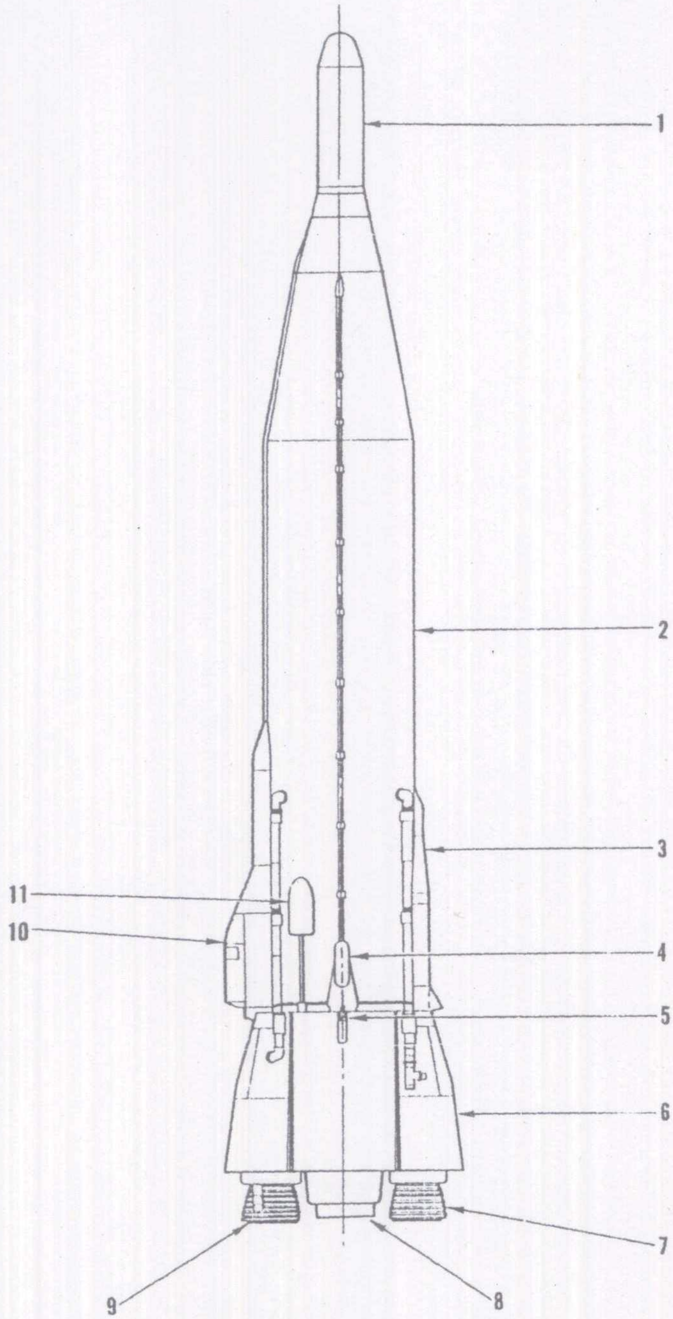
*Created: CLimoges 04/01/05*
*Revised: CLimoges 10/21/05*
*Source: Ref. 13, p. 4*

**Figure 15**
**Launch Platform Diagram**




1 RE-ENTRY VEHICLE
2 TANK SECTION
3 EQUIPMENT POD
4 VERNIER RETARDING ROCKET
5 VERNIER ENGINE
6 BOOSTER SECTION
7 BOOSTER ENGINE
8 SUSTAINER ENGINE
9 BOOSTER ENGINE
10 EQUIPMENT POD
11 DECOY POD

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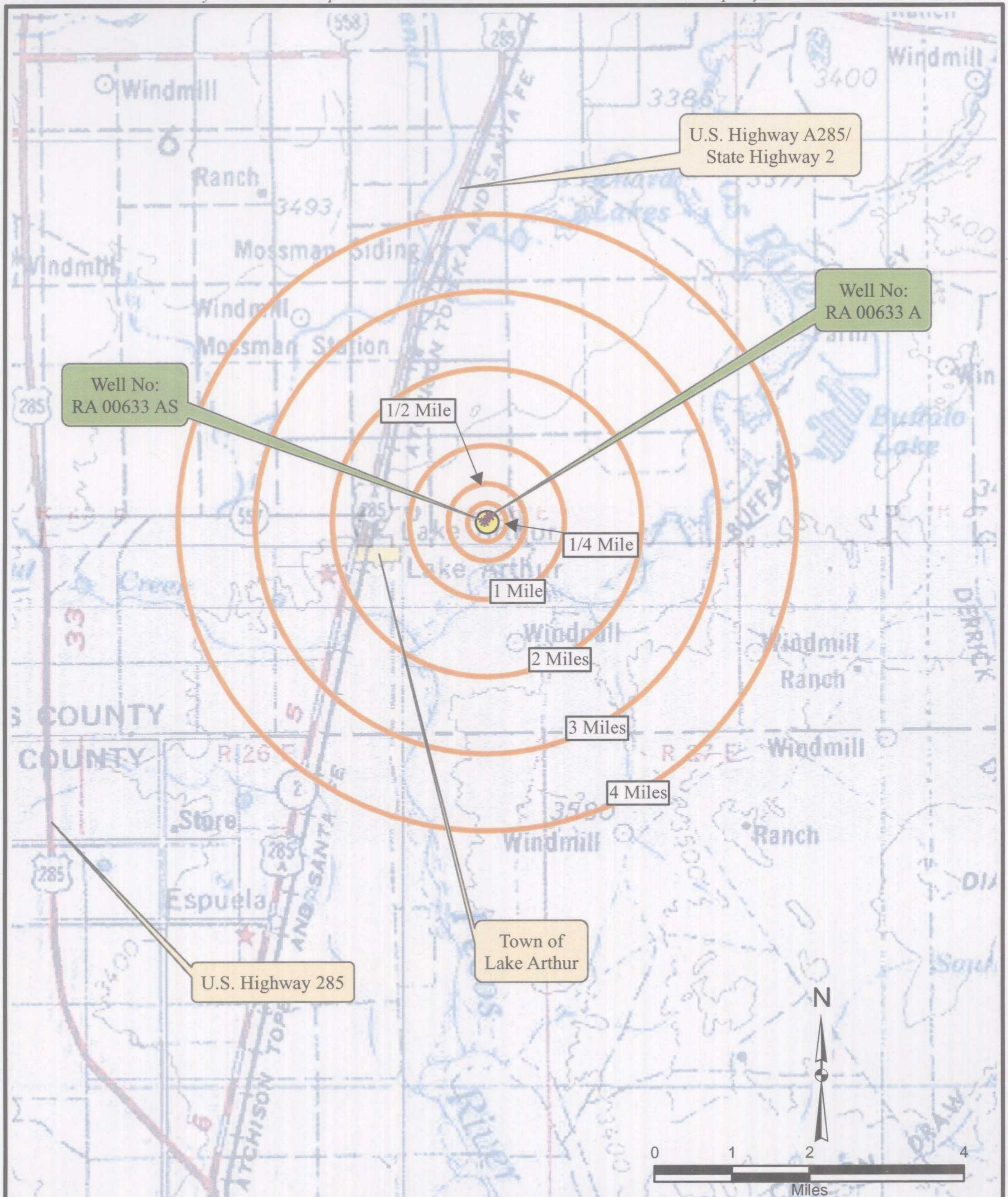
Figures\Silo8\2.3-Figures-8.cdr
Created: CLimoges 04/01/05
Revised: CLimoges 10/21/05
Source: Ref. 13, p. 6*

HYDRO GeoLogic INC.

**Figure 16
Atlas "F" Missile
Diagram**




*Filename: X:/Phoenix/Graphics/Atlas (SHA002)/Maps/Silo 8 Final PA/Fig 17-8-Municipal-Wells.mxd*
*Project: SHA002*
*Created: C. Limoges 3/28/2005*
*Revised: C. Limoges 10/24/2005*
*Map Source: NM-OSE, RGIS, USGS 7.5 Minute Quad Map 1974, 1976*

HYDRO GeoLogic INC.

**Legend**

- Former WAFB Atlas "F" Missile Silo 8
- Municipal Wells
- 1/4-1/2-1-to 4-Mile Target Distance Limits

**Figure 17**
**Location of Municipal Wells Within 4-Mile Boundary of Former WAFB Atlas "F" Missile Silo 8**

# Figure 18
# Location of Known Municipal & Private Domestic Wells Within a 4-Mile Target Distance Limit

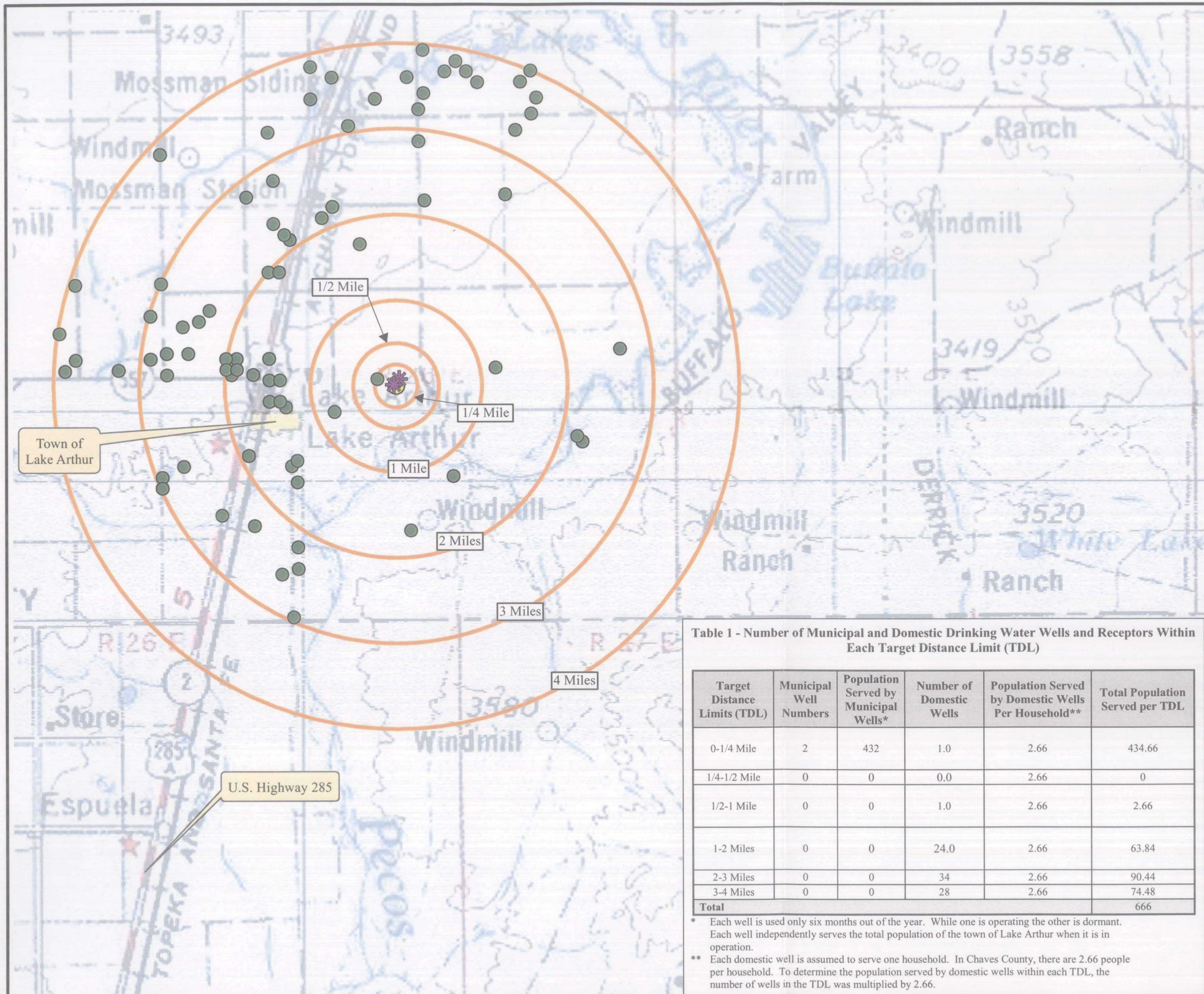



**Table 1 - Number of Municipal and Domestic Drinking Water Wells and Receptors Within Each Target Distance Limit (TDL)**

| Target Distance Limits (TDL) | Municipal Well Numbers | Population Served by Municipal Wells* | Number of Domestic Wells | Population Served by Domestic Wells Per Household** | Total Population Served per TDL |
|---|---|---|---|---|---|
| 0-1/4 Mile | 2 | 432 | 1.0 | 2.66 | 434.66 |
| 1/4-1/2 Mile | 0 | 0 | 0.0 | 2.66 | 0 |
| 1/2-1 Mile | 0 | 0 | 1.0 | 2.66 | 2.66 |
| 1-2 Miles | 0 | 0 | 24.0 | 2.66 | 63.84 |
| 2-3 Miles | 0 | 0 | 34 | 2.66 | 90.44 |
| 3-4 Miles | 0 | 0 | 28 | 2.66 | 74.48 |
| **Total** | | | | | 666 |

* Each well is used only six months out of the year. While one is operating the other is dormant. Each well independently serves the total population of the town of Lake Arthur when it is in operation.

** Each domestic well is assumed to serve one household. In Chaves County, there are 2.66 people per household. To determine the population served by domestic wells within each TDL, the number of wells in the TDL was multiplied by 2.66.

*Filename: X:/Phoenix/Graphics/Atlas (SHA002)/Maps/Silo 8 Final PA/Fig 18-8-Wells.mxd*
*Project: SHA002*
*Created: C. Limoges 11/2004*
*Revised: C. Limoges 10/24/2005*
*Map Source: NM-OSE, RGIS, USGS 7.5 Minute Quad Map 1974, 1976*

HydroGeoLogic Inc.


**Figure 19**
**Former WAFB**
**Atlas "F" Missile Silo 8**
**Surface Water Map**

U.S. Army Corps of Engineers
Albuquerque District

**Legend**

Former Walker AFB Atlas "F" Missile Silo 8

2-Mile Target Distance Limit

Pecos River Stream Flow Within 2-Mile Target Distance Limit

N

0.5 0.25 0 0.5
Miles

*Filename: X:/Phoenix/Graphics/Atlas (SHA002)/Maps/Silo 8 Final PA/Fig 19-Silo 8 Surface-H2O-Analysis.mxd*
*Project: SHA002*
*Created: C. Limoges 05/02/05*
*Revised: C. Limoges 10/24/05*
*Map Source: NM-OSE, USGS, RGIS*

## Table 2 - Population Tabulation

| Target Distance Limits (TDL) | Location | Area (Miles Sq.) | Average Population/Mile Sq. | Total |
|---|---|---|---|---|
| **1-Mile TDL** | | | | |
| | Chaves County | 3.14 | 10 | 31 |
| | **Total** | | | **31** |
| | | | | |
| **4-Mile TDL** | | | | |
| | Town of Lake Arthur | 0.55 | 432* | 432 |
| | Chaves County | 49.65 | 10 | 497 |
| | **Total** | | | **929** |

*Actual Population based on 2000 U.S. Census data

# Appendix A

# APPENDIX A
# FIELD LOGBOOK

# FINAL PRELIMINARY ASSESSMENT REPORT
# FORMER WALKER AIR FORCE BASE
# ATLAS "F" MISSILE SILO 8
# CHAVES COUNTY, NEW MEXICO
# PROPERTY NO. K06NM0486

National® Brand

# COMP BOOK

Atlas "F" PA Logbook

80 SHEETS • 10 x 7 7/8 • COLLEGE & MARGIN • 43-461

0 73333 43461 3

AVERY DENNISON
Office Products
Brea, CA 92821
Made in Brazil

8/2/2004

9:40 AM. Silo 11 - Site Visit

- observation from property perimeter
  - free range cattle
  - healthy vegetation
  - spent shell casings observed on the ground.

- closest house = ~ 1.7 miles

- Mr. Farat owns Silo 11

- Silo 11 is located ~ 8.5 miles from interchange of Interstate 285 & Hwy 70.

- Brian Jordan said all evaporation ponds from silo to another had the same relative dimensions, however they had to fit the topography of the site.

8/2/2004

10:30 AM. Silo 12 - Site Visit

Mr. Henkley is the owner. He has a legal representative since he is an ambassador

2

Photo of Silo 12
- facing east from roadway

2 water tanks are present
from Helix Oil

Helix Oil owned the site c one
fence

site Visit
11:44 Silo 1 - Mr. Zigler property
- No evaporation pond per Br

Photo taken from gate in
N W ly direction

- Mr. Zigler lives on the property
- Brian said this one of the
silos that blew up.

11:55 Silo 2 - Site Visit
- owner is Dickowitz (spelling)
- Helix Oil used to pump
water @ the site

ldh 8/2/04

8/2/04

12:00 Silo 3 - Site Visit

- Photo taken in northerly direction
- silo owned by Mrs. Bates, divorced

- Brian said Mr. Baker constructed towers on the property for project with Los Alamos
- he also said there are no evaporation ponds on the property
- the silo got water from town

- Nearest House - is Elkins road located about 0.7 miles

12:15 Silo 2 -

Owner lives on-site
Photo taken facing south

Observed 3 vertical tanks. Two tanks are associated Helex Oil operations. Brian did not know what the 3rd tank was used for

Observed trailer/camper
back hoe
tractor

4

Brian indicated that Silo 3 also blew up. Also, the elevator in silo flew to the ground and killed about 5 people

8/2 12:40 p.m.

Silo 4 – site visit

- owned by Mr. Baker

- nearest residence is located off Hwy 380 about 5 miles east of silo.

- Observed drilling operations due north of site – several drilling rigs are present

- Brian said evaporation ponds are located SW of silo pad.

Photo 1 – leach field facing North
Photo 2 – water treatment pd facing SW
Photo 3 – outfall from silo facing NEly direction
- observed 5-inch clay pipe

Silo 4

- observed 2 access vents

- observed big hole. Nog silo pad used for water UST

- MW present on-site - USACE install

- antenna tower was installed by Mr. Baker for Los Alamos project

8/2 1:05 p.m.

Silo 5

This silo also blew up.
Brian said the silo property also has USACE MW.

Photo 1 facing North

- closest residence is 2.7 mile west of silo

Photo 2-5 - antelope in spoil pad
- dirt pile that was dug out for the missile

Photo 6 - taken in NEly direction from roadside

8/2 2:02 pm

Silo 7 — Site Visit

✓ Tank ~~frame~~ (Leh 8/2/04) forms used for diesel fuel blending

Trailer w/resident on-site

- observed pile of barrels on the lot. Barrels laying horizontally

Photos 1 — launch control entrance

Photo 2 — barrels

Photo 3 — barrels

Photo 4 — all ASTs

- taken facing due North

Owner will not allow USACE access

2:15 pm

Silo 6 — Site Visit

- owner Wendel Petie

Photo 1 taken from road facing east

Photo 2 — taken facing South

- closest residence is 8 miles

2:51 p.m. Silo 8

- City of Lake Arthur owns it
- bought it to get water rights
- very good water in this area - under artesian pressure

- residence on the property - 3 people including young child

- Brian said USACE has completed work @ this site

Photo 1 - silo pad - facing NEly

Photo 2 - former DOD water treatment bldg & current locat. of City wells

Photo 3 - "Brian's engineering master piece"

Brian said former DOD wells are now the city's drinking water wells - use salt for chlorination

- 4 MW locations
  - 2 well locations has 2 wells for a total of 6 wells
  - MWs installed in July 2004

Silo 8

- evaporation ponds are north of treatment facility - enclosed in fence

- observed 2 sewer manholes
  - leach field is located to the west of the silo pad

4:03 p.m. Silo 10 Site Visit

Photo taken facing N.
- doors of silo remain open

- nearest residence is on HWY 380 west of silo about 5 miles away

4:15 pm. Silo 9 Site Visit

McCrea Ranch
Bonham Farms leases property to get water wells.

DOD wells are no longer used.

Silo 9

- closest residence is 1 mile
- Evaporation ponds are north of the silo
- Brian said leach field was sampled & all work @ silo done.

Photo 1 - water treatment Bldg pad - SW direction

Photo 2 - Leach field - NE
Photo 3 - silo pad - S

No MW @ this location

2 UST $H_2O$ tanks
1 larger UST $H_2O$ tank

well - 792' 25 GPM
↳ gallons per minute

lch
8/2/2004

10

8/3 Met with Gary Baker over dinner
2:00pm. - notes from meeting

SAC - SIMS - civil engineering manua

- 6th Aerospace Engineering Squadron - possible source of info on Atlas

- NARA DC - Cartographic Branch has film on Roswell

- Bid packet for Atlas silo.

Gary Baker is interested in getting the following

1) Atlas "F" TOs
2) Bid Packages for silos 3 & 4 from DLA
3) "As-Built"
4.) master list of TOs for Atlas "F"
5) Prints from NARA
6) Unit History stuff from Maxwell

Gary said salvage contract #CIFRA, may be deed of conveyance to property

8/3 Gary Baker provided tour of Silo 4 LCC & silo.

- He also provided access to Silo 10.

He said silo 9 has a big water tank because depth to GW is ~800' - Pumped about 25 gal/minute

- Gary said other silos had GW closer to surface.

[signature]

8/3/2004

12

8/4/2004

County Clerk

10AM — spoke w/ Aileene
- microfiche - 1987-1999
- computer - 5/1998 to present
- books

Computer - can look @ index from 1987 to present
- docs on computer 1999 to present

(illegible initials) 8/4/2004

Use books for index ~~pre-index~~ pre-1987

Docs pre-1999 on microfiche

8/4 Spoke w/ Pam B @ County Assessor's Office

Aileene suggested using local title company for research.
- Lawyers Title 622-4331
- Landmark Title ← licensed bonded → 622-5340

Plat maps - must be recorded
Survey map - may or may not be recorded

→ after a certain date

Organized by subdivision or section - If index doesn't have a card for section or subdivision id (leh 8/21/04) is not provided in docs so you can go to index, then no plat map.

leh
8/4/04

14

8/4/2004 Gary Baker

4pm – 8pm

Gary provided us some details about the Atlas "F" program

- 4 companies worked together to build all the silos

Prime Contractor – Convair (originally)
~~Astronautics~~
General Dynamics bought out Convair
- became GDA

GDA was the prime contractor of everything, including missile and silo construction
- the 4 companies are "brick and mortar" ~~Ko~~ (lch 8/4/04) contractors w/ GDA.

The USACE ~~refereed~~ (lch 8/4/04) refereed between GDA & the 4 contractors
. The 4 contractors contracted directly with the USACE

Western Development Division went to Bechtel to design Atlas "F"

Worked w/ Semon Raymond of TRW - an engineer
- He was a USAF Ballistic Division man.

TRW - did systems development for missiles. It directed USAF to Bechtel to commission construction.

Vetech & Black made the site-specific prints
- Gary tried to contact for "As-Builts"

Also, Silo 11 owner called Bechtel for Drawings.

Bechtel - USAF says build Atlas "F" at Vandenberg (OSTF)
~~"omitting it"~~ (del 8/4/04)

| | | |
|---|---|---|
| Schilling Atlas | 550 SMS | 1 month apart |
| Lincoln Atlas | 551 SMS | |
| Abilene Atlas | 578 SMS | |

## Maintenance

Les Hayles - was enlisted guy. He was talked into joining AF. He went into electrical school.

Les Haylas — When he went to the missile squadron, he knew nothing about it when he got there. He is very knowledge-able

Maintenance Facility Technician

Mr. Ziegler = Section Maintenance Officer for sites 10, 11, 12
= He was also Chief Warrant Office
= He may not disclose classified info

MAMS — Maintenance Assembly Maintenance Squadron
579th HQ — Offices (Hangar 85?)

Steel canopy for 13th missile @ WAFB

- had space for another missile in same area

Bechtel did sanitary prints, which are broken down by site #

17

Bob Kaplan — curator of San Diego Aeronautical Museum

All Atlas missiles were built in San Diego.

LA District of USACE start Atlas = Ballistic Missile Construction

Bridigier General Wellington was appointed.

→ Albuquerque District handles the Roswell site = Area engineer was in charge

[by July 1961 in effect]

☆ Kemple was the Area Engineer for the Roswell sites

General of Program - General Schwei's collection is @ Texas A&M.

TRW = 2 engineers out of Hughes formed this company b/c they could not be the prime contractor.

18

Aerospace Corp Engineers
- may have information
- non-profit organization

Silo I
- contaminated
- 1992, 1994, 1997 sampling activity

- post-DOD operations likely caused the contamination

- 1st site to blow up
- Accident occurred in July 1963
- It had been in operation for 10 months

Liquid Oxygen Plant in Hangar (Hangar 853) - generated $LO_2$

Mr Baker showed us a photograph of Silo II
- can observed LOX off-gassing @ the top

RP1 - don't want $LO_2$ mixing with RP1

14

Guidance pod - distinguished structure for Atlas F

Site 11 photo - Phil Moore has whole set of photos

~~37th Maintenance~~ (ch 8/4/04)

37th Munitions Maintenance Squadron were responsible for the upkeep of war heads
- specialized training @ LOWRey.
- they were cream of the crop enlisted men

Had diagnostic tool @ site for missile work.

n

$O_2$ Doors of the silos weighed about 75 tons.

pl Gary has no contact for 37th Munitions Maintenance Squadron at WAFB

The Surveillance & Inspection Bldg was used for Atlas warhead maintenance. - building designed 1) a this.

2

Silo 1

Silo 1 accident – fire burned for a week
– the missile dropped 20 feet down

– the doors blew off 150' in each direction

Silo 1 has always had a water problem since it was built

Gary said there were 4 soggy sites – Silos 1, 2, 7, 8.
– For silo 1, underground river runs beneath the silo.
→ Also, Crosby Draw & river nearby.

Silo 1 owners
– initially Wickham owned it – from TX
– then Richard Dove

[signature]
8/4/04

Phil Moore was Deputy Crew Commander for the site (Silo 1), and the Commander was Jim Bloodworth

Gary said he had copies of all silo property owners prior to DOD ownership

- A 24-hour shift was really 36 hours. Missile crew initially go to the MAMS bldg. at WAFB.
  - go to the building
  - get a debriefing
  - get 100% on tests
  - Go to silo
  - do shift @ silo
  - then debrief new missile crew for next shift

Joseph Conrad - had other duties when not on active alert.

Billy? @ the MAMS bldg did the checkout of equipment. He was the NCO who conducted a lot of tests on the equipment.

If there was a problem w/ LOX loading, the AF may have called GDA to fix it

22

Sumps - went into outfall. Gary doesn't believe the material contained any waste products.

- There was no chemical waste clarifier associated w/ the outfall. (unlike the Titan missile)

Silo 2 Phil Moore transferred to Silo 2

- This silo was the third site to blow up on 3/1964.

Standard Crew -

Stand Board Crew - go through a check w/ 5 instructors overlooking everything for 24 hours.

The Stand Board Crew - altho in oversight role, they have no more experience or knowledge than the Standard Crew. The Standard Crew may even have "hands on" experience while the Stand Board crew had none

Issue – Who gives orders when an incident occurs while Stand Board Crew is there.

Bill Burgleson – Silo 2 – Section Maintenance Officer for Silos 1, 2 & 3.

Silo 2 accident

The missile goes up 3/4 won't go up or down.

The "Stand Board" Commander gives an order (Combat Crew Commander).

The standard crew Commander Jim Bloodworth said "No, not according to TO"

Jack Neves tried to go into silo thru utility tunnel – He wasn't able to open the blast door due to the pressure.

The missile caught fire.

2 guards on 6-hr shifts @ all silos

24

Silo 2 explosion

Phil has only key to gate
to get off of silo property

Clothe was lead-padded material

Scot air packs - lower level
began to fill up w/smoke.
The people put the pack on
to get out of smoke filled
area

- The accident reports are tape recorded
for Silo 2. These reports are @
Kirtland AFB b/c it was the safety office
for the AF.

- Al Kerz - was @ Silo 5 when
it blew. He is an engineer
from Tacoma. His role @
Silo 5 is as MFT.

Gary doesn't think the silo is
Contaminated @ Silo 2

Silo 2 and 12 were the last
sites owned by Helix Oil

Helex Oil also owned Silo 11 & sold it to John Fieret. Fieret is a movie director ("Dr. Doolittle" & "Mask")

~~-Bob Lazzari is a friend of Johns~~

Helix Oil sold silos:

Silo 6 – Wildel
5 – Jeff Heath
11 – John Fieret
12 – Henkley
2 – Dinkelweitz

-also owned Silo 10 & sold it.

Silo 4 – Helex Oil, then Phase 3 Corp

Silo 7 – City of Hagerman
Silo 8 – City of Lake Arthur
↳ Helix Oil wanted it.

~~Nov~~ Sept ~~2~~/4/04

George Berry was the foreman

8/4/04 leh

2

Silo 2 was left abandoned for several years

When water shortage, George sold water

Derkewitz worked on it & bought it.

3/2002 - started his work

Derkewitz lives on the site of Silo 2

[signature]

8/4/04

8/6/04 4:30 pm
Interview w/ Gary Bake

Silo 3 — SATFC — Site Activation Task Force Command

Salvage Ka — Gary wants these docs.
- IFB #
- Salvage Contract #

(DIA — may be a source for these docs)

→ # may be present in the deed of conveyance of the property.

— runs w/ property until salvage is completed.

The salvage process may take 2 years to complete

Silo 3 — was the last salvage site. — 4/8/1967

28

Silo 3 –
Louie Angelo was the salvage contractor
◦ Bed #
◦ Salvage #

✱ Master List of TOs for Atlas F
– Gary would like this list

"Defend & Deter" – a book that may have info on Atlas 'F's

Issue – Where did the records
✱ & manuals go after the base closed?

✱ AF Historical Research
– a research body
– 579th
– 6th

◦ When he went to Maxwell Gary only asked about Unit Histories

8/16/04
SCH

8/6/04 (Continued - Gary Baker)

Black & Veatch - Kansas City MO

BMD - Ballistic Missile Division
- when did the records for this go?
- Were they assumed by AF Systems Command

Bechtel - do they have docs.

WS107-A1 - reference to drawing w/this #

Gary said that there is only 1 sump inside the silo that collected a lot of stuff.

- another sewer sump in hallway

2 Unit Histories
- 1 is small and abbreviated
- 1 is larger version w/dates of events included.

UHF antenna - came in @ a later date & is not referenced in the drawing.
- SAC antenna

Diesels & Catchment Tanks

PAD Chief - NCO who dealt w/ surface operations

Quonset Hut - had bathrooms and were insulated.

Cess pool on surface part of site - no septic tanks

Silo 3
heater on level 5

$LO_2$ tanks

Civil Engineering Manual may have utility drawing for silos.

Salvage contractor had to take bond w/ govt. sign bond & put $ up

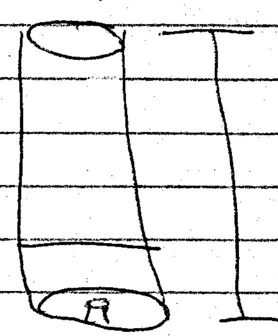
Gary's question - Who inspected salvage effort & signed off on it

GSA – salvage material

Gary got GSA docs for
Silos 3 & 4 from NARA–
Denver

Silo 3
– had a 2nd launch console
– had double communication
lines
– more electrical wires

Silo height – 185 feet
– from top to bottom of
sump



★ 3 sites had double sumps
in them, including Lake
Arthur

Silo 2 – the elevator would
take off to different
floors

32

Silo 7
UFO sitengs
= manuevers that were not w/i our plane's capability

Also saw ghosts @ some silos - ghosts were mostly Indians

Silo 2 - Phil Moore was Deputy Crew Commander when it blew up.

Silo 3 Louie Angeles sold to Lynn Meer 1 month later.

Louie also had the salvage contract for this silo.

Silo 4 - Louie had salvage contract for the silo

JCH 8/6/04

Slide 3 Lynn's former company
was Investment grp
↓
Phase 3 corp - went defunct
↓
John
↓
Al Woodworth
↓
Laura & Steve Sotka
↓
Gary Baker

Slide 4
Helix Oil
↓
Lynn Meier
↓
Investment Corp
↓
Phase 3
↓
John
↓
Al
↓
Sotka
↓
Gary Baker

41

Silo 5

Helix Oil - only operation
- had until
mid 1980s(?)

↓

Jeff Heath & Elizabeth
↳ bankruptcy

↓

Ed Payton

↓

Billy Wilcox - engineer out of Alaska

↓

~~Stove~~?

Silo 6

Helix Oil - sign w/ rocket on spar

↓

Wendell $1500

- silo has no stairs & no landing
- good see
- vandalism by kids

- no other operators

Lela 7

City of Hageman
Pegasus Valley Refining
→ old watchman that lived in trailer on-site
↓
he is dead now

Ray Bell ↑ - is very wealthy

Pegasus? Valley Refining is a tank farm
- Has lead contamination per Gary's buddy who worked there
→ Craig Sutherland

They put lead in gasoline, Tanks cost more than others

- It was cheaper for the company to put lead in petroleum than someone else doing it or buying gas w/ lead in it.

Ray Bell - IRS & EPA are after him
- penny pincher

36

Silo 7

Gary thinks Silo 7 is on the EPA list - CERCLIS

- defunct company, maybe go after officers.

No water wells in Silos 1, 3, 4, & 5

City installed waterline to Nike installation near Bottomless Lake

- put in T & sent line to Silo 4

- Water went thru. treatment system & sent to Silo 5

- demineralized water - name plate on silo

Silo 2

also has water treatment system

4" pipe goes to Silo 1 and 2.

Jch
8/6/05

<u>Silo 11</u>
- 2 wells + water treatment facility

<u>Silo 12</u> - 2 wells + water treatment facility
- large evaporation ponds.

<u>Silo 10</u> water treatment facility that fits 1 tank only.

<u>Silo 7</u> - has a very large tank, but can't see it due to barrels @ the site.

Water treatment facility varies @ every site!

<u>Silo 6</u> - it is provided water
- no well
- City of Hagerman provided $H_2O$ out of Pegasus River

38

Silo 7 - same story
- no well

- Hagerman fed water
from Pecos River

- Gary said this site
may now have well

Asbestos - clay pipeline from
City of Hagerman
for silos 6 & 7 and
Silo 4

Separate contracts existed
for communication lines
and water lines

↳ 400 miles of underground
cable

MAMS Plant & LOX Plant

Silo 8 - always owned by
Lake Arthur ~~only~~ lch
~~8/6/05~~
lch
8/4/04

lch
8/4/04

Silo 8 - only wells + water treatment plant
10
11
12

Silo 9 - 1 owner
- no operations
- provide $H_2O$ to roosters
- owns pecan ranch

Silo 10
Helex Oil backed out of buying this silo.

Wulfson got it on the rebid

- 89 acres
- Wulfson got the silo, then went through divorce - (Carrie - wife's name?)

Wulfson heard about sale of silo through radio.

Wulfson's wife, Carrie got the silo.
- a couple of deed changes occurred.

104

40

Selo 10 –

Starlite operated the site

– had a portable septic tank

Starlite leased land from Carrie in 1999 to conduct a laser show

Starlite didn't make good on loans –

Gary thought there may be a mechanics' lien on property due to Starlite not paying.

Selo 11

Helex Oil
Ed Payton (a Peden) sold it to John Farret in 1997 / 1998

Selo 12 Helix Oil
– sold through Ed.
– to Henkley

– operations involved the sale of water rights (M. Bend)

Silo 2
Helix Oil
Dinkelwitz

- operations involved the sale of $H_2O$ (Mr Bench)

George Bench (or Benge) - Helix Oil sold $H_2O$ altho not under company though

Silo 12 - no ~~future~~ further activity (ech 8/6/04)

Silo 2 - no further activity

Silo 1 - rumor is that it was sold on the courthouse steps for back taxes & liens
- or Zeegler bought it

Silo 2 - Gary heard Dinkelwitz raised [illegible] worms & mushrooms in the silo

42

Although silo 1 had a lot of $H_2O$ near it, water was brought in.

[initials]
8/6/04

~~Ho~~ lch 8/7/04

8/7/04

- Visit State Engineers Office
- research water wells

- after 1933 - need to file well.

Silo 6

T15S R28E S1-7, 14-16 = ∅
T15S R27E S1 = ∅
T15S R29E S. 5-7 = ∅

T14S R27E S24-24 = ∅
✓ T14S R28E S1-5, 7-34 = * = 1
(lch, 8/6/04)

NW ¼, SE ¼ S27 - January 1960, Depth of well - 240'
Sample Log 0"

✓ T14S R29E S7, 17-20, 29-33 = 1 well

Section 7 - 1999 = use = Stock well.

Total # of wells = 2

44

Sulo 7

T 13S R27E
T 13S R26E
T 14S R24E = 95 wells
T 14S R27E
T 15S R27E

T14S R26E – S1-3, 10-15, 22-27, 35, 36

1) Shallow well – W½, W½ ¼NW of S1 = 1954

2.) Shallow well NW¼, NW¼ of S2 1959, Use: Oil

3) Section 2
use: Dom / Stock 1988

4.) Shallow well – SE ¼, SW ¼, SW ½, Sec 2
1962 – use: Domestic

5.) Shallow well – 1959
use: Irrigation

6.) Shallow – 1961
use: oil

7.) SW 1/4, SE 1/4, S2 1947
use: oil

8.) Shallow - SW 1/4, SE 1/4, S10
1944 Use: ?

9.) well - SW 1/4 SE 1/4, S10
1946 use = ?

10.) Shallow well - NW 1/4 NW 1/4, SE 1/4, S10
1959 - use: domestic

11.) Section 10 - Artesian well
1905 - use: municipal

12.) Shallow - N 1/2, SW 1/4 SE 1/4 of S10
1957 use: domestic

13) Shallow - NE 1/4, SW 1/4, SE 1/4, S10
1952 use: ?

14.) Shallow - SE 1/4, SE 1/4, SE 1/4, S10
1980 use = Domestic

15) Shallow well - S11
1962 use: Domestic

4

16) Shallow — SW 1/4, SE 1/4, NE 1/4 S12
1940

17) Shallow - SW 1/4, SE 1/4, SW 1/4, S12
1950

18.) SW 1/4, SW 1/4, SE 1/4, S12
1938

19.) Shallow - SW 1/4, SW 1/4, SE 1/4, S12
1950

20) Well - NE 1/4, NW 1/4, S13
1937

21.) Shallow — S13

22) Well - SW 1/4, NW 1/4, NW 1/4, S14

23) Shallow — SW 1/4, NW 1/4, NW 1/4, S14
1948

24.) Well - SW 1/4, NW 1/4, NW 1/4, S14
1938

S12 25) Shallow - NW 1/4, NW 1/4, S14
1960 use: irrigation

12 26) Shallow - SW 1/4, SW 1/4, NW 1/4, S14
1952

27) Shallow SW 1/4, SW 1/4, NW 1/4, S14
1958

12 28) Shallow - SW 1/4 SW 1/4, NW 1/4, S14
1936 use: irrigation

29) S14 - NW 1/4, SW 1/4, S14

14 30) Shallow - SW 1/4, NW 1/4, NW 1/4 S14
1953

14 31) Shallow - E 1/2, SW 1/4, S14
1965 - use: irrigation

S14 32) Test well - W 1/2, SW 1/4, S14
1964

uf

33) Shallow - W 1/2 NE 1/4, SW 1/4, S14
1965 use - irrigation

34.) Shallow - SW 1/4, SE 1/4 SW 1/4, S14
1963 use - irrigation

35) SW 1/4, NW 1/4, SE 1/4, S14
1941

36) NW 1/4, SE 1/4, SE 1/4, S14
1934

37) Shallow - NW 1/4, SE 1/4, SE 1/4, S14
1952

38.) SW 1/4, SE 1/4, SE 1/4, S14
1952 - use: - irrigation

39.) Shallow - SW 1/4, SE 1/4, SE 1/4, S14
1943

14 40) S15 - 1957
use: Domestic

S14 41) Shallow - NW 1/4, NE 1/4 S15
1955 use: domestic

42) W 1/2, W 1/2, NW 1/4, NE 1/4, S15

43) SW 1/4, NW 1/4, NE 1/4 S15
1963 use: irrigation

44) NW 1/4, SW 1/4, NE 1/4, S15

S14

45) Shallow - NW 1/4, SW 1/4, NE 1/4, S15
1972 use: irrigation

46) Shallow - NW 1/4, SE 1/4, S15
1970 use - irrigation

1/4, S14

47) Shallow - SW 1/4, SW 1/4, SE 1/4, S15
1955 use: irrigation

50

48.) Artesian NE 1/4, NE 1/4, SE 1/4 S15
1978 use: irrigation

49.) SW 1/4, NW 1/4, NE 1/4, S22
1936 use: irrigation

50.) Shallow - SW 1/4, NW 1/4, NE 1/4, S22

51) S22
1954 use - irrigation

52) Shallow - N 1/2, NE 1/4, SW 1/4, S22
1960 Use: domestic

53) E 1/2, SE 1/4, S22
1907

54) Shallow - SW 1/4, NE 1/4, SE 1/4, S22
1958 use: domestic

S15 55) Shallow SW 1/4 NE 1/4 SE 1/4, S22
1955 use: domestic

56) Shallow SW 1/4 NE 1/4 SE 1/4, S22
1960 use: domestic

57) Shallow NW 1/4, SW 1/4, NW 1/4, S23
1952

S22

58.) Shallow - NW 1/4, SW 1/4, NW 1/4, S23
1955

59.) Shallow NW 1/4 SW 1/4 NW 1/4 S23
1961 use: irrigation

22

60) SE 1/4 NW 1/4, S23
1907

61) NW 1/4, NE 1/4, S23

62) SW 1/4, NE 1/4, S23
1961 use: irrigation

22 63) SE 1/4, NE 1/4, S23

1946

5

64) Shallow SE 1/4, NE 1/4 S23
1970 use: irrigation

65) Shallow – SE 1/4, NE 1/4 S23
1970 use: irrigation

66) Shallow – SE 1/4, NE 1/4, S23
1946

67) SE 1/4, NE 1/4, S23
1981 use: irrigation

68) SE 1/4, NE 1/4, S23
1953

69) Shallow SE 1/4, NE 1/4 S23
1966 use: irrigation

70) Shallow NE 1/4, SW 1/4, SW 1/4 S23

71) NE 1/4, SW 1/4, SW 1/4, S23
1957 use: irrigation

72) Shallow - NE 1/4, SW 1/4, SW 1/4,
S23

1959 use: irrigation

73) Shallow - W 1/2, SE 1/4, SW 1/4, S23
1944

74) Shallow - NE 1/4, SE 1/4 SW 1/4 S23
1974 - use: exploratory irrigatio

75) NE 1/4, NE 1/4, SE 1/4, S23
1957 use: domestic

76) NE 1/4, NE 1/4, SE 1/4, S3
1961 use: domestic

77) NW 1/4, SE 1/4, SE 1/4, S23
1965 use: supplemental

23

78) Shallow - NE 1/4, SW 1/4, S24

79.) Shallow - NE 1/4, SW 1/4 S24
1963 use: irrigation

80) Shallow – S24
1969 use – irrigation

81) NW 1/4, SW 1/4, NE 1/4, S24
1954 use – dome

82) SE 1/4, NE 1/4, S25
1980 use: domestic

83) SE 1/4, SE 1/4, NE 1/4, S25
1988 use: domestic

84) SE 1/4, SE 1/4, SE 1/4, S25
2003 use: domestic

85) Shallow – NW 1/4, NW 1/4, NE 1/4
S3

dch
8/7/04

8/2/04

T13S R27E S27-35

1) shallow Sec 28
1956 use: domestic

2) SW 1/4, NW 1/4, S34
1959 - use: oil

T13S R26E S25, 35, 36

Ø

T15S R27E S3-6

Ø

T14SR27E S1 - 35

1/4 1) Shallow N 1/2, SW 1/4, S4
1968 use: stock

2) SW 1/4, SE 1/4, S7

56

3) Shallow - Center S10
1971 use: stock

4) Log of oil or gas well - S15
1962

5) SW 1/4, NE 1/4, S17
1/1960 use: exploratory

6) SE 1/4, NW 1/4, S18
use - domestic

7.) Shallow - W 1/2 S22
1965 - use - domestic

8.) Shallow - NW 1/4, NW 1/4, SW 1/4,
S30
1964 - use: stock

# Silo 8

T14S R26E
T15S R26E
T15S R25E
T16S R26E — 199 well
T16S R27E
T15S R27E

1) Shallow NW 1/4, NE 1/4, SE 1/4, S32
2001 use: domestic

2) Shallow SW 1/4, SE 1/4, SE 1/4, S32
1955 use: domestic

3) NW 1/4, SW 1/4, S33
1961 use: domestic

1/4, 4) Shallow NW 1/4, SW 1/4, S33
1953

5.) Shallow S33
1938

58

6) SE 1/4, NE 1/4, SE 1/4 S33
1978 use: domestic

7.) SE 1/4, NE 1/4, SE 1/4, S33
1976 use: domestic

8.) S 1/2, NW 1/4, S34
1979

9.) W 1/2, NW 1/4, SW 1/4, S34
1989 use: domestic &stock

10.) E 1/4, NE 1/4, SW 1/4, S 1/2 S34
1991 use: domestic

11) S 1/2, SW 1/4, SW 1/4, S34
1977 use: domestic

12) NW 1/4, SE 1/4, S34

8/7/04 ~~19~~ leh   2002   use - domestic/stock

13) N 1/2, SE 1/4, S34

1982   use: domestic/stock

14) W 1/2, W 1/2, SW 1/4, S35

2002   use: domestic/stock

15) Shallow   SE 1/4, SE 1/4, SW 1/4, S35

ock   1955

34   16) S 1/2, NE 1/4, SW 1/4, S35

1979   use: domestic

17) SE 1/4   S35

1981   use - domestic

60

Silo 8

T15S R26E S1-36

1) NW 1/4, SW 1/4 S1

1955

2) SW 1/4, SW 1/4 S1

1941

3) NE 1/4, SW 1/4, NW 1/4 S2

1987 use: domestic

4) NW 1/4 NW 1/4 S3

1996 use: domestic/stock

5) SW 1/4, SW 1/4, NW 1/4, S3

1981 use: domestic/stock

6.) E 1/2, NW 1/4 S4

19?

7.) Artesian SW 1/4, NE 1/4, NW 1/4 S4
1965 use: irrigation

8.) NE 1/4, SW 1/4, S4
1912

9.) ~~AW~~ leh 8/7/05 NE 1/4, NW 1/4, S5
1937

10.) SW 1/4, SW 1/4, NE 1/4, S5
1995 use: domestic/stock

11) SE 1/4, SW 1/4, S5
1987 use: repair - deepen
stock/domestic

ak

12) NW 1/4, SW 1/4, S6
1938

13) Shallow NW 1/4, NW 1/4, SW 1/4, S6
1948

3

14.) NW 1/4, NW 1/4, S7
1938 use: oil

15) NW 1/4, NW 1/4, NW 1/4 S7
1937

16) NW 1/4, NW 1/4, S7
1909

17) Shallow NE 1/4 S7
1948

18.) NW 1/4, NE 1/4 S7
1910

19) N 1/2, NW 1/4, SW 1/4 S7
1942

20) Shallow NW 1/4 S8
1973 use: domestic

21) Shallow NW 1/4, NW 1/4, NW 1/4 S8

1946

22) NE 1/4, NE 1/4, S 8

1910

23) N 1/2, S 1/2, NE 1/4 S8

1978 use: domestic/stock

24) NW 1/4, SW 1/4, SW 1/4, S8

1909

25) NE 1/4, SW 1/4, S8

1979 use: domestic

26) SE 1/4, SW 1/4, S8

1986 use: domestic

27) Shallow SW 1/4, SE 1/4, SW 1/4 S8

1969 use: domestic

28) Center 1/4, NW 1/4, NW 1/4, SE 1/4
S 8

1943

29.) NW 1/4, NW 1/4, SE 1/4, S8

30) Shallow NE 1/4, NW 1/4, SE 1/4,
S8

31) NW 1/4, SE 1/4, S8
1977 use - irrigation

32) Shallow N 1/2, SE 1/4, S8
1979 use - irrigation

33) NW 1/4, NW 1/4, S9
1938

34) Artesian NW 1/4, SW 1/4, S9
1955

35) Artesian NW1/4, NW1/4, SW1/4, S9
1951

36) Domestic NW1/4, NW1/4, S10
1954 use - domestic

37) Shallow SE 1/4, NE1/4, ~~SE~~ NW1/4 [ltb 8/7/04]
NW1/4, S10

ltb 8/7/04 ~~1922~~ 1973 use - irrigation

38) NE1/4, NW1/4, NW1/4, S10

1974 use - irrigation

39) NW1/4, NE 1/4, NW1/4 S10

1943

40) Shallow NW1/4, NE1/4, NW1/4,
S10

1950

41) Shallow NW1/4, NE1/4, NW1/4
S10
1955 use: irrigation

we

42) S10
1977 use - irrigation

43) SW 1/4, NW 1/4, S10
1978 use - irrigation

44) SE 1/4, SE 1/4, S10
use - oil

45) NW 1/4, SW 1/4, ~~S10~~ S11
(lch 8/7/04)
1910 use - domestic

46) SW 1/4, SE 1/4, S11
1982 use - livestock

47) Artesian NW 1/4, NE 1/4, NW 1/4 S13
1955

48) ~~Artesian~~ NW 1/4, NE 1/4, NW 1/4 S13
1909

49) Artesian NW 1/4, NE 1/4, NE 1/4 S13
1968 use - irrigation

50) NE corner S13
1960 use - irrigation

51) NW 1/4, NW 1/4, NW 1/4 S17
1945

52) NE 1/4, NW 1/4 S17

53) NE 1/4, NW 1/4, S17
1909

54) Shallow NW 1/4, NW 1/4, NE 1/4, S17
1942

S13

55) NW 1/4, NW 1/4, NE 1/4, S17
use - irrigation

S13

56) Shallow SW 1/4, SE 1/4, SW 1/4 S17
1967 use: domestic/stock

57) Artesian S18
1948

58) Shallow NW 1/4, NW 1/4, S18
1943

59) Shallow NW 1/4, NW 1/4, S18
1954

60) Shallow NW 1/4, NW 1/4, S18
1961 use irrigation

61) Shallow NW 1/4, NW 1/4, NW 1/4, S18
1948 use. domestic

62) Artesian W 1/2, E 1/2, NW 1/4, S18
1941 use, irrigation

'17 63) Artesian NE 1/4, NE 1/4, NW 1/4 S18

ch

64) Artesian NE 1/4, NE 1/4, NW 1/4, S18
1948

65) Shallow SW 1/4, NW 1/4 S18
1961 use - irrigation

66) NW 1/4, NW 1/4, NE 1/4, S18
1908

67) NW 1/4, NE 1/4, SW 1/4 S18
1908

68) Artesian SW 1/4, SW 1/4, S18
1965 use. domestic

8 69) Shallow - SE 1/4, SW 1/4, S18
2003 use - domestic

70

70) Shallow S 1/2, NE 1/4, SE 1/4 S18

1941

71) Domestic NW 1/4, NW 1/4, S19

1959 use - domestic

72) NW 1/4, NW 1/4, S19

1906

73) SE 1/4, NE 1/4, NE 1/4, S19

1984, use - domestic/stock

74) Shallow GW - NE 1/4, NE 1/4, S19

1941

75) Shallow NW 1/4, NE 1/4, NE 1/4, S19

1953

76) NE 1/4, NE 1/4, NE 1/4 S19
2001 use - domestic/stock

77) NW 1/4, SE 1/4, SW 1/4, S 19
1929

78) Shallow NW 1/4, SW 1/4, SW 1/4, S19
1970 use - irrigation

79) SE 1/4, SW 1/4, S19
1906

80) Artesian NW 1/4, SE 1/4, SW 1/4, S19
1974 use - irrigation

81) Shallow - SW 1/4, NE 1/4, NW 1/4
S 20
1960 use - irrigation

x✓

82) Shallow - NE 1/4, NW 1/4, S20
1943

83) ~~Shallow~~ NE 1/4, NW 1/4 S20
1996 use - domestic

84) ~~Shallow~~ NW 1/4, NE 1/4, SW 1/4 S20
1956 use: municipal

85) ~~Artesian~~ SW 1/4, NW 1/4, NE 1/4
S21
1960 use - domestic

86) SW 1/4, NW 1/4, NE 1/4, S21
USACE well - (Site 4 #5)

87) ~~Artesian~~ S21
1960 - ~~public works, sanitary~~

88) ~~Artesian~~ S21
1960 - public works &
~~sanitary~~

89) Domestic NW1/4, NW1/4, SW1/4, S2
1961 use - domestic

90) Shallow NW1/4, SE1/4, S23
2003 use - irrigation

91) Shallow NE1/4, NE1/4, NE1/4, S22
1952

92) Shallow SE1/4, SE1/4, S23
1978 use - domestic

93) Shallow SE1/4, SE1/4 S25
1966 use - exploratory

94) NW1/4, NW1/4, S26
1943

74
~~73~~ [illegible] 8/7/04

95) Shallow NE 1/4, SE 1/4 S26
1966

96) Shallow SE 1/4, SE 1/4, SE 1/4 S28
1967 use - domestic / stock

97) NW 1/4, NW 1/4, S29
1910

98) Artesian NW 1/4, NW 1/4, NW 1/4 S29
1976 use - domestic

99) Shallow NW 1/4, NW 1/4, NW 1/4, S29
1971 use - irrigation

100) NW 1/4, NE 1/4, S29
19? use - exploratory

101) Shallow NW 1/4, NW 1/4, NE 1/4, S29
1955

6 102) SW 1/4, NW 1/4, NE 1/4, S29

1950

103) Shallow NW 1/4, SW 1/4, NE 1/4, S29

S28 1955 use - exploratory

tock

104) Artesian SW 1/4, SW 1/4, NE 1/4, S29

1974 use - irrigation

105) Shallow SE 1/4, NE 1/4, S29

S29 1955 use - exploratory

106) NW 1/4, NE 1/4, SW 1/4, S29

S29 107) Shallow SE 1/4, SE 1/4, SW 1/4 S29

1955 use - exploratory

108) Shallow SE 1/4, SE 1/4, S29

1955 use - exploratory

S29 109) Shallow NE 1/4, NE 1/4, NW 1/4

S30

1970 use - domestic

7u

110) Shallow SW 1/4, NE 1/4, ~~NE~~ NW 1/4 S 30 leh 8/7/04

1954

111) SE 1/4, NW 1/4, S30

1909

112) SE, SW, SW, NE, NW S30

1974 use - irrigation

113) Artesian N 1/2, SW 1/4, NW 1/4, S30

1959 use - exploratory

114) Shallow N 1/2, SW 1/4, NW 1/4, S30

1959 use irrigation

115) Shallow N 1/2, SW 1/4, NW 1/4 S30

1959 use - irrigation

116) N 1/2, SW 1/4, NW 1/4, S30

1962 use - irrigation

lu4

117) SW 1/4, NW 1/4 S30

1938

118) SW 1/4, SW 1/4, NW 1/4, S30
1958 use - irrigation

119) Shallow NW SW SW S30

1978 use - irrigation

120) Shallow S30

S30 1983

121) Shallow W 1/2, SE 1/4, E 1/2,
SE 1/4, S30

S30 2001 use - domestic/stock

122) NW, NW SE S30

S30 1938

123) NW NW S31

19?

124) NW NW NW S31
1937

125) Shallow NE NE NE S31
1967 use - stock

126) Shallow NE SW S31
1955 use - irrigation

127) Shallow SW SW S31
1941

128) SW SW S31
1907

129) shallow NW NW S32
1989 use - stock

130) Artesain SE SW NW S32
1955 use - exploratory

131) Shallow NE NE SW S32

1955

132) Shallow SE NE SW S32
1955

133) Shallow S31
1980 use - irrigation

134) Shallow SE, SE, SW S32

1955

135) SW 1/4, SE 1/4 S32

1907

T15S R27E S7, 18-19, 30-31

1) Shallow NW NW S31
1966 use - exploratory

2) Shallow S31

1962

lab 8/7/04

2

8

T 15 S R25E S1, 12-14, 23-26, 36

1) Shallow NW 1/4, NW 1/4, NE 1/4 S12

1943

2) SWNWNE S12

192

3) Shallow NWNW NE S12

1943

4.) NW NE S12

1910

5) Shallow SW SW S12

1939

6) Shallow SWSW S12

1989 use-stock

7) Shallow SESWSW S12

1963 use-observation

26, 36

S12

8) Shallow S½, NW¼ NW¼, N½ SW ¼, NW¼, S13

1994 use - domestic/stock

9) Shallow SESE S13
1978 use - domestic

10) SWSWSW S13
1978 use - domestic/stock

11) SWSESW S13

1945

12) SESW S13
1908

13) Shallow SENE S14
1999 use - domestic/stock

14) Shallow E½, NE SE, S14
1978 use - domestic

8/

15) Artesian NE NE NE S23
1941 use - Domestic

~~[illegible]~~ 8/7/04

16) NE 1/4, ~~SW~~ lch NW 1/4, S24
1924

17) Artesian NW NE NW S24
1948

18) Artesian NW NE NW S24
1992 use - irrigation

19) Shallow SW SW NW S24
1967 use : stock

20) Shallow NW NW NE S24
1971 use - domestic

21) Artesian NW NE NE S24
1995 use - irrigation

22) NW NE NE S24
1948

23) NENE S24
1927

24) NW NENE S24
1938

25) SW NE S25
1906

26) Shallow NE SENE S25
1945

27) Shallow NE SE NE S25
1957 use - irrigation

28) Artesian SE 1/4 S26
1995 use - irrigation

29) Shallow NE 1/2, N 1/2, NW 1/4 S36
1958

30) Shallow
1950 use - domestic

31) Shallow S36
1984 use - irrigation

~~32)~~ ~~eih~~ ~~8/9/04~~

84

T16S R26E S4

1) Shallow SWSE S1
1941

2) NW NW NW, S2
1942

3) NE ~~SW~~ lot 8/7/04 SE, S3
1907

4) Shallow S4
1964 use - domestic/stock

5) Shallow S4
1967 use - irrigation

6) Shallow S4
1963 use - irrigation

7) Shallow S4
1963 use - irrigation

8) Shallow S4
1961 use irrigation

9) Shallow S4
1950

10) Shallow NW NW NE S4
1981 use - domestic

11) Shallow NE NE NE S4
2000 use - domestic/stock

12) shallow SW, NE, NE S4
1960 use - domestic

13) Shallow NE S4
1990 use domestic

leh 8/2/04
14) Shallow NE, SE, ~~SE~~ ~~SW~~ NE
1980 use - domestic/stock

T16S R27E S4-6

Ø

leh
8/7/04

Silo 9

T10S R19E
T10S R20E
T11S R19E
T11S R20E
T12S R19E
T12S R20E

(14)

T10S R19E S25-28, 32-36

∅

T10S R20E S31

∅

T11S R19E S1-36

1) NW SW S14
1986 use-stock

2) NW SW S14
1960 use-exploratory
@ USACE well

3) NW 1/4, SW 1/4, S14

USACE Site "B" #6

4) Shallow NW NW SW S14

2001 use stock (SWS to H2O)

5) Shallow SE SE S20

1960 use domestic/stock

6) Shallow SE NE S27

1963 use-stock; domestic

7) Shallow NE, NE, NE S26

1955 use-stock

8) Shallow SW, NE, NW S29

1957 use-domestic

9) Shallow SW, SW, NW S9

2003 use-irrigation

80

10) Shallow - SE NW S29

1961 use - irrigation

11) NW, SW, S29

1959 use - irrigation

12) Shallow NW, NE, SW S29

1961 use - domestic

13) NW, SW, SW S29

1959 use Domestic

14) Shallow ~~SW NW~~ ldh 8/2/04 SW NE SE S30

1982 use - irrigation

~~15)~~ ldh 8/2/04

8/7/04

T11S R20E S 5-8, 17-20, 29-31

Ø

T12S R19E S 1-4

Ø

T12S R20E S6

Ø

leh 8/7/04

90

8/7/04 – Gary Baker

<u>Silo 1-12</u>

State of NM in dispute w/ USA w/ water rights – ligations

GSA water rights then state has issues w/ it

<u>Silo 9-10</u>

Helix Oil – acquires 8 of 10 sites – won bid of 10 sites (backed out of 2 sites)

Hagerman bought site from GSA

<u>Silo 10</u> – 89 acres

– why so much land

<u>Site 4</u> – taken from state

Silo 3 – not from state
600' wide & 1,200' long

Silos 9 & 10

GSA let Helex out of contract for buying it.

LA

Bonham – Wolverson 10 / 9 > ruled out

Silo 10
service salvage contract – language (1-liner)

agreement – 30-day period to remove / salvage

mm

He thinks Silos 3, 4 & 5 were originally alternates, since they were Sites 10, 11, 12 – during construction

92

Silo 3 – Gary thinks a well is located near store @ east, NE of site

Silos 3, 6, 9 – had runways

NARA

Still collection – get index – get collection

If find photos get double prints for Gary

Silos 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 → was open land

Silo 11 – had a lot of problem during construct – w/ blasting – hit rock broke well casings – of neighboring wells

Get Silos 3 & 4 – real estate map

USACE - Office History
digitized copies

8/10/04

8:50 - County of Lincoln
Assessor's Office

David LaFave - mapper
- provided us w/ plot map
& parcel # &
2 deeds numbers

- went to Clerk's Office

Notes
Jack Patterson Parcel
- Patsy Sanchez - she worked
in Quonset hut in
1961 to 1962
- It was office work
for the uranium mine

8/10/04
[signature]

# Appendix B

# APPENDIX B
# PHOTOGRAPH LOG

# FINAL PRELIMINARY ASSESSMENT REPORT
# FORMER WALKER AIR FORCE BASE
# ATLAS "F" MISSILE SILO 8
# CHAVES COUNTY, NEW MEXICO
# PROPERTY NO. K06NM0486

**APPENDIX B**
**PHOTOGRAPH LOG**

# FINAL PRELIMINARY ASSESSMENT REPORT FORMER WALKER AIR FORCE BASE ATLAS "F" MISSILO SILO 8 CHAVES COUNTY, NEW MEXICO PROPERTY NO. K06NM0486

## INTRODUCTION

HydroGeoLogic, Inc. (HGL) prepared this photograph log as part of a preliminary assessment of the former Walker Air Force Base Atlas "F" Missile Silo 8 (site). HGL is performing the PA for the U.S. Army Corps of Engineers, Albuquerque District, through a subcontract with Shaw Environmental, Inc. This log contains photographs taken by HGL during site reconnaissance on August 2, 2004. The site is located in Chaves County, New Mexico and has been assigned Formerly Used Defense Site (FUDS) Property Identification Number K06NM0486.

| **Photograph Number:** |
|---|
| • 1 |
| **Date:** |
| • August 2, 2004 |
| **Time:** |
| • 2:58 p.m. |
| **Direction:** |
| • Northeast |
| **Weather:** |
| • Partly Cloudy |
| **Photographer:** |
| • HydroGeoLogic, Inc. |
| **Location:** |
| • Silo Pad |

**Description:**
The silo pad remains intact with small cracks evident. This photograph depicts the silo doors that cover the underground silo complex. The area surrounding the silo pad is well vegetated. A metal structure associated with the Lake Arthur Water Cooperative Corporation is visible.

| Photograph Number: |
| --- |
| • 2 |
| **Date:** |
| • August 2, 2004 |
| **Time:** |
| • 3:00 p.m. |
| **Direction:** |
| • North-Northwest |
| **Weather:** |
| • Partly Cloudy |
| **Photographer:** |
| • HydroGeoLogic, Inc. |
| **Location:** |
| • Former Silo Water Treatment Building |

**Description:**
The foundation of the former Water Treatment Building is the current location of the Lake Arthur Water Cooperative Corporation water wells. Evaporative ponds associated with site operations are visible behind the fenced-in area. Also visible is the foundation for the water storage tank.

| Photograph Number: |
| --- |
| • 3 |
| **Date:** |
| • August 2, 2004 |
| **Time:** |
| • 3:02 p.m. |
| **Direction:** |
| • West-Southwest |
| **Weather:** |
| • Partly Cloudy |
| **Photographer:** |
| • HydroGeoLogic, Inc. |
| **Location:** |
| • Roll-Off Bin |

**Description:**
Roll-off bin containing site investigation material.

# Appendix C

# APPENDIX C
# HISTORICAL AERIAL PHOTOGRAPH ANALYSIS REPORT

## FINAL PRELIMINARY ASSESSMENT REPORT
## FORMER WALKER AIR FORCE BASE
## ATLAS "F" MISSILE SILO 8
## CHAVES COUNTY, NEW MEXICO
## PROPERTY NO. K06NM0486

# TABLE OF CONTENTS



## LIST OF FIGURES



## LIST OF TABLES

# APPENDIX C
# HISTORICAL AERIAL PHOTOGRAPH ANALYSIS REPORT

# FINAL PRELIMINARY ASSESSMENT REPORT
# FORMER WALKER AIR FORCE BASE
# ATLAS "F" MISSILE SILO 8
# CHAVES COUNTY, NEW MEXICO
# PROPERTY NO. K06NM0486

## 1.0 INTRODUCTION

HydroGeoLogic, Inc. (HGL) performed this aerial photograph review and analysis as part of its preliminary assessment of the former Walker Air Force Base Atlas "F" Missile Silo 8 (site), located in Chaves County, New Mexico. Shaw Environmental, Inc., under contract to the U.S. Army Corps of Engineers (USACE), Albuquerque District, requested this analysis to assist in the determination of the nature and extent of responsibility that the USACE may have in the investigation and cleanup of potential contamination at the site. This site has been assigned Formerly Used Defense Site (FUDS) Property Identification Number K06NM0486.

Aerial photography of the site representing three years was obtained for the period from 1957 to 1981. These photographs were examined to characterize long-term physical changes and environmentally significant features at the site. Black-and-white photography from 1957 and 1964, and color photography from 1981 were used for this analysis. Significant findings from these years are annotated on the photographs and are discussed in the text of this report in chronological order.

The purpose of the analysis is to document historical activity at the site and its chronological development, and to identify any major visible features that may indicate the location of potential disposal areas and other relevant features. The findings from the analysis of aerial photography include buildings, areas of disturbed ground, mounded material, and unidentifiable objects that may be of environmental significance.

# 2.0 METHODOLOGY

HGL conducted a search of government and commercial sources to obtain the best available aerial photography of the site spanning the representative period. A list of the aerial photography used during the analysis of this site is provided in Table 1.

**Table 1**
**List of Aerial Photographs Analyzed**

| Date of Photograph | Source | Scale | Type |
|---|---|---|---|
| 7/26/1957 | ASCS | 1:20,000 | Black and White |
| 1/15/1964 | ASCS | 1:20,000 | Black and White |
| 4/24/1981 | BLM | 1:24,000 | Color |

ASCS: U.S. Department of Agriculture, Agricultural Stabilization and Conservation Service
BLM: Bureau of Land Management

Three sets of aerial stereo-photographic pairs were analyzed that reflect the chronological development of the site. The analysis was performed viewing black-and-white and color aerial stereo-photographic pairs under magnification through a mirror stereoscope. Stereoscopic viewing creates a perceived three-dimensional effect, which enables the analyst to identify characteristics associated with features and environmental conditions. Visual characteristics include depth, height, tone, shadow, texture, size, shape, pattern, and association, which allow a specific object or condition to be recognized on aerial photography.

Scale and resolution precluded the ability to make a positive identification of some features; consequently, these features could not be characterized. Each one of these features was classified as an unidentifiable object (UO). This unique identification permits the reader to observe areas of interest (AOIs) without being led to any inaccurate conclusions.

The terms "possible" and "probable" are used to indicate the degree of certainty of feature identification. "Possible" is used when only a few characteristics are recognizable or the characteristics are not unique to a feature or environmental condition. "Probable" is used when more characteristics are recognizable. No qualifying terms are used when characteristics of a feature or environmental condition allow for a definite identification.

The aerial stereo-photographs were analyzed to identify features with potential environmental significance. The focus of this analysis was on the 500 feet by 500 feet alert area of the silo property as well as the Quonset huts constructed in conjunction with silo operations. Features of interest are labeled on the site photographs, illustrated in Figures 1 through 3, and are described in detail in Section 4.0 of this report. The description system begins in the northwestern-most AOI progressing from left to right and southward, by row, like reading a book. Features are annotated from their first appearance until they are no longer visible. Features have been numbered for the convenience of the reader. Site boundaries or areas used in this analysis were determined from observations made from the aerial photography in conjunction with selected collateral information and do not denote legal property lines or ownership.

A 1964 operational manual and a construction status report site plan provide information about the property including the buildings, as well as the roads and miscellaneous structures.

## 3.0 ANNOTATION ABBREVIATIONS

The figures, which accompany the narrative in Section 4.0, were initially scanned from the aerial photographs, with features added to successive figures as changes were observed over time. In this analysis of the site, a "bullet" system combined with a textual description has been used for identifying significant features. A simple system of abbreviations is utilized to illustrate items described in the text and identified in the figures as areas of interest.

| | |
|---|---|
| B | Building |
| MM | Mounded Material |
| T | Vertical/Horizontal Tank |
| UO | Unknown Object |

Once identified, the same label is used to identify the object in subsequent years of analysis if the feature remains visible. If the feature is no longer visible or deemed irrelevant to further discussion, it is not included on subsequent figures.

# 4.0 AERIAL PHOTOGRAPH SITE ANALYSIS

For each year of coverage, a general description of the site as depicted in the photograph is provided. Site features are presented for the photograph, using the "bullet" system and the textual description discussed above.

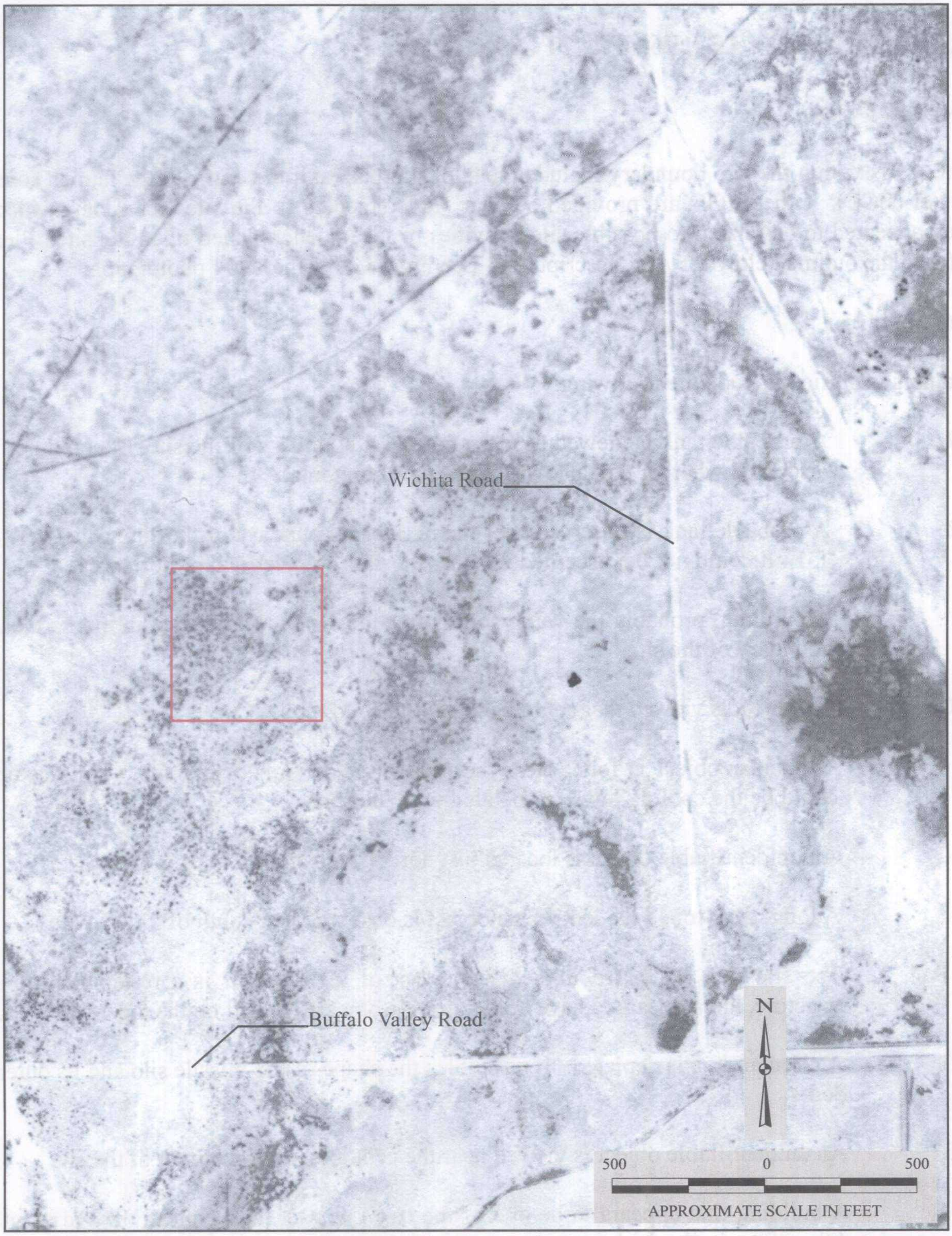
## 4.1 JULY 26, 1957 PHOTOGRAPH

**General Description:**

This photograph year is before construction of the site. The region is mostly desert and vegetation is sporadic. See Figure 1 for the 1957 photograph.

**Site Features:**

No features of interest were identified on the 1957 photograph.




*X:\Phoenix\Graphics\Atlas (SHA002)\AirPhotos\Site08_Aerial_Photos.cdr*
*Created: CLimoges 03/15/05*
*Revised: Climoges 10/21/05*
*Source: ASCS*

HYDRO GeoLogic INC.

**Legend**

Site Boundary

**Figure 1**
**Former WAFB**
**Atlas "F" Missile Silo 8**
**July 26, 1957 Photograph**

## 4.2 JANUARY 15, 1964 PHOTOGRAPH

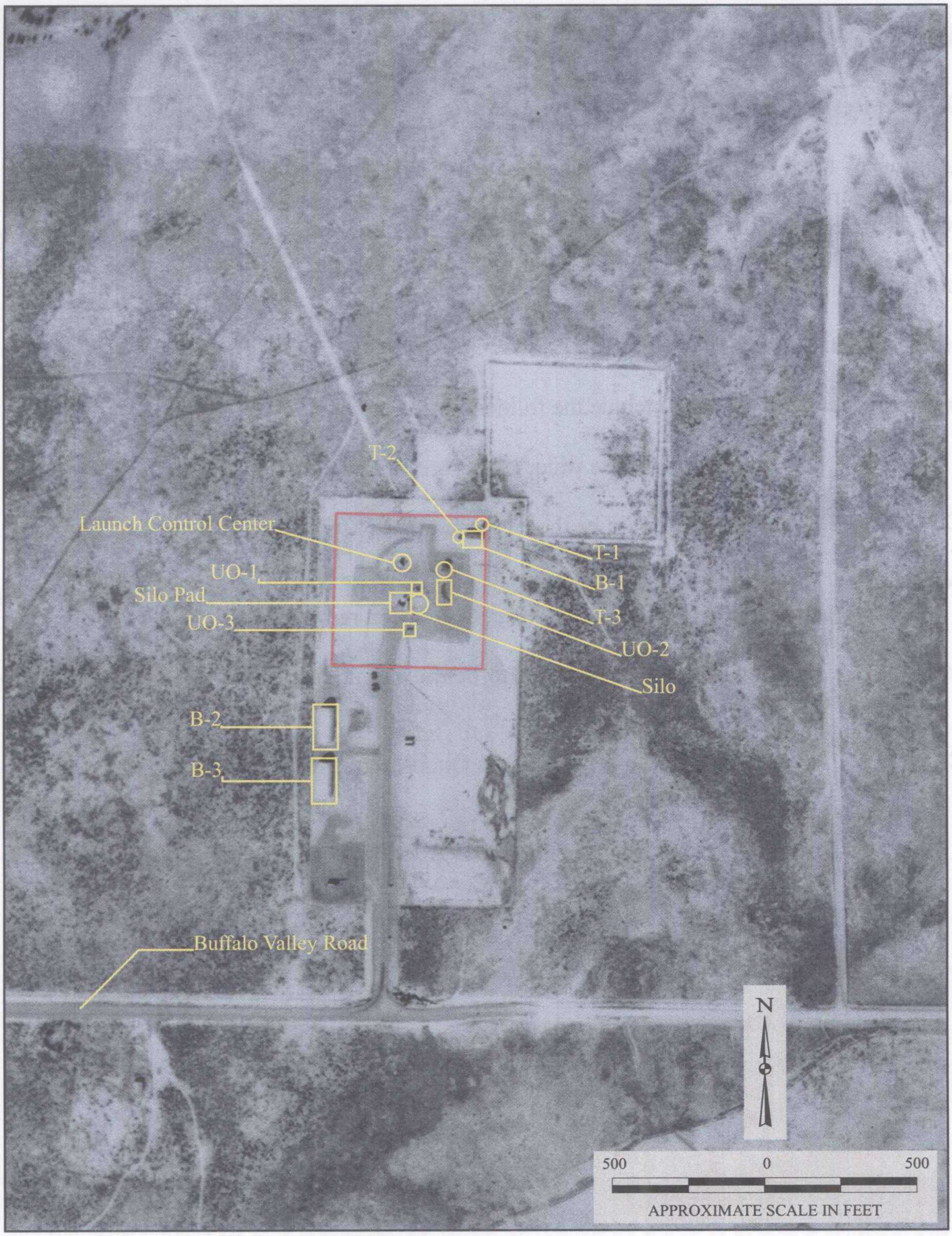
**General Description:**

The AOIs within the site boundary include the silo, silo pad, and the entry to the launch control center (LCC). Other AOIs are provided below. AOIs adjacent to the site were documented if they appeared to be related to possible silo activities or if they encroached upon the site. Please refer to the outline below for AOI descriptions. See Figure 2 for the 1964 photograph.

**Site Features:**

Features identified include the following:

| | |
|---|---|
| T-1 | A probable tank is viewed near the northeast boundary of the site. It could not be discerned whether the tank was vertical or horizontal. |
| T-2 | A probable tank is observed near the northeast boundary of the site, southwest of T-1. It could not be discerned whether the tank was vertical or horizontal. |
| B-1 | A building, probably the water supply treatment plant, is located in the northeast boundary of the site. |
| LCC | An object is viewed that could be the entrance to the LCC. |
| T-3 | A circular object is found near the east-central region of the site. This feature could be the cooling tower associated with the silo. |
| UO-1 | An unidentifiable object is located just north of the silo. It is dark-toned. |
| UO-2 | A long, dark-toned unidentifiable object is observed just south of T-3. |
| Silo Pad | The silo pad is located immediately west of the silo. It is a rectangular-type structure, and appears to have unidentifiable objects located on the top of the area. |
| Silo | A circular area is depicted. It resembles the shape of the missile silo and its outer doors. |
| UO-3 | An unidentifiable object is viewed near the central-southern border of the site. |
| B-2 | A building that appears to be one of the two Quonset huts typically found at an Atlas "F" missile site is present. |
| B-3 | This building appears to be the location of the second Quonset hut typically found at an Atlas "F" missile site. |




*X:\Phoenix\Graphics\Atlas (SHA002)\AirPhotos\Site08_Aerial_Photos.cdr*
*Created: CLimoges 03/15/05*
*Revised: CLimoges 10/21/05*
*Source: ASCS*

HYDRO GeoLogic INC.

**Legend**

Site Boundary

Area of Interest

**Figure 2**
**Former WAFB**
**Atlas "F" Missile Silo 8**
**January 15, 1964 Photograph**

## 4.3 APRIL 24, 1981 PHOTOGRAPH

**General Description:**

Analysis of the 1981 photograph indicates that the silo is out of commission. Most of the buildings, structures and objects have been removed from the site. AOIs adjacent to the site were documented if they appeared to be related to possible activities or if they encroached upon the site. Please refer to the outline below for AOI descriptions. See Figure 3 for the 1981 photograph.

**Site Features:**

Previously identified features include the following:

| | |
|---|---|
| B-1 | The foundation for the water supply treatment plant remains. |
| LCC | The object that could be the entrance to the LCC still exists. |
| Silo Pad | The silo pad is located immediately west of the silo. It is a rectangular-type structure. All unidentified objects have been removed. |
| Silo | The circular area that appears to be the silo and its outer doors remains near the center of the site. |
| B-2 | The former location for one of the Quonset huts has a smaller building located on the top of the foundation. |
| B-3 | This Quonset hut has been removed. A foundation remains. |


*X:\Phoenix\Graphics\Atlas (SHA002)\AirPhotos\Site08_Aerial_Photos.cdr*
*Created: CLimoges 03/15/05*
*Revised: Climoges 10/21/05*
*Source: BLM*

**Legend**

Site Boundary
Area of Interest

**Figure 3**
**Former WAFB**
**Atlas "F" Missile Silo 8**
**April 24, 1981 Photograph**

# 5.0 SUMMARY OF OBSERVATIONS

Table 2 presents a list of AOIs noted at the subject site for the period 1957 to 1981.

**Table 2**
**Summary of Aerial Photograph Observations**

| Feature Designation | 1957 | 1964 | 1981 |
|---|---|---|---|
| B-1 | | × | × |
| B-2 | | × | × |
| B-3 | | × | × |
| LCC | | × | × |
| Silo Pad | | × | × |
| Silo | | × | × |
| T-1 | | × | |
| T-2 | | × | |
| T-3 | | × | |
| UO-1 | | × | |
| UO-2 | | × | |
| UO-3 | | × | |

# Appendix D

# APPENDIX D
# REFERENCES

## FINAL PRELIMINARY ASSESSMENT
## FORMER WALKER AIR FORCE BASE
## ATLAS “F” MISSILE SILO 8
## CHAVES COUNTY, NEW MEXICO
## PROPERTY NO. K06NM0486

**REFERENCE 1**

DEPARTMENT OF THE ARMY
SOUTHWESTERN DIVISION, CORPS OF ENGINEERS
1114 COMMERCE STREET
DALLAS, TEXAS 75242-0216

REPLY TO
ATTENTION OF

CESWD-ED-G

31 December 1990

MEMORANDUM FOR

HQUSACE, ATTN: CEMP-R
COMMANDER, HUNTSVILLE DIVISION
COMMANDER, MISSOURI RIVER DIVISION

SUBJECT: Defense Environmental Restoration Program - Formerly Used Defense Sites (DERP-FUDS), Inventory Project Reports (INPR's)

1. I am forwarding the INPR's for the following sites for appropriate action. The sites are all eligible for DERP-FUDS.

a. Walker Air Force Base (WAFB) Facility Site #1 (Atlas Missile Site), Site No. K06NM047900 (encl 1).

b. WAFB Facility Site #2 (Atlas Missile Site), Site No. K06NM048000 (encl 2).

c. WAFB Facility Site #5 (Atlas Missile Site), Site No. K06NM048300 (encl 3).

d. WAFB Facility Site #6 (Atlas Missile Site), Site No. K06NM048400 (encl 4).

e. WAFB Facility Site #8 (Atlas Missile Site), Site No. K06NM048600 (encl 5).

f. WAFB Facility Site #11 (Atlas Missile Site), Site No. K06NM048900 (encl 6).

g. WAFB Facility Site #12 (Atlas Missile Site), Site No. K06NM049000 (encl 7).

2. I recommend that a hazardous and toxic waste (HTW) Site Investigation (SI) be approved for each of the sites.

3. The sites are recommended for a SI rather than a Remedial Investigation/Feasibility Study (RI/FS) because results from SI's at other similar Atlas Missile Sites have revealed the presence of HTW contamination at approximately 10% of the sites. Therefore, since contamination is unlikely but possible, a SI is the appropriate level of investigation. A RI/FS would follow any SI that determines there is significant contamination at a site.

CESWD-ED-G
SUBJECT: Defense Environmental Restoration Program - Formerly Used Defense Sites (DERP-FUDS), Inventory Project Reports (INPR's)

4. Preparation of the scope of work for a contract award could begin in the 1st quarter of FY92. In-house funds of $10,000 and an estimated contract amount of $65,000 would be required to perform each SI.

7 Encls

Stanley G. Genega
STANLEY G. GENEGA
Brigadier General, USA
Commanding

CF:
✓CESWA-ED-G (Gregory w/original FDE's)

DEPARTMENT OF THE ARMY
TULSA DISTRICT, CORPS OF ENGINEERS
POST OFFICE BOX 61
TULSA, OKLAHOMA 74121-0061

REPLY TO
ATTENTION OF:

CESWT-EC-GR (415-10c) 4 December 1990

MEMORANDUM FOR Commander, Southwestern Division, ATTN: CESWD-ED-E (Mr. Barber)

SUBJECT: Defense Environmental Restoration Program - Formerly Used Defense Sites (DERP-FUDS), Inventory Project Reports (INPR's)

1. Reference memorandum, CESWA-ED-M, 15 August 1990 (encl 1).

2. The INPR's for the Preliminary Assessment (PA) of the following sites have been reviewed by Tulsa District and are submitted for General Genega's signature. Four copies of each INPR are enclosed:

a. Walker Air Force Base (WAFB) Facility Site #1 (Atlas Missile Site), Site No. K06NM047900 (encl 2).

b. WAFB Facility Site #2 (Atlas Missile Site), Site No. K06NM048000 (encl 3).

c. WAFB Facility Site #5 (Atlas Missile Site), Site No. K06NM048300 (encl 4).

d. WAFB Facility Site #6 (Atlas Missile Site), Site No. K06NM048400 (encl 5).

e. WAFB Facility Site #8 (Atlas Missile Site), Site No. K06NM048600 (encl 6).

f. WAFB Facility Site #11 (Atlas Missile Site), Site No. K06NM048900 (encl 7).

g. WAFB Facility Site #12 (Atlas Missile Site), Site No. K06NM049000 (encl 8).

3. The sites are all eligible for DERP-FUDS. The recommended Findings and Determination of Eligibility (FDE) for each site is enclosed.

4. There are potential hazardous and toxic waste (HTW) projects at each site. There are also eligible building demolition/debris removal (BD/DR) projects at Sites 2, 5, 6, 11, and 12. The BD/DR projects are not proposed because the sites are privately owned, and current policy does not permit BD/DR projects to be proposed at privately owned sites. Project summary sheets for each project are enclosed.

5. A HTW Site Investigation (SI) is recommended for each site. The SI's can begin in the 1st quarter of FY92. In-house funds of $10,000 and an estimated contract amount of $65,000 would be required to perform each SI.

6. A SI is the appropriate level of investigation for the potential HTW sites since contamination is unlikely but possible. Investigations at other similar Atlas Missile Sites within SWD have revealed HTW contamination at approximately 10% of the sites. A RI/FS would follow any SI that determines there is significant contamination present.

7. Please have General Genega sign the enclosed FDE's and forward the INPR's to HQUSACE for approval and determination of the need for further study at each site. A memorandum to forward the INPR's to HQUSACE is enclosed (encl 9). Also forward a copy of each INPR to Missouri River Division and Huntsville Division.

8. If you need additional information, please contact Mr. Randall L. Bratcher, CESWT-EC-GR, at 918-581-6116 or FTS 745-6116.

FOR THE COMMANDER:

9 Encls

for FRANK W. PARKER, P.E.
Chief, Engineering and
Construction Division

DEPARTMENT OF THE ARMY
ALBUQUERQUE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 1580
ALBUQUERQUE, NEW MEXICO 87103-1580
FAX (505) 766-2770

REPLY TO ATTENTION OF:

CESWA-ED-M (415-10f)

15 AUG 1990

MEMORANDUM FOR Commander, Southwestern Division

SUBJECT: Defense Environmental Restoration Program - Formerly Used Defense Sites Inventory Project Reports

1. Enclosed are the INPR's for the preliminary assessment of the following DERP-FUDS sites:

Site No. K06NM047900 WAFB Facility Site #1 (Atlas Missile Site)
Site No. K06NM048000 WAFB Facility Site #2 (Atlas Missile Site)
Site No. K06NM048300 WAFB Facility Site #5 (Atlas Missile Site)
Site No. K06NM048400 WAFB Facility Site #6 (Atlas Missile Site)
Site No. K06NM048600 WAFB Facility Site #8 (Atlas Missile Site)
Site No. K06NM048900 WAFB Facility Site #11 (Atlas Missile Site)
Site No. K06NM049000 WAFB Facility Site #12 (Atlas Missile Site)

2. We determined that these sites were formerly used by DOD. The recommended Findings and Determination of Eligibility for each site is enclosed.

3. We also determined that there are potential HTW projects involving, initially, site investigations at each site. Eligible BD/DR projects also exist at Sites 2, 5, 6, 11 and 12, however, these projects could not be proposed due to policy considerations. Project Summary Sheets for each project, with appropriate attachments, are enclosed.

4. Recommendations:

a. Approve and sign the Findings and Determination of Eligibility for each site;

b. Forward a copy of each INPR to MRD for a determination of the need for further study at each site;

c. Forward a copy of each INPR to HND for the PA file.

5. Should you have questions or need additional information, please call Dave Gregory, DERP-FUDS Coordinator, at FTS 474-1773.

Encl

Steven M Dougan
STEVEN M. DOUGAN
LTC, EN
Commanding

DERA, WALKER AFB, ATLAS MISSILE SITE # 8, Project No. K06NM05300

PROPERTY FORMERLY USED BY DOD

DOD AGENCY: Department of Air Force

DOD POINT OF CONTACT (POC):

SITE NAME WHEN USED BY DOD: Walker AFB, AF Facility S-8, NM

FORMER USE BY DOD: Construction and operation of ATLAS missile site

LOCATION (CITY/COUNTY/STATE): Chaves County, New Mexico

LATITUDE/LONGITUDE: T. 15 S., R. 26 E., Sec 21

PROPERTY FORMERLY USED BY DOD CURRENTLY CONTROLLED BY:

CURRENT SITE NAME:

ALIAS SITE NAME:

CATEGORY OF HAZARD: None known
(Debris, Unexploded Ordnance, Toxic/Hazardous Waste, Other)

DESCRIPTION OF PROBLEM: None known

CURRENT OWNER POC (NAME/ADDRESS/PHONE):

assumed Lake Arthur Water Cooperative Corporation

OTHER RELEVANT INFORMATION: This project was under the control of DOD from 1960 through 1966
(Photographs, Maps, Drawings, Property Use by Current Owners, Evidence of Discharge, etc.)

It consisted of 249.58 acres:

14.62 acres fee, acquired by condemnation, CA#4527, D/T filed 1 Aug 1960 from L. O. Fullen, Roswell, NM (2.27 ac); Carroll Jackson, Jr, Lake Arthur, NM (~~1.35~~ 12.35 acres). The land was conveyed to Lake Arthur Water Cooperative Corporation by Deed Without Warranty dated 26 Sep 1966.

234.91 acres easement acquired from various owners by the mentioned condemnation and by purchase. 2.01 acres easement were conveyed by the Department of HEW to the Lake Arthur Water Cooperative Cooperation by Deed Without Warranty dated 22 Sep 1966 and 232.95 acres expired 29 Jun 1966 by the terms of the acquisition upon non-use for more than a period of one year.

DERA, WALKER AFB, ATLAS MISSILE SITE # 8, Project No. K06NM0530

The Deed Without Warranty to the Lake Arthur Water Cooperative Cooperation contains a "hold harmless" clause.

Cost to the Government: $2,546,085.00

Property sold for $4,350.00

DEFENSE ENVIRONMENTAL RESTORATION PROGRAM
FORMERLY USED DEFENSE SITES
FINDINGS AND DETERMINATION OF ELIGIBILITY

Lake Arthur Water Cooperative Corp. Water Well Site

Site No. K06NM048600

FINDINGS OF FACT

1. This site consists of 249.58 acres of land in southern Chaves County, NM acquired by the Department of Defense in 1960. Of the total, 14.62 acres were acquired in fee by condemnation and 234.96 acres in easement.

2. The site was developed and operated by the U.S. Air Force as an Atlas "F" Missile launching facility and designated Atlas Missile Site #8, Walker AFB, NM. Structures built on the site by DOD included an underground missile silo and launch control center, two quonset huts, water wells, a water treatment building and other support facilities such as water and fuel storage tanks and a septic system. The area was never under other than DOD control during the period of DOD use.

3. The site and improvements were reported as excess to the General Services Administration on 30 June, 1965. The 14.62 acres fee, 2.01 acres in easement and all improvements were conveyed to the Lake Arthur Water Cooperative Corporation, through the Department of Health, Education and Welfare, by Deed Without Warranty dated 26 September, 1966. The remaining easements expired on 29 June, 1966 due to non-use for a period exceeding one year, as stipulated in the acquisition documents.

The deed conveying ownership of the fee land to the Lake Arthur Water Cooperative contains a hold harmless clause which releases the United States from liability for claims of personal injury or property damage resulting from the government occupancy and use of the land. The deed further indicates that the underground facilities were stripped of all usable equipment and material and that the closure gates were closed and sealed. The deed stipulates that the site be used for public health purposes by the Lake Arthur Water Cooperative. There is no specific mention of restoration responsibilities in the deed. The current owner of the fee property is the Lake Arthur Water Cooperative Corporation.

## DETERMINATION

Based on the foregoing findings of fact, the site has been determined to be formerly used by DOD. It is therefore eligible for the Defense Environmental Restoration Program - Formerly Used Defense Sites established under 10 USC 2701 et seq.

31 Dec 90
Date

STANLEY G. GENEGA
Brigadier General, USA
Commanding

PROJECT SUMMARY SHEET
FOR
DERP-FUDS HTW PROJECT NO. K06NM048601
LAKE ARTHUR WATER COOPERATIVE CORPORATION WATER WELL SITE
SITE NO. K06NM048600
April 27, 1990

PROJECT DESCRIPTION. Several sources of potential HTW contamination exist at this site. A brief description of each follows:

a. A 26,700 gallon underground diesel fuel storage tank was installed at this site. Mr. Nelson knows that the tank was removed when DOD left the site and a slight depression remains at the former tank location. Plant growth in the depression and the surrounding area does not appear to be inhibited, however, the use of this tank to store fuel for an extended period does pose as a potential source of contamination. This tank was in place for approximately 5 years.

b. The water supply system installed at this site included 3 water wells, a water treatment system and several evaporation ponds. Treatment methods required and used by DOD at the site are not known, however, it is believed that wastewater generated by backflushing the system was discharged into the evaporation ponds. None of the DOD installed treatment equipment remains and the evaporation ponds are currently dry. Plant growth in the evaporation ponds does not appear to be much different from that in the surrounding area.

Two of the wells on the site remain in use by the current owner for municipal water supply. Mr. Nelson stated that, since these wells are used for municipal water supply, the water is subject to both State and Federal water quality criteria and is therefore frequently tested. He further stated that water samples from these wells have never shown contaminant levels in excess of acceptable limits. These wells are approximately 1130 feet deep.

c. The main silo at this site is known to contain water. Equipment originally installed, and possibly remaining, in the silo is considered a potential source for contamination of the silo water. All access to this silo is now closed so the amount of water contained could not be determined. Mr. Nelson said that he was down in the launch control center before it was sealed and indicated that it was thoroughly stripped of all salvageable material. This would seem to indicate that the silo was also stripped.

d. A septic system and leach field installed by DOD at this site is another potential source of contamination. The septic tanks were recently collapsed and filled in by the current owner. The leach field and surrounding area is heavily vegetated.

PROJECT ELIGIBILITY. The facilities mentioned above were installed and utilized by DOD. Due to the current use of the site as a municipal water source, any contamination present in the area could have a considerable impact.

POLICY CONSIDERATIONS. With the exception of the water wells, none of the facilities at this site have been used since DOD ownership ended.

PROPOSED ACTIVITY. A site investigation to determine the existence and extent of possible HTW contamination in the above mentioned areas is proposed. Further investigation might also reveal other potentially contaminated areas not initially considered.

EPA FORM 2070-12: Attached

DISTRICT POC: David Gregory, DERP-FUDS coordinator, Albuquerque District, 505-766-1773 (FTS 474-1773).

POTENTIAL HAZARDOUS WASTE SITE
PRELIMINARY ASSESSMENT
(EPA Form 2070-12)

I. IDENTIFICATION: DERP-FUDS HTW Project No. K06NM048601 (DERP-FUDS Site No. K06NM048600, Lake Arthur Water Cooperative Corp. Water Well Site)

II. HAZARDOUS CONDITIONS AND INCIDENTS:

01. A. GROUNDWATER CONTAMINATION
02. Potential
03. Population Potentially Affected: less than 10
04. Description: Potential for groundwater contamination from silo water, former UST, septic tanks and evaporation ponds exists.

01. B. SURFACE WATER CONTAMINATION
02. Potential
03. Population Potentially Affected: less than 10
04. Description: Potential for contamination of surface runoff fron the evaporation ponds exists.

01. C. CONTAMINATION OF AIR-Not Noted

01. D. FIRE/EXPLOSIVE CONDITIONS-Not Noted

01. E. DIRECT CONTACT-Not Noted

01. F. CONTAMINATION OF SOIL
02. Potential
03. Area Potentially Affected: less than 5 acres
04. Description: Potential soil contamination from the former UST, evaporation ponds and leach field exists.

01. G. DRINKING WATER CONTAMINATION
02. Potential
03. Population Potentially Affected: Approximately 500
04. Description: Former DOD wells at this site are currently used as the source of municipal water for Lake Arthur, NM and surrounding area. Potential for contamination of these wells and aquifer from silo water, former UST, septic tanks and evaporation ponds exists.

01. H. WORKER EXPOSURE/INJURY-Not Noted

01. I. POPULATION EXPOSURE/INJURY-Not Noted

01. J. DAMAGE TO FLORA-Not Noted

01. K. DAMAGE TO FAUNA-Not Noted

01. L. CONTAMINATION OF FOOD CHAIN-Not Noted

01. M. UNSTABLE CONTAINMENT OF WASTES-Not Noted
(EPA Form 2070-12 cont.)

01. N. DAMAGE TO OFFSITE PROPERTY-Not Noted

01. O. CONTAMINATION OF SEWERS, STORM DRAINS, WWTPs-Not Noted

01. P. ILLEGAL/UNAUTHORIZED DUMPING-Not Noted

SITE SURVEY SUMMARY SHEET
FOR
DERP-FUDS SITE NO. K06NM048600
LAKE ARTHUR WATER COOPERATIVE CORPORATION WATER WELL SITE
May 22, 1990

SITE NAME: Lake Arthur Water Cooperative Corporation Water Well Site, formerly Atlas "F" Missile Site #8, Walker Air Force Base, NM.

LOCATION: The site is located approximately 1.5 miles east of the village of Lake Arthur, NM. See attached location and site maps.

SITE HISTORY: In 1960, the Department of Defense acquired numerous parcels of land in the vicinity of Roswell, NM for the purpose of establishing a complex of Atlas "F" Missile launching facilities. The complex consisted of twelve individual sites, all of which were manned by personnel from former Walker Air Force Base, NM. All of these sites were completed in the early 1960's. This particular site was referred to as Site #8 and consisted, mainly, of an underground missile silo and launch control center and support facilities such as fuel storage tanks, a water supply system including wells and treatment equipment, a septic system and above-ground administrative office buildings. This site was excessed to the General Services Administration in 1965. Ownership of the fee land and all improvements was conveyed to the Lake Arthur Water Cooperative Corporation by the Department of Health, Education and Welfare in 1966. The site is still owned by the Lake Arthur Water Cooperative and the former DOD water wells are used to provide municipal water to the village of Lake Arthur, NM.

SITE VISIT: The site was visited on April 20, 1990 by Richard Barnitz, CESWA-ED, who was accompanied by Mr. John Nelson, President of the Lake Arthur Water Cooperative Corporation.

CATEGORY OF HAZARD: Suspected HTW

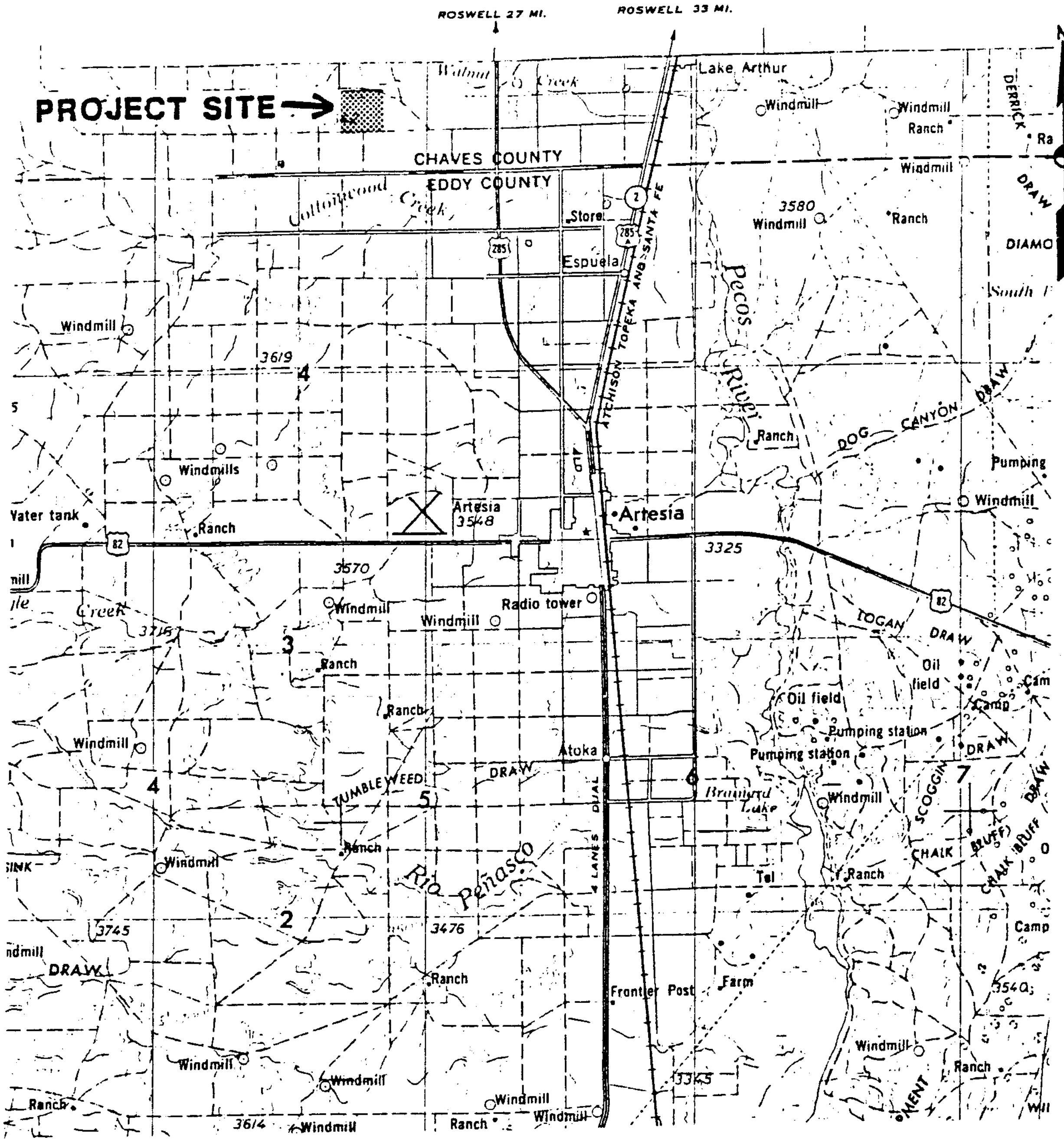
PROJECT DESCRIPTION: Several potential HTW areas were initially identified and subsequently investigated during the site visit. A brief description of each follows:

a. Facilities installed at this site included fuel storage tanks, a water supply system including wells and treatment equipment, a septic system and evaporation ponds. Possible site and/or groundwater contamination resulting from these facilities was initially suspected. In addition, the main silo is known to contain water which might also be contaminated. No obvious evidence of HTW contamination (i.e. leachate, denuded areas, etc.) was noticed during the site visit, however, further investigation would be required to make a final determination. A site investigation is a potential HTW project.

AVAILABLE STUDIES AND REPORTS: Draft Final Report of Contamination Evaluation at Former Atlas Missile Site, Albany, Texas, US Army

Corps of Engineers, Fort Worth District, July, 1989 and a reduced copy of various views of a typical site (attached).

PA POC: David Gregory, DERP-FUDS coordinator, Albuquerque District, 505-766-1773 (FTS 474-1773).

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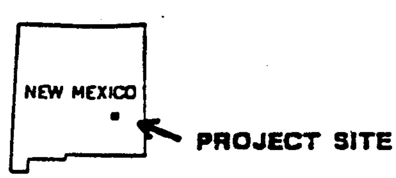


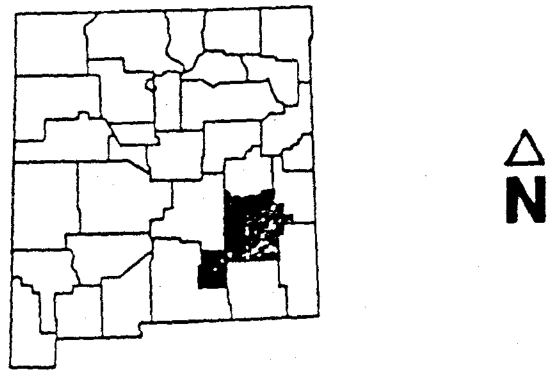

SITE LOCATION MAP

DERP-FUDS SITE NO. K06NM049600
WAFB Auxilliary Landing Field No. 4

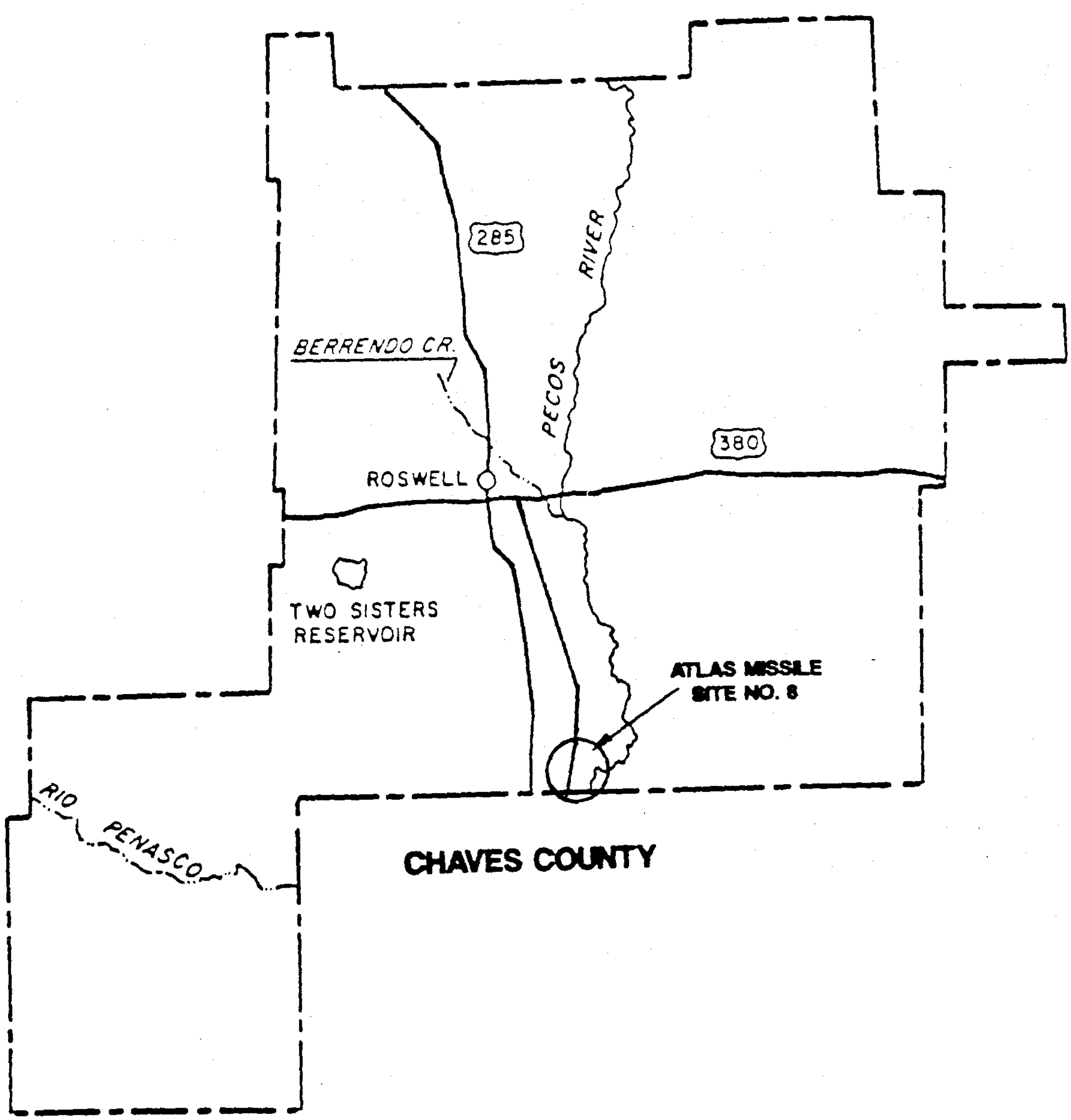
# LOCATION MAP

**[ .P-FUDS SITE NO. K06NM04860(**

**ATLAS MISSILE SITE NO. 8**




**STATE OF NEW MEXICO**



# REFERENCE 2

# ENVIRONMENTAL SITE INVESTIGATION REPORT
## *Former Atlas Missile Silo Sites 8 and 9*
## *Roswell, New Mexico*
## *FUDS Project ID Nos. K06NM048602 (Site 8) and K06NM048701 (Site 9)*

***Contract No. DACW05-96-D-0011***
***CTO-15, WAD 2***

***Document Control Number ACE15-085-S***
***Revision C***

***Draft Final—April 2005***

Prepared for:
U.S. Army Corps of Engineers
Albuquerque District
4101 Jefferson Plaza, NE
Albuquerque, New Mexico 87109

Prepared by:
Shaw Environmental, Inc.
5301 Central Avenue NE, Suite 700
Albuquerque, New Mexico 87108

## *Table of Contents*

## *Table of Contents (continued)*

## *List of Figures*



## *List of Tables*

## List of Photographs

## *List of Appendices*

## *Acronyms and Abbreviations*

| | |
|---|---|
| ADR | Automated Data Review |
| amsl | above mean sea level |
| AVM | AVM Environmental Services, Inc. |
| BaP | benzo(a)pyrene |
| bgs | below ground surface |
| CAR | corrective action request |
| CD | compact disc |
| CTO | Contract Task Order |
| DERP | Defense Environmental Restoration Program |
| DOD | U.S. Department of Defense |
| DQO | data quality objective |
| DRO | Diesel Range Organics |
| EDD | electronic data deliverable |
| EDMS | Environmental Data Management System |
| EPA | U.S. Environmental Protection Agency |
| ESI | Environmental Site Investigation |
| °F | Degrees Fahrenheit |
| FORMS | Field Operations and Records Management System |
| FUDS | Formerly Used Defense Site |
| FWV | Field Work Variance |
| GPS | Global Positioning System |
| GRO | Gasoline Range Organics |
| ID | Identification |
| IDW | investigation-derived waste |
| kg | kilogram |
| LCC | Launch Control Center |
| MDL | method detection limit |
| μg | microgram(s) |
| mg/kg | milligram(s) per kilogram |
| mg/L | milligram(s) per liter |
| MQO | measurement quality objective |
| NAD | North American Datum |
| NMED | New Mexico Environment Department |
| NMAC | New Mexico Administrative Code |
| NMWQCC | New Mexico Water Quality Control Commission |
| PAH | polynuclear aromatic hydrocarbons |
| PDF | portable document format |
| ppm | part(s) per million |
| PVC | polyvinyl chloride |
| QAPP | Quality Assurance Program Plan |
| QC | quality control |
| RPD | relative percent difference |
| SARA | Superfund Amendments and Reauthorization Act |

## *Acronyms and Abbreviations (continued)*

| | |
|---|---|
| Shaw | Shaw Environmental, Inc. |
| SPCS | State Plane Coordinate System |
| SVOC | semivolatile organic compound |
| TAL | Target Analyte List |
| TCLP | Toxicity Characteristic Leaching Procedure |
| TDS | total dissolved solids |
| TIC | tentatively identified compound |
| USACE | U.S. Army Corps of Engineers |
| UST | underground storage tank |
| VOC | volatile organic compound |
| WAD | Work Authorization Directive |

# 1.0 Introduction

## 1.1 Purpose

This report describes the activities and presents the detailed results of the Environmental Site Investigation (ESI) performed at the Former Atlas Missile Silo Sites 8 and 9, located near Roswell, New Mexico (Figure 1-1). The ESI was conducted for the U.S. Army Corps of Engineers (USACE), Albuquerque District, under Contract Number DACW05-96-D-0011, Contract Task Order 15, Work Authorization Directive (WAD) 2 to the Sacramento Total Environmental Restoration Contract II. The ESI followed specifications in the *Final Work Plan, Environmental Site Investigation, Former Atlas Missile Silo Sites 8 and 9, Roswell, New Mexico, Formerly Used Defense Site (FUDS) Project Identification (ID) Nos K06NM048602 (Site 8) and K06NM048701 (Site 9)* (Shaw, 2004) and approved field work variances. The investigation activities, performed between May 24 and October 13, 2004, included surveys of site features, collection of surface and subsurface soil samples, installation of BARCAD™ monitoring wells, collection of groundwater and standing silo water samples, and site restoration.

The investigations performed at Silo Sites 8 and 9 were accomplished in accordance with the Superfund Amendments and Reauthorization Act (SARA) of 1986, which amended the Comprehensive Environmental Response, Compensation, and Liability Act of 1980. Upon the passage of SARA, the Defense Environmental Restoration Program (DERP) was established (EPA, 2002). DERP assigns the Secretary of Defense the responsibility to carry out response actions at FUDS. The Department of Defense's executing agent for implementation of the FUDS program is the USACE. In general, regulatory oversight of FUDS activities is delegated by respective U.S. Environmental Protection Agency (EPA) regions to states within those regions. For this investigation, the New Mexico Environment Department (NMED) is responsible for regulatory oversight of activities conducted at the Atlas F Missile Silo Sites in New Mexico.

Background site descriptions and historical information for Silo Sites 8 and 9 are provided in Chapter 2.0 of this report. Chapter 3.0 presents regional characteristics. The investigation activities of soil assessment, groundwater and silo water assessment, survey, and site restoration are discussed in Chapters 4.0, 5.0, 6.0, and 7.0, respectively. Management of investigation-derived waste (IDW) is discussed in Chapter 8.0 and quality assurance and quality control (QC) procedures are presented in Chapter 9.0. Chapters 10.0 and 11.0 provide the summary and recommendations and references, respectively. Included at the end of this report are the following appendices:

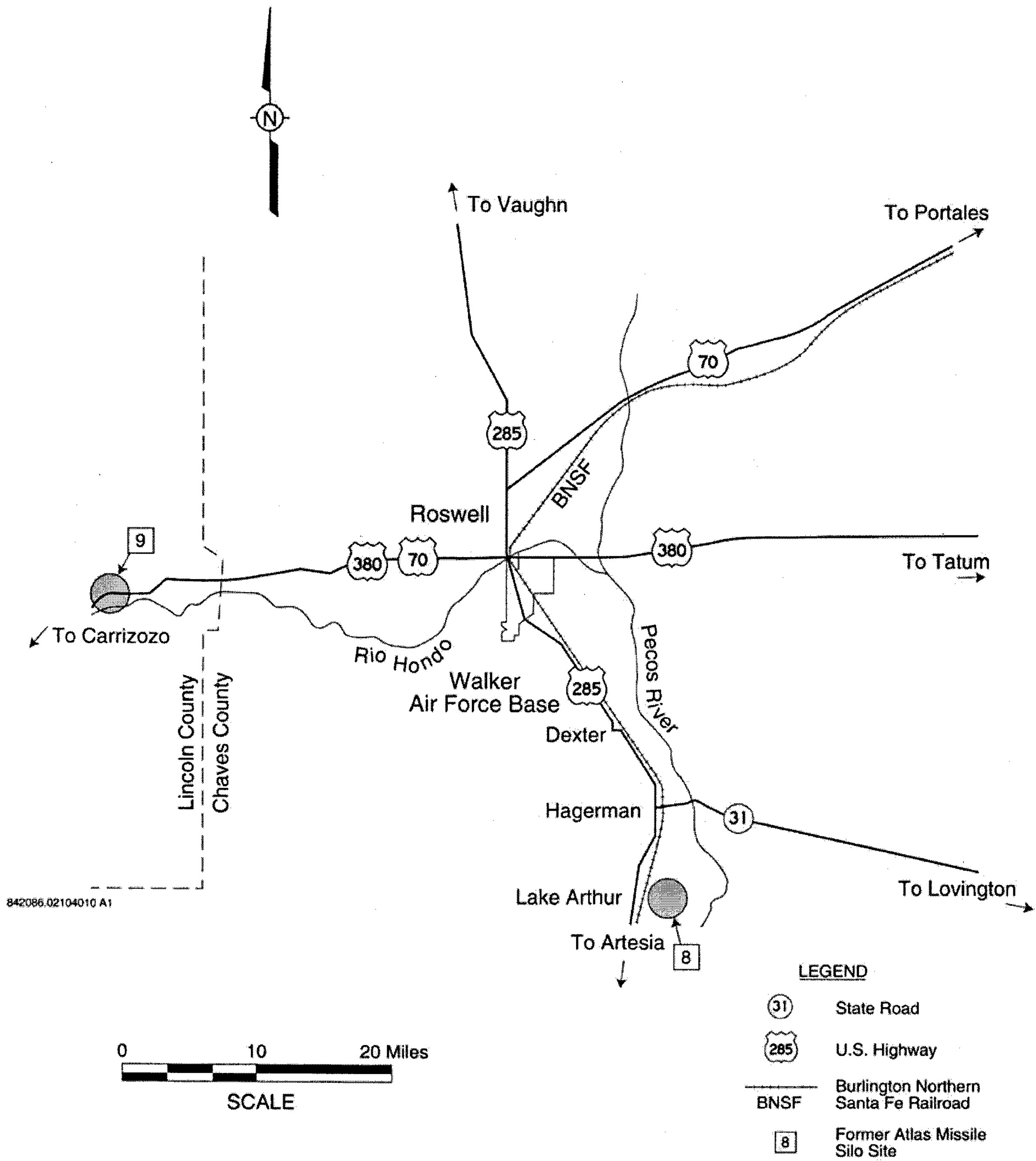



**Figure 1-1**
**Site Location Map, Former Atlas Missile Silo Sites 8 and 9**
**Roswell, New Mexico**

- Appendix A, Field Documentation
- Appendix B, Analytical Result Tables
- Appendix C, Soil Boring Logs
- Appendix D, BARCAD™ Monitoring Well Completion Diagrams
- Appendix E, Survey Data
- Appendix F, Laboratory Data Reports
- Appendix G, Automated Data Review
- Appendix H, Environmental Data Management System
- Appendix I, Field Work Variances and Corrective Action Requests
- Appendix J, Geochemical Evaluation of Soil and Groundwater Samples

## 1.2 Sampling Objectives

The following sampling objectives for the ESI at the Former Atlas Missile Silo Sites 8 and 9 are based upon the following Data Quality Objectives (DQO) developed during the technical project planning meeting held on September 30, 2003:

- Determine whether or not previous U.S. Department of Defense (DOD) activities at the Former Atlas Missile Silo Sites resulted in the presence of chemicals at concentrations that may impact human health and the environment.

- Identify potentially hazardous constituents that may have migrated from the Former Atlas Missile Silo Sites to the surrounding soil and/or groundwater, and determine whether any detectable constituents present at concentrations above evaluation criteria can be attributed to past DOD activities.

- Determine the presence of potentially hazardous constituents at three potential source areas at each silo site. Potential contaminant source areas include soil and groundwater surrounding the silo to a depth of approximately 250 feet below ground surface (bgs) (including standing water within the silo), the septic tank leachfields, and the silo sump outfall areas for silo sump discharge.

These objectives are consistent with the work plan developed for the ESI at Former Atlas Missile Silo Sites 8 and 9 (Shaw, 2004).

## 1.3 Activities

The ESI at Silo Sites 8 and 9 included the following activities:

- Conducted a survey of surface features at Silo Sites 8 and 9 using a global positioning system (GPS) to generate a site-specific layout.
- Advanced three deep boreholes at Silo Site 8 and one deep borehole at Silo Site 9.
- Collected subsurface soil samples within the deep boreholes for analysis of specific hazardous constituents.
- Completed the deep boreholes at Silo Site 8 as BARCAD™ monitoring wells.
- Collected groundwater samples for analysis of specific hazardous constituents from the installed BARCAD™ monitoring wells at Silo Site 8.
- Collected samples of standing water from the top and bottom of the water column inside the silo at Silo Site 8 for analysis of specific hazardous constituents.
- Advanced four shallow soil borings and collected subsurface soil samples from the leachfield area at both Silo Sites 8 and 9 for analysis of specific hazardous constituents.
- Collected surface and shallow subsurface soil samples from the sump outfall area at both Silo Sites 8 and 9 for analysis of specific hazardous constituents.
- Conducted a civil survey at Silo Sites 8 and 9 to accurately locate monitoring wells, soil borings, and surface soil sample points.
- Performed site restoration at Silo Sites 8 and 9.

# 2.0 Background

In the early 1960s, the DOD constructed a complex of 12 Atlas "F" Missile launching facilities within an approximate 50-mile radius of Roswell, New Mexico. Each site consisted of an underground missile silo and launch control center (LCC). The sites also included typical features such as a septic system and associated leachfield, a silo sump pump system, one or two Quonset-style buildings, underground fuel and water storage tanks, water treatment system, and a nearby evaporation pond. Aboveground water-treatment facilities included a diesel generator cooling tower, filtration shed, well pump house shed, and small water storage tanks.

The Atlas "F" Missile, an advanced version of the Atlas intercontinental ballistic missile, was stored vertically in the underground concrete and steel silo. The missiles were fueled with RP-1 (kerosene) liquid fuel when placed on alert, and fueled with liquid oxygen if a decision was made to launch. The Atlas "F" Missiles were phased out, and all the silo sites were permanently closed in 1965. By 1966, the silos and LCCs had been sealed, and all usable equipment and material had been salvaged; therefore, most of the site features mentioned above no longer exist at the silo sites.

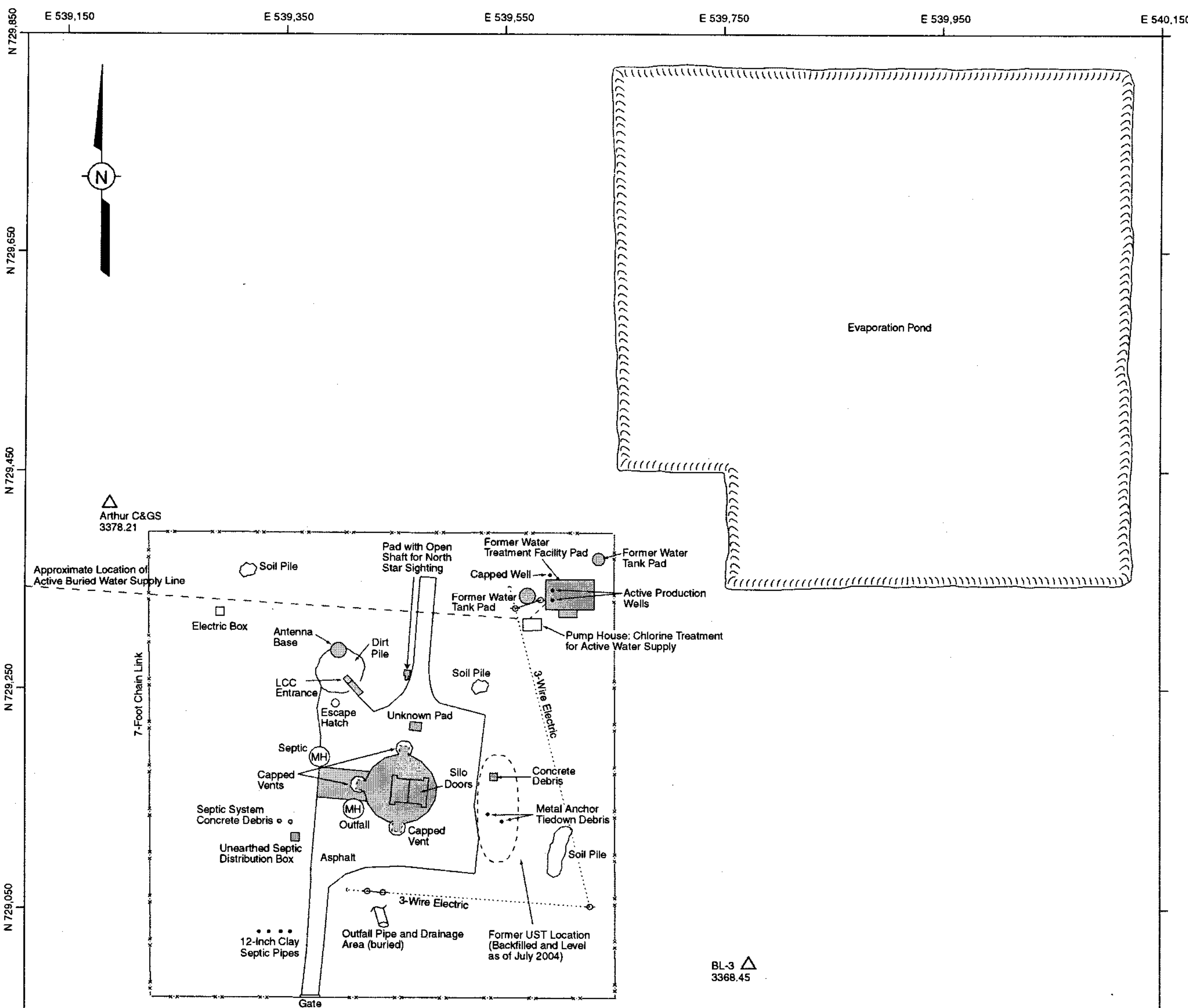
Background information specific to Silo Sites 8 and 9 are summarized in the following sections. The site descriptions provided are based upon current site features observed and surveyed in May 2004. Survey activities and methods are discussed in Chapter 6.0.

## 2.1 Site Description

### 2.1.1 Silo Site 8

Former Atlas Missile Silo Site 8, approximately 30 miles southeast of Roswell, New Mexico, is located approximately 5 miles east of U.S. Highway 285, and approximately ½-mile east of New Mexico State Highway 2, near the town of Lake Arthur, New Mexico. Elevation at the site is approximately 3,375 feet above mean sea level (amsl).

Features surveyed at Silo Site 8 are presented in Figure 2-1. The original construction and layout of the silo sites are similar at each site. Modifications by subsequent property owners, vandalism, and weathering may have uniquely altered the features at any individual site. The original 70-foot-diameter concrete silo pad at Silo Site 8 remains intact while the surrounding 170-foot-square asphalt area has been heavily weathered and overgrown with native vegetation. Concrete foundations from the former water treatment facility, including a pump house and




Basis of Coordinates: New Mexico State Planar Coordinates, East Zone, U.S. Survey Feet, North American Datum, 1983

**LEGEND**

| | |
|---|---|
| (shaded) | Shaded areas are concrete features |
| △BL-3 3368.45 | Survey benchmark with elevation (feet above mean sea level) |
| MH | Manhole cover |
| LCC | Launch Control Center |
| UST | Underground Storage Tank |

Note: Some small feature symbols not to scale

0 200 FT
SCALE

**Figure 2-1**
**Site Map**
**Former Atlas Missile Silo Site 8**
**Roswell, New Mexico**

two water tanks, are located northeast of the silo pad. Active wells supplying drinking water to the town of Lake Arthur are present on the former water treatment facility pad. A small shed located just southwest of the pad houses the chlorine treatment system for the municipal water supply. The active water line runs underground relatively parallel to the northern site fence line. The silo doors remain welded shut, and vent openings adjacent to the paved area are currently cemented shut; however, the silo currently contains water. The stairwell entrance to the LCC and underground structures, located northwest of the silo pad, has been rendered inaccessible and is currently covered by an earthen berm. At the beginning of the ESI at Silo Site 8, a depression was present to the east of the silo pad where the underground storage tank (UST) was formerly located. Remnant debris related to the tank tie-downs were partially exposed within the depression area. Broken and unearthed remnants of the septic system are visible on the site west of the silo pad. A partial perimeter of earthen berm and salt cedar vegetation delineates the former location of the evaporation pond to the northeast of the silo.

ESI activities resulted in minor changes to site features. The former UST depression has been backfilled and leveled in order to accommodate drilling equipment. Buried remnants of a clay pipe, used for silo sump discharge, were unearthed during the ESI and have since been backfilled and leveled. All disturbed areas resulting from clearing and leveling have been reseeded with native vegetation (see Chapter 7.0 for site restoration details).

### *2.1.2 Silo Site 9*

Former Atlas Missile Silo Site 9 is located approximately 30 miles west of Roswell, New Mexico, along U.S. Highway 70/380. Elevation of the site is approximately 5,130 feet amsl.

Current site features of Silo Site 9 are provided in Figure 2-2. The silo doors remain welded shut; however, the LCC door and some of the ventilation shaft grates are damaged. A ground depression, east of the silo pad, indicates the former location of a UST. Remnants of the former septic system appeared undisturbed and in their original locations. An exposed clay drainage pipe and French drain area for the silo sump discharge were discovered in an apparent original configuration during the site survey. Three-tiered evaporation ponds are delineated by earthen berms. The original concrete pad foundations for the water tanks and water treatment facility remain relatively intact. The former water treatment facility pad has a hole from an abandoned production well that is partially obstructed with debris. Two heavily weathered concrete pads indicate the former location of Quonset huts. An active well and water pump are located on the site in the small metal pump house, west of the LCC entrance. Two active water lines run through the site and are delineated by linear earthen mounds from 1 to 2 feet high.

During the ESI activities, the former UST depression was backfilled and leveled. The original condition of the sump outfall French drain was altered by trenching and backfilling. The disturbed areas have been reseeded with native vegetation.

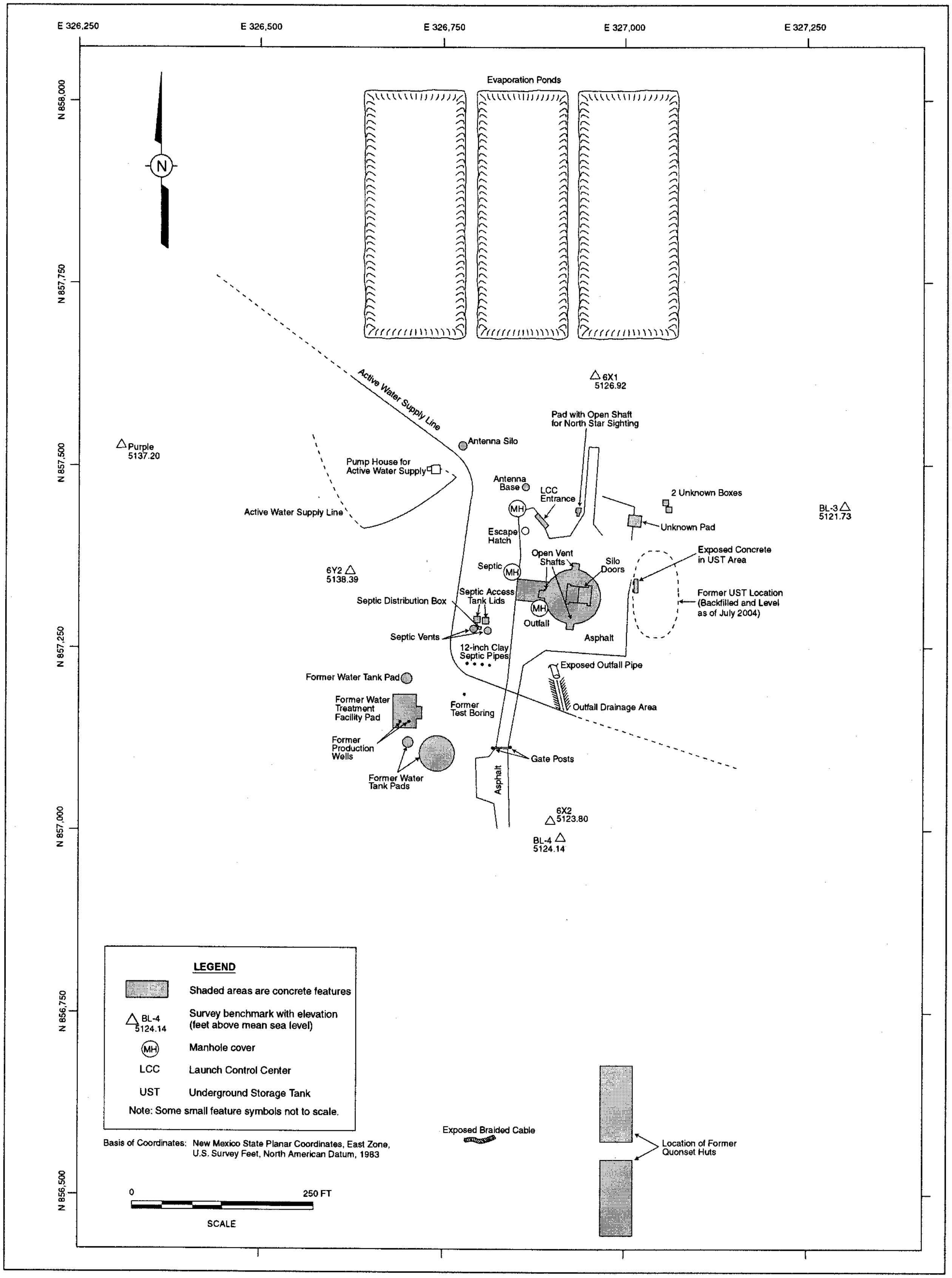



**Figure 2-2**
**Site Map**
**Former Atlas Missile Silo Site 9, Roswell, New Mexico**

## 2.2 Site History

### 2.2.1 Silo Site 8

Of the approximately 250 acres acquired by the DOD for the development of Silo Site 8, the actual missile facility occupied approximately six acres including a road easement. The current owner, the Lake Arthur Water Conservation Cooperative, obtained the property from the U.S. Government General Services Administration on September 26, 1966. According to well records obtained from the New Mexico State Engineers Office, the DOD originally installed four deep wells at Silo Site 8. All four wells were drilled to a depth of 1,110 feet bgs and were under artesian conditions. The City of Lake Arthur Water Conservation Cooperative currently uses two of these wells to supply water to the Lake Arthur community. The well records obtained from the State Engineers Office are included in Appendix A7.

### 2.2.2 Silo Site 9

The U.S. Government acquired multiple tracts of land for the development of Silo Site 9 from the State of New Mexico between May 24, 1960, and August 8, 1962. Silo Site 9 and its adjacent evaporation pond-area, each occupied approximately six acres. An aviation landing strip of unknown size was also associated with Silo Site 9 during operational years. Bonham Farms, Inc. purchased the property from the General Services Administration on March 18, 1968. Three wells have been observed at Silo Site 9. One active well located at the pump house (Figure 2-2) is currently being used as a stock well. Two inactive production wells are located within the concrete pad of the former water treatment facility. According to well records obtained from the New Mexico State Engineers Office, the three wells had total depths of 850, 750, and 650 feet bgs. The records indicate that the 850-foot well was cleaned out in 1986 and is likely the stock well located in the pump house. The depth to water in these wells ranged from 545 to 712 feet bgs at the time of completion. The well records obtained from the State Engineers Office are included in Appendix A7.

## 2.3 Previous Investigations

A soil-vapor survey conducted at some of the Former Atlas Missile Silo Sites in 1992 included Silo Site 8. The vapor from the vadose zone was analyzed for those aromatic volatile hydrocarbons and other petroleum vapors commonly associated with refined fuel products as well as halogenated volatile hydrocarbon vapor, specifically trichloroethene. No significant concentrations of soil vapors of concern were found at any of the sites, and the data produced were inconclusive as to the potential impacts of DOD activities on the environment (USACE, 1993).

Both Silo Sites 8 and 9 were included in site investigations conducted by the USACE between 1994 and 1997. The data collected during the site investigations were compiled into an ESI report (IT, 2001). However, the analytical laboratory contracted for the investigation became involved in potentially fraudulent practices, which compromised the data. The USACE considers the previous analytical results unusable; therefore, the data cannot be used to determine the potential impact of DOD activities on the environment.

# 3.0 Regional Characteristics

## 3.1 Regional Geology and Structure

Silo Sites 8 and 9 are located in the Pecos River Valley, a north-south–trending topographic feature situated along the southwestern boundary of the Great Plains physiographic province (Havenor, 1968). The geologic setting for Silo Sites 8 and 9 is the Roswell Artesian Basin, north of the western edge of the Guadalupian reef complex of the Permian Basin (Havenor, 1968). Physiographically, the Roswell Artesian Basin is bounded by the Capitan, Sacramento, and Guadalupe Mountains to the west, the Seven Rivers Hills to the south, and the scarp of the east bank of the Pecos River to the east (Kinney et al., 1968). The northern boundary of the basin is indefinite, but probably coincides with the main stem of Arroyo del Macho (Kinney et al., 1968). The northern part of the Roswell Artesian Basin exhibits an east-southeast regional dip of about 50 feet per mile (Havenor, 1968). At least three major structural zones traverse the northern part of the basin, including the Border Hill, Six Mile, and Y-O Faults (Havenor, 1968). The Six Mile Fault occurs between the Border Hill Fault, which is the westernmost, and the Y-O Fault, which is the easternmost (Havenor, 1968). The City of Roswell lies above the Roswell block, which is formed by the Six Mile and Y-O Faults (Havenor, 1968). Silo Site 8 is located in the southern part of the Roswell Artesian Basin, 1 mile west of the Pecos River, south of the Y-O Fault, and north of the Sever Rivers Hills. Silo Site 9 is located north of the Borders Hills Fault in the northwestern part of the Roswell Artesian Basin. The Queen Formation, which forms the aquitard on the Orchard Park block, is the area southeast of the Y-O Fault and is absent throughout both the Roswell block west of the Pecos River and most of the Six Mile Fault. The Queen Formation is composed of very fine-grained red sandstone and siltstone containing abundant quartz grains with red siltstone and gray anhydrite commonly interbedded with dark red sandy or silty shale. Regional stratigraphy consists of quaternary valley-fill alluvium, overlying Permian marine clastic, carbonate, and evaporite rocks that dip gently to the east-southeast. The uppermost Permian rock unit is the San Andres Formation, which varies in thickness from 1,200 to 1,400 feet (Havenor, 1968). On the Roswell block, the San Andres Formation is deeply eroded (Havenor, 1968) and ranges in thickness from 550 to 600 feet. The lithology of the San Andres Formation varies within the basin, but is generally limestone with varying amounts of calcite, dolomite, anhydrite, halite, shale, and varying degrees of porosity and permeability (Kinney et al., 1968). The San Andres Formation is underlain by the Glorieta Sandstone, which varies in thickness from 0 to 750 feet (Havenor, 1968). The Glorieta Sandstone is a fine-grained to very fine-grained, moderately well-cemented, well-sorted, clean quartz sandstone that is generally gray to white or buff to yellow in color (Havenor, 1968). It yields less water than the San Andres Formation, but is the principal aquifer in the extreme western part of the Roswell Artesian Basin (Kinney et al., 1968). Presumably, the water supply wells drilled at the Former Atlas Missile Silo Sites are completed in the San Andres formation (USACE, 1993).

## 3.2 Regional Hydrogeology

Several aquifers exist within the Roswell Artesian Basin; they generally coincide with the structural regions previously described. Two distinct but closely related water systems within the upper carbonate-evaporite member of the San Andres Formation lie within the Roswell Artesian Basin. The first is a shallow aquifer, composed in part from alluvial fill, and the second is an artesian aquifer. Quaternary unconsolidated gravel, sand, silt, and clay form alluvium that lies unconformably above the Permian Rocks in the Roswell Artesian Basin. The quaternary alluvium sequence is thinner on the north side of the Y-O Fault. An artesian aquifer occurs beneath an aquitard, formed by the Queen Formation, in faulted eastward-dipping rocks at the northwestern edge of a large depositional basin of Permian age. In general, groundwater flows in a southeasterly direction across the basin. The Glorieta Sandstone is considered one of the primary transport (recharge) units for the artesian aquifer (Havenor, 1968).

## 3.3 Meteorology

The region has a generally temperate climate. During the summer, from June through September, rather frequent showers and thunderstorms deliver more than half of the annual precipitation. The relative humidity ranges from 70 percent in early morning to 30 percent in the mid-afternoon. Temperatures can be quite warm with readings of 100 degrees Fahrenheit (°F) or higher on an average of 10 days per year. In July, temperatures range from 63 to 96°F. Conditions in the fall consist of decreased rainfall, slight winds, and mostly clear skies. Cool nights turn into warm days and the relative humidity is low. In October, temperatures range from 41 to 75°F. Winter is marked by cold nights and temperate days. Zero or lower temperatures occur only one day during an average winter. Winter is the season of least precipitation. In January, temperatures range from 21 to 57°F. The spring is the driest season of the year with respect to relative humidity. Winds increase in the spring, particularly from the plateau areas of the west. On average, wind speed averages 25 miles per hour or more 60 days per year; the majority of these days occur from February to May. In April, temperatures range from 40 to 79°F (NWS, 1998).

## 3.4 Demographics and Land Use

Roswell is the largest city in the vicinity of Silo Sites 8 and 9. According to the 2000 U.S. Census (Census, 2000), 45,293 people reside in the City of Roswell, comprising approximately 2.5 percent of New Mexico's population. Chaves County has 61,382 residents according to the 2000 U.S. Census. The City of Roswell, which is the county seat of Chaves County, accounts for 74 percent of the county's population. Some of the top employers in the area include the Roswell Independent School District, Eastern New Mexico Medical Center, and the City of Roswell. Land use adjacent to the City of Roswell consists of dairy farming, cattle ranching, and agricultural production (Census, 2000).

Silo Site 9 is situated just west of the Chaves County line, within Lincoln County. Approximately 19,411 people reside in Lincoln County according to the 2000 U.S. Census. Land use within this county consists primarily of cattle ranching and agricultural production (Census, 2000).

# 4.0 Soil Assessment

The soil assessment activities at Silo Sites 8 and 9 were designed to investigate potential releases of hazardous constituents from the following potential source areas:

- Septic System and Associated Leachfield; herein after referred to as Septic Leachfield
- Sump Outfall
- Former UST Area

Soil assessment activities also included:

- Deep Soil Boring
- Background Soil Sampling

The soil assessment activities implemented to characterize each potential source area at Silo Sites 8 and 9 are presented in Sections 4.1 and 4.2, respectively; analytical parameters are presented in Section 4.3; soil sample procedures are summarized in Section 4.4; soil sample results are documented in Section 4.5; and subsurface geology is described in Section 4.6. A summary of soil samples collected during the ESI at Silo Sites 8 and 9 is presented in Table 4-1.

## 4.1 Source Area Characterization Activities Silo Site 8

### 4.1.1 Septic Leachfield

Four shallow leachfield soil borings (AHL8-1, AHL8-2, AHL8-3, and AHL8-4) were advanced to approximately 9 to 14 feet bgs using hollow-stem auger drilling methods. Soil samples were collected from the bottom of each soil boring (Photo 1). Soil boring locations were chosen along a line parallel to the four clay vent pipes, as shown in Figure 4-1, and placed such that the soil boring locations lie within the leachfield. This configuration was chosen to provide a representative sampling scheme across the slope of the leachfield. Soil samples were collected with a 2-inch, stainless-steel split-spoon sampler driven ahead of the 3.25-inch-diameter augers (Photos 2 and 3) (Table 4-1). In order to characterize potentially hazardous constituents that may have migrated into the subsurface, each sample was collected from the native material directly beneath the leachfield. The soil samples were then collected from the brown native silt beneath the chalky-white silt that comprises the leachfield. No organic vapors were detected with field-screening methods, and no discolored soil was observed in the drill cuttings.

### 4.1.2 Sump Outfall

The termination of the clay outfall pipe for the Silo Site 8 sump system was located approximately 80 feet south of the silo. A backhoe was used to unearth the sump outfall pipe,

**Table 4-1**
**Soil Sample Summary**
**Environmental Site Investigation: Former Atlas Missile Silo Sites 8 and 9**
**Roswell, New Mexico**

| Location ID | Sample Number | Sample Date | Sample Type | Sample Depth (ft bgs) | Analytical Methods[a] |
|---|---|---|---|---|---|
| | | | **Silo Site 8** | | |
| | | | **Deep Borehole Samples** | | |
| BH8-1 | BH8-1-1 | 6/18/2004 | Environmental Soil | 45 | VOC (EPA 8260B)<br>SVOC (EPA 8270C)<br>PAH (EPA 8270C-Modified for Low Level PAH)[c]<br>TAL Metals (EPA 6010B/6020/7470A/7471A) |
| | DBD8-1-1 | 6/18/2004 | Duplicate Soil of BH8-1-1 | 45 | |
| BH8-2 | BH8-2-1 | 6/21/2004 | Environmental Soil | 45 | |
| | DBT8-2-2 | 6/21/2004 | USACE Split of BH8-2-1 Soil[b] | 45 | |
| | EBD8-1 | 6/21/2004 | Equipment Rinsate after BH8-2-1 | N/A | |
| BH8-3 | BH8-3-2 | 6/22/2004 | Environmental Soil | 45 | |
| | BH8-3-2 | 6/22/2004 | MS/MSD Soil | 45 | |
| | | | **Septic Leachfield Samples** | | |
| AHL8 | AHL8-1 | 6/28/2004 | Environmental Soil | 9.5–12 | VOC (EPA 8260B)<br>SVOC (EPA 8270C)<br>PAH (EPA 8270C-Modified for Low Level PAH)[c]<br>TAL Metals (EPA 6010B/6020/7470A/7471A) |
| | AHL8-2 | 6/28/2004 | Environmental Soil | 10.5–13 | |
| | AHL8-2 | 6/28/2004 | MS/MSD Soil | 10.5–13 | |
| | AHL8-3 | 6/28/2004 | Environmental Soil | 11–14 | |
| | AHD8-1-1 | 6/28/2004 | Duplicate Soil of AHL8-3 | 11–14 | |
| | AHT8-1-2 | 6/28/2004 | USACE Split of AHL8-3 Soil[b] | 11–14 | |
| | EBL8-2 | 6/28/2004 | Equipment Rinsate after AHL8-3 | N/A | |
| | AHL8-4 | 6/28/2004 | Environmental Soil | 9–12 | |

**Table 4-1 (Continued)**
**Soil Sample Summary**
**Environmental Site Investigation: Former Atlas Missile Silo Sites 8 and 9**
**Roswell, New Mexico**

| Location ID | Sample Number | Sample Date | Sample Type | Sample Depth (ft bgs) | Analytical Methods[a] |
|---|---|---|---|---|---|
| | | | **Sump Outfall Samples** | | |
| OFT8 | OFT8-1 | 5/25/2004 | Environmental Soil | 1.0 | VOC (EPA 8260B)<br>SVOC (EPA 8270C)<br>PAH (EPA 8270C-Modified for Low Level PAH)[c]<br>TAL Metals (EPA 6010B/6020/7470A/7471A) |
| | OFT8-2 | 5/25/2004 | Environmental Soil | 1.0 | |
| | OFD8-1-1 | 5/25/2004 | Duplicate Soil of OFT8-2 | 1.0 | |
| | OFT8-1-2 | 5/25/2004 | USACE Split of OFT8-2 Soil[b] | 1.0 | |
| | OFT8-3 | 5/25/2004 | Environmental Soil | 1.0 | |
| | OFT8-5 | 5/25/2004 | Environmental Soil | 4.0 | |
| | OFT8-6 | 5/25/2004 | Environmental Soil | 4.0 | |
| | OFT8-6 | 5/25/2004 | MS/MSD Soil | 4.0 | |
| | OFT8-7 | 5/25/2004 | Environmental Soil | 4.0 | |
| | OFT8-8 | 5/25/2004 | Environmental Soil | 4.0 | |
| | | | **Background Samples** | | |
| S8-BK1 | S8-SS-BK-1 | 7/26/2004 | Environmental Soil | 0–0.25 | TAL Metals (EPA 6010B/6020/7471A ) |
| S8-BK2 | S8-SS-BK-2 | 7/26/2004 | Environmental Soil | 0–0.25 | |
| | S8-SS-BK-2 | 7/26/2004 | MS/MSD Soil | 0–0.25 | |
| | BKD8-2 | 7/26/2004 | Duplicate Soil of S8-SS-BK2 | 0–0.25 | |
| | BKT8-2 | 7/26/2004 | USACE Split of S8-SS-BK2 Soil[b] | 0–0.25 | |
| S8-BK3 | S8-SS-BK-3 | 7/26/2004 | Environmental Soil | 0–0.25 | |

**Table 4-1 (Continued)**
**Soil Sample Summary**
**Environmental Site Investigation: Former Atlas Missile Silo Sites 8 and 9**
**Roswell, New Mexico**

| Location ID | Sample Number | Sample Date | Sample Type | Sample Depth (ft bgs) | Analytical Methods[a] |
|---|---|---|---|---|---|
| | | | **Silo Site 9** | | |
| | | | **Deep Borehole Samples** | | |
| BH9-1 | BH9-1-1 | 7/2/2004 | Environmental Soil | 245-250 | VOC (EPA 8260B)<br>SVOC (EPA 8270C)<br>PAH (EPA 8270C-Modified for Low Level PAH)[c]<br>TAL Metals (EPA 6010B/6020/7470A/7471A) |
| | DBD9-1-1 | 7/2/2004 | Duplicate Soil of BH9-1-1 | 245-250 | |
| | DBT9-1-2 | 7/2/2004 | USACE Split of BH9-1-1 Soil[b] | 245-250 | |
| | | | **Septic Leachfield Samples** | | |
| AHL9 | AHL9-1 | 6/28/2004 | Environmental Soil | 4–6 | VOC (EPA 8260B)<br>SVOC (EPA 8270C)<br>PAH (EPA 8270C-Modified for Low Level PAH)[c]<br>TAL Metals (EPA 6010B/6020/7470A/7471A) |
| | AHD9-1-1 | 6/28/2004 | Duplicate Soil of AHL9-1 | 4–6 | |
| | AHT9-1-2 | 6/28/2004 | USACE Split of AHL9-1 Soil[b] | 4–6 | |
| | AHL9-2 | 6/28/2004 | Environmental Soil | 4–7 | |
| | AHL9-2 | 6/28/2004 | MS/MSD Soil | 4–7 | |
| | AHL9-3 | 6/28/2004 | Environmental Soil | 4–6 | |
| | EBL9-2 | 6/28/2004 | Equipment Rinsate after AHL9-3 | | |
| | AHL9-4 | 6/28/2004 | Environmental Soil | 4–6 | |

**Table 4-1 (Continued)**
**Soil Sample Summary**
**Environmental Site Investigation: Former Atlas Missile Silo Sites 8 and 9**
**Roswell, New Mexico**

| Location ID | Sample Number | Sample Date | Sample Type | Sample Depth (ft bgs) | Analytical Methods[a] |
|---|---|---|---|---|---|
| **Sump Outfall Samples** | | | | | |
| OFT9 | OFT9-1 | 5/26/2004 | Environmental Soil | 0–0.5 | VOC (EPA 8260B)<br>SVOC (EPA 8270C)<br>PAH (EPA 8270C-Modified for Low Level PAH)[c]<br>TAL Metals (EPA 6010B/6020/7470A/7471A) |
| | OFT9-2 | 5/26/2004 | Environmental Soil | 0–0.5 | |
| | OFD9-1-1 | 5/26/2004 | Duplicate Soil of OFT9-2 | 0–0.5 | |
| | OFT9-1-2 | 5/26/2004 | USACE Split of OFT9-2 Soil[b] | 0–0.5 | |
| | OFT9-3 | 5/26/2004 | Environmental Soil | 0–0.5 | |
| | OFT9-4 | 5/26/2004 | Environmental Soil | 0–0.5 | |
| | OFT9-5 | 5/26/2004 | Environmental Soil | 3.5 | |
| | OFT9-6 | 5/26/2004 | Environmental Soil | 3 | |
| | OFT9-6 | 5/26/2004 | MS/MSD Soil | 3 | |
| | OFT9-7 | 5/26/2004 | Environmental Soil | 2.5 | |
| | OFT9-8 | 5/26/2004 | Environmental Soil | 2 | |
| **Background Samples** | | | | | |
| S9-BK1 | S9-SS-BK-1 | 7/26/2004 | Environmental Soil | 0–0.25 | TAL Metals (EPA 6010B/6020/7471A ) |
| S9-BK2 | S9-SS-BK-2 | 7/26/2004 | Environmental Soil | 0–0.25 | |
| S9-BK3 | S9-SS-BK-3 | 7/26/2004 | Environmental Soil | 0–0.25 | |

**Table 4-1 (Continued)**
**Soil Sample Summary**
**Environmental Site Investigation: Former Atlas Missile Silo Sites 8 and 9**
**Roswell, New Mexico**

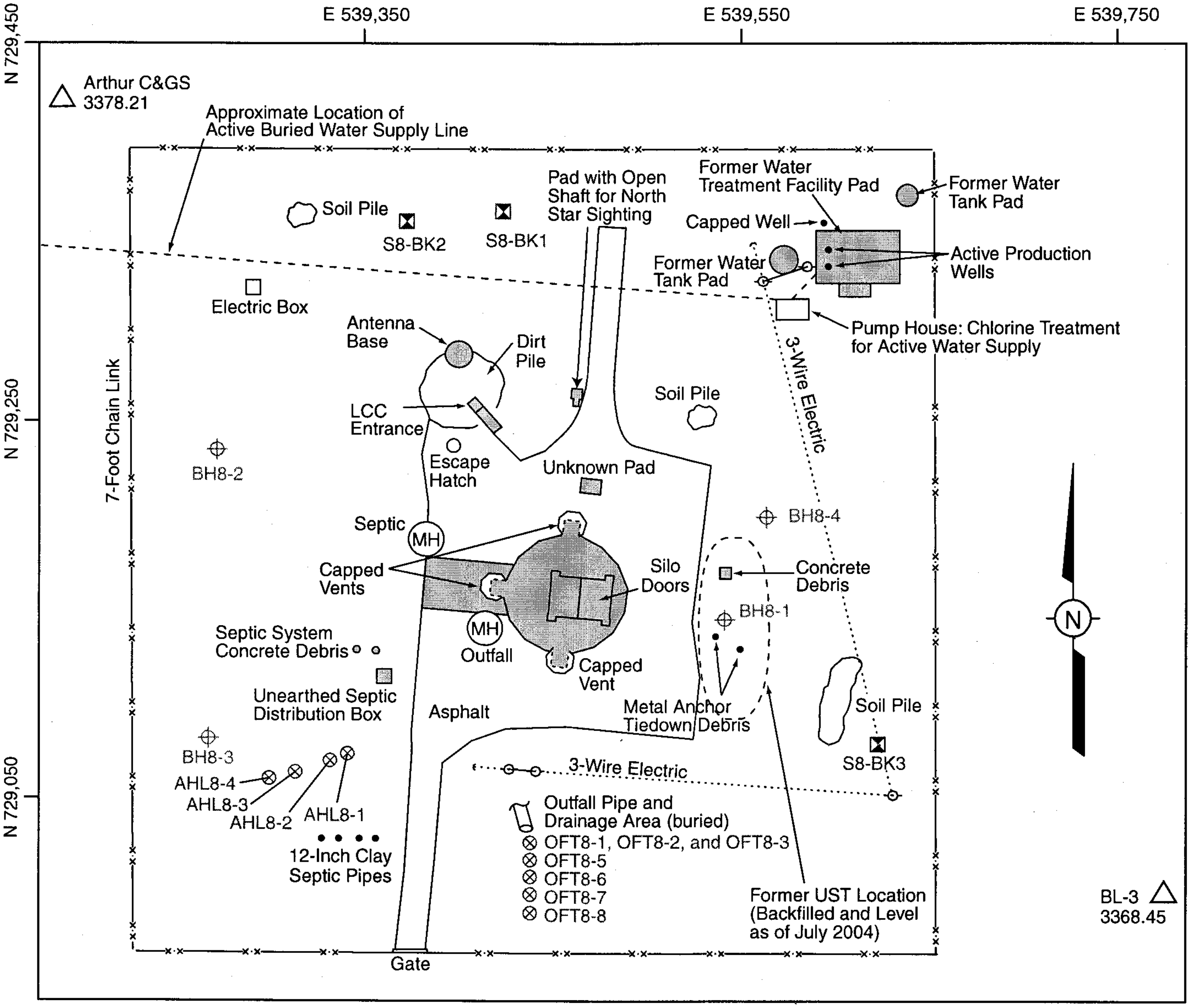
| Location ID | Sample Number | Sample Date | Sample Type | Sample Depth (ft bgs) | Analytical Methods[a] |
|---|---|---|---|---|---|
| **Investigation-Derived Waste (Silo Sites 8 and 9)** | | | | | |
| Composite<br>BH8-1<br>BH8-2<br>BH8-3 | IDW-1 | 6/23/2004 | Investigation-Derived Waste | 10–108 | TCLP VOC (EPA 1311/8260B)<br>TCLP SVOC (EPA 1311/8270C)<br>TCLP Metals (EPA 1311/6010B/7470A) |
| BH9-1 | IDW-2 | 7/2/2004 | Investigation-Derived Waste | 10–250 | |
| BH8-4 | IDW-3 | 7/11/2004 | Investigation-Derived Waste | 10–247 | TCLP VOC (EPA 1311/8260B)<br>TCLP SVOC (EPA 1311/8270C)<br>TCLP Metals (EPA 1311/6010B/7470A)<br>Diesel Range Organics (EPA 8015 TPH/DRO)<br>Gasoline Range Organics (EPA 8015 TPH/GRO) |

*[a]U.S. Environmental Protection Agency (EPA), 1986, "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, 3rd ed., U.S. Environmental Protection Agency, Washington, D.C.*

*[b]USACE Split Samples shipped to the U.S. Army Corps of Engineers Omaha Laboratory, Omaha, Nebraska.*

*[c]Kemron Environmental Services, 2003, "Standard Operating Procedure for the Analysis of Organic Analytes, Method 8270C for Low Level PAHs, SOP MSS03," Kemron Environmental Services, Marietta, Ohio.*

*bgs = Below ground surface.*
*DRO = Diesel Range Organics.*
*EPA = U.S. Environmental Protection Agency.*
*ft = Foot (feet).*
*GRO = Gasoline Range Organics.*
*ID = Identification.*
*MS/MSD = Matrix spike/matrix spike duplicate.*
*N/A = Not applicable.*
*PAH = Polynuclear aromatic hydrocarbons.*
*SVOC = Semivolatile organic compound.*
*TAL = Target Analyte List.*
*TCLP = Toxicity Characteristic Leaching Procedure.*
*TPH = Total petroleum hydrocarbons.*
*USACE = U.S. Army Corps of Engineers.*
*VOC = Volatile organic compound.*




**LEGEND**

| | |
|---|---|
| [shaded] | Shaded areas are concrete features |
| △BL-3 3368.45 | Survey benchmark with elevation (feet above mean sea level) |
| (MH) | Manhole cover |
| LCC | Launch Control Center |
| UST | Underground Storage Tank |
| ⌖ | Deep Soil Boring |
| ⊗ | Shallow Subsurface Soil Sample |
| ⊠ | Surface Background Soil Sample |

Note: Some small feature symbols not to scale

0 200 FT

SCALE

Basis of Coordinates: New Mexico State Planar Coordinates, East Zone, U.S. Survey Feet, North American Datum, 1983

**Figure 4-1**
**Soil Boring and Soil Sample Location Map**
**Former Atlas Missile Silo Site 8**
**Roswell, New Mexico**

which was covered with approximately 1 foot of soil and cobbles. Once the sump outfall pipe was exposed, a 16-square-foot area downgradient of the sump outfall was excavated so that the surrounding soil horizon was approximately the same elevation as the bottom of the pipe. Three soil samples (OFT8-1, OFT8-2, and OFT8-3) were collected from this soil horizon: one sample from directly below the pipe, a second sample at approximately 1 foot downgradient of the pipe, and a third sample from organic-rich soil material inside the clay pipe (Photo 4) (Table 4-1). The area downgradient of the pipe was then excavated to 4 feet bgs and four soil samples (OFT8-5, OFT8-6, OFT8-7, and OFT8-8) were collected from a deeper soil horizon (Photo 5) to determine whether potentially hazardous constituents have migrated into subsurface soil downslope of the sump outfall. No organic vapors were detected at outfall soil sample locations.

### 4.1.3 Former UST Area

In order to characterize potential impacts to subsurface soil from the former UST, a deep borehole (BH8-1) was advanced through the former UST area, and a soil sample was collected at 45 feet bgs (Table 4-1). Soil samples were collected from 2-inch, stainless-steel split spoons driven into native soil (Photo 6). No organic vapors were detected with field-screening of the soil samples.

### 4.1.4 Additional Deep Borehole Soil Sampling

Two additional deep boreholes (BH8-2, BH8-3) were advanced at Silo Site 8. One soil sample was collected from each borehole from the vadose zone above the first encountered groundwater at 45 feet bgs, in order to determine whether potentially hazardous constituents are present. The soil samples were collected from a 2-inch, stainless-steel split spoon driven into native soil (Photo 6). No organic vapors were detected with field-screening of the soil samples. A fourth deep borehole (BH8-4) was advanced north of BH8-1; however, due to the drilling method required (mud rotary), a representative soil sample was not collected from BH8-4. The locations of the boreholes advanced at Silo Site 8 are shown in Figure 4-1.

### 4.1.5 Background Soil Sampling

Background soil samples were collected for trace metal analysis to support geochemical evaluations of metals in soil. Specifically, background soil samples were used for geochemical modeling to aid in determining whether a detected trace metal is a contaminant or a naturally occurring constituent. Background soil samples were collected within the boundary of the silo site away from any of the potential contaminant source areas. The three sample locations (BKG8-1, BKG8-2, and BKG8-3) are shown in Figure 4-1. At each sample location, a composite sample was collected that consisted of five grab samples within an approximate 4-foot-square area. Each grab sample (S8-SS-BK-1, S8-SS-BK-2, and S8-SS-BK-3) was collected from 0 to 3 inches bgs (Table 4-1). The grab samples from each location were passed through a No. 4 sieve to remove coarse material, homogenized in a stainless-steel bowl, and transferred into a 4-ounce jar.

## 4.2 Source Area Characterization Activities for Silo Site 9

### 4.2.1 Septic Leachfield

Shallow leachfield soil boring locations (AHL9-1, AHL9-2, AHL9-3, and AHL9-4) were selected to provide representative samples of the Silo Site 9 leachfield, while maintaining the integrity of the leachfield components, which remain in their original locations. The four soil borings, advanced 4 to 7 feet bgs, were placed just beyond and downslope of the presumed boundary of the leachfield. Two of the soil borings were completed immediately south of the leachfield boundary while the other two were completed parallel to the long axis, down-slope, and west of the leachfield (Photo 7). Soil samples were collected from a 2-inch, stainless-steel split-spoon sampler driven ahead of the 3.25-inch-diameter auger. Figure 4-2 presents the sample locations relative to the leachfield.

### 4.2.2 Sump Outfall

The termination of the clay outfall pipe for the Silo Site 9 sump system was located approximately 50 feet south of the silo (Figure 4-2). The sump outfall pipe and associated cobbled French drain were discovered in their original configuration (not buried as these were at Silo Site 8), gently sloping from the outfall pipe towards the south (Figure 4-2) (Photo 8). Approximately 6 inches of cobbles on the surface of the French drain area were removed, exposing the soil below for sample collection. Outfall soil samples (OFT9-1, OFT9-2, OFT9-3, and OFT9-4) were collected from immediately below the drip edge of the clay outfall pipe (Photo 9), and downslope, beyond the edge of the pipe at distances of 5, 10, and 20 feet, respectively. Upon collection of the first four samples, a backhoe was used to excavate a trench from the clay outfall pipe extending southward approximately 20 feet (Photo 10). During trenching activities, limestone bedrock was encountered at approximately 2 to 4 feet bgs. Outfall soil samples (OFT9-5, OFT9-6, OFT9-7, and OFT9-8) were collected at the same distances from the outfall pipe as the first four samples (0, 5, 10, and 20 feet), but at an average depth of approximately 3.5 feet bgs along the side wall of the trench. Organic vapors were not detected in outfall soil samples collected at Silo Site 9.

### 4.2.3 Former UST Area

The lithology, shallow bedrock, at Deep Borehole BH9-1 did not permit the collection of soil samples at multiple intervals as planned. One sample of limestone rock flour material (BH9-1-1) was collected from approximately 240 to 250 feet bgs at BH9-1, directly from the cyclone into a stainless-steel bowl. The sample material was homogenized, and a representative

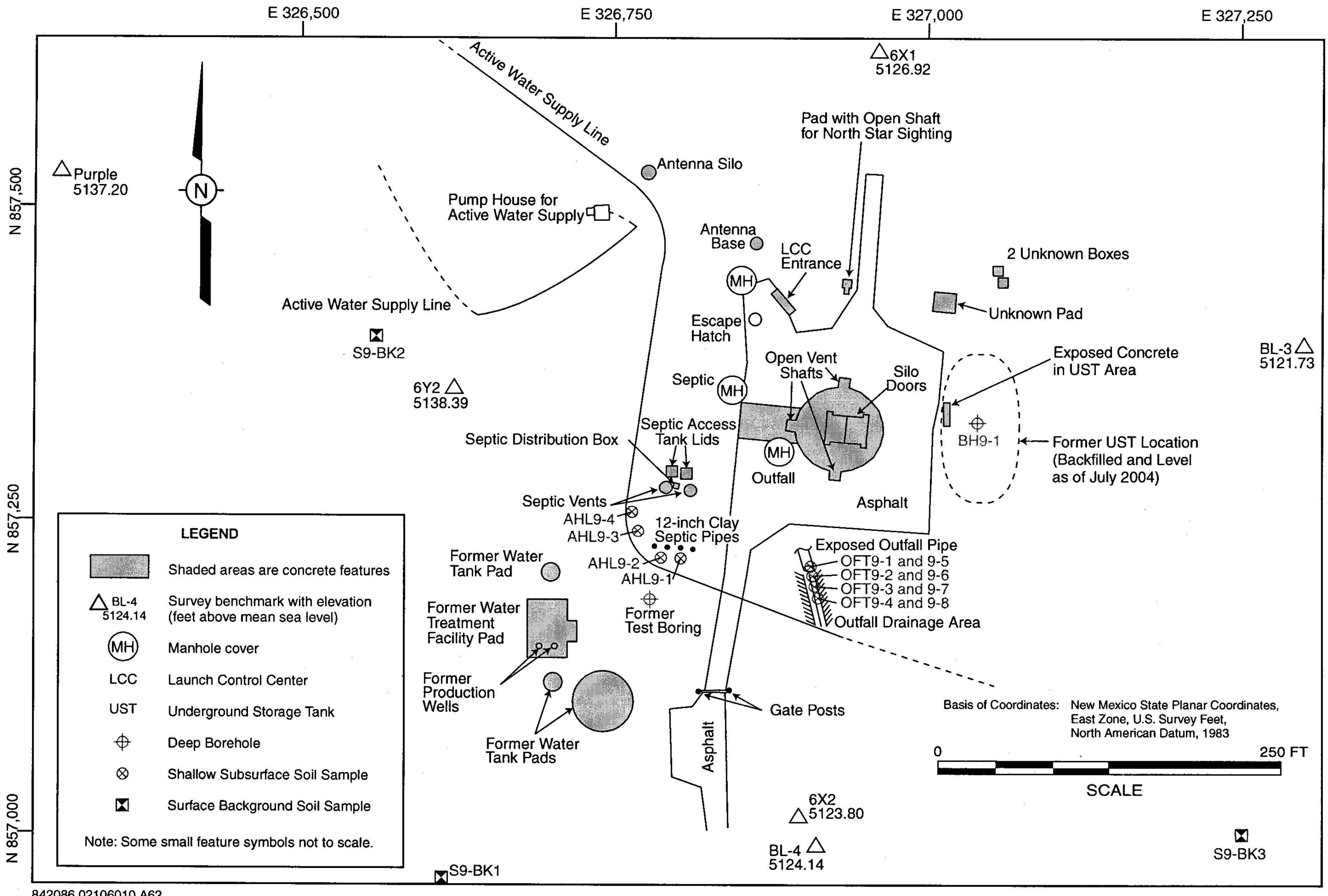



**Figure 4-2**
**Soil Boring and Soil Sample Location Map**
**Former Atlas Missile Silo Site 9, Roswell, New Mexico**

sample was collected in an 8-ounce jar. EnCore® sample collection was not favorable at this location due to the lithology. No organic vapors were detected with field-screening methods, and no visible evidence of contamination was observed from this deep borehole.

### 4.2.4 Background Soil Sampling

Background soil samples were collected within the boundary of the silo site, away from any of the potential source areas identified in the ESI. The three sample locations (BKG9-1, BKG9-2, and BKG9-3) are shown in Figure 4-2. At each location, a composite sample was collected that consisted of five grab samples within an approximate 4-foot-square area. Each grab sample (S9-SS-BK-1, S9-SS-BK-2, and S9-SS-BK-3) was collected from 0 to 3 inches bgs (Table 4-1). The grab samples from each location were passed through a No. 4 sieve, homogenized in a stainless-steel bowl, and a representative sample was collected in a 4-ounce jar. Figure 4-2 provides the locations of Silo Site 9 background samples.

## 4.3 Analytical Parameters

Analytical procedures from EPA SW-846 (EPA, 1986) were used for the chemical analyses of soil samples. Soil samples and field QC samples were submitted to Kemron Environmental Services, Inc. (Kemron) in Marietta, Ohio, for laboratory analysis. The following analyses were performed on all soil samples collected at both Silo Sites 8 and 9, with the exception of background soil samples, which were analyzed for Target Analyte List (TAL) metals only.

- Volatile organic compounds (VOC) by EPA Method 8260B
- Semivolatile organic compounds (SVOC) by EPA Method 8270C
- Polynuclear aromatic hydrocarbons (PAH) by EPA Method 8270C-Modified for Low Level PAH
- TAL metals by EPA Methods 6010B/6020/7470A/7471A
- The laboratory also performed searches of mass spectra library files and reported the top 10 tentatively identified compounds (TIC) for each VOC and SVOC analysis.

## 4.4 Sample Procedures and Documentation

EnCore® samplers were used to collect soil samples for VOC analysis where applicable. Both 4- and 8-ounce glass, wide-mouth jars were used for the collection of soil samples for analysis of the other parameters (SVOCs, PAH, and TAL Metals). All sample containers were provided by Kemron.

Sampling tools such as stainless-steel bowls, split-spoon samplers, and sieves were decontaminated between sample locations and depths using a solution of tap water and

Alconox®, followed by a final deionized water rinse. Sterile, disposable scoops were used during soil homogenizing to reduce the risk of cross-contamination.

Upon filling each sample container, the sample was immediately placed into a laboratory-provided cooler with ice. Shaw Environmental Inc. (Shaw) maintained custody of the samples at all times until relinquished to Federal Express for priority overnight shipment to the laboratory.

Chain-of-custody documentation was electronically generated in the field using the EPA software program, FORMS [Field Operations and Records Management System] II Lite, Version 5.1 (DynCorp, 2002) and placed in each cooler to accompany samples to Kemron.

Table 4-1 provides a summary of all soil samples collected during the ESI at Silo Sites 8 and 9. Field documentation, including Field Activity Daily Logs, Soil Sample Collection Logs, Calibrations Logs, and Chains-of-Custody Records are included in Appendix A of this report.

## 4.5 Soil Sample Results and Evaluation

To aid in the identification of potential hazardous constituents, soil sample results were compared to previously determined evaluation criteria. The evaluation criteria were chosen as the most conservative of either the NMED Soil Screening Levels (NMED, 2004), or the EPA Region 6 Human Health Medium-Specific Screening Levels for residential exposure (EPA, 2003). The evaluation criteria for soil samples are presented in Appendix B1. Table 4-2 summarizes the potentially hazardous constituents detected above evaluation criteria in the soil samples collected at Silo Sites 8 and 9, which are discussed in the following sections. A table of detected analytes in soil samples is included in Appendix B2, which presents the constituent concentrations detected in soil samples collected during the ESI, as well as laboratory reporting detection limits, method detection limits (MDL), laboratory and final data validation qualifiers. Complete soil sample analytical results are available within the laboratory data reports in Appendix F. Background soil sample results for Silo Sites 8 and 9 have been incorporated into a Geochemical Evaluation, which is included in Appendix J.

### 4.5.1 Silo Site 8 Soil Sample Results

#### 4.5.1.1 Former UST Area and Additional Deep Boreholes

Arsenic was detected at a concentration of 13.4 milligram(s) per kilogram (mg/kg) in the soil sample collected from the 45-foot depth at Deep Borehole BH8-3 (BH8-3-2) (Table 4-2). No other TAL metals, VOCs, or SVOCs were detected above evaluation criteria in soil samples collected from any of the other deep boreholes.

## Table 4-2
## Soil Analytical Results Exceeding Evaluation Criteria
## Environmental Site Investigation: Former Atlas Missile Silo Sites 8 and 9
## Roswell, New Mexico

| Sample Number | Sample Depth (ft bgs) | Analytical Method[a] | Analyte | Result | Units | Final Qualifier | Evaluation Criteria[b] | Reporting Limit | Laboratory MDL |
|---|---|---|---|---|---|---|---|---|---|
| **Silo Site 8** | | | | | | | | | |
| **Deep Borehole Samples** | | | | | | | | | |
| BH8-3-2 | 45 | 6020 | Arsenic | 13.4 | mg/kg | | 3.9 | 0.756 | 0.378 |
| **Septic Leachfield Samples** | | | | | | | | | |
| AHL8-4 | 9–12 | 6020 | Arsenic | 4.71 | mg/kg | | 3.9 | 0.597 | 0.298 |
| **Sump Outfall Samples** | | | | | | | | | |
| OFD8-1-1[c] | 1 | 8270C-MOD[d] | Benzo(a)pyrene | 63.0 | μg/kg | J | 62 | 67.4 | 33.7 |

[a]*U.S. Environmental Protection Agency (EPA), 1986, "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, 3rd ed., U.S. Environmental Protection Agency, Washington, D.C.*

[b]*Evaluation criteria are found in Appendix B1. Evaluation criteria were selected from either 1) New Mexico Environment Department (NMED), 2004, "Technical Background Document for Development of Soil Screening Levels," Revision 2.0, Hazardous Waste Bureau, New Mexico Environment Department, Santa Fe, New Mexico, 2) U.S. Environmental Protection Agency (EPA), 2003, "EPA Region 6 Human Health Medium-Specific Screening Levels," electronic database maintained by Region 6, U.S. Environmental Protection Agency, Dallas, Texas, or 3) OHM Remediation Services Corporation (OHM), 1997, "Final Background Soil Sampling Report, Former Walker Air Force Base (WAFB)," prepared for U.S. Army Corps of Engineers, Tulsa District, TERC No. DACA-56-94-D-0020, Tulsa, Oklahoma.*

[c]*Field QC duplicate sample. Concentration in the primary sample did not exceed evaluation criteria.*

[d]*Modified for Low Level PAH.*

*bgs* = *Below ground surface.*
*ft* = *Foot (feet).*
*J* = *The result is either an estimated quantity less than the reporting limit but greater than the method detection limit or considered an estimate because of some problem with associated quality control measures. The result is still usable.*
*μg/kg* = *Microgram(s) per kilogram.*
*MDL* = *Method detection limit.*
*mg/kg* = *Milligram(s) per kilogram.*
*PAH* = *Polynuclear aromatic hydrocarbons.*
*QC* = *Quality control.*

#### 4.5.1.2 Septic Leachfield

The sample collected from the 9- to 12-foot bgs depth interval (AHL8-4) had an arsenic concentration of 4.71 mg/kg, exceeding the evaluation criteria of 3.9 mg/kg (Table 4-2). No other TAL metals, VOCs, or SVOCs were detected above evaluation criteria in soil samples collected at the Silo Site 8 septic leachfield.

#### 4.5.1.3 Sump Outfall

Benzo(a)pyrene (BaP) was detected at an estimated concentration of 63 micrograms (μg)/kilogram (kg) in one soil sample, collected from the outfall pipe (OFD8-1-1), exceeding the evaluation criteria of 62 μg/kg (Table 4-2). This result was from a field QC duplicate. The primary sample did not contain a BaP concentration above the evaluation criteria. VOCs and metals were not detected above evaluation criteria in soil samples collected at the Silo Site 8 sump outfall.

### 4.5.2 Silo Site 9 Soil Sample Results

No analytical results exceeded evaluation criteria for soil samples collected from the Silo Site 9 septic leachfield, sump outfall, or deep borehole. Appendix B2 lists all analytes detected above laboratory MDLs.

### 4.5.3 Tentatively Identified Compounds in Soil Samples

Kemron performed mass-spectra library searches during all VOC and SVOC analyses in an attempt to identify nontarget compounds that may be present in the samples. Nontarget compounds were identified in order to assess the presence of unanticipated, unknown, or exotic compounds in soil at Silo Sites 8 and 9 in accordance with Section 3.2 and Table 3-1 of the Quality Assurance Project Plan (Shaw, 2004, Appendix A, Part II). The identified, nontarget compounds, referred to as TIC, for soil samples are listed along with estimated concentrations in Table 4-3.

TIC were identified in one deep borehole soil sample (BH8-1-1) and two sump outfall soil samples (OFT8-1 and OFT8-6) at Silo Site 8. TIC were identified in one deep borehole soil sample and its field duplicate, two septic leachfield soil samples, and one leachfield field duplicate at Silo Site 9. Standard chemical reference volumes were consulted to determine the possible sources for the TIC. Possible TIC sources, with references footnoted, are also shown in Table 4-3. Generally, the TIC shown are likely weathered, degraded fuel, other refined hydrocarbons, or pesticide components. No evaluation criteria for the TIC were listed, and comparison against the TIC estimated concentrations could not be made. The greatest estimated concentrations for the TIC were in the low part(s)-per-million (ppm) range with most TIC

**Table 4-3**
**Tentatively Identified Compounds In Soil Samples**
**Environmental Site Investigation: Former Atlas Missile Silo Sites 8 and 9**
**Roswell, New Mexico**

| Sample Number | Analytical Method[a] | CAS Number | Tentatively Identified Compound | Estimated Concentration (ppm) | Chromatograph Retention Time (minutes) | Possible Source for TIC |
|---|---|---|---|---|---|---|
| **Silo Site 8** | | | | | | |
| **Deep Borehole Samples** | | | | | | |
| BH8-1-1 | 8260B | 141-78-6 | ETHYL ACETATE | 0.0432 | 7.454 | Industrial solvent but also naturally occurs from the fermentation of plant sugars[b] |
| **Sump Outfall Samples** | | | | | | |
| OFT8-1 | 8270C | 3179-47-3 | 2-PROPENOIC ACID, 2-METHYL-, DECYL | 8.30 | 13.8 | Degradation product of propenoic acid-based pesticides[c,d] |
| | | 142-90-5 | 2-PROPENOIC ACID, 2-METHYL-, DODEC | 3.76 | 14.81 | |
| | | 142-90-5 | 2-PROPENOIC ACID, 2-METHYL-, DODEC | 6.60 | 15.7 | |
| OFT8-6 | 8270C | 205-82-3 | BENZO[J]FLUORANTHENE | 0.292 | 19.84 | Primary alkane component of kerosene, diesel, fuel oil, and other refined oil products[e] |

## Table 4-3 (Continued)
## Tentatively Identified Compounds In Soil Samples
## Environmental Site Investigation: Former Atlas Missile Silo Sites 8 and 9
## Roswell, New Mexico

| Sample Number | Analytical Method[a] | CAS Number | Tentatively Identified Compound | Estimated Concentration (ppm) | Chromatograph Retention Time (minutes) | Possible Source for TIC |
|---|---|---|---|---|---|---|
| **Silo Site 9** | | | | | | |
| **Deep Borehole Samples** | | | | | | |
| BH9-1-1 | 8270C | 112-95-8 | EICOSANE | 0.213 | 19.58 | Primary alkane component of kerosene, diesel, fuel oil, and other refined oil products[e] |
| DBD9-1-1 (duplicate of BH9-1-1) | 8270C | 56862-62-5 | 10-METHYLNONADECANE | 0.221 | 19.58 | |
| **Septic Leachfield Samples** | | | | | | |
| AHL9-1 | 8260B | 629-78-7 | HEPTADECANE | 0.012 | 15.05 | Primary alkane component of kerosene, diesel, fuel oil, and other refined oil products[e] |
| | | 62199-06-8 | HEPTANE, 5-ETHYL-2,2,3-TRIMETHYL- | 0.015 | 15.38 | |
| AHD9-1-1 (duplicate of AHL9-1) | 8260B | 15869-86-0 | OCTANE, 4-ETHYL- | 0.009 | 15.05 | |
| | | 62199-06-8 | HEPTANE, 5-ETHYL-2,2,3-TRIMETHYL- | 0.012 | 15.37 | |
| AHL9-4 | 8270C | 61-54-1 | 1H-INDOLE-3-ETHANAMINE | 2.990 | 15.13 | Degradation product of ethanamine-based pesticides[d,g] |

[a] *U.S. Environmental Protection Agency (EPA), 1986, "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, 3rd ed., U.S. Environmental Protection Agency, Washington, D.C.*

[b] *Bisesi, M.S. Esters, 1994, In: Patty's Industrial Hygiene and Toxicology. 4th ed. Vol. II. Toxicology. Part D. John Wiley & Sons, Inc., 1994. p. 2967-2971, 2977-2984.*

[c] *Montgomery, J. H., 1991, Groundwater Chemicals Desk Reference Volume 2, Lewis Publishers, Chelsea, Michigan.*

[d] *Wood, A, 2004, Compendium of Pesticide Common Names (http://www.alanwood.net/pesticides/index.html).*

[e] *Murphy, B. L. and R. D. Morrison, 2002, Introduction to Environmental Forensics, Academic Press, New York.*

**Table 4-3 (Continued)**
**Tentatively Identified Compounds In Soil Samples**
**Environmental Site Investigation: Former Atlas Missile Silo Sites 8 and 9**
**Roswell, New Mexico**

[f]*Orme, S. and S. Kegley, 2004, PAN Pesticide Database, Pesticide Action Network, San Francisco, CA. <http:www.pesticideinfo.org>.*

[g]*Oxford Dictionary of Chemistry 3rd Edition; Oxford University Press, 1996.*

| | |
|---|---|
| *CAS* | *= Chemical Abstracts Service.* |
| *ppm* | *= Part(s) per million.* |
| *TIC* | *= Tentatively identified compound.* |

concentrations estimated at less than 1 ppm. In accordance with decision rules established in Table 4-3 of the Quality Assurance Project Plan (Shaw, 2004), no further action regarding the TIC is necessary.

## 4.6 Site-Specific Geology

### 4.6.1 Silo Site 8

Shallow subsurface geology consists of unconsolidated silty sand and fill from ground surface to a depth of approximately 8 to 15 feet bgs. A reddish-brown to brown silty sand containing occasional angular quartites and anhydrite nodules was observed in all deep boreholes underlying the silty sand.

Underlying the silty sand in BH8-1, a red silty clay with moderate plasticity was present to 45 feet bgs. Evaporite deposits with weathered quartz conglomerate were encountered from 45 to 70 feet bgs. A dark-red silty clay was encountered from 70 to 96 feet bgs with a 3-foot-thick limestone bed from 90 to 93 feet bgs.

A grey to red clay with varying amounts of quartz conglomerate was encountered from 32 to 105 feet bgs in Deep Boreholes BH8-2 and BH8-3. A limestone unit of unknown thickness was encountered in Deep Boreholes BH8-2 and BH8-3 at depths of 105 and 102 feet bgs, respectively.

Deep Borehole BH8-4 included silty sands and clays with occasional cobbles from 15 to 100 feet bgs. Anhydrite with thinly bedded clay and limestone were encountered to 247 feet bgs, the total depth of the borehole. Two limestone beds were encountered within the upper portion of the anhydrite (100 to 120 feet bgs and 130 to 140 feet bgs, respectively). Deep borehole logs for Silo Site 8 are included in Appendix C.

### 4.6.2 Silo Site 9

The geology beneath Silo Site 9 is based upon interpretation of Deep Borehole BH9-1. In the vicinity of BH9-1 (former UST area), fill material exists in the top 10 feet. A 2-foot-thick well-graded sand with gravel and rock fragments is deposited in contact with the top of the competent limestone that was encountered at approximately 12 feet bgs.

The limestone exhibited alternating zones of less competent weathered sequences with thinly-bedded finer material. At 200 feet bgs, the limestone becomes very competent, as evidenced by slow drill rates, to 250 feet bgs, the total depth of the borehole. The soil boring log for BH9-1 is included in Appendix C.

Road cuts along US Highway 70/380, within a few miles of Silo Site 9, reveal numerous faults, extensive folding, and deformation of the limestone in this region. Thin, (1 to 3 feet thick) interbedded zones of silts and various soils can be seen within the limestone unit at a majority of the road cuts.

# 5.0 Groundwater and Silo Water Assessment

The ESI at former Atlas Missile Silo Sites 8 and 9 was performed to determine whether previous DOD activities at the silo sites resulted in the release of potentially hazardous constituents in groundwater. To accomplish this, BARCAD™ monitoring wells were installed in the deep boreholes, and groundwater samples were collected and analyzed for hazardous constituents. Groundwater was not encountered during drilling activities to the study boundary (250 feet bgs) at Silo Site 9 (BH9-1); therefore, site investigation activities described in this section apply only to Silo Site 8. Two nested BARCAD™ wells were installed in a deep borehole at the location of the former UST area. Two more BARCAD™ monitoring wells were installed in deep boreholes located northwest and southwest of the UST area in a triangular orientation, in order to determine groundwater flow direction. A fourth deep borehole was advanced to 250 feet bgs in order to satisfy the established study boundary. The following sections present the borehole advancement techniques employed, BARCAD™ installation activities, BARCAD™ sampling and field collection methods, and results of the BARCAD™ monitoring well sampling. Table 5-1 provides a summary of groundwater samples collected during the ESI at Silo Site 8.

## 5.1 Borehole Advancement Techniques

### 5.1.1 Silo Site 8

Prior to commencement of drilling activities, limited surface preparation activities were performed at Silo Site 8 to accommodate the drill rig and support vehicles. Preparation activities included brush clearing, followed by fill and leveling activities with clean fill material transported from an off-site source. Photo 11 shows the cleared area leading to and surrounding deep borehole location BH8-3.

Three deep boreholes, identified as Borehole 8-1 (BH8-1), Borehole 8-2 (BH8-2), and Borehole 8-3 (BH8-3), were advanced to total depths ranging from 95 to 108 feet bgs (Figure 4-1). Deep Borehole 8-4 (BH8-4) was advanced to a total depth of 247 feet bgs. The selected drilling methods used to advance the deep boreholes were modified, based upon subsurface geologic conditions encountered during advancement. Revised methods were approved by USACE oversight, prior to implementation, and documented in a Field Work Variance (FWV) (Appendix I).

BH8-1, located east of the silo in the former UST area, was advanced using a Stratex® drill bit with 9⅝-inch temporary steel casing to approximately 95 feet bgs (Figure 4-1). A perched groundwater unit was encountered at 40 to 45 feet bgs, and a deeper groundwater unit was encountered at the bedrock interface at 92 feet bgs.

**Table 5-1**
**Groundwater Sample Summary**
**Environmental Site Investigation: Former Atlas Missile Silo Sites 8 and 9**
**Roswell, New Mexico**

| Well ID | Sample Number | Sample Date | Sample Type | Sample Depth (ft bgs) | Analytical Methods[a]: VOC (EPA 8260B) SVOC (EPA 8270C) PAH (EPA 8270C-MOD)[b] Unfiltered TAL Metals (EPA 6010B/6020/7470A) | Analytical Methods[a]: Filtered TAL Metals (EPA 6010B/6020/ 7470A) | Analytical Methods[a]: Total Dissolved Solids (EPA 160.1) |
|---|---|---|---|---|---|---|---|
| S8-MW1-A | S8-MW1-A-1 | 8/30/2004 | Environmental Groundwater | 56.25–57.25 | X | | |
| | S8-MW1-A-2 | 8/30/2004 | Environmental Groundwater | | | X | |
| S8-MW1-B | S8-MW1-B-1 | 8/30/2004 | Environmental Groundwater | 89.75–92.25 | X | | |
| | S8-MW1-B-2 | 8/30/2004 | Environmental Groundwater | | | X | |
| S8-MW2 | S8-MW2-1 | 8/31/2004 | Environmental Groundwater | 100.33–102.83 | X | | |
| | S8-MW2-1 | 8/31/2004 | MS/MSD Groundwater | | X | | |
| | S8-MW2-2 | 8/31/2004 | Environmental Groundwater | | | X | |
| | S8-MW2-2 | 8/31/2004 | MS/MSD Groundwater | | | X | |
| | S8-MWD1-A-1 | 8/31/2004 | Duplicate Groundwater of S8-MW2-1 | | X | | |
| | S8-MWT1-A-2 | 8/31/2004 | USACE Split of S8-MW2-1 Groundwater[c] | | X | | |
| S8-MW3 | S8-MW3-1 | 8/30/2004 | Environmental Groundwater | 102.50–105.00 | X | | |
| | S8-MW3-2 | 8/30/2004 | Environmental Groundwater | | | X | |
| S8-MW4-A | S8-MW4-A-1 | 8/30/2004 | Environmental Groundwater | 142.00–144.50 | X | | X |
| | S8-MW4-A-2 | 8/30/2004 | Environmental Groundwater | | | X | |

**Table 5-1 (Continued)**
**Groundwater Sample Summary**
**Environmental Site Investigation: Former Atlas Missile Silo Sites 8 and 9**
**Roswell, New Mexico**

| Well ID | Sample Number | Sample Date | Sample Type | Sample Depth (ft bgs) | Analytical Methods[a] | | |
|---|---|---|---|---|---|---|---|
| | | | | | VOC (EPA 8260B) SVOC (EPA 8270C) PAH (EPA 8270C-MOD)[b] Unfiltered TAL Metals (EPA 6010B/6020/7470A) | Filtered TAL Metals (EPA 6010B/6020/ 7470A) | Total Dissolved Solids (EPA 160.1) |
| S8-MW4-B | S8-MW4-B-1 | 9/9/2004 | Environmental Groundwater | 239.80–242.30 | X | | X |
| | S8-MW4-B-2 | 9/9/2004 | Environmental Groundwater | | | X | |
| Silo 8 Top 15 ft column | S8-SW1-1 | 8/31/2004 | Standing Silo Water | 150 | X | | X |
| | S8-SW1-2 | 8/31/2004 | Standing Silo Water | | | X | |
| Silo 8 Bottom 15 ft column | S8-SW2-1 | 8/31/2004 | Standing Silo Water | 165–170 | X | | X |
| | S8-SW2-2 | 8/31/2004 | Standing Silo Water | | | X | |
| Silo Site 8 Town Well North | TownWellNorth-1 | 9/9/2004 | Water Supply | 200[d] | X | | |
| | TownWellNorth-2 | | | | | X | |
| | TownWellNorth-3 | 10/13/2004 | | | | | X |

*[a]U.S. Environmental Protection Agency (EPA), 1986, "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, 3rd ed., U.S. Environmental Protection Agency, Washington, D.C.*

*[b]Modified for Low Level PAH.*

*[c]USACE split samples shipped to the U.S. Army Corps of Engineers Omaha Laboratory, Omaha, Nebraska.*

*[d]Depth based upon approximate pump intake depth provided by the Lake Arthur Water Co-Op via phone conversation on October 11, 2004. Screened interval is unknown.*

*bgs = Below ground surface.*
*EPA = U.S. Environmental Protection Agency.*
*ft = Foot (feet).*
*ID = Identification*
*MS/MSD = Matrix spike/matrix spike duplicate.*
*PAH = Polynuclear aromatic hydrocarbons.*
*SVOC = Semivolatile organic compound.*
*TAL = Target Analyte List.*
*USACE = U.S. Army Corps of Engineers.*
*VOC = Volatile organic compound.*

BH8-2 and BH8-3 were placed northwest and southwest of the silo (Figure 4-1), respectively, in order to determine groundwater flow direction. The deep boreholes were advanced using air-rotary methods, with a roller bit and 9⅝-inch temporary steel casing driven to 85 feet bgs. Beyond 85 feet bgs, the deep boreholes were drilled as open holes, utilizing the 8.5-inch roller bit to 108 and 107 feet bgs, respectively. Photos 12 and 13 show the typical drill rig and setup for the drilling activities. Groundwater was encountered at the bedrock interface in both BH8-2 and BH8-3.

A fourth deep borehole (BH8-4), located north of BH8-1, was advanced adjacent to the former UST area to the study boundary of 250 feet bgs. Mud-rotary drilling methods were used to install 9⅝-inch permanent steel casing to 105 feet bgs. The steel casing was advanced 5 feet into shallow bedrock and cemented in place, which sealed off both the perched and bedrock interface groundwater units. The remainder of the deep borehole was advanced, uncased to 247 feet bgs, through competent rock, with an 8.5-inch roller bit. A third groundwater unit was encountered in the shallow bedrock between 120 and 185 feet bgs. Water production was reduced significantly through a clay layer observed from 185 to 190 feet bgs, then increased again below 190 feet bgs, which suggests a possible fourth groundwater unit within the deep bedrock.

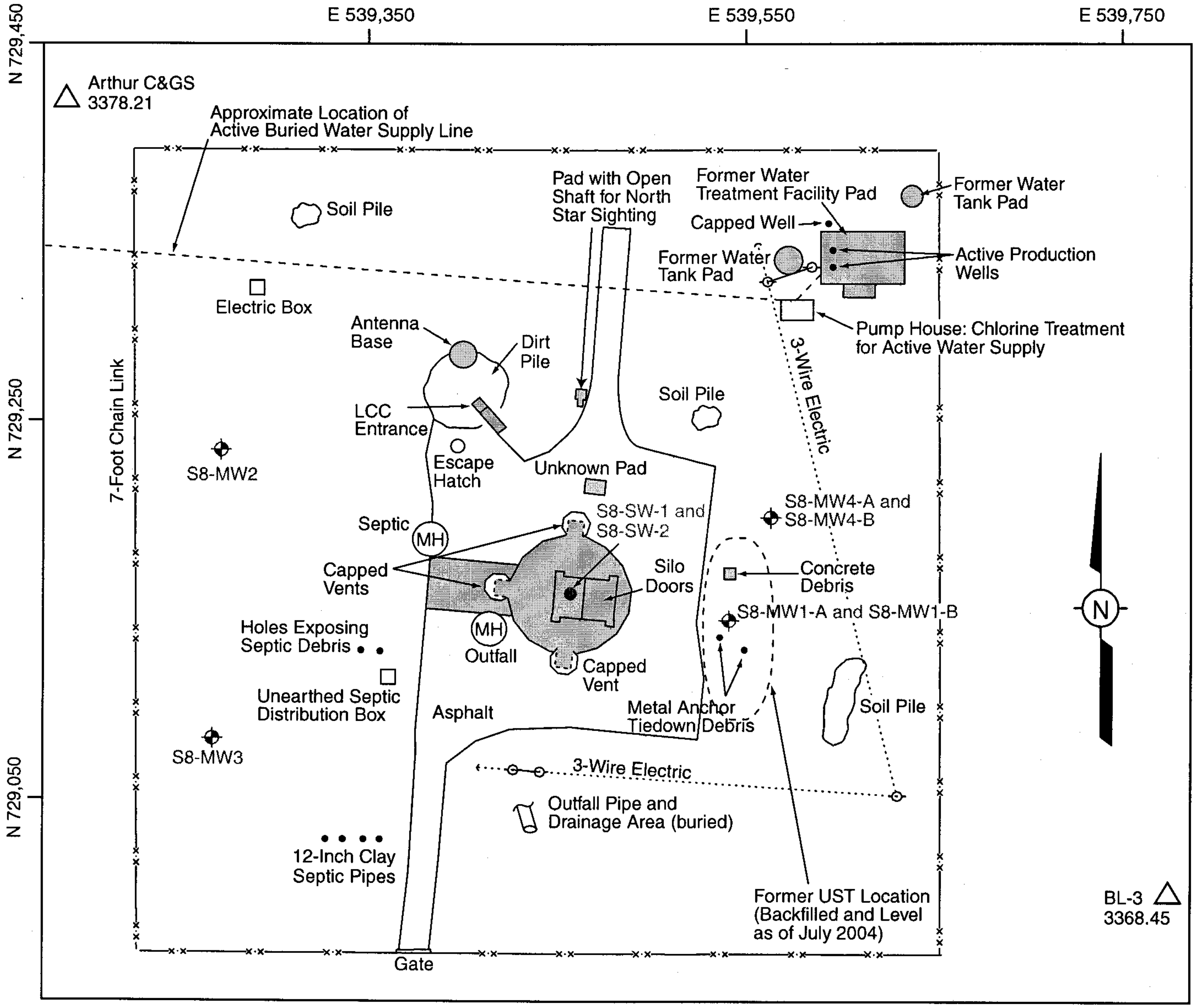
### *5.1.2 Silo Site 9*

Limited surface preparation activities were performed in the vicinity of the planned deep borehole location, at the former UST area, in order to accommodate the drill rig and support vehicles (Photo 14). Surface preparation activities included brush clearing, followed by fill and grading, with clean fill material delivered to the site.

One deep borehole (BH9-1) was advanced to the study boundary of 250 feet bgs at the former UST area, east of the silo (Figure 4-2). The Stratex® drilling method was used in an initial attempt to drill BH9-1. The Stratex® proved unsuccessful in the shallow limestone bedrock conditions; therefore, a second attempt was made a few feet north. This deep borehole was advanced as an uncased open hole through competent limestone using an 8.5-inch roller bit, following the installation of temporary casing to 15 feet bgs. Groundwater was not encountered within the study boundary (250 feet bgs), and the deep borehole was abandoned by backfilling with a cement grout.

## *5.2 BARCAD™ Monitoring Well Installation*

A total of six BARCAD™ monitoring wells (S8-MW1-A, S8-MW1-B, S8-MW2, S8-MW3, S8-MW4-A, and S8-MW4-B) were installed among four deep boreholes (BH8-1, BH8-2, BH8-3, and BH8-4) at Silo Site 8 (Figure 5-1).




| | **LEGEND** |
|---|---|
| (shaded box) | Shaded areas are concrete features |
| △BL-3 3368.45 | Survey benchmark with elevation (feet above mean sea level) |
| (MH) | Manhole cover |
| LCC | Launch Control Center |
| UST | Underground Storage Tank |
| ⌖ | BARCAD™ Monitoring Well |
| ● | Core Location for Standing Silo Water Samples |

Note: Some small feature symbols not to scale

0 200 FT

SCALE

Basis of Coordinates: New Mexico State Planar Coordinates, East Zone, U.S. Survey Feet, North American Datum, 1983

**Figure 5-1**
**Monitoring Well and Silo Water Sample Location Map**
**Former Atlas Missile Silo Site 8**
**Roswell, New Mexico**

The six BARCAD™ monitoring wells were completed at depths within the four potential water bearing zones encountered during borehole advancement, as follows:

- Deep Borehole BH8-1 (nested BARCAD™ monitoring wells):
  - S8-MW1-A completed at 57 feet bgs within the perched groundwater unit
  - S8-MW1-B completed at 92 feet bgs within the bedrock interface groundwater unit
- Deep Borehole BH8-2:
  - S8-MW2 completed at 103 feet bgs within the interface groundwater unit
- Deep Borehole BH8-3:
  - S8-MW3 completed at 105 feet bgs within the bedrock interface groundwater unit
- Deep Borehole BH8-4 (nested BARCAD™ monitoring wells):
  - S8-MW4-A completed at 145 feet bgs within the shallow bedrock unit
  - S8-MW4-B completed at 242 feet bgs within the deep bedrock unit

Photo 15 shows a nested pair of BARCAD™ monitoring wells prior to wellhead completion. Figure 5-1 shows the location of BARCAD™ monitoring wells installed at Silo Site 8, and Table 5-2 summarizes BARCAD™ monitoring well specifications, including groundwater elevations. Appendix D contains BARCAD™ monitoring well completion diagrams.

The BARCAD™ monitoring wells were installed under the supervision of AVM Environmental Services, Inc. (AVM) of Grants, New Mexico. AVM was subcontracted by Shaw to supply the BARCAD™ monitoring well materials and supervise WDC Exploration and Wells, Inc. during installation. With the exception of one BARCAD™ monitoring well (S8-MW-1A) completed with a 1-foot porous section, the remaining BARCAD™ monitoring wells were completed with 2.5-foot-long porous sections. Photo 16 shows a 2.5-foot-long porous section prior to installation. Above the porous section, 1-inch Schedule 80 polyvinyl chloride (PVC) riser pipe extended to the ground surface. The quantities and types of materials used for BARCAD™ monitoring well completion are not consistent for each BARCAD™ monitoring well and were selected based upon subsurface conditions. Typical completion materials consisted of No. 60 silica sand filter pack, ¾-inch bentonite chips placed above the filterpack for seal material, and a bentonite grout mix placed above the seal to ground surface. For BARCAD™ Monitoring Wells S8-MW1-A and -B, nested within BH8-1, Nos. 8 to 12 silica sand was placed above the No. 60 sand for stability. In the nested BARCAD™ monitoring wells within BH8-1 and BH8-4, sufficient seal material was placed to ensure no hydraulic communication between groundwater

**Table 5-2**
**BARCAD™ Monitoring Well Location and Completion Information**
**Environmental Site Investigation: Former Atlas Missile Silo Sites 8 and 9**
**Roswell, New Mexico**

| Silo Site 8 Borehole ID | Well ID | Date of Installation | Completion Zone | Northing[a] | Easting[a] | Top of Riser Elevation (ft amsl) | Depth to Groundwater ft btor (Gauged 8/30/04) | Groundwater Elevation (ft amsl) | BARCAD™ Interval (ft bgs) | Total Borehole Depth (ft bgs) |
|---|---|---|---|---|---|---|---|---|---|---|
| BH8-1 | S8-MW1-A | 6/20/04–6/21/04 | Perched | 729138.60 | 539555.30 | 3381.28 | 40.56 | 3340.72 | 56.25–57.25 | 94.75 |
| | S8-MW1-B | | Interface | 729138.40 | 539555.24 | 3380.80 | 48.07 | 3332.73 | 89.75–92.25 | |
| BH8-2 | S8-MW2 | 6/21/04 | Interface | 729235.40 | 539261.92 | 3379.27 | 45.92 | 3333.35 | 100.33–102.83 | 107 |
| BH8-3 | S8-MW3 | 6/23/04 | Interface | 729070.43 | 539257.94 | 3377.71 | 44.57 | 3333.14 | 102.50–105.00 | 107 |
| BH8-4 | S8-MW4-A | 7/12/04–7/14/04 | Shallow Bedrock | 729196.70 | 539578.02 | 3385.27 | 51.23 | 3334.04 | 142.00–144.50 | 247 |
| | S8-MW4-B | | Deep Bedrock | 729196.62 | 539578.21 | 3385.17 | 61.09 | 3324.08 | 239.80–242.30 | |

*[a]State Plane Coordinate System, New Mexico East, NAD 83.*

*amsl* = *Above mean sea level.*
*bgs* = *Below ground surface.*
*btor* = *Below top of riser.*
*ft* = *Foot (feet).*
*ID* = *Identification.*
*NAD* = *North American Datum.*

units. The BARCAD™ monitoring well riser pipes were completed aboveground within locking, protective steel casings (Photo 17). Appendix D presents BARCAD™ monitoring well completion diagrams for the two single (S8-MW2 and S8-MW3) and two nested BARCAD™ (S8-MW1-A and -B and S8-MW4-A and -B) monitoring wells.

Following installation, the BARCAD™ monitoring wells were tested to ensure that they were operating correctly. Each of the six BARCAD™ monitoring wells functioned properly after installation.

## 5.3 Site-Specific Hydrogeology at Silo Site 8

Four possible groundwater units were encountered during drilling activities at Silo Site 8. The depths and hydrogeologic setting of each unit are described as follows:

- A perched groundwater unit producing significant amounts of water during drilling was encountered within the basin-fill deposits, ranging from 40 to 55 feet bgs in all deep boreholes.
- A second groundwater unit ranging from 89 to 105 feet bgs was encountered at the interface of the basin fill deposits and bedrock.
- Two additional groundwater units were observed within the bedrock. A shallow bedrock groundwater unit was encountered at 120 feet bgs and possibly the second deeper bedrock groundwater unit was encountered at approximately 190 feet bgs. The two bedrock groundwater units were separated by a red clay unit from 185 to 190 feet bgs. It is uncertain whether the shallow and deep borehole groundwater units are separate units.

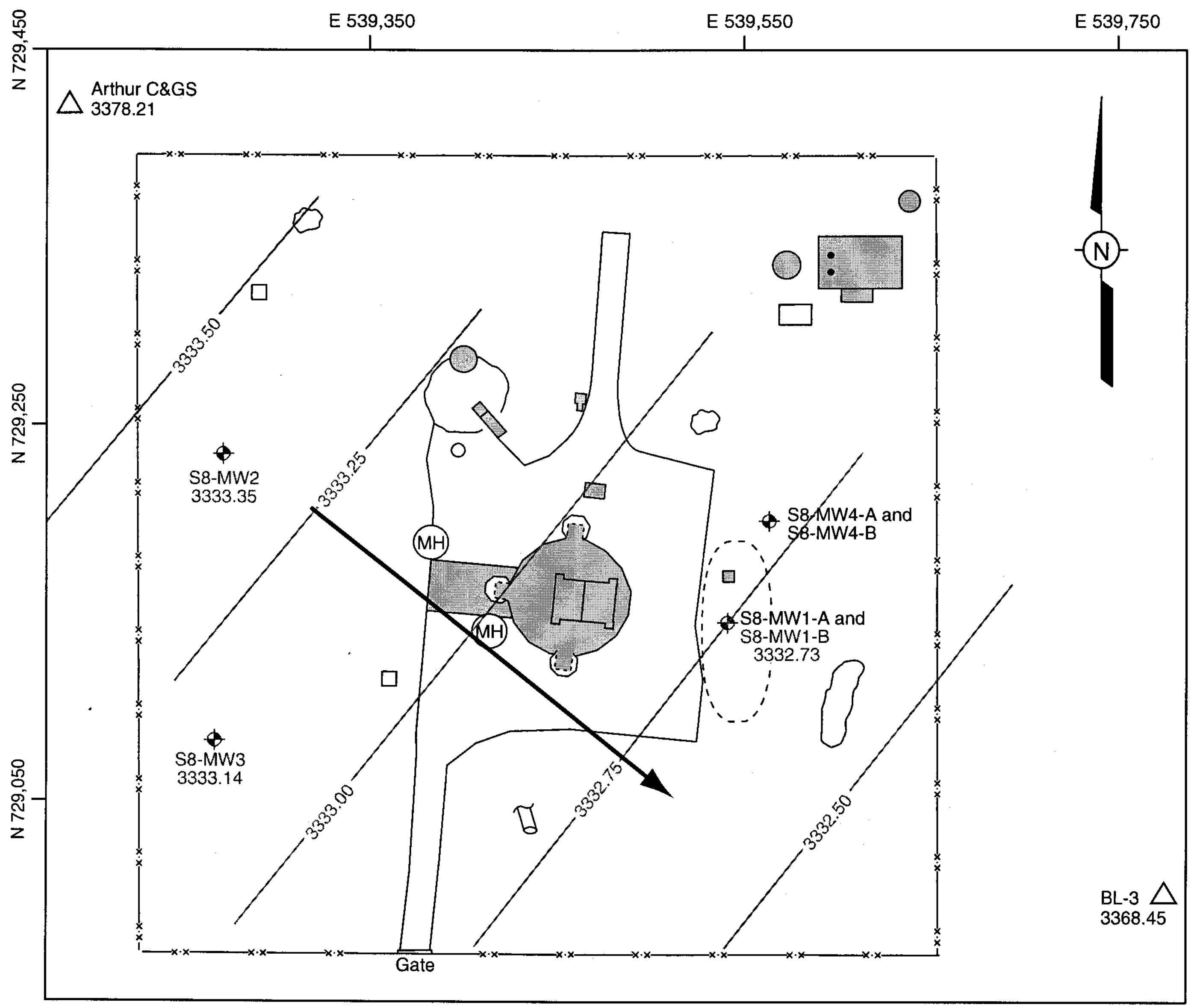
Based upon well records, the town of Lake Arthur's two water supply wells at Silo Site 8 were drilled to depths ranging from 1,020 to 1,069 feet bgs, with pumps set at 200 feet bgs. Information regarding perforated intervals for the Lake Arthur Town Wells was not available.

A groundwater elevation map was constructed for the interface unit in three deep boreholes (Figure 5-2). Groundwater flow direction in the interface unit is to the southeast, and groundwater gradient across the site is approximately 0.0025 feet/foot. Table 5-2 summarizes groundwater elevations, completion zones, and depth to water measurements collected during the groundwater sampling activities.

## 5.4 Groundwater and Silo Water Sampling Activities and Methods

### 5.4.1 Well Gauging

Approximately one month after the BARCAD™ well sampling systems were installed, and immediately prior to sample collection activities, Shaw gauged the depth to groundwater at each BARCAD™ monitoring well to the nearest 0.01 feet using a well-sounder tape. The




**LEGEND**

- Shaded areas are concrete features
- BL-3 3368.45 — Survey benchmark with elevation (feet above mean sea level)
- MH — Manhole cover
- S8-MW3 3333.14 — BARCAD™ monitoring well with groundwater elevation (feet above mean sea level)
- 3332.50 — Groundwater elevation contour
- Groundwater flow direction

Note: Some small feature symbols not to scale

0 — 200 FT

SCALE

Basis of Coordinates: New Mexico State Planar Coordinates, East Zone, U.S. Survey Feet, North American Datum, 1983

Water level elevations measured August 30, 2004. S8-MW1-A, S8-MW4-A, and S8-MW4-B are not included in groundwater elevation contours.

**Figure 5-2**
**Groundwater Elevation Contour Map**
**Interface Zone**
**Former Atlas Missile Silo Site 8**
**Roswell, New Mexico**

measurements were used to estimate the volume of water in the BARCAD™ riser pipe. Table 5-2 presents the groundwater elevation data collected at Silo Site 8 during these activities.

### 5.4.2 BARCAD™ Monitoring Well Sampling Methodology

Groundwater analytical samples were collected from the six newly installed BARCAD™ monitoring wells at Silo Site 8. Figure 5-1 shows each sampling location. The BARCAD™ monitoring wells were sampled using a dedicated ¼-inch tube inserted into the 1-inch PVC riser pipe, down to a depth within a few inches above the porous section. Compressed nitrogen gas was applied through a ½-inch air line to the 1-inch well riser pipe with the control of a regulator. Application of the compressed gas closed the check valve, located above the porous section, which pushed the water column in the riser pipe to the surface through the ¼-inch discharge tubing. Once one volume of water was purged, the nitrogen gas was turned off, opening the check valve so that groundwater could recharge the riser pipe. Samples were collected directly from the ¼-inch discharge tubing into the sample containers. Filtered water samples were also collected by placing a 0.45-micron filter in line with the ¼-inch tubing. Photo 18 shows the sampling setup at one of the wells.

### 5.4.3 Silo Water Sampling Activities

Under subcontract to Shaw, Albuquerque Concrete Coring, Inc. cored through the silo door at Silo Site 8 for access to the silo interior for gauging and sampling activities. Several attempts to core through the door were unsuccessful due to imbedded hardened steel plates and 1¼-inch-diameter steel reinforcing bars. The 32-inch-thick reinforced concrete door was cored with a diamond-impregnated, hollow-core barrel. Once the door was successfully cored, gauging and sampling activities within the silo interior commenced.

AVM installed a temporary BARCAD™ monitoring well assembly within the silo water column (Photo 19). The temporary assembly included a ¼-inch air line in place of the typical 1-inch PVC riser pipe. The BARCAD™ assembly was lowered into the silo with a safety rope to within the top 15 feet of the silo water column. Once the BARCAD™ assembly was secured, the ¼-inch tubing waterline was purged using compressed nitrogen, and silo water samples were collected. After sampling the upper 15 feet of the silo water column, the BARCAD™ assembly was lowered into the bottom 15 feet of the silo water column. After securing the BARCAD™ assembly at this location, the water line was purged, and samples were collected (Photo 20). The entire BARCAD™ assembly was then removed from the silo and the holes in the silo door were patched flush to the surface with nonshrink grout, prior to leaving Silo Site 8.

### 5.4.4 Lake Arthur Water Supply Well Sampling

At the direction of the USACE, samples were collected from one of the two water supply wells in the town of Lake Arthur, located at Silo Site 8. Water is pumped from these two wells to an adjacent chlorine treatment system; however, the samples were collected directly from the wellhead prior to chlorination. While the pump was in operation, water was collected from a brass sample port attached to a PVC union on the wellhead of the well, identified as Town Well North. The Town Well North pump had been operating for at least 20 minutes prior to sample collection. The sample flow was controlled to allow low flow through a short piece of dedicated tubing directly into the sample container. The town well was sampled twice, at an approximate one-month interval. Groundwater quality parameters were measured during the second sampling event.

### 5.4.5 Field Procedures and Methods

Groundwater quality measurements (pH, specific conductivity, turbidity, dissolved oxygen, temperature, and oxidation-reduction potential) were collected during BARCAD™ monitoring. Water quality readings were obtained from sensors in a closed, flow-through cell using a Horiba™ U-22 water quality meter. The instrument sensors were checked, calibrated, and documented to be operational prior to purging activities (Appendix A4). Table 5-3 provides the groundwater quality measurements from BARCAD™ monitoring wells at Silo Site 8.

All groundwater samples were collected by filling the laboratory-provided sample bottles. The filtered fraction sample for TAL metals was passed through a 0.45-micron, disposable filter cartridge directly into sample containers. Upon filling each container, the sample was immediately placed into a laboratory-provided cooler with ice. Shaw maintained custody of the samples at all times, until relinquished to Federal Express for overnight shipment to the laboratory.

Chain-of-custody documentation was electronically generated in the field, using the EPA software program "FORMS II Lite, Version 5.1" (DynCorp, 2002), and placed in each cooler to accompany samples to the laboratory. Sample collection logs were completed for each collected sample (Appendix A4).

## 5.5 Analytical Parameters

Analytical procedures from EPA SW-846 (EPA, 1986) were used for the chemical analyses of parameters in the groundwater samples collected. Water samples were submitted to Kemron for the following analyses.

- VOCs by EPA Method 8260B
- SVOCs by EPA Method 8270C
- PAH by EPA Method 8270C-Modified for Low Level PAH

**Table 5-3**
**Water Quality Field Measurements**
**Environmental Site Investigation: Former Atlas Missile Silo Sites 8 and 9**
**Roswell, New Mexico**

| Silo Site 8 Location ID | Measurement Date | Purge Volume (liters) | Dissolved Oxygen (mg/L) | ORP (mV) | pH | Specific Conductance (mS/cm) | Temperature (°C) | Turbidity (NTU) | Comment |
|---|---|---|---|---|---|---|---|---|---|
| S8-MW1-A | 08/30/2004 | 1.2 | 4.04 | 112 | 7.81 | 3.60 | 20.82 | 7.5 | N/A |
| S8-MW1-B | 08/30/2004 | 5.5 | 1.62 | 104 | 7.58 | 3.10 | 20.01 | 0 | N/A |
| S8-MW2 | 08/31/2004 | 6.0 | 1.06 | 194 | 6.88 | 3.29 | 18.98 | 0 | N/A |
| S8-MW3 | 08/30/2004 | 7.1 | 1.49 | 102 | 7.60 | 3.37 | 19.70 | 28.7 | N/A |
| S8-MW4-A | 08/30/2004 | 8.8 | 0.26 | 73 | 7.46 | 22.2 | 20.74 | 9.4 | N/A |
| S8-MW4-B | 08/30/2004 | 21.31 | 1.84 | 119 | 7.88 | 31.4 | 20.10 | 3.1 | N/A |
| Upper 15-foot silo water column | 08/31/2004 | 2.750 | 0.75 | -203 | 9.19 | 28.2 | 21.99 | 0 | Strong hydrocarbon odor, slight sheen |
| Bottom 15-foot silo water column | 08/31/2004 | 2.9 | 1.78 | -287 | 9.43 | 32.4 | 21.17 | 5.6 | Strong hydrocarbon odor, slight sheen |
| TownWellNorth-3 | 10/13/2004 | N/A | 0.32 | -74 | 7.25 | 1.06 | 23.9 | 3.3 | Clear |

*°C = Degrees Celsius.*
*ID = Identification.*
*mg/L = Milligram(s) per liter.*
*mS/cm = Millisiemens per centimeter.*
*mV = Millivolts.*
*N/A = Not applicable.*
*NTU = Nephelometric turbidity unit.*
*ORP = Oxidation Reduction Potential.*

- TAL metals by EPA Methods 6010B/6020/7470A (filtered and unfiltered)
- The laboratory performed searches for mass spectra library files and reported the top 10 TICs for each VOC and SVOC analysis.
- Additional analyses were performed for total dissolved solids (Method 160.1) for four samples.

## 5.6 Groundwater and Silo Water Sample Results and Evaluation

To aid in the identification of potential hazardous constituents, selected evaluation criteria were established representing the more conservative standard of either the New Mexico Water Quality Control Commission (NMWQCC) groundwater standards (NMWQCC, 2002), or the EPA's National Primary and Secondary Drinking Water Regulations Maximum Contaminant Levels (EPA, 2001). Appendix B1 lists the evaluation criteria used for groundwater results. The following sections discuss the groundwater and silo water sample results that exceeded evaluation criteria.

### 5.6.1 Groundwater Sample Results

BARCAD™ Monitoring Well S8-MW1-A, completed in the perched unit at 56 feet bgs, had concentrations of lead (0.0503 milligram(s) per liter [mg/L]) and antimony (0.0585 mg/L) in the unfiltered sample exceeding evaluation criteria of 0.015 and 0.006 mg/L, respectively. Lead and antimony did not exceed evaluation criteria in the filtered groundwater sample. VOCs, SVOCs, and PAH were not detected above evaluation criteria in any groundwater sample collected from Silo Site 8.

Manganese and aluminum were detected above evaluation criteria in all groundwater samples collected at Silo Site 8. The maximum manganese and aluminum concentrations were detected in BARCAD™ Monitoring Well S8-MW1-A at 0.531 and 32.8 mg/L, respectively. Evaluation criteria of 0.05 mg/L for manganese and aluminum are secondary EPA drinking water standards and are not enforceable.

Various other metal concentrations detected in groundwater samples from BARCAD™ Monitoring Wells S8-MW4-A and S8-MW4-B exceeded evaluation criteria. BARCAD™ Monitoring Wells S8-MW4-A and S8-MW4-B are completed at 142 and 239 feet bgs, respectively. Results for total dissolved solids (TDS) samples collected from BARCAD™ Monitoring Wells S8-MW4-A and S8-MW4-B were 98,200 and 34,100 mg/L, respectively. According to the NMWQCC Regulations (Section 20.6.2 New Mexico Administration Code [NMAC]), standards for groundwater do not apply to groundwater with TDS concentrations greater than 10,000 ppm; therefore, metal results from these BARCAD™ monitoring wells are not discussed. Table 5-4 lists analyte concentrations in excess of evaluation criteria.

**Table 5-4**
**Groundwater and Silo Water Results Exceeding Evaluation Criteria**
**Environmental Site Investigation: Former Atlas Missile Silo Sites 8 and 9**
**Roswell, New Mexico**

| Sample Number | Sample Depth (ft bgs) | Analytical Parameters[a] | Total or Dissolved Sample[b] | Analyte | Result | Units | Evaluation Criteria[c] | Reporting Limit | Laboratory MDL |
|---|---|---|---|---|---|---|---|---|---|
| **Silo Site 8** | | | | | | | | | |
| **BARCAD™ Monitoring Well Samples** | | | | | | | | | |
| S8-MW1-A-1 | 56.25–57.25 | 6010B | Total | Aluminum | 32.8 | mg/L | 0.05 | 0.100 | 0.05 |
| | | | | Iron | 21.2 | mg/L | 0.3 | 0.0400 | 0.02 |
| | | | | Lead | 0.0503 | mg/L | 0.015 | 0.00500 | 0.0025 |
| | | | | Manganese | 0.531 | mg/L | 0.05 | 0.0100 | 0.001 |
| | | 6020 | | Antimony | 0.0585 | mg/L | 0.006 | 0.00100 | 0.0005 |
| S8-MW1-A-2 | | 6010B | Dissolved | Aluminum | 0.173 | mg/L | 0.05 | 0.100 | 0.05 |
| | | | | Manganese | 0.0996 | mg/L | 0.05 | 0.0100 | 0.001 |
| S8-MW1-B-1 | 89.75–92.25 | 6010B | Total | Aluminum | 0.223 | mg/L | 0.05 | 0.100 | 0.05 |
| | | | | Manganese | 0.107 | mg/L | 0.05 | 0.0100 | 0.001 |
| S8-MW1-B-2 | | 6010B | Dissolved | Aluminum | 0.153 | mg/L | 0.05 | 0.100 | 0.05 |
| | | | | Manganese | 0.106 | mg/L | 0.05 | 0.0100 | 0.001 |

**Table 5-4 (Continued)**
**Groundwater and Silo Water Results Exceeding Evaluation Criteria**
**Environmental Site Investigation: Former Atlas Missile Silo Sites 8 and 9**
**Roswell, New Mexico**

| Sample Number | Sample Depth (ft bgs) | Analytical Parameters[a] | Total or Dissolved Sample[b] | Analyte | Result | Units | Evaluation Criteria[c] | Reporting Limit | Laboratory MDL |
|---|---|---|---|---|---|---|---|---|---|
| **BARCAD™ Monitoring Well Samples (Continued)** | | | | | | | | | |
| S8-MW2-1 | 100.33–102.83 | 6010B | Total | Aluminum | 0.142 | mg/L | 0.05 | 0.100 | 0.05 |
| | | | | Manganese | 0.102 | mg/L | 0.05 | 0.0100 | 0.001 |
| S8-MWD1-A-1 (Duplicate of S8-MW2-1) | | 6010B | Total | Aluminum | 0.149 | mg/L | 0.05 | 0.100 | 0.05 |
| | | | | Manganese | 0.105 | mg/L | 0.05 | 0.0100 | 0.001 |
| S8-MW2-2 | | 6010B | Dissolved | Aluminum | 0.156 | mg/L | 0.05 | 0.100 | 0.05 |
| | | | | Manganese | 0.0953 | mg/L | 0.05 | 0.0100 | 0.001 |
| S8-MW3-1 | 102.50–105.00 | 6010B | Total | Aluminum | 0.760 | mg/L | 0.05 | 0.100 | 0.05 |
| | | | | Manganese | 0.197 | mg/L | 0.05 | 0.0100 | 0.001 |
| S8-MW3-2 | | 6010B | Dissolved | Aluminum | 0.201 | mg/L | 0.05 | 0.100 | 0.05 |
| | | | | Manganese | 0.179 | mg/L | 0.05 | 0.0100 | 0.001 |

**Table 5-4 (Continued)**
**Groundwater and Silo Water Results Exceeding Evaluation Criteria**
**Environmental Site Investigation: Former Atlas Missile Silo Sites 8 and 9**
**Roswell, New Mexico**

| Sample Number | Sample Depth (ft bgs) | Analytical Parameters[a] | Total or Dissolved Sample[b] | Analyte | Result | Units | Evaluation Criteria[c] | Reporting Limit | Laboratory MDL |
|---|---|---|---|---|---|---|---|---|---|
| **BARCAD™ Monitoring Well Samples (Continued)** | | | | | | | | | |
| S8-MW4-A-1 | 142.00–144.50 | 6010B | Total | Aluminum | 286 | mg/L | 0.05 | 0.100 | 0.05 |
| | | | | Arsenic | 0.175 | mg/L | 0.05 | 0.00400 | 0.002 |
| | | | | Iron | 42.3 | mg/L | 0.3 | 0.0400 | 0.02 |
| | | | | Lead | 0.0399 | mg/L | 0.015 | 0.00500 | 0.0025 |
| | | | | Manganese | 1.07 | mg/L | 0.05 | 0.0100 | 0.001 |
| | | 6020 | | Antimony | 0.105 | mg/L | 0.006 | 0.00100 | 0.0005 |
| | | | | Selenium | 0.0550 | mg/L | 0.05 | 0.0100 | 0.005 |
| | | 160.1 | | TDS | 98,200 | mg/L | 10,000 | 1000 | 500 |
| S8-MW4-A-2 | | 6010B | Dissolved | Aluminum | 1.85 | mg/L | 0.05 | 0.100 | 0.05 |
| | | | | Arsenic | 0.149 | mg/L | 0.05 | 0.00400 | 0.002 |
| | | | | Manganese | 0.476 | mg/L | 0.05 | 0.0100 | 0.001 |
| | | 6020 | | Selenium | 0.0645 | mg/L | 0.05 | 0.0100 | 0.005 |
| S8-MW4-B-1 | 239.80–242.30 | 6010B | Total | Aluminum | 1.28 | mg/L | 0.05 | 0.500 | 0.25 |
| | | | | Manganese | 0.462 | mg/L | 0.05 | 0.0100 | 0.001 |
| | | 160.1 | | TDS | 34,100 | mg/L | 10,000 | 1000 | 500 |
| S8-MW4-B-2 | | 6010B | Dissolved | Aluminum | 0.596 | mg/L | 0.05 | 0.100 | 0.05 |
| | | | | Manganese | 0.417 | mg/L | 0.05 | 0.0100 | 0.001 |

**Table 5-4 (Continued)**
**Groundwater and Silo Water Results Exceeding Evaluation Criteria**
**Environmental Site Investigation: Former Atlas Missile Silo Sites 8 and 9**
**Roswell, New Mexico**

| Sample Number | Sample Depth (ft bgs) | Analytical Parameters[a] | Total or Dissolved Sample[b] | Analyte | Result | Units | Evaluation Criteria[c] | Reporting Limit | Laboratory MDL |
|---|---|---|---|---|---|---|---|---|---|
| **Silo Water Samples** | | | | | | | | | |
| S8-SW1-1 | 150 | 6010B | Total | Aluminum | 0.288 | mg/L | 0.05 | 0.100 | 0.05 |
| | | | | Manganese | 0.153 | mg/L | 0.05 | 0.0100 | 0.001 |
| | | 160.1 | | TDS | 16,900 | mg/L | 10,000 | 200 | 100 |
| S8-SW1-2 | | 6010B | Dissolved | Aluminum | 0.241 | mg/L | 0.05 | 0.100 | 0.05 |
| | | | | Manganese | 0.100 | mg/L | 0.05 | 0.0100 | 0.001 |
| S8-SW2-1 | 165–170 | 6010B | Total | Aluminum | 0.383 | mg/L | 0.05 | 0.100 | 0.05 |
| | | | | Manganese | 0.244 | mg/L | 0.05 | 0.0100 | 0.001 |
| | | 160.1 | | TDS | 20,100 | mg/L | 10,000 | 1000 | 500 |
| S8-SW2-2 | | 6010B | Dissolved | Aluminum | 0.272 | mg/L | 0.05 | 0.100 | 0.05 |
| | | | | Manganese | 0.236 | mg/L | 0.05 | 0.0100 | 0.001 |

[a]*U.S. Environmental Protection Agency (EPA), 1986, "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, 3rd ed., U.S. Environmental Protection Agency, Washington, D.C.*

[b]*Total = Unfiltered samples.*

[c]*Evaluation Criteria are found in Appendix B1. Evaluation criteria were selected from either 1) U.S. Environmental Protection Agency (EPA), 2001, "National Primary Drinking Water Regulations," Office of Water, U.S. Environmental Protection Agency, Washington, D.C. or 2) New Mexico Water Quality Control Commission (NMWQCC), 2002, "New Mexico Water Quality Control Commission Regulation," Section 20.6.2 of the New Mexico Administrative Code, New Mexico Water Quality Control Commission, Santa Fe, New Mexico.*

*bgs = Below ground surface.*
*Dissolved = Samples collected through a 0.45 micron filter.*
*ft = Foot (feet).*
*MDL = Method detection limit.*
*mg/L = Milligram(s) per liter.*
*TDS = Total dissolved solids.*

### 4.1.3 Former UST Area

One soil sample was collected 45 feet bgs in the former UST area at the site. Organic vapors were not detected with field-screening methods (Ref. 2, pp. 29, 32). The analytical results from the soil sample did not exceed the evaluation criteria (Ref. 2, p. 33).

The TIC ethyl acetate was identified in the soil sample. In accordance with the site investigation quality assurance plan, no further action was necessary regarding the TIC (Ref. 2, pp. 35-36, 39).

### 4.1.4 Additional Soil Sampling

Soil samples were collected 45 feet bgs from two deep boreholes drilled to the west of the concrete silo pad. No organic vapors were detected with field-screening methods (Ref. 2, pp. 28-29).

Arsenic was detected at a concentration of 13.4 mg/kg in one of the soil samples. No other TAL metals, VOCs, or SVOCs were detected above evaluation criteria in the soil samples collected from the deep boreholes (Ref. 2, p. 33).

### 4.1.5 Groundwater and Silo Water Sampling

Six monitoring wells were installed in the four deep boreholes at the site. The borehole in the former UST area had nested wells completed within groundwater zones at 57 feet bgs and 92 feet bgs. Nested wells were also completed in groundwater zones in the borehole immediately north of the former UST area at 145 feet bgs and 242 feet bgs. One well was completed at 103 feet bgs northwest of the former UST area and another well was completed at 105 feet bgs southwest of the former UST area (Ref. 2, pp. 45-46).

The well at 57 feet bgs in the former UST area had concentrations of lead at 0.0503 milligrams per liter (mg/L) and antimony at 0.0585 mg/L in the unfiltered sample, which exceeded the evaluation criteria of 0.015 and 0.006 mg/L, respectively. Lead and antimony did not exceed evaluation criteria in the filtered groundwater sample. Manganese and aluminum were detected above evaluation criteria in all groundwater samples collected at the site. VOCs, SVOCs, and PAH were not detected above evaluation criteria in any groundwater samples collected from the site (Ref. 2, p. 53).

The established evaluation criteria are not applicable to the standing water in the silo, but silo water sample results were compared to the evaluation criteria. Manganese and aluminum concentrations were detected above evaluation criteria in the two silo water samples at 0.244 mg/L and 0.383 mg/L, but VOCs, SVOCs, and PAH were not detected above evaluation criteria. It should be noted that the silo water is not considered a domestic water supply (Ref. 2, p. 58).

## 4.2 PROPOSED PROJECTS

No additional HTRW and CON/HTRW projects are proposed.

Appendix B2 presents all detected compounds in groundwater samples, and Appendix F2 contains complete analytical laboratory reports.

### 5.6.2 Silo Water Sample Results

The established evaluation criteria are not applicable to the standing water in the silo; however, the silo water sample results are compared to the evaluation criteria here for discussion purposes only. VOCs, SVOCs, and PAH were not detected above evaluation criteria in silo water samples. Manganese and aluminum concentrations were detected above evaluation criteria in silo water samples at maximum concentrations of 0.244 and 0.383 mg/L, respectively. TDS results for both unfiltered silo water samples (S8-SW1-1 and S8-SW2-1) were 16,900 and 20,100 mg/L, respectively. Silo water is not considered a domestic water supply and will not be considered for domestic supply in the future; therefore, no further action is necessary.

# 6.0 Survey Activities

## 6.1 GPS Survey

Two levels of surveying were conducted at Silo Sites 8 and 9. An overall site survey was conducted prior to commencement of drilling and sampling activities in order to locate and identify site features, as they currently exist. Locations of site features, such as small concrete structures or debris, were mapped as point coordinates. Linear data were mapped for features such as the outline of the evaporation ponds, circular water tank pads, and the rough outline of the former UST excavation depression. Point coordinates and linear definitions of site features were surveyed with a Trimble Pro XRS GPS unit that recorded horizontal coordinates in latitude and longitude, referenced to the North American Datum (NAD) of 1927 (Photo 21). Horizontal and vertical data were corrected in three-dimensional real time, at the time of mapping from base station correction signals. GPS data were converted to the State Plane Coordinate System (SPCS) New Mexico East Zone, (NAD 83), with Trimble Pathfinder Office Software. Results of the GPS Survey are presented in Figures 4-1 and 4-2.

## 6.2 Civil Survey

Upon completion of BARCAD™ monitoring well installation and sample collection activities, a civil survey was conducted by Landmark Surveying, a licensed New Mexico surveyor, to accurately locate BARCAD™ monitoring wells, soil borings, and soil sample locations. The civil survey was performed with a Rascal® 8-Channel Real Time Kinematic Surveying System and a Zeiss® Automatic Level. Horizontal coordinates were recorded in the SPCS New Mexico, East Zone, referenced to the NAD 83. Vertical elevations were referenced to the U.S. Coast and Geodetic Survey's 1988 National Geodetic Vertical Datum. Elevations, in feet amsl, for BARCAD™ monitoring wells were measured to the top of the PVC riser pipe and at ground surface. Surveyed points were tied to a known benchmark at each silo site. Civil survey data for the BARCAD™ monitoring wells, deep boreholes/soil borings, and soil sample locations are incorporated in Figures 4-1 and 4-2. Table 5-2 presents the BARCAD™ monitoring well survey data.

# 10.0 Summary and Recommendations

The objectives of the ESI are as follows:

- Determine whether or not previous DOD activities at the Former Atlas Missile Silo Sites resulted in the presence of chemicals at concentrations that may impact human health and the environment

- Identify potentially hazardous constituents that may have migrated from the Former Atlas Missile Silo Sites to the surrounding soil and/or groundwater, and determine whether any detectable constituents present at concentrations above evaluation criteria can be attributed to past DOD activities.

- Determine the presence of potentially hazardous constituents at three potential source areas, at each silo site. Potential contaminant source areas include soil and groundwater surrounding the silo to a depth of approximately 250 feet bgs (including standing water within the silo), the septic tank leachfields, and the silo sump outfall areas for silo sump discharge.

To accomplish these objectives, soil and groundwater samples were collected and analyzed for potentially hazardous constituents. This section presents a summary of the soil and groundwater assessments and provides recommendations based upon these findings.

## 10.1 Summary

### 10.1.1 Silo Site 8

#### Soil Assessment Summary

The soil assessment investigated potential releases of hazardous constituents to surface and subsurface soil from the following potential contaminant source areas:

- Septic Leachfield
- Sump Outfall
- Former UST Area

Arsenic concentrations exceeded evaluation criteria (3.9 mg/kg) in samples collected from Deep Borehole BH8-3 (45 feet bgs) and the septic leachfield soil boring AHL8-4 (9 to 12 feet bgs) at concentrations of 13.4 and 4.71 mg/kg, respectively. BaP was detected at an estimated concentration of 63 μg/kg, slightly exceeding the evaluation criteria of 62 μg/kg, in the duplicate soil sample collected from material in the sump outfall pipe; however, the primary sample result for BaP was below evaluation criteria. No analytes were detected above the evaluation criteria in the soil sample collected from the deep borehole (BH8-1) advanced through the former UST area. No other VOCs, SVOCs, or PAH, were detected at concentrations exceeding evaluation criteria in soil samples collected during the ESI at Silo Site 8.

Given the geologic setting of Silo Site 8, where basin fill deposits overlay evaporates (anhydrite and limestone), it is not uncommon to find naturally occurring arsenic levels at slightly elevated concentrations. To demonstrate that arsenic levels detected during the ESI are naturally occurring, a geochemical evaluation was performed on soil samples collected at Silo Site 8. The geochemical evaluation of arsenic in soil involved correlating detectable concentrations of arsenic to iron. Soil samples with higher arsenic concentrations also contained higher iron concentrations, indicating naturally occurring conditions. Appendix J discusses arsenic in soil and the geochemical methods used in the evaluation.

Based upon soil sample results, there have been no impacts to soil from the potential source areas at Silo Site 8.

#### *Groundwater Assessment*

Four potential groundwater units were encountered during deep borehole advancement at Silo Site 8 as follows:

- A perched groundwater unit encountered within the basin fill deposits ranging from 40 to 55 feet bgs
- A second groundwater unit at the interface of the basin fill deposits and bedrock ranging from 89 to 105 feet bgs
- A shallow bedrock groundwater unit encountered at 120 feet bgs
- A potential deep bedrock groundwater unit encountered at 190 feet bgs

Based upon recharge rates during sampling and observations made during drilling, the deep bedrock groundwater unit produces less water than the other three identified groundwater units. Groundwater flow direction in the interface groundwater unit is to the southeast.

In order to determine whether groundwater has been impacted, BARCAD™ monitoring wells were completed in each of the groundwater units. Both filtered and unfiltered samples were collected. Lead (0.0503 mg/L) and antimony (0.0585 mg/L) were detected at concentrations exceeding evaluation criteria (0.015 and 0.006 mg/L, respectively) in the unfiltered groundwater sample collected from BARCAD™ Monitoring Well S8-MW-1A, completed in the perched unit. The NMWQCC Regulations, Section 20.6.2.3103, state that standards shall apply to the dissolved portion of the contaminant. Therefore, based upon the filtered sample results (dissolved), lead and antimony concentrations were below evaluation criteria. Manganese and aluminum were detected above evaluation criteria (0.05 and 0.05 mg/L) in all groundwater units at Silo Site 8. The maximum manganese and aluminum concentrations were detected in BARCAD™ Monitoring Well S8-MW1-A at 0.531 and 32.8 mg/L, respectively. Evaluation criteria for these metals are unenforceable secondary standards and no further action is recommended, in accordance with the established DQOs (Shaw, 2004). Various other metals were detected above evaluation criteria in groundwater samples collected from the shallow bedrock groundwater unit (S8-MW-4A) and deep bedrock groundwater unit (S8-MW-4B). TDS results for these BARCAD™ monitoring wells were well above the NMWQCC standard of 10,000 mg/L; therefore, groundwater standards are not applicable, and no further action is recommended in accordance with the established DQOs (Shaw, 2004).

TDS results for both unfiltered silo water samples (S8-SW1-1 and S8-SW2-1) were 16,900 and 20,100 mg/L, respectively. Silo water is not considered a domestic water supply and will not be considered for domestic supply in the future; therefore, no further action is necessary.

### 10.1.2 Silo Site 9

There were no analytes detected in the soil samples collected at Silo Site 9 exceeding evaluation criteria. Groundwater was not encountered at Silo Site 9 within the study boundary (250 feet bgs). No further action is recommended in accordance with the established DQOs (Shaw, 2004).

## 10.2 Recommendations

Based upon the results of field activities and a review of the ESI analytical data, the following recommendations are proposed for each silo site.

### 10.2.1 Silo Site 8

Metals detected in soil samples at concentrations exceeding evaluation criteria were determined to be naturally occurring and not indicative of contamination. Metals in groundwater samples from the perched groundwater unit exceeding evaluation criteria, are not indicative of contamination, and most likely represent natural conditions. TDS in the bedrock groundwater units and silo water indicate that they are not a potable water source, and will not be used as a potable water source in the future; therefore, no further action is recommended for Silo Site 8 in accordance with the established DQOs (Shaw, 2004).

### 10.2.2 Silo Site 9

No analytes were detected in soil samples at Silo Site 9 exceeding evaluation criteria. Groundwater was not encountered at Silo Site 9 to the study boundary of 250 feet bgs. Subsurface conditions consisted of limestone bedrock to 250 feet, making migration of any potential contaminants to the groundwater table unlikely; therefore, no further action is recommended for Silo Site 9 in accordance with the established DQOs (Shaw, 2004).

**REFERENCE 3**

# Final Environmental Site Investigation Report
# Atlas Missile Silo Nos. 2, 3, 4, 5, 6, 8, 9, 10, 11, and 12
# Roswell, New Mexico

**Contract No. DACA47-97-D-0021**
**Delivery Order No. 0003**

**PREPARED FOR:**
**United States Army Corps of Engineers**
**Albuquerque, New Mexico**

**PREPARED BY:**
**IT Corporation**
**5301 Central Avenue NE, Suite 700**
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Approved by: Craig Stevens Date: 01/17/01
IT QC Manager

Approved by: Wale T. Moe for Steve Rangel Date: 1/18/01
IT Delivery Order Manager

Approved by: Stephen A. Dodds for Devon Jercinovic Date: 1/18/01
IT Project Manager

January 2001

# 7.0 Silo No. 8

## 7.1 Site Background

### 7.1.1 Site Description

The Silo No. 8 site is located approximately 30 miles southeast of Roswell, New Mexico, along Highway 285. Elevation at the highway is approximately 3360 feet amsl and gently climbs to approximately 3,375 feet amsl at the site an estimated 0.25 mile from the highway (Corps, 1993). A site map showing the current features and layout of the site is shown on Figure 6.

### 7.1.2 Site History

The DoD acquired approximately 250 acres for site development. The actual missile facility consisted of approximately 6 acres including a road easement. The DoD installed three 1,130-foot water wells on the site. The current site owner, the Lake Arthur Water Conservation Cooperative, uses two of the wells to supply water to the Lake Arthur Community. The Lake Arthur Water Conservation Cooperative samples the wells quarterly and sends the samples for analysis to a state-authorized laboratory in Clovis, New Mexico. Water sample results indicated no unacceptable levels of contaminants as defined by State and Federal drinking water quality criteria. The LCC and silo entrances remain sealed, but the silo is known to contain water (Corps, 1993). Figure 6 is a site location map for Silo No. 8 showing the features and layout of the site.

### 7.1.3 Summary of Field Investigations

The following field activities took place at Silo No. 8.

- April 1994—Four test borings were advanced and soil samples were collected.
- August 1994—A deep soil boring was advanced and completed as a monitoring well (MW-8).
- August 1995—A groundwater sample was collected from MW-8.
- September 1995—A silo water sample was collected.
- September 1996—A supplemental soil boring was advanced and a soil sample was collected from the soil boring.
- June 1997—Monitoring Well MW-8 was abandoned.

## 7.2 Study Area Investigations

### 7.2.1 Contaminant Source Investigations (Local)

Contaminant source investigations at Silo No. 8 included sample collection at locations where contamination could potentially exist, based on known activities at the site. Potential contaminant source areas at Silo No. 8 include the former location of the diesel UST, a septic system (septic tank and leachfield), and the silo or a source inside the silo. Section 7.4 discusses the results of the contaminant investigations.

### 7.2.2 Soil and Vadose Zone Investigations

Shallow test borings were advanced in the vicinity of Silo No. 8 in order to investigate soil and vadose zone contamination. The test borings were drilled with hollow-stem auger methods by a CME 75 mounted on a 2-wheel drive truck. All drilling equipment, including the drill rig, augers, and drill rod, were decontaminated prior to borehole advancement (Corps, 1999a).

Soil samples were obtained either with a 5-foot continuous sampler or with a 2-inch diameter split-spoon sampler. The continuous sampler was attached to rods inside the auger flights and was advanced ahead of the lead auger to collect an undisturbed soil sample 3 inches in diameter and 5 feet in length. The split-spoon sampler was used in place of the continuous sampler only when friction caused high temperatures inside the continuous sampler. The split-spoon sampler was driven 18 inches into the soil ahead of the lead auger to obtain undisturbed soil samples (Corps, 1999a).

#### 7.2.2.1 Test Borings

In April 1994 four shallow test borings were advanced at Silo No. 8 to a depth of 17.5 feet bgs using the methods described above (Corps, 1999b). Two soil samples were collected from each test boring; the first from 1.5 foot bgs, and the second from the bottom of the test boring. A soil sample was collected during drilling of the monitoring well (MW-8) soil boring from a depth of 230 to 235 feet bgs. The locations of the four test borings and MW-8 are shown on Figure 6.

A supplemental soil boring (SB1) was advanced at Silo No. 8 to 15 feet bgs in September 1996. A soil sample was collected from SB1 from the 14- to 15-foot bgs depth interval. The location and objective of the supplemental soil boring is not known.

#### 7.2.2.2 Soil Sampling and Analysis

Soil samples collected from the shallow test borings were analyzed for VOCs using EPA Method 8240; for SVOCs using EPA Method 8270; for pesticides and PCBs using EPA Method 8080; for metals using EPA Method 6010/7000; for TPH using EPA Method 8015m; and for total solids using EPA Method 160.3. The soil sample collected from the monitoring well soil boring was analyzed for all the above parameters and corresponding methods with the exception of VOCs.

The soil sample collected from SB1 was analyzed for SVOCs using EPA Method 8270; for pesticides and PCBs using EPA Method 8080; for metals using EPA Method 6010/7000; and for TPH using EPA Method 8100m. The dates, depths, sample parameters, and laboratories for soil samples from Silo No. 8 are summarized in Table 1.

#### 7.2.2.3 Test Boring Abandonment

The test borings were abandoned immediately after sampling by backfilling with drill cuttings. Headspace measurements with a PID were used to screen excess soil samples and cuttings. Any soil material exceeding 5 parts per million on the PID was returned to the test boring, and the remainder of uncontaminated cuttings were spread evenly around the borehole (Corps, 1999a).

### 7.2.3 Groundwater/Silo Water Investigations

A groundwater monitoring well was installed to 235 feet bgs at Silo No. 8 in order to investigate potential groundwater contamination. A groundwater sample was collected from MW-8 on August 1995. The groundwater sample was analyzed for VOCs using EPA Method 8240; for SVOCs using EPA method 8270; for pesticides and PCBs using EPA Method 8080; for metals using EPA Method 6010/7000; and for TPH using EPA Method 8015m.

Field documentation provided by the Corps indicated that a silo water sample was collected from Silo No. 8 in September 1995. Results for the Silo No. 8 water sample were not available for inclusion in this report.

## 7.3 Physical Characteristics of the Site

### 7.3.1 Surface Features

The construction and layout of the silo pad are similar at each silo and are shown in Figure 2. The silo pad consists of a paved area approximately 170 feet square with a 70-foot outside diameter silo in the center. A covered stairwell entrance to the LCC and the underground structure is in the northwestern corner and a UST for diesel fuel was typically located off the eastern edge of the pad. The LCCs are 33 feet deep and 44 feet in diameter. The missile silos are 174 feet deep with an inside diameter of 52 feet. Other features of the silo include septic systems, evaporation ponds, and concrete building pads (Corps, 1993) (Figure 2). Current features at Silo No. 8 are shown on Figure 6.

### 7.3.2 Geology

This section discusses the site-specific subsurface soils and bedrock as observed in test borings and during drilling of the monitoring well soil boring.

Site-specific geologic conditions were interpreted from the four shallow test borings and the monitoring well soil boring advanced at the site (Corps, 1999a). Brown to red-brown sands with varying amounts of clay, silt, and gravel were encountered in Test Borings 1 and 2 to 17.5 feet bgs. A brown sandy clay was encountered to 17.5 feet bgs in Test Borings 3 and 4.

Stratigraphically deeper geologic conditions (greater than 17.5 feet) consisted of a sandy-clay extending to approximately 34 feet bgs. Alternating sands, gravels, and clays were encountered from 34 feet to approximately 62 feet bgs. A thin shale unit (approximately 1 foot thick) was encountered at 62 feet bgs. Underlying the shale was a red-brown clay to 97 feet bgs. An anhydrite deposit was encountered from 97 to 105 feet underlain by interbedded anhydrite and clay shale to 150 feet bgs. Limestone was encountered from 159 feet bgs to the total depth of the soil boring (235 feet bgs) (Corps, 1999b).

### 7.3.3 Hydrogeology

#### 7.3.3.1 Depth to Water

The depth to water measured in MW-8 in August 1994 was 136 feet bgs.

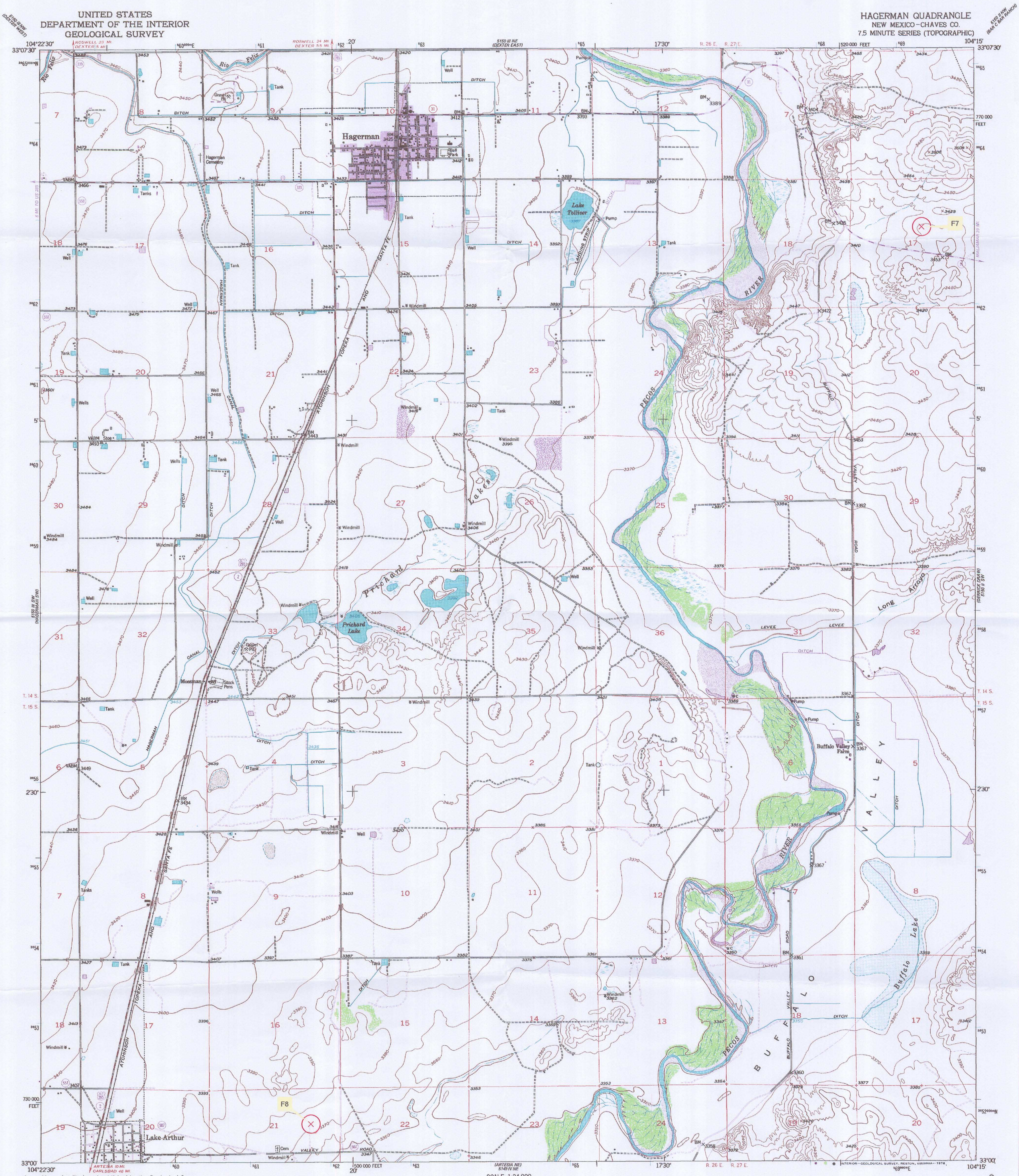
#### 7.3.3.2 Monitoring Well Construction

The monitoring well soil boring was drilled to 103 feet bgs with a 7-7/8-inch rock bit. The soil boring was then cored to a depth of 235 feet bgs (Corps, 1999a). The soil boring was completed with a 2-inch monitoring well to 220 feet bgs. The monitoring well was screened from 120 to 220 feet bgs. No monitoring well completion diagram was available for MW-8.

**REFERENCE 4**

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

HAGERMAN QUADRANGLE
NEW MEXICO—CHAVES CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)




Mapped, edited, and published by the Geological Survey

Control by USGS and USC&GS

Culture and drainage in part compiled from aerial photographs taken 1947. Topography by plane-table surveys 1951

Polyconic projection. 1927 North American datum
10,000-foot grid based on New Mexico coordinate system, east zone
1000-meter Universal Transverse Mercator grid ticks, zone 13, shown in blue

Revisions shown in purple compiled from aerial photographs taken 1975. This information not field checked

Purple tint indicates extension of urban areas

UTM GRID AND 1975 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

SCALE 1:24 000

CONTOUR INTERVAL 10 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS
FOR SALE BY U. S. GEOLOGICAL SURVEY, DENVER, COLORADO 80225, OR RESTON, VIRGINIA 22092
A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST

QUADRANGLE LOCATION

ROAD CLASSIFICATION

| | |
|---|---|
| Primary highway, all weather, hard surface | Light-duty road, all weather, improved surface |
| Secondary highway, all weather, hard surface | Unimproved road, fair or dry weather |
| U. S. Route | State Route |

HAGERMAN, N. MEX.
N3300—W10415/7.5

1951
PHOTOREVISED 1975
AMS 5150 III SE—SERIES V881

0001

**REFERENCE 5**

# ARTESIA 6 S, NEW MEXICO (290600)

### Period of Record Monthly Climate Summary

**Period of Record : 1/ 1/1914 to 9/30/2004**

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average Max. Temperature (F) | 56.8 | 62.1 | 69.1 | 78.2 | 86.4 | 94.0 | 94.7 | 93.2 | 86.9 | 77.9 | 65.8 | 57.9 | 76.9 |
| Average Min. Temperature (F) | 23.4 | 27.7 | 34.0 | 42.6 | 52.4 | 61.2 | 65.1 | 63.4 | 55.9 | 44.1 | 31.8 | 23.9 | 43.8 |
| Average Total Precipitation (in.) | 0.40 | 0.41 | 0.45 | 0.62 | 1.25 | 1.47 | 1.61 | 1.75 | 1.79 | 1.21 | 0.47 | 0.47 | 11.90 |
| Average Total SnowFall (in.) | 1.7 | 1.2 | 0.5 | 0.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.8 | 1.7 | 6.2 |
| Average Snow Depth (in.) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Percent of possible observations for period of record.
Max. Temp.: 64.4% Min. Temp.: 64.4% Precipitation: 98.5% Snowfall: 60% Snow Depth: 58.5%
Check Station Metadata or Metadata graphics for more detail about data completeness.

---

*Western Regional Climate Center, wrcc@dri.edu*

0001

**REFERENCE 6**

XVIII-20-1c

# HISTORY

# OF

# CORPS OF ENGINEERS

# BALLISTIC MISSILE CONSTRUCTION OFFICE

# CONSTRUCTION AND CONTRACT

# ACTIVITIES

# AT

# WALKER AIR FORCE BASE
# ROSWELL, NEW MEXICO

JUNE 1960 - JUNE 1962

~~"FOR OFFICIAL USE ONLY"~~


Stanford I. Polonsky
STANFORD I. POLONSKY
Lt. Col., CE
Area Engineer

UNITED STATES ARMY
CORPS OF ENGINEERS BALLISTIC MISSILE CONSTRUCTION OFFICE
LOS ANGELES, CALIFORNIA

WS-107A-1 MISSILE LAUNCH COMPLEXES
WALKER AIR FORCE BASE
ROSWELL, NEW MEXICO

## TABLE OF CONTENTS



## PART I - ADMINISTRATION

## PART II - CONSTRUCTION

## PART II - CONSTRUCTION

PART IV - MISCELLANEOUS
(cont'd)



## LIST OF FIGURES



## APPENDICES

# INTRODUCTION

Presented herewith is a complete and factual summary report of construction and contract activities associated with the construction of the Walker Air Force Base Atlas F Ballistic Missile Launching Facilities.

The scope of the report includes activities in connection with construction of twelve launching complexes and support facilities. It does not include installation of missiles and controls which is being accomplished by separate contract directly under the administration of the Site Activation Task Force of the Air Force.

The report is prepared and submitted in accordance with instructions contained in Corps of Engineers Ballistic Missile Construction Office Circular Number 61-74, issued 27 October 1961, subject: "Historical Summary Report of Major ICBM Construction".

# PART I

## ADMINISTRATION

ESTABLISHMENT AND FUNCTION: CORPS OF ENGINEERS BALLISTIC MISSILE CONSTRUCTION OFFICE (CEBMCO)

The U. S. Army Engineers established the Ballistic Missile Construction Office in Los Angeles on 1 August 1960. The office was established to further streamline, strengthen, and expedite ICBM site construction. ICBM construction consists of Atlas, Titan, and Minuteman squadron sites at various bases, as well as certain testing facilities at Vandenburg AFB, California and Cape Canavaral, Florida.

The Corps of Engineers Ballistic Missile Construction Office (CEBMCO) is commanded by Colonel E. E. Wilhoyt, Jr.

CEBMCO, through various Construction Directorates, controls the overall missile site construction program and supplies to the Area Offices any guidance required of them, ie: Construction, Electrical, Mechanical, Engineering, Propellant Loading System (PLS), Administration, etc.

Inasmuch as the Atlas F Areas were quite a distance from CEBMCO, numerous visits were made by CEBMCO Representatives to the different Area Offices, thereby assuring CEBMCO of the currency of events occurring in the field.

The Organization Chart (Fig. 1) shows the five ICBM Directorates under CEBMCO, with a further breakdown of the Atlas "F" Directorate, together with its six area offices.

ORGANIZATION CHART

CORPS OF ENGINEERS BALLISTIC MISSILE CONST. OFFICE
U S ARMY
LOS ANGELES, CAL.

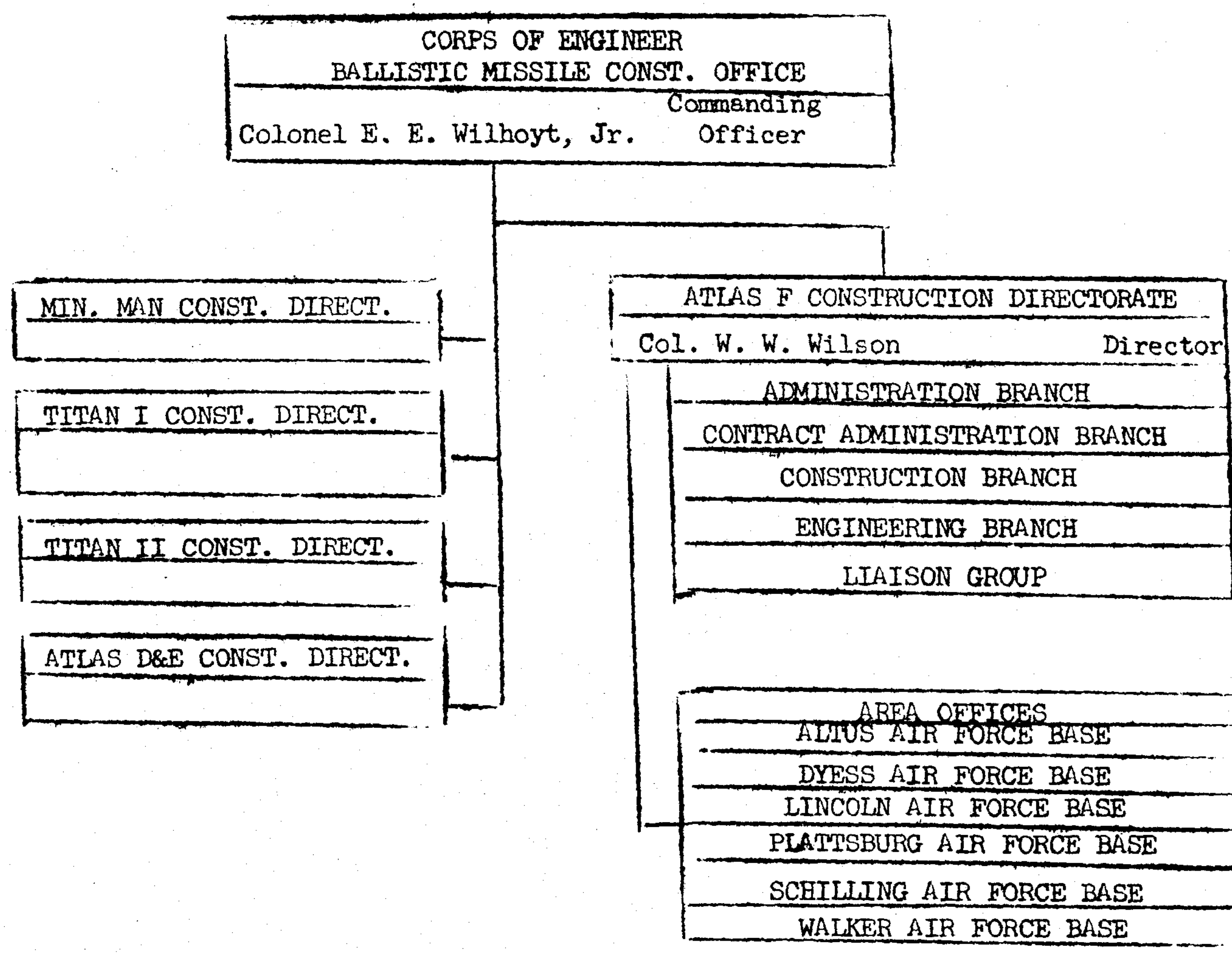



Figure 1

ESTABLISHMENT AND FUNCTION: WALKER AREA OFFICE

The decision to construct Atlas Missile Launching Facilities in this area was reached in early January 1960, at which time the Albuquerque District Office was requested to perform certain soils investigations, et cetera, to determine whether or not the geological conditions in this area would support the proposed installation. This investigation was accomplished by the Spencer J. Buchanan Co., and by Gordon Herkenhoff and Associates with favorable results.

Design was initiated in early March 1960 after completion of the investigation.

The Walker (Roswell) Area Office was established 15 May 1960 by District Order #231 under the Albuquerque District, to handle supervision, inspection and contract administration for construction of 12 Atlas Missile Sites in the vicinity of Roswell, New Mexico.

The facility was advertised for bids on 16 May 1960 and a total of six bids were received. Bids were opened on 15 June 1960.

Successful bidder was the Macco Corporation, Raymond International, Inc., The Kaiser Co., Puget Sound Bridge and Dry Dock Co., a Joint Venture. The contract was awarded 16 June 1960 and the Notice to Proceed issued 20 June. Work started on 23 June 1960.

Although, as indicated previously, a Ballistic Missile Construction Office was established with Headquarters in Los Angeles on 1 August 1960, it was not until 22 November 1960, by means of General Order 37, that the transfer of construction responsibility from the Albuquerque District Office to CEBMCO was accomplished. By this means the Walker Area Office came under the jurisdiction of CEBMCO and was removed from the control of the Albuquerque District. Effective that date, a Civilian Personnel Administration agreement was entered into by CEBMCO and the Support District. Extensive recruiting efforts were continued.

The mission of the Walker Area Office was to perform those portions of Contract Administration which were delegated from the Atlas F Directorate of CEBMCO to the Area Office. The contracts to which this mission applied were those under which twelve Atlas F ICBM Launch Base Complexes and their related support facilities were constructed. Administrative and logistical support was provided the Area by CEBMCO and the Albuquerque District to the extent indicated in the document entitled "Division of Responsibilities, Administrative and Logistical Support, Walker Area Office".

The Walker Area Engineer's Office was organized with four primary branches and two offices (Safety and Counsel), each reporting directly to the Area Engineer. Organization Chart Fig. 2 shows the organization at approximately peak strength in July 1961. Organization Chart Fig. 3 shows the organization on 1 January 1962, at which time construction progress permitted the assignment of one project engineer to two or sometimes three missile sites, depending on the status of completion of each site. As the construction phase neared completion, personnel phase-cuts were increasingly evident. Displacement of personnel was accomplished almost entirely by attrition, and spirited efforts were made by the Area Engineer's staff to assist these individuals in securing positions in other agencies, particularly within CEBMCO. A great deal of cooperative spirit prevailed also in the rotation of individuals to accomplish needed tasks, which often became necessary due to the selection and loss of individuals for new assignments within the Corps and to other agencies.

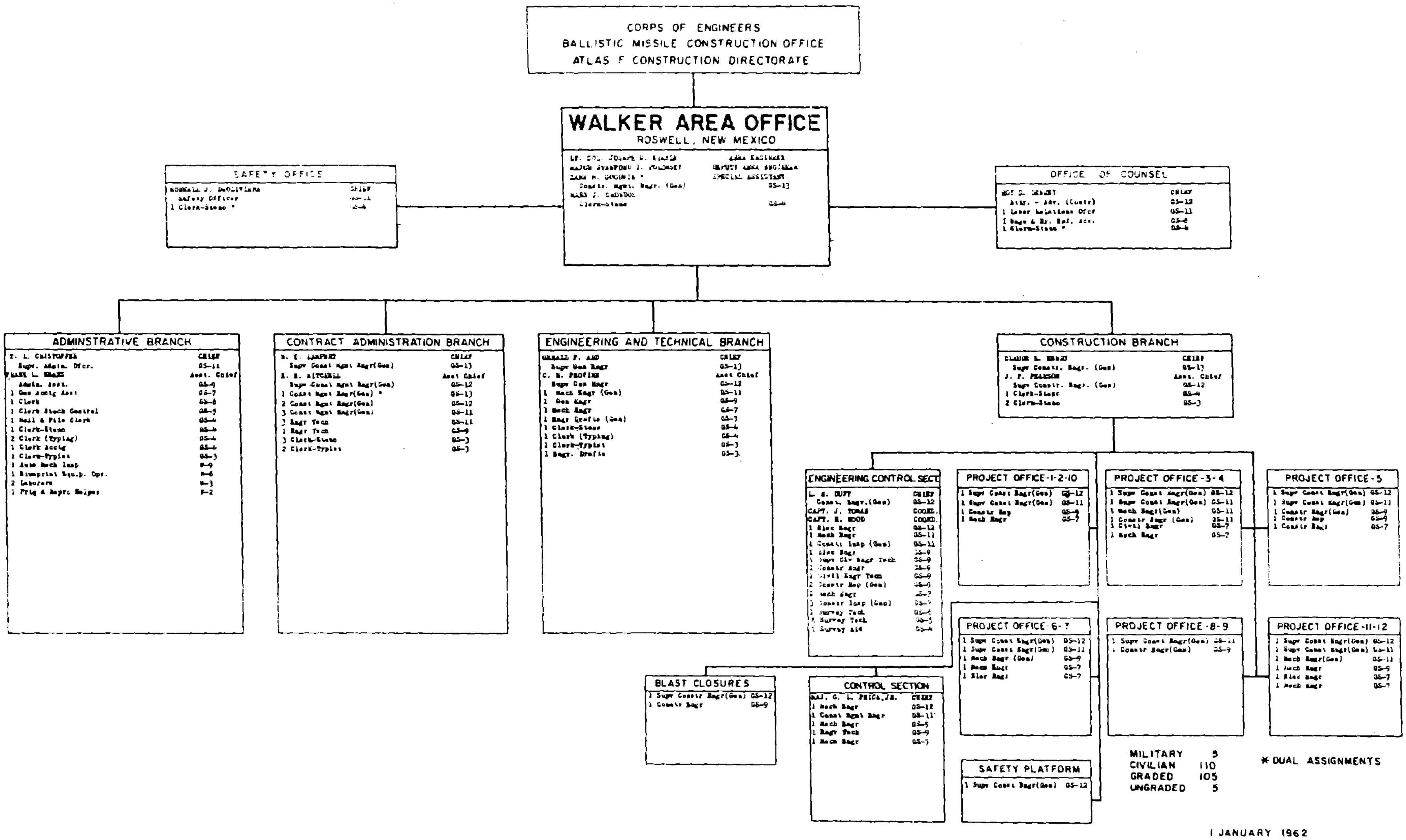

CORPS OF ENGINEERS
BALLISTIC MISSILE CONSTRUCTION OFFICE
ATLAS F CONSTRUCTION DIRECTORATE
WALKER AREA OFFICE
ROSWELL, NEW MEXICO
SAFETY OFFICE
OFFICE OF COUNSEL
ADMINSTRATIVE BRANCH
CONTRACT ADMINISTRATION BRANCH
ENGINEERING AND TECHNICAL BRANCH
CONSTRUCTION BRANCH
ENGINEERING CONTROL SECT
PROJECT OFFICE-1-2-10
PROJECT OFFICE-3-4
PROJECT OFFICE-5
PROJECT OFFICE-6-7
PROJECT OFFICE-8-9
PROJECT OFFICE-11-12
BLAST CLOSURES
CONTROL SECTION
SAFETY PLATFORM
MILITARY 5
CIVILIAN 110
GRADED 105
UNGRADED 5
* DUAL ASSIGNMENTS
1 JANUARY 1962

FIGURE 3

The relatively high percentage of professional engineers comprising the Area Office was a major factor in the accomplishment of construction efforts. It is considered noteworthy that at one time (when the organization was approximately at peak strength) 92% of all Area Office personnel were qualified professional engineers.

Project Engineers, responsible to the Construction Branch, were selected for each of the 12 sites to inspect and supervise contract construction. The Propellant Loading System (PLS) functions were also accomplished under the immediate responsibility of the Construction Branch.

The functions of the branches and offices of the Walker Area Office were as follows:

AREA ENGINEER: The Area Engineer supervised assigned construction contracts, represented the Contracting Officer and enforced contract provisions as well as providing direction and coordination of the area's organization activities.

DEPUTY AREA ENGINEER: The Deputy assisted the Area Engineer and acted as Area Engineer during his absence. He provided direction to the technical, advisory, and administrative in all matters of a technical nature.

EXECUTIVE OFFICER: He assisted the Area Engineer and the Deputy in a staff capacity in delegated matters not requiring the immediate or personal attention of those officials. His duties included the coordination, review or approval of matters delegated by the Area Engineer or his Deputy, serving as focal point in all matters relating to the Administrative and Advisory staff. He supervised Military Personnel Administration as directed, and performed numerous additional duties as specifically assigned.

ADMINISTRATION BRANCH: Furnished administrative services to all elements of the Area Office, including each of the twelve missile construction sites. Furnished instruction to clerical personnel and provided stenographic and typist assistance. Provided office services including: supply, communication, custodial services, reproduction, transportation, mail distribution, records, purchasing and procurement. Directed civilian personnel actions and maintained records to include: time and attendance, leave, cost and pay. Received and approved for funds all obligating documents other than Construction Contracts and Modifications.

ENGINEERING AND TECHNICAL BRANCH: Provided engineering and technical assistance to area personnel. Reviewed plans and specifications and furnished comments to CEBMCO. Resolved conflicts and design inadequacies in plans and specifications and instituted change order action. Furnished contract plans and specifications for use by other branches. Maintained set of all contract plans and specifications and files of all approved material and shop drawings. Provided Administration Branch with documents (shop drawings, catalogues, etc.) required by using service. Prepared as-built drawings. Performed technical and engineering approvals of soils, concrete, and other materials and equipment. Performed engineering inspections of construction to insure adequate construction standards and compliance with design criteria. Maintained liaison with Architect-Engineer, USAF AMC/BMD Field Office, CEBMCO, KCDO, and other Corps of Engineer Districts on engineering and technical matters.

CONTRACT ADMINISTRATION BRANCH: Advised area personnel on contractual matters. Received progress schedules from contractors, reviewed same, and initiated action for revision or approval. Furnished Engineering Branch with comments for addendum changes on plans and specifications. Prepared Government Construction Cost Estimates for Change Orders. Branch Chief represented Area Engineer on SATAF Change Order Board. Monitored proposed change orders within Area Office and initiated change order action with contractors. Conducted modification negotiations and prepared and distributed modification documents. Investigated and determined validity of claims. Initiated action and follow-up on government furnished equipment until arrival at job site or railhead. Expedited construction materials. Maintained and reported status of modifications and claims. Reported work stoppages to CEBMCO. Processed documents on transfer of completed work to Air Force.

CONSTRUCTION BRANCH: Supervised and conducted continuous inspections of construction activities. Directed the job-level Engineer Trainee Program. Reported to the Engineering Branch conflicts and design inadequacies occuring in the plans and specifications. Reviewed proposed changes for construction feasibility and time impact. Provided Contract Administration with information for progress reports. Insured maintenance of a set of contract prints showing as-built conditions. Provided Contract Administration Branch with data for ENG Form 290 and other transfer documents. Established and furnished construction completion and acceptance dates to Contract Administration Branch. Reported work stoppages to Contract Administration Branch and prepared formal work stoppage reports. Directly supervised the Project Engineers.

SAFETY OFFICE: Assisted the Area Engineer in administering the Corps of Engineers' Safety Program within the Area.

Provided for frequent safety inspections at all work sites.

Advised the Area Engineer of potential safety hazards on all sites which he was unable to have corrected.

Prescribed and coordinated a balanced program of Safety activities.

Assured prompt reporting of accidents.

Prepared formal reports of findings with recommended corrective action on all accidents and serious hazards which hampered efficient uninterrupted construction progress.

OFFICE OF COUNSEL: Assisted and advised the Area Engineer and his supporting elements on legal matters except Real Estate.

Rendered staff advise in the negotiation and preparation of contractual documents and reviewed all contract actions for legal sufficiency.

Reviewed actions concerning all contractual and non-contractual claims initiated by Contract Administration Branch.

Processed settlement of contractual documents as delegated by the Office of Counsel, CEBMCO.

Reviewed actions initiated by Contract Administration Branch on appeals made by contractors to decisions made by the Contracting Officer or Contracting Officer's Representative.

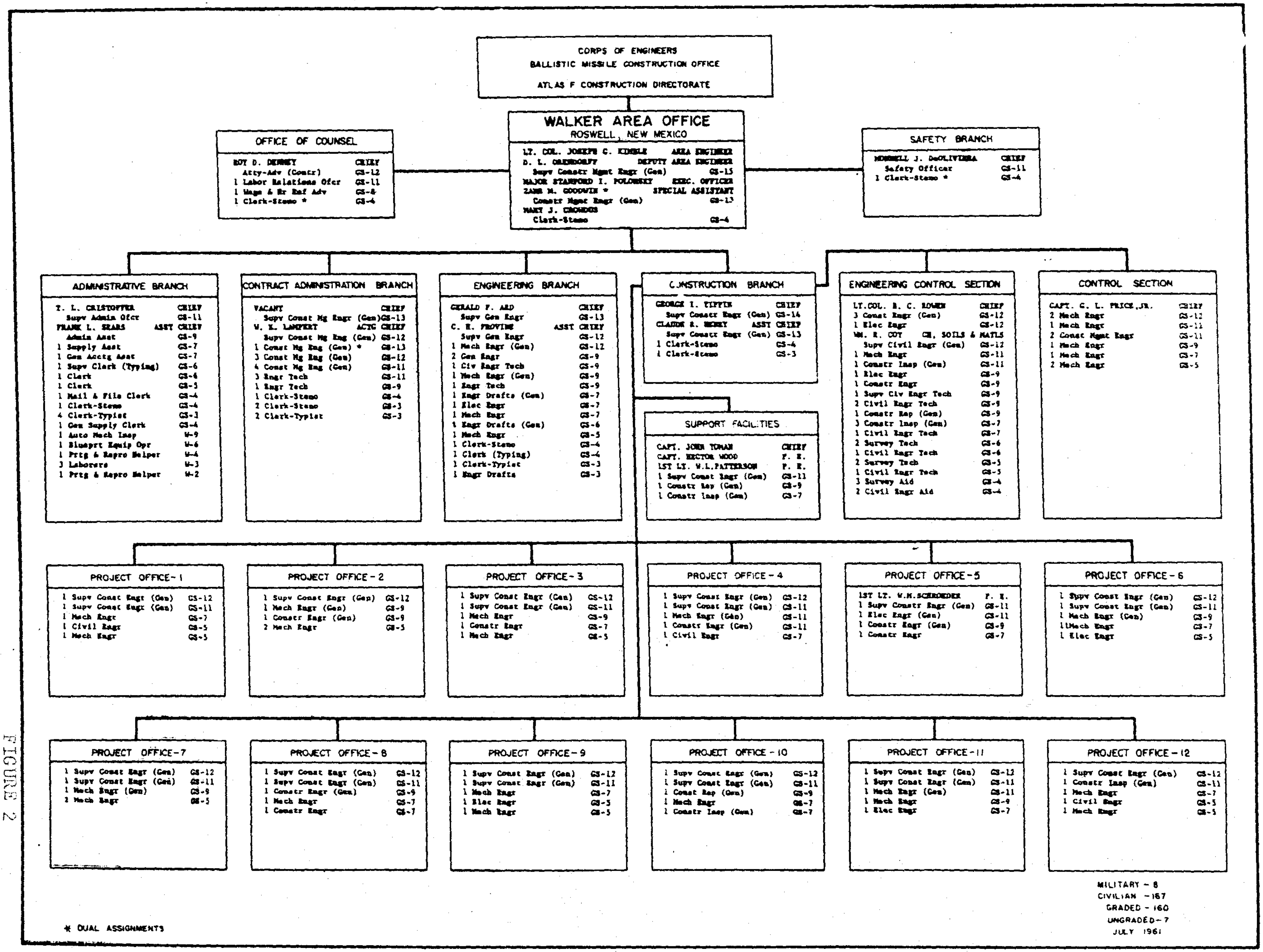



FIGURE 2

0016

Prepared litigation reports as required.

Performed labor relations functions, assuring enforcement of contract labor standards and promoted good working relationships between the Corps of Engineers, organized labor and contractors.

Received, reviewed, and initiated necessary action on all contractor's payrolls.

ADMINISTRATIVE PROBLEMS:

The question of re-employment rights for CEBMCO employees created a great deal of confusion in the minds of most of the people assigned to the Area Office. Higher headquarters must have anticipated the problems which would result upon completion of the work at the different ICBM bases when individuals became available for a new assignment and/or wished to exercise re-employment rights. A letter published by the Office of the Chief of Engineers dated 13 December 1960, Symbol ENGEP-CE, established Civilian Personnel policies to provide re-employment rights for certain categories of CEBMCO employees. One basis for confusion or misunderstanding was the fact that so-called "absolute" re-employment rights were apparently granted to individuals assigned to Headquarters, CEBMCO, whereas so-called "administrative" re-employment rights, only, were granted to persons assigned to the different field offices. In addition, these administrative re-employment rights granted to field employees applied only to individuals who had reported for assignment to a field (Area) office directly from another Corps of Engineers Office. As a result, many individuals, assigned to the Area Office as recent graduate engineers or from government offices other than the Corps of Engineers, were not entitled to re-employment rights. In a number of cases, too, individuals were assigned to the Area Office from a Corps of Engineer District at a much later date than other individuals not formerly connected with the Corps. This inequality was particularly applicable to young engineer trainees who were recruited from college and who, during phase-out, did not have re-employment rights with the Corps even though they were, in many cases, among our most desirable employees from the standpoint of insuring their retention in CEBMCO. Over twenty (20) engineer trainees were thus affected. Although a number of these individuals subsequently received assignment to other newly activated Area Offices, many of them accepted assignment in other federal agencies or with private industry and their services were thus lost to CEBMCO.

Further complicating this problem was the fact that re-employment rights were based on the grade held by the individual at the time he departed a District Office. Upon exercising these re-employment rights, the affected individual competed with other District Office employees at their <u>current grade</u> while his rights were based on the grade held at the time of his departure from the District.

It is recommended that further study be made of the civilian personnel re-employment policy to afford more uniform treatment of individuals in like circumstances.

## PART II

## CONSTRUCTION

ORIGIN AND MISSION:

Prime responsibility for Atlas "F" Weapon System Development rests with the United States Air Force. Six geographical locations in the United States were selected to house the construction of Atlas "F" Operational Base Missile Launch Complexes, each consisting of twelve unitary Silo Launch Complexes and Support Facilities. This is the history of the construction at Walker Air Force Base, Roswell, New Mexico. The United States Air Force, through its Ballistic Missile Division, established a Site Activation Task Force to accomplish this mission at Roswell, New Mexico. The United States Army Corps of Engineers was selected as the construction agency to perform construction for the Site Activation Task Force. This is solely a report of the work encountered by the United States Army Corps of Engineers element of the SATAF organization.

The decision to build the Atlas "F" Launch Facilities in the Roswell, New Mexico, area was reached in early January 1960, at which time the Albuquerque District of the United States Army Corps of Engineers was requested to perform soil investigation to determine if the geological conditions in this area would support the proposed installation.

This investigation was accomplished by Spencer J. Buchanan and Associates and Gordon Herkenhoff and Associates with favorable results. Design was assigned in early March 1960 to the Bechtel Corporation.

The proposed construction was advertised for bids on 16 May 1960, bids were opened on 15 June 1960, and the basic construction contract in the amount of $22,115,828 was awarded to a joint venture consisting of the Macco Corporation, Raymond International, Inc., The Kaiser Company, and Puget Sound Bridge and Drydock Company on 16 June 1960. Notice to proceed was issued on 20 June 1960 and the work was initiated on 23 June 1960. The Roswell Area Office of the United States Army Corps of Engineers was activated on 15 May 1960 with a nucleus of people that was expanded to eight officers and 168 civilians at the peak of activity. (See organizational chart, Part I)

Lt. Colonel Joseph G. Kimble was selected as the Area Engineer and was the Officer-in-Charge throughout the construction.

DESCRIPTION OF THE PROJECT:

Basically the project consists of a silo, having a twenty-six feet minimum inside radius by an inside height of 165 feet, and a launch control center, forty feet inside diameter by twenty-seven feet clear height. The launch silo consists of two feet six inch thick concrete walls up to a point approximately fifty feet below the top of the silo at which point the wall flares to a total thickness of nine feet. It has a concrete cap nine feet thick. Concrete floors normally are six inches thick, but are five feet thick where ground water causes excessive hydrostatic pressure. The launch control center has two feet six inch thick walls with a three feet six inch floor and a three foot roof. In the interior of the silo is a steel crib which is suspended by four shock absorbing hangers, contains eight levels, and supports all the facilities inside the silo. The launch control center has two suspended floors on which all the equipment is mounted. Descriptive sketches of silo and LCC appear on Figures 4, 5 and 6. The LCC and silo are connected by an underground tunnel. The silo and LCC represent the basic construction unit. Twelve such units are distributed within a forty mile radius in concentric arrangement around Walker Air Force Base. Distances vary from 21.4 and 42.4 road miles from Walker Air Force Base (See Vicinity Plan, Figure 7). In addition, maintenance and support facilities, consisting of a Re-Entry Vehicle Facility, a Missile Assembly Building, a Liquid Oxygen Generator Plant, and Water Supply Systems for the Missile Launch Complexes, were constructed.

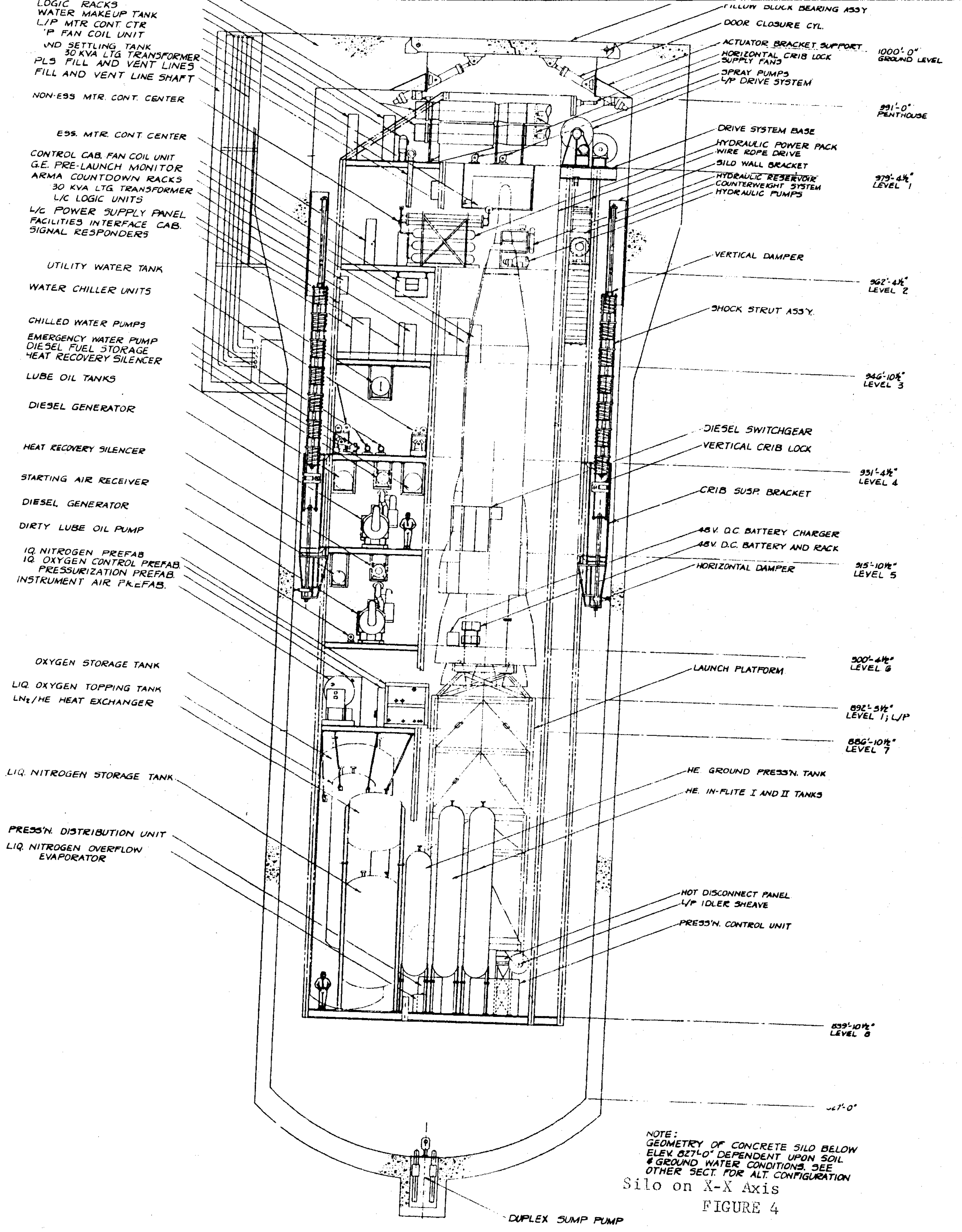
TOPOGRAPHY:

The sites are located in the majority of cases on gently rolling terrain adjacent to the Pecos River Valley. Site 5 lies actually in the valley fill area. Sites 6 and 7, near the foot of the Sacramento Mountains, lie on somewhat rougher ground. Elevations average about 3500 feet above sea level. Vegetation is scant, consisting of semi-desert type grasses and shrubs.

GEOLOGY AND GROUND WATER CONDITIONS:

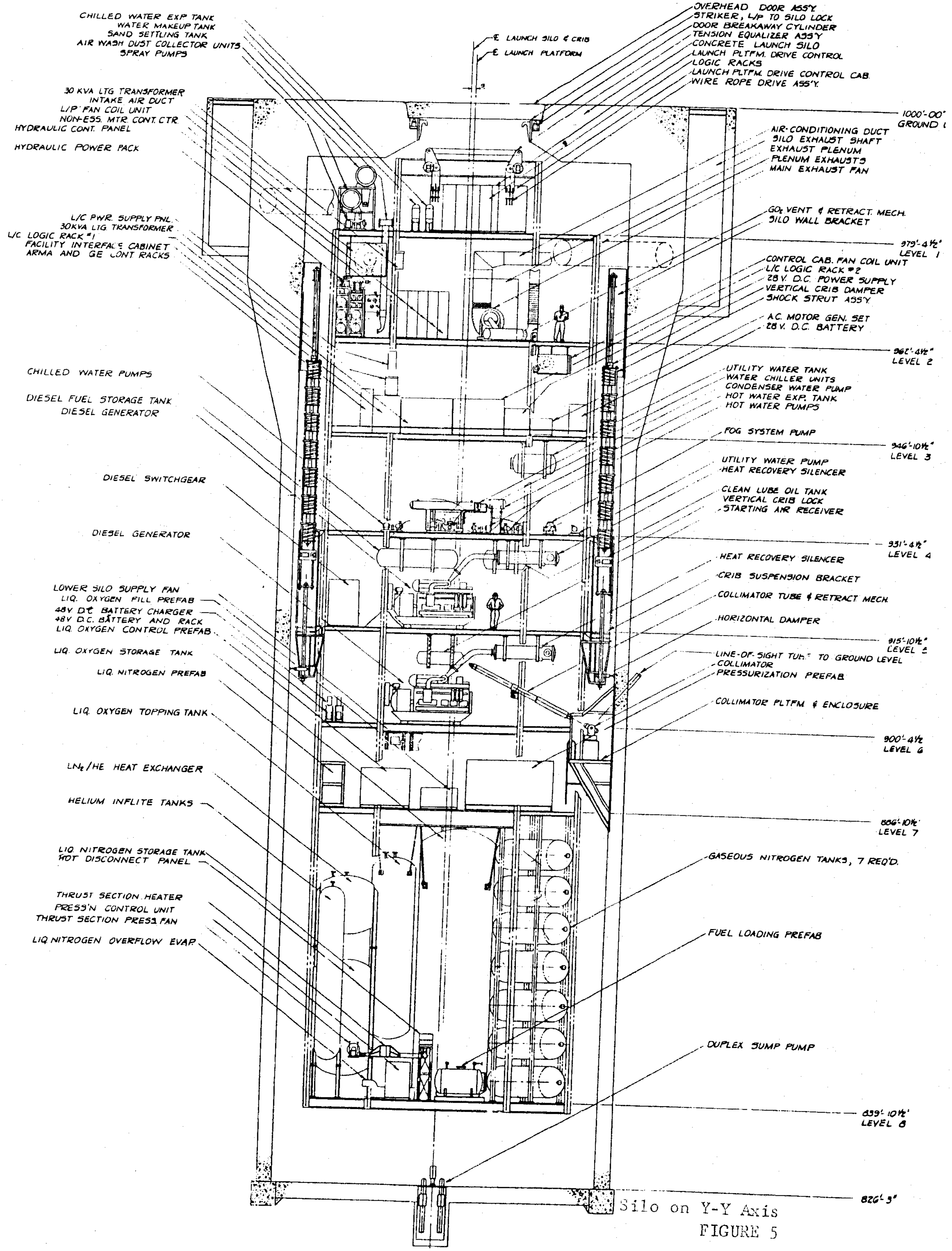
All sites are located in what is known as the Roswell Artesian Basin. This title is misleading. Artesian water production does occur in the vicinity of the City of Roswell. Some years ago there were large flowing wells in that area but the flows have ceased as a result of over-pumping of the artesian aquifer.

Geological formations are of Permian, Triassic and Quaternary ages. They consist of the Chupadera, Chalk Bluff and Dockum formations



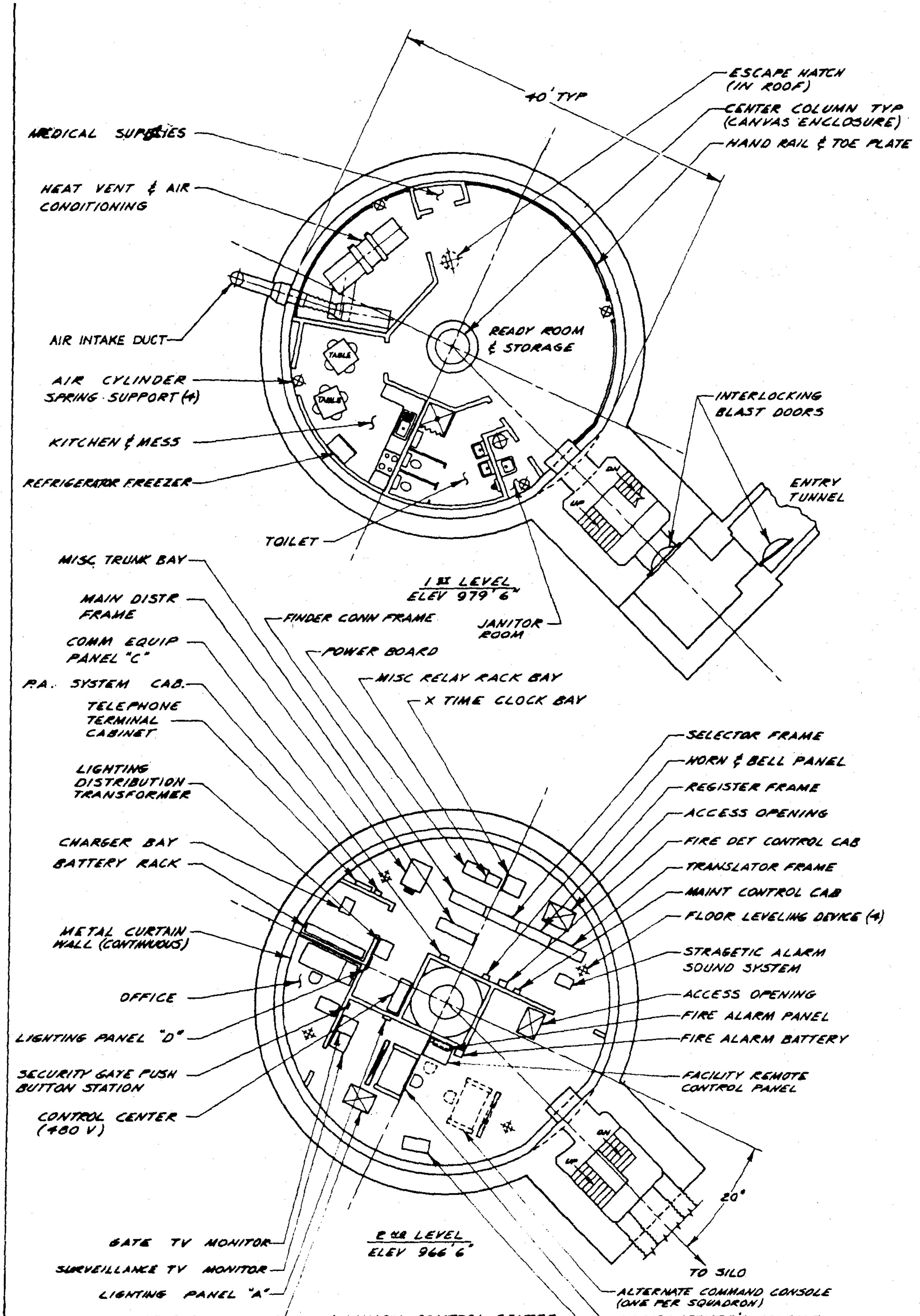

Silo on X-X Axis

FIGURE 4




Silo on Y-Y Axis

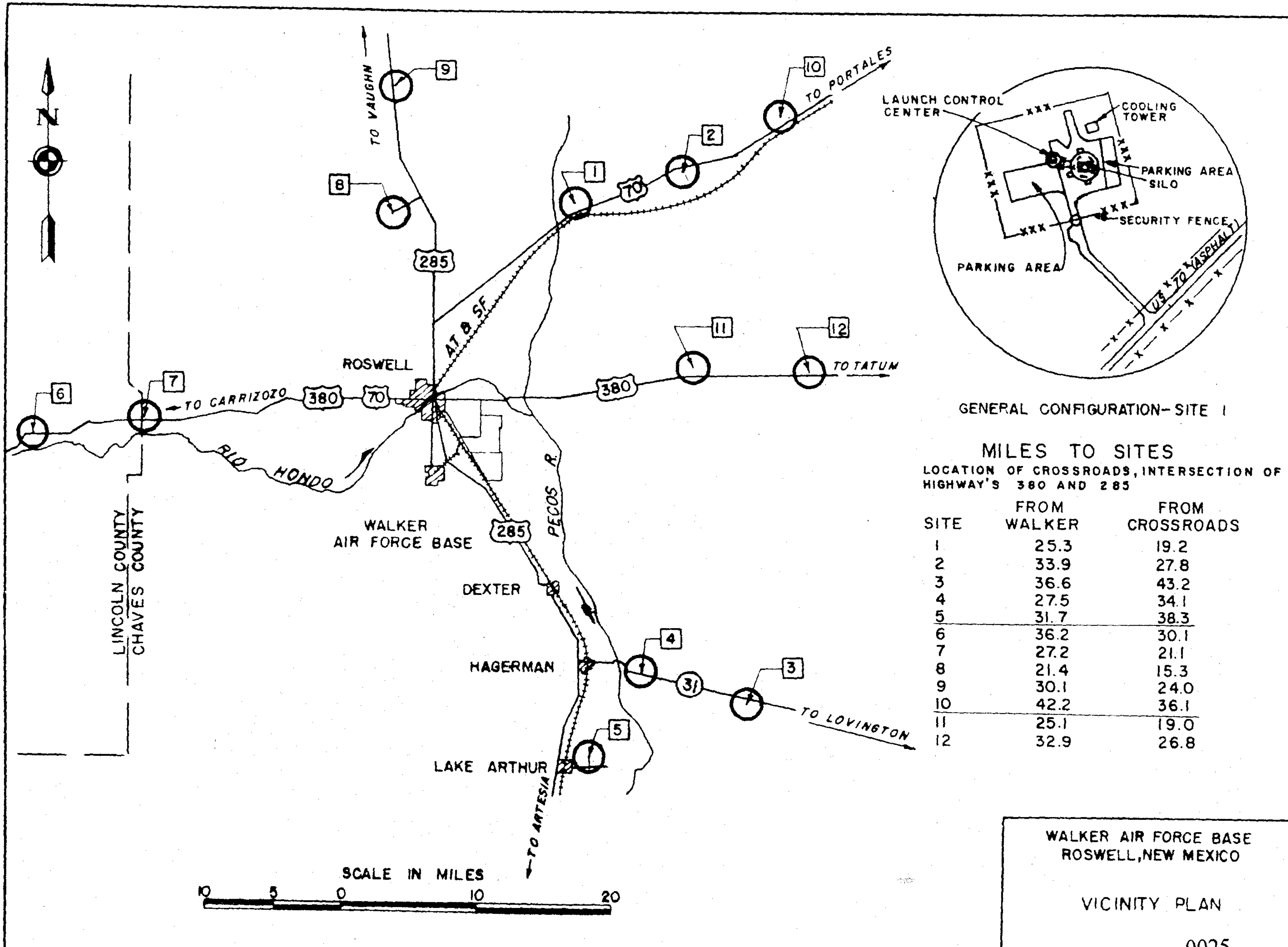
FIGURE 5




LAUNCH CONTROL CENTER PLAN VIEWS

SCALE 1/60

FIGURE 6




## MILES TO SITES

LOCATION OF CROSSROADS, INTERSECTION OF HIGHWAY'S 380 AND 285

| SITE | FROM WALKER | FROM CROSSROADS |
|---|---|---|
| 1 | 25.3 | 19.2 |
| 2 | 33.9 | 27.8 |
| 3 | 36.6 | 43.2 |
| 4 | 27.5 | 34.1 |
| 5 | 31.7 | 38.3 |
| 6 | 36.2 | 30.1 |
| 7 | 27.2 | 21.1 |
| 8 | 21.4 | 15.3 |
| 9 | 30.1 | 24.0 |
| 10 | 42.2 | 36.1 |
| 11 | 25.1 | 19.0 |
| 12 | 32.9 | 26.8 |

WALKER AIR FORCE BASE
ROSWELL, NEW MEXICO

VICINITY PLAN

FIGURE 7

overlain by a mantle of Quaternary overburden. The Chupadera formation is made up of the Yeso member at its base and the San Andres limestone member at its top. The San Andres has very recently been further subdivided, with the lower portion being known as the Glorieta formation and the upper part as the San Andres limestone. The Chalk Bluff formation overlies the San Andres and the Dockum formation overlies the Chalk Bluff. The formations generally dip eastward approximately one degree. The San Andres formation is exposed in the westward portion of the sites area near the foot of the Sacramento Mountains, the Chalk Bluff through the central portion, and the Dockum at the eastern limits.

The Artesian condition is brought about by the presence of the permeable San Andres limestone on the surface in the Sacramento Mountains, an area of fairly good annual rainfall, and by the slope of the San Andres to the east at fifty to sixty feet per mile, a slope greater than the surface. The relatively impermeable red beds of the Chalk Bluff formation tend to hold water in the permeable San Andres under pressure, although this is highly variable with local conditions since the formations are interconnected and leakage from fractures and improperly constructed wells locally modifies conditions.

Subsurface exploratory investigations were made prior to issuing plans and specifications for bid. Core hole and seismic investigations were made by Spencer Buchanan and Associates of Bryan, Texas. Ground water explorations were performed by Gordon Herkenhoff and Associates of Albuquerque, New Mexico. Findings of the investigations and the reports received thereof are the basis of most of this geological report. Results of the investigation were presented in log form on contract drawings. Descriptive logs and notes on water encountered are extracted from the drawings and exhibited as Figures 8 through 12.

Consistently, the material encountered in excavation was as shown on the logs, although there were some variations in thickness of strata across the width of silo excavations. Some unexpected difficulties in the way of more water than expected was encountered. Sites 3, 6, 7, 8, 9, 11 and 12 were dry holes. Site 10 had water in the shaft in negligible amounts. Considerable water was encountered at Sites 1, 2, 4, and 5, leading to claims by the contractor.

Generally, the valley area west of the Pecos River contains ground water in almost unlimited quantities and of fair quality. The thickness of the San Andres diminishes to the west and production tends to be less than in the valley fill area. Massive salt beds to the east, and particularly east of the Pecos river where wells were drilled in the Chalk Bluff formation, contained water with so many salts as to be unusable without special treatment. All water from the San Andres is hard and requires treatment if Public Health Standards are to be met.

Water for use at the sites was developed by wells at Sites 2, 5, 6, 7, 8, and 9. Water for Sites 1 and 10 is transmitted by pipe line from Site 2. Water for sites 3 and 4 is obtained from the nearby village of Hagerman via pump station and pipe line and for Sites 11 and 12 from the City of Roswell. All waters were too highly mineralized for intended usage. Special demineralization and softening processes were provided.

Site No. 2

LCC

DOCKUM FORMATION (TRIASSIC)

| | |
|---|---|
| Ca | CALICHE, brown & white, very soft |
| CL | CLAY, brown, sandy, silty |
| Ss | SANDSTONE, brown, fine-grained |
| CL | CLAY, dark red, sandy, soft, with streaks of green sandy clay |
| Ss | gray-green, silty; soft, red; streaks of red silty shale; SANDSTONE, dark red, hard, fine-grained with spots and bands of dark red silty clay with green streaks |

BORING COMPLETED 2-6-60 AT A DEPTH OF 77.3 FEET CONTINUOUS 6-INCH CORE

NOTE 1: A static water level was measured 128 feet below the ground surface in the deep boring upon recovery from total dewatering by bailing. The bailing rate was less than 15 g.p.m.

Site No. 10

Silo

OVERBURDEN (QUATERNARY)

| | |
|---|---|
| SAND, red, silty, soft | SM |
| CLAY, red, silty | CL |
| CALICHE, white | Ca |

DOCKUM FORMATION (TRIASSIC)

| | |
|---|---|
| SANDSTONE, red, silty, massive, fine-grained, weathered, soft; sandstone becomes firm, unweathered | Ss |
| MUDSTONE, red, firm but crushed, weakened, slickensided | Ms |
| SANDSTONE & SILTSTONE red and greyish, firm to very firm; becoming brown sandstone; gray sandstone; dark gray sandstone with calcareous stringers at 140'; changing to light green sandstone with interbedded green shale, interbedded coal at 163'; light gray sandstone with 3-in. layer of limestone at 170'; gray sandstone with interbedded light green shale; sandstone, dark gray | Ss & Si |
| SHALE red shale (mudstone), slickensided; red and green shale, slickensided | Sh |

BORING COMPLETED 2-20-60 AT A DEPTH OF 225.0 FEET

CONTINUOUS 6-INCH DIA CORE

LCC

OVERBURDEN (QUATERNARY)

| | |
|---|---|
| CL | CLAY, light reddish brown, soft, sandy with caliche nodules to ½-in. size. Grades to lt. br. with weathered red siltstone seams |

DOCKUM FORMATION (TRIASSIC)

| | |
|---|---|
| Sh | SHALE, red and gray, clayey |
| Ss | SANDSTONE, red, mod. hard, very fine-grained, argillaceous at top, micaceous below 34.3'. Occasional hairline seam of red shale; Seams of shale and silty clay 62.5'-64.0'; Sandstone becomes conglomeratic with shale & limestone @66' |

BORING COMPLETED 2-19-60 AT A DEPTH OF 75.0 FEET CONTINUOUS 6-INCH CORE

NOTE 1: The drilling water in the deep boring was bailed out upon completion of drilling at a bailing rate of less than 20 g.p.m. No recovery water level was reported after bailing the test hole.

DEPTH IN FEET: 10, 20, 30, 40, 50, 60, 70, 80, 90, 100, 110, 120, 130, 140, 150, 160, 170, 180, 190, 200

Contract No. DA-29-005-ENG-2598
Walker AFB-Roswell, New Mexico
BORING LOGS-NORTHEAST GROUP
SITES 1, 2 AND 10
(Extracted from Contract Drawings)
FIGURE 8.

## Site No. 1

### Silo

| | |
|---|---|
| RDEN (QUATERNARY) | |
| d, silty, trace of sand, gravel | CL |
| UFF FORMATION (PERMIAN) | |
| gray & pink, some gravel | Gy |
| k red, very soft, contains pebble gravel, some gypsum | CL |
| gray and pink | Gy |
| silty, trace of gravel | CL |
| with traces of red clay | Gy |
| sandy, trace of gravel | CL |
| , gray and pink; red clay 65' to 66' | Gy |
| , silty | CL |
| gray, with streaks of ty clay and gravel | Gy |
| , very broken, slick- d at many angles | CL |
| alternating in layers; LAY, red, slickensided | Gy CL |
| , gray; layer of clay; d red mottled gray clay; layer of red, silty, firm | Gy |
| ITE, gray, with thin artings | An |
| gray, with scattered of gray anhydrite and bed of clay at 148 ft. | Gy |
| d and gray mottled, with yers of gypsum, firm | CL |
| , gray-brown, dense well fractures in all directions | Gy |
| soft to firm, with gyp- rtings and nodules; Gypsum bed; Gypsum bed | CL |

COMPLETED 2-4-60
PTH OF 225.0 FEET
JOUS 6-INCH CORE

### LCC

| | |
|---|---|
| | OVERBURDEN (QUATERNARY) |
| CL | CLAY, red, silty. Bed fine sand 10.0'-10.4' |
| | CHALK BLUFF FORMATION (PERMIAN) |
| Gy | GYPSUM, gray |
| CL | CLAY, dark red, shaly |
| Gy | GYPSUM, gray |
| CL | CLAY, red, shaly, gypsum particles |
| Gy | GYPSUM, gray. Lost water circulation at 45.5' |
| CL Gy | CLAY & GYPSUM. Alternating layers of gray gypsum and red clay. Gypsum fragments in clay. Gray gypsum at bottom. |

BORING COMPLETED 2-7-60
AT A DEPTH OF 75.0 FEET
CONTINUOUS 6-INCH CORE

NOTE 1: A static water level was measured 27 feet below the ground surface upon completion of drilling. The deep boring could not be bailed dry by bailing at approximately 15 g.p.m. for four hours. However, the water supply test well, 250 feet from the deep boring was totally dry.

## Site No. 2

### Silo

| | |
|---|---|
| DOCKUM FORMATION (TRIASSIC) | |
| SANDSTONE, red, friable, very fine grained | Ss |
| CLAY, red, sandy, loose, with gray granular gypsum. Soft bed 41'-42' | CL |
| SILTSTONE, red, firm | Si |
| SANDSTONE, red, fine-grained, friable, minor clay. sandstone is dark red, fine-grained, with dk. red, silty clay, jointed & air slakes. sandstone is gray and green, fine-grained, gypsiferous 86'-90'. Highly crushed. sandstone is dark red, fine-grained | Ss |
| CLAY, green, silty, with seams of dark red, silty clay & air slakes | CL |
| SHALE, dark gray, silty, and air slakes | Sh |
| SANDSTONE; gray, fine-grained; dark brown, fine-grained, scattered large lumps of very soft, green, silty clay; dark red, fine-grained; gray-green, fine-grained, with red soft, silty clay. | Ss |
| CHALK BLUFF FORMATION (PERMIAN) | |
| CLAY, red, silty, soft, with gypsum and streaks of hard gypsum; red, soft, silty, with gypsum streaks and horizontal, gypsum-filled cracks | CL |

BORING COMPLETED 2-5-60
AT A DEPTH OF 226.1 FEET
CONTINUOUS 6-INCH CORE

### LCC

| | |
|---|---|
| | DOCKUM FORMATION (TRIASSIC) |
| Ca | CALICHE, brown & white, very soft |
| CL | CLAY, brown, sandy, silty |
| Ss | SANDSTONE, brown, fine-grained |
| CL | CLAY, dark red, sandy, soft, with streaks of green sandy clay |
| Ss | gray-green, silty; soft, red; streaks of red silty shale. SANDSTONE, dark red, hard, fine-grained with spots and bands of dark red silty clay with green streaks |

BORING COMPLETED 2-6-60
AT A DEPTH OF 77.3 FEET
CONTINUOUS 6-INCH CORE

NOTE 1: A static water level was measured 128 feet below the ground surface in the deep boring upon recovery from total dewatering by bailing. The bailing rate was less than 15 g.p.m.

Site No. 1

DEPTH IN FEET

## Silo

| Depth (ft) | Description | Symbol |
|---|---|---|
| 0–10 | OVERBURDEN (QUATERNARY) CLAY, red, silty, trace of sand, some gravel | CL |
| 20 | CHALK BLUFF FORMATION (PERMIAN) GYPSUM, gray & pink, some gravel | Gy |
| 30 | CLAY, dark red, very soft, contains small pebble gravel, some gypsum | CL |
| 40 | GYPSUM, gray and pink | Gy |
| | CLAY, red, silty, trace of gravel | CL |
| 50 | GYPSUM, with traces of red clay | Gy |
| | CLAY, red, sandy, trace of gravel | CL |
| 60–70 | GYPSUM, gray and pink, bed of red clay 65' to 66' | Gy |
| 80 | CLAY, red, silty | CL |
| 90 | GYPSUM, gray, with streaks of red, silty clay and gravel | Gy |
| | CLAY, red, very broken, slickensided at many angles | CL |
| 100 | GYPSUM, alternating in layers with CLAY, red, slickensided | Gy CL |
| 110–130 | GYPSUM, gray; 6-inch layer of clay; 1-in. bed red mottled gray clay; 6-inch layer of red, silty, firm clay | Gy |
| 140 | ANHYDRITE, gray, with thin clay partings | An |
| 150 | GYPSUM, gray, with scattered zones of gray anhydrite and a 4-in bed of clay at 148 ft. | Gy |
| 160–170 | CLAY, red and gray mottled, with thin layers of gypsum, firm | CL |
| 180 | GYPSUM, gray-brown, dense, well healed fractures in all directions | Gy |
| 190–220 | CLAY, red, soft to firm, with gypsum partings and nodules; Gypsum bed; Gypsum bed | CL |

BORING COMPLETED 2-4-60
AT A DEPTH OF 225.0 FEET
CONTINUOUS 6-INCH CORE

## LCC

| Symbol | Description |
|---|---|
| CL | OVERBURDEN (QUATERNARY) CLAY, red, silty, Bed fine sand 10.0'-10.4' |
| Gy | CHALK BLUFF FORMATION (PERMIAN) GYPSUM, gray |
| CL | CLAY, dark red, shaly |
| Gy | GYPSUM, gray |
| CL | CLAY, red, shaly, gypsum particles |
| Gy | GYPSUM, gray. Lost water circulation at 45.5' |
| CL Gy | CLAY & GYPSUM. Alternating layers of gray gypsum and red clay. Gypsum fragments in clay. Gray gypsum at bottom. |

BORING COMPLETED 2-7-60
AT A DEPTH OF 75.0 FEET
CONTINUOUS 6-INCH CORE

NOTE 1: A static water level was measured 27 feet below the ground surface upon completion of drilling. The deep boring could not be bailed dry by bailing at approximately 15 g.p.m. for four hours. However, the water supply test well, 250 feet from the deep boring was totally dry.

## Silo

DOCKUM FORMATION (TRIASS…

SANDSTONE, red, friable, ve… fine grained

CLAY, red, sandy, loose, with gr… granular gypsum

Soft bed 41'-42'

SILTSTONE, red, firm

SANDSTONE, red, fine-grained, friable, minor clay.

sandstone is dark red, fine-grained, with dk. red, silty clay, jointed & air slakes

sandstone is gray and green, fine-grained, gypsiferous 86'-9…

Highly crushed

sandstone is dark red, fine-grained

CLAY, green, silty, with seams of dark red silty clay & air slakes

SHALE, dark gray, silty, and air slakes

SANDSTONE
gray, fine-grained
dark brown, fine-grained, scattered large lumps of ver… soft, green, silty clay.
dark red, fine-grained
gray-green, fine-grained, with red, soft, silty clay.

CHALK BLUFF FORMATION (PERMIA…

CLAY, red, silty, soft, with gyp… sum and streaks of hard gypsum

red, soft, silty with gypsum streaks and horizontal gypsu… filled cracks

BORING COMPLETED 2-5-60
AT A DEPTH OF 226.1 FEET
CONTINUOUS 6-INCH CORE

Site No. 4

LCC

OVERBURDEN (QUATERNARY)

CL — CLAY, lt. brown, sandy, some caliche, badly disturbed

CHALK BLUFF FORMATION (PERMIAN)

Sh — SHALE, dark red to red, soft, very clayey with soft plastic clay, gypsum fragments, broken

CH — CLAY, red, shaly, hard, very plastic, some gypsum, caliche nodules and gravel to ¾" size.

SC — SAND, red, fine grained, clayey

CL — CLAY, red, sandy, very stiff

SC — SAND, red, v.f. grained, clayey

BORING COMPLETED 2-6-60
AT A DEPTH OF 75.0 FEET
CONTINUOUS 6-INCH CORE

NOTE 1: A static water level was established 61 feet below the ground surface in the deep boring approximately 24 hours after bailing. The nearby water supply test well yielded water at the rate of some 35 g.p.m. with only moderate drawdown. The test well extended to a depth of 105 feet, perforated from 75 feet to 105 feet

Site No. 5

Silo

OVERBURDEN (QUATERNARY)

ML — SILT, red, clayey, with fine sand, caliche above 15', somewhat calcareous and moist below

CHALK BLUFF FORMATION (PERMIAN)

Si — SILTSTONE, red, fine sandy, soft

CL — CLAY, red silty, generally soft, some gravel 40'-45', moist below 45'
limestone fragments 55'-60'
limestone gravel 90'-95'
lost drilling mud

Gy - CL — GYPSUM & CLAY in alternating 10" layers. Red clay 102'-104'

Gy — GYPSUM, gray
with some anhydrite 126'-131'
with thin layers of black shale and red clay 131.4'-136.4'
lost drilling mud 125'-135'
gypsum is interbedded with brown and red clay
gypsum is gray, massive
interbedded with soft red shale
gypsum is gray, massive
interbedded w/soft, grey shale
broken gypsum and anhydrite in brown clay matrix
gray gypsum
anhydrite
alternating layers of gypsum, clay and anhydrite

BORING COMPLETED 2-8-60
AT A DEPTH OF 225.0 FEET
CONTINUOUS 6-INCH CORE

LCC

OVERBURDEN (QUATERNARY)

ML — SILT, red, sandy, with caliche
mottled red and gray 13.4'-15.0'

CHALK BLUFF FORMATION (PERMIAN)

CL — CLAY, light brown to brown, silty, stiff to very stiff, some gypsum. Limestone pebbles 28'-30'
clay is dark red, shaly, with friable sand and gravel to cobble size, some gypsum.

Ss — SANDSTONE, red, very friable, thinly bedded w/silty clay.

BORING COMPLETED 2-10-60
AT A DEPTH OF 75.0 FEET
CONTINUOUS 6-INCH CORE

NOTE 1: A static water level was measured 23 feet below the ground surface in the deep boring after bailing. Bailing at a rate of approximately 20 g.p.m. lowered the water level from 23 feet to a depth of 60 feet.

DEPTH IN FEET: 10, 20, 30, 40, 50, 60, 70, 80, 90, 100, 110, 120, 130, 140, 150, 160, 170, 180, 190, 200

Contract No. DA-29-005-ENG-2598
Walker AFB-Roswell, New Mexico
BORING LOGS-SOUTH GROUP
SITES 3, 4 AND 5
(Extracted from Contract Drawings)
FIGURE 9

## Site No. 3

### Silo

| Description | Symbol |
|---|---|
| ...RDEN (QUATERNARY) red, silty, with caliche | SM |
| ...M FORMATION (TRIASSIC) | |
| ...TONE & SILTSTONE, fine-grained, very weakly ...ented, friable, some calcar-... | Ss & Si |
| ...aveling during drilling | |
| ...LUFF FORMATION (PERMIAN) ...d, silty | CL |
| ...NE, red, mottled with ...ray granular gypsum, ...ately firm | Si |
| ...d, silty, firm, mottled ...enses of gypsum and ...clay ...ated and weakly recemented | CL |
| ... massive, broken and ... with clay along fractures | |
| Collapse breccia | |
| ...breccia in matrix of ...ed, silty clay | Gy |
| ...massive with little ... | Ha |

...OMPLETED 2-4-60
...TH OF 225.0 FEET

### LCC

| Description | Symbol |
|---|---|
| OVERBURDEN (QUATERNARY) SAND, red, silty, with caliche | SM |
| DOCKUM FORMATION (TRIASSIC) SANDSTONE & SILTSTONE Red, fine to very fine-grained calcareous friable. Few beds of dark red hard, sandy clay. | Ss & Si |
| SANDSTONE, red, fine grained. Bed of dark red sandy clay 71.0'-71.7' | Ss |

BORING COMPLETED 2-6-60
AT A DEPTH OF 75.0 FEET
CONTINUOUS 6-INCH CORE

NOTE 1. No water was encountered in the deep boring and the nearby water supply test well.

CONTINUOUS 6-INCH CORE
★ HOLE DEEPENED 2-11-60 TO A DEPTH OF 276.5 FT - ALL MASSIVE ROCK SALT BED WITH MINOR RED CLAY IMPURITY

## Site No. 4

### Silo

| Description | Symbol |
|---|---|
| OVERBURDEN (QUATERNARY) CLAY, red, loose, silty, with broken pieces of caliche | CL |
| CHALK BLUFF FORMATION (PERMIAN) MUDSTONE, reddish, crushed, slickensided planes all directions, strength of stiff clay, secondary gypsum veins. | Ms |
| SAND, red, medium-grained, clayey, calcareous and very friable, gravelly at base. | SC |
| CLAY, red, silty, soft, with limestone gravel. | CL |
| Clay is red, silty to sandy, firm to soft, small (¼") green clay balls, carbonaceous | CL |
| Clay contains angular pebbles of yellow mudstone and rounded pebbles of quartzite, with sandy lime and green clay fragments. | CL |
| GYPSUM, massive | Gy |
| CLAY, red, silty | CL |
| GYPSUM | Gy |
| CLAY, red and green, silty | CL |
| GYPSUM, broken, with red and green clay in fractures 161.5'-172.2'; gray-green fractured siltstone 172.2'-173.6'; massive gypsum 183'-193'; soft, silty clay 197'-199'; 10" of soft clay at 205' | Gy |
| ANHYDRITE & GYPSUM massive with small solution cavities | An & Gy |

BORING COMPLETED 2-6-60
AT A DEPTH OF 225.0 FEET
CONTINUOUS 6-INCH CORE

### LCC

| Description | Symbol |
|---|---|
| OVERBURDEN (QUATERNARY) CLAY, lt. brown, sandy, some caliche, badly disturbed | CL |
| CHALK BLUFF FORMATION (PERMIAN) SHALE, dark red to red, soft, very clayey with soft plastic clay, gypsum fragments, broken. | Sh |
| CLAY, red, shaly, hard, very plastic, some gypsum, caliche nodules and gravel to ½" size. | CH |
| SAND, red, fine grained, clayey | SC |
| CLAY, red, sandy, very stiff | CL |
| SAND, red, v.f. grained, clayey | SC |

BORING COMPLETED 2-6-60
AT A DEPTH OF 75.0 FEET
CONTINUOUS 6-INCH CORE

NOTE 1. A static water level was established 61 feet below the ground surface in the deep boring approximately 24 hours after boring. The nearby water supply test well yielded water at the rate of some 25 g.p.m. with only moderate draw down. The test well extends to a depth of 105 feet, perforated from 75 feet to [illegible] feet.

## Site No. 3

DEPTH IN FEET: 10, 20, 30, 40, 50, 60, 70, 80, 90, 100, 110, 120, 130, 140, 150, 160, 170, 180, 190, 200, 210, 220

### Silo

| Depth | Description | Symbol |
|---|---|---|
| 0–11 | OVERBURDEN (QUATERNARY)<br>SAND, red, silty, with caliche | SM |
| 11–107 | DOCKUM FORMATION (TRIASSIC)<br>SANDSTONE & SILTSTONE, red, fine-grained, very weakly cemented, friable, some calcareous.<br>Hole raveling during drilling | Ss & Si |
| 107–113 | CHALK BLUFF FORMATION (PERMIAN)<br>CLAY, red, silty | CL |
| 113–131 | SILTSTONE, red, mottled with light gray, granular gypsum; moderately firm | Si |
| 131–150 | CLAY, red, silty, firm, mottled with lenses of gypsum and gray clay<br>Brecciated and weakly recemented | CL |
| 150–219 | GYPSUM, massive, broken and jointed with clay along fractures.<br>Collapse breccia<br>GYPSUM, breccia in matrix of firm, red, silty clay. | Gy |
| 219–225 | HALITE, massive, with little red clay | Ha |

BORING COMPLETED 2-4-60 AT A DEPTH OF 225.0 FEET

CONTINUOUS 6-INCH CORE

★ HOLE DEEPENED 2-11-60 TO A DEPTH OF 276.5 FT. - ALL MASSIVE ROCK SALT BED WITH MINOR RED CLAY IMPURITY.

### LCC

| Depth | Description | Symbol |
|---|---|---|
| 0–10 | OVERBURDEN (QUATERNARY)<br>SAND, red, silty, with caliche | SM |
| 10–66 | DOCKUM FORMATION (TRIASSIC)<br>SANDSTONE & SILTSTONE<br>Red, fine to very fine-grained, calcareous, friable. Few beds of dark red, hard, sandy clay. | Ss & Si |
| 66–75 | SANDSTONE, red, fine-grained<br>Bed of dark red sandy clay 71.0'-71.7' | Ss |

BORING COMPLETED 2-6-60 AT A DEPTH OF 75.0 FEET CONTINUOUS 6-INCH CORE

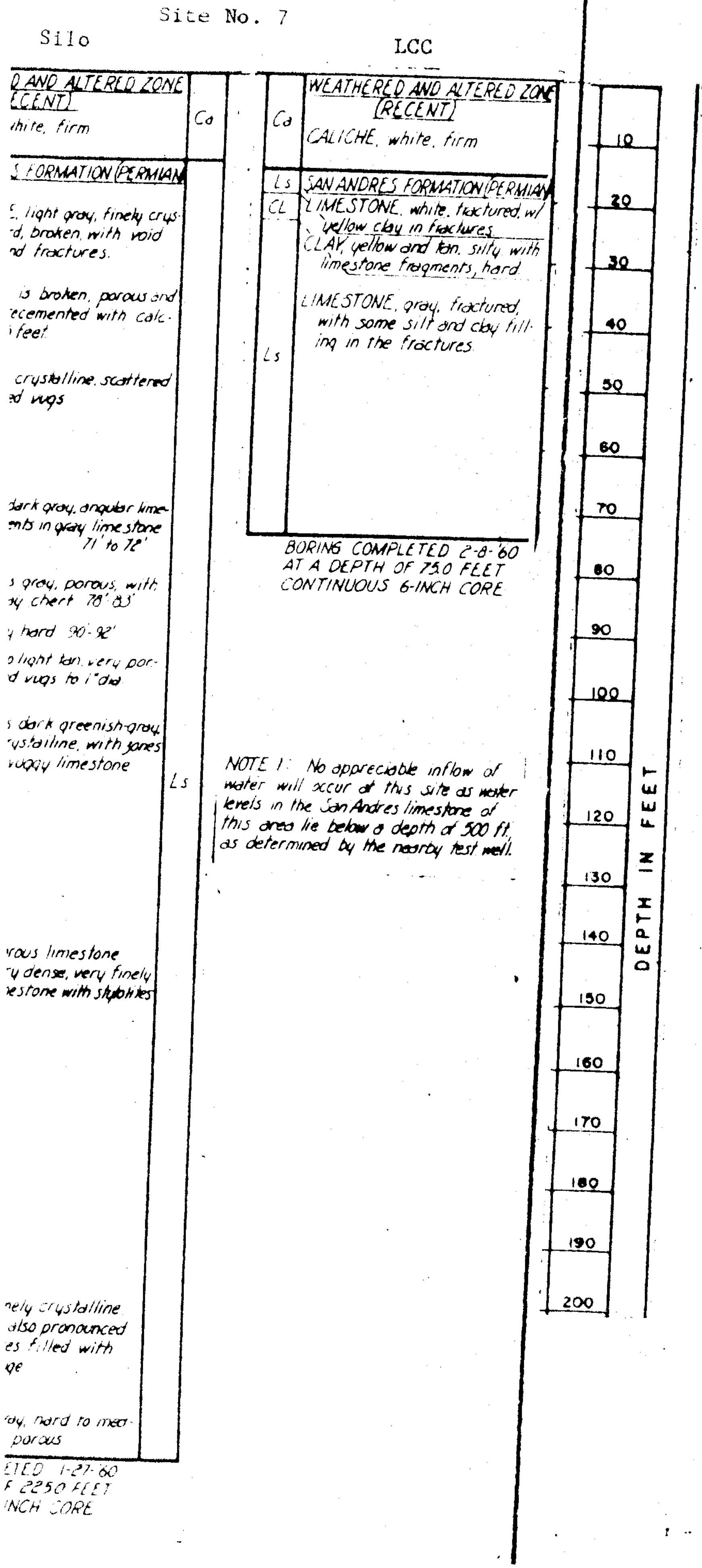
NOTE 1: No water was encountered in the deep boring and the nearby water supply test well.

### Silo

| Depth | Description |
|---|---|
| 0–16 | OVERBURDEN (QUATERNA[RY])<br>CLAY, red, loose, silty, with broken pieces of caliche |
| 16–60 | CHALK BLUFF FORMATION (PER[MIAN])<br>MUDSTONE, reddish, crushed, slickensided planes all direct[ions] strength of stiff clay, secon[dary] gypsum veins. |
| 60–79 | SAND, red, medium-grained, c[lay]ey, calcareous and very fri[able] gravelly at base. |
| 79–100 | CLAY, red, silty, soft, with lim[e]stone gravel. |
| 100–120 | Clay is red, silty to sandy, f[irm] to soft; small(?) green clay balls, carbonaceous. |
| 120–150 | Clay contains angular pebbl[es] of yellow mudstone and roun[d] pebbles of quartzite, with s[ome] lime and green clay fragme[nts] |
| 150–209 | GYPSUM, massive<br>CLAY, red, silty<br>GYPSUM<br>CLAY, red and green, silty<br>GYPSUM,<br>broken, with red and green clay in fractures 161.5'-172.2<br>gray-green fractured siltsto[ne] 172.2' - 173.6<br>massive gypsum 183'-193'<br>soft, silty clay 197'-199'<br>10" of soft clay at 205' |
| 209–225 | ANHYDRITE & GYPSUM massive with small solutio[n] cavities. |

BORING COMPLETED 2-6-[60] AT A DEPTH OF 225.[0] FEET

CONTINUOUS 6-INCH CORE




Contract No. DA-29-005-ENG-2598
Walker AFB-Roswell, New Mexico
BORING LOGS-WEST GROUP
SITES 6 AND 7
(Extracted from Contract Drawings)
FIGURE 10

Site No. 7

## LCC

SAN ANDRES FORMATION (PERMIAN)

LIMESTONE, gray, hard with horizontal fracture seams containing silt and clay. Caliche above 10'

Damp clay at 43'

BORING COMPLETED 2-9-60 AT A DEPTH OF 75.0 FEET CONTINUOUS 6-INCH CORE

1: The 225-foot boring was ring drilling. The water levels in nestone of the area are believed below 500 feet.

## Silo

WEATHERED AND ALTERED ZONE (RECENT)

Ca — CALICHE, white, firm

SAN ANDRES FORMATION (PERMIAN)

Ls — LIMESTONE, light gray, finely crystalline, hard, broken, with void pockets and fractures.

Limestone is broken, porous and partially recemented with calcite to 145 feet

Gray, finely crystalline, scattered calcite filled vugs

Breccia of dark gray, angular limestone fragments in gray limestone 71' to 72'

Limestone is gray, porous, with dark gray chert 78'-83'

Hard to very hard 90'-92'

Light gray to light tan, very porous, scattered vugs to 1" dia

Limestone is dark greenish-gray, very hard crystalline, with zones of light tan, vuggy limestone

Hard, gray, porous limestone grading to very dense, very finely crystalline limestone with stylolites

Gray, dense, finely crystalline with stylolites also pronounced vertical fractures filled with calcite and gouge

Limestone is gray, hard to medium hard, very porous

BORING COMPLETED 1-27-60 AT A DEPTH OF 225.0 FEET CONTINUOUS 6-INCH CORE

## LCC

WEATHERED AND ALTERED ZONE (RECENT)

Ca — CALICHE, white, firm

SAN ANDRES FORMATION (PERMIAN)

Ls — LIMESTONE, white, fractured w/ yellow clay in fractures

CL — CLAY, yellow and tan, silty with limestone fragments, hard

Ls — LIMESTONE, gray, fractured, with some silt and clay filling in the fractures

BORING COMPLETED 2-8-60 AT A DEPTH OF 75.0 FEET CONTINUOUS 6-INCH CORE

NOTE 1: No appreciable inflow of water will occur at this site as water levels in the San Andres limestone of this area lie below a depth of 500 ft, as determined by the nearby test well.

DEPTH IN FEET: 10, 20, 30, 40, 50, 60, 70, 80, 90, 100, 110, 120, 130, 140, 150, 160, 170, 180, 190, 200

Contra
Walke
BC
(Extrac

7

Site No. 6

Silo

DEPTH IN FEET

10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220

SAN ANDRES FORMATION (PERMIAN)

LIMESTONE

Gray, hard, with 5-10% solution vugs lined with calcite crystals, occasional clay seams 45°-60° and vertical joints

Gray, dense, hard, with hard red clay seams, calcite lenses.

Dark gray, with pink calcite and red clay seams.

Medium to light gray, dense, hard, fine to very fine crystalline with calcite seams.

Massive between 70' and 75'

Brownish-gray, hard, fine grained, 1" vugs lined with calcite, horizontal fractures with red calcareous clay.

Greenish gray, dense, irregular fractures, small, red clay seams between 119.5' and 128.5'

Dark gray, massive, highly fractured, fractures filled with calcite and clay. Slickensides at 145' within 1' clay, which may be gouge. Water seep 152.3'-152.8' in breccia.

Tan, silty, badly fractured, also crystalline, fractured, wet at 162'.

Mottled gray and tan, sandy, also gray, platy limestone.

Some raveling.

Gray, hard, dense, with interbeddings (?) of red, tan, buff, clayey limestone. Fossiliferous.

Locally sandy and clayey limestone 175' to 185'.

Dark gray, hard, dense, horizontal fractures lined w/red clay & calcite.

Ls

BORING COMPLETED 1-31-60
AT A DEPTH OF 225.1 FEET
CONTINUOUS 6-INCH CORE

LCC

SAN ANDRES FORMATION (PERMIAN)

LIMESTONE, gray, hard with horizontal fracture seams containing silt and clay. Caliche above 10'.

Ls

Damp clay at 43'

BORING COMPLETED 2-9-60
AT A DEPTH OF 75.0 FEET
CONTINUOUS 6-INCH CORE.

NOTE 1: The 225-foot boring was dry during drilling. The water levels in the limestone of the area are believed to lie below 500 feet.

Site No

Silo

WEATHERED AND ALTERED ZONE (RECENT)

CALICHE, white, firm. Ca

SAN ANDRES FORMATION (PERMIAN)

LIMESTONE, light gray, finely crystalline, hard, broken, with void pockets and fractures.

Limestone is broken, porous and partially recemented with calcite to 145 feet.

Gray, finely crystalline, scattered calcite filled vugs

Breccia of dark gray, angular limestone fragments in gray limestone 71' to 72'

Limestone is gray, porous, with dark gray chert 78'-83'

Hard to very hard 90'-92'

Light gray to light tan, very porous, scattered vugs to 1" dia.

Limestone is dark greenish-gray, very hard crystalline, with zones of light tan, vuggy limestone

Ls

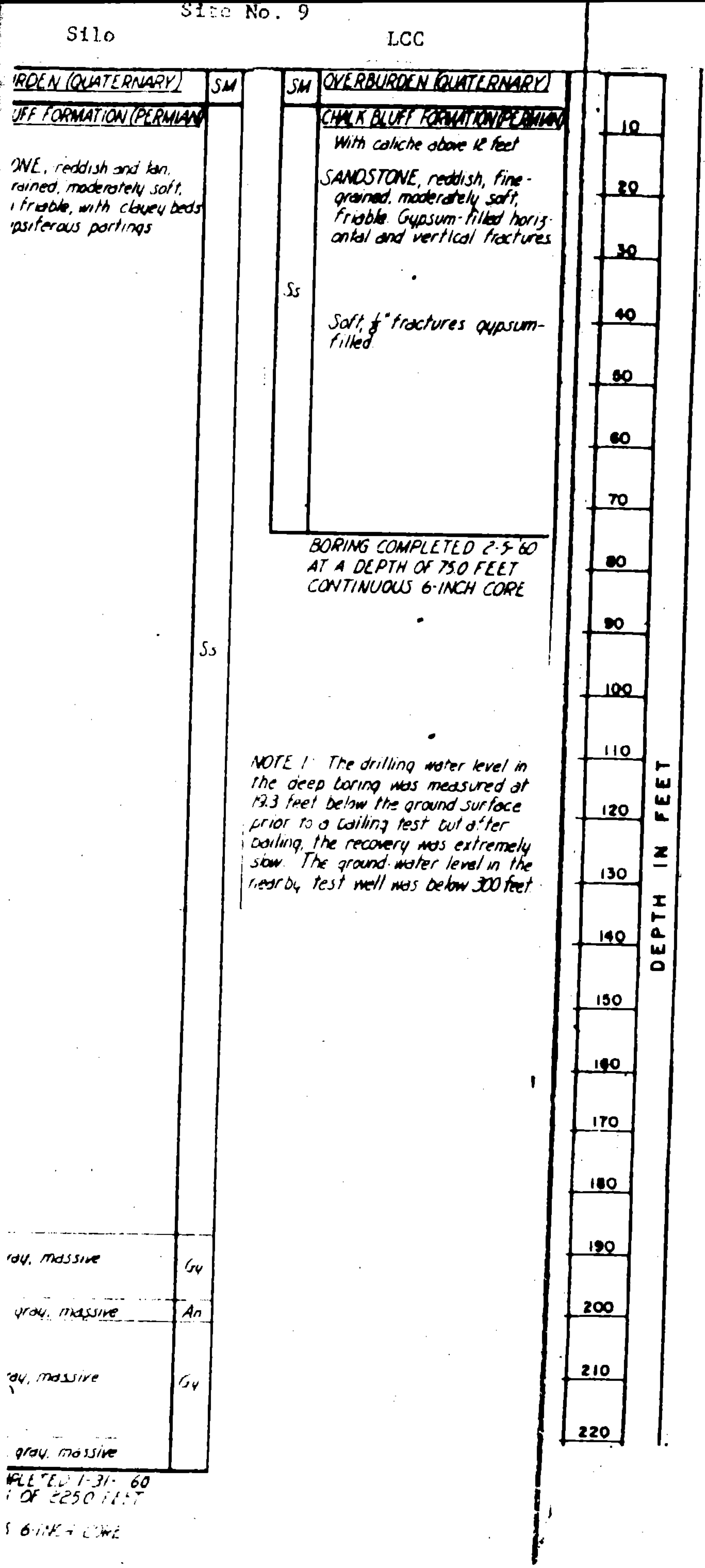
Hard, gray, porous limestone grading to very dense, very finely crystalline limestone with stylolites

Gray, dense, finely crystalline with stylolites also pronounced vertical fractures filled with calcite and gouge

Limestone is gray, hard to medium hard, very porous

BORING COMPLETED 1-27-60
AT A DEPTH OF 225.0 FEET
CONTINUOUS 6-INCH CORE

NO... wat... leve... this... as ...




Contract No. DA-29-005-ENG-2598
Walker AFB-Roswell, New Mexico
BORING LOGS-NORTH GROUP
SITES 8 AND 9
(Extracted from Contract Drawings)
FIGURE 11

DEPTH IN FEET

10, 20, 30, 40, 50, 60, 70, 80, 90, 100, 110, 120, 130, 140, 150, 160, 170, 180, 190, 200, 210, 220

## Site No. 8

### Silo

| Description | Symbol |
| --- | --- |
| OVERBURDEN (QUATERNARY) | |
| SILT with caliche | |
| CHALK BLUFF FORMATION (PERMIAN) | |
| LIMESTONE, gray, hard, fine-grained. | Ls |
| GYPSUM, gray, massive, with few thin beddings and streaks of hard, gray limestone. Gypsum is reddish gray to dk. gray. Gray gypsum. Earthy, porous limestone, 6" at 64.5'. Very calcareous, tan clay, 74'-75' | Gy |
| SAN ANDRES FORMATION (PERMIAN) | |
| 1' greenish, clayey, limestone; 2' brittle, calcareous claystone; 2' gray-green, soft, calcareous clay | |
| LIMESTONE, gray, porous, fractured, light gray, calcareous fillings. Greenish-gray, calcareous clay, 126'-129'. Limestone is gray, hard | Ls |
| CLAYSTONE, brown, calcareous, hard, fractured. | Cl |
| SHALE, gray, hard, calcareous, fractured. | Sh |
| LIMESTONE, gray, porous, partially decomposed, fractured and poorly recemented. | Ls |
| SHALE & LIMESTONE, shale is light to dark gray, clayey to silty, fractured. | Sh - Ls |
| CLAY, silty, moist | CL |
| SHALE, dark gray, with silty clay | Sh |
| LIMESTONE & ANHYDRITE | Ls-An |
| SHALE, turning to light gray, porous limestone w/shale at base | Sh |

BORING COMPLETED 2-9-60
AT A DEPTH OF 225.0 FEET
CONTINUOUS 6-INCH CORE

### LCC

| Description | Symbol |
| --- | --- |
| OVERBURDEN (QUATERNARY) | |
| CLAY, red, silty, with calcareous nodules. Brown, sandy 10'-13' | CL |
| CHALK BLUFF FORMATION (PERMIAN) | |
| GYPSUM, gray and SHALE, gray, in alternating layers. | Gy Sh |
| GYPSUM, gray. Few gray clay shale layers | Gy |

BORING COMPLETED 2-12-60
AT A DEPTH OF 74.9 FEET
CONTINUOUS 6-INCH CORE

NOTE 1: The water level was measured after bailing at a depth of 186 feet below the ground surface in the deep boring. This water level represents a slight artesian head, as no water was encountered in the deep boring above the depth of about 200 feet.

## Site No. 9

### Silo

| Description | Symbol |
| --- | --- |
| OVERBURDEN (QUATERNARY) | SM |
| CHALK BLUFF FORMATION (PERMIAN) | |
| SANDSTONE, reddish and tan, fine-grained, moderately soft, mostly friable, with clayey beds and gypsiferous partings | Ss |
| GYPSUM, gray, massive | Gy |
| ANHYDRITE, gray, massive | An |
| GYPSUM, gray, massive | Gy |
| ANHYDRITE, gray, massive | |

BORING COMPLETED 1-31-60
AT A DEPTH OF 225.0 FEET
CONTINUOUS 6-INCH CORE

| Description | Symbol |
| --- | --- |
| OVER[...] | SM |
| CHALK [...] With [...] | |
| SAND[...] grai[...] Fria[...] contai[...] Soft, filled [...] | Ss |

BORING [...]
AT A D[...]
CONTIN[...]

NOTE 1: The [...] the deep bori[...] 19.3 feet below [...] prior to a bai[...] bailing, the re[...] slow. The gro[...] nearby test w[...]

Site No. 12

Silo

DEN QUATERNARY)
with caliche & gravel — SP

RMATION (TRIASSIC)
red, massive, firm, bro-
d, calcareous cement — Si

red and gray, jointed,
firm, slickensided — Ms

& SILTSTONE
green mottling, fine-
ssive, firm

seams and deposits
and limestone.
d)

Ms & Si

calcareous
deposits

ed to greenish,
, some cross-bed-
eous cement

Ss

nation conglomer-
stone and shale
and 175.0'-177.0'

SILTSTONE,
, massive, firm — Ms & Si

ed, with some
hear planes

Ss

ed and gray w/seam
14.5'-215.7'

gray — Sh

TED 2-18-60
225.0 FEET
INCH DIA. CORE

LCC

OVERBURDEN (QUATERNARY)

SM — SAND, red, silty, with caliche and gravel below 2.5 feet

DOCKUM FORMATION (TRIASSIC)

Ms & Si — MUDSTONE & SILTSTONE
Red and gray, firm except where broken.
Silty, hard, jointed, slickensided.
Red, with horizontal shear planes (slickensided); becomes jointed at 55.0'.
Slickensided

BORING COMPLETED 2-19-60
AT A DEPTH OF 75.0 FEET
CONTINUOUS 6-INCH CORE

NOTE 1 The 225-foot deep boring was dry upon completion of drilling; the nearby water supply test well was dry to a depth of 350 feet. Virtually no pumping will be required.

DEPTH IN FEET: 10, 20, 30, 40, 50, 60, 70, 80, 90, 100, 110, 120, 130, 140, 150, 160, 170, 180, 190, 200, 210, 220

Contract No. DA-29-005-ENG-2598
Walker AFB-Roswell, New Mexico
BORING LOGS-EAST GROUP
SITES 11 AND 12
(Extracted from Contract Drawings)
FIGURE 12

## Site No. 11

### Silo

Depth scale (feet): 10, 20, 30, 40, 50, 60, 70, 80, 90, 100, 110, 120, 130, 140, 150, 160, 170, 180, 190, 200, 210, 220

| Description | Symbol |
| --- | --- |
| OVERBURDEN (QUATERNARY) SAND, red, fine, silty with caliche | SM |
| DOCKUM FORMATION (TRIASSIC) SHALE & SANDSTONE red, badly broken, jointed and weathered above 17' becoming firmer below | Sh & Ss |
| SANDSTONE, red, firm, fine to medium-grained, 45° joint from 33.5' to 34.0' | Ss |
| SILTSTONE, MUDSTONE, AND SANDSTONE, interbedded, moderately firm to firm, 60°-90° joints throughout. crushed, with irregular slickensides: 47.5'-48.5', 52.0'-54.0', 56.0'-58.0', 75.5'-76.0' | Si Ms Ss |
| SANDSTONE, red, fine-grained, locally conglomeritic with claystone pebbles, generally firm but becoming soft where extremely broken, some cross-bedding. | Ss |
| SILTSTONE, SANDSTONE, AND MUDSTONE, about 4:4:2, red to locally gray, highly jointed throughout, firm to moderately firm except for crushed zones 161'-161.5'; 167.0'-167.1'; and 181'-194' (gypsiferous) which are soft | Si Ss Ms |
| CHALK BLUFF FORMATION (PERMIAN) GYPSUM AND SHALE, gypsum in massive beds to 3' thick, shale shot through with secondary gypsum plus some primary gypsum nodules. Below 220' gypsum beds show clay-filled solution joints. Shale is moderately soft to moderately firm | Gy Sh |

BORING COMPLETED 2-3-60
AT A DEPTH OF 227.3 FEET

CONTINUOUS 6-INCH CORE

### LCC

| Symbol | Description |
| --- | --- |
| CL | OVERBURDEN (QUATERNARY) CLAY, dark red, [illegible], silty |
| Sh Ss | DOCKUM FORMATION (TRIASSIC) SHALE & SANDSTONE, red, badly broken, jointed and weathered |
| Ss | SANDSTONE, red fine-grained, mod hard, calcareous. Becomes greenish-gray near base. |
| Si Ms Ss | SILTSTONE, MUDSTONE, & SANDSTONE, interbedded, moderately firm to firm |
| Ss | SANDSTONE, red, fine-grained, firm to soft where broken |

BORING COMPLETED 2-8-60
AT A DEPTH OF 76.9 FEET
CONTINUOUS 6-INCH CORE

NOTE 1: The deep boring was dry to the maximum depth of exploration. The nearby water supply test hole was dry to a depth of 435 feet.

## Site No. 12

### Silo

| Description | Symbol |
| --- | --- |
| OVERBURDEN (QUATERNARY) SAND, red, with caliche & gravel | SP |
| DOCKUM FORMATION (TRIASSIC) SILTSTONE, red, massive, firm, broken, jointed, calcareous cement | Si |
| MUDSTONE, red and gray, jointed, weak to firm, slickensided | Ms |
| MUDSTONE & SILTSTONE red with green mottling, fine-grained, massive, firm. Jointed w/seams and deposits of gypsum and limestone, (slickensided). Jointed with calcareous seams and deposits | Ms & Si |
| SANDSTONE, red to greenish, fine-grained, some cross-bedding, calcareous cement. w/inner formation conglomerate of sandstone and shale 163.8'-165.8' and 175.0'-177.0'. | Ss |
| MUDSTONE & SILTSTONE, red and gray, massive, firm | Ms & Si |
| SANDSTONE, red, with some horizontal shear planes. Sandstone is red and gray, w/seam of red shale 214.5'-215.7' | Ss |
| SHALE, red and gray | Sh |

BORING COMPLETED 2-18-60
AT A DEPTH OF 225.0 FEET

CONTINUOUS 6-INCH DIA. CORE

### (second column, cut off)

| Symbol | Description |
| --- | --- |
| SM | OVERB[...] SAND, r[...] and g[...] |
| Ms & Si | DOCKUM [...] MUDST[...] Red a[...] wher[...] Silty, [...] sided. Red, w[...] planes [...] jointe[...] Slicken[...] |

BORING C[...]
AT A DEP[...]
CONTINU[...]

NOTE 1: The 2[...] was dry upon c[...] the nearby wate[...] was dry to a de[...] Virtually no pum[...]

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# SITE ACTIVATION TASK FORCE

Walker AFB, New Mexico

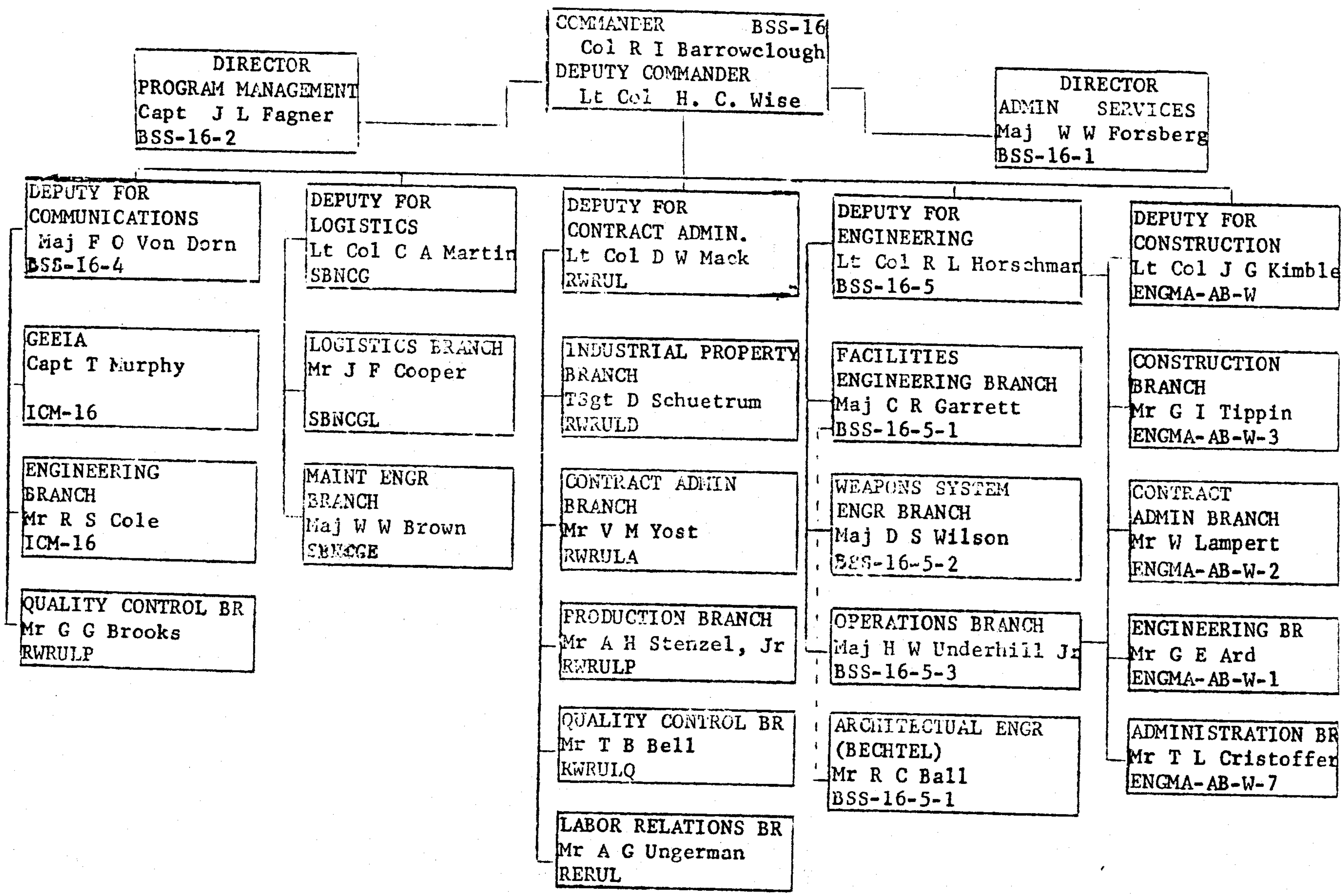


FIGURE 13

6 January 1962, fifty-seven days later than originally scheduled. The contract contained a completion schedule listing 25 August 1961 as completion date for the first site with others following at one week intervals. A sequence of construction starting dates by sites, was scheduled in early stages. However, due to differences in conditions met, progress did not develop at the same rate for each site and sequences changed several times. In addition, time extensions were granted in varying amounts by sites but averaging sixty days. Following is a tabulation of original contract completion dates by site sequence and a second tabulation of actual completion dates by Site Numbers:

| Contract Schedule | | Actual Completion | |
|---|---|---|---|
| Site Sequence | Completion Date | Site Number | Completion Date |
| 1 | 25 Aug 61 | 10 | 24 Oct 61 |
| 2 | 1 Sep 61 | 9 | 30 Oct 61 |
| 3 | 8 Sep 61 | 1 | 6 Nov 61 |
| 4 | 15 Sep 61 | 8 | 13 Nov 61 |
| 5 | 22 Sep 61 | 3 | 19 Nov 61 |
| 6 | 29 Sep 61 | 12 | 27 Nov 61 |
| 7 | 6 Oct 61 | 11 | 5 Dec 61 |
| 8 | 13 Oct 61 | 6 | 18 Dec 61 |
| 9 | 20 Oct 61 | 2 | 22 Dec 61 |
| 10 | 27 Oct 61 | 7 | 25 Dec 61 |
| 11 | 3 Nov 61 | 5 | 5 Jan 62 |
| 12 | 10 Nov 61 | 4 | 6 Jan 62 |

The above actual completion dates coincide with scheduled completion dates revised to include time extensions. Final inspections on or before those dates revealed each site substantially complete. No liquidated damages were assessed. Support facilities contracts were awarded and completed within the period of custody by the basic prime contractor.

CONSTRUCTION FEATURES AND OPERATIONS:

MASS EXCAVATION: Mass excavation from ground to reference elevation 960 feet first commenced at site number 1 on 2 July 1960, upon completion of the clearing and grubbing operations. This particular phase of work was subcontracted by the prime contractor to Anderson Brothers, an earth moving corporation located in Albuquerque, New Mexico. This portion of the work progressed rapidly after two ten hour shifts were established on 12 July 1960. Some sites were excavated to reference elevation 960 feet in the short time of five days using three twenty yard Tournapulls, two D-8 bulldozers with rippers, one D-6 angle ditcher, a motor grader for dressing slopes and a service truck for serving field equipment. The amount of mass excavation at the various sites was approximately forty-eight to fifty thousand cubic yards, excavated, hauled and stock piled on individual site easement areas. On complex numbers 1, 2, 6, 7 and 8, drilling and blasting was necessary during the mass excavation operations and progress was considerably less on these sites. Caliche rock from one foot to three feet in thickness was encountered at sites 11 and 12. The site contractor was able to break up the rock utilizing heavy rippers on the D-8 caterpillar tractors and complete the mass excavation at these sites without resorting to drilling and blasting. Mass excavation was completed at the final site, Site No. 6, 12 October 1960.

SHAFTING: Shafting for silos for site numbers 1 and 2 commenced on 25 July 1960 and on 30 July 1960 for site number 10. This operation was completed on 22 November 1960 at site complex number 4 which was the wettest site complex of the twelve. Water was encountered during excavation at four of the twelve silos. The average time for shafting of the dry holes from reference elevation 960 feet to 820 feet was fifty-five days. This averaged 2.5 feet per day. The wet hole, complex number 4, was shafted in fifty-five calendar days, being shafted as rapidly as possible under very adverse conditions. Most of the material encountered was saturated sand, silt, and clay, all of which produced various amounts of water. Silo number 4 encountered anhydrite strata requiring drilling and blasting for the last ten feet of excavation. Extra silo ring beams and vertical supports were required. The vertical supports consisted of angle irons welded between ring beams to obtain a cage effect for mutual support against slopping pressure behind the lagging.

The wet hole at silo complex number 5 was shafted in eighty-one days, the longest time utilized in any shafting operation. An attempt to intercept the 150 to 200 gallons per minute was unsuccessful and shafting below reference elevation 930 feet was conducted in a vertical rain of water. Slowness of shafting was directly attributal to the unstable nature of the material and to the necessity of reducing blasting to a minimum amount for any one blasting operation. Discomfort of the miners working constantly in the falling water also contributed to the slow rate of progress. As in the instance of site number 4, extra silo wall support ring beams and angle iron vertical stiffeners were provided. Although the contractor started operations behind schedule he was able to increase progress and actually completed silo shafting some ten days ahead of schedule.

<u>WATER CONTROL</u>: At site complex number 1, a seep of water was en-

countered at a depth of nineteen feet with increasing amounts as the mass excavation progressed. Pumping was necessary from the mass excavation area and started on 25 July 1960. Shafting of the silo commenced on 29 September 1960 and increasing increments of water were encountered with additional depth for about fifty to sixty feet. Weep pipes were installed at numerous places through ringbeam lagging, and a system of sheet metal troughs was devised to intercept infiltrating water and decrease the amount falling on operations below. Pumping was continued from bottom of excavation as it progressed and from the air shaft excavation adjacent to the silo throughout silo shaft excavation and shaft wall concrete placement and was not discontinued until backfill operations started on 27 February 1961. Grouting was necessary, particularly in the area around the fill and vent shaft. Portland cement and pozzolan were used.

At site complex number 2, water was encountered at silo shaft excavation depth of 126 feet reference elevation 834 on 27 August 1960. Pumping started and the inflow increased with additional depth reaching a maximum of 270 gpm. It was necessary to change the type of foundation to an alternate type because of the water inflow and unstable conditions encountered at the bottom of shaft excavation. The contractor elected to provide a second sump for dewatering purposes in addition to the sump required by the contract drawings. Consequently, the shaft was excavated below the originally required level to provide space for filter material and the 5'6" thick base. A 6" electric driven turbine pump was installed in the temporary sump and effectively removed the water during silo floor and wall concrete placement. After the silo walls were completed, grouting was performed in the lower area of the silo through grout pipes installed prior to concrete placement.

Core logs indicated that water would be found in excavation for site complex number 4 at about sixty feet below original ground surface. The contractor test-pumped a test well located about 200' from the silo and found that as much as 150 gpm could be pumped from the 105' deep 6" test well with a twelve foot drawdown. Stang Corporation (Engineering Dewatering Specialists) was called in 29 July 1960 to make a study of the underground water, soil conditions and to recommend dewatering treatment. A 16" dia. test well was drilled about 150 feet from the 6" test well to a depth of 195 feet, cased and perforated and a core hole was drilled 100 feet from the original 6" test well in line with 16" well and center of the silo. Stang Corporation representative and the contractor installed pumps, pumped for several days making numerous measurements on drawdown and volume of water pumped.

Stang Corporation's report stated that as much as 400 to 500 gpm inflow could be expected in the silo excavation and that a peripheral treatment was recommended.

Halliburton Company (an oil well grouting specialist firm) was called in on 22 August 1960, and drilled holes and installed 2" grout pipes at five foot centers just inside the concrete ring beam collar support to a depth of sixty-one feet. These 2" diameter grout pipes were grouted in place with standard Portland cement with two per cent calcium chloride. Over 900 sacks of cement were used for an average of about fifteen sacks for each of the sixty-one grout pipes installed.

Chemical grouting started on 1 September 1960, using formalin and urea to form a synthetic resin belonging to the group of amino-aldehyde resins. The chemical was pumped at a rate of 1 to 2 gpm under pressures of 80 to 100 psi through perforations in the 2" grout pipe. Approximately eighty gallons of solution were pumped through each two feet increment of perforated pipe. The perforations in the pipe were made utilizing a shaped charge made by Jet Research Center and lowered into the pipe by a small cable and then detonated. A few areas took the grout so fast that pressures could not be built up and consequently some Howcogel (grained bentonite) was mixed with the chemical grout. All water for chemical grouting operations was hauled in from Artesia due to the fact that water available on the site was so salty that it affected the chemical reactions.

After placing some 17,000 gallons of this type of chemical grout, a rotary drill rig was brought in and cores were taken in the grouted area. Very little of the grout was found and as a result, operations with the resin chemical were discontinued on 17 September 1960. On 24 September, a shipment of PWG was received and some 7,100 gallons of this plastic type chemical grout were pumped in the ground by 28 September 1960. The grout used was polymerized water gel with additives that allowed control of time of set to as quickly as five minutes. Additional core boring was performed and very little of the PWG was found in the cores. Halliburton Company moved out 30 September 1960.

The contractor then drilled ten wells, eighty foot deep around the perimeter of the silo in the mass excavation area. These were 20" diameter gravel packed wells with 3" pump inside perforated casing. The first well was completed and pump installed on 6 October 1960. Drilling of the dewatering wells and shaft excavation was performed concurrently until shaft excavation reached about fifty foot depth at which time the inflow into the shaft increased considerably, and pumping had to be accomplished from the silo shaft excavation bottom. The water inflow was sixty gpm at a fifty-five foot depth and increased proportionately with additional depth to a 350 gpm inflow on 16 November 1960 at a depth of 130 feet at which time the ten dewatering wells stopped producing water. Shaft excavation was completed on 26 November 1960 and a 5'6" slab was placed 17 December 1960. Pumping was continued until after the fourth wall lift of concrete was placed.

Any evaluation of the effectiveness of the chemical grouting is pure speculation as it is not known what the conditions would have been without the grouting. However, it is the general consensus of opinion among the engineers working with the water problem at site number 4 that the chemical grouting was ineffective due to the fact that the movement or flow of the underground water was fast enough to dilute and wash the grout away before it could set.

At complex number 5, mass excavation was started on 13 August 1960 and water was encountered before reaching the bottom on 18 August. A collection trench was dug around the perimeter of the mass excavation area from eight to fourteen feet deep, draining to a sump on the northwest side and was backfilled with gravel. An electric turbine pump was then installed in the sump. Silo shafting started on 26 August 1960 with dewatering being accomplished by means of electric and air sump pumps operating from the bottom of the shaft excavation. Water inflow increased with depth from about 20 gpm at twenty foot depth to a maximum of 200 gpm at 60 to 100 foot depth. Serious sloughing of material behind the ring beams and lagging occurred, making it necessary to suspend shaft excavation on several occasions. Lean concrete and grout was placed in the voids behind the lagging and additional ring beams and vertical stiffeners were installed. Rock (anhydrite) was encountered at the sixty foot level in the shaft and drilling and blasting were necessary for the balance of the shaft excavation. Layers of clay sandwiched between layers of rock made dewatering and excavation difficult. At the time the shaft was at the sixty-five foot depth, two dewatering wells were drilled from the bottom of the mass excavation area, one on the north side and one on the south. Pumps were installed but insufficient water entered the wells to make any appreciable change in the volume of water entering the silo excavation. The water did not travel in any particular strata, but seeped through the clay and made sloughing a real problem. Shafting was completed on 17 November 1960 and metal plates were welded to the ring beams from elevation 887 to 903 and grout pipes were installed at frequent intervals. Grouting started on 7 February 1961 after the silo concrete walls were placed and continued intermittently until 14 April 1960, effectively sealing off all but a few minor seeps.

CONCRETE OPERATIONS: Concrete placement started on 25 September 1960, about five days behind schedule and proceeded slowly at a rate considerably less than the scheduled rate. This was due in part to the rate of delivery and in part to the inability of the contractor to get forms ready for succeeding pours.

Conventional type forming was selected because of the Type V (Sulphate resistant) cement specified for use. Time of set for this type cement was known to be much longer than Type I standard Portland cement. Tests were made on the time of set of the Type V cement at the Corps of Engineers Southwest Division Laboratory, and initial set was found to be approximately seven hours at 50°F.

The contractor started silo wall concrete placement with three sets of forms thirty foot in heighth for the portion below reference elevation 962, and two sets of forms for use from reference elevation 962 to 991. Early in November 1960, the Area Engineer directed the contractor to construct a fourth set of lower wall forms. The contractor complied and also constructed a third set of upper wall forms.

Reinforcing steel forming and placement was subcontracted to Cobusco-Salyer, a joint venture consisting of Colorado Builders Supply Company and Ira Salyer of California. All bending and forming was performed on several sites and hauled to others. About 12,000 tons of reinforcing steel was placed in the twelve silos and launch control centers in sizes from number two through number eighteen bars. The reinforcing steel ironworkers worked two ten hour shifts per day throughout most of the construction period and were able, in most instances, to keep ahead of forming and placement by use of several ingenious jigs and slings that allowed placement of a score or more bars with a single crane operation. The number eighteen bars in the silo cap and doors were required to be butt-welded by either the exothermic or shielded arc methods. The contractor elected to make the welds manually, using a low hydrogen rod by the shielded arc welding process with certified welders. After the joints were butt-welded, radiographic films were made of ten per cent of the welds by Western Industrial X-Ray Corporation of Lubbock and Houston, Texas, using an iridium isotape. A few questionable welds were found, cut out, rewelded and additional radiographs taken.

All concrete was furnished by the F. M. Reeves Company of Roswell. The aggregates were produced from Reeves pit southwest of Roswell, except that about twenty-five per cent of sand from the Acme pit, twenty miles northeast of Roswell was blended with sand from the Reeves pit to improve gradation. Originally, the concrete was dry-batched into two batch truck-trailers, hauling two six yard batches to five transfer hoppers located near the midpoints of two and three site complex groupings. At the hoppers the dry-batched concrete and water hauled from Roswell was transferred to truck mixers for mixing and transporting to the various sites. During cool weather it was possible to supplement the twelve batch trucks with truck mixers hauling direct from the batch plant to the sites. In cold weather the mixing water was heated by steam at the batch plant supplemented by additional heating from liquid petroleum gas burners in the water tanks of the dry batch trucks. During the hot summer weather of 1961, all concrete was hauled by the dry batch trucks to the transfer hoppers, at which point ice was added in lieu of mixing water in amounts up to 300 pounds per six yard batch. In addition, the major portion of concrete placement was scheduled for night placement in order to take advantage of the lower night time temperatures.

Winter concrete protection met minimum requirements through the use of tarpaulins and various types of heating devices. No frozen concrete was experienced, and all placing temperatures were 50°F or higher.

Concrete quality control was very good. Adequate tests were made on aggregates and compression tests on the finished product. One set of compression test cylinders was made from each approximate eighty cubic yards of concrete placed. Engineer control personnel were continuously present on a twenty-four hour basis at the (1) batch plant, (2) the transfer hopper points, (3) the work site for receiving, running slumps and making cylinders and (4) for proper placement and vibration. Further, in consideration of the hour experience factor of Corps of Engineers field personnel, during two of the three daily shifts, the Construction Branch assigned two coordinators to the concrete operation, one to swing shift and one to the graveyard shift. In this manner, the Roswell area deviated from normal practice of assigning coordinators to groupings of complex sites and assigned coordinators to specific construction operations over the entire twelve sites to provide a high degree of continuity of control.

Compression cylinders made on the sites were hauled to the contractor's fog curing room located at his Roswell shop and yards area, and then transferred to the Corps of Engineers field testing laboratory, located on Walker Air Force Base as the break dates fell due. Average cylinder breaks on Class AA concrete were approximately 500 psi above the 3750 psi required and on Class AAA concrete were well above the 5000 psi requirement.

Most milestones for silo wall concrete placement were met except that the last four silos slipped four to seven days because of unusually severe storms in December. All milestones for silo cap and door concrete placement were reached ahead of schedule. Concrete placement rates for LCC and silo concrete (except caps) were less than forty cubic yards per hour on a twenty-four hour basis, although the forty yard per hour rate was exceeded for short periods of time. The slow rate was caused by the inability of the supplier to transport concrete from the central batch plant to the various sites. Truck breakdowns, tire trouble, slick highways, delayed deliveries of cement (also truck transported) all added up to a slow rate of placement. On the silo cap pours, it was determined that a minimum rate of fifty cubic yards per hour would be necessary because of a modified Type V cement with faster time of set proposed for use and because of higher summertime temperatures. The supplier was able to place his equipment in such condition that the fifty yard per hour rate was exceeded at all sites and no cold joints were experienced.

The finished concrete product at all sites is considered excellent and well above average in appearance, soundness and structural stability.

CRIB STEEL: An interesting phase of construction was the erection of the steel structure inside the concrete silo known as crib steel. After the completion of the concrete walls of the silo, the necessary progressive task was the erection of the crib steel. This operation consisted of erecting the equivalent of an eighteen story fifty foot by fifty foot building, built of high strength structural steel, inside of the silo. Approximately 500 tons of steel went into each silo, enough to build a first class railroad for a length of two and one half miles. The eighteen story steel frame structure is an eight sided structure with a 22.5-foot vertical opening near the east side of the silo which was to later become the Missile Inclosure. The steel structure thus built around the Missile Inclosure contains eight floor levels. Level eight, the lowest, is at elevation 840, fourteen feet above the silo floor. Level one, the highest, is at elevation 979'-6", approximately eleven feet below the silo cap. At each floor, steel grating and checkered plate was placed and utilized as a base to set the numerous Propellant Loading System, heating, air conditioning, ventilation and electrical equipment. The erection of crib steel commenced from the bottom of the silo on temporary column extensions resting on concrete pads. There are eight exterior columns and two interior. The crib structure is hung from four compression spring type shock hangers with suspensions points at Level 5. A peripheral truss between Levels 5 and 4 transfers loads to the suspension points. The two interior columns are supported by trusses between Levels 4 and 3. Columns are in tension below trusses and compression above. At the lower portion of the Missile Inclosure are two frames composed of box girders and box hangers which are located one each at the north and south sides of the inclosure. The box hangers serve to hold the Missile in true position while in the silo and are correlated with lock brackets placed at the silo cap to hold the top of the Missile in alignment with the bottom of the Missile. The box hangers have Korfund springs at the top and bottom pre-compressed to 70,000 pounds. The purpose of these springs is to give the Missile a vertical flexible movement. All structural members were designed with high strength bolted connections and conformed to the AISC specifications for structural steel joints utilizing ASTM A-325 bolts. Fabrication of the steel was performed by Mosher Steel Company of Dallas, Texas. After the crib steel had been erected from the silo floor through level three, suspension assembly systems consisting of high strength steel rods and pre-tension springs were installed. These assemblies were known as the shock hangers. Shock hangers consisted of hanger rods and a series of compression springs which were shipped in an un-compressed state. The springs were compressed at the site, utilizing a hydraulic jack, to approximately seventeen inches less length than in the shipping state. Stanchions were then placed at the assembly base to hold the springs in a compressed state until such time as they were supporting the entire silo crib load. The assemblies were then attached by their upper ends to steel plates previously embedded in the silo concrete wall and to the crib structure at their lower ends. At this point in time the crib steel had been erected through the third level.

At this time it was necessary to vertically jack the crib steel approximately two inches to allow eight inch threaded nuts to be fastened to the base of the shock hanger assembly rods. This was accomplished through the use of eight hydraulic jacks placed under the eight exterior columns. During this operation the contractor had to be exceptionally careful in order to meet critical design criteria of the final position of the crib structure. The crib steel structure at the fifth level, elevation 915 feet 10.5 inches, had to be placed within a quarter inch vertical of reference elevation and 1/16 inch of a true north, south, east and west position. The shock hanger assemblies were positioned to within a quarter inch plumbness, top to bottom. When this task was accomplished the hydraulic jacks and jack pads were removed from the base of the eight exterior columns and the crib structure was left suspended on the shock hanger assemblies fastened to the concrete silo walls. With the crib structure suspended from four sides to the silo walls, a gentle but measurable swaying motion was in effect at all time. This lateral and vertical sway which is comparable to the gentle rocking of the baby crib, led to the naming of the crib structure. This motion, combined with the position hanger Korfund spring motion, will enable the Missile to remain in a slightly flexible position through its tenure inside the silo. At the suspension of the crib structure the erection of the crib through level one was completed.

<u>LAUNCH CONTROL CENTER</u>: The Launch Control Center, better known as the LCC, is a two story cylindrical structure of reinforced concrete set six feet below ground level, wherein operating personnel for the Atlas Launch Complex will be housed. The first or top level has kitchen, first aid, toilet and living accommodations as modern and

complete as the average new home. The second level houses the remote control and communications equipment, and is the nerve center of the Launch Complex. The bulk of the control and communications equipment will be installed by others (not under CE contract) during the second phase of construction.

A reinforced concrete stairway and entry tunnel leads from grade level down two flights of stairs, through a pair of electrically locked entrapment doors, past a surveillance TV camera and into a vestibule adjoining the LCC. Stairwell affords the sole means for personnel entrance to the LCC and Launching Silo. The LCC in turn is connected to the Launching Silo by an eight-foot diameter steel tunnel, thirty-five foot below grade, leading from the LCC stairwell to the silo vestibule. Two pairs of heavy steel blast doors located in the entry tunnel and silo vestibule seal off the LCC from ground level and the Launching Silo.

The LCC as stated before is a cylindrical structure, 44'-6" in diameter and 33'-6" high outside, having walls 2'-3" thick, a 3'-6" base slab and a 3'-0" roof slab, all of reinforced concrete amounting to 875 c.y. A center column 4'-0" in diameter with a 12'-0" diameter cone base and capital extending from the base slab to roof slab is the lone interior support member for the roof slab.

Concrete was placed in three lifts, base, walls, and roof slab, with the stairwell placed monolithically with the LCC. The entrance stairway and vestibule were treated as separate structures and concrete placed accordingly. Ninety-six tons of steel were placed in the concrete as reinforcing, varying in size from # 4 to # 10 bars and in certain locations constituted such a dense maze that it was all but impossible to place concrete.

Within this concrete shell, a structural steel frame or "crib" was erected as the framing structure for the two levels and the various rooms. The entire crib is suspended from the concrete roof slab by four air cylinder spring supports and is free to move independently of the concrete shell, providing protection for personnel and equipment from external shock waves. Four floor leveling devices sense the level of the crib in respect to the concrete base slab and supply or bleed off compressed air to their respective air cylinders as necessary to maintain the crib level and at the proper height regardless of the load distribution within the L.C.C. Crib members range in size from light angles and channels up to 21" wide flanged beams 30'-6" long.

It would appear that since the crib is suspended from the concrete roof slab that steel erection would precede roof concrete placement. Yet, because of the monolithic placement requirements resulting in restricted access for hoisting heavy and bulky materials into the L.C.C. (down the Launching Silo and through the connecting tunnel, for pieces longer than 10'-0" could not negotiate the corners or narrow doorways in the entry stairway and vestibule passage) it became necessary to erect the crib before placing the roof slab. However, the crib being designed for suspension at the upper level, it could not be used as the sole support of the roof forms. The lighter members designed for tension only would, in compression, be subject to over-stressing. The contractor did erect steel on one site after placing the roof slab, but found the experiment costly and time consuming. Thereafter crib erection preceded concrete placement. The crib was solidly blocked up from the base slab, shored between levels with 4" x 4" studs approximately 3'-4" on centers set on the main floor members, and the top level decked over with 3" - 12" planking. Steel forming scaffolds were then set on the planking to support the roof forms. The planking was field cut so as to distribute the load to the shored framing members. Prior to shoring, crib erection including steel decking was completed.

Construction through completion of concreting was accomplished in the open excavation area simultaneously with silo concreting and crib steel erection. Subsequent to concreting, work by the various crafts within the L.C.C. was completed during backfill operations of the open excavation.

The contractor did not prosecute work on the L.C.C. as a separate entity. Instead, he elected to work the L.C.C. simultaneously with each phase of construction in the Launching Silo. Thus, while completion of the L.C.C.'s was delayed in a sense, waiting for the larger silo structure to catch up before entering another phase of construction, it proved advantageous in that the L.C.C. provided the means to correct organizational inefficiencies and to shake out crews. Certainly then the L.C.C.'s absorbed much of the "learning curve" inherent to large construction, particularly where so much of the work is consolidated within a single narrow structure and yet so widely dispersed over a large geographical area.

MECHANICAL WORK:

1. Utility and Domestic Water: The utility water system is installed with a hydropneumatic pressure booster system which is located in the silo. The system consists of one turbine type utility water pump and one certrifugal fog spray pump, a hydro-pneumatic tank, with all necessary valves, fittings, and controls attached thereto. The domestic water is used for human consumption and is so piped to all facilities used by the occupants. Utility water is classified as water used for fire protection equipment and make up water for the other systems.

2. Hydro-Pneumatic Tank: This tank is the center of all water systems with the exclusion of hot and chilled water used for air conditioning systems. This tank supplies the pressure and the make up for the water systems.

3. Sump Water Disposal System: This system is so constructed as to dispose of all water used for human consumption. The water is disposed of by the use of two pumps and is so piped into a drainage field outside of the silo. Other waste water is disposed of by another set of pumps which pipe the water to grade and so to drainage ditches.

4. Condenser Water Supply and Return System: The purpose of this system is to remove heat from the diesel generator and the water chillers. This water is in turn piped to a cooling tower at grade for cooling and then returned to diesel generators and chillers for the removal of heat.

5. <u>Chilled and Hot Water Systems</u>: These are two separate systems which work in conjunction in the heating and air conditioning systems. Two refrigeration plants keep the chilled water at its proper temperature. The hot water system gets its source of heat from the exhaust of the diesel generator and is so controled to keep the water temperature at desired conditions.

6. <u>Heating, Ventilating and Air Conditioning Systems</u>: Both of these systems are complex in nature and gigantic in size. The purpose of both systems is to keep a constant temperature as required by the various locations within the complex itself. Outside air is taken in and purified by a dust collector before it is available for use in the silo. A combination of fans, supply and exhaust the air at the complex so as to maintain enough fresh air for consumption.

7. <u>Compressed Air System:</u> This system supplies air pressure to the air cylinder supports, blast closures and the hydro-pneumatic tank. The Air cylinder spring supports suspend the floor at the Launch Control Center in four columns of air within the cylinders so as to have a floating floor. The blast closures when closed will isolate the complex from the outside atmosphere.

8. <u>General</u>: All the systems are fully automatic. The many automatic controls that operate these systems are so wired as to reflect any malfunction in the systems on an indicating lights cabinet. The supply of water for the systems is obtained from four underground storage tanks. All piping is rigidly supported to the floating crib steel and is identified as to the type of liquid being carried by it.

ELECTRICAL WORK:

1. Site Work: The electrical features at grade include gate controls, communications, remote power receptacles for support equipment, personnel audio and visual warning alarms, lighting of work areas and a cooling tower which automatically cools condenser water from major units located in the silo.

Rough-in work has been accomplished to provide means for future commercial power, heat and shock sensing devices and communication manholes for intersite communications system.

2. Security Control: The entry tunnel is equipped with an entrapment area for security control. Entry to the entrapment area is remotely controlled from the L.C.C. A pushbutton, when operated, warns the operator in the L.C.C. that entry into the entrapment area is desired. The first entrapment area door latch is released by the L.C.C. operator for entry. When inside the entrapment area, a television camera, which is connected to a monitor set in the L.C.C. provides the means for proper recognition of the party desiring entry. Communication with the party and the L.C.C. operator is maintained through a speaker-mike set installed in the proximity of the entrapment area. The second entrapment area door latch is also remotely controlled from the L.C.C. by the operator. Once past the entrapment area, access to the L.C.C. and silo is gained through a series of blast doors. All doors encountered are equipped with limit switches to alarm the L.C.C. personnel of activity taking place and location. Each door limit switch is identified at the monitor station, Facility Remote Control Panel.

3. Stairwell: The stairwell is equipped with an electrically controlled pneumatically operated blast closure. The blast closure operates under blast conditions and seals off the flow of air to and from the stairwell. Emergency light units provide limited lighting during a power failure. Communication means, public address and telephone, are provided at various locations.

4. Launch Control Center - First Level: The first, upper, level of the L.C.C. includes two blast closures which are electrically controlled and pneumatically operated. The mechanical room and kitchen are equipped with surge panels to protect the direct burial cables from surges due to lightning and/or overload conditions. The panels are equipped with lightning arrestors. This level is also equipped with telephone outlets, public address system outlets, fire alarm detector, audible and visual alarms. The four air-spring cylinder supports for the L.C.C. crib are equipped with solenoid valves which cause the cylinders to raise and lower the crib. The solenoid valves are energized by the operation of the floor leveling devices installed in four respective locations at the second level of the L.C.C. The floor leveling devices are mechanically controlled which in turn operate limit switches. Electrical power is provided for the range, refrigerator, water cooler, garbage grinder, hot water heater and lighting.

5. Launch Control Center, Second Level: The L.C.C. second, lower, level includes the main power panel, lighting distribution transformer and various lighting and communications distribution panels. There is a diesel general remote control panel to start, stop, parallel

and transfer load at the diesel generators in the silo fifth and sixth levels respectively. The Facility Remote Control Panel located in the Launch Control room contains audible and visual alarms for critical circuits. The indicator panel visually indicates equipment normal operating conditions. In the event a failure occurs, the visual and audible alarms operate simultaneously. This is to provide immediate action to clear systems of faults or break down. The fire alarm system power supply and annunciators located by the Facility Remote Control Panel provides immediate audible and visual fire alarms from designated zones throughout the Launch Control Center and Silo.

6. Utility Tunnel: The utility tunnel, which provides access from the L.C.C. to the silo includes various cable trays which carry the control, power and signal cables. Provisions have been made for communications, public address system and emergency lighting at the utility tunnel.

7. Launching Silo: The Launching Silo is equipped with two 500 kilowatt diesel generators, one of which is normally in operation. Power is supplied to hundreds of relays, solenoid valves, limit switches and motors through miles of wiring and cables. Dry-type transformers were installed for all lighting and convenience receptacles. Interconnecting wiring and cabling was accomplished through numerous conduits, cable trays and wire-ways.

Various panels, cabinets and boxes have been provided to house relays, breakers, motor starters, terminal blocks, fuses, future telephone and public address system and motor disconnect switches.

In the missile enclosed area the receptacles, lighting, public address and telephone outlets and conduits are explosion-proof types. This is an explosion-proof area and rigid requirements are set forth to confine an electrical explosion within the explosion-proof fixtures.

An electrically operated personnel elevator was installed to provide immediate access to desired floor levels.

8. Grounding: Hundreds of bare stranded copper leads were installed throughout the Site, Launch Control Center and the Launching Silo. This was to reduce the noise, stray and static electrical current flow which otherwise would interfere with the missile critical operational electronic equipment.

9. Tests: All electrically operated equipment was subjected to tests to insure that desirable results were met.

PROPELLANT LOADING SYSTEM: The propellant loading system, or PLS, consists of facilities to store and transfer liquid propellant fuels with auxiliary fluids and gases from supply sources to the missile. Propellants used are liquid oxygen and RP-1 fuel. Auxiliary systems contain liquid nitrogen, gaseous nitrogen, gaseous oxygen, and gaseous helium.

Liquid oxygen is maintained at $-297^{\circ}F$ and liquid nitrogen at $-320^{\circ}F$. Piping systems for those liquids are heavily insulated and storage vessels are, in effect, giant thermos bottles, having inner and outer shells separated by a vacuumed annular space.

Gaseous oxygen, nitrogen and helium are confined in their systems under high pressure.

Storage vessels were fabricated and installed as a part of the prime contract. All piping and equipment were fabricated and installed by Paul Hardeman, Inc. under a separate contract administered by the Ft. Worth District. The installation portion of Hardeman's contract was assigned to the prime contractor with the status of a subcontractor. Piping was fabricated as spools and equipment assembled on six prefabricated skids as follows:

| Skid | Silo Location |
|---|---|
| Liquid Oxygen Control Prefab | Level 7 |
| Liquid Oxygen Fill Prefab | Level 7 |
| Liquid Nitrogen Prefab | Level 7 |
| Pressurization Prefab | Level 7 |
| Instrument Air Prefab | Level 7 |
| Fuel Loading Prefab | Level 8 |

During the first few months of silo construction, plans were being made to meet the new challenge of installing and testing a complex Propellant Loading System, in which the Walker Area Office had almost no one trained and very few with past experience. The magnitude of importance could be measured by the strict and almost unbelievable cleanliness criteria. Specifications stated that the Contractor must install and maintain a system with no particulate matter in excess of 150 microns in size. There were other criteria, of course, but the greatest problem remained with developing techniques to minimize airborne and man-made particulate contamination during system installation. This phase was considered by many as the determining factor, whether or not the using agency could satisfactorily launch or have to abort a missile. It was imperative that a program be instituted to familiarize all of Engineering personnel concerning the intricacies of PLS.

In the Fall of 1960, a Propellant Loading Service Systems Orientation Course was conducted in Denver, Colorado by United Testing Laboratories' personnel, under the auspices of CEBMCO. It was realized that this course would be instrumental in establishing a basic and common understanding of Propellant Loading Service Systems and to standardize installation and acceptance testing procedures. During the latter part of the year, more than fifty of the Walker Area Engineers, including the Chief of Military Construction Branch and his staff, attended this course.

The 15th day of March 1961, PLS installations commenced in the Walker Area. At the inception of the PLS installation stage, an indoctrination course was set up at the Area level for all Engineering personnel who had not attended the course in Denver. A serious attempt was made to duplicate the Denver material in order to give one and all a common background. In addition, intensified training was given in the techniques involved in connecting spools to maintain the highest degree of cleanliness possible. Cleanliness of the Area, personnel, tools, and using of the proper inspection aids, such as blacklight, white light, and Wipe Test, were stressed.

To attain the highest degree of confidence possible with the using agencies, Air Force and General Dynamics/Astronautics, a compact Propellant Loading Systems Indoctrination Course was offered to them. It was the belief that in this way the agencies involved would benefit from the same information and also would be useful as a sounding board for differences of opinion. During the months of May and June, approximately eighty GD/A and Air Force personnel attended lectures designed to acquaint the customer with the Area Office's dedicated interest of giving them a system that would be functionally sound.

During the installation of PLS at the up-stream sites, the PLS section, consisting of a staff of approximately six engineers, devoted themselves to constantly roving the sites in a attempt to standardize our procedures and techniques. Wherever possible, spools were connected together top-side within the confines of a more than adequate spool make-up enclosure. The wall interiors were covered with polyethylene, a vacuum intake was located in the enclosure, strict uniform requirements were maintained, all lines being connected were under constant, adequate, gaseous nitrogen purge, a window was placed in each enclosure for observation of spool hook-ups by staff members, to again insure our strict techniques were being followed.

From their arrival, all prefabs and vessels were daily monitored to insure adequate, positive pressure was maintained at all times. Periodic spot checks were taken to establish correct dewpoint maintenance.

To further assist its staff, Corps of Engineers transferred personnel from up-stream bases, giving the Area invaluable knowledge and experience to further develop its PLS capability. During this time, preparations were being made to establish a program of standardization for acceptance testing. Specifications were reviewed meticulously for these requirements, sample testing forms were developed, and again, a course in acceptance testing was begun. Night after night each system was reviewed to a select group of test engineers, so that one and all would understand not only the systems individually, but as they relate to one another. The slogan "Be one step ahead of the Contractor" was instituted and was the ultimate goal of all.

Approximately the first of August, PLS testing commenced with the lead site, Site 10. It was realized that all decisions made at this time would pattern effectiveness of down-stream sites. Continuous surveillance by the PLS section was maintained. It was at this site that Modification #94, which concerned the blowing down of the gaseous nitrogen and gaseous oxygen A. O. Smith vessels, commenced. Techniques developed at this lead site saved many man-hours in accomplishing this modification down-stream. The gaseous nitrogen bottle in particular was most troublesome. Approximately one hundred blow-downs were required before obtaining an acceptable blowdown pad. During PLS acceptance testing at this site, refinements of the test procedures were made, accounting for sizeable savings in time and money. During this period, a PLS bulletin was developed and distributed to all sites. Each problem as it arose was studied, and final resolution was dissiminated to all. A policy was established to insure that the down-stream sites would be in a position to take full advantage of the experience gained at the lead site.

Approximately one million gallons of liquid nitrogen was used in checkout and testing of the PLS system. The majority of this liquid was converted to high pressure gas for pressurization and blowdown of the systems. Liquid nitrogen was also used for cold flow tests on the liquid systems in place of the more hazardous liquid oxygen. In addition, 900,000 standard cubic feet of helium and 10,000 gallons of RP-1 were used.

LAYOUTS AND SURVEYS: The Atlas "F" Launching Silos and their contents were constructed under unusually close tolerance requirements. In fact, it is believed that many of the requirements were something new in the heavy construction industry. To accomplish the degree of accuracy required by the contract documents it was necessary to establish special survey controls and procedures.

The launching silo design and construction was measured and located from three axis lines. Two horizontal axes, $90^{\circ}$ apart, were centered on a vertical axis which constituted the rotational center line of the truly cylindrical shape of the silo concrete structure. The X-X axis was oriented parallel to a true East-West direction, the Y-Y axis parallel to true North-South, and the Z-Z axis was plumb. Vertically, the structure was controlled by measurements above specified data surfaces. Each silo structure was referenced to an exact elevation above mean sea level datum. For uniformity of plans all silos were detailed, vertically, to a reference datum 1000.00 feet below the finished top surface of the concrete cap.

Because of the high degree of accuracy required to be established in locating the silos horizontally and vertically, the United States Coast and Geodetic Survey was called on to establish base line control markers. Prior to issuance of plans and specifications the Coast and Geodetic Survey established a base line at each site with brass cap monuments. It provided the exact length and true bearing of each base line which it terminated at each end with a brass cap monument showing grid locations and elevation above mean sea level. At a later date, and before start of construction it provided similar brass cap monuments on the X-X and Y-Y axes of each silo.

During excavation and concreting operations the Corps of Engineers survey crews, equipped with highly accurate instruments, set brass cap markers on the X-X and Y-Y axes adjacent to or on the structures as work progressed. They first set markers at ground surface near the lip of the open cut excavation, then on the concrete collar at beginning of shaft excavation, later in the silo concrete floor, and finally in the silo concrete walls.

For control of crib steel erection the survey crews installed four vertical wire cables on the X-X and Y-Y axes, one at each silo wall. The ironworkers were thus able to locate the axes by attaching horizontal string lines to the cables across the silo at any floor elevation. For vertical control during crib steel erection the survey crews provided a rigidly attached high-grade calibrated steel tape from top to bottom of the silo, located on the silo wall.

Many construction features required highly accurate setting to unusually close tolerances. The contractor's surveyors located the items first and were followed by the Corps of Engineers in a careful check. Principal of the items thus installed, together with tolerance setting requirements, were as follows:

1. Silo wall form panels - plus or minus 1 inch tolerance horizontally from the Z-Z axis.

2. Special steel wall form panel with collimator plate insert-maximum 3/8 inch from Y-Y axis and plus or minus 1 inch from the Z-Z axis.

3. Imbedded items in silo wall concrete-variable tolerances.

4. Site tube - 3/8 inch tolerance horizontally and ¼ inch vertically.

5. Shock hanger wall bracket concrete inserts, approximately 10 feet wide by 12 feet high and 9000 pounds each - 1 inch tolerance, all directions and elevations.

6. Crib steel - 1/8 inch tolerance at each floor level, horizontally and vertically.

7. Launch platform counterweights and drive base assemblies - 1/8 inch tolerance.

8. Silo cap door - 1/16 inch tolerances.

9. Propellant loading system flanged interface connections - 1/16 inch tolerances.

A part of the final setting accuracy checks was participation by General Dynamics/Astronautics surveillance teams. Their interest was in verifying accuracies required for their later installation of the missile and control systems.

PHOTOS: Photos of construction features and operations are contained in Appendix A.

DESIGN CHANGES: There were no major design changes after construction started, but there were a multitude of small ones. An outstanding example is in silo crib steel drawings. In the interest of interchangibility of parts and operating and maintenance personnel the Using Service established the policy that plans and specifications for all six Atlas "F" missile base projects must be identical. Contract documents contained normal engineering drawings of the silo crib steel structure, but the concept of uniformity was carried further to structural details. A provision in the specifications stated that supplemental structural steel detail drawings would be issued after award of contract. Normally, such detail drawings are prepared for the contractor by its structural steel fabricator, and their accuracy are thus a contractor responsibility. The supplemental detail drawings, as later provided, were subsequently found to contain many errors and deviations from the contract drawings. These led to loss of time and extra work on the part of the contractor; and, since he was not responsible for the accuracy of detail drawings, he was able to recover costs incurred.

The contract drawings were revised a number of times during construction. The revisions were not major in scope but so numerous in number that they caused unusual confusion, delays and loss of effort in tearing out and replacing work.

A list of modifications and allied claims resulting from design changes is contained in the MAJOR MODIFICATIONS AND CLAIMS section, Part III, of this report.

ENGINEERING AND TECHNICAL BRANCH:

With the establishment of the Roswell Area Office, the Engineering and Technical Branch came into being. It was staffed with three engineers and six engineer trainees.

The design architect-engineers contracted to the Air Force and were to perform design on all changes to the standard package. After the issuance of the first eleven modifications, subsequent modifications totaling one hundred and twenty-five were designed and contract documents revised by E and T Branch engineers and draftsment. The Walker Area Office was the only one under the Atlas "F" Directorate that revised the contract drawings to reflect all changes. The modifications varied from simple to very complex and in numerous cases required revisions to hundreds of reproducible drawings. Over one thousand three hundred contract drawings were revised by E and T Branch personnel.

The file room in the E and T Branch contained over nine-thousand seven hundred shop and contract drawings. Approximately five thousand shop drawings were reviewed and approved by personnel of the E and T Branch. A drawing log was maintained constantly to show all information about each drawing and its whereabouts. Drawings were processed at the rate of eighteen per day and were reviewed and approved at the rate of nine per day.

A large percentage of time of the higher level engineers in the E and T Branch was spent in liaison between the Area Office and Air Force (SATAF), higher authority (CEBMCO), General Dynamics/Astronautics (GD/A), Inspecting Districts, and Districts responsible for the seventeen Assigned Services Contracts. Much of their time was spent advising the Air Force of construction progress feasibility of proposed changes, estimating costs of changes and in determining that changes were mandatory.

**LABOR RELATIONS:** Relations between contractors and labor at the Walker Area were excellent. There were some disputes which resulted in six walkouts or strikes by certain trades for periods of two to six days as follows:

Strikes and/or Work Stoppages

| Start | End | Union | Cause | Man Days Lost |
|---|---|---|---|---|
| 23 Aug 60 | 26 Aug 60 | Carpenters | Work Assignment | 66 |
| 31 Aug 60 | 5 Sept 60 | Laborers | Safety Factors | 2231 |
| 4 Apr 61 | 5 Apr 61 | Electricians | Discharge of Workers | 32 |
| 8 June 61 | 9 June 61 | Electricians | High Time Pay | 68 |
| 9 June 61 | 12 June 61 | Plumbers | Ice Water | 75 |
| 20 June 61 | 21 June 61 | Ironworkers | Work Assignment | 40 |
| | | | Total | 2512 |

## PART III

## CONTRACT ADMINISTRATION

GENERAL: The construction of the Walker Air Force Base Atlas "F" Ballistic Missile launching facilities was accomplished under five prime contracts - a basic contract for the twelve missile launch complexes consisting of silo, LCC and immediate site work and four support facilities contracts.

Because of an atmosphere of urgency, plans and specifications were prepared hurriedly and issued for bids with full knowledge that revisions would be required to fit requirements of the missile which was still in the development stage. This understanding became known as a "concept of concurrency." Because of this condition many changes were made to plans and specifications during construction. In many instances, changes were made upon changes, quite often resulting in the necessity to tear out construction work already accomplished. A total of 177 modifications in the aggregate amount of $16,240,500.00 were negotiated and processed for the basic construction contract. Approximately half of the dollar volume of this amount resulted from directed changes and the remaining half from claims found valid.

In the early stages of construction the impetus of urgency continued. The Contractor was in constant reminder that there would be no alternative but to complete the job on schedule; to include changes and additions by modifications. A close watch was kept on progress as reported versus a progress schedule established at the beginning of the job. When it began to appear that progress was lagging behind that schedule the contractor was prodded by GC-5 letters to get back on schedule. In February 1961, the "big push" was relaxed by directive. All GC-5 letters were rescinded with the exception of those on cryogenic vessel fabrication which were known to be the most critical features of the job. Nevertheless, situations had been created which resulted in large claims.

Another aspect of the job which led to large claims was the number of people on the sites other than contractor and normal inspection forces. The Air Force, being vitally concerned that the finished product be compatible with the needs and requirements of its missile, placed a surveillance crew by its missile contract at each site. In addition, personnel from the various branches and departments of the Air Force's Site Activation Task Force and related Ballistic Missiles Division made frequent and periodic visits. This, coupled with the limited work space in silos, led to claims of unusual and astronomic proportions.

A total of 241 claims were received from the basic contractor. Of these, 197 were denied or withdrawn, thirty-eight were approved and successfully negotiated, and six remain outstanding. The contractor has signed a release from all claims as negotiated. A part of the release is a stipulation placing dollar value limitations on the six outstanding claims, thus limiting the dollar value of the contract.

CONSTRUCTION PRIME CONTRACTS:

LAUNCH COMPLEXES: The basic construction prime contract was Contract No. DA-29-005-ENG-2598, WS-107A-1 Operational Base Missile

Launch Complexes, awarded to a joint venture composed of the Macco Corporation, Raymond International, The Kaiser Company, and Puget Sound Bridge and Dry Dock Company. The Macco Corporation, as sponsors, administered the project from its home office at Paramount, California. The original contract, in the amount of $22,115,828.00 was awarded 20 June 1960. Work was accepted as substantially completed 6 January 1962 with all minor deficiencies corrected as of 8 February 1962. Because of the great number of changes, "concept of concurrency," limited working spaces and other unusual conditions there were a great many modifications and an abnormal number of claims. As a result of 177 modifications and 241 claims, thirty-eight of which were recognized, the contract was finally settled at $38,356,329.42, with time extensions granted averaging sixty days per site. There were no liquidated damages. The final settlement is subject to six claims exceptions which are stipulated in a release signed by the contractor not to exceed $274,000.00.

The contractor's performance has been rated above average in quality of work performed and satisfactory in all other respects.

LIQUID OXYGEN PLANT: Contract No. DA -29-005-ENG-2654, 25 Ton Liquid Oxygen Plant, was awarded to S.I.P., Inc., of Houston, Texas, 31 October 1960, in the amount of $383,893.00. It consisted of central storage and handling facilities for liquid oxygen and liquid nitrogen, located at Walker Air Force Base. The contract was completed on 18 August 1961, ahead of contract schedule and with no time extensions. There were ten modifications, all minor in nature. The contract was closed at a total cost of $385,088.00.

The contractor's performance is rated average on evidence of ingenuity and economy, excellent in effectiveness of safety program, and above average in all other factors.

RE-ENTRY VEHICLE FACILITIES: Contract No. DA-29-005-ENG-2656, Re-Entry Vehicle Facilities, was awarded to Earl F. Puckett, of Roswell, New Mexico, 4 November 1960, in the amount of $118,254.00. It consisted of a vehicle maintenance building addition, office and toilet additions to an existing storage building, and a mounded concrete igloo storage magazine. All are located at Walker Air Force Base. The basic contract was completed 3 months ahead of schedule on 9 June 1961, with no time extensions and with five modifications. All additional work was completed by 12 September 1961. The contract was closed at a total cost of $123,830.32.

The contractor's performance rating has been established as excellent in quality of work, effectiveness of safety program, and cooperative attitude and above average in all other respects.

SHOPS, MISSILE ASSEMBLY AND MAINTENANCE, AND TECHNICAL SUPPLY BUILDING: Contract No. DA-29-005-ENG-2697, Shops, Missile Assembly and Maintenance, and Technical Supply Building, wasawarded to Arvol D. Hays, Lubbock, Texas, 25 November 1960, in the amount of $536,883.00. It was a building job, as titled, at Walker Air Force Base. The contract was completed 30 September 1961, on schedule and with no time extensions. Eighteen minor modifications were issued, bringing the total cost of the job to $536,658.02 at closing.

The contractor's performance rating: Effectiveness of Safety Program - Excellent; Quality of work and Cooperative Attitude - Above

Average Meeting Schedules, Ingenuity and Economy, Organizational Ability and Efficiency, and Adherence to Security Regulation - Average; Effective Use of Materials, Equipment, Manpower and Facilities - Satisfactory; Effectiveness of Supervision - Unsatisfactory. The last rating resulted from the condition that supervision with authority to act for the contractor was available on an indeterminate, part-time basis only.

WATER SUPPLY FOR 12 SITES: Contract No. DA-29-005-ENG-2801, Water Supply for 12 Sites, was issued to Brown-Olds Plumbing and Heating Corporation, El Paso, Texas, 18 January 1961, in the amount of $814,253.70. It provided domestic and service water for the sites and consisted of wells, raw water storage, demineralization and softening treatment, treated water storage, pump stations and transmission pipelines. Sixteen modifications have been negotiated and processed in amounts ranging from a $35,911.05 decrease to a $19,218.25 increase, bringing the total cost of the contract to $854,893.44. Nine claims have been received, of which four have been recognized and processed as modifications, three have been withdrawn, and two are outstanding as of this date. The contract was physically completed 9 March 1962 on schedule as revised by time extension granted by reason of added work and excusable delays.

The contractor's performance rating: above average for adherence to security regulations and effectiveness of safety program; average in quality of work, ingenuity and economy, and cooperative attitude; and satisfactory in all other factors.

PRINCIPAL SUBCONTRACTS: The basic construction contractor awarded nine major subcontracts as follows:

MASS EXCAVATION: Anderson Brothers of Albuquerque, New Mexico. Open cut excavation to a level at the bottom of the LCC structure, about 35 feet of depth.

REINFORCING STEEL: Cobusco-Salyer Company of Denver, Colorado. Furnish and install concrete reinforcing steel in LCC's and silos.

CRIB STEEL ERECTION: Owl Trucking and Construction Company of Compton, California. Erection of crib steel at the last seven sites. The prime contractor performed crib steel erection with its own crew at the first five sites.

MECHANICAL: The Stanley-Carter Company of Detroit, Michigan. Furnish and install plumbing, heating, ventilating and air conditioning systems in LCC's and silos.

ELECTRICAL: Clarkson-Douglass Electric Company of El Paso, Texas. Furnish and install electrical work in LCC's and Silos.

PERSONNEL ELEVATORS: Otis Elevator Company of New York City, New York. Installation of personnel elevators in silos. Otis had a separate contract with the Government for fabrication and installation of the elevators. In accordance with terms of their contracts, the installation portion was assigned to the prime contractor, thus Otis effectively became a subcontractor.

PROPELLANT LOADING SYSTEM: Paul Hardeman, Inc., of Stanton, California. Installation of missile fuel propellant systems, including piping and equipment. Hardeman also had a separate contract with the Government for fabrication and installation. The installation portion was assigned to the prime contractor.

PAINTING: Eric Lundeen of Los Angeles, California. All painting work.

ROADS AND PARKING AREAS: Floyd Haake of Roswell, New Mexico. Paving and graveling of access roads and parking areas.

Data on cost to the prime contractor of the above subcontracts are not available. Efficiencies of the subcontractors have not been analyzed and thus cannot be included. There were no major subcontracts under the Support Facilities prime contracts.

MAJOR MODIFICATIONS AND CLAIMS: In connection with the basic prime Contract No. DA-29-005-ENG-2598, Launch Complexes, there were twenty-two major contract modifications negotiated for amounts in excess of $100,000.00. Of these, four formally assigned seventeen Assigned Service Contracts to the prime contractor in the aggregate amount of $4,142,193.90. Assignment was in accordance with contract provisions of both prime and Assigned Service contractors. The prime contract contained an estimate of the value of the ASC contracts as $4,774,000.00. However, this amount was not included in the prime contractor's original contract amount. The assigned amount, therefore, actually constitutes a reduction of about $630,000.00 in the anticipated dollar volume of the prime contract. Eight more of the twenty-two major modifications were for changes or additions and ten resulted from recognized claims. Six claims remain unsettled but are limited in maximum amounts by stipulations contained in a release signed by the Contractor. The above are listed as follows:

| Modification Number | Description | Amount |
|---|---|---|
| | **A - Assigned Service Contract Assignment Modifications** | |
| 40 | PLS Subcontract | $1,702,000.48 |
| 41 | Overhead Door Hinge Assembly Subcontract | 239,199.75 |
| 42 | Electric Switchgear, etc., Subcontract | 166,669.61 |
| 46 | Remaining ASC Subcontracts | 2,034,173.45 |
| | **B - Major Modifications Due to Changes** | |
| 11 | Major Mechanical and Structural Changes | $1,215,000.00 |
| 13 | Provide for a Continuous Electromagnetic Screen | 112,592.55 |
| 57 | Struc., Mech. and Elec. Changes & Revisions | 111,500.00 |
| 77 | Mechanical & Electrical Changes & Additions | 135,800.00 |
| 87 | Add Hangars & Pipe Supports | 137,000.00 |
| 100 | Supplemental Design Drawings - Changes | 308,000.00 |
| 106 | Operate Diesel Generator for Power | 388,000.00 |
| 108 | Mech., Elec., & Painting Changes & Additions | 157,800.00 |
| | **C - Major Modifications Due to Recognized Claims** | |
| 155 | Struc. Steel - Field Correction Memoranda | $ 129,000.00 |
| 157 | Silo Slip Forms vs., Conventional Forms | 932,100.00 |
| 158 | Additional Modif. Overhead for Time Extensions | 525,000.00 |
| 159 | Crib Steel Erection Tolerances | 277,000.00 |
| 161 | Joint Occupancy & Multiple Inspection | 1,250,000.00 |
| 162 | Validation Procedures | 244,000.00 |
| 163 | Acceleration | 3,499,950.00 |
| 171 | Jt. Occup. & Mult. Insp., Elec. Sub. | 296,122.00 |

| Modification Number | Description | Amount |
| --- | --- | --- |
| 172 | Valid. Procedures - Elec. Sub. | 114,838.00 |
| 176 | Acceleration - Elec. Subcontractor | 643,539.00 |

Copies of memoranda describing claims resulting in the above modifications are contained in Appendix B.

D - Unsettled Claims with Stipulated Maximum Amounts

| Claim Number | Description | Amount |
| --- | --- | --- |
| C-20 | Crane Accident at Site 2 | $ 25,000.00 |
| C-24 | Delayed Delivery, PLS Vessels, Yuba Industries | 53,000.00 |
| C-26 | Concrete Supplier - Davis-Bacon Wages | 17,000.00 |
| C-40 | Delayed Delivery, PLS Vessels, Taylor-Forge | 30,000.00 |
| C-32 & 131 | Delayed Delivery, PLS Vessels, GAT Co. | 149,000.00 |
| | Total Stipulation | $ 274,000.00 |

There were no major modifications or claims in connection with the Support Facilities contracts.

## PART IV

## MISCELLANEOUS

ACCIDENTS:

The Walker Area suffered three major accidents involving eight fatalities as follows:

1. Laborer electrocuted while guiding a corrugated culvert section suspended from a crane boom when the crane boom contacted a power line. The accident occured 29 August 1960. It resulted in one fatality and two temporary total disabilities. Corrective action: Contractor was issued strict instruction that no equipment with the capability of contacting high voltage lines would be operated, maneuvered, or in any manner positioned in close proximity to high voltage lines until compliance with the provisions of Section 18-10 of General Safety Requirements had been satisfied.

2. Oiler-driver of truck crane started truck engine as ironworkers removed outriggers and wheel chocks. Truck was in reverse gear and backed into silo. This accident occured 16 February 1961. It resulted in six fatalities, one permanent disability, eighteen temporary disabling injuries and $149,000.00 damage. Action taken: Backfill to be kept eighteen inches below top of silo parapet walls. Braking systems to be checked periodically. Shaped wheel chock blocks to be provided. Recommendation that truck cranes used near silos be equipped with "fail safe" braking systems.

3. Ironworker, while attempting to tighten bolts between Levels 4 and 5, leaned over and grasped a tie rod which was loose at one end.

The spring action of the tie rod threw him against the silo wall and he fell to the bottom. The accident occurred 1 May 1961 and resulted in one fatality. Action taken: Contractor directed to properly secure all structural members immediately at time of installation in silo. Nets to be installed to afford protection in rattle spaces as well as in shafts.

The Walker Area accident experience data was as follows:

| | |
|---|---|
| Man-hours Worked | 3,971,189 |
| Disabling Injuries | 74 |
| Fatalities | 8 |
| Days Lost | 51,086 |
| Frequency Rate | 18.63 |
| Severity Rate | 12.89 |

VISITS:

Because of the nature of the project there were many visitors to the Area Office and the job sites. A list of visits, as extracted from the Area Daily Log and Register, is contained in Appendix C.

CEREMONIES:

There were two formal ceremonies during the construction work.

The Liquid Oxygen Plant was turned over to Walker Air Force Base 28 April 1962.

Site 10 was turned over to the Air Force 31 October 1961 in a ceremony wherein the keynote speech was made by New Mexicos' Governor Mechem.

Photos and newspaper articles appear in Appendix C.

RELATIONS WITH SATAF:

Key personnel heading the Site Activation Task Force are shown on Figure 13.

Relations with SATAF were generally excellent. However, the quality of personnel initially employed by General Dynamics Astronautics, which is a part of the SATAF organization, was extremely marginal. This Area was staffed with 92% graduate or professional engineers. GD/A surveillance personnel were composed of airplane factory quality control types of personnel, similar in quality with inspection type personnel in the GS-5 to GS-7 grade range. They lacked basic comprehension of their tasks and were not familiar with construction practices. As the job progressed and GD/A personnel became available from "up-stream" bases, the situation improved in direct relationship to influx of qualified engineers employed by GD/A on the sites.

CONCLUSIONS:

a. The program as constituted was generally properly organized and controlled by CEBMCO in Los Angeles, California.

b. The plans and specifications for the work, while requiring many changes due to the "concept of concurrency", were generally satisfactory.

RECOMMENDATION:

It is recommended that:

a. Information from "up-stream" bases should have been more promptly relayed to down-stream bases.

b. The lump-sum fixed price control not be utilized for construction involving concurrency. A fixed price incentive type contract would appear to be more appropriate.

c. The installation and checkout phase of the work should have been under the direction of the construction contracting officer in order to facilitate better control of the quality and cost of the work.

# REFERENCE 7

*The following is a verbatim transcript of a report written by The founding trustee of the National Aerospace trust. Any personal comments of mine will be italicized. Les Hayles*

*The report:*

**ATLAS F (SM-65F/HGM-16F)**

**Intercontinental Ballistic Missile (ICBM)**

**United States Air Force (USAF)**

**Strategic Air Command (SAC)**

**Walker Air Force Base, Roswell, New Mexico**

**HQ 6th (Heavy) Bomb Wing/6th Strategic Aerospace Wing**

**579th Strategic Missile Squadron (579th SMS)**

**Atlas Series F was designed and developed to counter the threat of strategic and/or tactical threat signature(s) to the economic (business/trade) interests of the United States of America. To be maintained as emergency capable, and if required, be used as emergency force against weak or undefended industrial and urban targets. Further, as primary force-capable projection in counter-economic/counter-value warfare towards destruction of hostile industry or urban centers. Finally, for the execution of hostage centers**

**Squadron force configuration was 12 remote launch sites (minimum 7 mile separation between complexes) located in a circular pattern around a host airbase (remote site support facilities).**

**Each remote launch site layout consisted of a missile silo and launch control center *(LCC)*. All essential ground/system support equipment was stored in silo on an 8 level shockmounted crib structure. Offset within the crib structure was a launcher platform elevator shaftway (also known as the missile enclosure area *[MEA]*).**

**Unlike later systems, Atlas F WAS NOT in-silo launched. The missile was raised to the surface for launching.**

**The missile silo and launch control center were connected by a blast lock (2 blast lock doors), a very short utility tunnel, and a post construction-installed blast debris door.**

**Entrance to the underground facility was via a surface door, down a two-tier personnel stairway, elbow corridor into a two-door entrapment area (with TV camera view point), short corridor to a blast lock (2 blast doors) and down into a vestibule stairwell to bi-level LCC doorway entrances and personnel utility tunnel entrance (at bottom of vestibule stairwell).**

**Above ground site surface features were a quonset style administration and storage buildings, water cooling tower *(diesel generator cooling)*, water filtration shed(s), well pumphouse shed(s), small water storage tanks(s), gatehouse sentry shed, sewage stabilization pond(s), discage communications antenna, and an access road to/from county or state highway/road. During Operation Red Heat updating (1963-64), the discage communications antenna was repositioned nearby, within easement, to make room for a periscopic high frequency communication antenna (silo) and a ultra- high frequency cone-shaped communications antenna concrete hardstand.**

**The complex was hardened to 150-200 psi (although system deficiencies would rate the sites at 30-50 psi during operational lifespan).**

**Missile silo was 179 ft deep (including 4 ft deep sump well) and 52 ft in (inside) diameter. Launch control center was 40 ft in (inside) diameer, with a floor-to-ceiling height of 27 ft, and a concrete support column (4 ft in diameter) in center of LCC structure. The launch control center had two levels. Both floors were hung from the ceiling on an air suspension system (4 cylinders) as shockmounting.**

**System Designer/Manufacturer: General Dynamics; Convair Division, San Diego, California.**

**Missile Length: 82 ft, 6in (MK-IV RV & OW-38 M1 warhead or MK-III & OW-49M4**

**warhead combinations)**

**Missile Diameter: 10 ft (tank stage), and/or 16 ft (booster) *(engines)***

**Missile Weight: 268,448 pds (minimum w/ MK-III RV/OW-49M4)**

**: 270,100 " (maximum w/ MK-IV RV/OW-38 M1)**

**Missile Thrust: 390,000 pds**

**Missile Range: Strategic Operational Requirements (SOR):**

**3,450 miles (minimum)**

**6,325 Miles (SOR Nominal) with MK-IV RV/OW-38M1 warhead or**

**alternate payload MK-III RV/OW-49M4 warhead**

**Missile Range; Maximums:**

**+8,760 miles maximum with MK-IV Mod-3A RV/OW-38M1**

**warhead with no penetration aids**

**+8,085 miles maximum with MK-IV Mod-5B-3 RV/OW-38M1/Mod-1A**

**Penetration Aid Mod**

**+9,042 miles maximum with alternate payload; MK-III Mod-2B RV &**

**OW- 49M4 warhead (348 pound RV/1,732 pd warhead/369 pounds**

**of subsystems)**

**Re-entry vehicle (RV) (primary) Weight/Dimensions; MK-IV:**

**225 pds, 11 ft 3 in length and 2 ft 7 1/2 in diameter (4 ft 0 in at adapter)**

**(alternate) Weight/Dimensions; MK-III:**

**348 pds, 11 ft 10 in length and 2 ft 0 in diameter (4 ft 0 in at adapter)**

**Warhead/War Reserve (WR) Weight: 3,309 pds (OW-38M1)**

**[3,000 pds XW-38 prototype weight]**

**: 1,732 pds (OW-49M4) (alternate)**

**[1,500 pds XW-49 prototype weight]**

**Yield Values (primary test): 3.50 - 3.75 Megatons**

**(alternate test): 1.40 - 2.50 Megatons**

**SOR/WR Yield Value: 2.35 Megatons (minimum value)**

**4.50 Megatons (nominal value)**

**6.70 Megatons (maximum value)**

**Emergency Yield Values: OW-38M1; 4.70 - 6.70 Megatons (select high)**

**OW-49M4; 2.35 - 3.35 Megatons (select low)**

**WR/RV Subsystems Weight: 368 pds (alternate RV; MK-III)**

*The word* Provisionals *is penned in here.* **291 pds (primary RV; MK-IV Mod 3A)**

**426 pds (primary RV; MK-IV Mod 3A with**

**Mod 1A Penetration Aid Pods)**

**Penetration Aids/Decoys: 3 loads (Mod-1A, Mod-2B, and Mod-4), plus Atlas F aeroframe**

*The word* Provisionals *is penned in here.* tank fragmentation.

Note: Penetration aids and decoys were incorporated into the MK-IV RVs to increase mid-course (free-space) and terminal (atmospheric) penetration by the re-entry vehicle into a hostile airspace to degrade and counter defensive detection systems (radars) down to 150,000 ft.

The MK-IV re-entry vehicle mounted a primary penetration aid pod, plus a secondary decoy payload ejection mechanism (DECPEM) pod.

The Mod-1A primary deception pod contained 5 vacuume *(spell?)* (free-space) inflatable aluminized mylar balloons shaped like the MK-IV RV. When disperced (1.1 - 2.0 seconds after RV separation from aeroframe) deployment was designated for a 65-mile diameter dispersion. The secondary DECPEM contained 5 high intensity flares.

To offset any potential aim point by hostile detection, fire control and acquisition radars, an open-loop tank fragmentation destruct sequence was built into the Atlas F aeroframe.

Further, a spin stabilization system was mounted in the MK-IV RV to increase speed (by generating non-RV oriented rotation of over 100 rpm) over the target area.

Finally, the MK-IV RV was coated with a "glove" of ablative material to reduce radar cross section and reduce wake ionization.

All decoys utilized either enhancement or reduction features to counter infrared detection and ultraviolet detection.

Total Payload Weight: 2,448 pds (alternate; MK-III Mod 2B/OW-49M4)

*Penned In :* 3,825 pds (primary; MK-IV Mod-3A)

4,100 pd citation 3,960 pds (primary; MK-IV Mod-5B with Mod-1A Penetration Aid Pod)

Target Selection: 2

Targets Allotted Per Force: 4 - 5 (2 - 3 missiles each target)

Detonation Points: 8,400 - 16,800 ft (airburst)

2,640 - 5,280 ft (near-surface burst0

0 ft (ground impact burst "failsafe")

Fuzing Options: 2 (airburst or near-surface burst)

**Circle Error Probability (CEP) [area 50% of targetted warheads will detonate in]:**

**2.2 miles from target (1963)**

**1.6 miles from target (1964, after upgrading)**

**Launch site Reaction Time: 10 - 12 minutes (SOR: - 8 minutes)**

**NOTE: During Operation Long Reach (24 July, 1963), Walker AFB remote launch sites achieved a simulated launch average of 14 min 35 sec (only 7 of 15 simulated launch attempts declared successful). Of those successful (7), five had an average simulated launch time of 10 min 54 sec.**

**The following are Operation Long Reach results respecting Walker AFB remote site simulated Operational Readiness Testing (ORT) EWO full-cycling drills. Ratios cited are launch attempts versus launch success. As follows:**

**579-1 Destroyed by fire, explosions, and burnout**

**579-2 Maintenance/Training**

**579-3 3/1**

**579-4 Maintenance/Training**

**579-5 1/1**

**579-6 2/1**

**579-7 Maintenance/Training**

**579-8 Maintenance/Training**

**579-9 1/1**

**579-10 4/1**

**579-11 1/1**

**579-12 3/1**

**Fuel Fill Time: Stored aboard missile (except RP-1 levelling/topping insertion prior to launcher/elevator lift to surface)**

**Propellant (oxidizer) Fill Time: 4 minutes 50 seconds, or less**

**Emergency War Order (EWO) Static (raised) Hold Time: 2 minutes**

**Emergency War Order (EWO) Static (in-silo) Hold Time: 60 minutes**

**EWO Silo Lift Time (raise missile): 1 min 20 sec**

**Time To Lower Missile: 8 - 20 min (at select descent speeds)**

**Blast Door Reaction Time (to open doors): 25 sec**

**Blast Door Weight: 75 tons**

**Launch Crew: 5 (combat crew rotation every 24 hours)**

**On-site Security Crew: 2 (rotation every 4 hours)**

**Launch Site Sufficiency (hold-out period): 10 days**

**Reserve Missiles: 1**

**Reserve Warheads: 1 - 2**

**Reserve RVs: 6**

**Training RVs: 6**

**Recycle of Propellant Tank Supply: Every 10 - 12 days**

**Recycle of Fuel Tank Supply: Every 180 days**

**Missile Squadron Force Load: Missiles Ready: 67% minimum**

**80% maximum**

**Missile System Relabilty: 1962; 53%**

**1963; 59%**

**1964; 37%**

**1965; 36%**

**Atlas F Silo Propellant Tank Volumes:**

**Liquid Oxygen *(Lox)* Storage Tank: 23,000 gal. capacity**

**" " " " : 21,850 gal. nominal load**

**" " Topping Tank: 3,629 gal. capacity**

**" " " " : 3,420 gal. nominal load**

**Atlas F Fuel Tank Volumes:**

**RP-1 (kerosene-type) Fuel Catchment Tank: 15,000 gal. capacity**

**RP-1 (kerosene type) Fuel Catchment Tank: 12,000 - 13,850 gal. nominal loads**

**" Levelling/Topping Tank (in silo): 630 gal. capacity**

**" " " " " " : 580 gal. nominal load**

**Note: Topping Tanks (LOX and RP-1) were used for "topping off"; filling up the Atlas F aeroframe tank immediately prior to launch.**

## CONSTRUCTION HISTORY

**Directive given, 6 January, 1960, from the U. S. Army Corps of Engineers (USACOE), Albuquerque District for establishing of a 12 - Atlas Series F intercontinental ballistic missile (ICBM) squadron around Walker AFB (Roswell), New Mexico.**

**On 15 May, 1960, USACOE establishes Walker (Roswell) Area Office.**

**Authority to advertise for construction bids given, 16 May, 1960. Six (6) bids received by end date. Lowest bid accepted.**

**Successful bidder is a joint venture of Macco Corporation, Raymond International, Inc., The Kaiser Company, and Puget Sound Bridge and Dry Dock Company with a bid of $22,115,828.00.**

**Contract is awarded 16 June, 1969, and Notice to Proceed issued 20 June, 1960.**

**Work begins 23 June, 1960. Initial efforts are site excavation down to base level of 35 ft below grade.**

**Missile silo shafting began 25 July, 1960. Shortest time to shaft 60 ft in diameter down to a depth of 180-185 ft achieved at Site 579-3 (Elkins) in 55 days (2.5 ft per day). Longest time to shaft required 81 days at Site 579-8 (Lake Arthur). due to water infiltration difficultied (150-300 gal per minute).**

**Concreting construction began at Site 579-3, 25 September, 1960 (5 days behind schedule). Site completion dates are as follows:**

**Site 579-3 24 Oct, 1961**

**" 579-12 30 Oct, 1961**

**" 579-1 06 Nov, 1961**

**" 579-11 13 Nov, 1961**

**" 579-4 19 Nov, 1961**

**" 579-7 27 Nov, 1961**

**" 579-6 05 Dec, 1961**

**" 579-9 18 Dec, 1961**

**" 579-2 22 Dec, 1961**

**" 579-10 25 Dec, 1961**

**" 579-8 05 Jan, 1962**

**" 579-6 06 Jan, 1962**

**On October 31, 1961, Site 579-3 (Elkins) became the first Walker AFB auxillery (remote) site to be turned over to the USAF Site Activation Task Force (SATAF) for essential ground support equipment installation.**

**On February 8, 1962, Site 579-5 became the final Walker AFB auxillary (remote) site to be turned over to USAF SATAF.**

**Total cost of primary construction contract: $38,356,329.42, and with additional contracts and post-construction claims awarded, the final affixed sum was $59,441,277.84.**

## CONSTRUCTION ACCIDENTS

**29 August, 1960 Laborer fatally electrocuted while guiding a corrugated culvert section suspended from a crane boom, when crane boom made contact with a power line.**

**16 February, 1961 Oil-driver of truck crane started truck engine as iron workers removed outriggers and chocks. Truck gears in reverse. Truck crane backs over silo edge into silo, falling 174 ft to silo bottom, resulting in 6 fatalities, 1 permanent disability, and 18 temporary disabilities.**

**1 May, 1961 Ironworker, while attempting to tighten bolts (between Silo Levels 4 and 5) leans over and grasps a tie rod which is loose at one end. The spring action of the tie rod throws worker against silo wall and worker falls 129 ft to silo bottom, fatally injuring.**

**During construction activity (3,971,189 manhours) there were 74 disabling injuries, and 8 fatalities.**

**The quality of construction by workers at Walker AFB (support sites) and auxillary (remote) ICBM sites was rated as excellent by the U. S. Army Corps of Engineers and the United States Air Force.**

**Site costs to maintain per year: $330,000 per year.**

## 579th Strategic Missile Squadron Milestones

**01 September, 1961: Organized/Acitvated**

**30 November, 1962: Turnover of final completed site to Strategic Air Command. Atlas F ICBMs**

**and Ready Crews declared fully operational. Squadron at Defense Condition 2 (DEFCON 2), due to the Cuban Missile Crisis. Retraction**

**to DEFCON 5 was set by May 1963.**

**01 June, 1963 Site 579-1 silo destroyed by fire and explosion.**

**13 February, 1964: Site 579-5 silo destroyed by fire and explosions.**

**09 March, 1964: Site 579-2 silo destroyed by fire and explosions.**

**16 May, 1964: Secretary of Defense Robert S. McNamara declares Atlas F to be**

**phased-out by end of June 1968.**

**19 November, 1964: Accelerated phase-out of Atlas F system, sites and squadrons announced**

**by Secretary of Defense Robert S. McNamara to be completed by end of**

**June 1964.**

**05 January, 1965: First Atlas F removed from alert readiness.**

**04 February, 1965: Last Atlas F removed from alert readiness.**

**09 February, 1965: Last Atlas F departs Walker AFB for storage.**

**25 March, 1965: 579th Strategic Missle Squadron is Inactivated.**

**The total cost for a 13 Atlas F missile force assigned to Walker AFB, from the beginning of site surveys (1959), site construction, site equipment installation, maintained operational status, until the conclusion of phase-out (1965) was $439,923,070.00.**

**The total cost for the Atlas program was $6,518,310,000.00.**

**The Atlas F was phased-out due primarily to economic considerations. It proved too costly to maintain, with exremely complex, highly flammable non-storable propellent/fuel loading aspects. The Atlas F also suffered from degrading reliability factors.**

**The advent of the more reliable, accurate, cost-effective, and quick reaction Minuteman I and Titan II ICBMs promised far reaching improvements over the Atlas F.**

**Minuteman I and Titan II had reaction times of 10 seconds and 48 seconds, respectively, versus Atlas F at 600 - 720 seconds.**

**Minuteman I was a smaller ICBM with solid propellent fuels, mounted a smaller 880 pd OR-56M2 warhead (1.3 megaton yield value), and had a CEP of 1,822 ft. Titan II had liquid storable propellent/fuel, "hard target" (the high probability of incapacitating a hardened target) capability, and a larger thermonuclear yield warhead (rate 9.4 - 13.4 megatons), versus Atlas F with a non-storable propellent (LOX), an EXTREMELY DELICATE propellent loading system (PLS), and half the thermonuclear yield (4.7 - 6.7 megatons).**

**Titan II had a CEP of 4,858 ft., versus Atlas F which obtained an improved CEP (in November 1964) of 8,500 ft.**

**Both the Minuteman I and the Titan II were in-silo launched. Further, it required 10 men to sevice the Minuteman, while it required over 80 to service the Atlas F.**

**These factors, plus more (political/strategic trade-off), accellerated the decision for phase-out. Due to forecast reliability problems with Atlas F (which surfaced very early in flight testing), phase-out was proposed by USAF Chief of Staff, General Curtis LeMay, only months after the final squadron of Atlas F sites (assigned to Plattsburgh AFB, New York) became operational!**

**Of the four (4) 1st-Generation ICBM systems (Atlas D, E, F, and TitanI), the Atlas F was the most troublesome. One major design flaw was mounting diesel generators directly above the propellent loading system (PLS).**

**During Operation "Long Reach" Force Operational Readiness Inspection evaluations at Walker AFB (1963), it was discovered that from a total 15 simulated EWO countdown - launch commit drills, only 7 were rated successful, and 8 were failures.**

**This implied that if, under a war footing, a launch order was directed (1963), only four Atlas F ICBMs would have launched. Of those launched, only one Atlas F was expected to neutralize the**

target. This figure did not include the force riding out thermonuclear subjegation and post-detonation environment. Include it and not one Atlas F was expected to be mission capable.

Atlas F sites, although rated to withstand thermonuclear overpressure of 150 - 200 pounds per square inch (PSI) proved (due to a very delicate propellent loading system) capable of withstanding only 30 - 50 psi. Not much greater than the horizontally-stored Atlas E system and "coffin" configured sites, which were rated at 25 psi.

By 1964 the Atlas F system and site was predicted to be completely vulnerable to Soviet "first Strike" attack. Even if inaccurate, Soviet warhead detonations (2 - 25 megatons) could incapacitate Atlas F, due to PLS design flaws, and launch site air intake/exhaust vent weakness (where post-detonation deposition was concerned).

The Atlas F's primary threats were the new Soviet ICBMs, designated SS-7 Saddler, SS-8 Sasin (mounting 5 - 10 megaton warheads), and the huge SS-9 Scarp (mounting a 20 - 25 megaton warhwad).

After phase-out of the Atlas F the mainframes/aeroframes were shipped to storage, and were later used to transport orbital/suborbital payloads into space. The mainframes/aeroframes were exhausted by September 8, 1981.

The warheads were dismantled and fissile elements reconstituted into national stockpile.

Currently, all sites are privately owned, and in most cases, are abandoned. All sites should be considered EXTREMELY DANGEROUS, due to uncovered fill vent shaft (depth of 85 feet), air intake and exhaust vent shafts (depths of 35 feet and 45 feet, respectively), and the missle silo. The primary danger in the silo is the entrance via the personnel utility tunnel(blast lock blast doors).

There is very little threshold beyond the final blast door. Further, if the silo has been salvaged, then there is a direct fall into deep water or an empty silo. Where water was observed, a fall of about 45 - 75 feet can be expected. Where a dry silo was observed, a fall of 145 feet can be expected. Survival is remote at best.

Finally, there is high methane levels, and a distinct "dead air" factor (lack of proper oxygen content, due to confined deep spaces and poor air circulation).

## WALKER AFB ACCIDENTS

01 June, 1963; Site 579-1, First propellent loading exercise *(PLX)* since ORI acceptance (9 months in operation). Propellent filter failure, fire, explosion, and further burnout (19 1/2 hours). Silo destroyed. No warhead mounted. As follows:

First accident occurred during a propellent loading exercise (PLX) at Site 579-1.

Ready operational crew RO-22 conducted exercise. Crew was declared qualified as a result of successful completion of a standardization board check on 17 April, 1963, and had conducted, prior to the accident, three (3) PLX's. A standboard check had been performed (check of crew's proficiency; performed by a team of highly qualified personnel.

579-1 was approaching completion of Operation "Long Reach" Operational Readiness Inspection *(ORI)* cerification; with site slightly ahead of schedule. Successful conclusion of scheduled PLX on 1 June, 1963, which required loading of liquid oxygen (LOX) and countdown through "Launch Commit" sequence (to "hold point" at 10 seconds to main engine ignition) would certify site as ready capable for emergency use.

On 1 June, 1963, 579-1 completed preparations for the acceptance PLX. In launch control center (LCC) were five-man ready operational crew, sector commander, safety technician, additional electrical power production technician, three-man mobile calibration and maintenance crew and four "Long Reach" engineers.

The PLX was scheduled for 10:00 AM, but thunderstorms in local area precluded any attempt, until unstable weather activity moved out of area. Note: SYSTEM VULNERABILITY TO INCLEMENT WEATHER PATTERNS!

PLX rescheduled for 5:30 PM. Ten minutes prior to PLX, sector commander proceeded to silo cap area to visually check the area sky for thunderstorm activity. After favorable observation, the command post at Walker AFB was notified that conditions were suitable for conducting the PLX. A "Long Reach" Phase III message was inititated by the commandpost.

However, a brief delay occurred when it was noticed that the diesel generators were putting out excessive current. A power factor adjustment was made in the electrical power production equipment, which improved situation, yet notably, current output was still slightly high.

PLX started at 5:44 PM and the RO crew initiated countdown. PLX was declared successful and abort sequence (term used to identify a button on missile combat crew commander's launch control console) started. Abort means "recovery" of missile from raised position, down into silo. Abort occurred at 5:57 PM. At 6:05 PM missile is in full down position.

At 6:06 (50) PM the LOX drain indication is noted. During the LOX drain, at 6:17PM, the drain valve indication changed from fully closed to intermediate (not fully open or closed).

Note: During the LOX loading sequence and drain sequence, the following sequences occur.

LOX is loaded aboard the Atlas F through two valves and a filter.

During drain, flow is accomplished from the missile LOX tank through a drain valve back into the LOX storage tank. The LOX drain sequence is automatically begun when the missile launch/elevatorplatform is down and locked. Drain is initiated by the opening of the airborne drain valve and the opening of the LOX line drain valve. LOX drain is accomplished by gravity flow. To insure that all LOX is offloaded, and to allow time for missile and oxygen line warmup, a timer was installed in the propellent loading system (PLS) which kept the missile drain and line drain valves open for 45 minutes.

As it was, then, at 579-1, the safety technicians were instructed to enter the silo and determine the nature of malfunction. However, before the technicians entered the silo, at 6:22 PM, the valve indication changed to fully open. The malfunction determination team was recalled back to the LCC, and LOX drain offloading continued. Such was proper procedure, since all weapon system indicators were visually normal.

At 6:24 PM the valve indicator again changed to intermediate (not fully open or closed). Again, the safety technicians proceeded to the silo to detemine the malfunction. After exit from LCC Level 2, down a few stairsteps to blast/debris door, (installed during post-construction SATAF contract) and through the very short utility tunnel, the team reached the silo area blast doors )2 blast forming the silo area blast lock).

At 6:26 PM the team was in the blast lock ready to open final blast door to enter the silo. Upon authorization to enter the silo, at 6:27 PM, the team encountered abnormal resistence to open the blast door. It was determined that the door was being held closed by overpressure within the silo.

One of six television monitors in the launch control center (LCC) began showing visual evidence of sparks and flashes on silo level 8 (lowest misile crib level).

Fire alert alarms were initiated at silo Level 7 and 8, and evacuation alarms sounded. Missile silo water fog spray system was actuated. Safety technicians were ordered to return immediately to safety of LCC, and after securing the blast and debris doors in the utility tunnel, arrived safely at 6:28 PM.

Concurrent with safety team's arrival, television monitors for silo Level 6A camera manifested flames rising from a lower level. *(All silo level designated 'A' were inside the Missile Enclosure Area (MEA.)*

At 6:28(32) PM all electrical power (provided by diesel generators on silo levels 5 and 6) failed. An explosion then occurred within the silo, with fires of varying intensity which would burn for about 19 1/2 hours. Flames were observed at heights estimated to be over 500 ft above the silo cap area. As the fires burned minor explosions and detonations were heard within the silo conflagration

In the LCC, smoke and dust filled the two levels. Visibility was severely limited even with emegency lighting. Contact was made by field phone with observers in the fallback area (2,000 ft. from silo). Observers related extent of fire and that flames were obscuring the emergency exit and the security fence on the north site boundary. However, observers determined the personnel entrance was clear of flames.

LCC personnel donned emergency breathing apparatus, evacuated via the personnel entranceway and scaled the security fence on the north side of the launch complex. Exsept for a few minor cuts and bruises, there were no injuries.

**Note: Liquid oxygen (LOX) is compresed air, distilled into a pale blue liquid state, which constantly boils at -297 degrees F (EXTREMELY COLD). LOX does not burn by itself, but it supports and rapidly accelerates the combustion of all flammable materials.**

**The mixture of LOX with any hydrocarbon substance causes a potentiol fire and explosion hazard, A hydrocarbon is an organic compound. Grease and lubricants are high in hydrocarbon content, and an explosive gel, resulting from LOX in contact with a hydrocarbon source, can be ignited by static electricity, mechanical and fluid friction and shock waves introduced by impact.**

**LOX fill and drain transfer system mandated hydrocarbons at no greated than 200 parts per million. A figure which exceeds the cleanliness of a hospital operating room!**

**During the post-accident inquiry of 579-1 fire and explosion it was determined that the LOX filter showed evidence of two holes burned through the bottom of the filter housing an either side of the mounting pedestal. Evidence of burning similar to that normally experienced from a cutting torch was found in the filter base plate.**

**When LOX is loaded, flow is accomplished through two valves and a filter to the missile.During offload LOX flow is accomplished through the drain valve with LOX going to, but not through the filter.**

**The LOX filter was removed and analyzed. Analysis showed that fracture had occurred to one of the J bolts which holds the filter element inside the filter housing.**

**The investigation board concluded that an oxygen/steel fire had been initiated within the filter housing while LOX was flowing from the missile through thedrain valve end of the housing.**

**It was concluded that the fracture of the J bolt was caused by the opening and closing of the LOX line drain valve. With the valve cycling, as it was, it was possible that the pressure surges of the LOX flowing, then not flowing again, could have fractured the J bolt. When the J bolt fractured, the filter element was then permitted to shake and rattle within the housing case. It was possible that the filter shaking action was enough to ignite the LOX by friction, thus starting an oxygen/metal fire.**

**Once the fire started with a large quantity of LOX present, the fire intensity was enough to burn holes through the sides of the filter case. LOX was permitted to escape through the holes and flow in around the filter on Level 7, as well as dropping to Level 8.**

**The large quantity of gaseous oxygen (GOX) released by the cascading LOX (GOX is derived from evaporating LOX) from the burned-through filter case was ignited by the burning filter. Flames progressed rapidly upward through the crib structure and burned through into the missile enclosure area (MEA), where the Atlas F rests on its launcher/elevator platform.** ***(The TV monitor on Level 6A [inside the MEA] showed flames rising from below, indicating fire was there already.)***

**The missile enclosure area walls are covered with an aluminum coated spun glass and wool insulation material. The burning enclosure walls subjected the Atlas F aero/mainframe skin (less than the thickness of a dime) to excessive temperatures.** ***(The Atlas skin was/is .040 inches thick - 40 thousandths of an inch.)***

Failure occurred in the missile tank, venting the LOX to zero (Atlas D, E, and F aero/mainframes must be constantly inflated by internal pressure!). Loss of internal pressure resulted instructural collapse, dropping the MK-IV inert training re-entry vehicle (no special physics munitions mounted during any PLX) down through aero/mainframe, rupturing the tanking bulkhead between the LOX tank and the RP-1 fuel tank, mixing the LOX remaining in the tank. Explosion was inevitable.

Another consideration for a prime suspect to the accident was the LOX filter gasket which could have been contaminated by hydrocarbon from a source external to the filter. It was poosible through leaks or spills, hydrocarbon could have gotten into the gasket and then, through a wicking action, be transferred from the outside of the gasket to the inside of the gasket. The presence of hydrocarbon within the filter could have been responsible for the high intensity of the fire.

Presence too of hydrocarbon on Levels 7 and 8 could have contributed in a compounding manner to fire intensity once LOX spilled through and out of the filter case. Be *(that)* as it may, the primary source of the fire was inside the filter case.

Besides destroying the inside of the silo, the force of the initial explosion blew one 70-ton silo cap door 99 ft. to the west, and the other 70-ton silo cap door 109 ft. to the east. Such was the force of the explosion. Entry to investigate silo interior damage was not attempted for four days. Even then, the interior had not cooled sufficiently, until two days more days.

13 February, 1964; Site 575-5. First propellant loading exercise since ORI acceptance (14 months in operation). Launcher/elevator fuel line disconnect failure, combined with vapor ignition in diesel exhaust ducts (electric wire fire) and silo fire. Missile in raised position explodes. Silo destroyed. No warhead mounted. As follows:

Second accident occurred (like 579-1 accident) after a successful propellent loading exercise (PLX), ar Site 579-5.

The inspector general for Headquarters, Strategic Air Command, Omaha, Nebraska, was at Walker AFB at the time conducting an operational readiness inspection (ORI). Site 579-5 was the last of five Atlas F sites to be exercised.

Ready operational crew RO-60, and standardization crew S-03 were scheduled for the exercise. Both crews were alert ready qualified. Crew S-03 had just completed a standardization check on 6 February 1963. The exercise to be conducted on 13 February, 1964, was a normal quarterly recheck of RO-60. Prior to this date S-03 had accomplished 10 PLXs and RO-60 had completed 3.

579-5 was declared ready for a PLX and the exercise order sent from Walker AFB command post. Countdown was initiated at 10:10 am.

Approximately 4 minutes into the countdown, a silo 19% oxygen indication alarm was noted, indicating a less than normal oxygen content. This was considered noncritical and the countdown was continued.

The Atlas was fully loaded with LOX and commit sequence initiated and progressed normally until launcher/elevator lift began.

As the launcher/elevator platform rose off the disconnects, fuel spillage was detected on the silo Level 8 television camera monitor located in the launch control center (LCC). The spillage appeared to be emanating from the launcher/elevator platform portion of the disconnect. Visual evidence estimated the spill to be between 5 and 50 gallons. An abort, or recovery sequence was not required for the situation.

Fuel spillage occurred at launcher/elevator rise when the fuel line demated. The portion of the line, which is attached to the launcher/elevator, disconnects from the portion immediately under the launcher/elevator platform. The fuel line is approximately 40 feet in length. Any fuel remaining in the line or any leak of the missile fuel-fill valve will gravity collect in the fuel line. Should the quantity be sufficient to fill the line up to or above the point of the launcher/alevator platform disconnect, a spillage of the amount collected, above the disconnect will occur at launcher/elevator rise.

As it was, the exercise was not delayed due to the noncritical condition. Therefore, the Atlas F was raised. The missile was up and locked at 10:20(47) am.

At 10:21(42) am, the ORI was concluded and declared successful.

Abort sequence was delayed for a visual inspection for fuel spillage. At 10:24 am, personnel proceeded to the silo cap to inspect the missile.

Topside inspection showed no indication of leaks and personnel returned to the LCC at 10:29 am. Then, members of the ORI inspection team left the site.

A 10:31 am, upon the recommendation of the standboard crew, the squadron commander ordered the nonessential bus be shut down to remove power from the electrical outlets in the silo. This was done as a safety precaution because of the fuel spillage on silo Level 8.

NOTE: The term "nonessential" is a misnomer, since shutting down nonessential power turns off power to many of the silo facilities. The more significant were: (1) Pumps, which circulate condensor water to the diesel generators; (2) the main silo exhaust fan; and (3) the fire fog system pump. The bus is called nonessential since it may be turned off for a short period during a combat is operating. It was done to reduce the electrical load so that one generator can provide sufficient power to raise the launcher/elevator platform with a fully loaded Atlas F missile.

The most vital equipment affected by the nonessential bus, at least as far as the accident was concerned, was the diesel cooling capability and the silo exhaust fan. Keeping the two vital systems inoperative for a prolonged period resulted in diesel overheating and hot exhaust gases being trapped in the exhaust plenum.

Overheating was indicated at 10:50(52) am when the operating diesel indicated high temperature.

With the missile in the raised up position - above ground - there was no way to control the pressure within the fuel-and LOX tanks unless an item of equipment known as the pneumatics test set is connected to the missile. At 10:38 am, a call to the fallback area was made requesting the pneumatic test-set operator to proceed to the silo cap area for pneumatic test-set hookup. The pneumatic test-set operator was in the process of connecting to the missile when he heard a noise that sounded like a "pop" and noticed gaseous oxygen (GOX) in he pneumatic test stand and on the ground. He looked outside and saw LOX spraying out of the main LOX fill-line disconnect on the launcher/elevator platform. He reported the information immediately to the LCC.

Underground in the LCC, monitors for television camers located on silo Levels 2, 6A, and 8 were obscured by what was determined to be GOX vapors. The television camera on the silo cap area also displayed vapor at ground level.

At 11:00(03) am loss of power occurred in the LCC. Nine seconds later alternating current was lost, and at 11:11 am, explosions in the silo of first, a low-order nature, then high order both in the silo and the Atlas F in the raised position at silo cap. The high-order explosion was a massive detonation and conflagration.

The post-accident investigation concluded that the primary cause of the accident was due to an error in judgement by the squadron commander. It was also concluded that vapor from the spilled fuel from the missile enclosure area (MEA) at silo Level 8 travelled through the exhaust duct to the exhaust plenum on Level 2. The vapor then mixed with the hot diesel exhaust gas and ultimately exploded.

A fire then ensued which burned the cables controlling the missile LOX drain valve. The cables were exposed to possible fire or explosion damage at several locations where the cables enter under the floor plating and pass within 1 o 2 inches from the exploded exhaust duct.

Located on silo Level 3 are units called logic racks, which are merely cabinets that have the control wiring and panels that go up to control the missile, and the harness, the wiring that goes up to the missile, is near the exhaust duct where the first low-order explosion occurred.

It was believed that when the fire started at silo Level 3, which was an RP-1 fuel vapor and hot diesel exhaust fire, the explosion then damaged the wires nearby, and sent a signal up to open the LOX fill and drain valve on the launcher/elevator platform.

When this occurred, LOX dropped into the silo, and with a fire already burning and mixing with the spilled RP-1 fuel no the bottom a low-order explosion occurred and a greater fire ensued, which burned for 10 minutes in the silo, until pressure support systems failed and the pressurized Atlas F aero/mainframe lost structural integrity.

The missile LOX drain valve was recovered from the missile wreckage and analyzed. The analysis showed that the valve had been driven open electrically.

It was further concuded that the signal that opened the airborne valve was the result of a shorting of the tanking panel wires which were damaged at one or more locations.

After this event occurred, the accident was inevitable: LOX spilled to the missile enclosure area floor on silo Level 8, which suffered cryogenic fracturing, and dropped to the bottom of the silo. LOX and RP-1 fuel formed a gel on silo Level 8 and silo foundation floor and detonated, resulting in a powerful pressure pulse to travel up the MEA shaftway to the underside of the launcher/elevator platfrom, ejecting the column of gaseous oxygen (GOX) that was observed by personnel at the fallback position (2,000 feet from the missile silo).

The explosion produced fires in the silo from hydraulic systems and from the diesel engine fuel supply lines. The Atlas F missile withstood the effects of the explosion and fire for 10 minutes before the missile LOX tank lost pressure and sructural failure occurred to the aero/mainframe.

This failure caused a LOX/RP-1 fuel detonation at or near the missile intermediate bulkhead. The MK-V inert training re-entry vehicle dropped almost straight down through the remaining missile fuel tank section and came to rest node down on the launcher/elevator platform in the sustainer engine space. With the fire raging in the silo and then the 12,000 gallons of RP-1 fuel and 19,000 gallons mixing on the surface, the missile's explosion was absolutely horrific!

09 March, 1964; Site 579-2. First propellant loading exercise since ORI acceptance (15 months in operation). Propellant (LOX) gaseous vapor venting freezes and fractures launcher/elevator cables. Launcher/elevator falls 3 feet and seizes. Support systems failure to maintain tank pressure in missile, causes tank failure, resulting in the collapse of the aeroframe. The inert "dummy" MK-IV RVfalls down through missile rupturing missile's LOX/RP-1 (Propellant/Fuel) tanking bulkhead. Explosion. Silo destroyed. No warhead mounted. As follows:

Third accident occurred during a propellant loading exercise (PLX0, at Site 579-2.

It was a routine PLX an was conducted by standardization crew S-02 and ready operational vrew RO-27. Both crews were alert ready qualified, and had previously conducte 13 and 2 PLX's respectively.

Countdown was started at 1:00pm, and was running normal until 1:12pm, when the commit sequence was initiated. After rising off the LOX disconnect panels the launcher/elevator stopped after rising 3 feet up. Seconds later, a 25% silo-oxygen alarm sounded indicating a possible LOX spill.

The abort; "recovery" sequence was immediately initiated, in an effort to return the launcher/elevator platform to a full down position. The sequence started but the launcher/elevator platform would not lower. It is not known, nor will it ever be, why the lift failed to raise or lower. Damage from the accident made such a determination impossible.

At 1:26pm, the crew started the emergency procedure checklist. Prior to launcher/elevator platform up-run, the LOX tank is pressurized to flight pressure of 26 pounds per square inch. The emergency procedure required that the LOX-tank pressure be reduced to a pressure of 7 pounds per square inch by opening the boiloff valve if the launcher/elevator platform has stopped.

<u>NOTE:</u> LOX, because of its very low temperature, is continually boiling. If left in a closed container gaseous oxygen (GOX) will raise the pressure within the container. The emergency procedure checklist stipulated opening of the boiloff valve so that pressure within the container,

**the Atlas F missile LOX tank, could be temporarily relieved of pressure.**

**The standboard missile combat-crew commander (MCCC) omitted depressing the emergency pushbutton which enables the boiloff valve to open. The step was intentionally omitted due to concern for the high-oxygen content already indicated and a desire not to further enrich the silo area with the addition of GOX. Therefore, troubleshooting the launcher/elevator platform was initiated, and qualified personnel were sent into the silo.**

**Personnel proceeded from LCC Level 2 to the silo, entering at silo Level 2. Due to the fire risk, personnel had to disregard the use of the personnel elevator, and descend by way of spiral stairway to silo Level 7, where they descended further to silo Level 8 via vertical ladder.**

**NOTE: With the boiloff valve closed, and the LOX contained within the LOX tank continually boiling off, GOX at high pressure is forced into suspension with the LOX. Under such conditions, when the boiloff valve is opened, the GOX escapes, reducing the pressure within the LOX tank. Since the GOX is suspended throughout the LOX, a large amount of LOX is also forced out of the boiloff valve.**

**A simple example of the phenomenon is shaking a can or bottle container of soda, then open it.**

**In 579-2 silo the missle tank pressure remained normal for an hour and then the LOX tank pressure began to rise. The system design provided an automatic switch to emergency at 30 pounds per square inch pressure in the LOX tank.**

**At 2:39pm the LOX tank pressure had built up to emergency release pressure levels. The system automatically switched to emergency which enabled the boiloff valve to open. Opening the boiloff valve, after having been closed for an extended period of time, resulted in the rapid expulsion of LOX.**

**Seconds later, a high and increasing oxygen content was measured by the safety technician in the silo. He, along with other technicians (who were trying to fix the lift system in the silo), noticing the increasing GOX levels, evacuated the silo immediately. After securing the two blast doors in the blast lock, the blast/debris door in the utility tunnel, the team returned to the LCC.**

**On one of the LCC monitors GOX was observed coming out of the missile enclosure area (MEA) into the non-explosive-proof area of the silo Level 2.**

**By 2;47PM the LOX tank pressure had dropped to normal pressure so the pressurization system was returned to automatic mode.**

**At 2:47(30)pm white smoke was seen coming out of the silo exhaust system by personnel at the fallback position (2,000 feet from the silo) and was observed on the television monitor in the LCC.**

**At 2:48pm the white smoke had turned grey and at 2:49pm, the smoke became black. The fire fog water spray system was initiated**

At 2:51(30)pm electrical power was lost, and at 2:53pm the firstt of two high-order explosions occurred. At 2:54pm the Atlas F missile exploded, destroying the missle and heavily damaging the silo.

Like the two previous accidents, there were no appreciable injuries and LCC crews were able to evacuate to the fallback position.

The post-accident investigation concluded that the LOX on the LOX tank was ejected through the boiloff valve and sprayed all over the missle enclosure area (MEA). It was further concluded the LOX being ejected from the boiloff valve struck the wire rope cables that are on each side of the MEA that lift the launcher/elevator platform.

When the cables were struck by the -297 degree F LOX, the cables experienced cryogenic fracturing; cold fracturing of the cables. When the cables broke the launcher/elevator platform suddenly dropped down to silo Level 8 (a fall of 3 feet) onto the downlocks. The impact would have been sufficient to cause bulkhead reversal and rupture the intermediate bulkhead between the missle LOX tank and RP-1 fuel tank, *(allowing LOX and fuel to)* mix together and explode.

Primary cause of the accident was an error in judgement, in that the standboard missi

le combat crew commander (MCCC) directed a deviation from the current technical order checklist which resulted in the missle boiloff valve remaining closed for an extended period of time.

NOTE: The MCCC faced two serious problems. One was a launcher/elevator platform which had seized and stuck with fully loaded tanks, and the other was a high GOX level within the silo. He did not want to further enrich the high GOX content, so he decided to leave the boiloff valve closed and attempt to correct the launcher/elevator platform lift and lower the platform down to drain points so that detanking could be done. His plan was overtakenby time when the boiloff valve opened in the emergency mode.

Also, the original cause was that the missle lift system failed to successfully drive up or down after stopping.

It was concluded that the wire rope cables connected between the tension equalizer, launcher/elevator platform, and launcher lift drive system were failed by impingement of LOX or GOX from the boiloff valve.

If the boiloff valve had been opened immediately as stipulated in emergency procedures, then the pressure within the LOX tank would have been relieved down to levels allowing the extended time required to troubleshoot the lift, and forecast to fix same before an emergency situation involving venting was required. An error in judgement was made when the boiloff valve was left closed by the decision of the missile combat crew commander (MCCC).

Another factor which contributed to the MCCC being unable to clear the GOX content in the silo was the lack of purge fan(s) on site during the PLX.

**NOTE: ALL PROPELLANT LOADING EXERCISES WERE FAILURES AT 579-2!**

**NOTE: There was a very serious launcher/elevator problem at 579-2 (8 consecutive unsuccessful missile lifts, before catastophic accident).**

**NOTE: The 579th Strategic Missile Squadron had the highest success rating regarding propellant loading exercises (PLX) amongst all Atlas F squadrons during "Operation Red Heat" updating (1963-1964). At the latest date of accident, 36 Atlas F missiles and silo sites had completed "Red Heat" updating throughout the United States.**

**SITE # MISSLE # MISSILE DISPOSITION**

**579-1 61-2563 (77F) Destroyed in silo by explosions, 01 June,1963.**

**579-2 62-12126 (90F) Destroyed at silo by fire and explosions, 09 March, 1964.**

**579-3 61-2530 (44F) Launched 03 December, 1969, for Advanced Ballistic**

**Re-Entry Systems (ABRES) program.**

**579-4 62-12131 (95F) Launched 03 May, 1968, ABRES.**

**579-5 61-2574 (88F) Destroyed in silo by fire and explosion, 13 February, 1964.**

**579-6 61-2565 (79F) Salvaged for spare parts ABRES.**

**579-7 62-12128 (92F) Launched 09 June, 1979 ABRES.**

**579-8 62-12139 (103F) Launched 29 June, 1971 ABRES.**

**579-9 61-2562 (76F) Launched 06 August, 1971, for Orbital Vehicle (OV) program. Made flight as OV-1.**

**579-10 61-2571 (85F) Launched 05 April, 1971, ABRES.**

**579-11 62-12138 (102F) Vandenberg AFB, California. Was modified for Space Test Program.**

**579-12 61-2560 (74F) Launched 01 September, 1971, ABRES.**

*** 62-12135 (99F) Launched 25 September, 1971, ABRES.**

*** Missile Assembly and Maintenance Site (MAMS). An Atlas F was stored as a spare missile mainframe/aeroframe at Walker AFB.**

**--------------32EA5E2C50F0--**

**REFERENCE 8**

STANDARD FORM 118
DECEMBER 1953
PRESCRIBED BY GENERAL SERVICES ADMINISTRATION
REGULATION 2-IV-201.00
118-102

# [illegible]ORT OF EXCESS REAL PROPERTY

1. HOLDI[illegible]ENCY NO.: Albuqu[illegible]que-148
2. DATE OF REPORT: 30 June 1965
DATE RECEIVED (*GSA use only*)
GSA CONTROL NO. (*GSA use only*)

3. TO (*Furnish address of GSA regional offices*)
General Services Administration
Region 8, Denver Federal Center
Denver, Colorado

4. FROM (*Name and address of holding agency*)
U. S. Army Engineer District, Albuquerque
P. O. Box 1538
Albuquerque, New Mexico 87103

5. NAME AND ADDRESS OF REPRESENTATIVE TO BE CONTACTED
H. K. Shadel, Chief, Real Estate Division
P. O. Box 1538
Albuquerque, New Mexico 87103

6. NAME AND ADDRESS OF CUSTODIAN
Commander
Headquarters, 6th Strategic Aerospace Wing (SAC) USAF
Walker Air Force Base, New Mexico

7. PROPERTY IDENTIFICATION
Atlas "F" Missile Site No. 8
Walker Air Force Base, New Mexico

8. PROPERTY ADDRESS (*Give full location*)
Site located approximately 25 miles south-east of Roswell, New Mexico, east of U.S. Highway No. 285

9. SPACE DATA

| USE | NUMBER OF BUILDINGS (1) | FLOOR AREA (*Sq. ft.*) (2) | NUMBER OF FLOORS (3) | FLOOR LOAD CAPACITY (4) | CLEAR HEADROOM (5) |
|---|---|---|---|---|---|
| A. OFFICE | | | | | |
| B. STORAGE | | | | | |
| C. OTHER (*See 9 F*) | 4 | 13,241 | 12 | | |
| D. TOTAL (*From SF 118a*) | 4 | 13,241 | | | |
| E. GOV'T INTEREST: | | | | | |
| (1) OWNER | 4 | 13,241 | | | |
| (2) TENANT | | | | | |

F. SPECIFY "OTHER" USE ENTERED IN C ABOVE
Missile Launch Facility

10. LAND

| (*From SF 118b*) | ACRE ~~OR SQUARE FEET~~ |
|---|---|
| A. FEE | 14.62 |
| B. LEASED | |
| C. OTHER | 234.96 |
| D. TOTAL | 249.58 |

11. COST TO GOVERNMENT

| ITEM | SCHEDULE | COST |
|---|---|---|
| A. BUILDINGS, STRUCTURES, UTILITIES, AND MISCELLANEOUS FACILITIES | A (*Col d*) | $2,570,165 |
| B. LAND | B (*Col. f*) | 2,543 |
| C. RELATED PERSONAL PROPERTY | C (*Col. h*) | |
| D. TOTAL (*Sum of 11A, 11B, and 11C*) | | $2,572,708 |

E. ANNUAL PROTECTION AND MAINTENANCE COST (*Government-owned or leased*) $12,000

12. LEASEHOLD(S) DATA (*Use separate sheet if necessary*)

| | |
|---|---|
| A. TOTAL ANNUAL RENTAL | $ |
| B. ANNUAL RENT PER SQ. FT. OR ACRE | $ |
| C. DATE LEASE EXPIRES | |
| D. NOTICE REQUIRED FOR RENEWAL | |
| E. TERMINAL DATE OF RENEWAL RIGHTS | |
| F. ANNUAL RENEWAL RENT PER SQ. FT. OR ACRE | $ |

G. TERMINATION RIGHTS (*in days*)
LESSOR GOVERNMENT

13. DISPOSITION OF PROCEEDS
Miscellaneous Receipts

14. TYPE OF CONSTRUCTION
Reinforced concrete, corrugated iron.

15. HOLDING AGENCY USE
Missile Launch Complex (Inactive)

16. RANGE OF POSSIBLE USES
Fuel and water storage;
Livestock feed storage;
Salvage.

17. NAMES AND ADDRESSES OF INTERESTED FEDERAL AGENCIES AND OTHER INTERESTED PARTIES Eastern New Mexico University, Portales, New Mexico; Highlands University, Las Vegas, New Mexico; Cities Service Oil Company, Bartlesville, Oklahoma; Farmers Coop, Hagerman, New Mexico; New Mexico State University, Las Cruces, New Mexico.

18. REMARKS The property was acquired for the construction, operation and maintenance of the Atlas "F" Missile Complex, located in the vicinity of Walker Air Force Base. Surrounding land areas consist mostly of livestock ranches and scattered irrigated farms. The installation was screened against known military needs, with negative results.

19. REPORT AUTHORIZED BY
NAME: H. K. SHADEL
TITLE: Chief, Real Estate Division
SIGNATURE: [signature]

9808

U. S. GOVERNMENT PRINTING OFFICE 16—60640-2

0001

ATCOEA

STANDARD FORM 118-A
DECEMBER 1953
PRESCRIBED BY GENERAL SERVICES ADMINISTRATION
REGULATION 2-IV-201.00

# BUILDINGS, STRUCTURES, UTILITIES, AND MISCELLANEOUS FACILITIES

118-202

SCHEDULE A—SUPPLEMENT TO REPORT OF EXCESS REAL PROPERTY

1. HOLDING AGENCY NO. Albuquerque-148

2. PAGE 1 OF 4 PAGES OF THIS SCHEDULE

GSA CONTROL NO. (*GSA use only*)

3. ANNUAL RENTAL

8086

| LINE NO. (a) | HOLDING AGENCY BUILDING NO. (b) | DESCRIPTION (c) | COST (d) | OUTSIDE DIMENSIONS (e) | FLOOR AREA (*Sq. ft.*) (f)* | NO. OF FLOORS (g)* | CLEAR HEAD-ROOM (h)* | FLOOR LOAD RANGE (i)* | RESTRICTIONS ON USE OR TRANSFER OF GOVERNMENT INTEREST (j) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | Buildings: | | | | | | | |
| 2 | 11350 | Water Supply Treatment Plant | 26,073 | 32'x48' | 1,536(c) | 1(c) | | | |
| 3 | | Butler type corrugated iron build- | | | | | | | |
| 4 | | ing, concrete slab floor and | | | | | | | |
| 5 | | foundation, consisting of 2 ea | | | | | | | |
| 6 | | wells; Well No. 1, depth 250' | | | | | | | |
| 7 | | with 7" casing; Well No. 2, 250' | | | | | | | |
| 8 | | depth with 8" casing. | | | | | | | |
| 9 | | Completed 1961. | | | | | | | |
| 10 | | | | | | | | | |
| 11 | | Structures: | | | | | | | |
| 12 | | | | | | | | | |
| 13 | 11356 | G/M Launch Control Center | 292,096 | 40' ID | 2,512(c) | 2(c) | | | |
| 14 | | Construction: underground circu- | | 27' depth | | | | | |
| 15 | | lar reinforced concrete with mem- | | | | | | | |
| 16 | | brane water-proofing, covered | | | | | | | |
| 17 | | with 7'-6" earth compacted fill. | | | | | | | |
| 18 | | Completed: 1962. | | | | | | | |
| 19 | | | | | | | | | |
| 20 | 11357 | Missile Launch Facility | 1,962,256 | 52' ID | 9,126(c) | 8(c) | | | |
| 21 | | Construction: reinforced concrete | | 165' depth | | | | | |
| 22 | | cylinder and base floor. | | from top | | | | | |
| 23 | | Completed 1962. | | of door to | | | | | |
| 24 | | | | base level. | | | | | |
| 25 | | | | | | | | | |
| 26 | 11365 | Tunnel | 85,300 | 8'x10'x15' | 67(c) | 1(c) | | | |
| 27 | | Connects Silo & LCC. | | | | | | | |
| 28 | | Construction: reinforced concrete, | | | | | | | |
| 29 | | steel concrete covered floor. | | | | | | | |
| 30 | | Completed 1962. | | | | | | | |
| 31 | | | | | | | | | |
| 32 | | | | | | | | | |
| | | TOTAL | 2,365,725 | | 13,241 | | | | 0002 |

*Prefix figures with symbols to denote type of space, as follows: (a) for office; (b) for storage; (c) for other.

16—69841-2 U. S. GOVERNMENT PRINTING OFFICE

8089

STANDARD FORM 118-A
DECEMBER 1953
PRESCRIBED BY GENERAL SERVICES ADMINISTRATION
REGULATION 2-IV-201.00

# BUILDINGS, STRUCTURES, UTILITIES, AND MISCELLANEOUS FACILITIES

118-202

## SCHEDULE A—SUPPLEMENT TO REPORT OF EXCESS REAL PROPERTY

1. HOLDING AGENCY NO. Albuquerque-148

2. PAGE 2 OF 4 PAGES OF THIS SCHEDULE

GSA CONTROL NO. (GSA use only)

3. ANNUAL RENTAL

| LINE NO. (a) | HOLDING AGENCY BUILDING NO. (b) | DESCRIPTION (c) | COST (d) | OUTSIDE DIMENSIONS (e) | FLOOR AREA (Sq. ft.) (f)* | NO. OF FLOORS (g)* | CLEAR HEAD-ROOM (h)* | FLOOR LOAD RANGE (i)* | RESTRICTIONS ON USE OR TRANSFER OF GOVERNMENT INTEREST (j) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 11368 | Pad, Hard Antenna - UHF - concrete | 600 | 10' dia. | | | | | |
| 2 | | construc - 9 S.Y. Compltd 1964 | | 3' depth | | | | | |
| 4 | 11369 | Silo Hard Antenna - HF | 34,832 | 8' dia. | | | | | |
| 5 | | underground, concrete encased | | 27' depth | | | | | |
| 6 | | with steel liner. | | | | | | | |
| 7 | | Completed: 1964. | | | | | | | |
| 9 | 11355 | Fence, Boundary, 5972 LF | 9,572 | | | | | | |
| 10 | | Constructed of 5 strands of | | | | | | | |
| 11 | | barbed wire on 4' high wooden | | | | | | | |
| 12 | | posts. | | | | | | | |
| 13 | | Completed 1962. | | | | | | | |
| 15 | 11360 | Fence Security, 1800 LF. | 21,298 | | | | | | |
| 16 | | Construction: 7' chain link sur- | | | | | | | |
| 17 | | mounted with 3 strands of barbed | | | | | | | |
| 18 | | wire supported on steel posts, | | | | | | | |
| 19 | | with an electrical operated gate | | | | | | | |
| 20 | | of tubular steel frame construc- | | | | | | | |
| 21 | | tion. Completed 1962. | | | | | | | |
| 23 | 11362 | Telephone Duct Facilities | 2,541 | | | | | | |
| 24 | | buried 1-1/2" and 4" conduit, | | | | | | | |
| 25 | | 571 LF. | | | | | | | |
| 26 | | Completed: 1962. | | | | | | | |
| | | TOTAL | 68,843 | | | | | | |

0003

*Prefix figures with symbols to denote type of space, as follows: (a) for office; (b) for storage; (c) for other.

16—60841-2 U. S. GOVERNMENT PRINTING OFFICE

STANDARD FORM 118-A
DECEMBER 1953
PRESCRIBED BY GENERAL SERVICES ADMINISTRATION
REGULATION 2-IV-201.00

# BUILDINGS, STRUCTURES, UTILITIES, AND MISCELLANEOUS FACILITIES

118-202

SCHEDULE A—SUPPLEMENT TO REPORT OF EXCESS REAL PROPERTY

1. HOLDING AGENCY NO. Albuquerque-148

2. PAGE 3 OF 4 PAGES OF THIS SCHEDULE

GSA CONTROL NO. (GSA use only)

3. ANNUAL RENTAL

| LINE NO. (a) | HOLDING AGENCY BUILDING NO. (b) | DESCRIPTION (c) | COST (d) | OUTSIDE DIMENSIONS (e) | FLOOR AREA (Sq. ft.) (f)* | NO. OF FLOORS (g)* | CLEAR HEAD-ROOM (h)* | FLOOR LOAD RANGE (i)* | RESTRICTIONS ON USE OR TRANSFER OF GOVERNMENT INTEREST (j) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | Utilities | | | | | | | |
| 2 | 11352 | Water Storage Tank, steel | 10,291 | | | | | | |
| 3 | | 8,000 gal. cap. | | | | | | | |
| 4 | | Completed: 1961. | | | | | | | |
| 5 | | | | | | | | | |
| 6 | 11358 | Water Storage Tank, steel | 45,919 | | | | | | |
| 7 | | 91,000 gal. cap. | | | | | | | |
| 8 | | Completed: 1962. | | | | | | | |
| 9 | | | | | | | | | |
| 10 | 11359 | Diesel Storage Tank, steel | 8,929 | | | | | | |
| 11 | | 486 bbl cap. | | | | | | | |
| 12 | | Completed: 1962. | | | | | | | |
| 13 | | | | | | | | | |
| 14 | 11353 | Water Mains | 4,237 | | | | | | |
| 15 | | 3" & 4" Transite, 80 and 100 PSI. | | | | | | | |
| 16 | | 313 LF - Completed 1961. | | | | | | | |
| 17 | | | | | | | | | |
| 18 | 11354 | Sanitary Sewage Mains | 18,948 | | | | | | |
| 19 | | 4" & 8" CI & VC pipe, 92 LF. | | | | | | | |
| 20 | | Completed 1961. | | | | | | | |
| 21 | | | | | | | | | |
| 22 | 11370 | Ind. Waste Mains | 12,000 | | | | | | |
| 23 | | 6" and 8" VC, 125 LF. | | | | | | | |
| 24 | | Completed 1961. | | | | | | | |
| 25 | | | | | | | | | |
| 26 | 11363 | Second Distribution Line | 54 | | | | | | |
| 27 | | Overhead, 900 LF. | | | | | | | |
| 28 | | Completed 1961. | | | | | | | |
| 29 | | | | | | | | | |
| 30 | | | | | | | | | |
| 31 | | | | | | | | | |
| 32 | | | | | | | | | |
| | | TOTAL | 100,378 | | | | | | |

0004

*Prefix figures with symbols to denote type of space, as follows: (a) for office; (b) for storage; (c) for other.

16—69841-2 U. S. GOVERNMENT PRINTING OFFICE

8088

STANDARD FORM 118-A
DECEMBER 1953
PRESCRIBED BY GENERAL SERVICES ADMINISTRATION
REGULATION 2-IV-201.00

# BUILDINGS, STRUCTURES, UTILITIES, AND MISCELLANEOUS FACILITIES

118-202

SCHEDULE A—SUPPLEMENT TO REPORT OF EXCESS REAL PROPERTY

1. HOLDING AGENCY NO. Albuquerque-148

2. PAGE 4 OF 4 PAGES OF THIS SCHEDULE

GSA CONTROL NO. (*GSA use only*)

3. ANNUAL RENTAL

| LINE NO. (a) | HOLDING AGENCY BUILDING NO. (b) | DESCRIPTION (c) | COST (d) | OUTSIDE DIMENSIONS (e) | FLOOR AREA (Sq. ft.) (f)* | NO. OF FLOORS (g)* | CLEAR HEAD-ROOM (h)* | FLOOR LOAD RANGE (i)* | RESTRICTIONS ON USE OR TRANSFER OF GOVERNMENT INTEREST (j) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | Miscellaneous: | | | | | | | |
| 2 | | | | | | | | | |
| 3 | 11361 | Road (Asphalt) | 29,019 | | | | | | |
| 4 | | Constructed of 6" crushed | | | | | | | |
| 5 | | stone, double bituminous, 5639 S.Y. | | | | | | | |
| 6 | | 18' width, 2895 LF. | | | | | | | |
| 7 | | Completed: 1962. | | | | | | | |
| 8 | | | | | | | | | |
| 9 | 11351 | Park, Vehicle, Non-org. | 6,200 | | | | | | |
| 10 | | Hardsurface gravel - 2495 S.Y. | | | | | | | |
| 11 | | Completed 1962. | | | | | | | |
| 12 | | | | | | | | | |
| 13 | | | | | | | | | |
| 14 | | | | | | | | | |
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| 29 | | | | | | | | | |
| 30 | | | | | | | | | |
| 31 | | | | | | | | | |
| 32 | | | | | | | | | |
| | | TOTAL | 35,219 | | | | | | |

0005

*Prefix figures with symbols to denote type of space, as follows: (a) for office; (b) for storage; (c) for other.

16—69841-2 U. S. GOVERNMENT PRINTING OFFICE

9808

STANDARD FORM 118-B
DECEMBER 1953
PRESCRIBED BY GENERAL
SERVICES ADMINISTRATION
REGULATION 2-IV-201.00

# LAND

SCHEDULE B—SUPPLEMENT TO REPORT OF EXCESS REAL PROPERTY

118-302

1. HOLDING AGENCY NO. Albuquerque-140

2. PAGE 1 OF 1 PAGES OF THIS SCHEDULE

3. GOVERNMENT INTEREST: ☐ LEASE ☐ LICENSE ☐ PERMIT ☐ EASEMENT ☐ FEE ☐ INFORMAL AGREEMENT

GSA CONTROL NO. (*GSA use only*)

| LINE NO. | TRACT NO. | NAME OF FORMER OWNER OR LESSOR AND ADDRESS | TRACT ACQUIRED (*Acres or sq. ft.*) | EXCESS REAL PROPERTY: ACRES OR SQUARE FEET | EXCESS REAL PROPERTY: COST | EXCESS REAL PROPERTY: ANNUAL RENTAL | TYPE OF ACQUISITION | RESTRICTIONS ON USE OR TRANSFER OF GOVERNMENT INTEREST |
|---|---|---|---|---|---|---|---|---|
| (a) | (b) | (c) | (d) | (e) | (f) | (g) | (h) | (i) |
| 1 | 100 | L. O. Fullon | 2.27 | 2.27 | 170 | | Condemn. | |
| 2 | 101 | Carroll Jackson Jr | 5.99 | 5.99 | 450 | | Condemn. | |
| 3 | 101-1 | Carroll Jackson, Jr | 6.36 | 6.36 | 480 | | Condemn. | |
| 4 | 100-E-1 | L. O. Fullon | (0.18) | (0.18) | 15 | | Easement | Acreage included in Tr. 105-E |
| 5 | 100-E-2 | L. O. Fullon | (2.27) | (2.27) | 140 | | Easement | " " " " |
| 6 | 101-E-1 | Carroll Jackson Jr | (1.83) | (1.83) | 155 | | Easement | " " " 106-E |
| 7 | 101-E-2 | Carroll Jackson Jr | (5.99) | (5.99) | 410 | | Easement | " " " " |
| 8 | 102-P | N.M. State Hwy Comm | -- | -- | -- | | Permit | |
| 9 | 103-E | State of N. M. | 17.93 | 17.93 | 30 | | Easement | |
| 10 | 104-E | Ellen M Terry Est. | 14.72 | 14.72 | 20 | | Easement | |
| 11 | 105-E | Emmett D White etux | 75.41 | 75.41 | 115 | | Easement | |
| 12 | 106-E | Carroll Jackson, Jr | 97.67 | 97.67 | 250 | | Easement | |
| 13 | 107-E | Viva A Armstrong | 14.06 | 14.06 | 25 | | Easement | |
| 14 | 108-E | A E Hobson, et ux | 15.17 | 15.17 | 25 | | Easement | |
| 15 | S-8-106-E-2 | Carroll Jackson Jr | (0.14) | (0.14) | 75 | | Easement | Acreage included in Tr. 106-E |
| 16 | S-8-108-E-2 | A E Hobson, et ux | (0.01) | (0.01) | 23 | | Easement | " " " 108-E |
| 17 | S-8-105-E-2 | Emmett D White etux | (0.15) | (0.15) | 75 | | Easement | " " " 105-E |
| 18 | S-8-108-E-3 | A E Hobson, et ux | (0.01) | (0.01) | * | | Easement | " " " 108-E |
| 19 | S-8-106-E-3 | Carroll Jackson Jr | (0 .19) | (0.19) | ** | | Easement | " " " 106-E |
| 20 | 105-E-3 | Emmett D White etux | (0.12) | (0.12) | *** | | Easement | " " " 105-E |
| 21 | S-8-108-E-4 | A E Hobson, et ux | (0.0008) | (0.0008) | * | | Easement | " " " 108-E |
| 22 | S-8-105-E-4 | Emmett D White " | (0.0008) | (0.0008) | *** | | Easement | " " " 105-E |
| 23 | S-8-106-E-4 | Carroll Jackson Jr | (0.92) | (0.92) | 85 | | Easement | " " " 106-E |
| 24 | | | | | | | | |
| 25 | | * Cost included in Tract S-8-108-E-2 | | | | | | All land acquired subject to |
| 26 | | ** Cost included in Tract S-8-106-E-2 | | | | | | oil, gas and mineral interests re- |
| 27 | | *** Cost included in Tract S-8-105-E-2 | | | | | | served to former owners and/or |
| 28 | | | | | | | | lessees. |
| 29 | | | | | | | | Land items are to be retained |
| 30 | | | | | | | | until final disposal has been |
| 31 | | | | | | | | accomplished on all Government-owned |
| 32 | | | | | | | | property located thereon. |
| | | TOTAL | 249.58 | 249.58 | 2,543 | | | |



U.S. GOVERNMENT PRINTING OFFICE : 1963—O-673279

STANDARD FORM 118-A
DECEMBER 1953
PRESCRIBED BY GENERAL
SERVICES ADMINISTRATION
REGULATION 2-IV-201.00

# BUILDINGS, STRUCTURES, UTILITIES, AND MISCELLANEOUS FACILITIES

118-202

SCHEDULE A—SUPPLEMENT TO REPORT OF EXCESS REAL PROPERTY

1. HOLDING AGENCY NO. Albuquerque-148-A

2. PAGE 1 OF THIS S[...]

GSA CONTROL NO. [...] only)

3. ANNUAL RENTAL

| LINE NO. (a) | HOLDING AGENCY BUILDING NO. (b) | DESCRIPTION (c) | Estimated COST (d) | OUTSIDE DIMENSIONS (e) | FLOOR AREA (Sq. ft.) (f)* | NO. OF FLOORS (g)* | CLEAR HEAD-ROOM (h)* | FLOOR LOAD RANGE (i)* | RESTRICTIONS ON USE OR TRANSFER OF GOVERNMENT INTEREST (j) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Total Reported on Previous Schedule | | $2,570,165 | - | 13,241 | | | | |
| 2 | | | | | | | | | |
| 3 | | | | | | | | | |
| 4 | | Buildings Added | | | | | | | |
| 5 | | | | | | | | | |
| 6 | 11364 | Administrative Office, Metal | 18,543 | 40'x100' | 4,000(a) | 1(a) | | | |
| 7 | | Quonset type, Concrete floors; | | | | | | | |
| 8 | | Concrete foundation. | | | | | | | |
| 9 | | Constructed: 1962 | | | | | | | |
| 10 | | | | | | | | | |
| 11 | 11363 | Warehouse Supply & Equipment | 14,609 | 40'x100' | 4,000(b) | 1(b) | | | |
| 12 | | Metal, Quonset type, Concrete | | | | | | | |
| 13 | | floors; concrete foundation. | | | | | | | |
| 14 | | Constructed: 1962 | | | | | | | |
| 15 | | | | | | | | | |
| 16 | | | | | | | | | |
| 17 | | | | | | | | | |
| 18 | | | | | | | | | |
| 19 | | | | | | | | | |
| 20 | | | | | | | | | |
| 21 | | | | | | | | | |
| 22 | | | | | | | | | |
| 23 | | | | | | | | | |
| 24 | | | | | | | | | |
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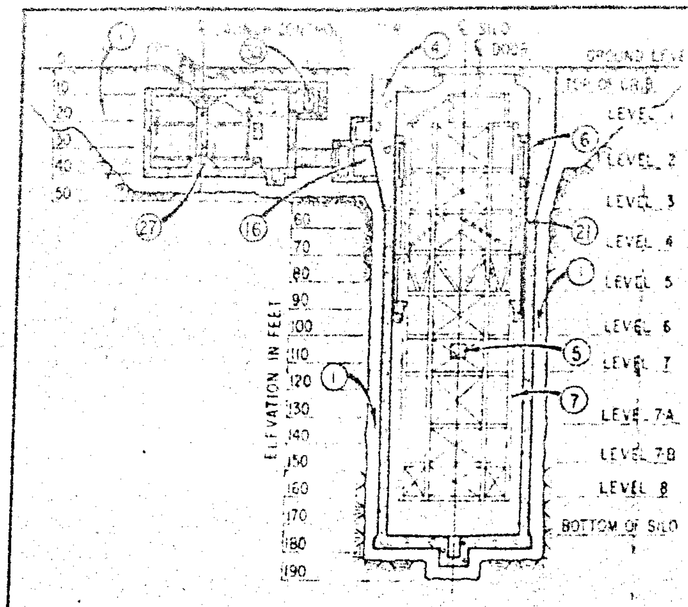
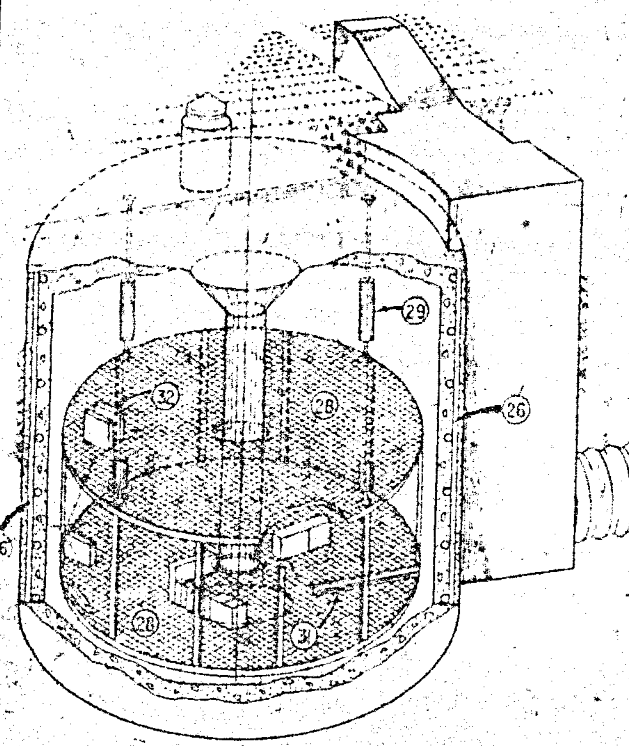
| 26 | | | | | | | | | |
| 27 | | | | | | | | | |
| 28 | | | | | | | | | |
| 29 | | | | | | | | | |
| 30 | | | | | | | | | |
| 31 | | | | | | | | | |
| 32 | | | | | | | | | |
| | | TOTAL | $2,603,317 | | 21,241 | | | | |

*Prefix figures with symbols to denote type of space, as follows: (a) for office; (b) for storage; (c) for other.

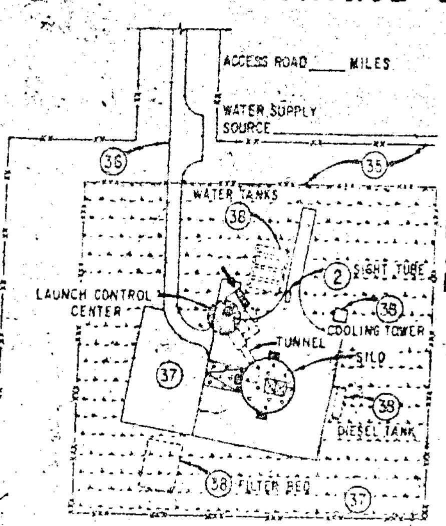
16—63841-2 U. S. GOVERNMENT PRINTING OFFICE




SECTIONAL ELEVATION



LAUNCH CONTROL CENTER




SITE PLAN

LEGEND

- NO ENTRY REQUIRED
- COLS: 4, 6, 8, 10, 12 — BEHIND SCHEDULE
- 6-61 DATE ACCOMPLISHED
- COLS: 14, 15, 16, 17 — 37 COMPLETED
- COL: 18 — EXPLANATION CONTAINED IN ACCOMPANYING NARRATIVE REPORT

# CORPS OF ENGINEERS
# BALLISTIC MISSILE CONSTRUCTION OFFICE
# CONSTRUCTION STATUS REPORT
## ATLAS F (WS-107 A-1)

DATE THIS REPORT ____

________ AIR FORCE BASE, SITE NO. ______ SITE NAME ______

CONTRACTOR ____________

| NO. | ITEM DESCRIPTION | EQUIPMENT: FABRICATION STARTED | EQUIPMENT: FABRICATION COMPL | EQUIPMENT: RECEIVED SCHEDULE | EQUIPMENT: RECEIVED ACTUAL | EQUIPMENT: PLACED SCHEDULE | EQUIPMENT: PLACED ACTUAL | INSTALL & CONSTR.: STARTED SCHEDULE | INSTALL & CONSTR.: STARTED ACTUAL | INSTALL & CONSTR.: COMPLETED SCHEDULE | INSTALL & CONSTR.: COMPLETED ACTUAL | EQUIPMENT VALIDATION CERTIFIED: COMPLETED CERTIFICATE | CONSTRUCTION STATUS: CONTRACTOR SCHEDULE NO. OF DAYS | CONSTRUCTION STATUS: NO. OF DAYS SINCE START OF SCHEDULE | CONSTRUCTION STATUS: ACTUAL STATUS DAYS AHEAD | CONSTRUCTION STATUS: ACTUAL STATUS DAYS BEHIND | PROBLEM AREA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | SILO | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| 1 | EXCAVATION & BACKFILL | | | | | | | | | | | | | | | | |
| 2 | SIGHT TUBE | | | | | | | | | | | | | | | | |
| 3 | REINFORCING STEEL | | | | | | | | | | | | | | | | |
| 4 | SILO CONCRETE (EXCEPT CAP) | | | | | | | | | | | | | | | | |
| 5 | COLLIMATOR EMBEDDED PLATE | | | | | | | | | | | | | | | | |
| 6 | CRIB SUSPENSION SYSTEM, EMBEDDED WALL BRACKET | | | | | | | | | | | | | | | | |
| 7 | STEEL CRIB | | | | | | | | | | | | | | | | |
| 8 | P.L.S. VESSEL INSTALLATION | | | | | | | | | | | | | | | | |
| 9 | P.L.S. TESTING | | | | | | | | | | | | | | | | |
| 10 | P.L.S. PREFABS AND INTERCONNECTING PIPING | | | | | | | | | | | | | | | | |
| 11 | CABLE TRAY INSTALLATION | | | | | | | | | | | | | | | | |
| 12 | COMPRESSED AIR SYSTEM | | | | | | | | | | | | | | | | |
| 13 | FACILITY ELEVATOR (PERSONNEL) | | | | | | | | | | | | | | | | |
| 14 | DIESEL GENERATOR, SWITCHGEAR & PANELS | | | | | | | | | | | | | | | | |
| 15 | HEATING, VENTILATING, AIRCONDITIONING & PUMPS | | | | | | | | | | | | | | | | |
| 16 | BLAST CLOSURE | | | | | | | | | | | | | | | | |
| 17 | LAUNCH PLATFORM GUIDERAILS & BRACKETS | | | | | | | | | | | | | | | | |
| 18 | LAUNCH PLATFORM COUNTERWEIGHT | | | | | | | | | | | | | | | | |
| 19 | LAUNCH PLATFORM DRIVE BASE | | | | | | | | | | | | | | | | |
| 20 | LAUNCH PLATFORM DRIVE MECHANISM | | | | | | | | | | | | | | | | |
| 21 | CRIB SUSPENSION SYSTEM SPRING & BRACKET | | | | | | | | | | | | | | | | |
| 22 | SILO CAP AND DOORS | | | | | | | | | | | | | | | | |
| 23 | C.B.R. FILTERS | | | | | | | | | | | | | | | | |
| 24 | | | | | | | | | | | | | | | | | |
| 25 | | | | | | | | | | | | | | | | | |
| | LAUNCH CONTROL CENTER | | | | | | | | | | | | | | | | |
| 26 | REINFORCING STEEL | | | | | | | | | | | | | | | | |
| 27 | CONCRETE INCLUDING VENTS, TUNNEL AND ENTRY | | | | | | | | | | | | | | | | |
| 28 | HUNG FLOOR | | | | | | | | | | | | | | | | |
| 29 | AIR CYLINDER SPRING SUPPORT | | | | | | | | | | | | | | | | |
| 30 | BLAST CLOSURE | | | | | | | | | | | | | | | | |
| 31 | CABLE TRAY INSTALLATION | | | | | | | | | | | | | | | | |
| 32 | HEATING, VENTILATING AND AIRCONDITIONING | | | | | | | | | | | | | | | | |
| 33 | | | | | | | | | | | | | | | | | |
| 34 | | | | | | | | | | | | | | | | | |
| | SITE WORK | | | | | | | | | | | | | | | | |
| 35 | FENCING | | | | | | | | | | | | | | | | |
| 36 | ACCESS ROADS | | | | | | | | | | | | | | | | |
| 37 | SITE AREA | | | | | | | | | | | | | | | | |
| 38 | UTILITIES | | | | | | | | | | | | | | | | |
| 39 | | | | | | | | | | | | | | | | | |
| | MISCELLANEOUS | | | | | | | | | | | | | | | | |
| 40 | CONTRACTORS CONSTRUCTION SCHEDULE | | | | | | | | | | | | | | | | |
| 41 | SHOP DRAWINGS | | | | | | | | | | | | | | | | |
| 42 | PROVISIONING DATA | | | | | | | | | | | | | | | | |
| 43 | | | | | | | | | | | | | | | | | |

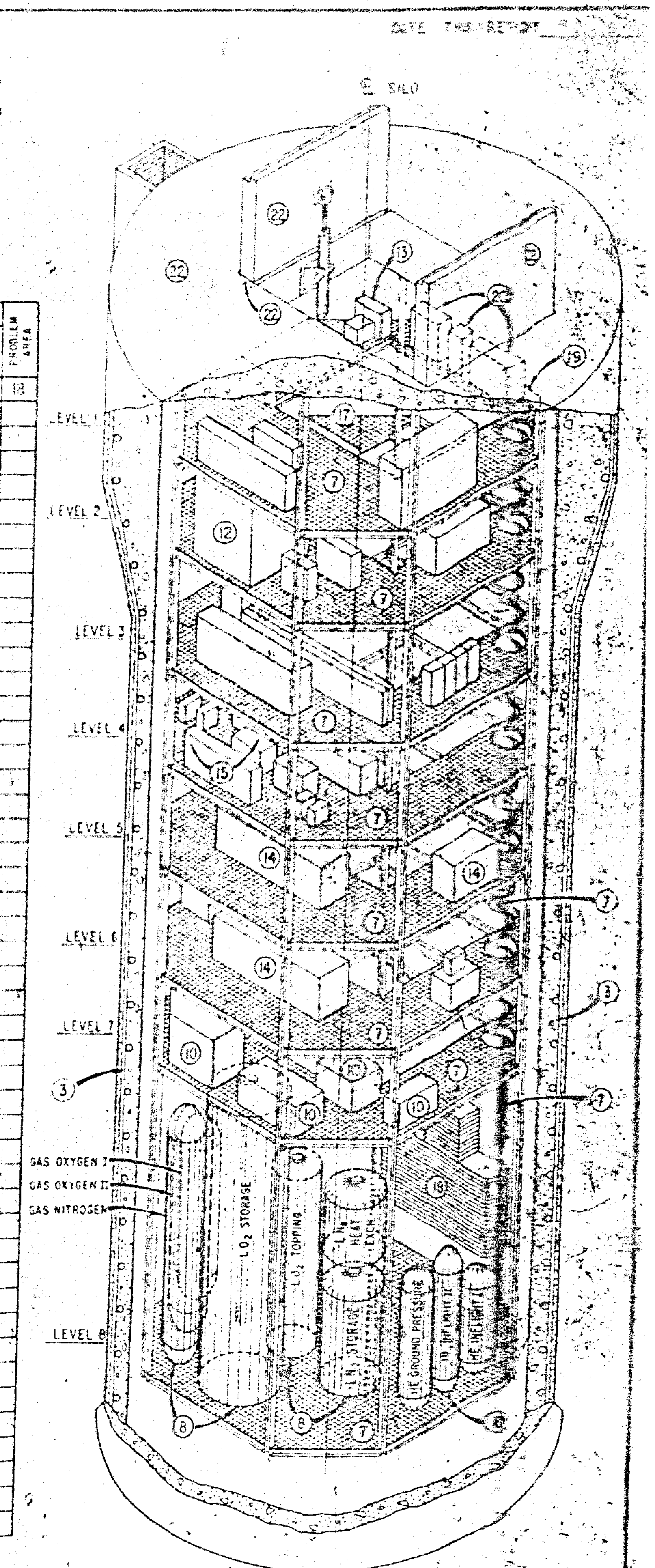
____ DATE THIS REPORT

____ AWARD OF CONTRACT ____ SCH. CONTRACT COMPLETION

CONTRACTOR SCHEDULE

| | 1960 | | | | | | | | | | | | 1961 | | | | | | | | | | | | 1962 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | J | F | M | A | M | J | J | A | S | O | N | D | J | F | M | A | M | J | J | A | S | O | N | D | J | F | M | A | M | J |
| SCHEDULE | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ACTUAL | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

| ACTUAL STATUS | |
|---|---|
| DAYS AHEAD | DAYS BEHIND |
| | |




SILO

# REFERENCE 9

Lake Arthur Water Coop. Rec# 33043
Box 71, Lake Arthur Fee $4.75

State of New Mexico, County of Chaves } ss.
FILED FOR RECORD
SEP 26 1966
at 7:45 o'clock P M. and recorded in book 243 page 311
Dorothy Herrera County Clerk
Jack Walker Deputy

DEED WITHOUT WARRANTY

THE STATE OF TEXAS ]

COUNTY OF DALLAS ]

KNOW ALL MEN BY THESE PRESENTS:

THIS INDENTURE, made this 26 day of September, 1966, between the United States of America, acting by and through the Secretary of Health, Education, and Welfare, by the Regional Director, Region VII, Department of Health, Education, and Welfare, under and pursuant to the powers and authority contained in the Federal Property and Administrative Services Act of 1949, Public Law 152, 81st Congress (63 Stat. 377), as amended (40 U.S.C. 471 et seq.), hereinafter referred to as the Act, and Reorganization Plan No. 1 of 1953, Public Law 13, 83rd Congress, and the Civil Rights Act of 1964, and the rules and regulations promulgated thereunder, GRANTOR, and the Lake Arthur Water Cooperative Corporation, a non-profit tax-exempt corporation, organized and existing under the laws of the State of New Mexico, with its principal office located in Lake Arthur, Chaves County, State of New Mexico, GRANTEE.

E-1

WITNESSETH:

1. WHEREAS, certain real and related personalty consisting of 14.62 acres, more or less, in fee and 234.96 acres of easements and lesser interests, together with the surface improvements, water wells and pumps, and all water rights heretofore held by the United States of America in the property known as the Atlas "F" Missile Site No. 8, Walker Air Force Base, New Mexico, located approximately 25 miles southeast of Roswell, New Mexico, east of U. S. Highway No. 285, was heretofore declared surplus and in accordance with the provisions of said Act was assigned by the Administrator of General Services to the Secretary of Health, Education, and Welfare, for disposal upon his recommendation that said property was needed for public health purposes; and

2. WHEREAS, the aforesaid GRANTEE desires to purchase said property and property rights for use in its water system as outlined in its application dated May 5, 1966, and amendment to said application, dated

June 6, 1966, which application and amendment are made a part hereof by reference as fully as though incorporated herein; and

3. WHEREAS, notice was given to the Administrator of General Services, in accordance with the provisions of said Act, of intention to convey said property to the Lake Arthur Water Cooperative Corporation, its successors and assigns, subject to certain exceptions, reservations, conditions and restrictions hereinafter set forth; and

4. WHEREAS, the Administrator of General Services advised the GRANTOR in writing that no objection is interposed to the said disposal for public health purposes; and

5. WHEREAS, the fair market value of the property is $7,250.00.

NOW, THEREFORE, the GRANTOR, in consideration of the sum of Four Thousand Three Hundred and Fifty Dollars ($4,350.00) cash in hand paid by the GRANTEE to the GRANTOR, receipt of which is hereby acknowledged, and in further consideration of the sum of Two Thousand Nine Hundred Dollars ($2,900.00) to be paid by the GRANTEE by earning a public benefit allowance of forty percent (40%) for said sum by observance and performance by the GRANTEE, its successors in function and assigns, of the covenants, conditions, reservations and restrictions hereinafter contained, does by these presents GRANT, WITHOUT WARRANTY, express or implied, under and subject to the restrictions, reservations, covenants and conditions hereinafter set forth, unto the said Lake Arthur Water Cooperative Corporation of Lake Arthur, New Mexico, its successors in function and assigns, the following described real property and easements, situate, lying and being in the County of Chaves, State of New Mexico, to-wit:

ATTORNEY'S REPORT OF TITLE
PURSUANT TO SECTION 6b, EM405-1-906
DATED THE 16th DAY OF JUNE 1965

Herbert A. Holt, an attorney in the Department of the Army, Corps of Engineers, Albuquerque District, New Mexico, certified:

(1) That he was a duly qualified and licensed attorney of law.

(2) That he had made a careful examination of the records of said office insofar as said records affected the title of the Government to those certain tracts of land situate in Chaves County, New Mexico, designated on the project map of Walker Air Force Base (new) Site 8, as more particularly described in paragraph No. 3 of said report.

(3) Description of tracts comprising Site No. 8 contained in the said instruments of acquisition are as follows (Reference Attorney's Report of Title):

| TRACTS NOS. | EXHIBIT NOS. |
|---|---|
| 100 and 101 | A-1 |
| 100E-1 | A-2 |
| 101-1 | A-3 |
| 100E-1 | B |
| 102-F | C |
| 103E | D |
| 104E | E and E-1 |
| 105E | F |
| 106E | G |
| 107E | H |
| 108E | I |
| S-8-106E-2, E-3 | J |
| S-8-105E-2, E-3, E-4 | K |
| S-8-108E-2, E-3, E-4 | L |
| S-8-106E-4 | M |

(4) Acquisition of Title.

a. Tracts No. 100 and 101. Fee Title vested in the United States by filing of declaration of taking in the United States District Court for the District of New Mexico on 1 August 1960, Civil Action No. 4527. Final judgment was entered on 5 October 1962. Preliminary Title Opinion of the Attorney General is dated 12 August 1960 and Final Title Opinion, 29 August 1963.

TRACT 100 (No. 4.a. above)

A tract of land situate in the E 1/2 W 1/2 NE 1/4 of Section 21, Township 13 South, Range 26 East of the New Mexico Principal Meridian, Chaves County, New Mexico, being more particularly described as follows:

BEGINNING at a point that bears North, a distance of 938.86 feet and West, a distance of 6,764.98 feet from the quarter (1/4) corner common to Sections 22 and 23, Township 13 South, Range 26 East, N.M.P.M., thence

F-3

North, a distance of 600.00 feet to a point; thence East, a distance of 169.77 feet to a point; thence South, a distance of 600.00 feet to a point; thence West, a distance of 169.77 feet to the point of beginning, containing an area of 2.27 acres, more or less.

TRACT 101 (No. 4.a. above)

A tract of land situate in the W 1/2 E 1/2 NE 1/4 of Section 21, Township 15 South, Range 26 East of the New Mexico Principal Meridian, Chaves County, New Mexico, being more particularly described as follows:

BEGINNING at a point that bears North, a distance of 938.86 feet and West, a distance of 6,164.98 feet from the quarter (1/4)corner common to Sections 22 and 23, Township 15 South, Range 26 East, N.M.P.M., thence continuing West, a distance of 430.23 feet to a point; thence North, a distance of 600.00 feet to a point; thence East, a distance of 430.23 feet to a point; thence South, a distance of 600.00 feet to the point of beginning, containing an area of 5.99 acres, more or less.

[Item "b" follows Item "c"]

c. Tract No. 101-1. Fee title vested in the United States by filing of declaration of taking No. 3 in Civil Action No. 4527 on 16 May 1961. Final judgment and Final Title Opinion of the Attorney General are the same as stated in preceding paragraph 4a.

TRACT 101-1 (No. 4.c. above)

A tract of land situate in the NE 1/4 NE 1/4 of Section 21, Township 15 South, Range 26 East of the New Mexico Principal Meridian, Chaves County, New Mexico, being more particularly described as follows:

COMMENCING at the quarter (1/4) corner common to Sections 22 and 23, Township 15 South, Range 26 East, N.M.P.M., thence North, a distance of 938.86 feet to a point; thence West, a distance of 6164.98 feet to a point; thence North, a distance of 600 feet to the point of beginning; thence West, a distance of 120 feet to a point; thence North, a distance of 420 feet to a point; thence East, a distance of 540 feet to a point; thence South, a distance of 540 feet to a point; thence West, a distance of 420 feet to a point; thence North, a distance of 120 feet to the point of beginning containing an area of 6.36 acres, more or less.

It is the intention of the GRANTOR to convey the above-described Tracts Numbered 100 and 101, and 101-1, containing a total of 14.62 acres of land, more or less, to the GRANTEE, its successors and assigns, in fee simple, without warranty, express or implied.

Acquisition of Title continued:

It is the intention of the GRANTOR to convey only the easements and lesser interests, together with the surface improvements and water wells and pumps in, under and upon the following described tracts to the GRANTEE, its successors and assigns.

b. Tract No. 101E-1. Easement for access road and water pipeline vested in the United States by filing of declaration of taking No. 2 in Civil Action No. 4327 on 11 January 1961. Final judgment is the same as stated in preceding paragraph 4a. Preliminary Title Opinion of the Attorney General is dated 26 January 1961. Final Title Opinion is the same as statement in preceding paragraph 4a.

[Item "c" preceded Item "b"]

d. Tract No. 100E-1. Easement for access road was conveyed by Mrs. Vashti Fullen to the United States by instrument dated 28 June 1960.

e. Tract No. 102-P. Permit for access road approach was granted by the State Highway Commission to the United States by Permit No. 2-431 dated 9 May 1960.

f. Tract No. 103E. Restrictive easement was granted by the State of New Mexico to the United States by Permit No. RW-15429, dated 6 June 1962.

g. Tract No. 104E. Restrictive easement was granted by J. J. Terry, Exa Terry Clayton, Beulah Terry Wardlow, Mary Jane Terry Gray, Tommie Ellen Terry Burnett, Lender Lee Terry, a/k/a Lenderman Lee Terry to the United States by instrument dated 3 September 1964. J. J. Terry, Guardian of the Estate of Jock M. Terry, Jr., a minor, granted a restrictive easement to the United States in the same tract by instrument dated 30 November 1962.

h. Tract No. 105E. Restrictive easement was granted by Emmett D. White and Blanche V. White, his wife, to the United States by instrument dated 8 July 1963.

i. Tract No. 106E. Restrictive easement was granted by Carroll Jackson, Jr., and Opal Jackson, his wife, to the United States by instrument dated 20 November 1963.

j. Tract No. 107E. Restrictive easement was granted by Viva A. Armstrong to the United States by instrument dated 17 December 1962.

k. Tract No. 108E. Restrictive easement was granted by Eugene Hobson and Louise Hobson, his wife, to the United States by instrument dated 8 July 1963.

l. Tracts No. S-8-106E-2 and E-3. Easements for Azimuth Marker facility were granted by Carroll Jackson, Jr., and Opal Jackson, his wife, to the United States by instrument dated 4 March 1964.

m. Tracts No. S-8-105E-2, E-3, E-4. Easements for Azimuth Marker facility were granted by Emmett D. White and Blanche V. White, his wife, to the United States by instrument dated 4 March 1964.

n. Tracts No. S-8-108E-2, E-3, E-4. Easements for Azimuth Marker facility were granted by Albert E. Hobson and Louise Hobson, his wife, to the United States by instrument dated 3 March 1964.

o. Tract No. S-8-106E-4. Easement for Soft Antenna facility was granted by Carroll Jackson, Jr., and Opal Jackson, his wife, to the United States by instrument dated 4 March 1964.

(5) The exceptions, reservations, conditions and restrictions relating to the title acquired by the United States are as follows:

a. Tracts No. 100 and 101. The fee simple title is vested in the United States, excepting and reserving to the owners and/or mineral lessees all oil, gas and other minerals in and under said land, but without the right to mine or remove any solid minerals from said land in any manner whatsoever for as long as the United States owns the land, or to enter upon the surface of said land or for a depth of five hundred (500) feet below said surface for the purpose of drilling thereon, extracting therefrom, or exploring for oil and gas, or for any other purposes, and in no event will explosives be used in any oil and gas operations for as long as the United States owns the land; subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

b. Tract No. 101E-1. There is reserved to the landowners, their heirs, executors, administrators and assigns, the right to cross over said tract, including the movement of machinery, equipment and livestock to their adjoining land at a place to be mutually agreed upon by the parties throught gates to be placed thereon by the United States; the above estate is taken subject, however, to existing easements for public roads and highways, public utilities, railroads, and pipelines.

c. Tract No. 101-1. The fee simple title is vested in the United States, excepting and reserving to the owners and/or mineral lessees all oil, gas and other minerals in and under said land, but without the right to mine or remove any solid minerals from said land in any manner whatsoever for as long as the United States owns the land, or to enter upon the surface of said land or for a depth of five hundred (500) feet below said surface for the purpose of drilling thereon, extracting therefrom, or exploring for oil and gas, or for any other purposes, and in no event will explosives be used in any oil and gas operations for as long as the United States owns the land; subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

d. Tract No. 100E-1. There is reserved to the GRANTOR, Mrs. Vashti Pullen, her heirs, executors, administrators and assigns the right to cross over said tract, including the movement of machinery, equipment and livestock to her adjoining land at a place to be mutually agreed upon by the parties through a gate or gates to be placed thereon by the United States and subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

e. Tract No. 102-P. The Permit of the State Highway Commission requires fencing of the access road and obligates the Licensee to comply with all the conditions, restrictions and regulations of the State Highway Commission.

f. Tract No. 103E. The easement is subject to existing easements for public roads and highways, public utilities, railroads and pipelines; and also subject to valid existing rights and future grazing leases. The easement rights revert to the State of New Mexico upon cessation of use for one year.

g. Tract No. 104E. The easement is subject to existing easements for public roads and highways, public utilities, railroads and pipelines. The easement rights revert to the GRANTORS upon cessation of use for one year.

h. Tract No. 105E. The easement is subject to the exception and condition subsequent stated in preceding paragraph 5g.

i. Tract No. 106E. The easement is subject to the exception and condition subsequent stated in preceding paragraph 5g.

j. Tract No. 107E. The easement is subject to the exception and condition subsequent stated in preceding paragraph 5g.

k. Tract No. 108E. The easement is subject to the exception and condition subsequent stated in preceding paragraph 5g.

l. Tract No. S-8-106E-2 and E-3. The easements are subject to existing easements for public roads and highways, public utilities, railroads and pipelines.

m. Tract No. S-8-103E-2, E-3, E-4. The easements are subject to the exception stated in the preceding paragraph 5.l.

n. Tract No. S-8-1082-2, E-3, E-4. The easements are subject to the exception stated in preceding paragraph 5.1.

(6) There is no record of any action, thing or circumstance that occurred from the date of the acquisition of the property by the United States to the date of the report which in any way affected or may have affected the right, title and interest of the United States in the aforesaid real property.

(7) There are no special circumstances affecting the status of civil and criminal jurisdiction over the land that is peculiar to the property by reason of it being Government-owned land. In the absence of compliance with Title 50 U.S.C. Section 175 in conjunction with Section 7-2-1.1, New Mexico Statutes Annotated 1953 Comp., civil and criminal jurisdiction was retained by the State of New Mexico.

(8) The Judge Advocate General, Department of the Army, Washington, D. C. 20315, is the custodian of pertinent title evidence. Dated the 16th day of June 1965. /s/ Herbert A. Bolt, Attorney.

IT IS understood and agreed that the above-described property has been used as a missile site consisting of a reinforced concrete launch silo 174 feet in depth and 52 feet in diameter and an underground launch control center adjacent to the silo. The underground facilities have or will be stripped of all useable equipment and material and the closure gates closed and sealed. The door leading from the launch control center to the silo will be closed and sealed. F-9

The GRANTEE covenants and agrees for itself, its successors and assigns, to assume all risk of claims for personal injuries and property damage arising out of ownership, maintenance, use and operation of the property and/or the existence of the underground and related facilities, and the GRANTEE further covenants and agrees to indemnify and save harmless the United States of America, its agents, officers and employees against any and all liability claims, causes of action or suits due to, arising out of, or resulting from immediately or remotely: (1) the existence of the underground and related facilities; (2) ownership of the property; (3) use and/or operation of the property; and (4) occupation or presence of the GRANTEE or any other party upon the property, lawfully or otherwise.

This conveyance is subject to all other easements, right-of-ways, and servitudes of record, together with all and singular the tenements, hereditaments and appurtenances thereunto belonging or in any wise appertaining and the reversion and reversions, except as hereinafter limited, remainder and remainders, rents, issues and profits and also the estate, right, title, interest, property, possession, claim and demand whatsoever, in law as well as in equity of the said GRANTOR, of, in, and to the herein described property for every part and parcel thereof with the appurtenances, except as hereinafter expressly reserved.

TO HAVE AND TO HOLD the foregoing described property, together with all and singular the rights, privileges and appurtenances thereto in any wise belonging, unto the said Lake Arthur Water Cooperative Corporation, the GRANTEE, its successors in office and assigns, in fee simple;

PROVIDED, HOWEVER, that this Deed is made and accepted upon each of the following conditions subsequent, which shall be binding upon and enforceable against said GRANTEE, its successors and assigns, and each of them as follows: £.10

1. That for a period of twenty (20) years from the date of this Deed, the above-described property shall be utilized continuously for public health purposes in accordance with the aforesaid application and amendment and for no other purpose.

2. That during the aforesaid period of twenty (20) years the GRANTEE will resell, rent, lease, mortgage, encumber, or otherwise dispose of the above-described property, or any part thereof or interest therein, only as the Department of Health, Education, and Welfare, or its successor in function, in accordance with existing regulations, may authorize in writing.

3. That one (1) year from the date of this Deed, and annually thereafter for the aforesaid period of twenty (20)

years, unless the Department of Health, Education, and Welfare, or its successor in function otherwise directs in writing, the GRANTEE will file with the Department of Health, Education, and Welfare, or its successor in function, reports on the operation of the above-described property, and will furnish, as requested, such other pertinent data as will evidence continuous use of the above-described property for the purpose specified in the above-referenced application and amendment.

4. That for the period during which the above-described property is used for a purpose for which the Federal financial assistance is extended by the Department or for another purpose involving the provision of similar services or benefits, the GRANTEE hereby agrees that it will comply with Title VI of the Civil Rights Act of 1964 (P.L. 88-352) and all requirements imposed by or pursuant to the Regulation of the Department of Health, Education, and Welfare (45 CFR Part 80) issued pursuant to that title and as in effect on the date of this deed, to the end that, in accordance with Title VI of that Act and the Regulation, no person in the United States shall, on the ground of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be otherwise subjected to discrimination under the program and plan referred to in condition 1 above or under any other program or activity of the GRANTEE, its successors or assigns, to which such Act and Regulation apply by reason of this conveyance.

IN THE EVENT of a breach of any of the conditions set forth above whether caused by the legal or other inability of the GRANTEE, its successors or assigns, to perform any of the obligations herein set forth, all right, title, and interest in and to the herein described property shall, at the GRANTOR'S option, revert to and become the property of the United States of

America, which shall have an immediate right of entry thereon, and the GRANTEE, its successors in office and assigns, shall forfeit all right, title and interest in and to the above-described property and in any and all of the tenements, hereditaments, and appurtenances thereunto belonging.

PROVIDED, HOWEVER, that the failure of the Department of Health, Education, and Welfare, or its successor in function, to insist in any one or more instances upon complete performance of any of the said conditions shall not be construed as a waiver or a relinquishment of the future performance of any of such conditions, but the GRANTEE'S obligations with respect to such future performance shall continue in full force and effect; PROVIDED FURTHER, that in the event the UNITED STATES OF AMERICA fails to exercise its option to re-enter the premises for any such breach of conditions subsequent numbered 1, 2, and 3 herein within 21 years from the date of this conveyance, conditions numbered 1, 2, and 3 herein together with all rights of the United States of America to re-enter as in this paragraph with respect to conditions numbered 1, 2, and 3 herein, shall, as of that date, terminate and be extinguished; PROVIDED FURTHER, that the expirations of conditions 1, 2, and 3, and the rights to re-enter shall not affect the obligation of the GRANTEE, its successors and assigns, with respect to condition numbered 4 herein or the right reserved to the United States of America to re-enter for breach of said condition.

The GRANTEE, by acceptance of this Deed covenants and agrees for itself, its successors and assigns, and every successor in interest to the property herein conveyed or any part thereof -- which covenant shall attach to and run with the land for so long as the property herein conveyed is used for a purpose for which the Federal financial assistance is extended by the Department or for another purpose involving the provision of similar services or benefits and which covenant shall in any event, and without regard to technical classification or designation, legal or otherwise, be binding to the fullest extent permitted by law and equity, for the benefit and in favor of and enforceable by the GRANTOR and its successors against the GRANTEE, its successors and assigns, and every successor in interest to the property, or any part thereof -- that it will comply with Title VI of the Civil Rights Act of 1964 (P.L. 88-352) and all requirements imposed by or pursuant to the Regulation of the Department of Health, Education, and Welfare (45 CFR Part 80) issued pursuant to that title and as in effect on the date of this Deed, to the end that, in accordance with Title VI of that Act and the Regulation, no person in the United States shall, on the ground of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be otherwise subjected to discrimination under the program and plan referred to in condition 1 above or under any other program or activity of the GRANTEE, its successors or assigns, to which such Act and Regulation apply by reason of this conveyance.

IN THE EVENT title to the above-described premises is reverted to the United States of America for non-compliance or voluntarily reconveyed in lieu of reverter, the GRANTEE, at the option of the Department of Health, Education, and Welfare, or its successor in function, shall be responsible and be required to reimburse the United States of America for the decreased value of the property not due to reasonable wear and tear, the common enemy, acts of God, and alterations and conversions made by the GRANTEE to adapt the property to the use for which the property was acquired. The United States of America shall, in addition thereto be reimbursed for such damages, including such costs as may be incurred in recovering title to or possession of the property as it may sustain as the result of non-compliance.

THE GRANTEE may secure abrogation of the conditions designated 1, 2, and 3 herein by:

First. Obtaining the consent of the Department of Health, Education, and Welfare, or its successor in function; and

Second. Payment to the United States of America of the public benefit allowance granted to the GRANTEE of Forty Percent (40%) from the fair market value of Seven Thousand Two Hundred and Fifty ($7,250.00), less a credit at the rate of five percent (5%) for each twelve (12) months during which the property has been kept, maintained, and utilized in accordance with the purpose set forth in the above-referenced application and amendment.

THE GRANTEE by the acceptance of this Deed, covenants and agrees, for itself, its successors in office and assigns, that in the event the property conveyed hereby is sold, leased, mortgaged, encumbered, or otherwise disposed of, or is used for purposes other than those set forth in the above-identified application and amendment without the consent of the Department of Health, Education, and Welfare, all revenues or the reasonable value, as determined by the Department of Health, Education, and Welfare, of benefits to the GRANTEE, its successors in office and assigns, deriving directly or indirectly from such sale, lease, mortgage, encumbrance, disposal or use (or the reasonable value as determined by the Department of Health, Education, and Welfare of any other unauthorized use) shall be considered to have been received and held in trust by the GRANTEE, its successors in office and assigns, for the United States of America and shall be subject to the direction and control of the Department of Health, Education, and Welfare.

THE GRANTEE, by acceptance of this Deed, covenants and agrees, for itself, its successors and assigns, that the United States of America shall have the right during any period of emergency declared by the President of the United States or by the Congress of the United States, to the full, unrestricted possession, control and use of the property hereby conveyed, or any portion thereof, including any additions or improvements thereto made subsequent to this conveyance. Prior to the expiration or termination of the period of restricted use by the GRANTEE, such use may be either exclusive or non-exclusive and shall not impose any obligation upon the United States of America to pay rent or any other fees or charges during the period of emergency, except that the United States of America shall (i) bear the entire cost of maintenance of such portion of the property used by it exclusively or over which it may have exclusive possession or control, (ii) pay the fair share, commensurate with the use, of the cost of maintenance of such of the property as it may use non-exclusively or over which it may have non-exclusive possession or control, (iii) pay a fair rental for the use of improvements or additions to the premises made by the GRANTEE without Government aid, and (iv) be responsible for any damage to the surplus real property caused by its use, reasonable wear and tear, the common enemy and acts of God excepted. Subsequent to the expiration or termination of the period of restricted use, the obligations of the Government shall be as set forth in the preceding sentence and in addition, the Government shall be obligated to pay a fair rental for all or any portion of the conveyed premises which it uses.

IN WITNESS WHEREOF, the GRANTOR and the GRANTEE have caused these presents to be executed as of the day and year first above written.

UNITED STATES OF AMERICA
Acting by and through the Secretary
of Health, Education, and Welfare

By: [signature]
J. H. BOND, Regional Director
Region VII, Department of Health,
Education, and Welfare, Dallas,
Texas

ACKNOWLEDGMENT

THE STATE OF TEXAS I

COUNTY OF DALLAS I

BEFORE ME, a Notary Public in and for said County, State of Taxas, on this day personally appeared J. H. BOND, Regional Director, Region VII, Department of Health, Education, and Welfare, acting for the United States of America and the Secretary of Health, Education, and Welfare, known to me to be the person whose name is subscribed in the foregoing instrument and acknowledged to me that he executed the same voluntarily for the purposes and considerations therein expressed and with full authority and as the act and Deed of the United States of America and the Secretary of Health, Education, and Welfare.

E-15

GIVEN under my hand and seal of office this 25th day of July, 1966.

[signature: Earlene Ransom]
Notary Public in and for Dallas
County, Texas
EARLENE RANSOM

My Commission Expires:

1st day of June, 1967.

ACCEPTANCE

THE STATE OF NEW MEXICO )
COUNTY OF CHAVES )

BY THE acceptance of this instrument, the Board of Directors, Lake Arthur Water Cooperative Corporation, for itself, its successors in office and assigns, hereby accepts and agrees to all of the terms, conditions, restrictions, and reservations contained herein.

IN WITNESS WHEREOF, the said Board of Directors, Lake Arthur Water Cooperative Corporation Lake Arthur, Chaves County, New Mexico, aforesaid has caused these presents to be signed by J. R. Funk, President of the Lake Arthur Water Cooperative Corporation, thereunto authorized by Resolution of the said Board of Directors, dated May 5, 1966, a copy of which is hereto annexed, and its seal hereunto affixed the 26 day of September, 1966.

THE BOARD OF DIRECTORS
LAKE ARTHUR WATER COOPERATIVE CORPORATION

By: J R Funk
J. R. FUNK, President
Lake Arthur Water Cooperative Corporation

ACKNOWLEDGMENT

THE STATE OF NEW MEXICO )
COUNTY OF CHAVES )

BEFORE ME, a Notary Public in and for said County of Chaves, State of New Mexico, on this day personally appeared J. R. FUNK, known to me to be the person whose name is subscribed to the foregoing instrument, and acknowledged to me that he executed the same voluntarily and as the act and Deed of the Board of Directors, Lake Arthur Water Cooperative Corporation, a non-profit tax-exempt corporation, an instrumentality of the State of New Mexico, organized and existing under the laws thereof, and as President of said Corporation, and for the purposes and considerations therein expressed.

**REFERENCE 10**

## HydroGeoLogic, Inc. - Confirmation Notice
## Atlas Missile Silo Preliminary Assessment

**Auto ROC ID#**
107

Print Record

☑ Phone ☐ Research/Doc Collection ☐ Interview

| Name of Person Contacted | Title Position | Company/Agency Name |
|---|---|---|
| Gina Levario | Water Clerk | Town of Lake Arthur |

| Street Address | City | State | Zip Code |
|---|---|---|---|
| | Lake Arthur | NM | |

| Phone Number | Fax Number | E-Mail |
|---|---|---|
| 505-365-2109 | | |

**Contact Made by**
Clark Limoges

**Date (s)**
12/7/2004

**Time**
10:25 AM

☐ Contact Initiated ☑ Contact Received

**Summary**

Ms. Levario returned my call from last week. I told her I was doing research for the USACE and needed some information regarding the number or percentage of people using Lake Arthur's wells. She stated they only used the two wells out by the missile site. One was used during the winter months, and the other used during the summer months. Both wells serve the entire population that is on the municipal water system (182 meters) when they are running.

REFERENCE 11

1/LT MOORE, PHILIP E. DMCCC Crew 27

579th Strategic Missile Squadron
6th Strategic Aerospace Wing (SAC)
UNITED STATES AIR FORCE
Walker AFB, New Mexico

OPERATIONAL READINESS TRAINING

ATLAS "F"

TASK 200

SILO FAMILIARIZATION (REVISED)

(This Guide replaces Silo Famiarlization Guide dated July 1962 and changes 1 Aug 62 and 1 Sep 62 thereto. Previous editions should be destroyed)

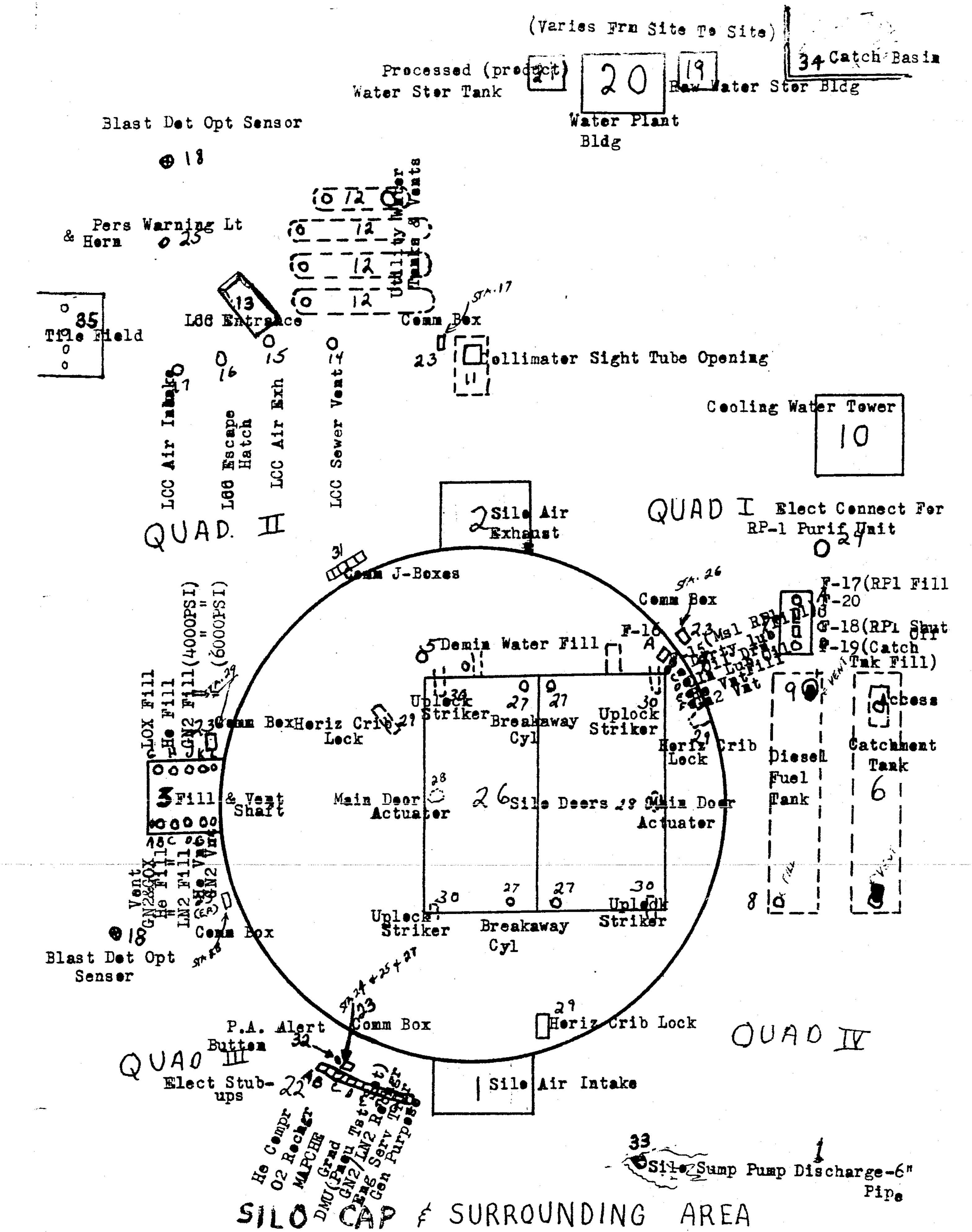
FOR INSTRUCTIONAL PURPOSES ONLY

SEPT 1962

# FLUID LINE CODE

| NAME | FUNCTION |
|---|---|
| AHE | Air Supply-Valves & Controllers |
| APC | Air Supply-LCC Air Cylinders |
| APD | Air Supply-PDU |
| APU | Air Supply-PCU Valves and Controllers |
| AUS | Air Supply-Blast Closures, Diesel Air Tank |
| FFM | Fuel Fill Line-Missile |
| FFP | Fuel Fill Line-Prefab |
| HAS1 | Helium Supply-PDU-Airborne Spheres |
| HAS2 | Helium Supply-PDU-Airborne Spheres |
| HCS | Helium Supply-HCU |
| HCX1 | Missile LOX Tank Exhaust |
| HCX2 | Missile Fuel Tank Exhaust |
| HES | Helium Emerg. Supply to PCU |
| HEX | Helium Exhaust from HCU |
| HFD | Helium Charge Line-Inflight Tanks |
| HFP | Fuel Tank Pressure Checkout |
| HFS | Fuel Tank Ullage Sensor (L/P) |
| HHE | Helium-Heat Exchanger for Airborne Spheres |
| HOP | LOX Tank Pressure Checkout |
| HOS | LOX Tank Ullage Sensor (L/P) |
| HMC | Helium-Missile Controls |
| HNS | Helium Normal Supply-PCU |
| HRS | Refrigerated Helium-Airborne Spheres |
| HSM | Helium Supply-Missile from HCU(L/P) |
| NDP | Equalize Pressure-Drain FFM |
| NEX | Vent LN2 Tank & Relief Valves on LN2 Prefab |
| NFD | GN2 Supply-Ground Pressure Tank (6000) |
| NFF | Equalize Pressure-Drain FFP |
| NFP | GN2 Charge Line for Fuel Prefab Cylinder |
| NHA | GN2 Charge Line for Hydraulic Accumulators |
| NHS | GN2 Supply-Hyd. Pumping Unit (L/P) |
| NLD | LN2 Drain from Missile Shrouds(L/P) |
| NLF | LN2 Coaxial Line-Airborne Spheres |
| NLS1 | LN2 Supply-LN2 Prefab |
| NLS2 | LN2 Supply from LN2 Storage Tank |
| NLS3 | LN2 Supply to Heat Exchanger |

| NAME | FUNCTION |
|---|---|
| NML1 | Lower Liquid Level Sensor, Heat Exchanger |
| NML2 | Lower Liquid Level Sensor, Liquid Nitrogen Storage |
| NMU1 | Upper Liquid Level Sensor, Heat Exchanger |
| NMU2 | Upper Liquid Level Sensor, LN2 Stge. |
| NOD | Equalize Pressure-Drain OFM |
| NOP | GN2 Supply-Pressurization Prefab to Press LOX Tanks |
| NOT1 | GN2 Press-LOX Storage Tank |
| NOT2 | GN2 Press-LOX Topping Tank |
| NPC | GN2 Supply-PDU-Missile Press |
| NPM | GN2 Purge-Mobile SFC. Unit(L/P) |
| NPP | GN2 Re-supply from Press'n Prefab |
| NPS1 | LN2 Storage Tank Press Line |
| NPS2 | LN2 Storage Tank Vent Line |
| NPS | Heat Exchanger Vent Line |
| NRM | GN2 - Retraction Mech. (L/P) |
| NSD | GN2 - PDU |
| NSU1 | GN2 Supply-Raised Launch Plat-Form |
| NSU2 | GN2 Supply-Launch Platform |
| NTP | GN2 Supply-Press'n Prefab |
| NUS | GN2 Press-APCHE Units (L/P) |
| NYP | Fuel Leveling Tank Vent |
| OAF | GN2 Supply-GN2 Tanks (4000 psi) |
| OFC | LOX Supply-Storage Tank |
| OFM | LOX Fill Line to Missile |
| OFP | LOX Supply Line-Fill Prefab |
| OFS | LOX Supply Line-Topping Tank |
| OFT | LOX Fill Line-Control Prefab |
| OML1 | Lower Liquid Level Sensor, LOX Storage |
| OMU2 | Upper Liquid Level Sensor, LOX Topping |
| OST | LOX Topping Line-Missile |
| OVC | Vent line from Relief Valve on LOX Control Prefab |
| OVF | Vent Line from Relief Valves on LOX Fill Prefab |
| OVP | Vent Line from LOX Tanks |
| PDX | PDU Exhaust from Relief Valves |


(Varies Frm Site To Site)
34 Catch Basin
Processed (product) Water Stor Tank
21
20
Water Plant Bldg
19
Raw Water Stor Bldg
Blast Det Opt Sensor
18
12
Utility Water Tanks & Vents
Pers Warning Lt & Horn
25
13
LCC Entrance
Comm Box
ST. 17
35
Tile Field
23
11
Collimator Sight Tube Opening
17
16
15
14
LCC Air Intake
LCC Escape Hatch
LCC Air Exh
LCC Sewer Vent
Cooling Water Tower
10
QUAD II
2 Silo Air Exhaust
QUAD I
Elect Connect For RP-1 Purif Unit
24
31
Comm J-Boxes
Comm Box
ST. 26
F-17(RP1 Fill
F-20
F-18(RP1 Shut Off
F-19(Catch Tnk Fill)
F-16
5 Demin Water Fill
LOX Fill
He Fill
GN2 Fill(4000PSI)
(6000PSI)
Comm Box
Horiz Crib Lock
Uplock Striker
Breakaway Cyl
Uplock Striker
Horiz Crib Lock
Diesel Fuel Tank
9
Catchment Tank
6
Access
3 Fill & Vent Shaft
Main Door Actuator
26 Silo Doors
Main Door Actuator
Vent GN2&GOX
He Fill
LN2 Fill
He Vent
LN2 Vent
Uplock Striker
Breakaway Cyl
Uplock Striker
8
18
Blast Det Opt Sensor
Comm Box
P.A. Alert Button
32
Comm Box
Horiz Crib Lock
QUAD III
QUAD IV
Elect Stub-ups
22
1 Silo Air Intake
He Compr
O2 Recharger
MAPCHE
DMU(Grnd Pneu Tstr)
GN2/LN2 Recharger
Eng Serv Tstr
Gen Purpose
33
Silo Sump Pump Discharge-6" Pipe
SILO CAP & SURROUNDING AREA

## SILO CAP AREA

1. Silo Air Intake: Goes to air wash dust collectors on Quad 3 level #1 of the crib.

2. Silo Air Exhaust: Exits from the Silo wall at level 2, Quad 2.

3. Fill and Vent Shaft:

a. GN2 and GOX Vent (OVP): To pressurization pre-fab to vent LOX storage tank through N-5 and topping tank through N-4.

b. Helium Fill: To Missile LOX tank from pneumatic check-out vehicle (PCV) (During MAPCHE checkout only) (HOF)

c. Helium Fill (HFP): To RP-1 tank from PCV (During MAPCHE check-out only)

d. LN2 Fill (NLS): Through LN2 pre-fab to LN2 storage tank and LN2 heat exchanger.

e. Helium Vent: (HCX-1) Missile LOX tank pressure exhaust through PCU valve 112.

f. GN2 Vent (NEX): LN2 vent from LN2 heat exchanger & storage tank through LN2 pre-fab.

g. LOX Fill: (OFP) Stub up L20 through LOX fill pre-fab valves L-7 & L-6 to LOX storage & topping tanks.

h. Helium Fill (HFD): 6,000 PSI helium through PDU to both inflight helium bottles. Manual valve 23 for IF #1. Manual valve 24 for IF#2.

j. GN2 Fill (NPP): 4,000 PSI GN2 fill to single 500 cubic foot bottle.

k. GN2 Fill (OAF): 4,000 PSI GN2 fill to 2 ea 625 cubic foot bottles.

l. GN2 Fill (NFD): To 6,000 PSI GN2 bottle (Gnd Pressurization & Routine use) through valve 25 in the PDU.

4. A. Manual Valve F-16: From missile to catchment tank.

B. Valve F-15: Missile fill stub up. (RPI)

C. Dirty Lube Oil Drain Line: From tank on level 5 and pump on level 6.

D. Clean Lube Oil Fill Line: To tank on level 5.

E. Helium Vent [illegible]: Missile fuel tank pressure exhaust through [illegible] valve [illegible]

F. GN₂ vent: Vent from fuel loading pre-fab (fuel leveling tank) located on level 8. (NVP)

5. Demineralized Water Fill: To demineralized water tank on level #1 (may not be used).

6. Catchment Tank: Access & vent (15000 gal cap).

7. A. F-17: RP-1 fill stub up.

   B. F-20: One way check valve to RP-1 catchment tank.

   C. F-18: RP-1 manual shut off valve located between F-19 and F-20.

   D. F-19: Catchment tank fill stub up.

8. Diesel Fuel Tank Fill: To diesel storage tank (15,300 gallon cap).

9. Diesel Fuel Tank Vent:

10. Cooling Water Tower: Cools condenser water to maintain return water temp at 90°F. Receives 8 GPM make up water from the utility water system through a chemical pot feeder on level 1. Cools Diesels, Water Chiller Units and Instrument Air Pre-fab.

11. Collimator Sight Tube Opening: Used to orientate the collimator to true North.

12. Utility Water Tanks and Vents: 4 ea tanks 6½ feet under surface. Total capacity 91,000 gallons. 1-16,000 gallon, 3 ea 25,000 gallon. High level alarm 89,450 gallons, low level alarm at 79,300 gallons.

13. LCC Entrance:

14. LCC Sewer Vent: Blast closure closes automatically in event of nuclear blast for 20 seconds, then opens.

15. LCC Air Exhaust: 16" blast closure closes automatically in event of nuclear blast for 30 minutes, then opens.

16. LCC Escape Hatch: Shaft contains 4 tons of sand which empties into level 1 of LCC when trap door is opened.

17. LCC Air Intake: 16" blast closure closes automatically in event of nuclear blast for 30 minutes, then opens.

18. Blast Detection Optical Sensors (2 ea): Converts the light radiation of a nuclear blast to an electrical pulse which is sent to the Nuclear Blast Detector Unit on level 2 of the LCC. The same mast has an optical test light which simulates the light of a Nuclear Blast.

NOTE: Used in conjunction with the optical sensers are 3 ea buried loop anntennae to detect ground shock. Each antenna consists of a 2 foot diameter loop, 10 feet underground and a matched test antenna.

19. Raw Water Storage Tank: Contains Unprocessed water.

20. Water Plant Building Containing:

A. #1 Well and Pump.

B. #2 Well and Pump (may be in seperate pump house).

C. Demineralization, Filtration and Softening Equipment.

21. Processed (Product) Water Storage Tank:

NOTE: Location and makeup equipment (19,20,21) varies from site to site.

22. Electrical Stub-ups: 480 VAC power from NEMCC

A. Helium Compressor Elect Connection. 75KW

B. Oxygen recharger electrical connection. 75KW

C. MAPCHE check-out vehicle electrical connection. MAPCHE contains electronic equipment for rapid automatic checkout of the various missile systems.

D. Ground connection.

E. DMU electrical connection. Now called PTS (Pneumatic test set). Set supplies pressure to the missile during installation and removal and during MAPCHE checkout. 50KW

F. GN2/LN2 recharger electrical connection. 130KW

G. Engine service trailer stubup. 25KW

H. 110V AC 3Ø general purpose outlet.

23. Comm Box (3)(Areas 3,4 and 11)

24. Electrical Connection: For fuel (RP-1) purification unit.

25. Personal Warning Light and Horns: Located above LCC actuated from FRCP, Level 2 of LCC.

26. Silo Doors: 2 ea. 150,000 lbs, 16' 8" X 22' X 2' 6" thick with a 14" overlap. Designed to withstand over-pressure of 100 PSI. Each door opens to 95° in 19 seconds. West door opens 6 seconds after start of east door. Total door opening time 25 seconds.

27. Breakaway Cylinders: 2 each door assists main door actuators. Has 4" stroke with 37,500 lbs lifting capacity.

28. Main Door Actuators: One for each door. Has snubbing action from 90 to 95 degrees of upward travel.

29. Horizontal Crib Locks: (3 each) 120 degrees apart. (NW-NE-S)

30. Uplock Strikers: (For Launcher Platform) 4 each. Used to lock the launcher platform to the silo cap when the launcher platform is in the raised position.

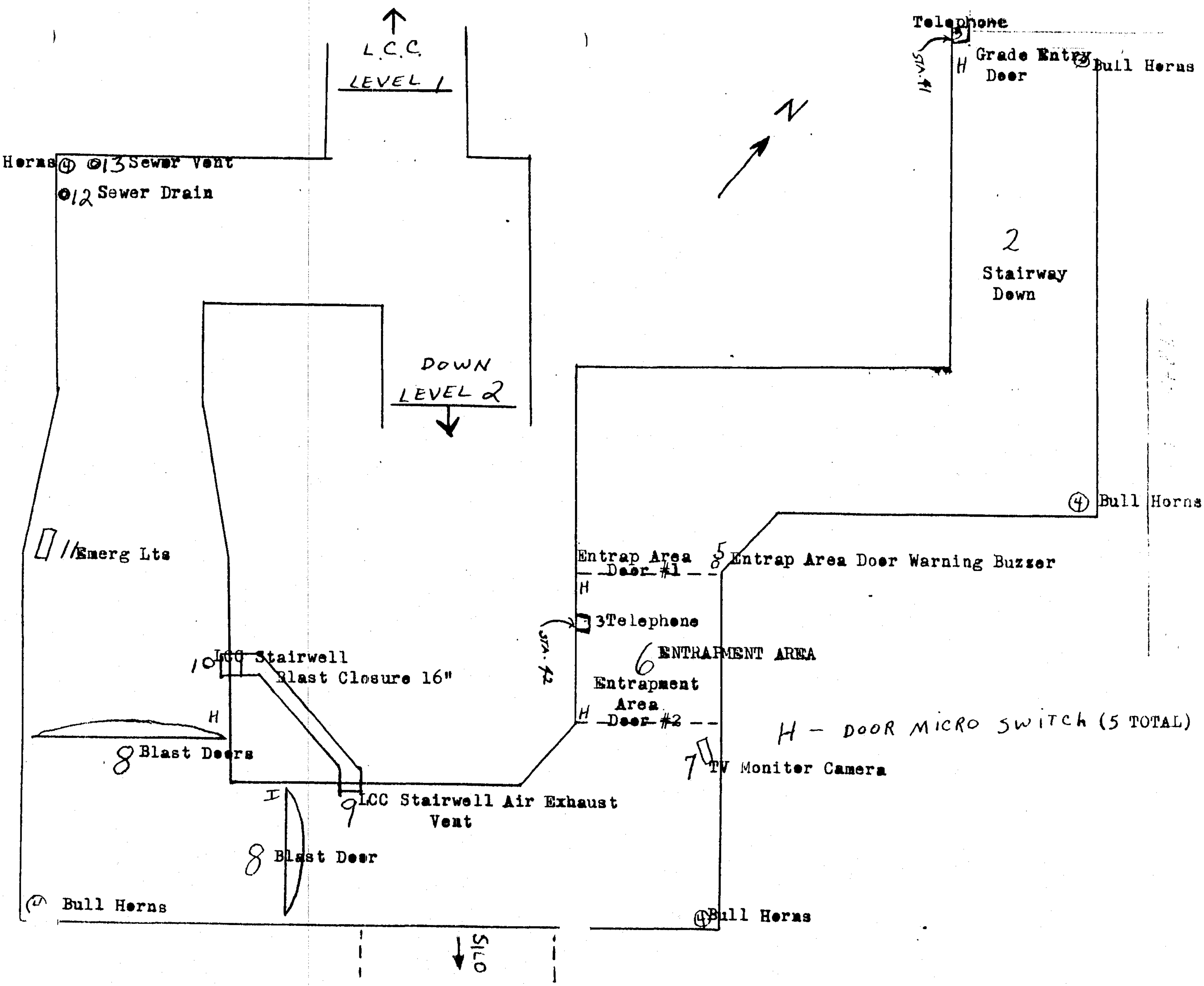
31. Comm "J" Boxes

32. P.A. Alert Button

33. Silo Sump Pump Discharge on to Ground Through 6" Pipe. Location may Vary.

34. Catch Basin: Receives waste water discharge from water processing plant when equipment is back-flushed. Location may vary.

35. Tile Field: Receives discharge from LCC sump pumps.


L.C.C.
LEVEL 1
Telephone
STA. 41
H
Grade Entry Door
5
Bull Horns
N
Bull Horns
4
13 Sewer Vent
12 Sewer Drain
2
Stairway Down
DOWN
LEVEL 2
4 Bull Horns
11 Emerg Lts
Entrap Area Door #1
5
Entrap Area Door Warning Buzzer
H
3Telephone
STA. 42
6 ENTRAPMENT AREA
10 LCC Stairwell
Blast Closure 16"
Entrapment Area Door #2
H
H
H - DOOR MICRO SWITCH (5 TOTAL)
8 Blast Doors
7 TV Moniter Camera
I
9 LCC Stairwell Air Exhaust Vent
8 Blast Door
Bull Horns
4 Bull Horns
SILO

7

8000

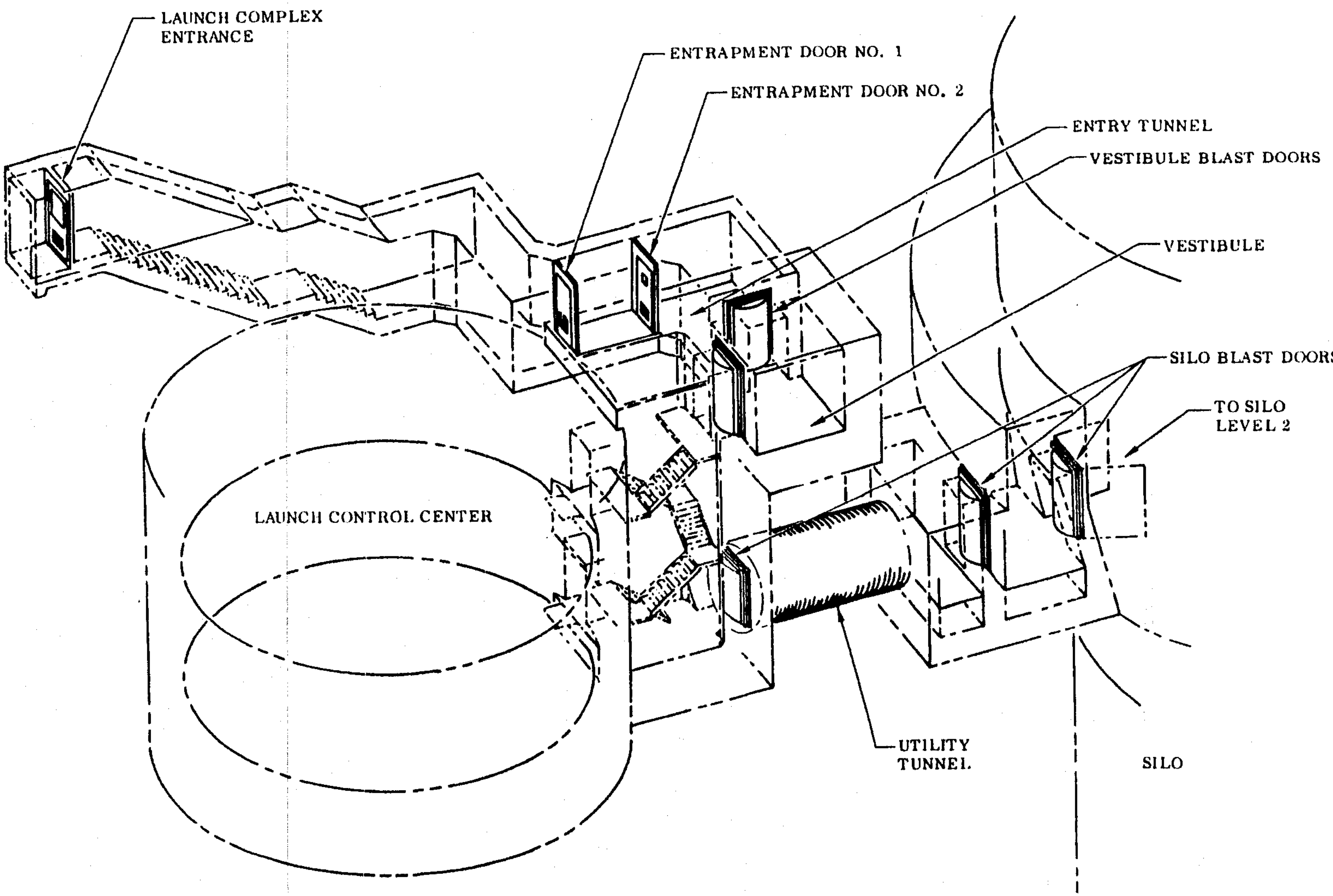



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Figure 1-3. Launch Complex Entrance

# LAUNCH CONTROL CENTER

Introduction: The Launch Control Center (LCC) is a cylindrical structure 40 feet in diameter, 6½ feet below grade, and contains a 2 story steel structure called a hung floor. This hung floor hangs from the ceiling of the concrete structure by a suspension system that is air cushinned to absorb ground shock.

The entranceway to the LCC consists of a stairway down from grade level, entrapment area, two blast doors, connecting tunnel and a stairwell for the LCC levels and to the silo connecting tunnel.

The upper floor (level 1) of the LCC is divided into various rooms: Ready room and storage area, janitor room, latrine and shower room, kitchen and dining area, heat, vent and air conditioning room, and medical supplies room.

The lower floor (level 2) of the LCC is also divided into various rooms in which the actual launch equipment is located: Launch Control Room, office, battery room and communications and equipment room. The tunnel to the silo connects LCC level 2 and silo level 2.

The utility tunnel which connects the LCC with the silo is approximately 50 feet long with an inside diameter of 8 feet. Two blast doors are presently located at the silo end of the tunnel together with two blast plates. These blast plates are permanently bolted to the concrete walls (one on the inside wall of the silo and the other in the tunnel) and have numerous 2½ inch holes used for routing cables between the LCC and silo. A third blast door is to be installed at the LCC end of the tunnel.

Entranceway to LCC

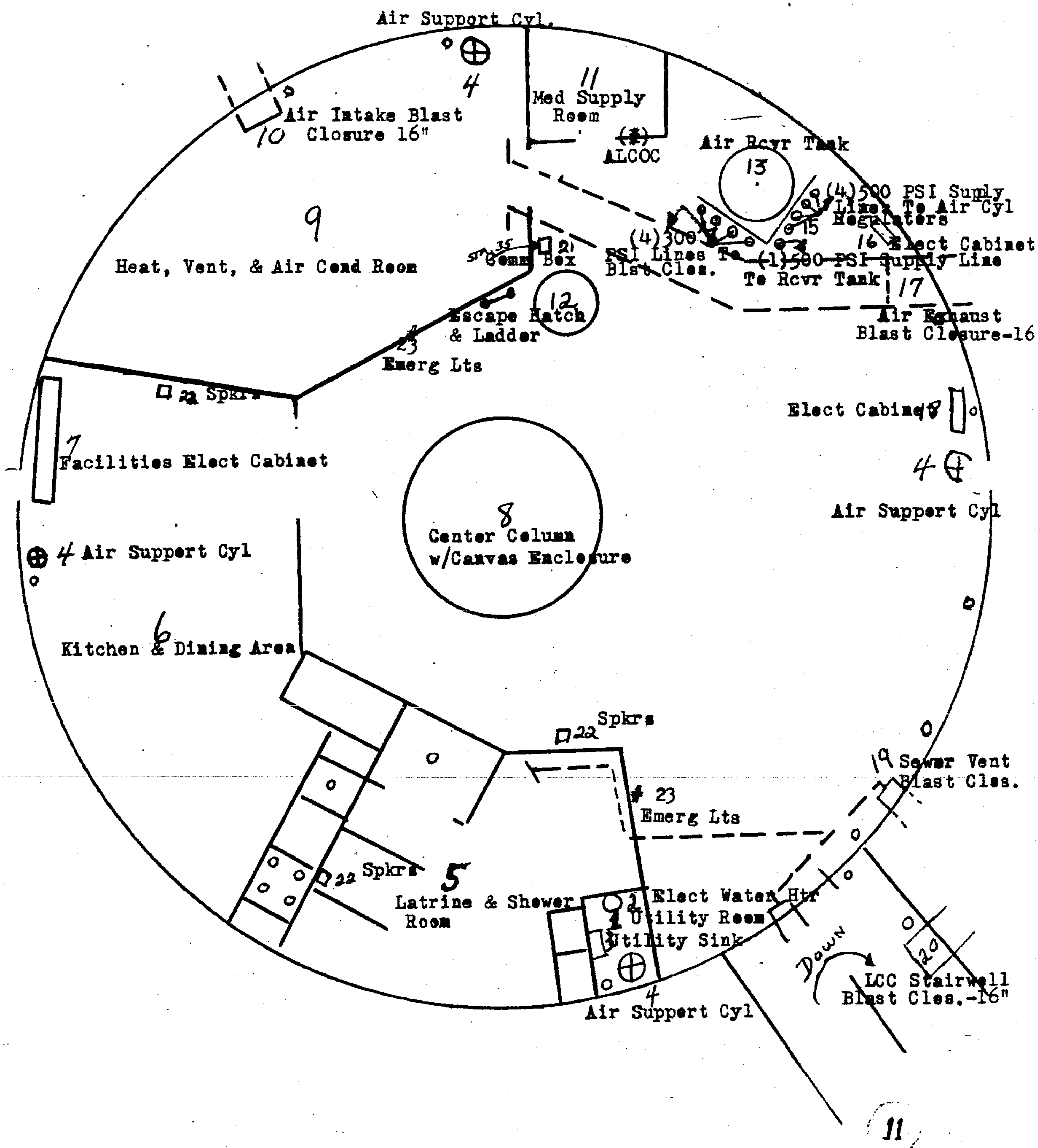
1. Grade entry door and micro switch
2. Stairway down
3. Telephone
4. Bull horns (5 ea)
5. Entrapment area door warning buzzer
6. Entrapment area - two doors and micro switches
7. T.V. monitor camera
8. Blast doors (2) and micro switches
9. LCC Stairwell air exhaust vent
10. LCC Stairwell blast closure - 16"

11. Emergency lighting

12. Sewer Drain

13. Sewer Vent

LEVEL ONE LCC.




11

13. Air Receiver Tank

14. 300 PSI Lines for 4 Blast Closures

15. Five 500 PSI Lines: L to R, 1 ea. supply line to reciver tank and 4 ea. supply lines to LCC support cylinder regulators.

16. Electrical Cabinet

17. Air Exhaust Blast Closure - 16"

18. Electrical Cabinet

19. Sewer Vent Blast Closure

20. LCC Stairwell Blast Closure - 16"

21. Comm Box (Sta - 35)

22. Speakers

23. Emergency Light (6 VDC )

## LCC LEVEL 1

1. Utility Room

2. Electric Water Heater

3. Utility Sink

4. Air Support Cylinders (4): The LCC contains a 2 story steel structure. This steel structure hangs from the concrete roof by a suspension system that is air cushioned by 4 supporting and leveling cylinders with approximately 350 ± 15 PSI instrument air supplied to them. The 4 cylinders provide air suspension and absorb ground shock. The support cylinders are individually and automatically controlled to maintain the structure level under normal operating conditions.

5. Latrine and Shower Room

6. Kitchen and Dining Area: The kintchen and dining room has all equipment necessary for a ten day isolation of the launch crew. This equipment consists of a stove, sink with disposal, refrigerator freezer, tables and chairs. Enough food will be stored in the kitchen area to feed the launch crew during a possible ten day isolation period.

7. Facilities Electrical Cabinet

8. Center Column with Canvas Enclosure

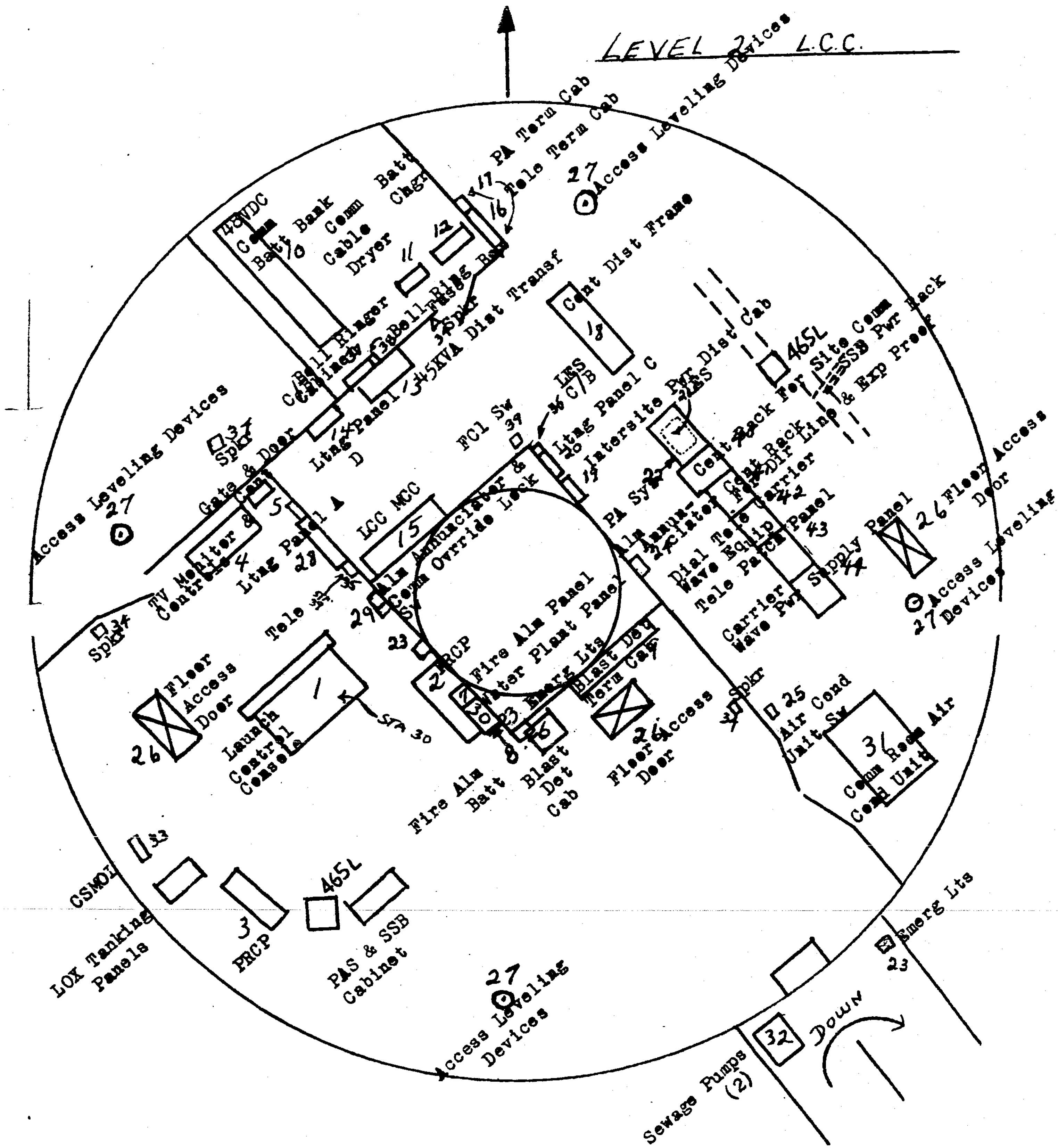
9. Heating, Ventilation and Air Conditioning Room: Equipment in this room is capable of supplying approximately 5550 CFM of clean refrigerated (or heated) and dehumidified air to the LCC. Air is drawn thru the above ground air intake duct, a 16" blast closure and filters (including a CBR filter) by a 7½ hp motor and supply fan (S-1). This same fan then forces the air thru a chilled water coil and a heated water coil and thru ducting to both levels of the LCC and the silo tunnel. Normally, approximately 3800 CFM of the 5550 CFM is recirculated air and 1750 CFM is fresh "outside" air. The LCC exhaust fan (E-1) draws approximately 1100 CFM of air from the communications emergency battery room, the kitchen and latrine and forces this air thru a 16" blast closure and out an above ground exhaust vent. In addition to the "recirculated" air and the "exhausted" air, approximately 650 CFM of air flows from the LCC thru the LCC stairwell 16" blast closure and vents into the LCC entranceway tunnel.

10. Air Intake Blast Closure - 16"

11. Medical Supplies Room

12. Escape Hatch and Ladder. Filled with 4 tons dry sand

LEVEL 2 L.C.C.




15

## LCC LEVEL TWO

1. Launch Control Console: Monitors standby and countdown status of weapon system with light and pressure gage indications. Has controls to start countdown, commit and abort sequences.

2. Facilities Remote Control Panel: Monitors RPIE. Can control blast closures and missile enclosure fog system.

3. Power Remote Control Panel: Monitors and partially remotaly controls the diesel generators.

4. T.V. Monitor & Controls: More than one system may be installed.

5. Gate and Door Control: The gate and door control panel contains 3 buttons and 3 indicator lights. The gate control button and light are for entrance through the perimeter gage (this may or may not be installed). The No. 1 entrapment area, after identification by T.V. The No. 2 button and light will permit entrance through the second security door. Both security doors are electrically un-locked and locked.

6. Blast Detection Console: Detect nuclear blast, closes blast closures and causes guidance to go on memory.

7. Fire Alarm Panel and Rectifier (12VDC): Provides fire alarm and monitor system. (See "note" for Fire Detector Zones and Locations.)

8. Fire Alarm Batteries (12VDC)

9. Blast Detection Terminal Cabinet

10. Battery Bank (Comm)(48VDC)

11. Comm Cable Dryer

12. Battery Charger for Communications Battery Bank and Telephone Ringers

13. Distribution Transformer 440 V (45KVA)

14. Lighting Panel "D" : Provide controlling Ckt. Bks for light system

15. Launch Control Center Motor Control Center: 480 V 60 cycle power through breakers for LCC.

16. Telephone Terminal Cabinet

17. P.A. Terminal Cabinet

18. Central Distribution Frame

19. Power Distribution Service Cabinet (120/208 Volts - 60 Cycle): For inter-site telephone carrier. Has 130V and 48V breakers.

20. Lighting Panel 'C': For communications.

21. Launch Enable System

22. P.A. System: Controls, amplifier (6 ea) and pre-amplifiers.

23. Emergency Lights (6VDC)

24. Alarm Annunciator: Visual and audible alarm or communications malfunction.

25. Switch for Air Conditioning Unit (Ref #31)

26. Floor Access Doors

27. Access, Leveling Devices

28. LCC Lighting Panel "A":

29. Alarm Annunciator and Comm Override Lock Switch

30. Water Plant Panel

31. Communications Room Air Conditioning Unit Chilled Water Only

32. Sewage Pumps (2): From LCC to septic tank and tile field.

33. Control Station Manual Operating Level (new location) Manual Operation of AMF.

34. Speakers

35. Telephone (Sta 39)

36. Circuit Breaker for LES

37. Circuit Breaker Cabinet for Bell Ringers and Communications Battery (48V) Chargers.

38. Fuse Box (slow-blow type): For bell ringers.

39. Switch for Fan Coil Unit-(FC-1)

40. Central Rack for Site Comm Boxes

41. Central Rack for Direct Lines (C.P., ACP etc) and Explosion Proof (E.P.) Comm Boxes

42. Dial Telephone Cable Carrier Wave Equipment

43. Telephone Patch Panel to Each Site and MAMS and Cable Carrier Wave Equip

44. Power Supply Panel for Carrier Wave Equipment

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NOTE: FIRE DETECTOR ZONES AND LOCATIONS

| ZONE | LOCATION |
|---|---|
| 1 | Silo Levels 1 and 2 |
| 2 | Silo Levels 3 and 4 |
| 3 | Silo Level 5 |
| 4 | Silo Level 6 |
| 5 | Silo Levels 7 and 8 |
| 6 | MEA Levels 2, 3 and 4 |
| 7 | MEA Levels 6, 7 and 8 |
| 8 | LCC |

Manual reporting stations on Levels 2, 4, 6 and 8 at entrance to Facility Elevator.

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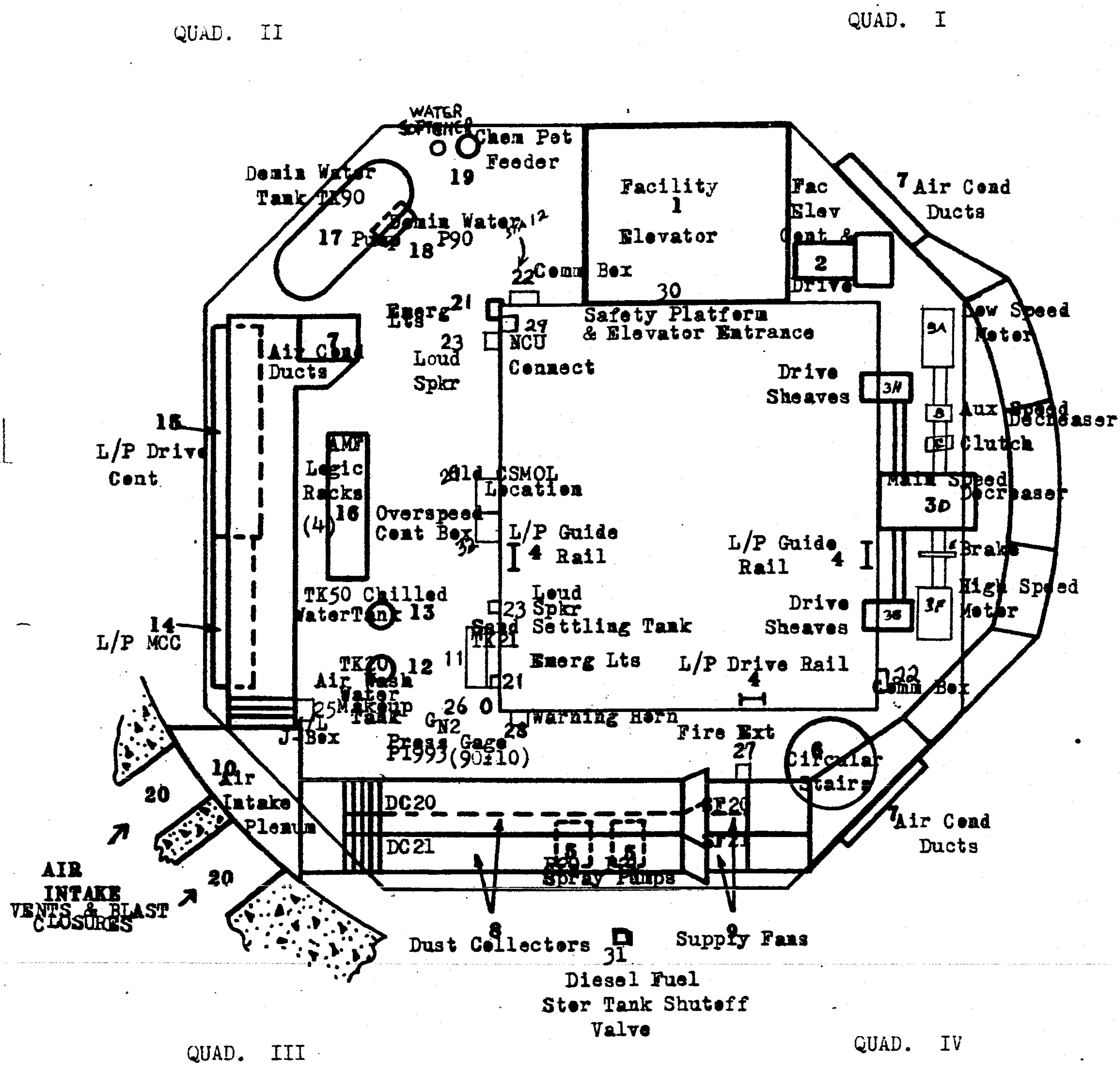

QUAD. II
QUAD. I
QUAD. III
QUAD. IV
WATER SOFTENER
Chem Pot Feeder
19
Demin Water Tank TK90
17
Demin Water P90
18
Facility 1 Elevator
30
Fac Elev Cont & Drive
2
7 Air Cond Ducts
22 Comm Box
Emerg Lts 21
29
23 Loud Spkr
NCU Connect
Safety Platform & Elevator Entrance
Low Speed Motor
3A
Drive Sheaves
3H
Aux Speed Decreaser
Clutch
Main Speed Decreaser
3D
Brake
High Speed Motor
3F
Drive Sheaves
3G
L/P Drive Cont
L/P MCC
14
Air Cond Ducts
AMF Logic Racks (4) 16
Old CSMOL Location
Overspeed Cont Box
L/P Guide 4 Rail
L/P Guide Rail 4
TK50 Chilled WaterTank 13
23 Loud Spkr
Settling Tank
TK21
Emerg Lts
L/P Drive Rail 4
21
11
TK20 12
26
GN2
Press Gage
P1993(90:10)
28
Warning Horn
Fire Ext
27
22 Comm Box
6 Circular Stairs
10 Air Intake Plenum
J-Box
20
20
AIR INTAKE VENTS & BLAST CLOSURES
DC20
DC21
Spray Pumps
SF20
7 Air Cond Ducts
8 Dust Collecters
31
9 Supply Fans
Diesel Fuel Stor Tank Shutoff Valve

SILO - Level 1

## SILO LEVEL 1

1. Facility Elevator: Combination freight and passenger elevator for interlevel service from level 1 to level 8. 6000 lb capacity, electrically operated.

2. Facility Elevator Drive and Control: Electric motor incorporating reduction drive and sheaves and pulleys providing motive force to raise and lower facility elevator.

3. Launcher Platform Drive: Elevates and lowers the launcher platform, between stowed and launch positions, under all load conditions. Direct mechanical actuation is supplied by either one of two 125 hp electric motors operating through a power transmission that rotates the two drive sheaves. Five cables for each of the two drive sheaves are attached to the crib structure at one end, and pass under the sheaves at the top of the counterweights, rise and reeve about the drive traction sheaves, undersling the launcher platform sheaves, and are anchored at the top of the crib structure through tension equalizers.

   A. Low Speed Motor
   B. Aux Speed Decreaser
   C. Clutch (Shaft Coupling)
   D. Main Speed Decreaser
   E. Brake
   F. High Speed Motor
   G. and H. Drive Sheaves

4. Launcher Platform Guide Rails: Located on three sides of the launcher platform serve to guide launcher platform as it is lowered and raised within the silo. These rails minimize lateral movement, or tilting of the launcher platform and provide a smooth vertical track for the launcher platform travel. The rails are of I-beam construction with flanges to provide a smooth bearing surface.

5. Spray Pumps (P20 & 21): Consist of two water pumps, each with a capacity of 280 gpm flow. The pumps are connected in parallel, as one pump is in continuous operation and the other pump is on standby. Water is pumped to the sprayers in the dust collectors and then recirculated by the operating pump. Water losses are supplied by the makeup tank, item 12.

6. Circular Stairs: An all steel circular stairway, 5 ft in diameter, goes from level 1 to level 7, thereon a vertical ladder is used to level 8.

7. Air Conditioning Ducts: Distributes air throughout the crib and is routed to the 8th level.

8. Dust Collectors (DC20 & 21): Cylindrical, wet impingement type air washer-dust collector units. Cleans supply air prior to distribution.

9. Supply Fans (SF 20 & 21). Draws the air from the dust collectors and distributes to the air ducting. Alternately used when outside temperature below 60°F.

   a. Direct driven axialvane inlet fan

   b. 20 hp 1750 rpm, 440v, 3 phase, 60 cps

   c. Water agitator equipped sump

10. Air Intake Plenum: Provides intake air chamber to the dust collector units.

11. Sand Settling Tank: In series with dust collectors, provides trap to allow impurities washed from conditioned air to precipitate out. 1 amp to sump.

12. Air Wash Water Makeup Tank: In series with silo air conditioning system.

13. Chilled Water Tank: In series with main water chilling system located on fourth crib level. This tank acts as a header or expansion tank. App 30 gpm.

14. Launcher Platform Motor Control Center: Contains controls that provide power for the two electric motors that in turn afford power to raise and lower missile. The 125 hp motors operate from 480v, 60 cps, 3 phase current. Also furnishes power to amf logic racks, hydraulic power pack and launch platform drive control.

15. Launcher Platform Drive Control: Both motors are controlled from a common saturable-reactor type control network. Motor speed is controlled by tachometer feedback control.

16. Logic AMF Racks (4): Controls the automatic and proper sequencing of mechanisms for raising the missile for launch and then return platform to hard state. Provides checkout and test of this lifting mechanism and locates malfunctions.

17. Demineralized Water Tank: Capacity 345 gal. Furnishes make-up water to chilled water system, hot water system, and diesel engine closed loop cooling system.

18. Demineralized Water Pump (P-90): Transfers water from demineralized water tank through a one way check valve to systems listed in para. 17. Pump is automatically controlled by liquid level control valves in the chilled and hot water systems. Manual operation is from FTC #2, silo level 2.

19. Chemical Pot Feeder: Softins 8 gpm utility water for use in the condenser water system.

20. Intake Vents and Blast Closures: Two 46 in. outside diameter pipes allow the intake air to the silo air conditioning system. It will automatically close upon detection of thermonuclear radiation. Elect heaters and dampers being installed.

21. Emergency Lights (6 Volts)

22. Comm Box

23. Loud Speakers (2 Each)

24. Control Manual Operating Level (Manual Operation of AFM System) Quad II (old location)

25. Missile Lift Junction Box

26. GN2 Pressure Guage (GN2 to Silo Doors Actuators for Cushion)

27. Fire Extinguisher

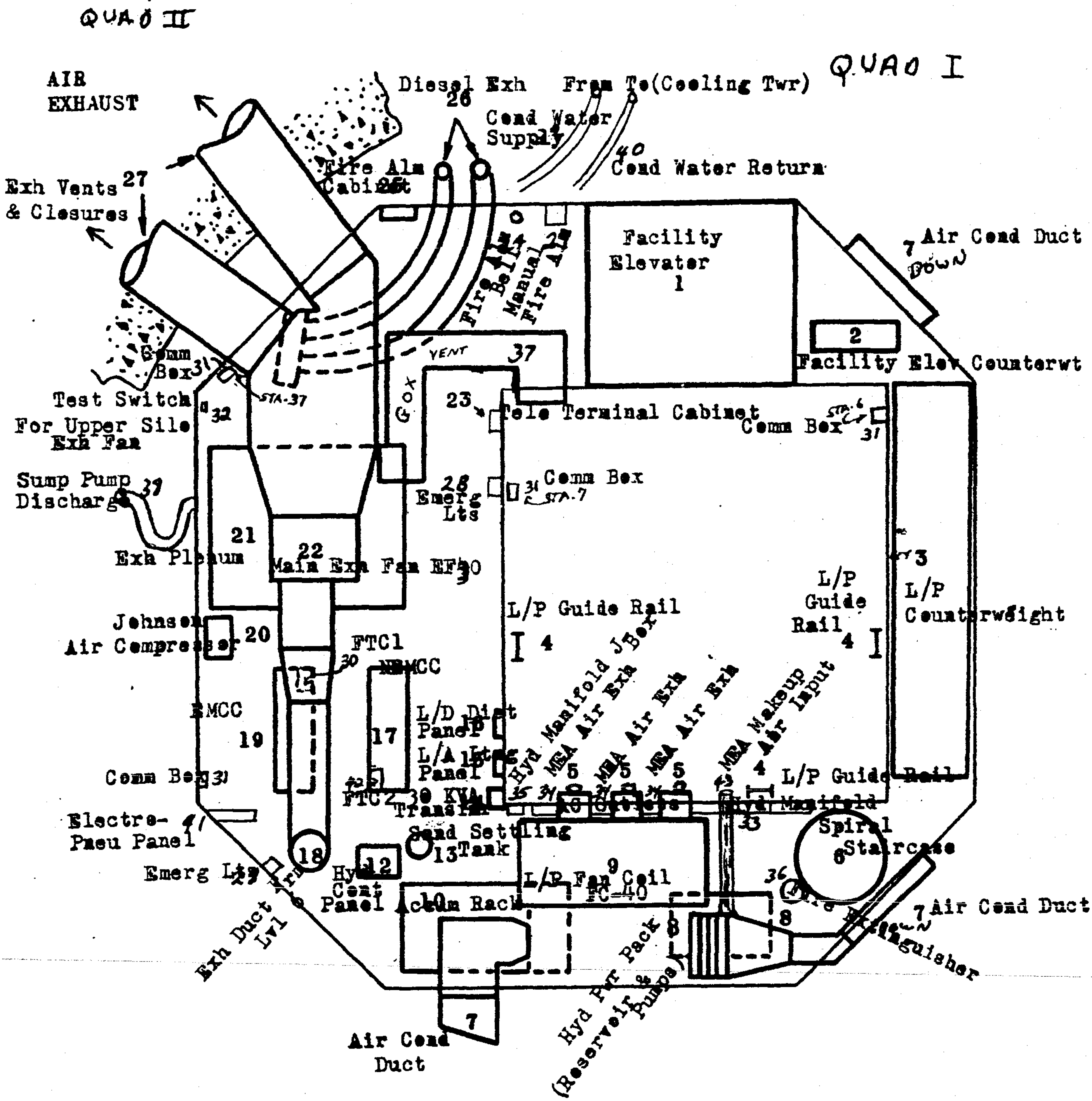
28. Warning Horn

29. NCU Connect: GN2 to NCU when L/P is up and locked.

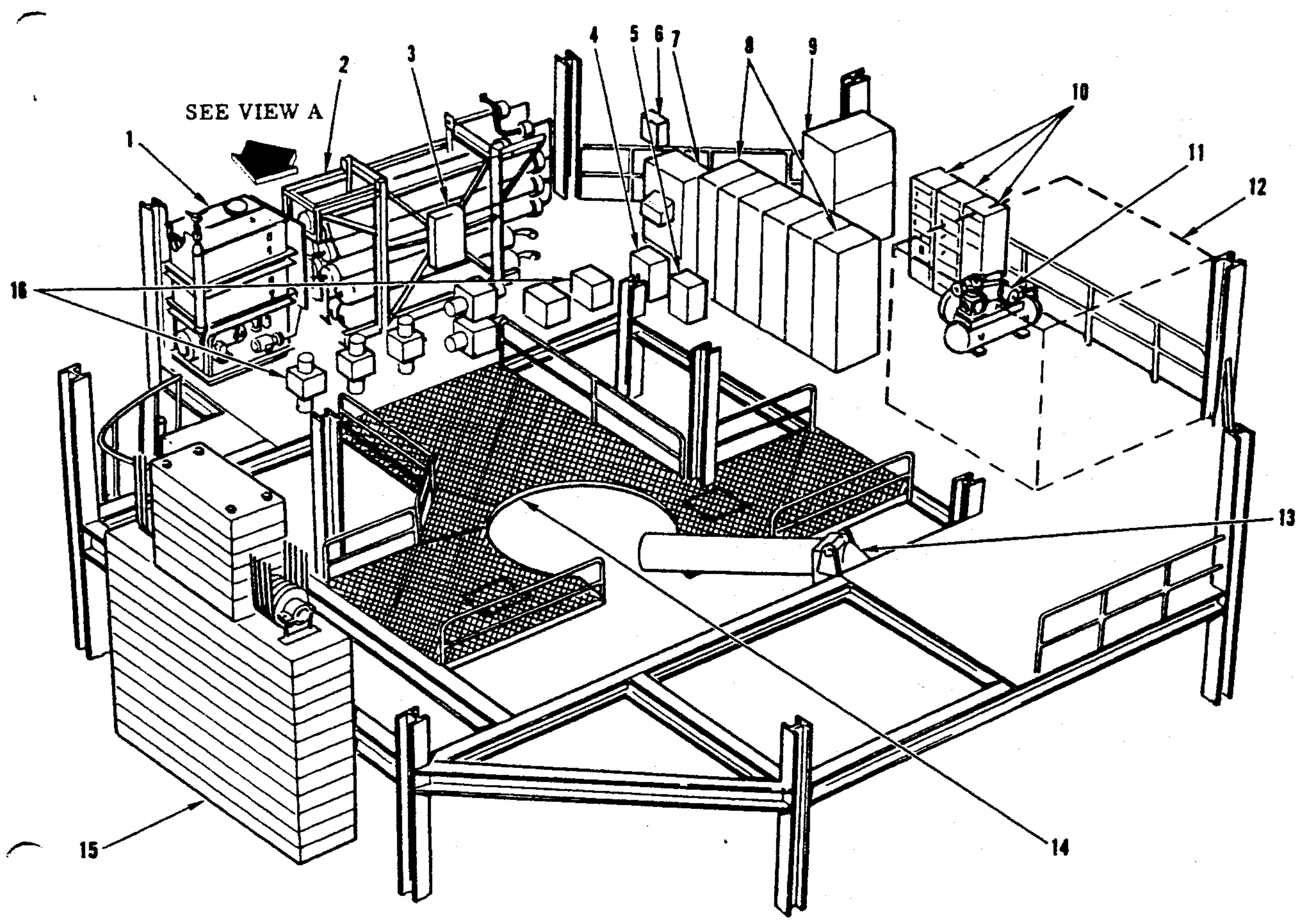
30. Safety Platform & Elevator Entrance ([illegible])

31. Diesel Fuel Storage Tank Shutoff Valve

32. Overspeed Control Box: This unit provides a means of checking the operation of the overspeed sensor and contains an annunciator to indicate that an emergency stop has been initiated by the overspeed sensor.




QUAD III Level 2 QUAD IV




LEVEL 2

1 HYDRAULIC PUMP AND RESERVOIR
2 HYDRAULIC ACCUMULATOR AND GASEOUS NITROGEN PRESSURE TANKS
3 INTERCONNECTING JUNCTION BOX
4 LIGHTING PANEL LA
5 LIGHTING PANEL LD
6 30 KVA TRANSFORMER
7 LOCAL CONTROL HYDRAULIC PANEL
8 NONESSENTIAL MOTOR CONTROL CENTER
9 COMPRESSED AIR SYSTEM REGULATOR PANEL
10 ESSENTIAL MOTOR CONTROL CENTER
11 EXHAUST FAN BLAST CLOSURE AIR COMPRESSOR
12 SILO EXHAUST FAN AND PLENUM
13 GASEOUS OXYGEN VENT
14 WORK PLATFORM 1
15 LAUNCH PLATFORM COUNTERWEIGHT
16 MANIFOLD ASSEMBLY WORK PLATFORMS CRIB LOCKS SILO OVERHEAD DOORS
17 FILTERS

VIEW A

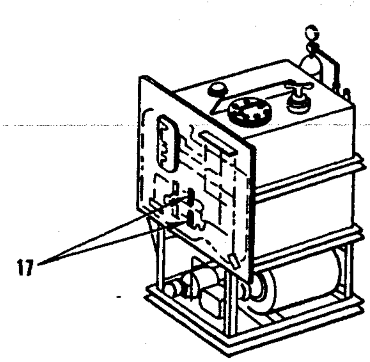



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Figure 1-24. Silo Level 2 Equipment Location

## SILO LEVEL 2

1. Facility Elevator

2. Facility Elevator Counterweights: Consist of iron slabs which are guided by rails and lower to the 8th level. Has chain attached to bottom to compensate for cable weight changes.

3. Launcher Platform Counterweight: This slab unit comprises 26 cast iron and three steel slabs bolted together to form a 541,000 lb counterweight. The counterweight minimizes the power requirement to raise and lower the launcher platform together with a fully loaded missile and all AGE on the platform. The V-shaped groove in each vertical end of the counterweight accomodates a guide rail. The counterweight weighs approximately 6000 pound more than the launch platform.

4. Launch Platform Guide Rails

5. AC Outlets: Three full size ac outlets provide receptacles for use of 115V and 208V.

6. Spiral Staircase

7. Air Conditioning Duct

8. Hydraulic Reservoir and Pump Unit (Hyd Power Pack): Contains a 275 gal reservoir, a 1 hp 5 gpm electric driven hydraulic pump with 200 psi output, a 40 hp 20 gpm pump with 3000 psi output, one accumulator and necessary filters and valves. Pumps receive power from M/L MCC and provide power to horizontal and vertical crib locks, doors, launch platform brakes, drive couplings and the work platforms.

9. Launcher Platform Fan Coil Unit (FC-40): Provides positive circulation of conditioned air throughout launch platform contained units.

10. Accumulator Rack: Eight accumulators and 5 GN2 bottles are mounted in a support rack. The hydraulic fluid is pressurized by 3700 psi nitrogen gas. Six accumulators and 2 GN2 bottles are used to operate the silo doors and the remaining two accumulators and 3 bottles operate the other systems.

NOTE: Silo Air Conditioning Specifications

| Areas | Temperatures | |
|---|---|---|
| Launch Platform Enclosure | 70°F ± 5° | 65% RH |
| Collimator | 70°F ± 3° | 65% RH |
| Control Cabinets | 70°F ± 3° | 65% RH |
| Remainder of Silo | 50°F to 100°F | |

12. Hydraulic Control Panel: Provides (1) a means of pinpointing trouble areas, (2) manual control of the main and standby hydraulic pumps and (3) control of nitrogen cylinder recharging.

13. Sand Settling Tank: Allows solid impurities washed from conditioned air to precipitate out. 1 GPM to sump.

14. 30 KVA Lighting Transformer: Input of 440 volts is reduced to 120/208 V, 3 phase power through panel LD to the lighting panels LA and LB for illumination of the crib and launch platform. (100 Amp with 70 A Breaker)

15. Lighting Panel LA: Provides 120VAC 60 cycle, single phase to silo lighting at silo levels 1,2,3 and grade.

16. Distribution Panel LD: Receiver 120/208VAC from the 30DVA lighting transformer on level 2 and distributes it to lighting panel LA on level 2, lighting panel LB on level 4, RP-1, diesel fuel and GOX detectors on level 7, and to the 6V emergency lighting chargers and relays on all levels.

17. Nonessential Motor Control Center (10 Units): Controls main air supply fans (2-20 hp each), lower silo supply fan (3 hp), hot water heater, (1 hp), main exhaust fan (15 hp), exhaust vent bent blast closures, waste water pump (10 hp), standby spray pump, spray pump, LO2 vacuum pump, LO2 vacuum pump subcooler, LN2 vacuum pump, water condensate return pump, missile fuel drain pump, fog system pump, water chiller pump, dirty lube oil pump air compressors (2-15 hp), utility water pump, defueling pump, condenser water pumps, hot water pump, hot water pump standby, launch platform purge exhaust fan, launch platform exhaust fan, launch platform fan control unit, 30 KVA transformer silo level 2 and detector units silo level 7. This bus is de-enterized at commit as these items are not necessary for launch.

18. Exhaust Duct for Level 6

19. Essential Motor Control Center (Six Units): 30KVA transformer, silo level 3, DC power supply unit, pod air conditioning control cabinet for air handling, air handling fan, control cabinet fan coils, thrust section heating blower, thrust section heating element, hydraulic pumping unit, 400 cps motor generator and distribution system, 48 vdc battery rectifier, water chiller unit, chilled water pump, emergency water pump. Contains motor controllers protective circuit devices and pilot controls for equipment required for standby and countdown.

20. Air Compressor: Supplies compressed air for electro-pneumatic panel.

21. Exhaust Plenum: Collects silo air conditioning exhaust and diesel exhaust into common plenum which vents gases to the atmosphere.

22. Main Exhaust Fan (EF-30): Provides impetus to used silo air, diesel exhaust and RP-1 vapors, with draws accumulated waster from plenum and forces it to vent to atmosphere at ground level. Draws air from silo levels 2 and 5.

23. Telephone Terminal Cabinet: Provides switching center to facilitate routing of telephone communication between silo and LCC.

24. Fire Alarm Bell

25. Fire Alarm Cabinet

26. Diesel Exhaust: Exhaust gases carried toward exhaust plenum from diesel engines located on levels 5 and 6.

27. Exhaust Vents and Closures: Two 46 in. outside diameter pipes provide exit of contaminated air into the exhaust tunnel and shaft. Blast closure doors will automatically close upon detection of thermonuclear radiation.

28. Emergency Lights, 6 Volts:

29. Fire Manual Alarm

30. FTC #1

31. Comm Box

32. Test Switch for Upper Silo Exhaust Fan

33. Hydraulic Manifold

    A. Hydraulic doors manifold (2 each).
    B. Crib Locks, and launch platform locks.
    C. Work Platforms.
    D. Launch Platform drive brake.

34. Missile Enclosure Air Exhaust: Air into missile enclosure area on level 7.

35. Hydraulic Manifold J Box

36. Portable Fire Extinguisher

37. GOX Vent: Mechanically extended and retracted (see P26, par 38)

38. Sump Pump Discharge

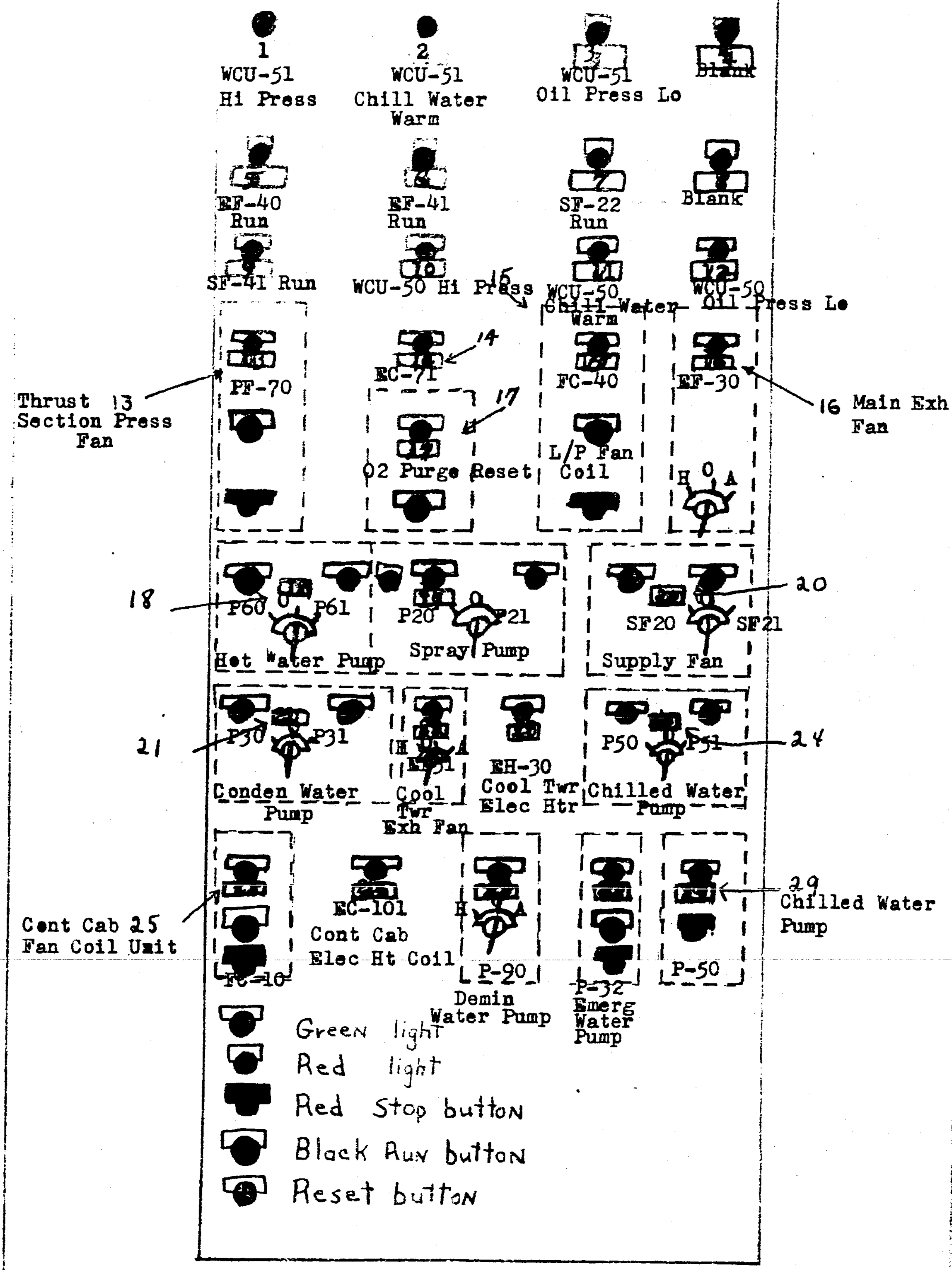
39. Condenser Water Supply (From cooling tower)

40. Condenser Water Return (To cooling tower)

41. Electro-Pneumatic Panel: Contains controls for electro-pneumatic valve system operation in the water and air conditioning systems.

42. FTC #2: Contains controls and indicators for EMCC and NEMCC equipment. The fact that it is physically a part of the NEMCC is insignificant.

43. Missile Enclosure Area Makeup Air Input




Facility Terminal Cabinet No. 2

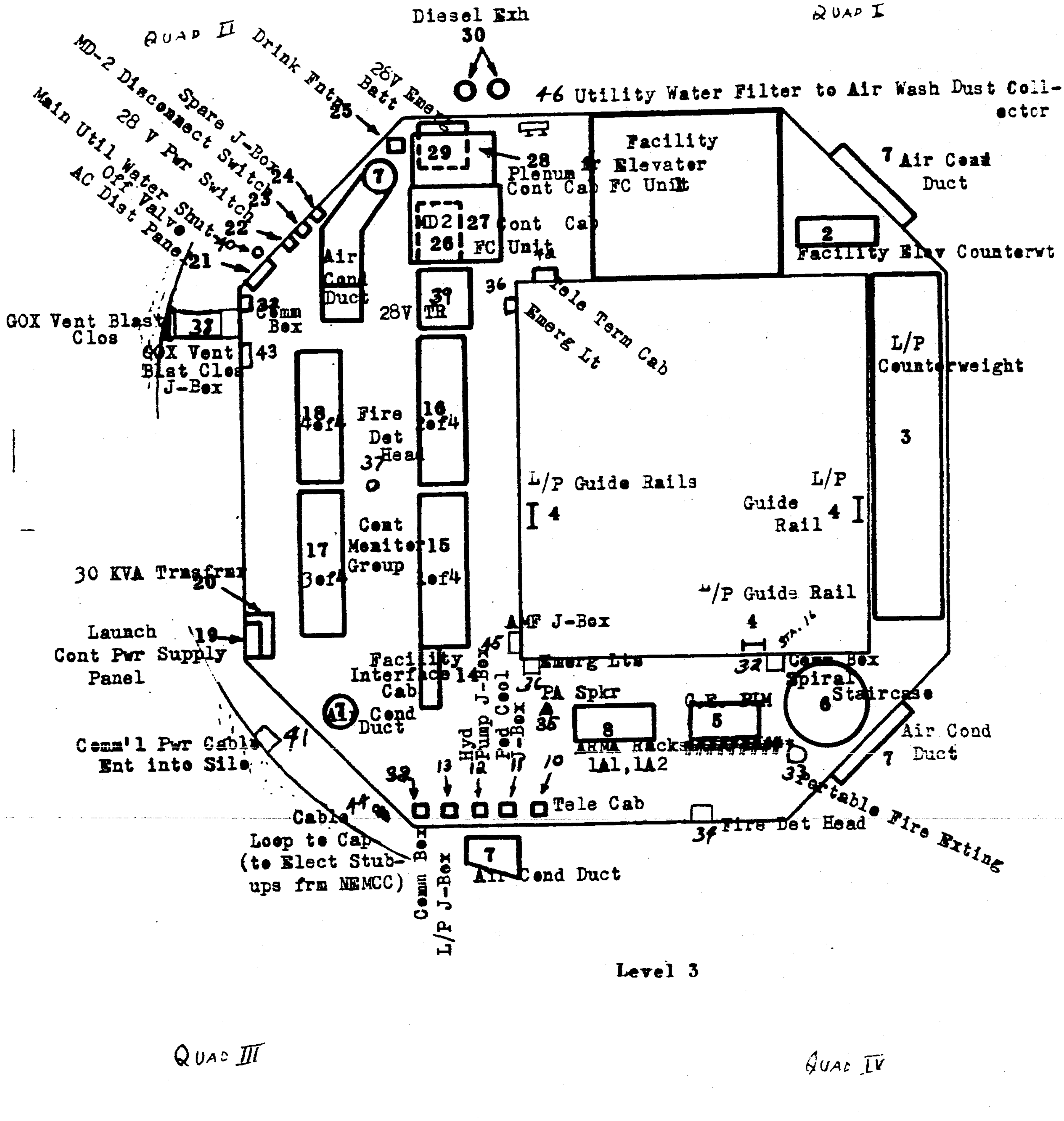
ATCH-4

A p. 103

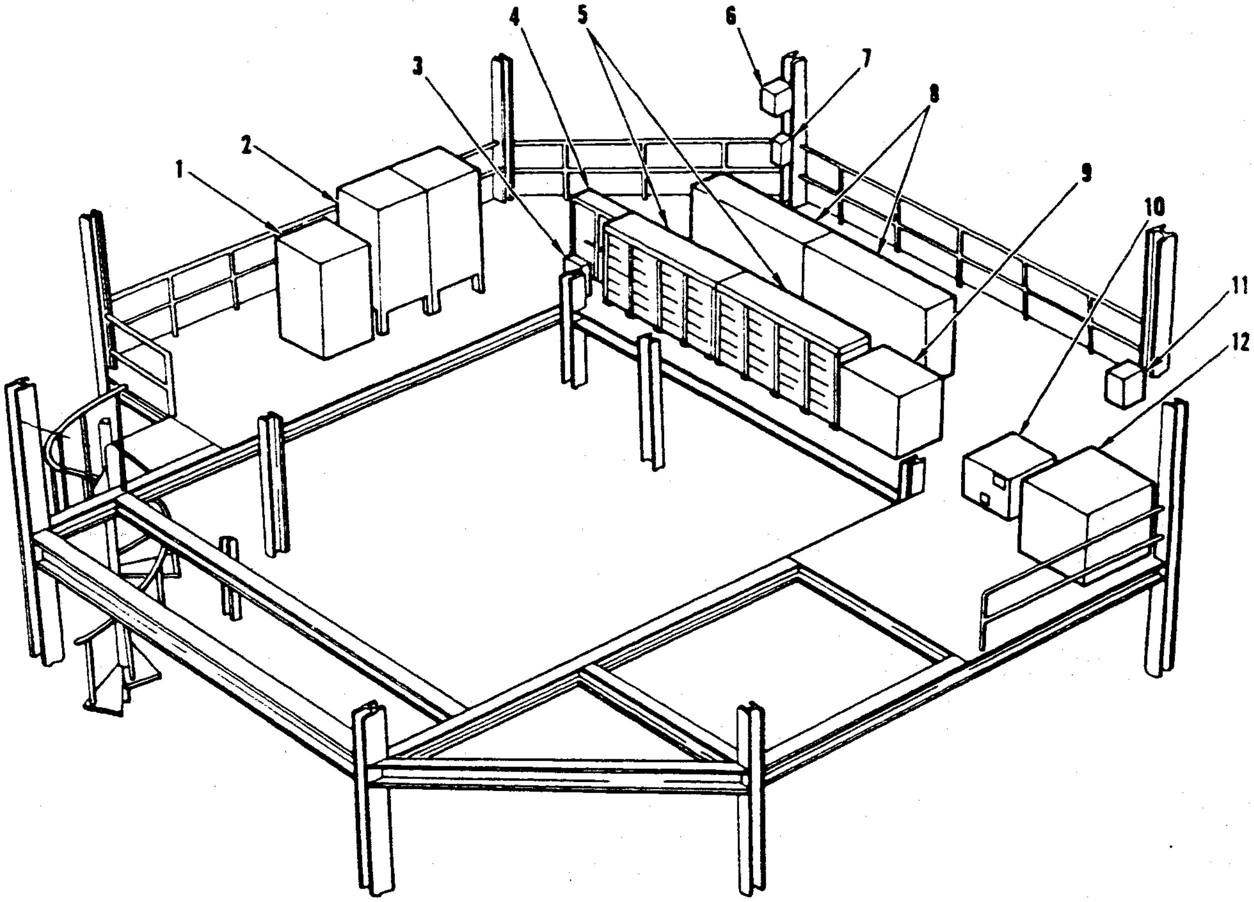
## FACILITY TERMINAL CABINET #2

1. Water Chiller Unit WCU-51 - "High Pressure" light.
2. Water Chiller Unit WCU-51 - "Chilled Water Warm" light.
3. Water Chiller Unit WCU-51 - "Oil Pressure Low" light.
4. Blank
5. Launch Platform Exhaust Fan EF-40 - "Run" light.
6. Launch Platform Purge Exhaust Fan EF-41 - "Run" light.
7. Lower Silo Supply Fan SF-22 - "Run" light.
8. Blank
9. Launch Platform Purge Supply Fan SF-41 - "Run" light.
10. Water Chiller Unit WCU-50 - "High Pressure" light.
11. Water Chiller Unit WCU-50 - "Chilled Water Warm" light.
12. Water Chiller Unit WCU-50 - "Oil Pressure Low" light.
13. Thrust Section Pressure Fan PF-70 - "Run" light; Start and Stop switch.
14. Thrust Section Heating Coil EC-71 - "On" light.
15. Launch Platform Fan Coil Unit FC-40 - "Run" light; Start and Stop switch.
16. Main Exhaust Fan EF-30 - "Run" light and "Hand-Off-Automatic" switch.
17. Oxygen Purge Reset - Reset Oxygen Detector Before Resetting Purge Cycle - Reset Button and Green Light.
18. Hot Water Pump P-60 & P-61 - P-61 "Run" light, P-60 "Run" light and "P-60 - Off - P-61" selector switch.
19. Spray Pump P-20 & P-21, P-21 "Run" light, PS-20 "Run" light; "P-20-Off-P-21" selector switch.
20. Supply Fan SF-20 & SF-21 - SF-21 "Run" light, SF-20 "Run" light and "SF-20-Off-SF-21" selector switch.
21. Condenser Water Pump P-30 & P-31 - "Run" light and "Hand-Off-Automatic" selector switch.

ATCH- 4
B


Diesel Exh
30
Quad I
Quad II
46 Utility Water Filter to Air Wash Dust Collector
Drink Fntn
26V Emer Batt
25
Spare J-Box
24
MD-2 Disconnect Switch
23
28 V Pwr Switch
22
Main Util Water Shut-Off Valve
AC Dist Panel
21
29
28
Plenum Cont Cab
Facility Elevator FC Unit
7 Air Cond Duct
MD2
27 Cont Cab
26
FC Unit
2
Facility Elev Counterwt
Air Cond Duct
28V TR
36
Tele Term Cab
Emerg Lt
GOX Vent Blast Clos
Comm Box
GOX Vent Blst Clos J-Box
43
L/P Counterweight
3
18
4of4
Fire Det Head
16
2of4
L/P Guide Rails
4
L/P Guide Rail
4
Cont Monitor Group
17
3of4
15
1of4
30 KVA Trnsfrmr
20
L/P Guide Rail
4
Launch Cont Pwr Supply Panel
19
AMF J-Box
45
Facility Interface Cab
14
Emerg Lts
32
Comm Box
Spiral Staircase
6
PA Spkr
35
8
5
Air Cond Duct
Air Cond Duct
7
ARMA Racks
1A1,1A2
Comm'l Pwr Cable Ent into Silo
41
Hyd Pump J-Box
Fed Cool J-Box
33
13
12
11
10
Tele Cab
Portable Fire Exting
Cable Loop to Cap (to Elect Stub-ups frm NEMCC)
44
Comm Box
L/P J-Box
7
Air Cond Duct
Fire Det Head
34
Level 3
Quad III
Quad IV

33




LEVEL 3

1 RE-ENTRY VEHICLE PRELAUNCH MONITOR AND CONTROL UNIT
2 COUNTDOWN GROUP
3 LIGHTING PANEL
4 FACILITIES INTERFACE CABINET
5 CONTROL MONITOR GROUP 1 OF 4 AND 2 OF 4
6 480-VOLT 30-KVA TRANSFORMER
7 LAUNCH CONTROL POWER PANEL
8 CONTROL MONITOR GROUP 3 OF 4 AND 4 OF 4
9 28 VDC BATTERY
10 400 CYCLE SKID MOUNTED MOTOR-GENERATOR TYPE MD-2
11 DISTRIBUTION BOX
12 POWER SUPPLY - DISTRIBUTION SET

40.10-126A

Figure 1-43. Silo Level Three Equipment Location

## SILO LEVEL 3

1. Facility Elevator

2. Facility Elevator Counterweights

3. Launch Platform Counterweights

4. Launch Platform Guide Rails

5. G.E. Pre-launch Monitor: Capable of continuous and periodic monitoring of the mated re-entry vehicle. MK3 or MK4 can set R/V for ground or air burst.

6. Circular Staircase

7. Air Conditioning Ducts

8. ARMA 1A1, 1A2 Racks: Two racks provide the continuous hold of the inertial guidance alignment system and includes confidence checks on the system. Controls and monitors the guidance system during C/D.

9.

10. Telephone Cabinet: Terminal board for all telephone cabling in the silo.

11. Pod Cooling J Box:
12. Hydraulic Pump J Box:
13. Launch Platform J Box:

(11–13) All three units receive electric power, 440, 3 phase, 60 cycles from the essential bus control center and from these three function boxes electric power is routed to the cableloop assembly, crib to launcher.

14. Facility Interface Cabinet: Junction box for providing electric power to the following prefabs: liquid oxygen, fuel and pressurization.

15 and 16. Control Monitor Group 1 & 2: Two units contain necessary relays, computers, comparators, and circuitry to sequentially send actuation signals to the missile and AGE during countdown. They obtain feedback information from these actuations, compute and compare these signals and present results of this analysis as GO/NO-GO signal at the launch control console.

17 and 18. Control Monitor Group 3 & 4: Two units designed to simulate signals that are normally produced by the missileborne and ground support equipment when stimulated by the two logic units. The feedback of signals from the simulated system of the LSR is computed and compared by the logic units and results are indicated as GO/NO-GO signals on the launch control console. Primary purpose of the LSR is to check-out the operation of the logic units and the launch control console and identify any malfunctions of these units.

19. Launch Control Power Supply Panel: Distributes 120/208 volts, 3 phase, 60 cps to the logic units, LSR units, GE pre-launch monitor and the ARMA guidance units.

20. 30 KVA Transformer: Reduces 440 volts, 3 phase, 60 cycles to 120/208 volts and this power is routed to the launch control power supply panel, item 19.

21. 60 Cycle and 400 Cycle AC Distribution Panel: Receives 120/208 volts, 3 phase, 400 cycles from the motor generator and directs it to the logic units, LSR units and ARMA guidance units. Motor generator requires 440 volts, 3 phase 60 cycle input from the motor control center. Voltage requlation is controlled electrically and frequency requlation is controlled by the 60 cycles power to the synchronous drive motor. Has SPGG and engine valve heater indicators.

22. 28 VDC Power Supply Switch: 60 amp, unfused safety switch for AC power input into the 28 vdc power supply unit.

23. Motor Generator Disconnect Switch: 30 amp, unfused safety switch for the AC power input into the motor generator unit.

24. Spare J Box

25. Drinking Fountain

26. MD-2 Motor Generator (400 Cycle)

27. Control Cabinet Fan Coil Unit: Contains three electric heating coils, one chilled water coil, and a 2 hp electric fan moter. Furnishes condioned air to launch control cabinets, checkout equipment (LSR), ARMA racks, and collimater equipment. Manually controlled from FTC #2, silo level #2.

28. Plenum: Air chamber for the control cabinet air conditioning system.

29. Emergency Missile Power Battery: This equipment supplements the normal 28 vdc power supply and distribution unit during countdown. Provides an emergency source of 28 vdc shutdown power in event normal DC power supply as a malfunction or an AC input voltage failure. Battery unit consists of 21 nickle-cadium alkaline cells mounted on wood trays. Each cell has an amp-hr rating of 240 amp-hr at the 8 hr rate to a cell voltage of 1.14 volts. Trickle charge from the main power supply (rectifier) will maintain the charging of the batteries. A test panel with a voltmeter, cell selector switch and a press-to-read switch will enable to check each individual cell.

30. Diesel Exhaust: Exhaust piping from levels 5 and 6.

32. Comm Box

33. Portable Fire Extinguisher

34. Fire Detector Head

35. P.A. Speaker

36. Emergency Lights

37. Fire Detector Head

38. GOX Vent Blast Closure: GOX from the missile boiloff valve through the duct on level 2 exhausts through the fan and 24" blast closure into the bottom of the fill and vent shaft.

39. Transformer Rectifier (28 VDC): Power supply component consists of a transformer rectifier assembly with required power input of 440 AC volts, 3 phase, 60 cycle. The output is 28 DC volts, 600 amp. A power distribution panel is mounted to the power supply unit. It contains the relays and terminals to switch and distribute rectified 28 vdc and/or battery DC to the ground support equipment and to the missile.

40. Main Utility Water Shutoff Valve Located on Silo Wall

41. Commerical Power Cable Entrance Throught Silo Wall

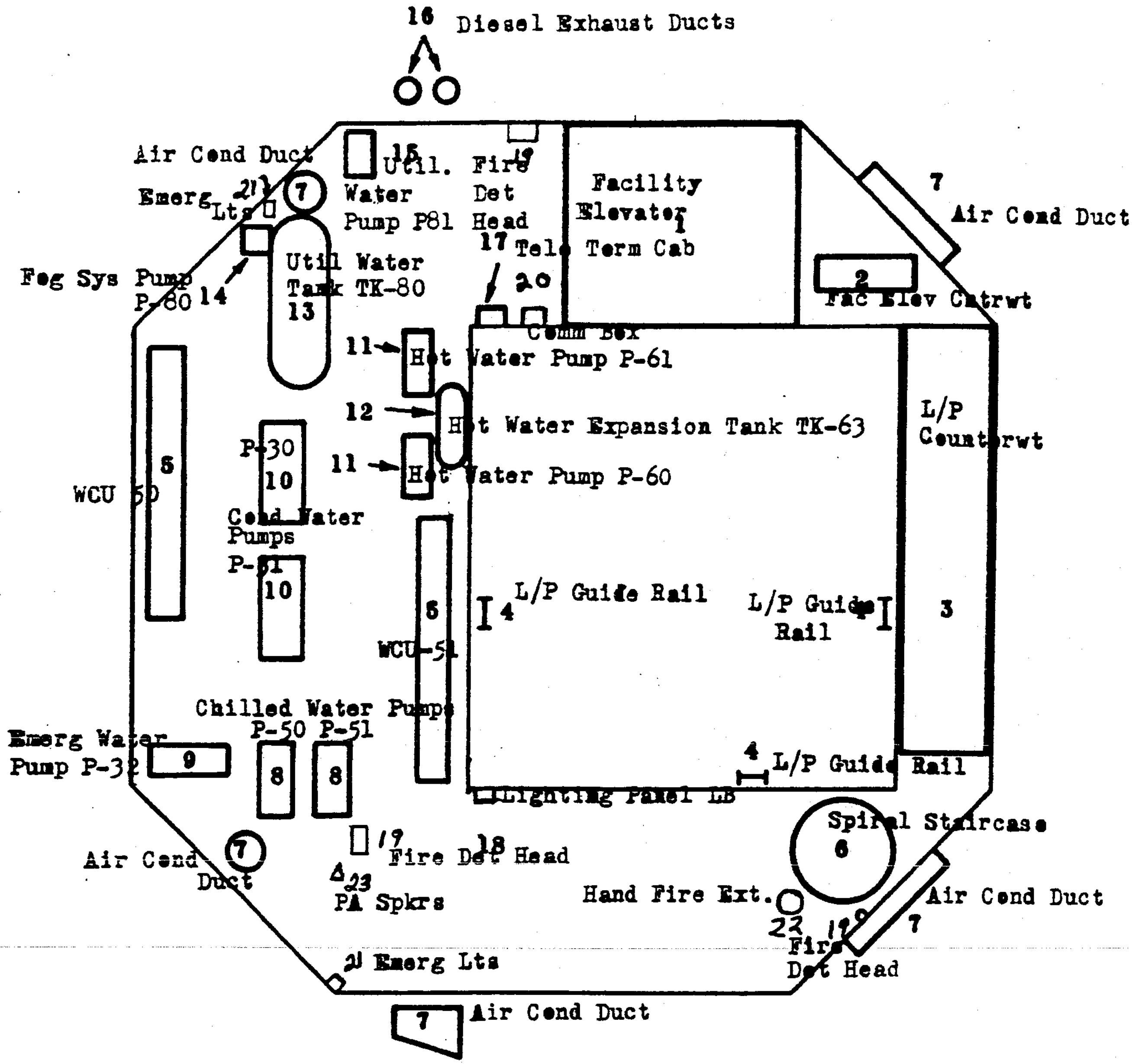
42. Telephone Terminal Cabinet

43. GOX Vent Blast Closure "J" Box

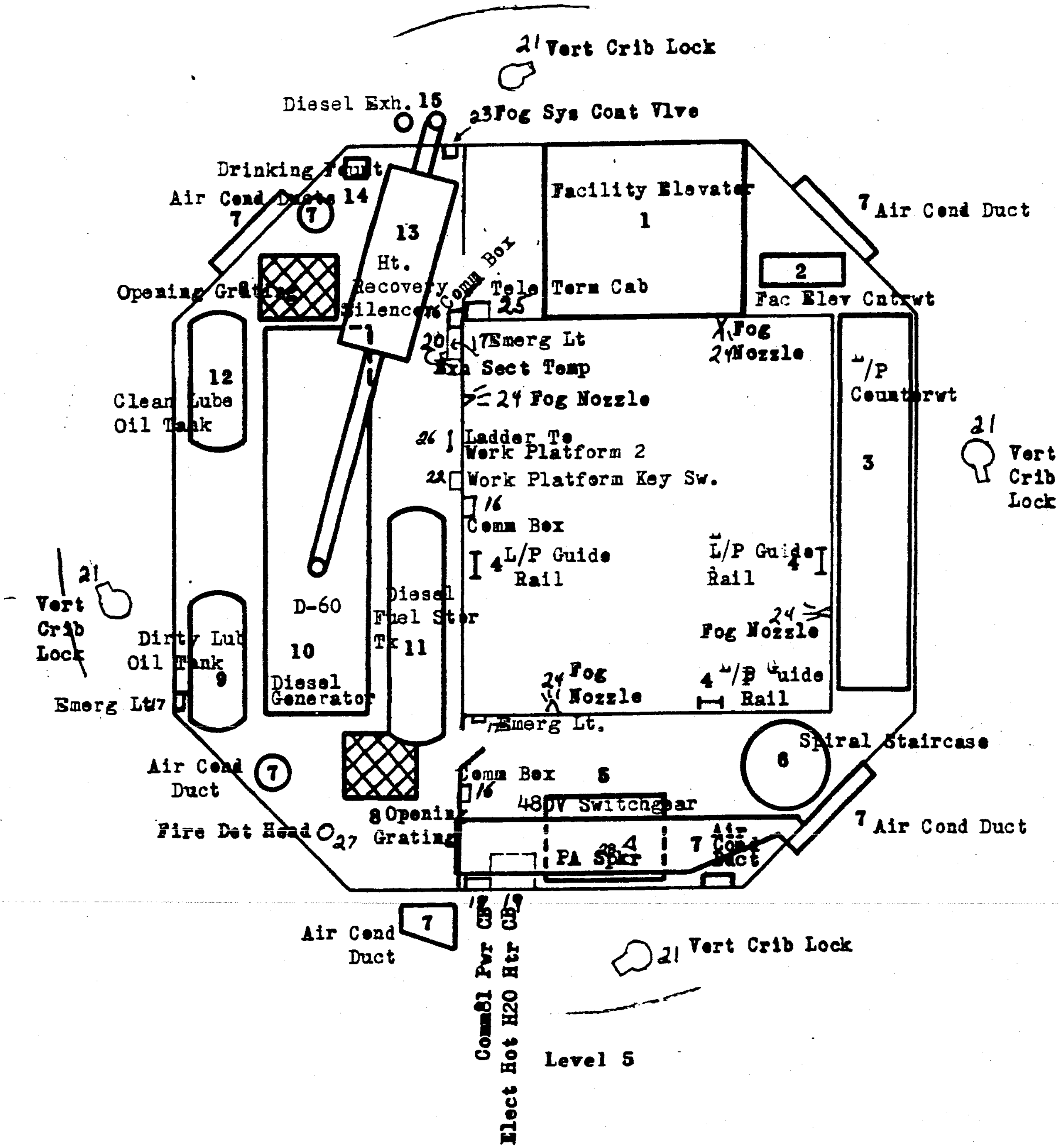
44. Cable Loop to Cap: Ref #22, page 1

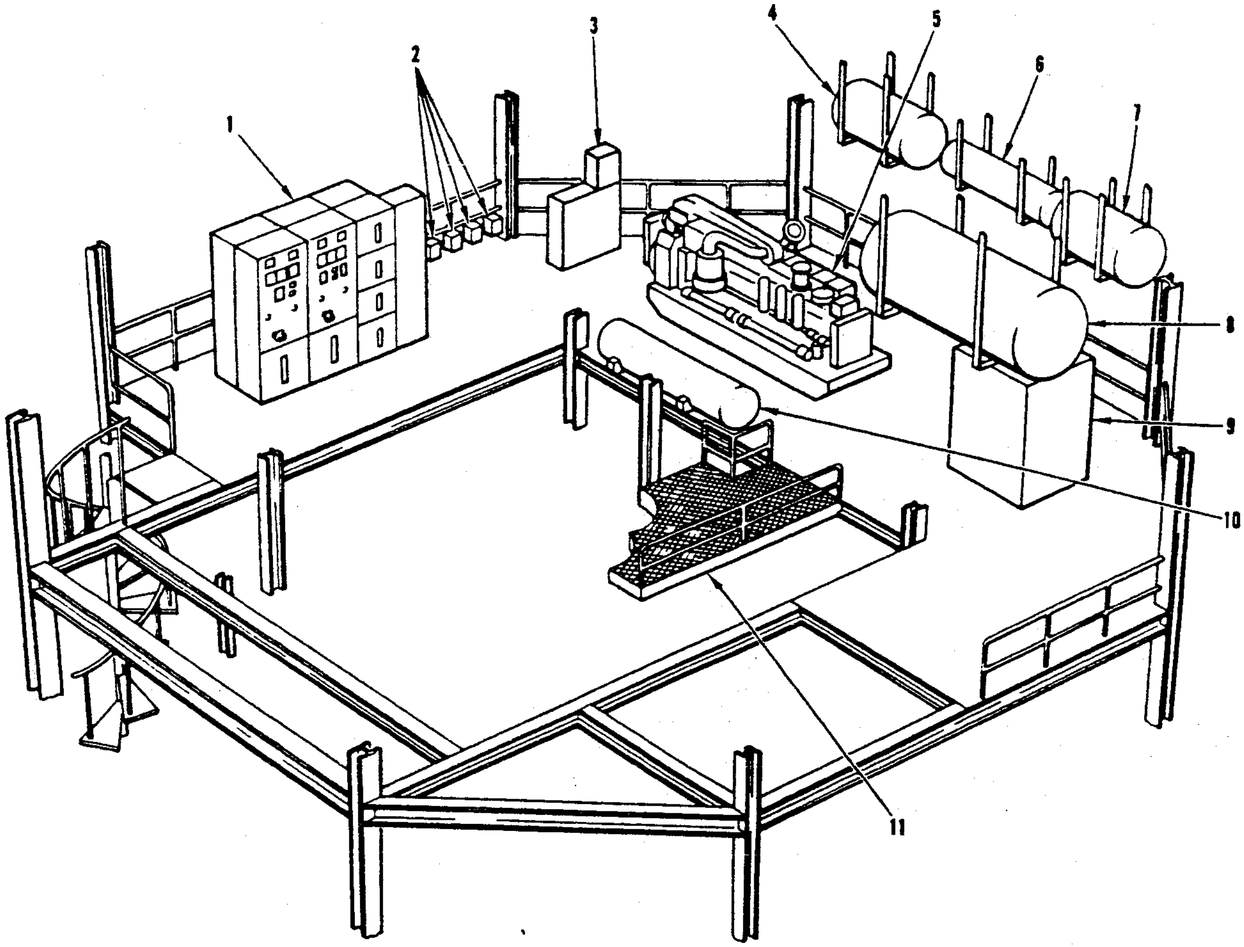
45. AMF "J" Box: For work Platforms.

46. Filter for Utility Water to Airwash Duct Collectors


16 Diesel Exhaust Ducts
Air Cond Duct
15 Util. Water Pump P81
19 Fire Det Head
Facility Elevator 1
7 Air Cond Duct
21 Emerg Lts
7
Fog Sys Pump P-80 14
Util Water Tank TK-80 13
17 Tele Term Cab
20
2 Fac Elev Catrwt
Comm Box
11 Hot Water Pump P-61
12 Hot Water Expansion Tank TK-63
L/P Countrwt
P-30 10
11 Hot Water Pump P-60
5
WCU 50
Cond Water Pumps
P-31 10
L/P Guide Rail 4
L/P Guide Rail 4
3
5 WCU-51
Chilled Water Pumps P-50 P-51
Emerg Water Pump P-32 9
8 8
4 L/P Guide Rail
Lighting Panel LB
Spiral Staircase 6
Air Cond Duct 7
19 Fire Det Head 18
23 PA Spkrs
Hand Fire Ext. 22
Air Cond Duct 7
19 Fire Det Head
21 Emerg Lts
7 Air Cond Duct

Level 4


Vert Crib Lock
Diesel Exh. 15
Fog Sys Cont Vlve
Drinking Fount
Air Cond Ducts 14
Facility Elevator
1
7 Air Cond Duct
13
Ht. Recovery Silencer
Comm Box
Tele Term Cab
2
Fac Elev Cntrwt
Opening Grating
Emerg Lt
Exh Sect Temp
Fog Nozzle
L/P Counterwt
12
Clean Lube Oil Tank
Ladder To Work Platform 2
Work Platform Key Sw.
3
Vert Crib Lock
Comm Box
L/P Guide Rail
D-60
Diesel Fuel Stor Tk 11
Dirty Lube Oil Tank 9
10 Diesel Generator
Emerg Lt
Emerg Lt.
Spiral Staircase
6
Air Cond Duct
Comm Box
5
480V Switchgear
7 Air Cond Duct
Fire Det Head
8 Opening Grating
PA Spkr
Air Cond Duct
Comm'l Pwr CB
Elect Hot H20 Htr CB
Level 5




LEVEL 5

1 480-VOLT SWITCHGEAR
2 INSTRUMENTATION BOXES (OSTF-2)
3 SURGE PROTECTION PANEL (EXCEPT OSTF-2)
4 DIRTY LUBE OIL TANK
5 500 KW DIESEL GENERATOR
6 AIR RECEIVER (OSTF-2)
7 CLEAN LUBE OIL TANK
8 HEAT RECOVERY SILENCER
9 WATER HEATER (OSTF-2)
10 DIESEL DAY TANK
11 WORK PLATFORM 2

40.10-118A

Figure 1-25. Silo Level 5 Equipment Location

## SILO LEVEL 5

1. Facility Elevator

2. Facility Elevator Counterweights

3. Launcher Platform Counterweights

4. Launcher Platform Guide Rails

5. 480V Diesel Switchgear: This unit receives the 440 vac, 3 phase, 60 cycle produced by the diesel generators. From the circuit breakers, which have protective trip breakers for undervoltage or overcurrent loads, the electrical power is distributed to the essential motor control center, nonessential motor control center, missile lift (L/P) motor control center and the launch control center. Operation of this switchgear can be locally controlled or partially remotely controlled from the launch control center.

6. Circular Stairs

7. Air Conditioning Ducts

8. Opening Grating

9. Dirty Lube Oil Tank (Overhead): Dirty lube oil from the two diesel generators is pumped into this tank. The tank capacity is 348 gal, size is 3 ft diameter by 7 ft length.

10. Diesel Generator (#60): The diesel engine is a model 40, manufactured by White Diesel Engine Division, Springfield, Ohio. It is a heavy duty, vertical, multicylinder, solid injection full diesel type. The electrical power unit is a roller bearing synchronous generator, manufactured by the Ideal Electric and Manufacturing Company. Specifications are: kw 440, dva 550, volts 480/277, amp 662, rpm 720, temperature 50°C, continuous duty, 3 phase, 4 wire, 60 cycles.

11. Diesel Fuel Storage Tank (Overhead): Stores adequate diesel fuel for one day operation. Capacity is 665 gal. Fuel oil from external underground tank of 15,300 gal is drawn continuously in a topping process to maintain the silo storage tank in a full capacity.

12. Clean Lube Oil Tank (Overhead): Provides clean lube oil to the two diesel generators. Capacity is 348 gal, size is 3 ft diameter by 7 ft length.

13. Heat Recovery Silencer: Designed as a muffler silencer for the diesel exhaust gases and also has a heat recovery unit. The heat recovery unit has coils in the silencer for heating of demineralized water which is circulated to the launch control center, thrust section heat coil and the air conditioning units.

Drinking Water

Diesel Exhaust

16. Comm Box

17. Emergency Light (6 Volts)

18. Commercial Power Circ Breaker

19. Electric Hot Water Heater Circuit Breakers

20. Exhaust Section Temperature

21. Vertical Crib Locks (4 Ea): Locks the crib to the silo wall by removing the spring tension on each odd numbered suspension spring. See page 66, item B and diagram on page 63.

22. Work Platform Key Switch

23. Fog System Control Valve

24. Fog Nozzles (4 Each)

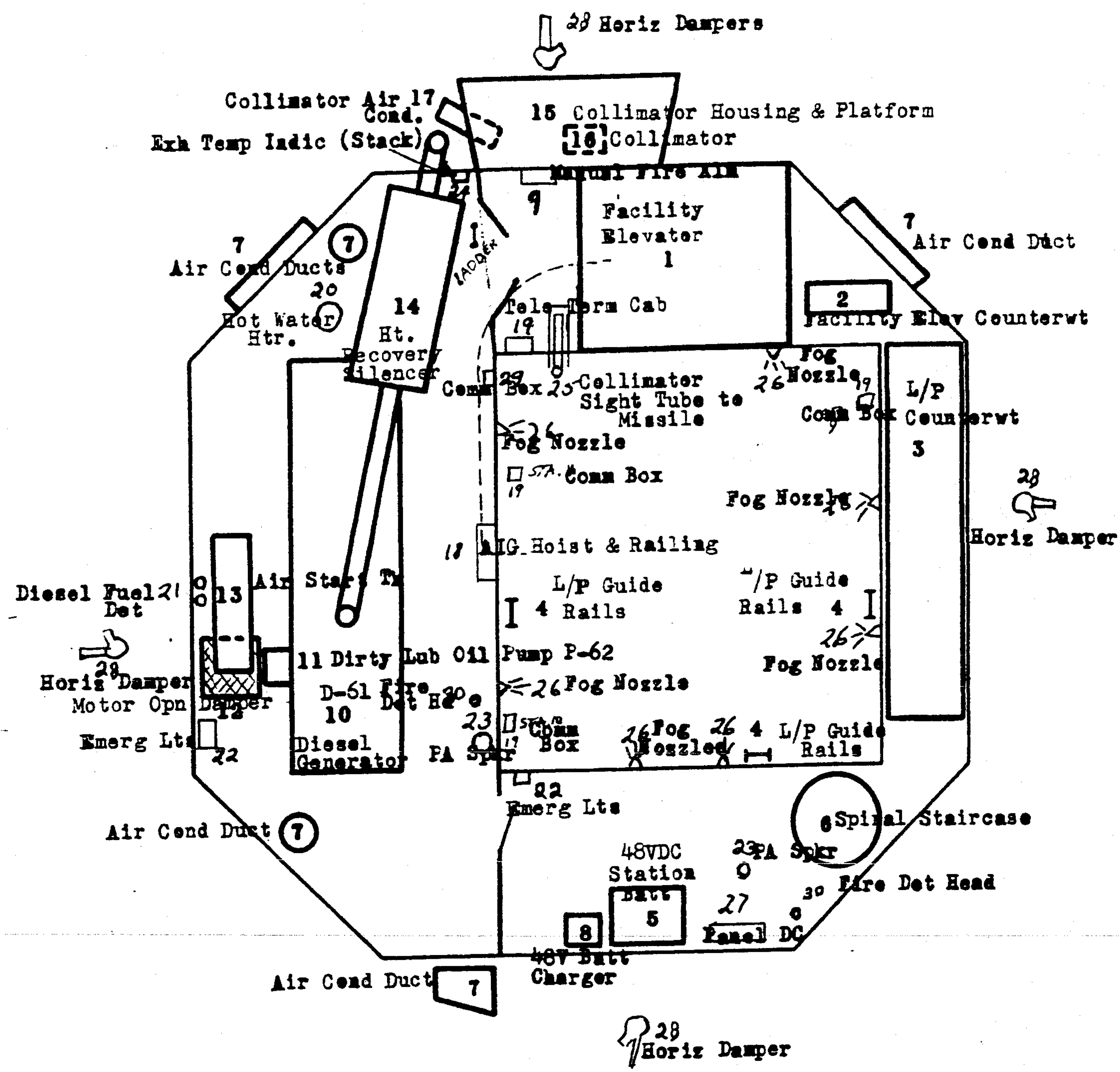
NOTE: Water Fog System pressure supplied by the fog system pump on level 4. Pump rated at 500 GPM. Fog System turned on manually at the FRCP in the LCC.

25. Telephone Terminal Cabinet

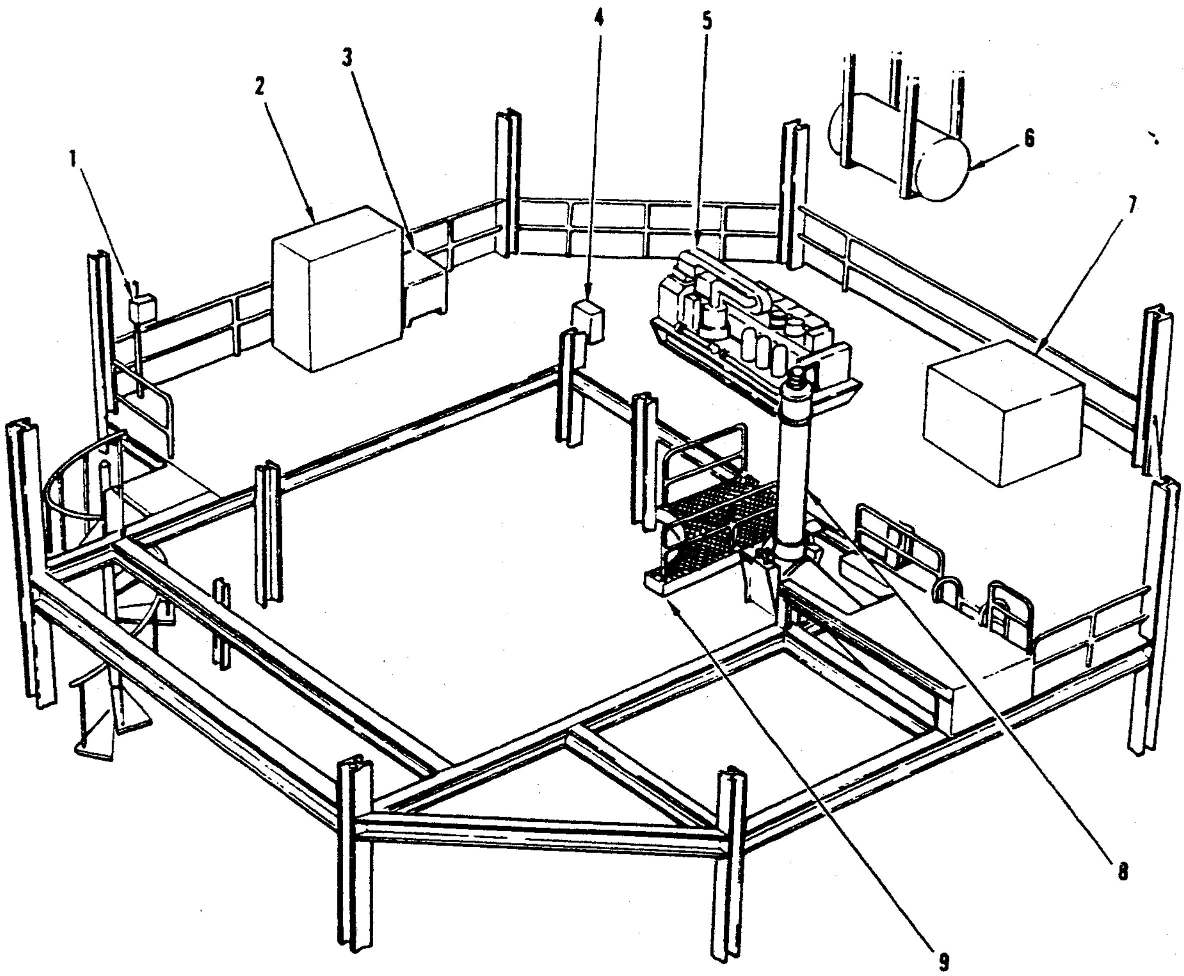
26. Ladder to Work Platform #2

27. Fire Detector Head

28. P.A. Speaker


28 Horiz Dampers
Collimator Air 17 Cond.
15 Collimator Housing & Platform
16 Collimator
Exh Temp Indic (Stack)
Manual Fire Alm
9
Facility Elevator 1
7 Air Cond Duct
7 Air Cond Ducts
7
20 Hot Water Htr.
14 Ht. Recovery Silencer
Ladder
Tele-Term Cab
19
2 Facility Elev Counterwt
Comm Box
25 Collimator Sight Tube to Missile
26 Fog Nozzle
19 Comm Box
L/P Counterwt 3
26 Fog Nozzle
Comm Box
19
Fog Nozzle 26
28 Horiz Damper
18 AIG Hoist & Railing
Diesel Fuel 21 Det
13
Air Start Tk
L/P Guide 4 Rails
L/P Guide Rails 4
28 Horiz Damper
Motor Opn Damper
12
11 Dirty Lub Oil Pump P-62
26 Fog Nozzle
D-61 10 Diesel Generator
Fire Det Hd 30
26 Fog Nozzle
Emerg Lts 22
23 PA Spkr
17 Comm Box
26 Fog Nozzles 26
4 L/P Guide Rails
22 Emerg Lts
Air Cond Duct 7
6 Spiral Staircase
48VDC Station Batt 5
23 PA Spkr
30 Fire Det Head
27 Panel DC
8 48V Batt Charger
Air Cond Duct 7
28 Horiz Damper

Level 6




1 48-VOLT DC DISTRIBUTION PANEL
2 48-VOLT BATTERY RACK
3 48-VOLT BATTERY CHARGER
4 INTERCONNECTING JUNCTION BOX (VAFB)
5 500 KW DIESEL GENERATOR
6 AIR RECEIVER
7 WATER HEATER
8 ALIGNMENT GROUP SIGHT TUBE
9 WORK PLATFORM

40.10-122

Figure 1-27. Silo Level 6 Equipment Location (Typical)

## SILO LEVEL 6

1. [illegible]ator
2. Facility Elevator Counterweights
3. Launcher Platform Counterweights
4. Launcher Platform Guide Rails
5. 48 VDC Station Battery: Provides 48 vdc power to the 480v diesel switchgear to trip the air circuit breakers and to operate the diesel engine controls. Battery is a 24 cell, wet, NICAD type, rated as 80 Amp/hr.
6. Circular Stairs
7. Air Conditioning Duct
8. 48 VDC Battery Charger: Transformer rectifier to charge the 48 vdc station battery. Receives electrical power 440 vac from the essential motor control center.
9. Manual Fire Alarm
10. Diesel Generator (#61): Same as Item 10, level 5.
11. Dirty Lube Oil Pump (#62): The pump will transfer the dirty lube oil from the lube oil sump of the two diesel engines to the dirty lube oil storage tank. The pump will also transfer dirty lube oil from the storage tank to a discharge at the top of the silo. Pump design is a rotary gear type with a capacity of 20 gpm.
12. Motor Operation Damper Below Grating: Grating opening is 36 by 36 in. square with air outlet capacity of 17,500 cfm. Damper is controlled by pneumatic motor operation through the air conditioning system.
13. Air Start Tank (Overhead): Provides air pressure for starting of the two diesel engines. Air pressure of 300 psi is supplied by the instrument air prefab. The air start tank is 2 ft in diameter by 7½ ft length.
14. Heat Recovery Silencer: Same as item 13, level 5.
15. Collimator Housing and Platform: The collimator enclosure is an insulated room which houses the collimator, collumator support platform, and bench mark supports (Fig 19). This room is fastened to the silo between the sixth and seventh levels and houses the operational and maintenance personnel for the collimator system. The enclosure is provided with a positive-action, self-closing door and is caulked and insulated to maintain a constant internal temperature level. A handrail is provided around the collimator platform for personnel and equipment safety.

[illegible] located approximately 8 ft above the level 7 of [illegible] A ladder is provided to give personnel safe and [illegible] access to the enclosure.

The collimator support platform is a 3 ft 6 in. diameter plate which supports the collimator rigidly. The supporting structure of the platform fastens to a steel plate mounted on the wall of the silo. Two bench mark supports are housed in the collimator enclosure. The supporting structures fasten to facility-furnished steel plates mounted on the wall of the silo.

1[illegible]. Collimator: The collimator sight tube provides an optically unobstructed path for a beam of light to transmit data from the collimator to the missile. The tube is constructed of 10.75 in. diameter aluminum tubing coated on the inside to reduce light diffraction. Neoprene boots and sleeve joints are installed at each end of the tube. These boots and joints preserve alignment adjoining structures. The tube is constructed in two section; one section is fixed, the other is movable. The fixed section is fastened to the crib structure with two adjustable fittings. These fittings allow minor adjustments in alignment. One end of the fixed section is provided with an adjustable, flexible connection with the collimator enclosure. The other end of this section mates with the hinged end of the movable section of the tube.

The movable section is fastened to the structure by a hinge. A seal fitting on the lower end of the movable section mates with a similar fitting on the fixed section when the tube is in operating position. The upper end of the movable section is coupled to the missile through a sleeve coupling, neoprene boot, and another sleeve coupling. This upper sleeve has a ½ in. thick neoprene gasket that mates and provides a soft contact with the skin of the B2 pod. The upper sleeve is also provided with a bar that acts as a window-hook fastener to keep the tube locked to the B2 pod.

The collimator sight tube retraction mechanism consists of a 190 lb counterweight. Upward movement of the missile causes the windowhook fastener to release and the movable section of the tube to swing upward through an arc of approximately 64 degrees to stowed possition. In stowed position there is a 2 in. minimum clearance between the sight tube and the launcher platform. A detent equipped with a neoprene bumper provides shock absorption and prevents tube rebound from the stowed position. This arrangement allows one man manual extension of the collimator tube to operating position.

Signal devices consisting of 28 vdc microswitches signal the position of the movable section of the collimator tube to the missile launcher lift control.

In order to align the collimator in reference to the polaris star, a sight tube is necessary. From level 904 ft 3 in. a 10 in. outside diameter pipe is inserted in the silo wall at a 4° degree angle. This piping extends in a straight line to the surface, approximately 100 ft, where the top end is protected by a manhole type cover. At the top and bottom of this pipe, glass plates are installed and sealed, and a vacuum is induced in order to prevent refraction effects on the collimator.

17. Collimator Air Conditioning: One 6 in. air conditioning duct which is insulated, tees off at the bottom of collimator housing and enters into the bottom of the housing at two ports. The temperature in the collimator must be maintained at 70°F ± 3°, 65% relative humidity maximum.

18. AIG Hoist and Rail

19. Telephone Terminal Cabinet

20. Hot Water Heater

21. Diesel Fuel Detector

22. Emergency Lights (6 Volt)

23. P.A. Speaker

24. Exhaust Temperature Indicator (Stack)

25. Collimator Sight Tube to Missile

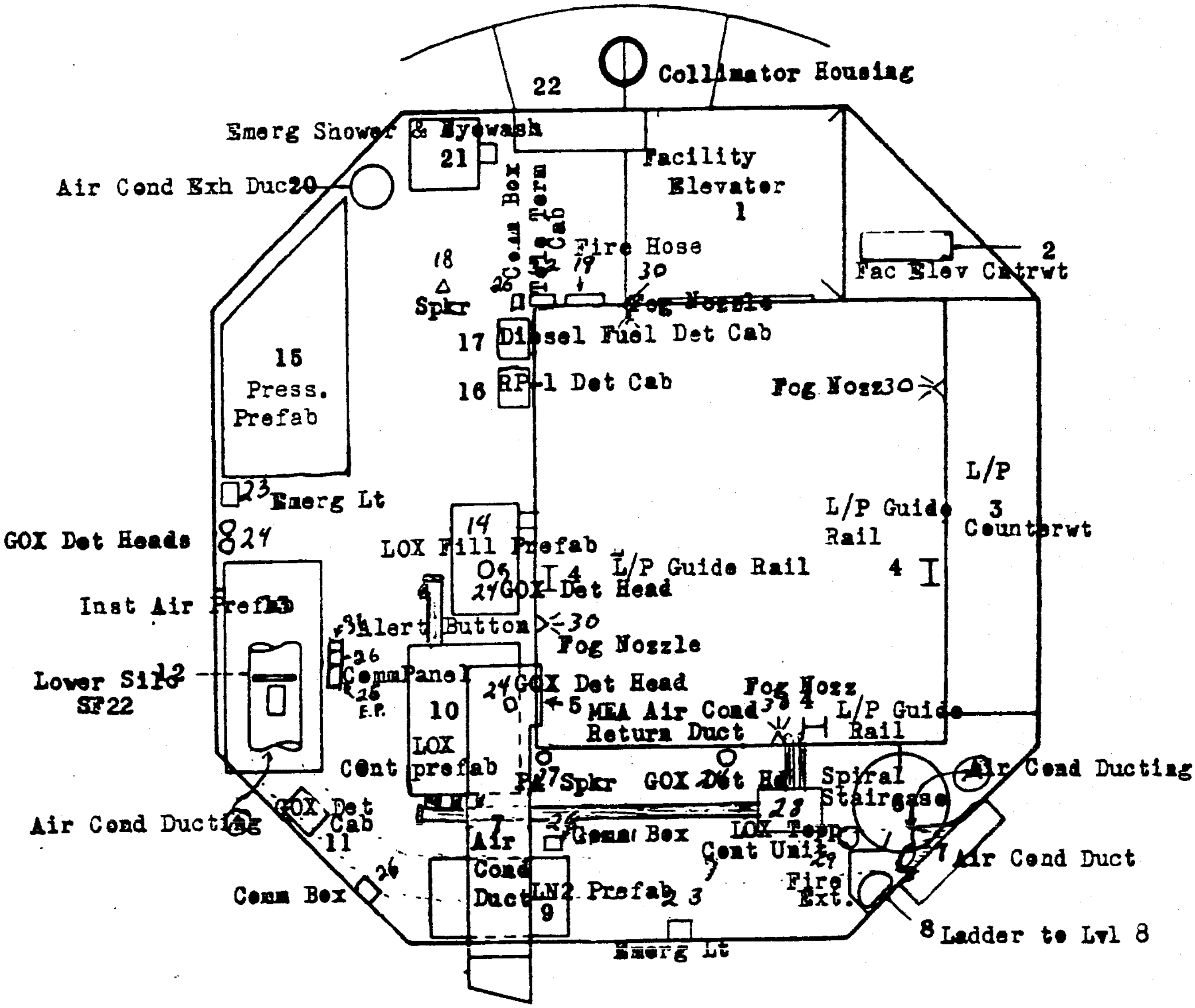
26. Fog Nozzles (8 Each)

27. Panel DC: 48VDC distribution panel contains 4 ea circuit breakers; diesel #60, diesel #61, 480 V switchgear and spare.

28. Horizontal Dampers (4 ea)

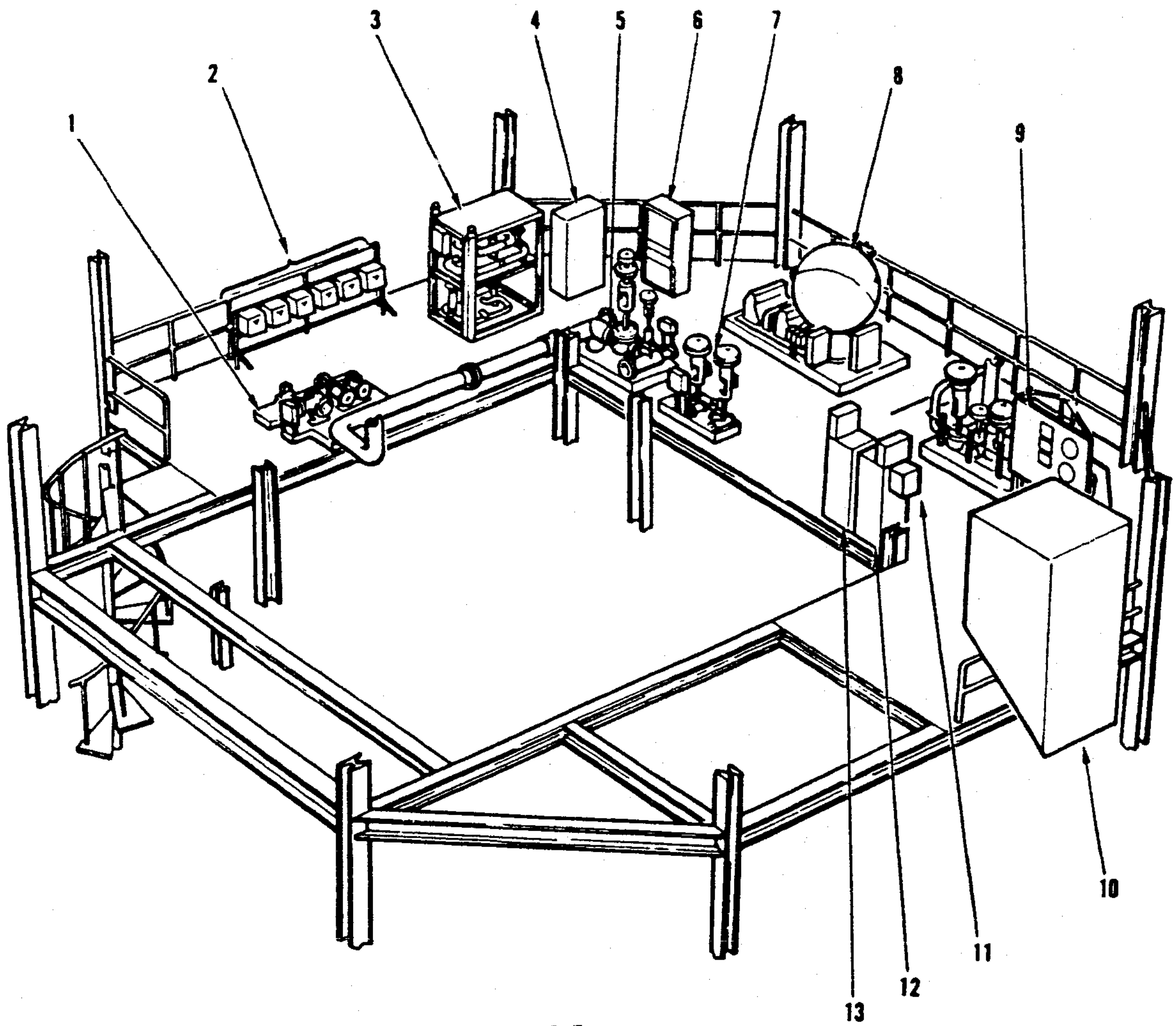
29. Comm Box

30. Fire Detector Head



Collimator Housing
22
Emerg Shower & Eyewash
21
Air Cond Exh Duct 20
Facility Elevator
1
Comm Box
Term Cab
Fire Hose
19
30
2
Fac Elev Cntrwt
18
Spkr
Fog Nozzle
17 Diesel Fuel Det Cab
15
Press. Prefab
16 RP-1 Det Cab
Fog Nozz 30
L/P
23 Emerg Lt
L/P Guide Rail
3
Counterwt
GOX Det Heads
24
14
LOX Fill Prefab
L/P Guide Rail
4
GOX Det Head
Inst Air Prefab
13
Alert Button
30
Fog Nozzle
Lower Silo SF22
12
26
Comm Panel
GOX Det Head
5
Fog Nozz
MEA Air Cond Return Duct
L/P Guide Rail
E.P.
10
LOX
Cont prefab
27 Spkr
GOX Det Hd
Spiral Staircase
Air Cond Ducting
Air Cond Ducting
GOX Det Cab
11
28
Air Cond Duct
Comm Box
LOX Temp Cont Unit
Fire Ext.
7
Comm Box
LN2 Prefab
9
Air Cond Duct
8 Ladder to Lvl 8
Emerg Lt


Level 7




1 $LO_2$ TOPPING CONTROL UNIT
2 INSTRUMENTATION BOXES (OSTF-2)
3 $LN_2$ PREFAB
4 GASEOUS OXYGEN DETECTOR
5 $LO_2$ CONTROL PREFAB
6 GASEOUS OXYGEN DETECTOR
7 $LO_2$ FILL PREFAB
8 INSTRUMENT AIR PREFAB
9 PRESSURIZATION PREFAB
10 ALIGNMENT GROUP ENCLOSURE
ALIGNMENT GROUP
BENCH MARKS
11 FIRE X CONTROL PANEL (VAFB)
12 DIESEL FUEL VAPOR DETECTOR
13 RP-1 DETECTOR

40.10-67(57G D/E)A

Figure 1-34. Silo Level 7 Equipment Location

# [illegible] LEVEL 7

1. [illegible]

2. [illegible] Elevator Counterweights

3. Launcher Platform Counterweights

4. Launcher Platform Guide Rails

5. Missile Enclosure Area Air Conditioning Return Duct: Acts as an air return to the missile [illegible] area from the fan coil unit FC-40 on silo level 2 for recirculation to the missile enclosure area.

6. Circular Stairs: End of the circular stairs at this level.

7. Air Conditioning Duct

8. Ladder: Vertical ladder extending downward to level 8.

9. Liquid Nitrogen Prefab: Unit contains the necessary sequence valves which are manually controlled to fill the liquid nitrogen storage tank and heat exchanger. During countdown, liquid nitrogen is directed through auto valves into the prefab to flow in the coax pipe (PN2/He) in order to maintain a cold temperature of the helium flow and to fill the LN2/He shrounds on the missile.

10. Liquid Oxygen Control Prefab: Unit contains the necessary valves and components to filter and control the flow of liquid oxygen from the storage tank to the missile. It contains the valves to provide rapid and fine loading of the missile during countdown. It also has the control of flow for draining the missile.

11. Gaseous Oxygen Detector Cabinet: Detector Contains the necessary electronic equipment and oxygen-analyzer to detect the oxygen atmosphere in the crib and launch platform areas. When the oxygen content goes below 19% or above 25% by volume, the detector unit will initiate audible and visible alarms in the silo area and to the facilities remote control panel in the launch control center.

12. Lower Silo Supply Fan (Overhead)SF22: Electric driven fan directs 17,500 cfm of air from diesel generator area on the 6th level to lower part of silo. Open grating between level 5 and 6 allow air to be drawn from level 5. Operates in conjunction with SF20 and SF21. Shuts off automatically when diesel vapor reaches 10% LEL.

13. Instrument Air Prefab: The unit contains two air compressors with capacity of 15 SCFM flow, 1500 psig output. The unit has a 65 SCFM spherical air receiver and contains the necessary valves, filters and air dryers. Purpose of the unit is to compress, store and deliver clean

[illegible] to pneumatically operated valves, cont- [illegible] the silo and LCC. An alarm indication on [illegible] will occur when receiver tank pressure drops to [illegible] applications: silo instrument air, LCC suspension, diesel start and blast closures.

14. Liquid Oxygen Fill Prefab: A unit that contains necessary valves to control, during resupply, the flow of liquid oxygen to the storage tank and topping tank in the crib assembly.

15. Pressurization Prefab: A unit which controls and distributes gaseous nitrogen to the following subsystems:

   a. Resupply of nitrogen and charging of the three gaseous nitrogen storage tanks. (4000 PSI)

   b. Liquid oxygen storage tank and topping tank for transfer flow to the missile.

   c. Nitrogen control unit on the launch platform.

   d. Pneumatic distribution unit. (PDU)

   e. GN2 storage bottle in the fuel prefab for fuel transfer to the missile. (4000 PSI)

16. RP-1 Detector Cabinet: Storing missile fuel (RP-1) in the missile tank makes the area inside the missile enclosure hazardous when contaminated by fuel fumes. An explosive vapor detection system initiates audible and visible alarms in the missile enclosure area and at the FRCP panel in the LCC when predetermined lower limit explosive levels are reached. High rate air purging at the 20% fume concentration level is automatic and continues until 40% LEL is reached. When 40% LEL is reached the purge cycle stops and the water fog system is manually activated. At 20% LEL the silo telephone system is deenergized to reduce explosion hazards. The 20% and 40% LEL alarm indications are located on the trouble section of the FRCP and on the RP-1 detector unit. Fog system "ON" "OFF" push buttons and indicator lights are located on the control section of the FRCP.

17. Diesel Fuel Dectector Cabinet: Contains electronic equipment and hydrocarbon-analyzer for detecting concentration of diesel fuel vapors. When a 10% concentration of diesel fuel vapor is indicated at the detector unit, circuitry will stop lower silo supply fan SF-22, close volume damper VD-21 (ceiling of silo level 7), and open volume damper VD-31 on main silo exhaust fan EF-30 (silo level 2). At 20% concentration of diesel vapors the above purge cycle continues and an audible and visual alarm will be initiated at the FRCP in the LCC.

18. Speaker

19. Fire Hose

20. Air Conditioning Exhaust Duct: A 28 in, duct, routing exhaust air from the launch platform area at level 8 to the exhaust plenum chamber at level 2.

21. Emergency Shower and Eye Wash

22. Collimator Housing: Described in item 15, level 6.

23. Emergency Light (6 Volts)

24. GOX Detector Heads

25. Communications Panel for Fueling/Defueling: Sta 36 (E.P.)

26. Comm Box

27. P.A. Speaker

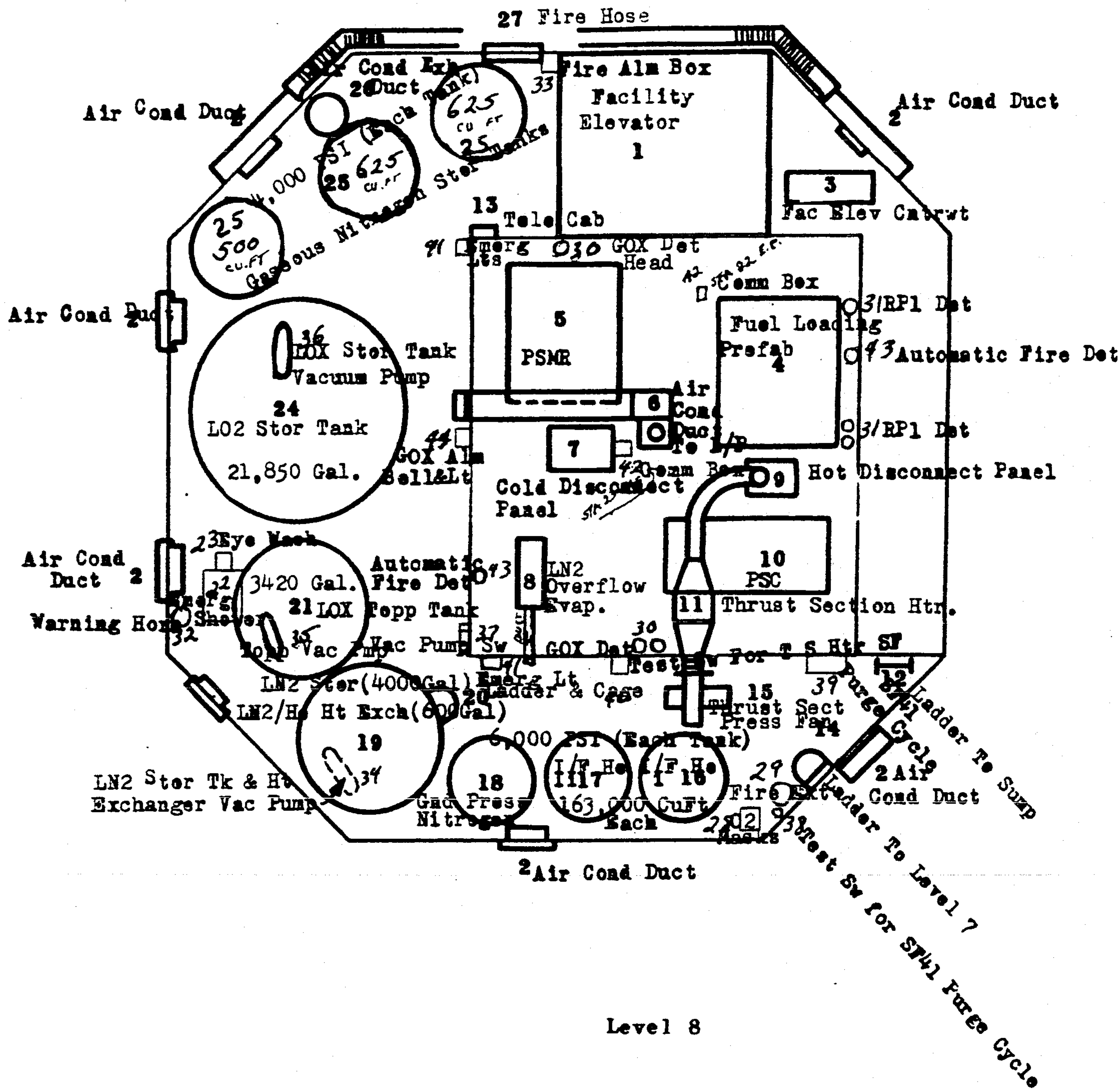
28. LOX Topping Control Unit: Controls the rate of LOX topping during countdown. Also performs LOX line drain.

29. Fire Extinguisher

30. Fog Nozzles (4 Each)

31. Alert Button

32. Telephone Terminal Cabinet


27 Fire Hose
Fire Alm Box
Facility
Elevator
1
Air Cond Duct
2
3
Fac Elev Catwalk
13
Tele Cab
GOX Det
Head
Comm Box
3/RP1 Det
Fuel Loading
Prefab
4
43 Automatic Fire Det
5
PSMR
6
Air
Cond
Duct
To L/P
7
Comm Box
9
Hot Disconnect Panel
Cold Disconnect
Panel
10
PSC
11
Thrust Section Htr.
8
LN2
Overflow
Evap.
GOX Det
Test Sw For T S Htr
SF
12
15
Thrust Sect
Press Fan
14
Ladder To Sump
Purge Cycle
2 Air
Cond Duct
Ladder To Level 7
Test Sw for SF41 Purge Cycle
Fire Ext
Masks
2 Air Cond Duct
6,000 PSI (Each Tank)
I/F He 17
I/F He 16
163,000 CuFt
Each
18
Gas Press
Nitrogen
19
LN2 Stor Tk & Ht
Exchanger Vac Pump
LN2/He Ht Exch (600 Gal)
LN2 Stor (4000 Gal)
Emerg Lt
Ladder & Cage
20
Air Cond
Duct
2
Warning Horn
Emerg
Shower
Eye Wash
3420 Gal.
21 LOX
Topp Tank
Topp Vac Pump
Automatic
Fire Det
Vac Pump Sw
24
L02 Stor Tank
21,850 Gal.
LOX Stor Tank
Vacuum Pump
GOX Alm
Bell&Lt
Air Cond Duct
2
Air Cond Duct
2
Air Cond Exh
26 Duct
6,000 PSI (Each Tank)
Gaseous Nitrogen Stor Tanks
25
500
CU.FT
25
625
CU.FT
625
CU FT
25
Emerg
Lts
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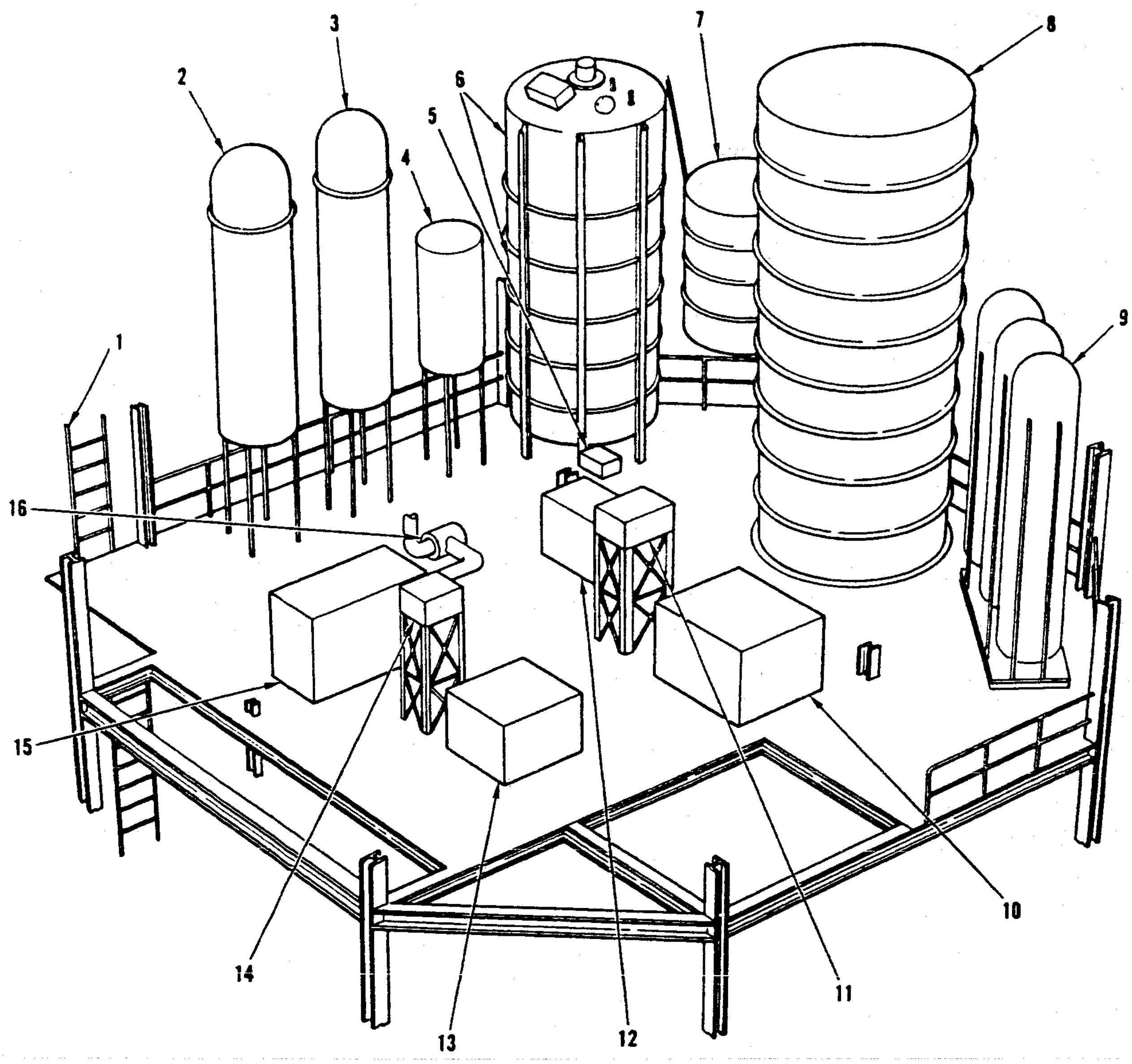
Level 8




LEVEL 8

1 LADDER TO LEVEL 7
2 INFLIGHT HELIUM SUPPLY TANK NO. 1
3 INFLIGHT HELIUM SUPPLY TANK NO. 2
4 GROUND PRESSURIZATION SUPPLY TANK
5 VACUUM PUMP
6 $LN_2$ STORAGE TANK AND HEAT EXCHANGER
7 $LO_2$ TOPPING TANK
8 $LO_2$ STORAGE TANK
9 GASEOUS NITROGEN TANKS
10 PNEUMATIC SYSTEM MANIFOLD REGULATOR
11 COLD DISCONNECT PANEL
12 $LN_2$ EVAPORATOR
13 FUEL PREFAB
14 HOT DISCONNECT PANEL
15 PRESSURE SYSTEM CONTROL
16 THRUST SECTION HEATER

40.10-68(576D/E)B

Figure 1-32. Silo Level 8 Equipment Location

## SILO LEVEL 8

1. Facility Elevator

2. Air Conditioning Ducting: Ducting for intake and exhaust air distribution is routed at the bottom of the crib, and also inter-connected to the enclosed launch platform area.

3. Facility Elevator Counterweight

4. Fuel Loading Prefab: Loading, topping and unloading the missile fuel tank is controlled by the prefab. It is an enclosed unit, having a fuel storage tank with capacity of 630 gal, gaseous nitrogen supply pressure tank, filter and necessary valves. Included is a 10 hp fuel pump used for draining the missile fuel tank.

5. Pressure System Manifold Regulator (Pressurization Distribution Unit): Remotely and semiautomatically controls and flow of helium and gaseous nitrogen and inst. air from storage vessels to other AGE equipment within the silo. The unit provides stable requlated pressure under both static and dynamic pressure conditions. It consists of the following system; helium flow control and regulating, helium emergency, helium charge, gaseous nitrogen pressurization and emergency instrument air. During standby provides GN2 to PCU for missile tank pressure. During C/D it provides He for missile tank pressure.

6. Air Conditioning Duct To Launch Platform: A rectangular ducting, which has a quick disconnect at the launch platform, is then routed downward to go underneath level 8 flooring and into the main air exhaust duct. The complete ducting, until connected to main air exhaust ducting, is insulated against heat loss. This ducting carries the heated exhaust air from the pod air conditioning unit.

7. Cold Disconnect Panel: Contains the lower half of riseoff connections which supply the following services to the launch platform; missile LO2 and fuel tank pressurization, helium pressurization line to one unshrouded sphere, helium to HCU and GN2 to NCU when L/P is down and locked.

8. Liquid Nitrogen Overflow Evaporator: The evaporator is a tank which collects the overflow of liquid nitrogen or gaseous nitrogen from the LN2/helium shrouds during countdown. Thereon, the liquid nitrogen boils off into a gaseous state and vents into silo level 8, quad III, Vapors are picked up and exhausted by exhaust fan EF41 in sump. The evaporator tank is fabricated of aluminum alloy.

9. Hot Disconnect Panel: Contains the lower half of riseoff connections which supplies RP-1 fuel and the thrust section heat to the launch platform.

10. Pressurization Control Unit (PCU): The PCU automatically and manually controls the pressures in the propellant tanks of the missile during all phases of operation. During standby, the PCU will maintain pressurization of missile tanks with gaseous nitrogen. This unit also has an emergency system for backup in maintaining missile pressurization.

NOTE: When PCU is in emergency, missile tank pressures can be maintained only from the LCC by means of the raise/lower buttons on the launch officers console.

11. Thrust Section Heater: This unit provides hot air, 145°F to 200°F into the thrust section of the missile during loading procedures of liquid oxygen and liquid nitrogen. The heater receives hot water from the two diesel heat recovery silencers and also an electric heat coil is used to heat the air to be blown through the ducting into the thrust section. The complete unit is insulated in order to maintain temperature control in the launch platform area.

12. Ladder (down from level 8): Vertical ladder from level 8 to the bottom of the silo.

13. Telephone Cabinet

14. Ladder (up to level 7): Vertical ladder with cage from level 8 to level 7.

15. Thrust Section Pressure Fan: Electric Operated fan (blower) to force ambient air through the heating coil section, where the air is heated and forced into the thrust section of missile. Capacity of the fan is 1000 cfm.

16. Inflight Helium I

17. Inflight Helium II: Two high pressure helium storage tanks are manifolded, so that either tank can be selected to provide pressurization. These tanks furnish helium for the spheres on the missile, to the missile propellant tanks during countdown, and for emergency pressurization of missile tanks during standby or countdown. Capacity per tank is 250 cu ft water volume, storing 163,000 scf of helium at 6000 psi.

18. Ground Pressurization Nitrogen (6000 PSI): Consists of one high pressure gaseous nitrogen storage tank. Provides nitrogen to the pressurization control unit for maintaining pressurization of the missile propellant tanks during standby status. It also provides nitrogen to the pneumatic distribution unit for pressurizing the hydraulic accumulator rack for opening the silo doors. Quad III

[illegible] gas is chilled in this exchange [illegible] immersed in liquid nitrogen. [illegible] loops. Each loop is 70 ft long and the [illegible] piping. The ends of the loops are mani- [illegible] piping is coaxial type with [illegible] center piping which is surrounded by liquid nitr- [illegible] outer piping. The coaxial piping is routed to the missile shrouds and spheres. The liquid nitrogen unit is a crygonic constr- [illegible] vessel, with a capacity of 600 gal. It is mounted above the liq- [illegible] nitrogen storage tank.

[illegible]. LN2 Storage Tank (below). This tank provides liquid nitrogen to the coaxial piping and thereon into the missile shrouds. The storage tank is vertically installed and it has a capacity of 4000 gal.

20. Ladder and Cage: Vertical ladder mounted to the LN2 storage tank extending to the top of the LN2/He heat exchanger. A work platform is provided at the top of the LN2 storage tank.

21. LO2 Topping Tank: During countdown, this tank will top off the missile oxidizer tank due to LO2 boiloff losses and for losses during hold periods. It is installed in a vertical position. It is a crygonic type vessel, with water volume capacity of 3600 gal. The normal LO2 capacity is 3420 gal which allows for ullage.

22. Emergency Shower

23. Eye Wash

24. LO2 Storage Tank: It is the main liquid oxygen storage tank for serv- icing the missile oxidizer tank and is installed in a vertical posit- ion. It is a crygonic type vessel, with a water volume of 23,000 gal. The normal LO2 capacity is 21,850 gal which allows for ullage.

25. Gaseous Nitrogen Storage Tanks: Stores adaquate supply of gaseous nitrogen to pressure transfer LO2 and LN2 to the Missile. Consists of three vertical mounted vissels. The two 625 scf tanks are used for the liquid oxygen transfer system. The remaining 500 scf tank is used to provide liquid nitrogen transfer pressure to LN2 storage tank and GN2 pressure to the nitrogen control unit on the launch platform. This tank also provides backup pressure for the instrument air preian sys- tem. The tanks have 1750 cubic feet of water volume total with press- urization at 4,000 PSI.

26. Air Conditioning Exhaust Duct: A 28 inch air exhaust duct into which two fan motors remove air from the launch platform area, route it thr- ough the exhaust duct to level 2, and force it into the exhaust shaft.

27. Fire Hose

28. Oxygen Masks

[illegible]

[illegible] [illegible] Detector

32. Warning Horn

33. Fire Alarm Box

34. [illegible] Storage Tank & Heat Exchanger Vacuum Pump: Located on floor.

35. LOX Topping Tank Vacuum Pump: Located on top of tank.

36. LOX Storage Tank Vacuum Pump: Located on top of tank.

37. Switches for Items 34, 35 and 36

38. Test Switch for SF-41 Supply Fan Purge Cycle

39. Supply Fan Purge Cycle SF-41: Purge supply fan will draw air from the silo area into the launcher platform enclosed area when the gas detector denotes there are hazardous air conditions in the shaftway. Also operates during a four minute purge cycle at start of C/D. Air flow is 10,000 CFM.

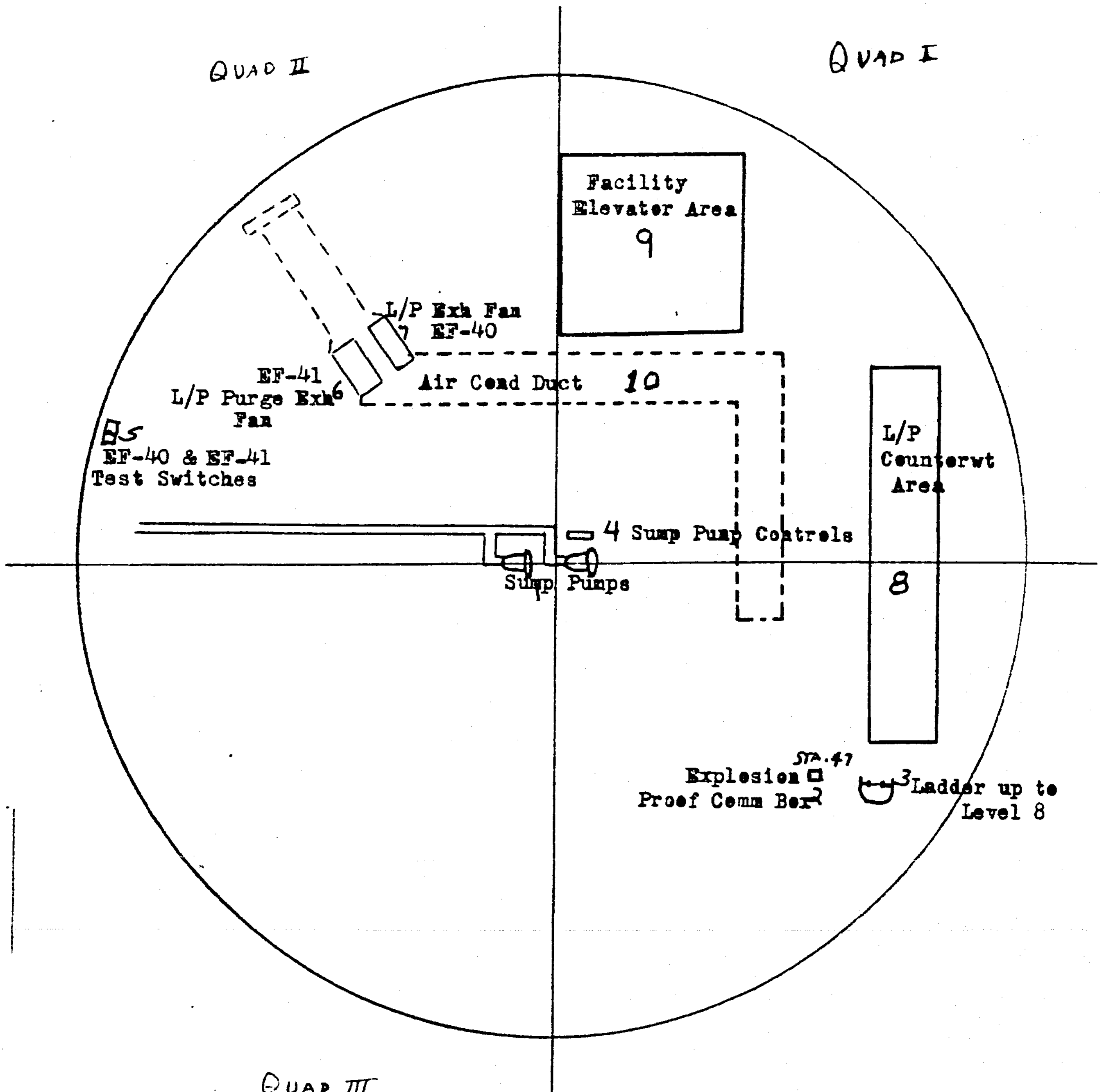
40. Test Switch for Thrust Section Heater Supply Fan

41. Emergency Light (6 Volts)

42. Comm Box

43. Automatic Fire Dectector

44. GOX Alarm Bell and Light


QUAD II
QUAD I
Facility
Elevator Area
9
L/P Exh Fan
7 EF-40
EF-41
L/P Purge Exh 6
Fan
Air Cond Duct 10
5
EF-40 & EF-41
Test Switches
L/P
Counterwt
Area
4 Sump Pump Controls
Sump Pumps
1
8
STA. 47
Explosion
Proof Comm Box 2
3 Ladder up to
Level 8
QUAD III
QUAD IV

SUMP LEVEL

## SILO SUMP

Sump Pumps: Two explosion proof submersion pumps, P-82 and P-83 are mounted in the Silo Sump. Each pump is rated at 7.5 hp and has a capacity of 100 GPM. Electrical power for the pumps is 480 VAC 3 phase current. The pumps are automatic in operation and are rotated in usage by means of a magnetic alternator to provide equal running time for each pump. Normally one pump will operate alone.

When the liquid level of the sump rises to 3' from the grating the first pump will start. When the liquid level rises to 1' 8" from the grating the second pump will cut in. If a malfunction occurs and the liquid level rises to within 1' 2" of the grating a high level alarm signal will be sent to the trouble section of the FRCP "Silo Sump Hi Level". All liquids discharged by the sump pumps are routed up the silo wall through the discharge line. The discharge line exits the silo through the concrete wall at crib level 2 and is routed to a catch basin outside the silo at grade level.

2. Comm Box: Explosion proof.

3. Ladder

4. Sump Pump Controls

5. EF-40 and EF-41 Test Switches

6. EF-41 Launcher Platform Purge Exhaust Fan: Exhaust fan EF-41 is electrically innerlocked with EF-40. EF-41 is normally deenergized. It will be energized to operate during the following conditions:

   A. RP-1 vapor concentration 20% LEL.

   B. At start of countdown (signal start of LN2 fill). EF-41 is powered by a 7.5 hp electric motor operating on 480 VAC 60 cycle 3 phase current. EF-41 has capacity of 13,000 CFM which is exhausted up through the main exhaust fan (EF-30) on level 2 and out of the silo. Operation of EF-41 opens Volume Damper VD-42 which signals the FRCP of the purge condition ("RP-1 fire fog system damper open" - Red Light).

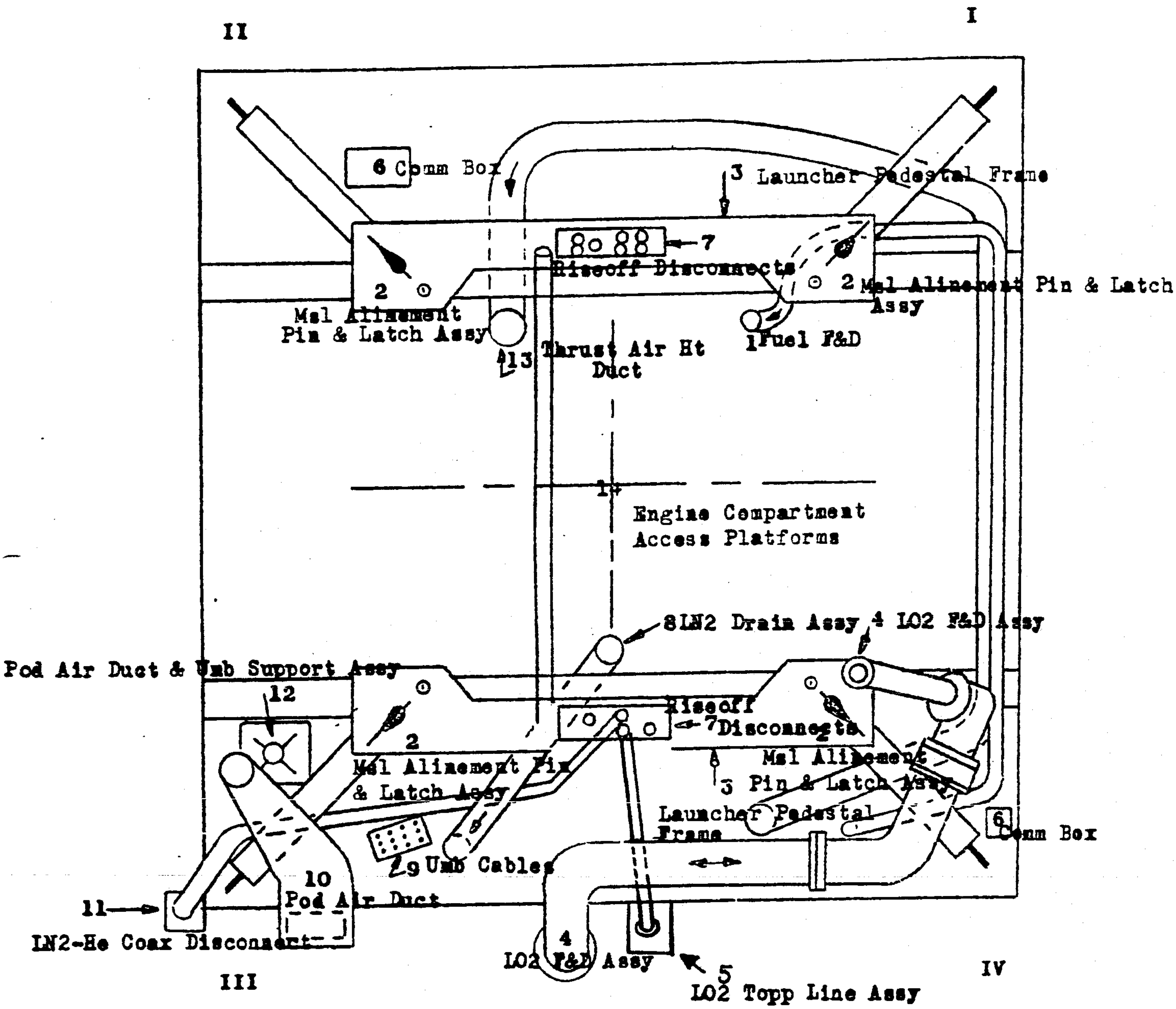
7. EF-40 Launcher Platform Exhaust Fan: Exhaust fan EF-40 is electrically innerlocked with EF-41. Only one fan will operate at a time. EF-40 will operate normally exhausting air from the launcher platform area at a rate of 3,000 CFM. The fan motor is rated at 2 hp and operates on 480 VAC 60 cycle 3 phase current. Air is exhausted identically as EF-41.

NOTE: A fire thermostat (FST-41) is located at the inlet side of the two exhaust fans and senses inlet temperature. When inlet temp. exceeds 125°F. Each fan will be deenergized.

8. [illegible] Center

9. [illegible] Elevator Area

10. Air Conditioning Duck




1st Level - Elevation 1015 ft 4 in.

Launcher Platform Equipment Location (Level 1)

1. Fuel Fill and Drain: The fuel fill-and-drain line is a 4 in. piping routed from the hot disconnect panel (level 4) to a ground fuel-and-drain valve located on the launcher pedestal in quad I.

2. Missile Alignment Pin and Latch Assembly: Four alignment pins are installed on a box housing support mounted to the launcher pedestal. The pins have length of approximately 2 3/8 in. protruding into the female connector of the missile. Two of the round pins have squared off sides mounted in quads I and II. The standard round pins are mounted in quads III and IV. The four latches have a hook design which slides into the slots of the four main lognerons of the missile booster section. They are used to clamp down the missile to the launcher when the missile is not fueled. During normal standby with the missile fueled, these latches are removed.

3. Launcher Pedestal Frame: The frame assembly consisting of two welded structures, is mounted with one structure in quads I and II and the other in quads III and IV. The structures consist of welded, 8 in. steel piping in a rigid, vertical and tripon framework. Another steel box framework is mounted on top of this assembly. This framework contains the riseoff disconnect panels, alignment pins, and latches. The pedestal support in quad IV contains the one inch rise-off switch (MOS Switch).

4. LO2 Fill-and-Drain Assembly: The ground LO2 fill-and-drain valve is mounted in quad III. It mates with the other half of the disconnect valve on the crib when the launcher platform is in the lowered position. The LO2 inlet piping is 10 in. in diameter until it connects to the probe that enters the missile. This probe has a diameter of 8 in. The probe unit is mounted in a swivel unit at the lower section, which is pneumatically actuated to move outboard 28 degrees upon riseoff of the Missile.

5. LO2 Topping Line Assembly: The LO2 topping line assembly provides liquid oxygen to the propulsion assembly prior to engine start. The piping is 3.5 in diameter.

6. Comm Box

7. Riseoff Disconnect Panels: Two panels provide automatic cutoff of servicing of fluids at missile riseoff. The two panels on the pedestals are the lower half disconnects, which contain the female couplings.

[illegible] I and II contain the following outlet [illegible] right,

1. [illegible] pressurization to ambient spheres in missile (1)

2. [illegible] to shrouds (1)

3. Fuel tank pressurization line (1)

4. Hydraulic pressure lines to booster and sustainer/vernier engines (2)

5. Hydraulic return lines from the engines (2)

The other panel, located at quads III and IV, has the following outlet ports.

1. LO2 tank pressurization (1)

2. LO2 topping (1)

3. LN2 to shrouds (1)

4. Helium pressurization to the shrouded spheres

8. <u>LN2 Drain Assembly</u>: During countdown, liquid nitrogen is directed into the missile shrouds for cooling the helium gas. The LN2 overflow and its boiloff gases are routed through the drain piping assembly and from there into the LN2 evaporator unit. This line assembly on the launch pedestal is divided into two sections and then coverges into one main drain line. The drain line at quad II is 4 in. diameter steel turing routed across to quad III. It tees into the main drain line, which is 8 in. diameter aluminum alloy material.

9. <u>Missile Umbilical Cables</u>: The six missile umbilical cables are routed from the umbilical J box on level 2, to vertical racks, to level 1, and from there to the missile. B2 pod.

10. <u>Pod Air Conditioning Duct (Quad III)</u>: Cooled air is routed from the pod air conditioning unit on level 4 through a rectangular duct (inside dimension of 2 in. X 15 in.) to level 1, and from there it is routed in a tubular duct of 8 in. diameter. This tubular duct is clamped to a vertical support, and in the proximity of B-2 pod, it is divided into three separate flexible tubes that are then connected to the B-2 pod.

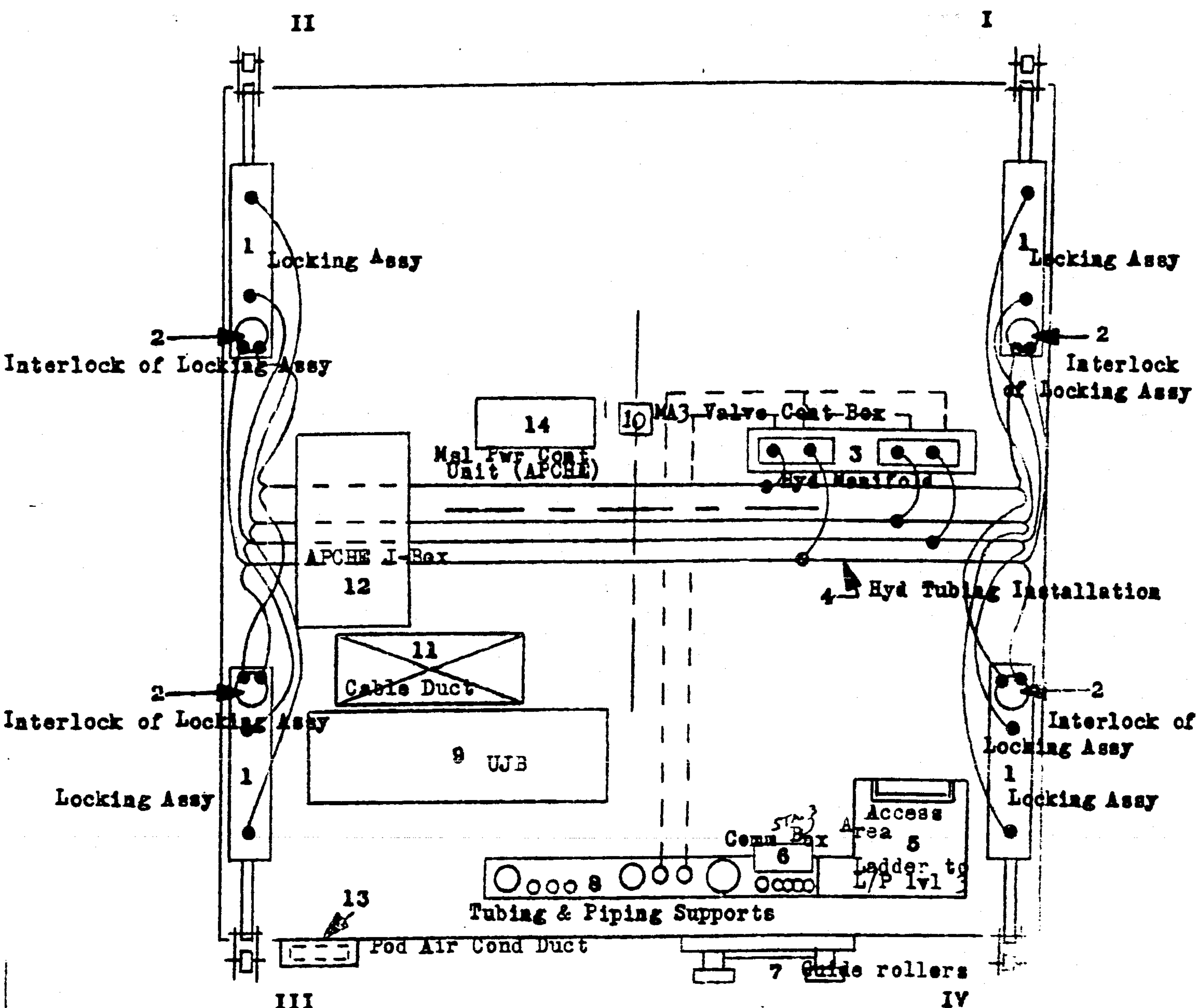
11. <u>LN2/He Coaxial Disconnect Panel</u>: The upper half of the quick-disconnect unit is mounted at the corner of quad III. This unit contains the female half of the quick disconnect. The mating unit, the male half, is mounted on the crib structure. The unit has spearate quick-disconnect valve for helium and for liquid nitrogen. The liquid nitrogen tees into the helium line and at this tee connection a coaxial tubing is

connected for helium to flow internal with liquid nitrogen surrounding it. This coaxial tubing is routed to the riseoff disconnect panel in quads III and IV.

12. Pod Air Duct and Umbilical Support Assembly: The pod air duct and umbilical support assembly is a tubular support of approximately 6.5 in. diameter by 12.5 ft length. It provides the support for clamping the pod air conditioning duct and the six missile umbilical cables. All of these cables are connected to the B-2 pod.

13. Thrust Air Heat Ducting: Heated air is routed from the thrust section heater on level 8 of the crib, through the hot disconnect panel of the launcher platform (level 4), upward to level 1 and into quad II of the launcher pedestal and missile. The duct is 8 in. in diameter and is insulated against heat loss.

14. Engine Compartment Access Platforms: [redacted]




2nd Level - Elevation 997 ft 4 3/4 in.

Launcher Platform Equipment Location (Level 2) [illegible] Each corner of this level has a hydraulic actuator [illegible] assembly for locking the launcher platform to the crib structure [illegible] cap. The rod end of the actuator has an attached guide roller assembly. This assembly consists of two rollers mounted in vertical plates. The upper roller follows an arc of the tapered rail mounted to the crib and pulls the lower roller into locking position as it hits the upper and lower striker plate. The four lock actuators are to be in rigid locked position within 5 sec after the platform is in full-raised or full-lowered position.

2. Interlock of Locking Assembly: Above each actuator locking assembly, there is at 90 degrees an additional mounted hydraulic actuator unit. The rod end is attached to a wedge. When the locking assembly piston rod has moved out to the rigid locked position, this interlock unit positions its wedge in down movement and locks the main piston rod from retracting. The interlock unit positions its wedge lock within 1 sec.

3. Hydraulic Manifold: The hydraulic manifold receives its main source of hydraulic pressure from the crib hydraulic equipment. By electric solenoid valves it distributes hydraulic pressure to the locking and interlock assemblies for locking or unlocking the launcher platform to the crib.

4. Hydraulic Tubing Installation: Stainless steel tubing is routed from the hydraulic manifold to the proximity of the locking actuators. From there, flexible hoses are attached from the tubing to the locking assemblies.

5. Access Area: An access area with a vertical ladder is provided to level 3.

6. Comm Box

7. Guide Rollers: On this level there is one large guide roller assembly. As the launcher platform rises to the full-up position, the rollers will rise over a small length rail tapered to an oversize I beam mounted to the silo cap. The tapered I beam is wedged between the rollers and aligns the launch platform to the silo.

8. Tubing and Piping Supports: Propellant gases, hydraulics, and heated air routed from level 4 to level 1 and into the missile. Reading from left to right the indentification of lines is:

   1. LN2 drain from missile shrouds (1)

   2. Helium pressurization of spheres in missile (3)

   3. LO2 topping to missile (1)

[illegible] assembly of launcher platform (2)

[illegible] air (1)

[illegible] HP [illegible] to missile or drain (1)

[illegible] Hydraulic pressure/return to booster and sustainer/vernier engines (4)

9. Umbilical J Box (A junction points for missile umbilical cables & launch control cables): This umbilical J box provides circuitry to the missile during standby and countdown from the AGE on the crib and the launch control center. During LSR checkout, it disconnects the missile and reroutes the circuitry to tie in the LSR and the logic units. When performing APCHE checkout of the missile, this unit provides ac and dc power to the missile power control unit (APCHE) (item 14, Fig 15). Cable connections at this J box are plug-in types for rapid replacement. The unit also houses an Arma (guidance) amplifier. The box enclosure is provided with cooling air from the pod air conditioning unit. The dimensions of this unit are 66 in. wide, 24 in. deep, and 80 in. high.

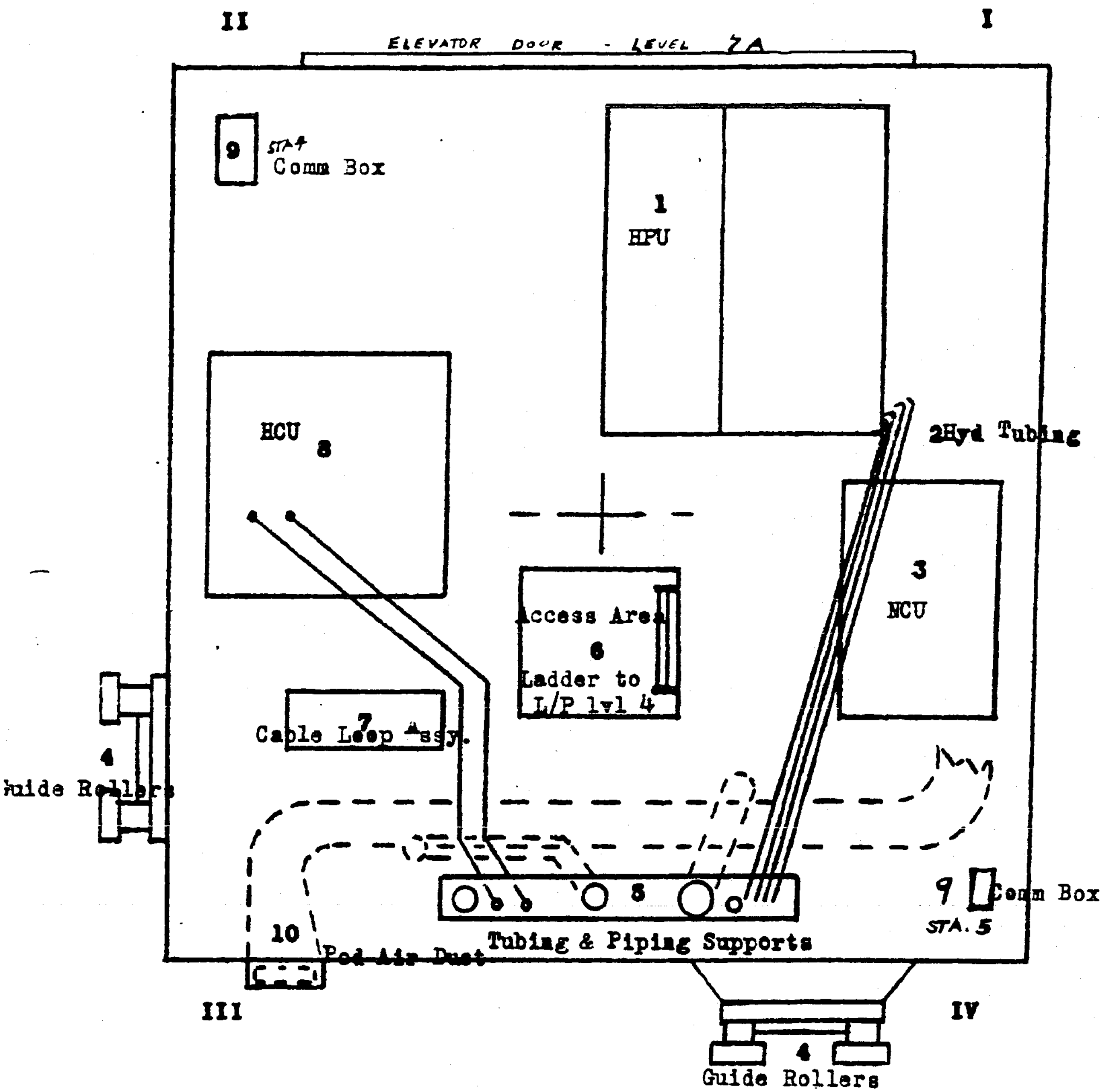
10. MA-3 Valve Control Box: The MA-3 valve control box receives 28 vdc power from the crib power distribution unit and command signals from the auto-pilot and signal control unit. Through relays, circuitry is directed when necessary to the booster, sustainer, and vernier engines for cut-off control.

11. Cable Duct: The cable duct is a ladder design on which electric cables are secured and supported. These cables are routed to various junction boxes and to the ground support equipment.

12. J Box (APCHE): This unit provides an interface for the MAPCHE trailer. It connects the trailer circuitry to the missile umbilical J box (item 9, Fig 15). Also dist power to MAPCHE, control monitors, PTS (DMU) and checkout equipment NOT incl. emer. 24VDC.

13. Pod Air Conditioning Duct: The pod air conditioning duct is insulated ducting that comes from the pod air conditioning unit on the fourth level and is routed to the missile.

14. Missile Power Control Unit (APCHE): This power control unit provides the necessary relays and receptacles for distribution of 400 cps and 28 vdc power to the missile and APCHE during APCHE checkout mode. Its power source is the power distribution boxes on level 3 of the crib assembly. Power is routed through the cable loop system to this unit. The dimensions are 24 in. long, 20 in. high, and 8 in. wide.




**3rd Level - Elevation 990 ft 1 1/16 in.**

**Launcher Platform Equipment Location (Level 3)**

1. Hydraulic Pumping Unit: The hydraulic pumping unit contains two independent hydraulic pumping systems in one common cabinet. The first stage system services the booster engine hydraulic system, and the second stage system services the sustainer/vernier engine hydraulic system. Each stage independently supports its system in the fill-and-bleed function and provides hydraulic pressure to its system. The first and second stages use a 20 gal common reservoir. Each hydraulic system contains a hydraulic pump with a capacity output of 3000 psig and 8 gpm flow, driven by a 30 hp, 400v, 3 phase electric motor. Standard components, such as filters, sight tubes, oil cooler, electric and hand-operated valves, restrictors, indicators, and relief valves, are in each system. The dimensions of the unit are: width, 5 ft; height, 5 ft; length, 6 ft; and weight, approximately 2,500 lb.

2. Hydraulic Tubing: Two hydraulic pressure and two return lines (one pair for booster and the other pair for the sustainer/vernier systems) are routed from the hydraulic pumping unit to the riseoff disconnect panels at level 1.

3. Nitrogen Control Unit (NCU): The NCU is an enclosed unit with necessary valves, regulators, and gages to regulate all nitrogen gas distribution to the missile and equipment on the launcher platform. Primarily, the unit is manually operated. Gaseous nitrogen is received from the crib storage and distribution units at an inlet pressure of 1200 to 4000 psig. It is then pressure regulated and distributed to the following:

    1. 1000 psig to engine service unit (checkout)
    2. 1000 psig to hydraulic pumping unit, item No. 1
    3. 0.1 psig to the J box (APCHE)
    4. 0.1 psig to the pod air conditioning unit

    Four additional outlets are provided, with each outlet having attached to it a 45 ft length of flexible hose. The hoses are mounted on reels in the unit. They are used for ground servicing in charging and purging the missile and launcher components. The dimensions of the NCU are: length, 4 ft; height, 5 ft; width, 3 ft; and weight, 1,500 lb.

4. Guide Rollers: Two large guide roller assemblies ride on a 17 in. wide I beam, with the beam positioned between the rollers. The guide rail and rollers minimize the lateral or tilting movement of the launcher platform. The rollers are 3.75 in. wide and 10.5 in. in diameter. The roller shaft is mounted in a roller bearing.

5. Tubing and Piping Supports (Item 8, level 2) (L/P)

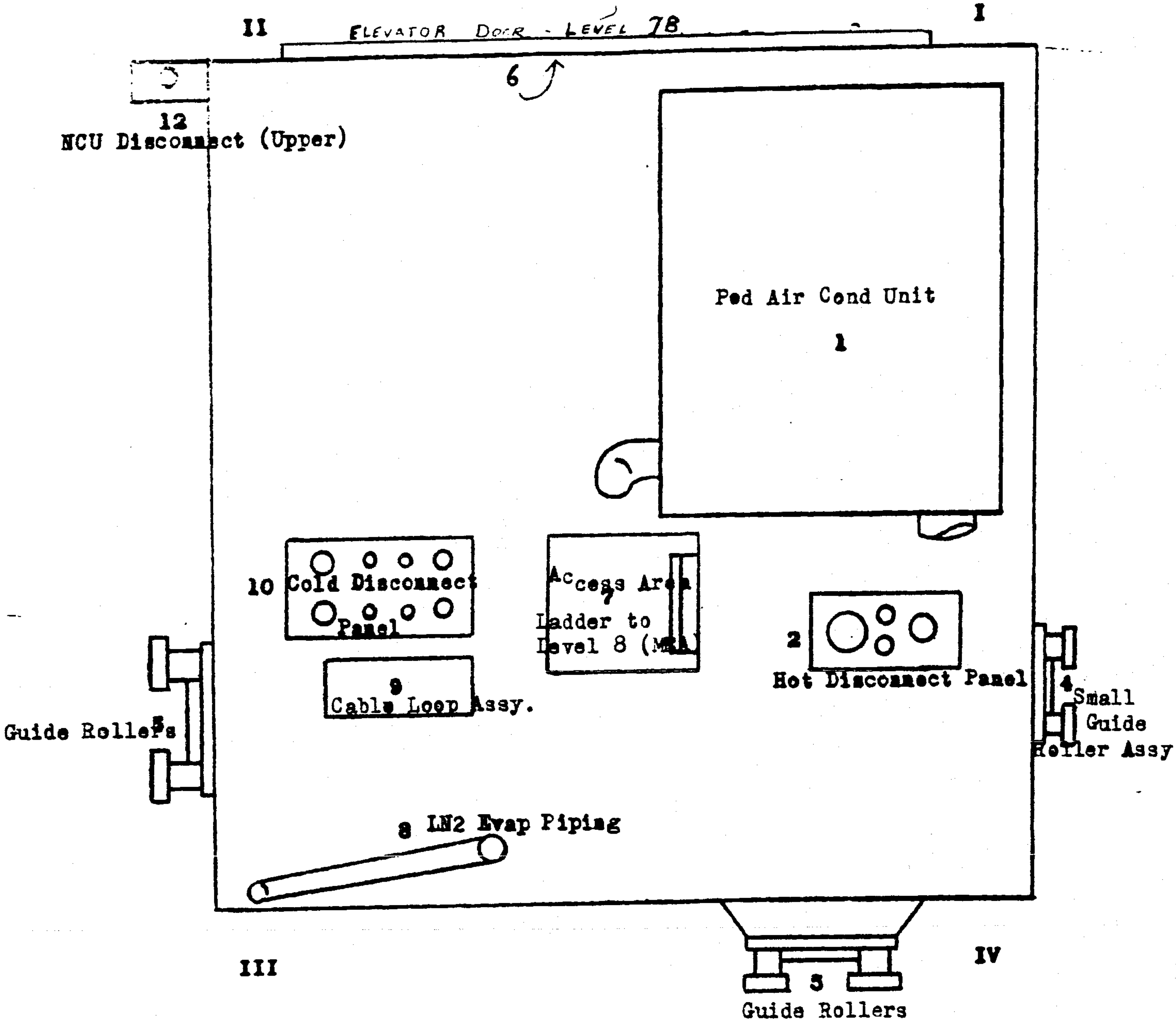
6. Access Area

7. Cable Loop Assembly (Item 9, level 4) (L/P)

8. Helium Charge Unit: When the launcher platform rises during tactical launch, this helium charge unit provides and continues the required pressurization of the missile. Two storage spheres are contained in this unit: One is a high-pressure sphere (6000 psi), and its controls maintain or relieve the required pressurization of the missile storage spheres during launching procedures. This sphere also provides emergency pressurization of the missile RP-1 tank. The second sphere, the low-pressure sphere (1000 psi), and its controls operate unit controllers in this assembly and sense variables of pressures. The unit is 60 in. square and weighs approximately 500 lb.

9. Comm Box

10. Pod Air Conditioning Duct: This is continuous duction from the missile and is routed underneath the level decking and into the pod air conditioning unit.




**4th Level - Elevation 976 ft 1 1/16 in.**

**Launcher Platform Equipment Location**

[illegible] Conditioning Unit: The pod air conditioning unit provides [illegible] cooled air to the missile pod, which contains the electronic equipment and circuitry requiring constant controlled temperature and humidity during checkout, standby and countdown. The required temperature is 40°F ± 3°, with maximum moisture content of 20 grains per pound of dry air, (Ref T.O. SM65F-2-30-1, page 1-1.) The major components enclosed in the unit are: dehumidifier, refrigeration, chilled water and expansion coils, blowers, filters, and necessary valves and controls. The unit is 8 ft square and 10 ft high and weighs approximately [illegible] lb.

2. Hot Disconnect Panel: The hot disconnect panel is the top half of the quick-disconnect panel. It mates to the lower half panel located on level 8 of the crib structure. The following subsystems are routed through this disconnect panel, reading the outlet ports right to left:

   1. RP-1 fuel (1)

   2. Thrust air heating line (1)

   The unit is 22 in. wide by 33.5 in. long.

4. Guide Roller Assembly: One small guide roller assembly rides on an I beam (10 in. wide with the beam positioned in between the rollers). The rollers are 2.5 in. wide and 7.5 in. in diameter, with their shaft mounted in a roller bearing.

5. Guide Roller Assembly (Same as item 4, level 3) L/P)

6. Elevator Door Level 7B

7. Access Area (An access area with a vertical ladder to the bottom of the crib, level 8)

8. LN2 Evaporator Piping: This piping routes the overflow of liquid nitrogen and its gases from the shrouds in the missile to a coupling located directly under the level decking. From there it is routed to the LN2 evaporator tank located on the crib, level 8.

9. Cable Loop Assembly: This cable loop assembly provides the necessary continuous circuitry and hydraulic pressure from the crib equipment to the launch platform equipment and missile. The cable consists of 63 electrical cables, 2 chilled water lines and 3 hydraulic lines secured and supported on 2 mount brackets. As they are routed upward in the launcher, the cables and lines are directed to their respective units for power and control.

[illegible] This is the top half of the quick-disconnect [illegible] to the lower half panel located on level 8 of the crib [illegible]. The following subsystems are routed through this panel, reading the outlet ports left to right:

a. [illegible] and fuel pressurization to missile lines (2)

b. GN2 to NCO when launcher platform is down and locked

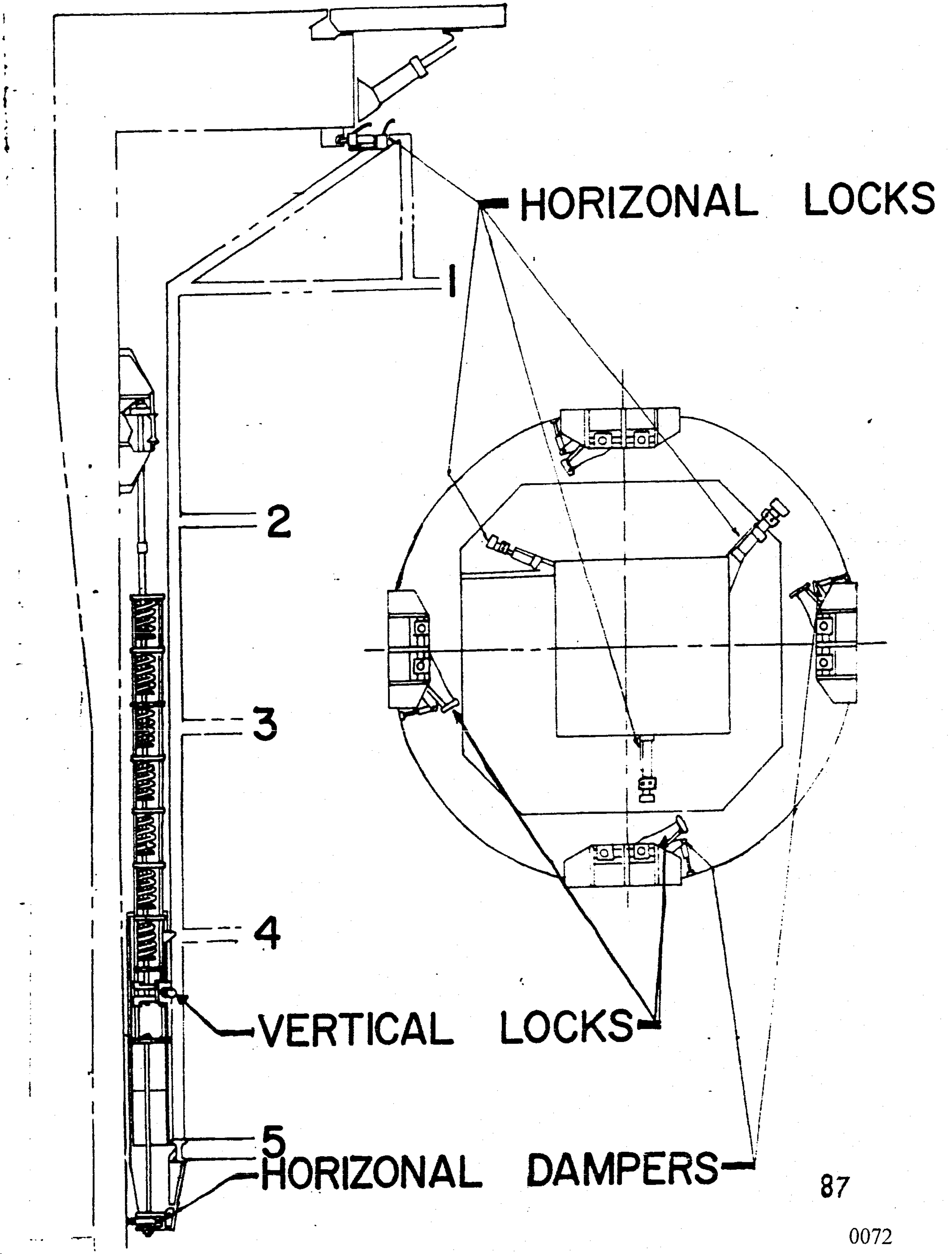
c. Helium missile controlline (1)

d. Helium to HCU

This panel is 27.5 in. wide and 45 in. long.

12. <u>NCU Disconnect (Upper)</u>: This is one-half of a quick-disconnect for receiving gaseous nitrogen from the crib storage equipment. The gaseous nitrogen pressurization is disconnected from the launcher to the crib on raising of the launcher at the cold disconnect panel. At the full-raised position, the upper NCU disconnect unit is connected to the other lower-half disconnect, which is mounted on the crib approximately 3 ft below crib level 1.

# CRIB LOCKING AND SUSPENSION SYSTEMS



## [illegible] EMERGENCY STRETCH SYSTEMS

A. Crib Suspension System Assembly: The crib suspension assembly provides for isolation of the crib and equipment, launcher platform and missile to minimize damage from ground shock. The suspension shock struts are mounted on the silo wall 90° apart at level 2 and are attatched to the crib at level 6. Each strut is 64' 2½" long and has 7 decks of springs, 3 sets of springs per deck. The suspension system will allow 1.45" of vertical travel.

B. Lock and Damper System Assembles:

1. A single vertical strut lock is mounted on the bottom of the 7th spring on each odd numbered suspension strut. Each lock consists of a hydraulic cylinder and fork lock that neutralizes the spring action of the strut and levels the crib.

2. Three horizontal crib locks are located 120° apart on the top level of the crib. Each lock has a hydraulic piston that exerts a force against a striker plate mounted to the silo cap and positions the crib center line. To the center line of the silo cap.

3. There are four friction type horizontal strut dampers, one mounted on the bottom of each shock strut assembly pair. The dampers exert a damping force of 200 lbs and allow 4" of horizontal crib travel.

C. Platforms: Missile Work Platforms are provided at four silo levels (2,5,5A & 6). In addition, a safety platform is located at silo level 1 and an engine compartment access platform is located on the launcher platform (at silo level 7 with the L/P down). These platforms are located so as to permit access to the missile for limited maintenance and service to support and house the missile stretch mechanism.

1. Work Platforms: Work platforms (w/p) 1,2,&3 are hydraulically retractable. Work platform 4 is mechanically linked to W/P 3. Hyd. pressure is supplied by the 40 hp motor driven pump, (Hyd. power pack) on crib level 2. The pump is started from either the Hyd. control panel on level 2 or the control station manual operating level panel on level 1. The W/P can be stopped and retracted at any point during the extend cycle, but they cannot be stopped or re-extended in the retract cycle until fully retracted.

A system of limit switches is utilized with the work platforms. These switches permit current flow to a light on the applicable level key switch panel to indicate that the platform on that level is extended, and by means of an interlock system to prevent motion of the L/P if any W/P is not fully retracted. Conversely, the interlock system prevents the extension of the work platforms when interference with the launcher platform would occur. The work platforms can be operated only when the L/P is in the fully down and locked position.

(a) [illegible] Three sections provide access for attach- [illegible], maintaining and servicing the re-entry vehicle. It also houses the stretch mechanism.

(b) W/P2 Silo Level 5. (Three feet above silo level 5). One section provides access to the upper section of the B-2 pod, containing the retro-rockects, missile inverter, exication transformer (U-4 Pkg), programmer (U-3 Pkg), filter servo amplifier (U-2 Pkg), programmer (U-3 Pkg), power changer over SW, rocket engine relay box, missile battery and propellant utilization system.

(c) W/P3 Silo Level 5A. (Eight feet above silo level 6). Five sections provide access to the vernier engines, B-1 pod and to the lower section of the B-2 pod, which contains the umbilical connections and the AIG platform, control and computer.

(d) W/P4 Silo level 6. Three sections provide access to the booster engine nacelles. Mechanically linked to W/P3.

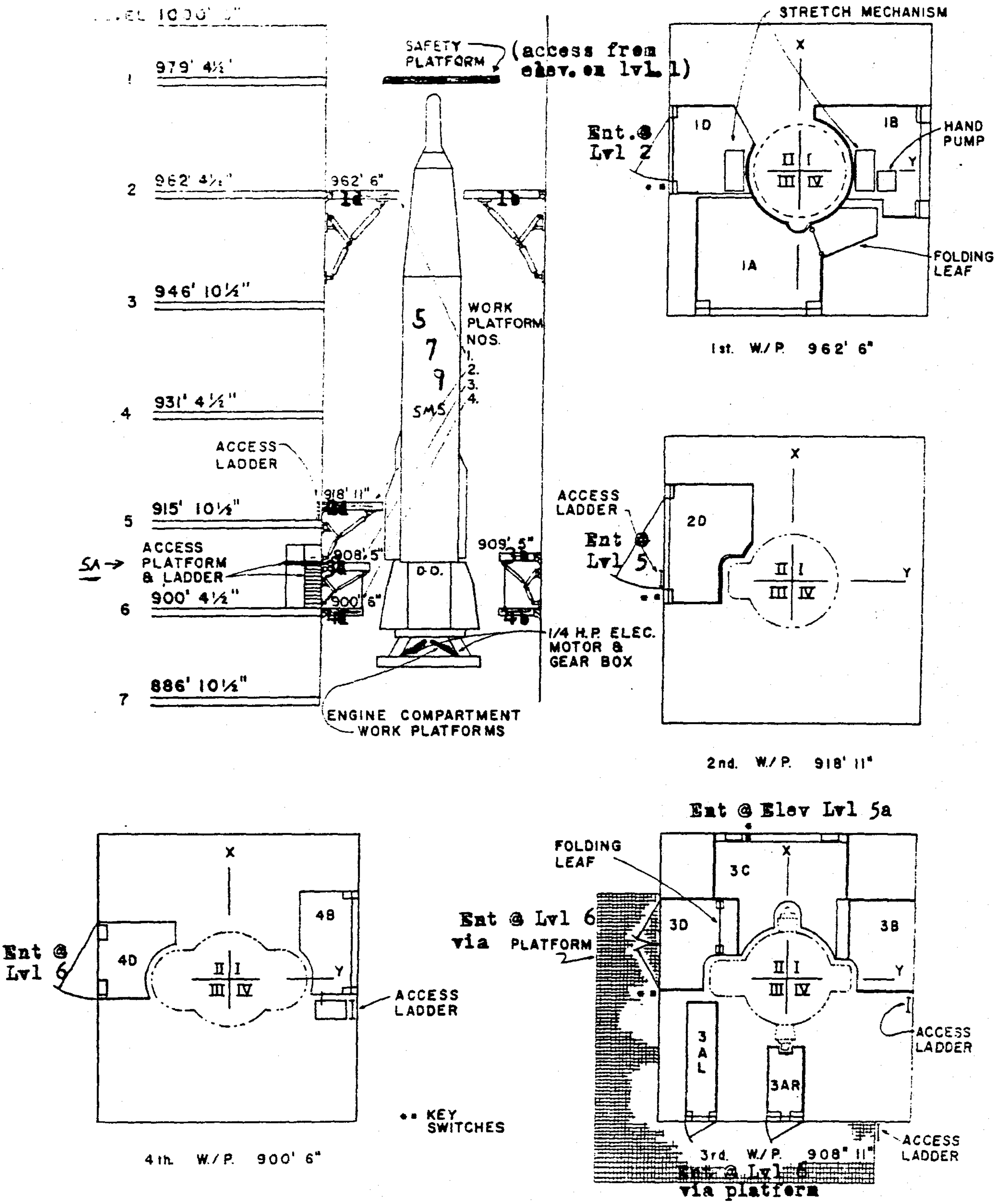
2. Safety Platform: The safety platform is located at silo level 1. Equipment can be lowered down through the silo cap and received at this platform. The safety platform is accessable from the facility elevator and is the largest of the platforms (13½' long X 8' wide). It is pneudraulically operated. 300 psi air pressure charges a hydraulic accumulator which supplies pressure to the "up" side of apair of actuators. These actuators retract the platform through pulley and cable linkages. The platform slowly free-falls to the extended position as hydraulic fluid is forced back into the de-pressurized accumulator through orfices. A Hyd. hand pump is provided for use in the event that air pressure fails.

3. Engine Compartment Access Platforms: The right and left engine compartment access platforms are each 15 ft long and 5 ft wide and are located directly under the missile engines. The platforms are fixed to the L/P and are actuated by ½ hp motors and gear boxes. The access ladder and electric motors control station are on level 1 of the L/P.

D. Stretch Mechanism:

(a) Functional Description: The function of the mechanisms is to supply two upward acting forces at diametrically opposite sides of the missile skin rendering the thin-walled cylinder section of the skin safe from collapsing under its weight in case the cylinder loses its internal pressure.

When loss of pressure occurs the stretch mechanism will be positioned in its operating position and locked. The support pin is manually moved forward and the pin insert is introduced into the opening provided for it in the skin of the missile cone.




WORK PLATFORM IN SILO CRIB

[illegible] from the missile skin onto the support pin is [illegible] work platform. The platform load in turn is transmitted to the [illegible] structure.

(b) Physical Description: The stretch mechanism is stored horizontally within a space envelope approximately 6 in. X 18 in. X 40 in. It is hinged into the No. 1 work platform along its lifting arm extends about 18 in. beyond the 18 in. envelope width to reach the missile. The mechanism has two main moving parts, or links contained between two outer side plates. Pins or shafts supported by the side plates pass through one end of each link allowing it to rotate about that end. One link is a hydraulic cylinder, the other a missile stretching arm. In operation, the cylinder presses upward on the lifting or stretching arm. The Top side plate is flush with the work platform deck when stored. There are two equivalent mechanism.

(c) Operation: The stretch mechanism is so designed that it may be manually positioned, pumped to operating pressure and manually locked in place within 10 min. by two men. The stretch mechanism is divided into a left hand mechanism assembly which is located in platform 1D and a right hand mechanism assembly which is located in platform 1B. Each mechanism assembly consists of a housing assembly, a support pin housing and a hydraulic actuator.

Either the right hand or the left hand mechanism may be erected first. The mechanisms are similar and the same erection and operating sequence is used with each mechanism. The steps of the sequence are as follows:

1. Unlatch and lift the left hand stretch mechanism assembly out of work platform 1D.

2. Lock in the upright position by allowing the lock block at the rear of the housing to drop into the locking slot.

3. Lift the support pin housing out of the mechanism housing and place it so that it is supported by its pivot and by the hydraulic stretch actuator.

4. Remove the tee handle from the clip on top of the pin housing and insert in the hole provided in the support pin.

5. Slide the support pin forward and insert the pin in the missile nose cone adapter bearing.

6. Repeat steps 1 through 5 with the right-hand mechanism assembly.

7. [illegible] pressure into both stretch mechanism act- [illegible] manually pumping the hand pump which is located on platform [illegible]

8. When the desired stretch has been achieved, lock each actuator mechanically by rotating the locking collar until it is jammed against the actuator cap.

9. The hydraulic pressure may then be relieved until it is necessary to remove the stretch mechanism from the missile.

10. When it is desired to relieve the stretch, again pump pressure into the actuators until the pressure is reliev- ed on the locking collar.

11. Turn the locking collar (on the actuator) down so that the actuator can be retracted.

12. Relieve hydraulic pressure by opening valve on the hand pump.

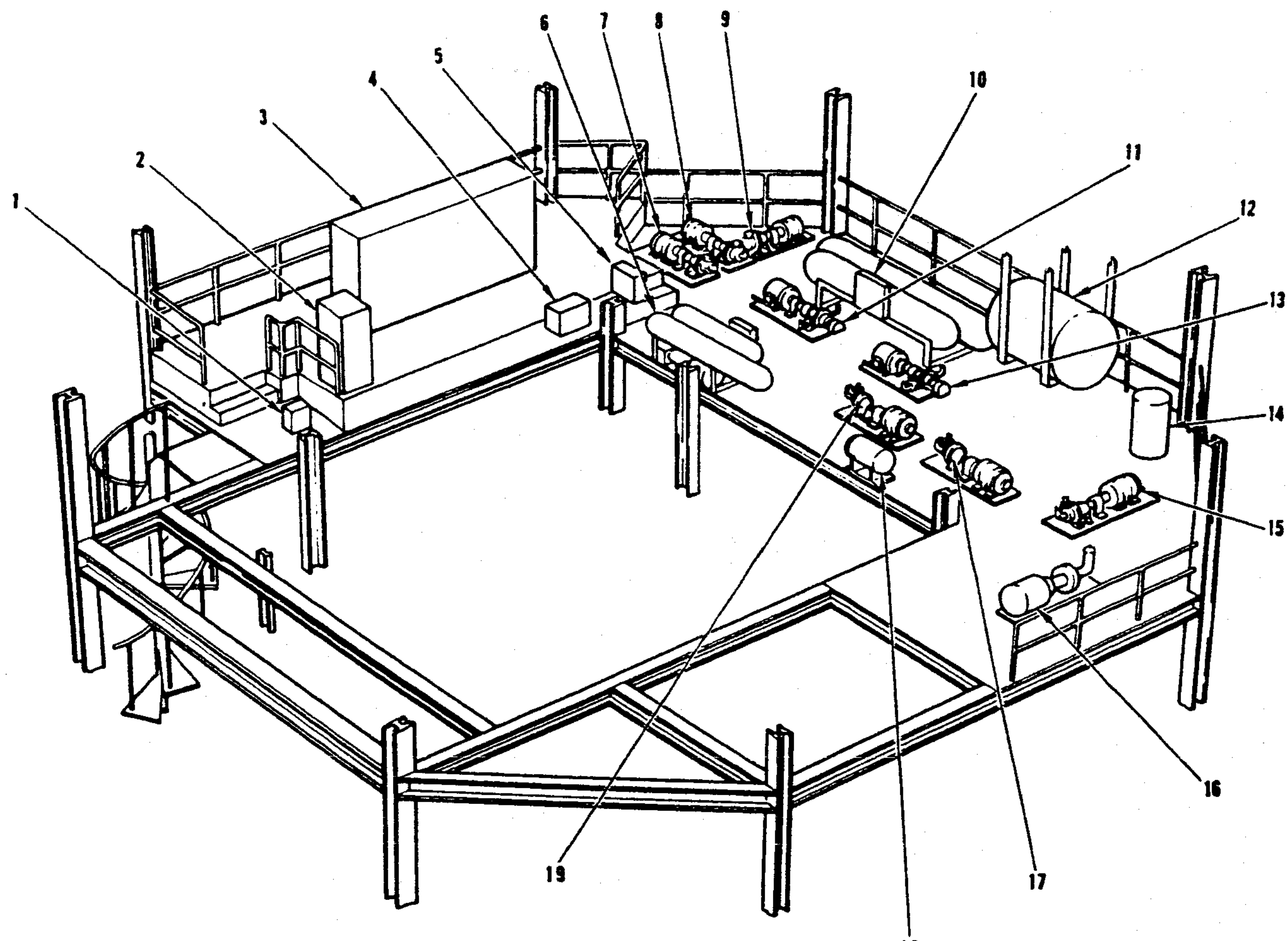
13. Slide the support pin back into the pin housing until the ball lock in the housing drops into the detent in the slide and holds the slide in place.

14. Replace the tee handle in the clip on top of the pin hous- ing.

15. Fold the pin housing and the actuator and replace in the mechanism housing.

16. Unlock the mechanism by pulling the cable handle to lift the lock block out of the locking slot.

17. Stow the stretch mechanism in the platform.




1 JUNCTION BOX ASSY IR56 SILO CHECKS (576 AND OSTF-2)
2 INSTRUMENTATION CABINET (OSTF-2)
3 INSTRUMENTATION CABINET (OSTF-2)
4 LIGHTING PANEL LB
5 LIGHTING PANEL LB
6 CONDENSER, WATER CHILLER, AND REFRIGERATIONN COMPRESSOR
7 CHILLED WATER PUMP P-51 (P-50 FOR OSTF-2)
8 CHILLED WATER PUMP P-50 (P-51 FOR OSTF-2)
9 EMERGENCY WATER PUMP P-32
10 CONDENSER, WATER CHILLER, AND REFRIGERATION COMPRESSOR
11 CONDENSER WATER PUMP P-31
12 HYDROPNEUMATIC UTILITY WATER TANK 50
13 CONDENSER WATER PUMP P-30
14 AIR TANK (OSTF-2)
15 WATER PUMP P-80
16 UTILITY WATER PUMP P-81
17 HOT WATER PUMP P-61
18 HOT WATER EXPANSION TANK 63
19 HOT WATER PUMP P-60

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Figure 1-17. Silo Level 4 Equipment Location

## SILO LEVEL 4

1. Facility Elevator

2. Facility Elevator Counterweights

3. Launcher Platform Counterweights

4. Launcher Platform Guide Rails

5. Water Chiller Units 50 and 51: To provide chilled water to the following:

   A. Launch Control Center Fan Coil Unit.

   B. Control Cabinet fan coil unit.

   C. Launch Platform enclosure fan coil unit.

   D. Pod air conditioner on the launch platform.

6. Circular Stairs

7. Air Conditioning Ducts

8. Chilled Water Pumps P50 and P51: Two 15 hp chilled water pumps, one pump for normal and the other is for standby. Water is circulated by these pumps to water chiller units then directed to air conditioning cooling coils throughout the silo, launch control center and returned to the pumps in a closed loop system.

9. Emergency Water Pump (P-32): Provides emergency backup for the condenser water pumps. It is started by a signal received from the blast detection system. Provides a 50 GPM flow of hard water from the utility water system. This water flows from the pump to the water chiller units, to diesel generators water jacket heat exchangers, inst. air prefab and to drain in the sump.

10. Condenser Water Pumps (P-30 & P-31): The two condenser water pumps provide normal circulation of cooling water from the cooling tower to water chiller units, diesel generator's heat exchangers and instrument air prefab.

11. Hot Water Pumps (P-60 & P-61): Circulates hot water in a closed loop system from the heat recovery silencers of the diesel generators to the thrust section heating coil, fan coil unit FC-40 on crib level 2 and fan coil unit FC-1 on level 1 of the LCC.

12. Hot Water Expansion Tank (TK-63): A 30 gallon capacity tank which serves dual purpose:

   (A) An expansion vessel for the system.

[illegible] tank for the system receiving make-up water as required from the demineralized water system.

13. Utility Water Tank (TK80): Primary function is to maintain a head pressure on the utility water system. The tank is pressurized with air of 85 psig from the instrument air prefab. As the water level drops, the air pressure will be simulataneously reduced, and at 63 psig the utility water pump will start operation to replenish the water supply and stop operation at 85 psig. When tank pressure drops to 48 psig a low level alarm indication will be registered on the FRCP in the LCC.

14. Fog System Pump (P-80): Pump is centrifugal type with a capacity of 500 GPM. This pump supplies water for the fog nozzles, emergency showers, eye wash fixtures, fire hose stations, air washer emergency supply and condenser water emergency supply. Operates in conjunction with the utility water pump. Starts when the utility water tank pressure drops to 55 psig and stops when pressure reaches 74 psig.

15. Utility Water Pump (P-81): The 30 GPM capacity utility water pump is sized to supply the normal demand for drinking water, domestic water, cooling tower make-up (8 GPM) and air wash system make-up (2 GPM). Operation of the pump is controlled by pressure switches located in the utility water tank. Pump starts when utility water tank pressure drops to 63 psig and stops when pressure reaches 85 psig.

16. Diesel Exhaust Ducts

17. Telephone Terminal Cabinet

18. Lighting Panel LB: Power to lights and reciptacles on levels 4,5,6,7, 8 and sumps.

19. Fire Detector Head

20. Comm Box

21. Emergency Lights (6 Volts)

22. Hand Fire Extinguisher

23. P.A. Speaker

Cooling Tower Exhaust Fan EF-31 - "Run" light and "Hand-Off-Automatie" selector switch.

23. Cooling Tower Electric Heater EH-30 - "On" light.

24. Chilled Water Pump P-50 & P-51 - P-51 "Run" light, P-50 "Run" light and "P-50-Off-P-51" selector switch.

25. Control Cabinet Fan Coil Unit FC-10 - "Run" light and Start-Stop switch.

26. Contrel Cabinet Electric Heating Coil EC-101 - "On" light.

27. Demineralized Water Pump P-90 - "On" light and Hand-Off-Automatie selector switch.

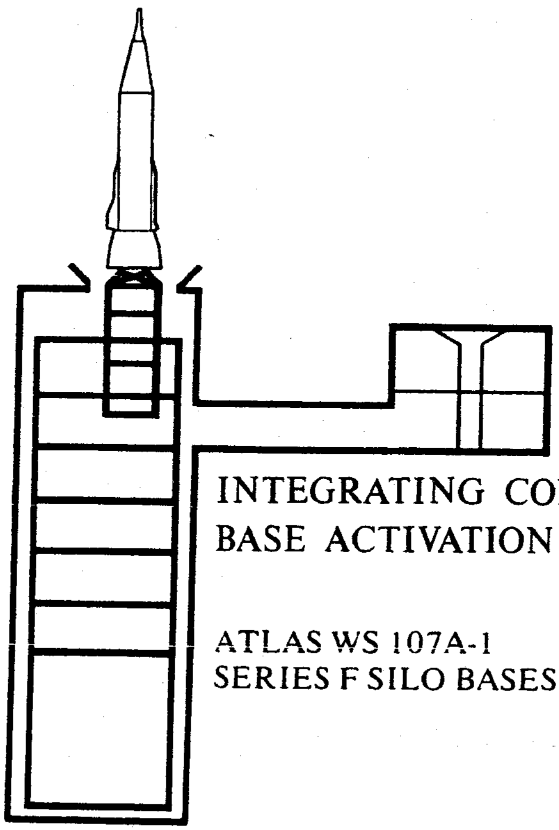
28. Emergency Water Pump P-32 - "Run" light, Start Button and Stop Button.

29. Chilled Water P-50 - Start and Stop Buttens, ne light.

REFERENCE 12

REPORT NO. 600-200

GENERAL DYNAMICS ASTRONAUTICS, A DIVISION OF GENERAL DYNAMICS CORPORATION



# INTEGRATING CONTRACTOR'S BASE ACTIVATION PROJECT MANUAL

## ATLAS WS 107A-1 SERIES F SILO BASES

REPORT NO. 600-200

# INTEGRATING CONTRACTOR'S BASE ACTIVATION PROJECT MANUAL

## ATLAS WS 107A-1
## SERIES F SILO BASES

*Prepared by*

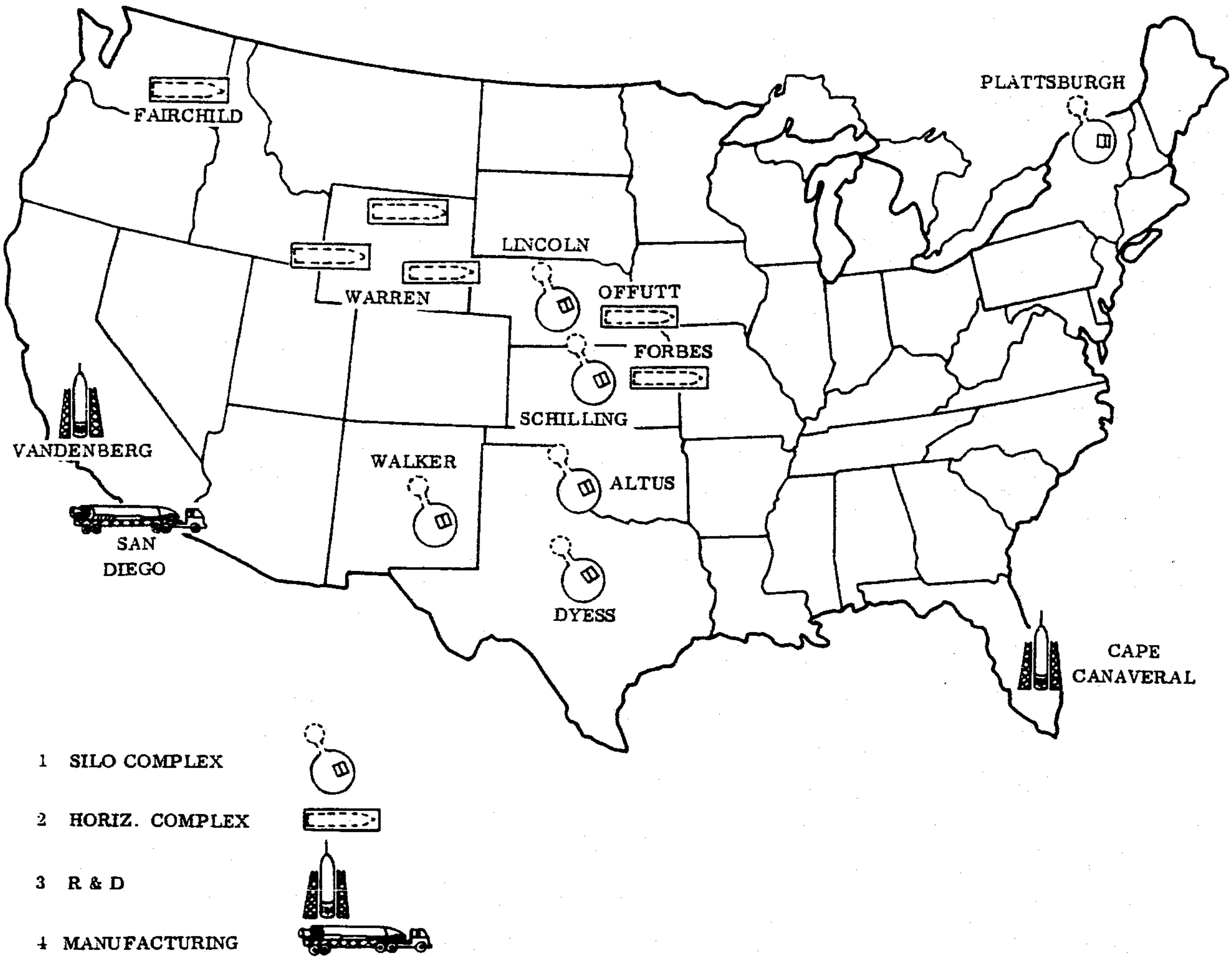
GENERAL DYNAMICS | ASTRONAUTICS
A DIVISION OF GENERAL DYNAMICS CORPORATION
San Diego, California

MARCH 1961

# IV. BASE DEPLOYMENT AND DESIGN

## BASE DEPLOYMENT

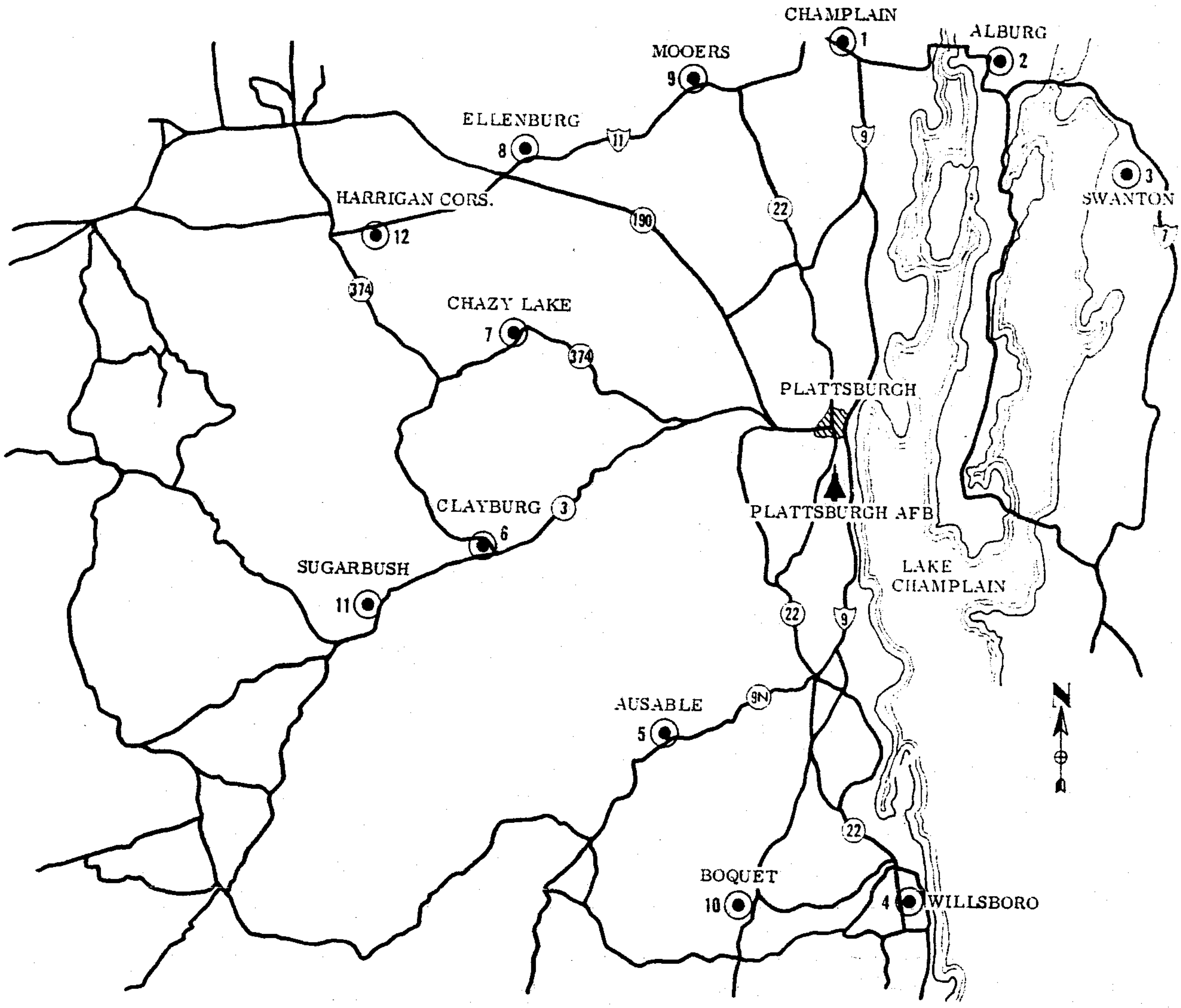
Currently authorized Atlas missile bases are deployed in the general pattern shown on the opposite page. The distances between bases and Base Activation headquarters in San Diego are natural deterrents to good communication. Total compliance with the detailed means and methods of the Project Control Plan provides maximum effectiveness of communication, coordination and control.




BASE DEPLOYMENT

## BASE DESIGN PHILOSOPHY

Each silo base consists of 12 launch sites deployed as shown on the accompanying map of Plattsburgh Air Force Base, New York. The first consideration in locating the sites is maximum dispersal for protection against enemy action. Other major considerations are local topographical and geological conditions. Each launch site is operationally independent. All 12 sites are dependent for logistic support on a common Squadron Maintenance Area, and are controlled from a central administration area.



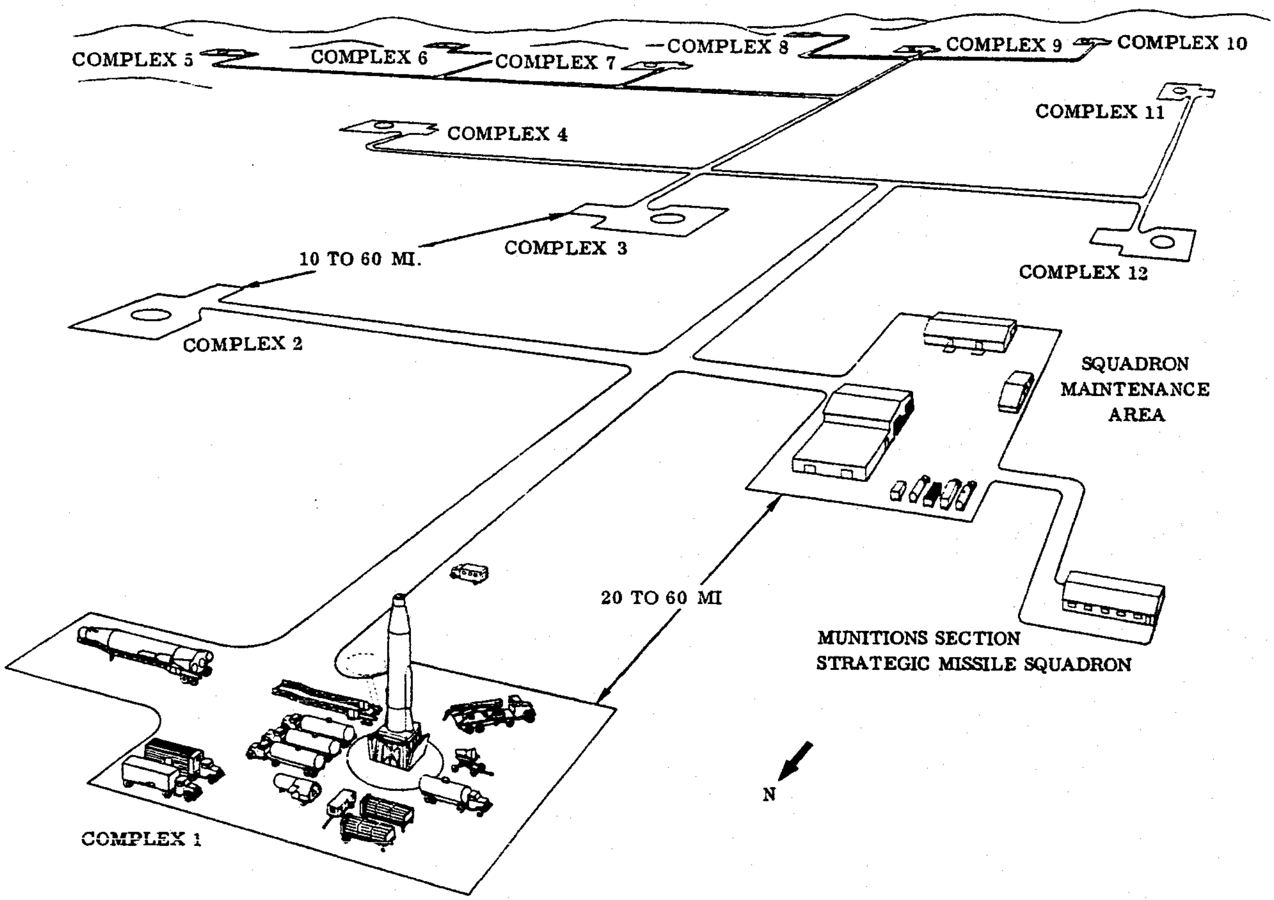

| MILES FROM PLATTSBURGH | | POPULATION |
|---|---|---|
| SITE | PLATTSBURGH | 19,000 |
| 1 | 30 MI. | 1,505 |
| 2 | 38 MI. | 1,400 |
| 3 | 52 MI. | 1,400 |
| 4 | 30 MI. | 1,000 |
| 5 | 26 MI. | 1,650 |
| 6 | 34 MI. | 500 |
| 7 | 32 MI. | 300 |
| 8 | 27 MI. | 500 |
| 9 | 33 MI. | 500 |
| 10 | 28 MI. | 100 |
| 11 | 36 MI. | 100 |
| 12 | 39 MI. | 100 |

0 10 20 30

SCALE OF MILES

## SILO BASE LAYOUT

A typical Series F silo squadron is shown on the opposite page. In the launch-ready configuration, all structures and equipment at a launch complex will be below ground, as at complexes 2 through 12 in the illustration. Only during maintenance operations will equipment be dispersed as shown at Complex 1. The mobile ground support equipment shown is based at the Squadron Maintenance Area and delivered to a launch complex as required.

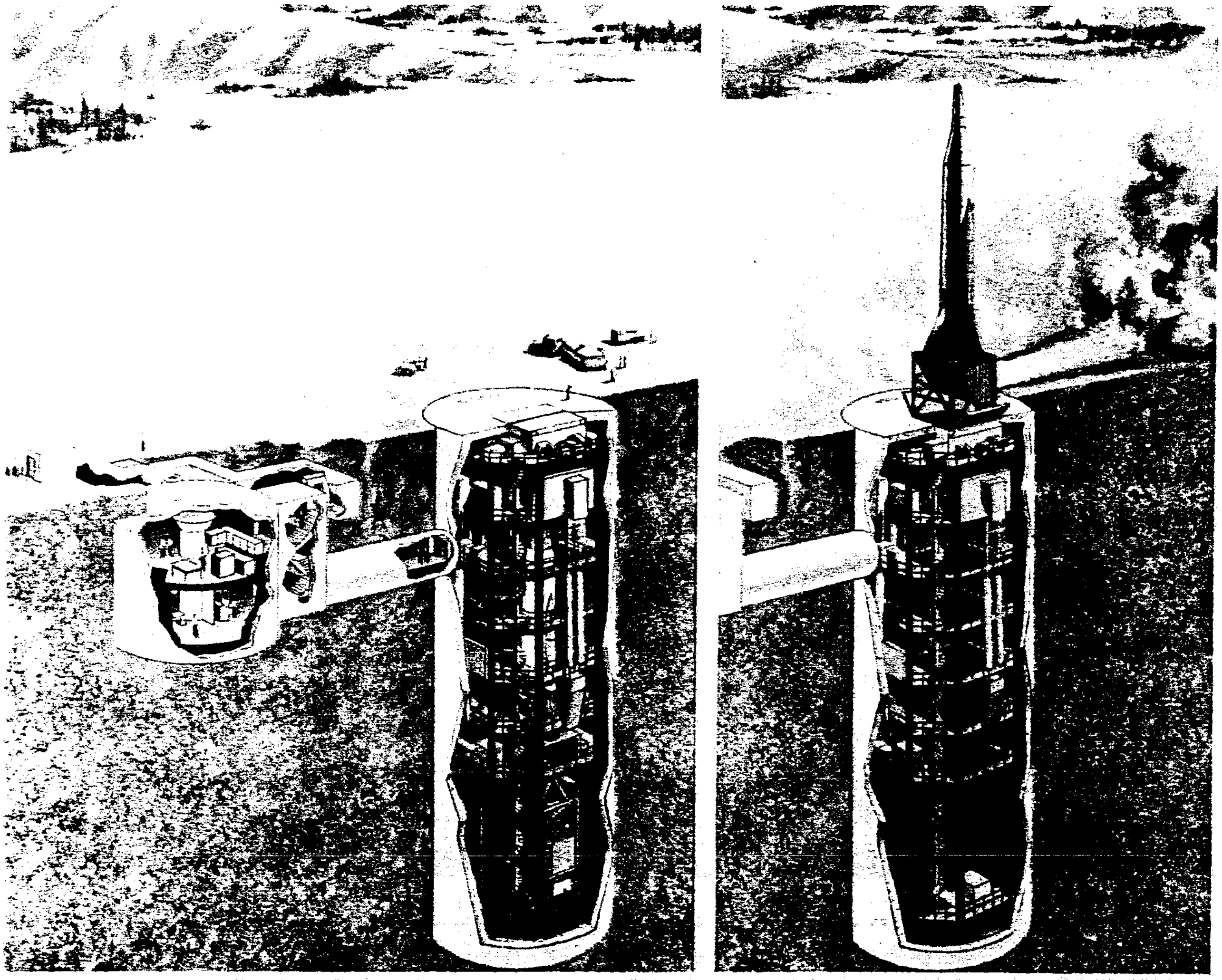



TYPICAL SILO BASE LAYOUT

## TYPICAL LAUNCH COMPLEX

A typical launch complex is shown in cutaway on the opposite page. Essentially, the complex consists of two concrete cylinders closed at both ends. Both cylinders are completely below ground level. The larger cylinder, the silo, is over 174 ft. deep and has an inside diameter of about 52 ft. The silo contains an Atlas missile, plus most of the structures, facilities and equipment needed to launch it. The other cylinder, called the launch control center, is approximately 27 ft. deep and is about 40 ft. in diameter. The launch control center contains living quarters and facilities for the launch crew, plus the equipment to monitor the operational readiness of the silo and launch its missile.

The silo and launch control center are connected by a cylindrical tunnel about 54 ft. long and about 8 ft. in diameter. This tunnel serves as a conduit for the launch control cabling, and provides access to the silo. Together, the silo and launch control center form a self-contained combat unit, with food, water and power. In the launch-ready configuration the ground level opening in the silo roof is sealed by blast-proof concrete doors. During a missile launch these doors are opened and the missile is lifted to ground level.

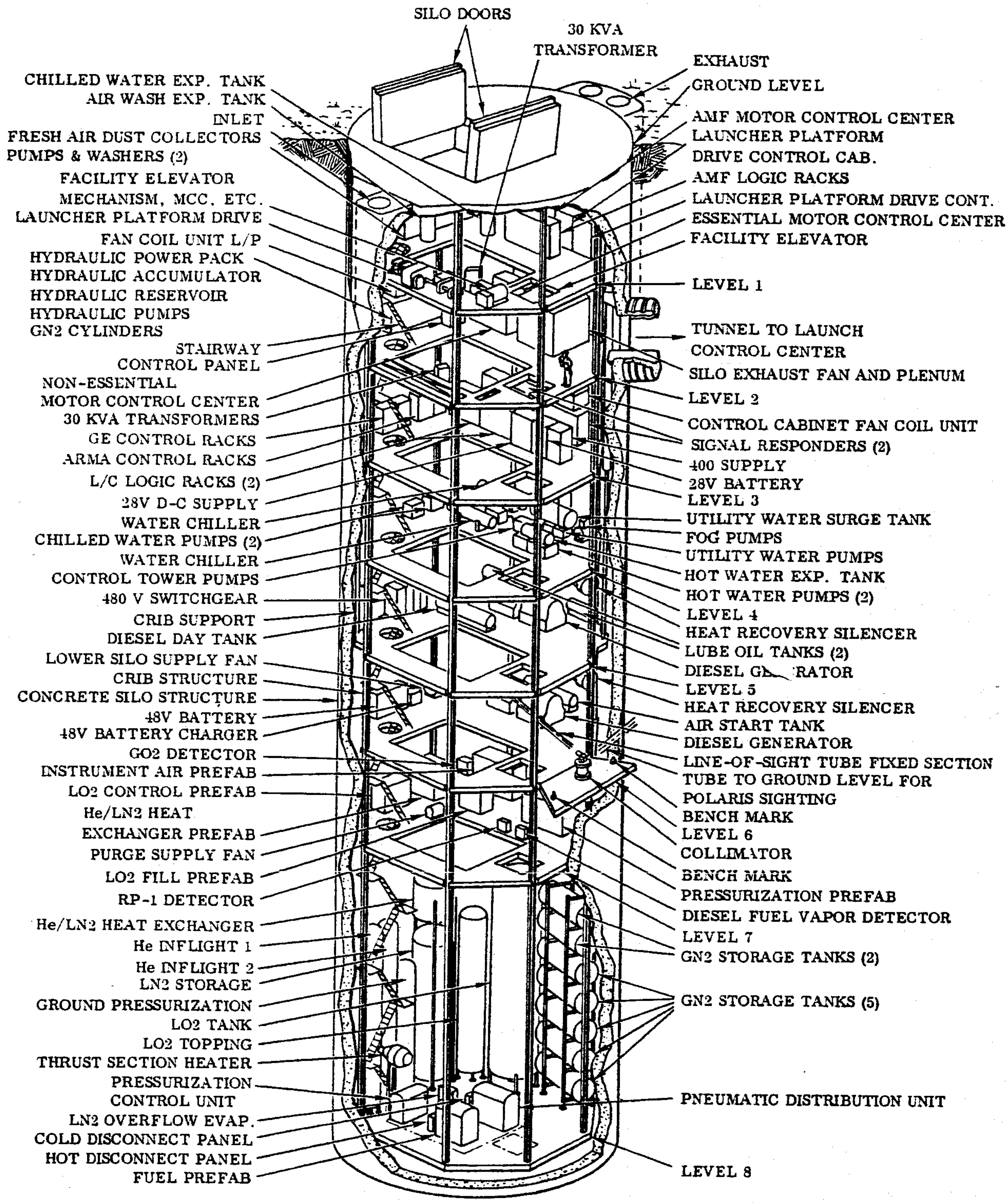


TYPICAL LAUNCH COMPLEX

# V. FACILITY AND GROUND SUPPORT EQUIPMENT

## SILO

The silo (see opposite page) is an 11-story building situated completely below ground. Its floor, walls and roof, which are of reinforced concrete, form a cylinder measuring over 174 ft. long and about 52 ft. in diameter. Inside this cylinder is a structural steel crib. The crib, which is octagonal in cross-section, contains eight floor levels. On these levels are mounted the storage tanks, machinery, control cabinets and other items of support equipment needed for the Atlas missile that is stored in and launched from the silo. Passing vertically through the levels of the crib are two square shafts. The larger shaft is for the launcher platform, on which the missile is lowered into the silo for storage and raised above ground level for launching. The smaller shaft contains a utility elevator for maintenance personnel and equipment movement. The crib is suspended from the silo walls on spring-loaded shock struts designed to cushion the crib and its contents against the shock of a nuclear blast. In the silo roof, which is flush with ground level, is a square opening sealed by blast-resistant doors. Through this opening, which is aligned with the launcher platform shaft, the missile is lowered into and raised out of the silo. Access to the silo for personnel is through a cylindrical concrete tunnel connected to the launch control center. Except during maintenance, operation of the equipment in the silo is remotely controlled and monitored from the launch control center.

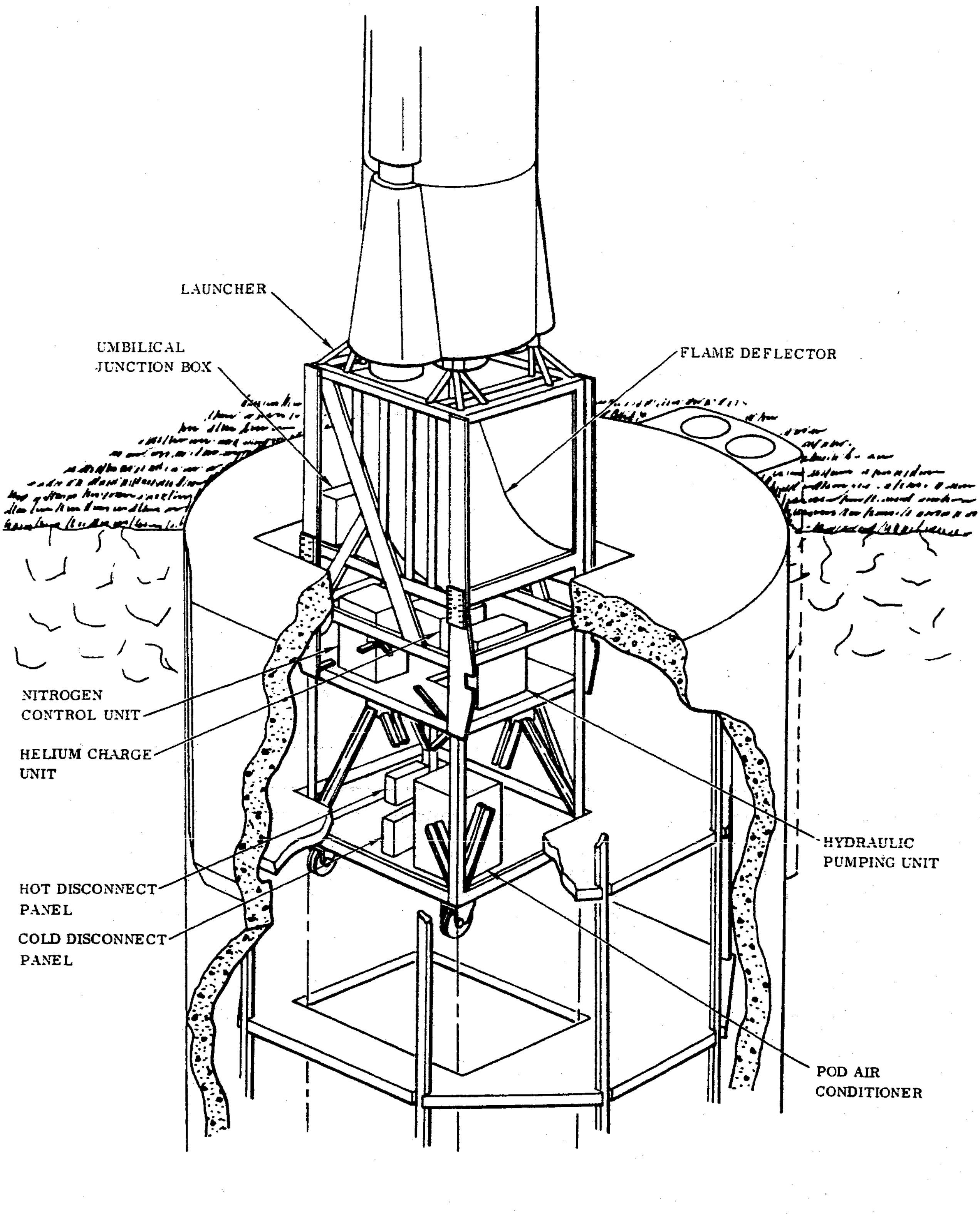

SILO DOORS
30 KVA TRANSFORMER
EXHAUST
GROUND LEVEL
CHILLED WATER EXP. TANK
AIR WASH EXP. TANK
INLET
FRESH AIR DUST COLLECTORS
PUMPS & WASHERS (2)
FACILITY ELEVATOR
MECHANISM, MCC, ETC.
LAUNCHER PLATFORM DRIVE
FAN COIL UNIT L/P
HYDRAULIC POWER PACK
HYDRAULIC ACCUMULATOR
HYDRAULIC RESERVOIR
HYDRAULIC PUMPS
GN2 CYLINDERS
STAIRWAY
CONTROL PANEL
NON-ESSENTIAL
MOTOR CONTROL CENTER
30 KVA TRANSFORMERS
GE CONTROL RACKS
ARMA CONTROL RACKS
L/C LOGIC RACKS (2)
28V D-C SUPPLY
WATER CHILLER
CHILLED WATER PUMPS (2)
WATER CHILLER
CONTROL TOWER PUMPS
480 V SWITCHGEAR
CRIB SUPPORT
DIESEL DAY TANK
LOWER SILO SUPPLY FAN
CRIB STRUCTURE
CONCRETE SILO STRUCTURE
48V BATTERY
48V BATTERY CHARGER
GO2 DETECTOR
INSTRUMENT AIR PREFAB
LO2 CONTROL PREFAB
He/LN2 HEAT
EXCHANGER PREFAB
PURGE SUPPLY FAN
LO2 FILL PREFAB
RP-1 DETECTOR
He/LN2 HEAT EXCHANGER
He INFLIGHT 1
He INFLIGHT 2
LN2 STORAGE
GROUND PRESSURIZATION
LO2 TANK
LO2 TOPPING
THRUST SECTION HEATER
PRESSURIZATION
CONTROL UNIT
LN2 OVERFLOW EVAP.
COLD DISCONNECT PANEL
HOT DISCONNECT PANEL
FUEL PREFAB
AMF MOTOR CONTROL CENTER
LAUNCHER PLATFORM
DRIVE CONTROL CAB.
AMF LOGIC RACKS
LAUNCHER PLATFORM DRIVE CONT.
ESSENTIAL MOTOR CONTROL CENTER
FACILITY ELEVATOR
LEVEL 1
TUNNEL TO LAUNCH
CONTROL CENTER
SILO EXHAUST FAN AND PLENUM
LEVEL 2
CONTROL CABINET FAN COIL UNIT
SIGNAL RESPONDERS (2)
400 SUPPLY
28V BATTERY
LEVEL 3
UTILITY WATER SURGE TANK
FOG PUMPS
UTILITY WATER PUMPS
HOT WATER EXP. TANK
HOT WATER PUMPS (2)
LEVEL 4
HEAT RECOVERY SILENCER
LUBE OIL TANKS (2)
LEVEL 5
HEAT RECOVERY SILENCER
AIR START TANK
DIESEL GENERATOR
LINE-OF-SIGHT TUBE FIXED SECTION
TUBE TO GROUND LEVEL FOR
POLARIS SIGHTING
BENCH MARK
LEVEL 6
BENCH MARK
PRESSURIZATION PREFAB
DIESEL FUEL VAPOR DETECTOR
LEVEL 7
GN2 STORAGE TANKS (2)
GN2 STORAGE TANKS (5)
PNEUMATIC DISTRIBUTION UNIT
LEVEL 8

SILO

## LAUNCHER PLATFORM

The launcher platform is an open cage-type, multiple-level elevator on which a missile is lowered into and raised out of the silo. The platform is 16 ft. square and 49 ft. high, and weighs approximately 171,500 lb.

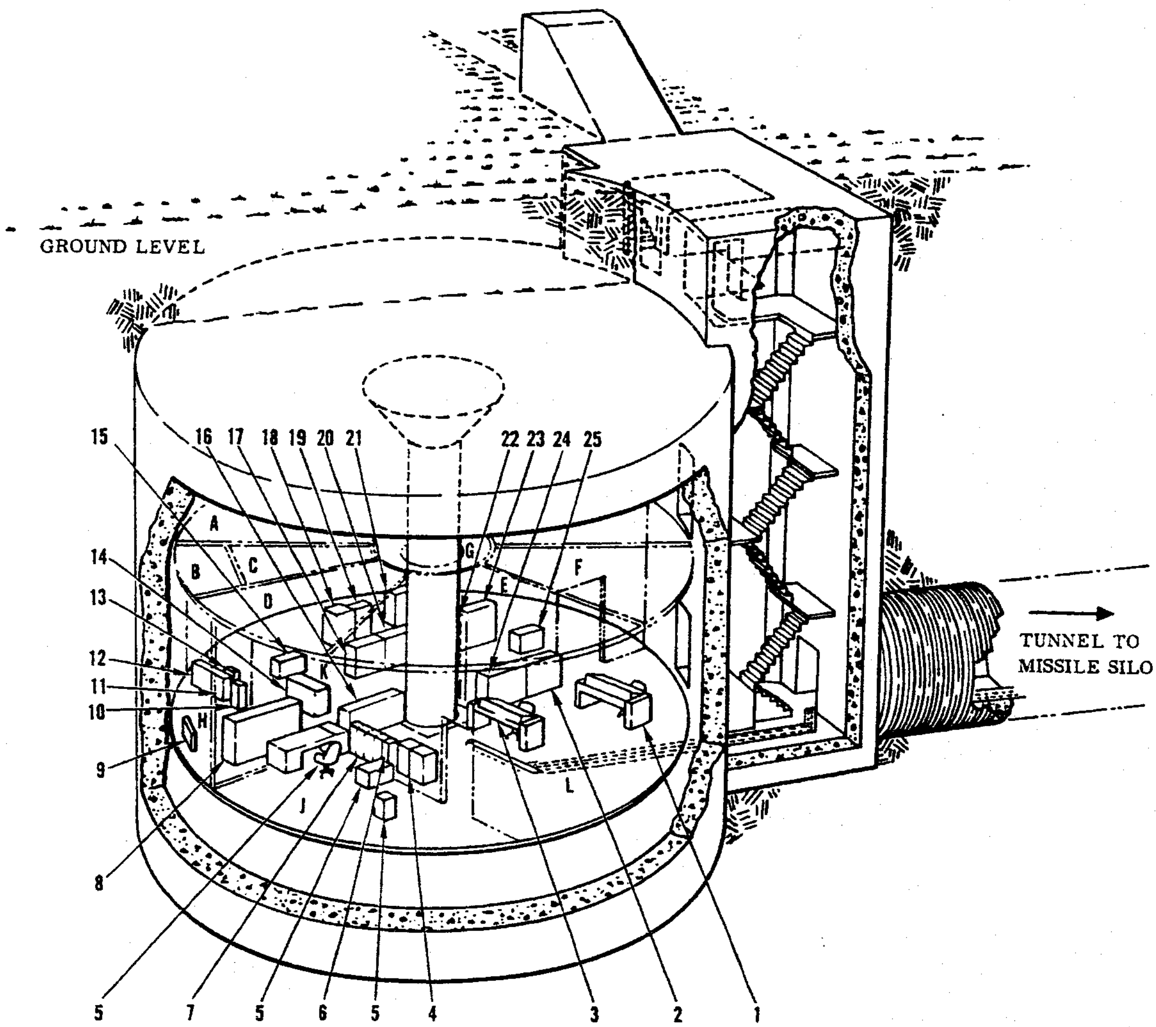
It is suspended on 10 cables within the silo crib. The platform structure consists of four levels. On the first level, which is above ground when the platform is raised, are the missile launcher and flame deflector. The second level holds the launcher platform locking system, which anchors the platform to the silo walls when it is raised, and to the crib structure when it is lowered. The third and fourth levels contain equipment for servicing the missile while the launcher platform is rising during a countdown.




LAUNCHER PLATFORM

## LAUNCH CONTROL CENTER

The launch control center is a cylindrical chamber of reinforced concrete about 27 ft. high and about 40 ft. in inside diameter. Built completely below ground, the chamber contains two floor levels supported by an air-cushioned suspension system designed to cushion against the ground shock of a nuclear blast. The rooms on the lower level contain the facility and launch control equipment used by the operating crew of a single launching silo. The rooms on the upper level contain living quarters and facilities for the crew. The launch control center is connected to its silo by a cylindrical concrete tunnel some 54 ft. long and about 8 ft. in inside diameter. Access from ground level to both the launch control center and the tunnel is through a blast-resistant concrete stairwell. Emergency exit can be made through an escape hatch in the launch control center roof.




LAUNCH CONTROL CENTER

AREA KEY

FIRST LEVEL
A READY ROOM & STORAGE
B JANITOR'S ROOM
C MEDICAL SUPPLY ROOM
D TOILET
E KITCHEN & MESS
F POWER DISTRIBUTION ROOM
G HALL
SECOND LEVEL
H BATTERY ROOM
J OFFICE
K COMMUNICATIONS EQUIPMENT ROOM
L LAUNCH CONTROL ROOM

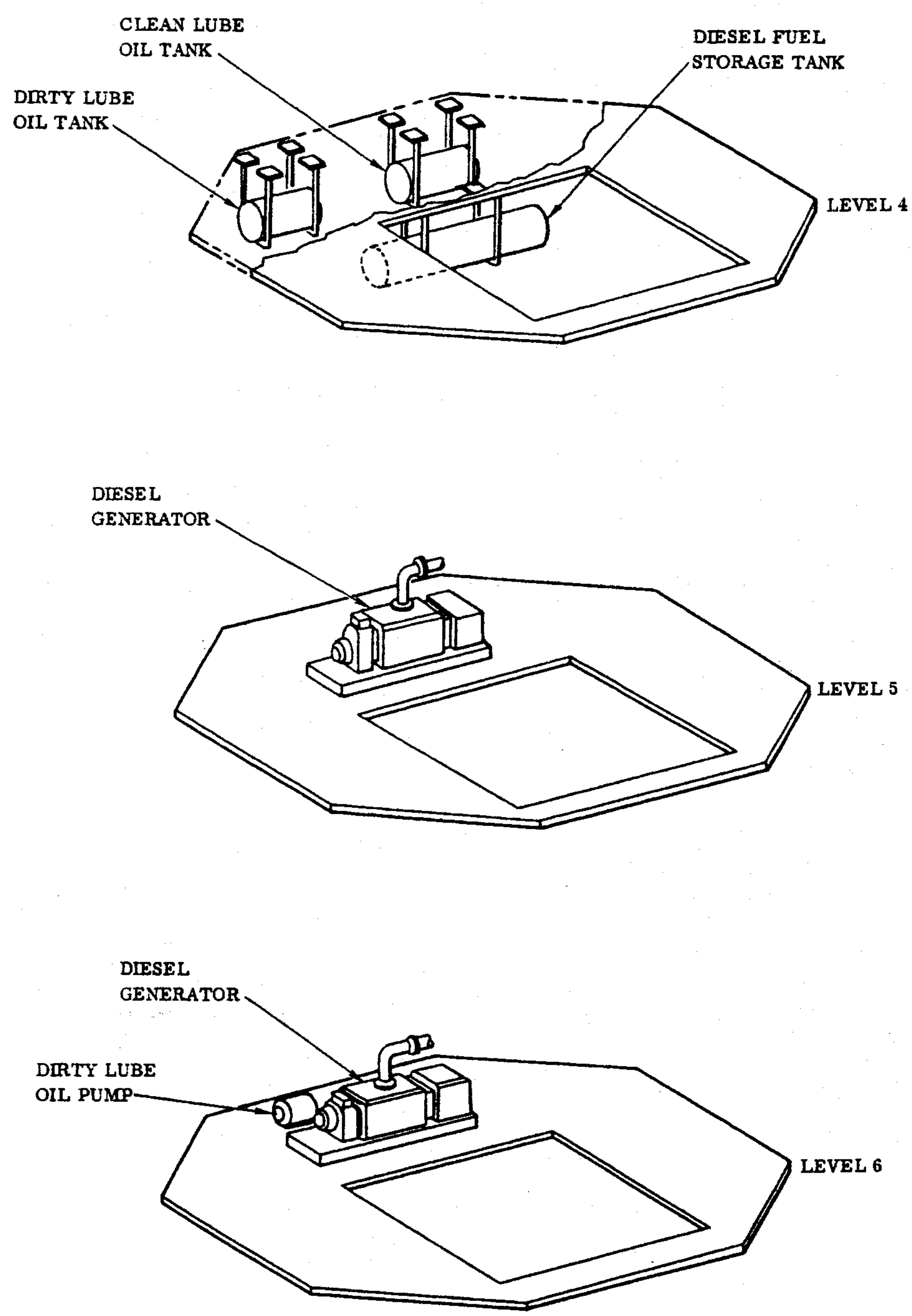
EQUIPMENT KEY

1 ALTERNATE COMMAND CONSOLE (ONE PER SQUADRON)
2 POWER PLANT REMOTE CONTROL PANEL
3 LAUNCH CONTROL CONSOLE
4 TV MONITOR
5 OFFICE EQUIPMENT
6 LIGHTING DISTRIBUTION TRANSFORMER
7 FIRE ALARM PANEL
EXIT & EMERGENCY LIGHTING PANEL
NORMAL LIGHTING PANEL
LIGHTING DISTRIBUTION PANEL
8 BATTERIES & RACK
9 TELEPHONE TERMINAL CABINET
10 CHARGER BAY
11 COMMUNICATION POWER DIST. PANEL
12 PA SYSTEM CABINET
13 COMMUNICATION EQUIP. PANEL "B"
14 MAIN DISTRIBUTION FRAME
15 MISCELLANEOUS TRUNK BAY (DIRECT LINES)
16 MOTOR CONTROL CENTER
17 FINDER CONNECTOR BAY
18 POWER BOARD
19 MISCELLANEOUS RELAY RACK
20 SELECTOR BAY
21 X-TIME CLOCK BAY
22 REGISTER BAY
23 TRANSLATOR BAY
24 FACILITY REMOTE CONTROL PANEL
25 SASS BAY

## LAUNCH CONTROL CENTER

## LUBE OIL AND FUEL OIL SYSTEM

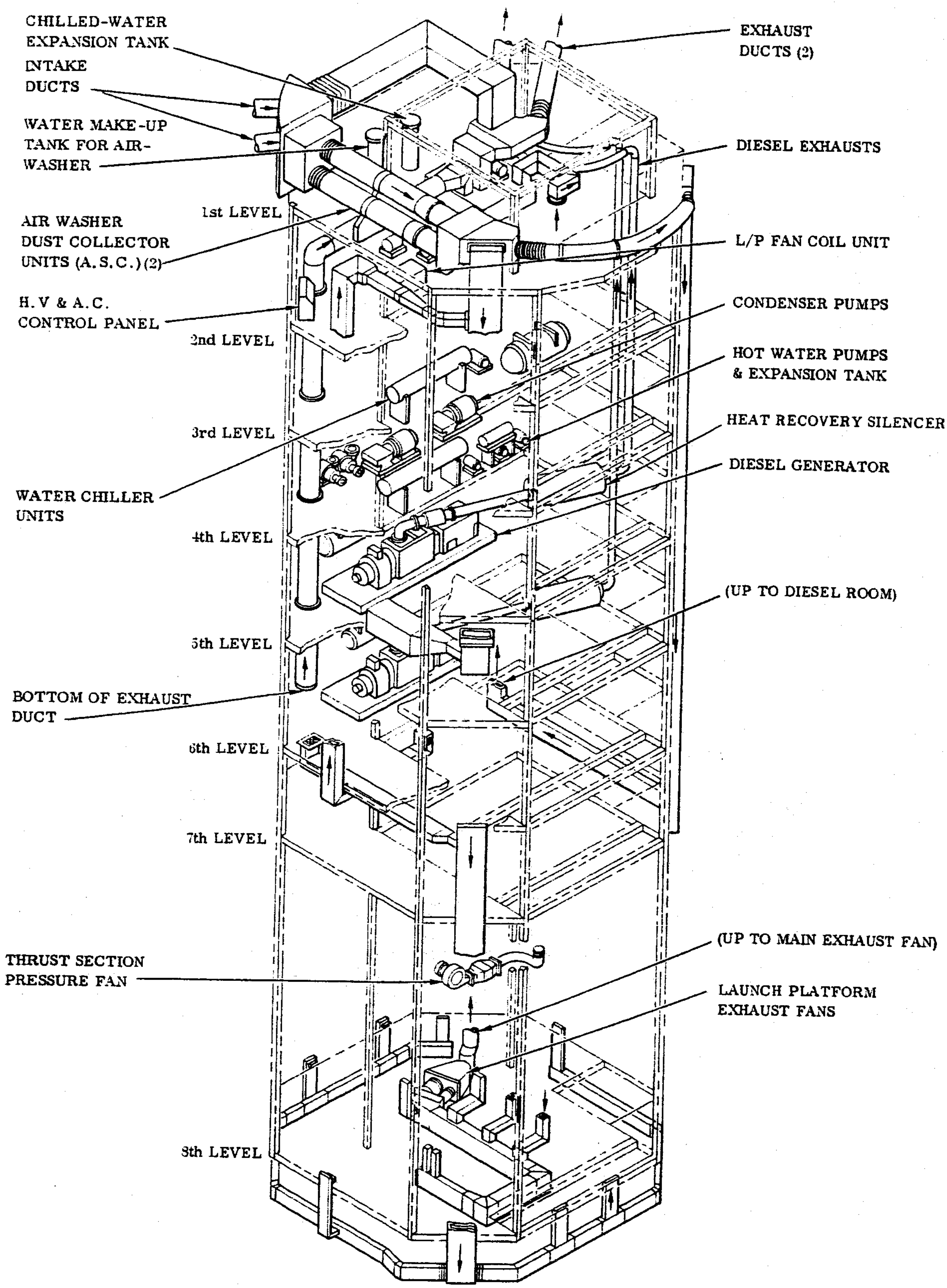
This system stores and distributes the fuel and lubricant required by the two diesel generators that supply facility electrical power for both the silo and the launch control center. The amount of oil stored in this system is a primary determinant of the length of time a launch complex can remain operationally independent.




LUBE OIL AND FUEL OIL SYSTEM

## HEATING, VENTILATING AND AIR-CONDITIONING SYSTEM

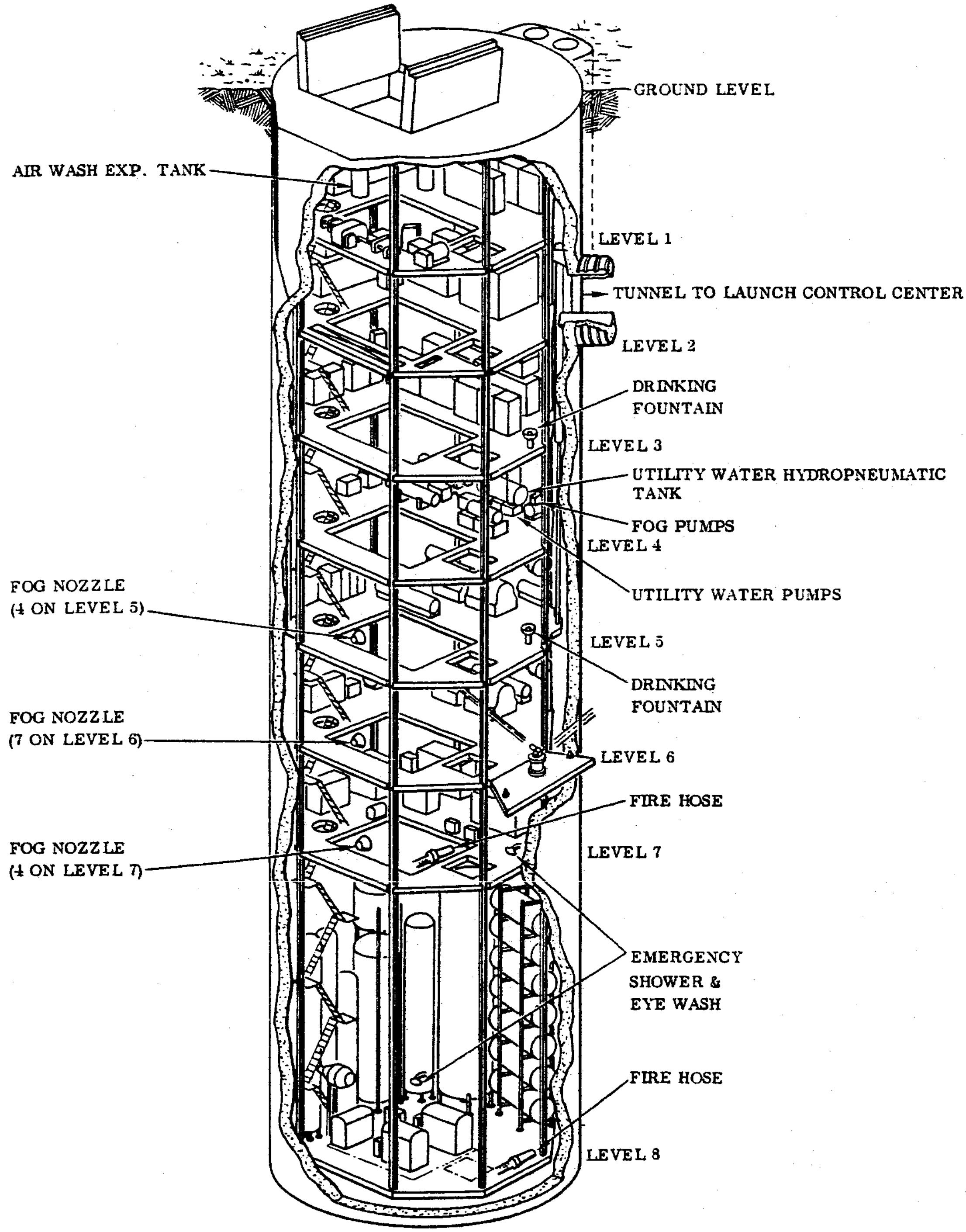
This system continuously pumps a supply of fresh, washed air into the silo, heats or cools the air as required, and distributes it throughout the silo. Part of the system maintains constant temperature inside the shaft that encloses the launcher platform. The system also continuously expels stale air, fumes and vapors from the silo.




HEATING, VENTILATING AND AIR-CONDITIONING SYSTEM

## UTILITY WATER SYSTEM

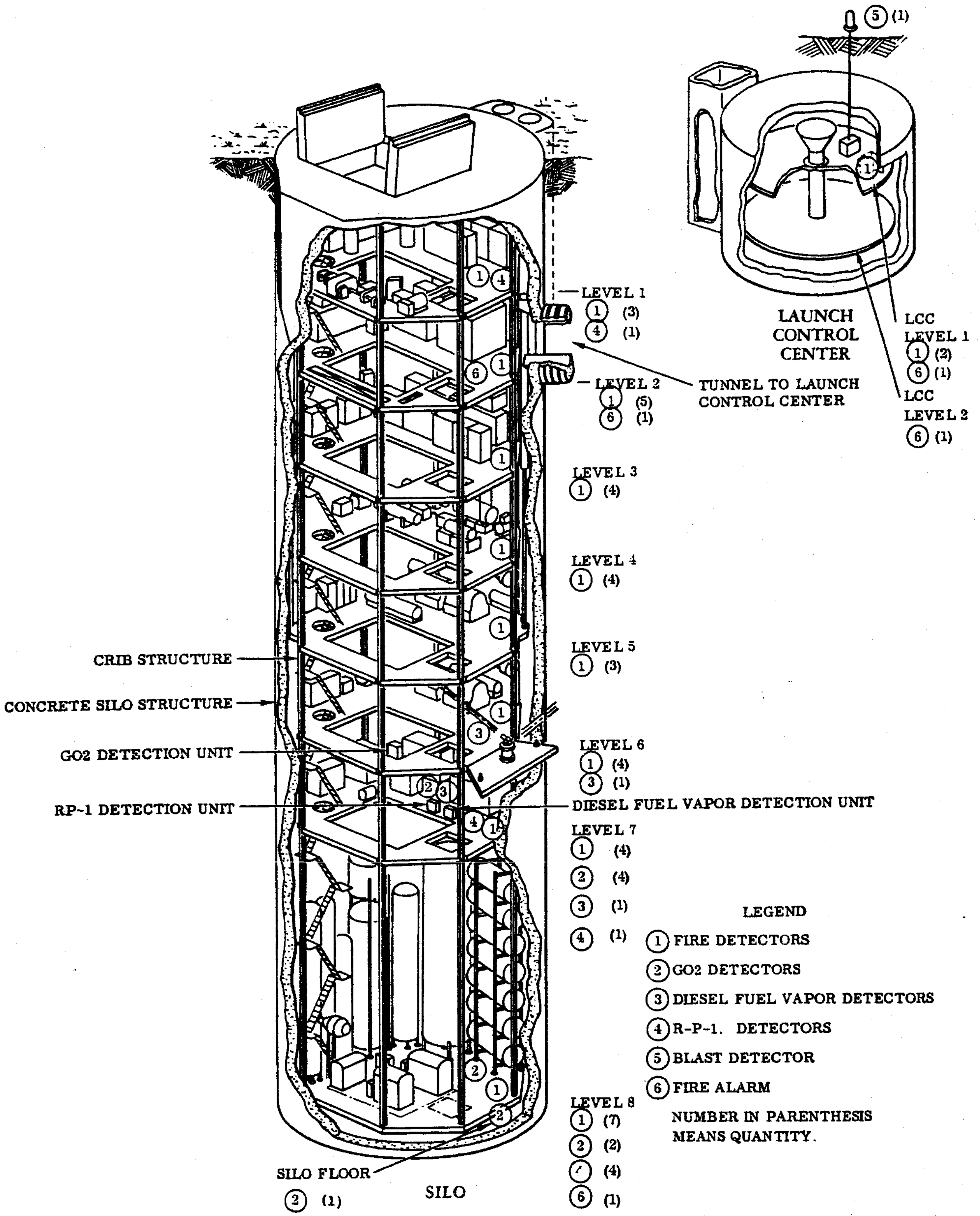
The utility water system provides the water for personnel, fire protection, and the air-conditioning system in both the silo and the launch control center.




UTILITY WATER SYSTEM

## DETECTION SYSTEMS

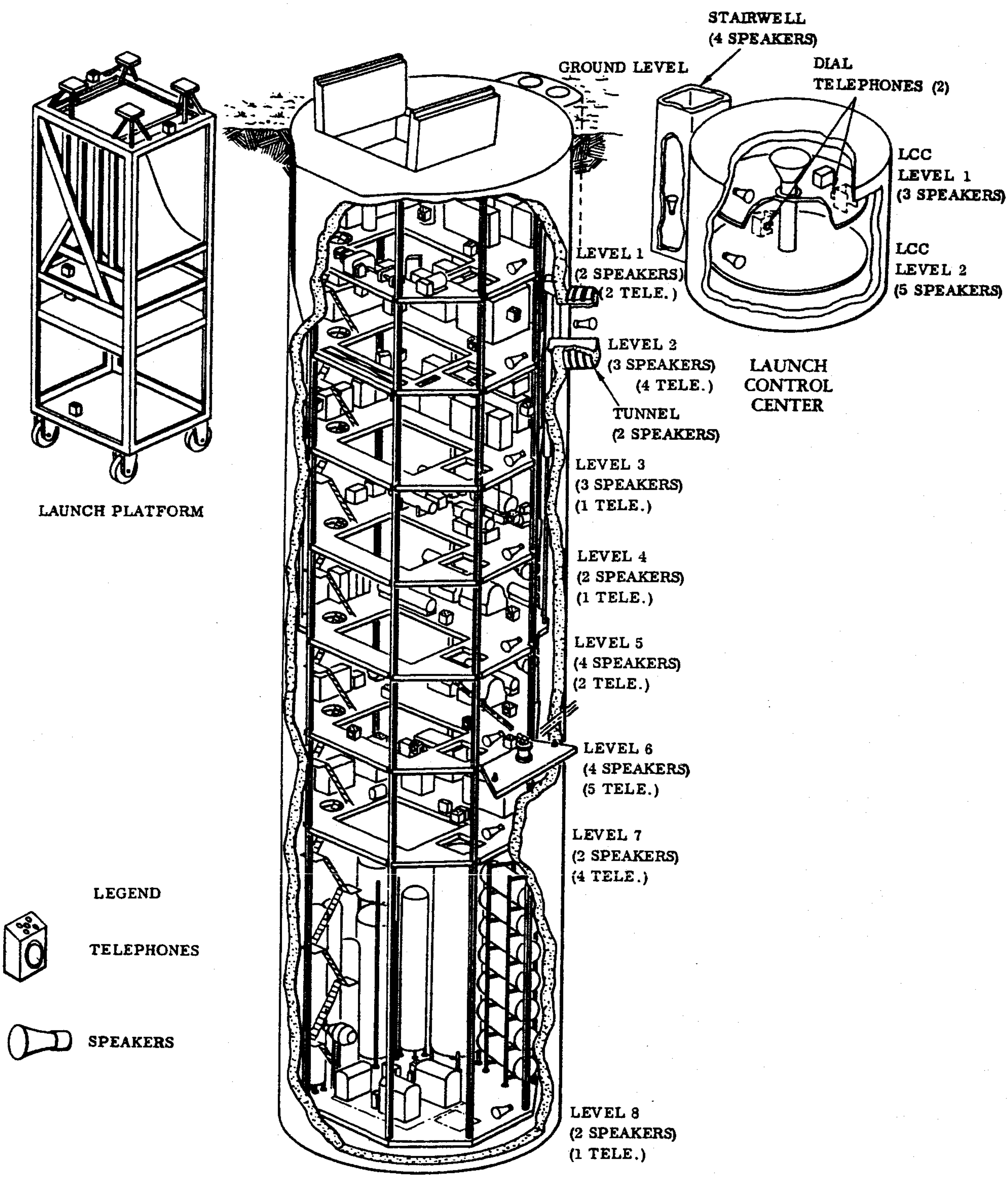
There are five detection systems at each launch complex: the fire alarm system, which detects and provides alarm signals in the event of fire; the gaseous oxygen detection system and the diesel fuel vapor detection system. These systems give both a visual and an audible warning if they detect critical concentrations of gaseous oxygen or diesel fuel vapor in the silo. Another detection system senses the presence of missile fuel vapor in the silo, gives a visual and audible warning, and causes the release of water fog which suppresses the vapor. Fifth is the blast detection system; this system consists primarily of a light-sensitive detector, mounted above ground level at the launch complex, which is sensitive only to high-intensity light, such as the flash of a nuclear explosion. Upon sensing such a flash, the detector sends a signal to a cabinet in the launch control center. This signal closes blast protection doors in the ventilator ducts, and at other passages with openings at ground level, before the blast forces of the explosion.




DETECTION SYSTEMS

## COMMUNICATION SYSTEMS

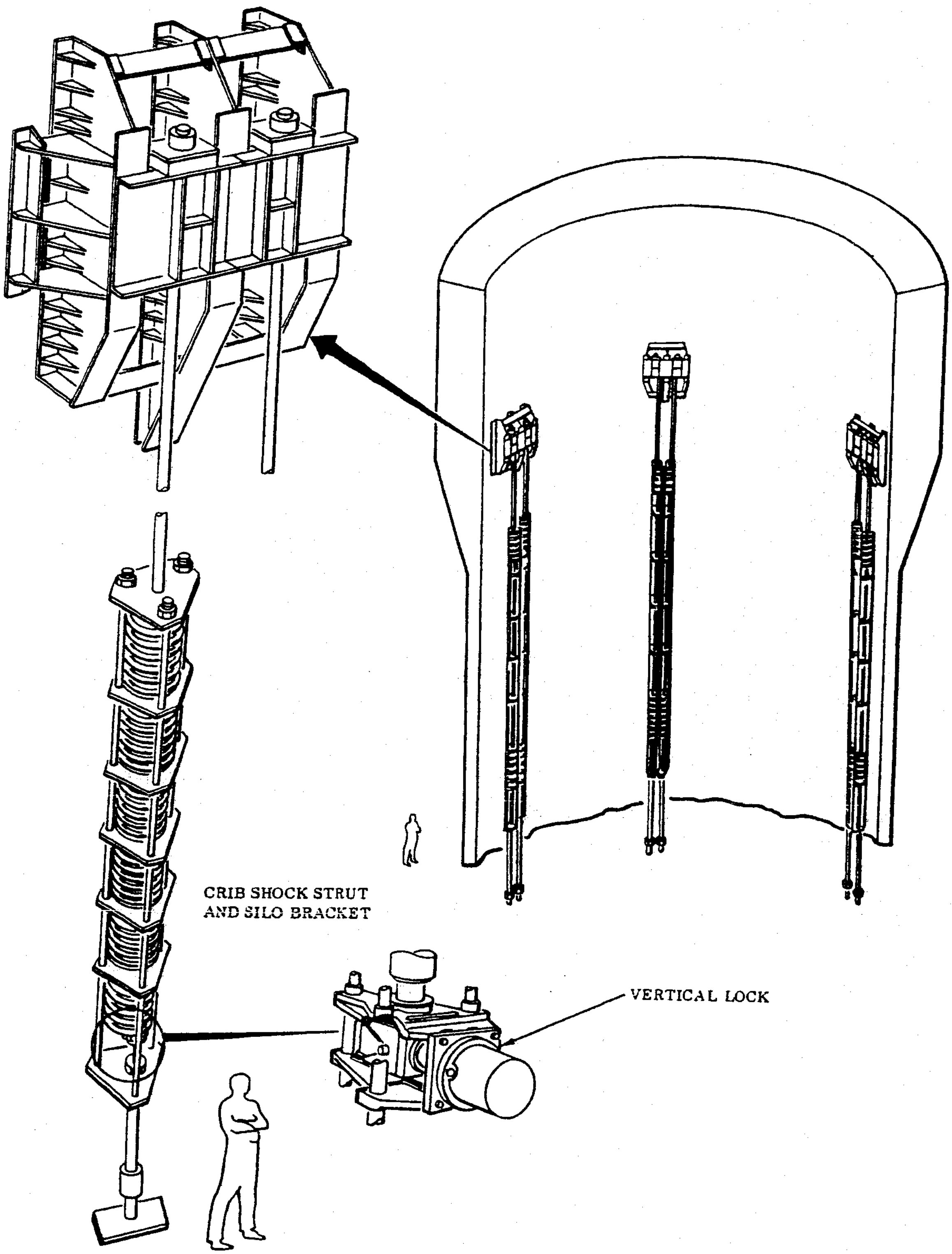
Each launch complex has a telephone system and a public address system. The telephone system interconnects the launch control center with all entrances to the launch complex and with the eight levels in the silo. Calls can be placed, via the launch control officer's console, from one silo level to another. Public address system inputs from the launch control center reach all areas of the launch complex.




COMMUNICATION SYSTEMS

## SILO CRIB SUSPENSION SYSTEM

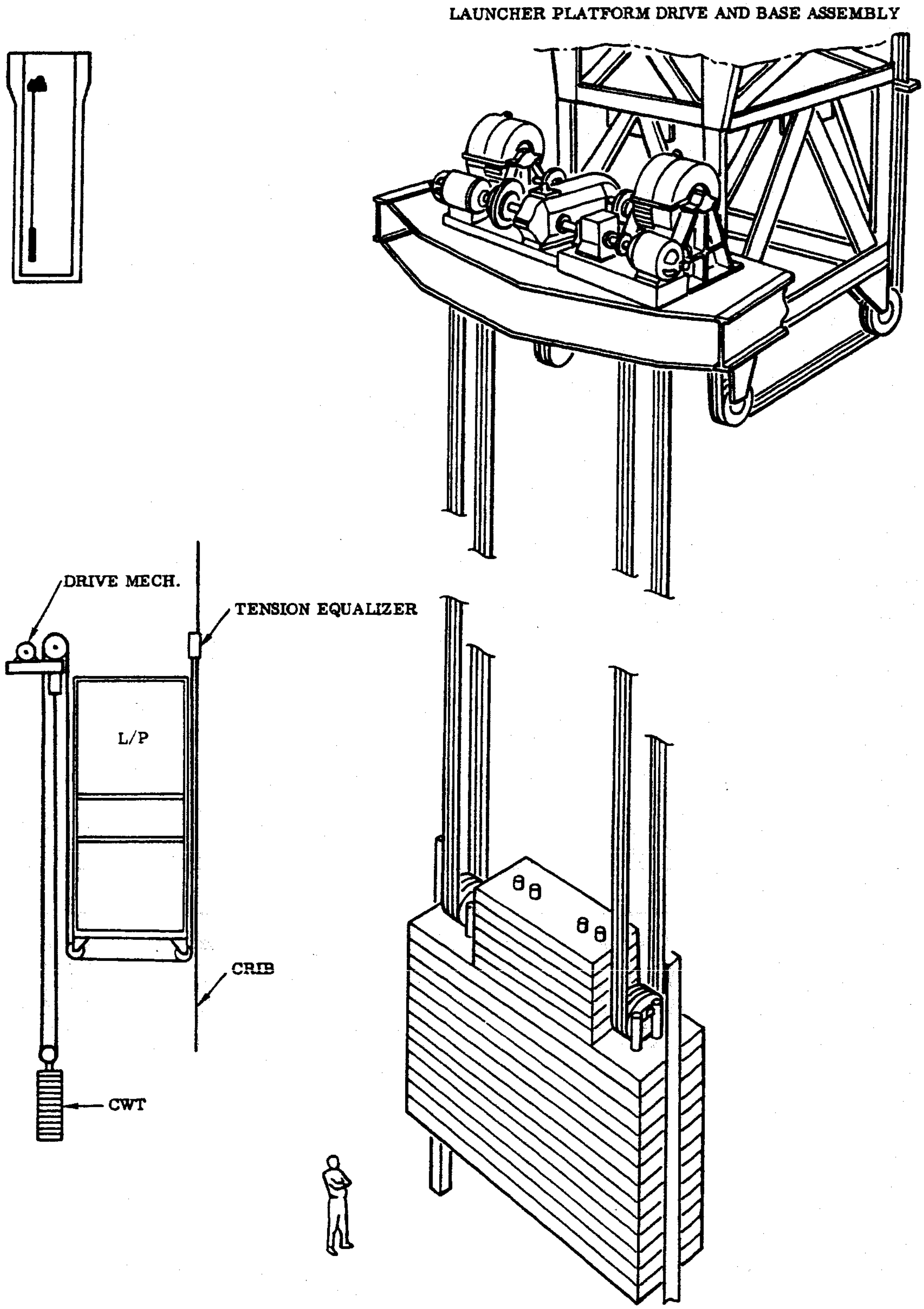
The major components of this system are four wall brackets and four pairs of spring-loaded shock struts. The wall brackets are mounted 90° apart on the silo wall, above the second level of the crib. The upper ends of each pair of shock struts are attached to a wall bracket, and the lower ends are attached to the crib at a point between the fifth and sixth levels. Each shock strut is 60 ft. long and consists of from 5 to 7 sets of concentric springs mounted on a central rod. Spring retainers on the rod transfer equal crib loads of each spring on the strut. The entire weight of the crib structure and its contents, including the launcher platform and missile, is suspended on the struts. Total weight is more than 1,500 tons. The system cushions the missile and its support equipment against the ground shock of a near-miss nuclear blast. Hydraulically actuated locks in the system anchor the crib structure to the silo walls during launcher platform operation.




SILO CRIB SUSPENSION SYSTEM

## LAUNCHER PLATFORM DRIVE SYSTEM

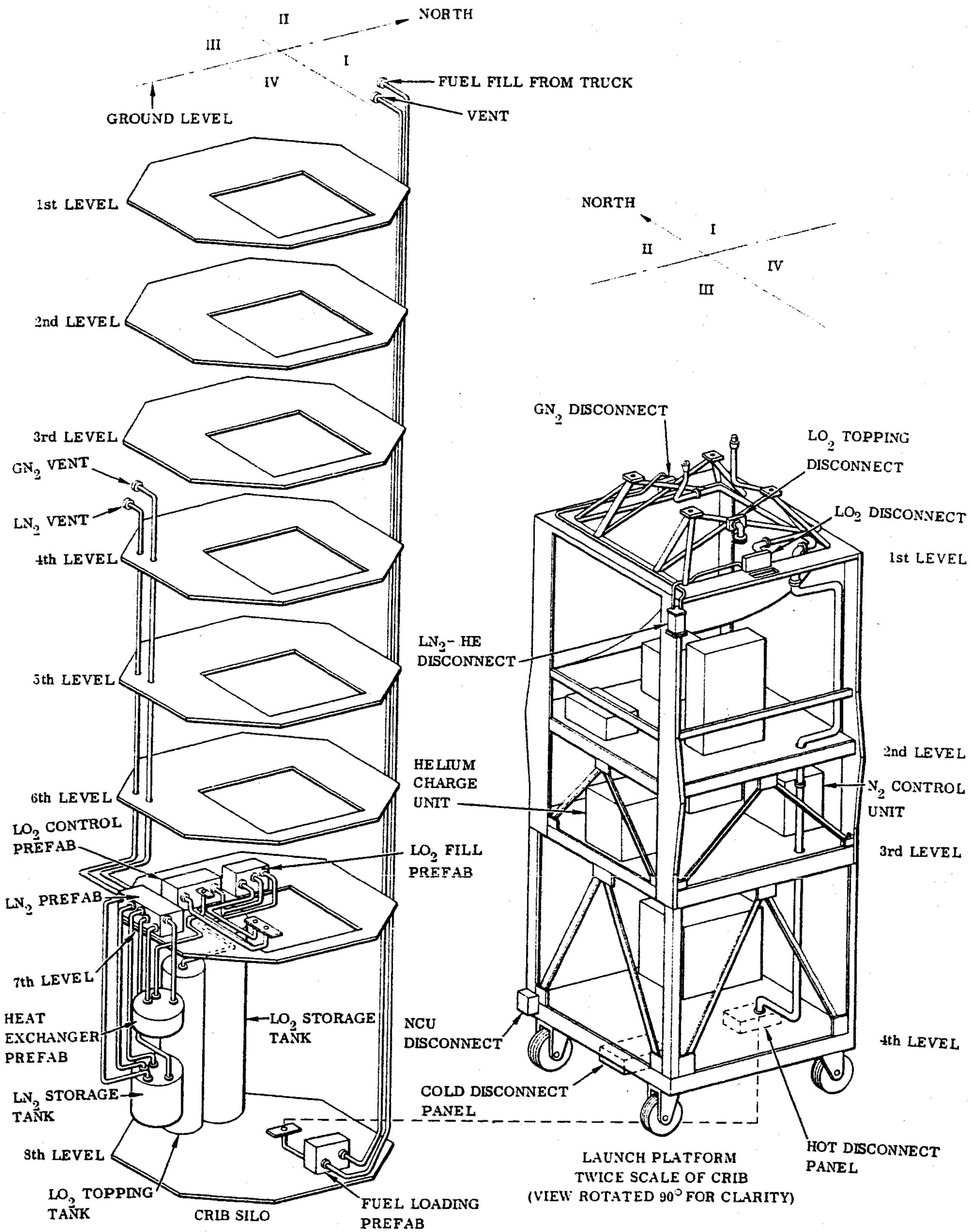
The launcher platform drive system raises and lowers the launcher platform along a set of guide rails attached to the inner sides of the launcher platform shaft structure. The drive system includes a drive mechanism, a launcher platform counterweight, 10 wire ropes, and a tension equalizer. The drive mechanism consists principally of two 125-hp electric motors, two reduction gears and two traction sheaves. The launcher platform counterweight, which has its own shaft and guide rails, is a stack of iron and steel slabs surmounted by two sheaves. The counterweight weighs 536,000 lb. The wire ropes are grouped in two sets of five ropes anchored to crib structure directly below the drive mechanism located on crib level No. 1. The opposite ends are attached to the tension equalizer, a teeter bar assembly anchored to crib structure above level No. 1. This assembly equalizes the tension between the sets of wire ropes.




LAUNCHER PLATFORM DRIVE SYSTEM

## PROPELLANT LOADING SYSTEM

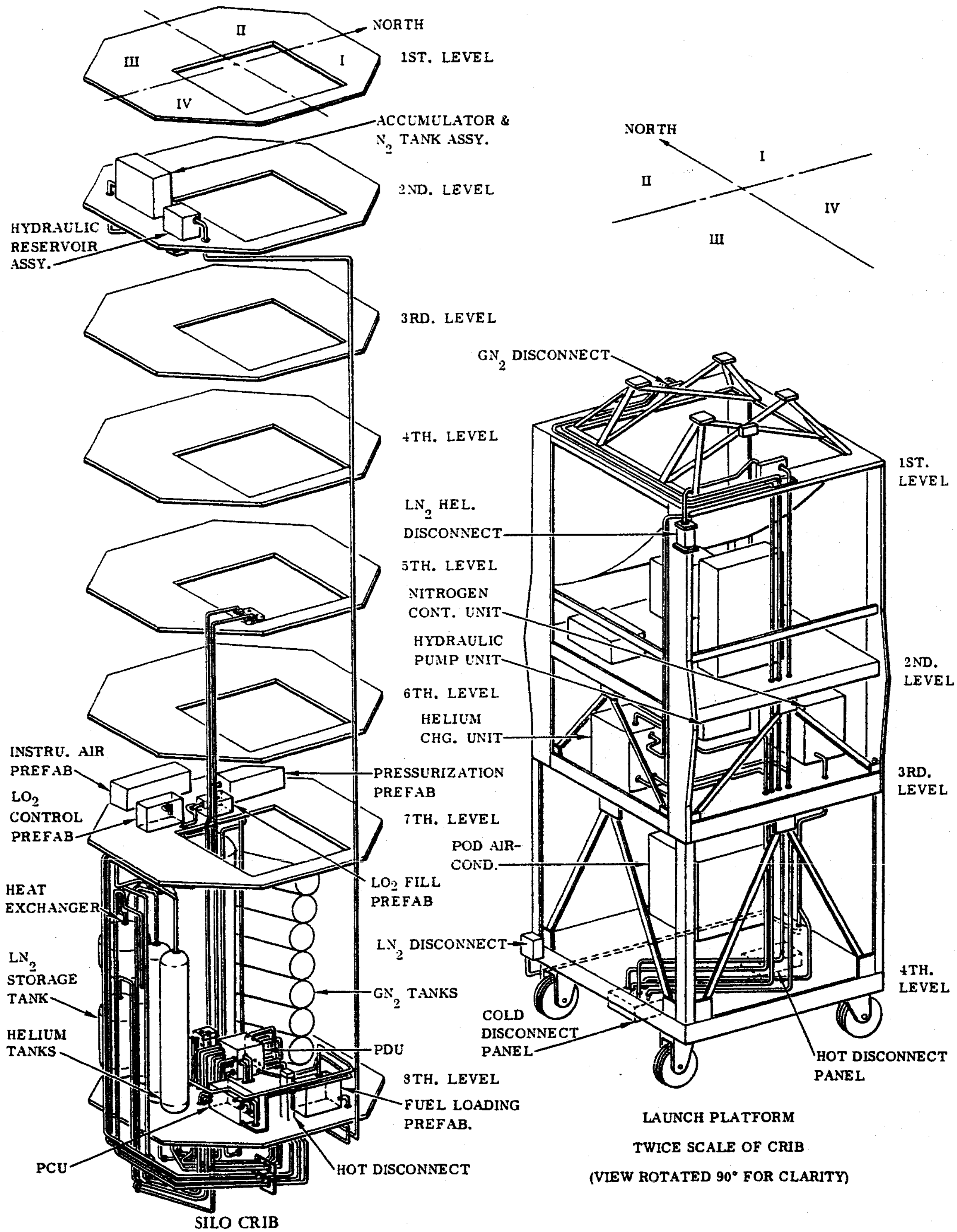
The propellant loading system consists of the silo-mounted storage tanks, control units and tubing which supply fuel and liquid oxygen to the missile (see illustration on opposite page). Fuel is loaded aboard the missile through fill lines connected to a tank truck above ground. The fuel then remains aboard the missile until the missile is launched or replaced. Two Dewar-type tanks in the system store liquid oxygen, which is transferred to the missile during countdown operations.




PROPELLANT LOADING SYSTEM

## PNEUMATIC SYSTEM

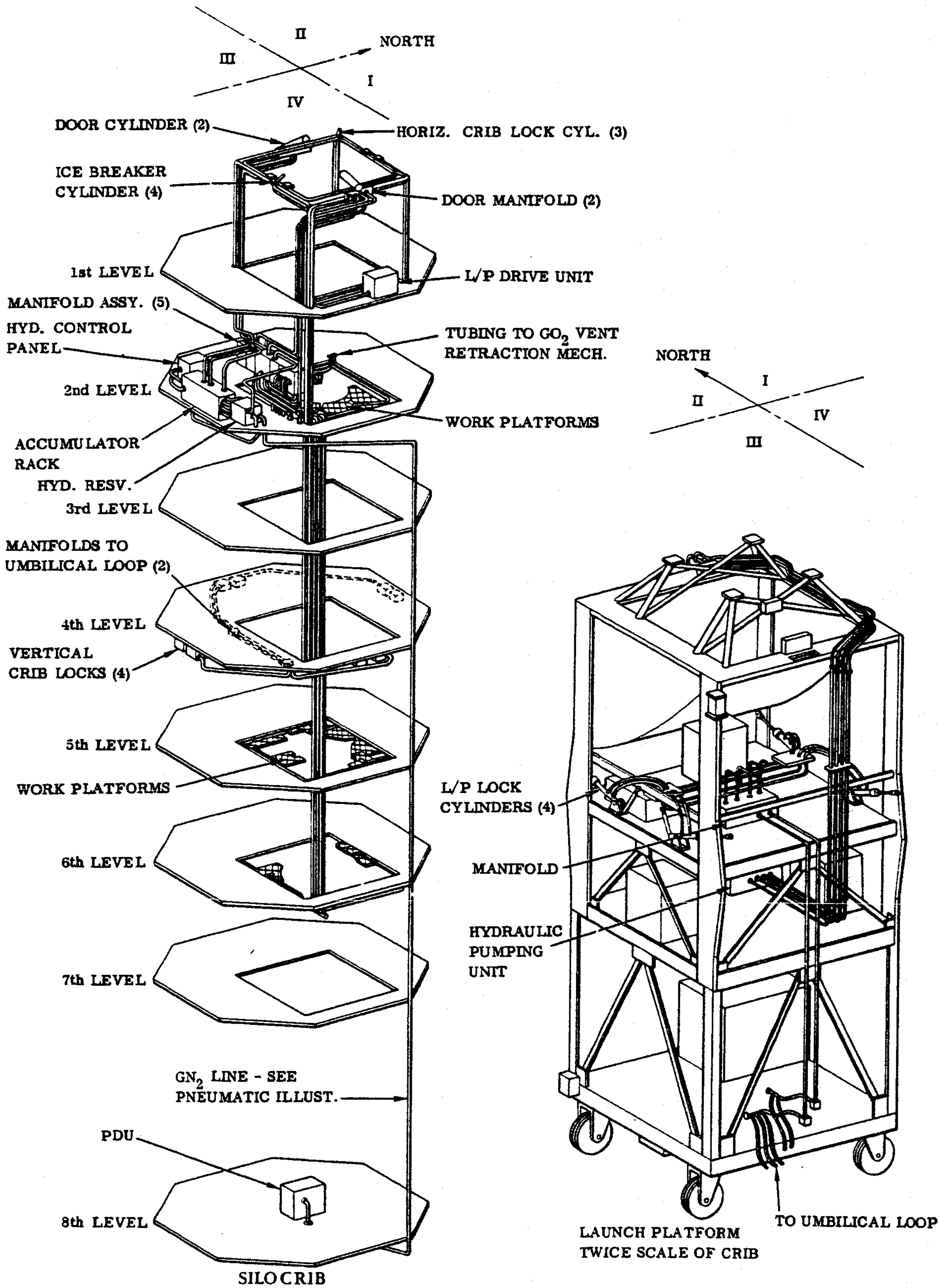
The pneumatic system includes the silo-mounted equipment used in the storage, control and transfer of gases. (See illustration on opposite page.) Gaseous nitrogen handled is used in missile propellant transfer, silo hydraulic equipment operation, and missile maintenance. Helium is used for missile tank pressurization.




PNEUMATIC SYSTEM

## HYDRAULIC SYSTEM

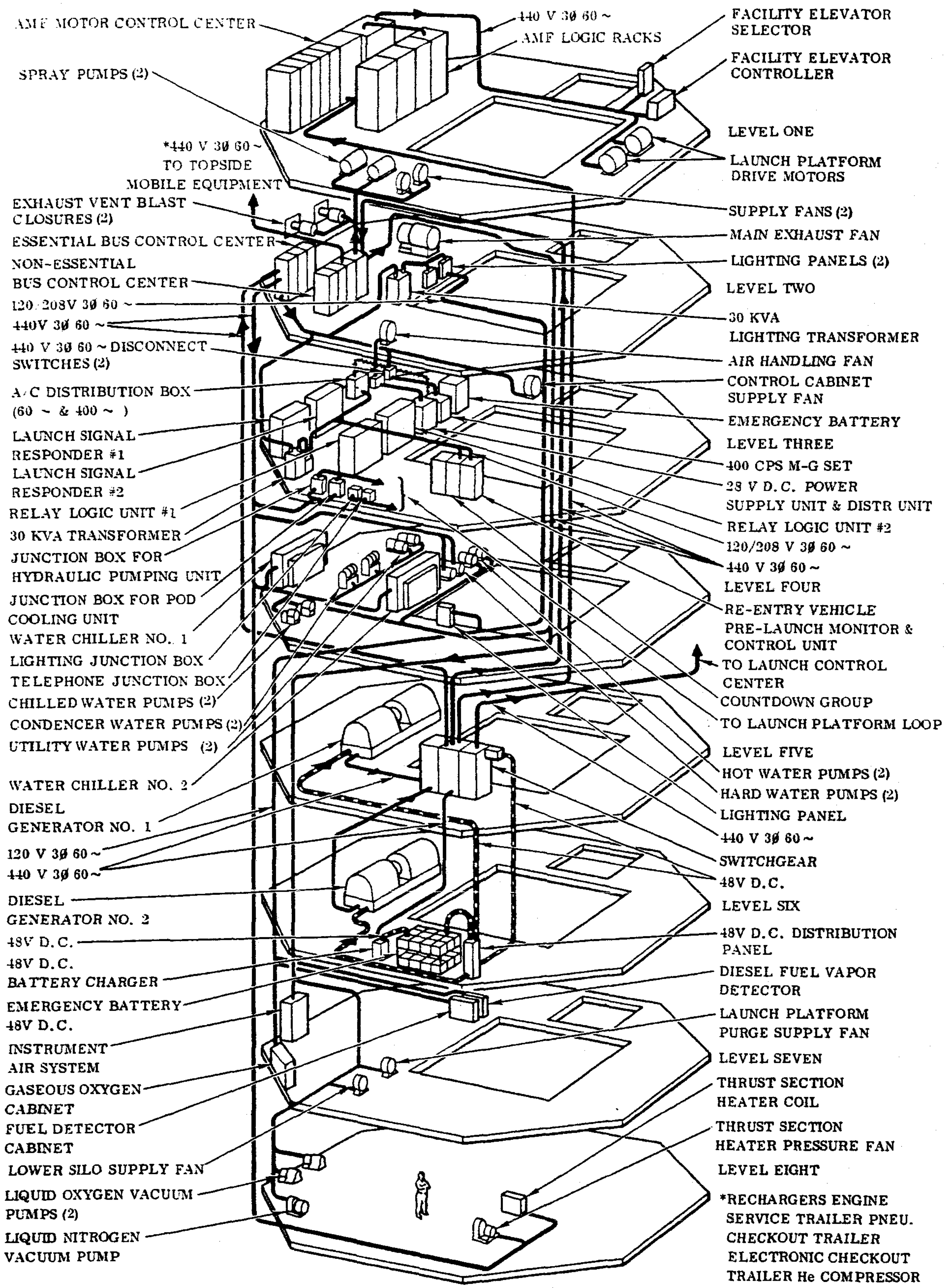
The hydraulic system consists of the silo-mounted control units, reservoirs, pumps, accumulators, lines and actuators needed for operating hydraulically powered equipment. (See illustration on opposite page.) This equipment includes the crib locks, the work platforms, the launcher platform locking mechanism, and the silo overhead doors. Also included is the hydraulic pumping unit on the launcher platform. This unit supplies hydraulic power to the missile during countdown and checkout operations.




HYDRAULIC SYSTEM

## SILO ELECTRICAL EQUIPMENT

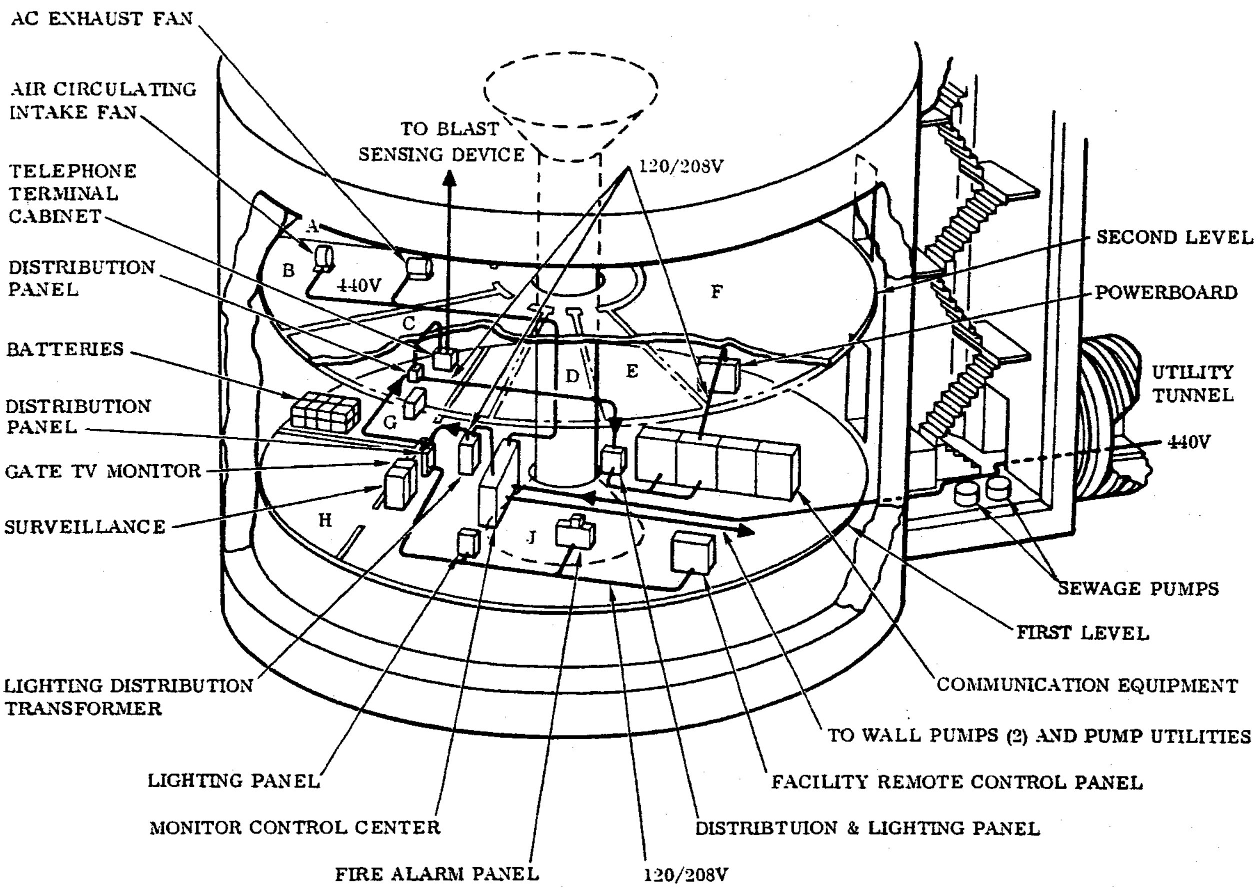
This equipment includes the generators, transformers, rectifiers, batteries, switchgear and cabling needed to make the entire launch complex electrically self-sufficient. Two diesel generators in the silo are the basic source of all electrical power for both the silo and the launch control center. The generators produce 480v 3-phase 60-cycle alternating current. Power is distributed through switchgear to the launch control center and to 480v operating equipment in the silo. This equipment includes pumps and motors, 120/208v transformers, 48v and 28v d-c rectifiers, and a 400-cycle 117v motor generator. Two sets of batteries, charged by rectifiers powered by the diesel generators, provide emergency 48v and 28v d-c power.




SILO ELECTRICAL EQUIPMENT

## LAUNCH CONTROL CENTER ELECTRICAL EQUIPMENT

The 440v 3-phase 60-cycle a-c power supply for the launch control center is routed through the utility tunnel that connects the launch control center to the silo. Within the launch control center the power is routed to the 440v equipment, and to a 120/208v transformer. The 120/208v power is routed throughout the launch control center. Emergency power is provided by batteries.

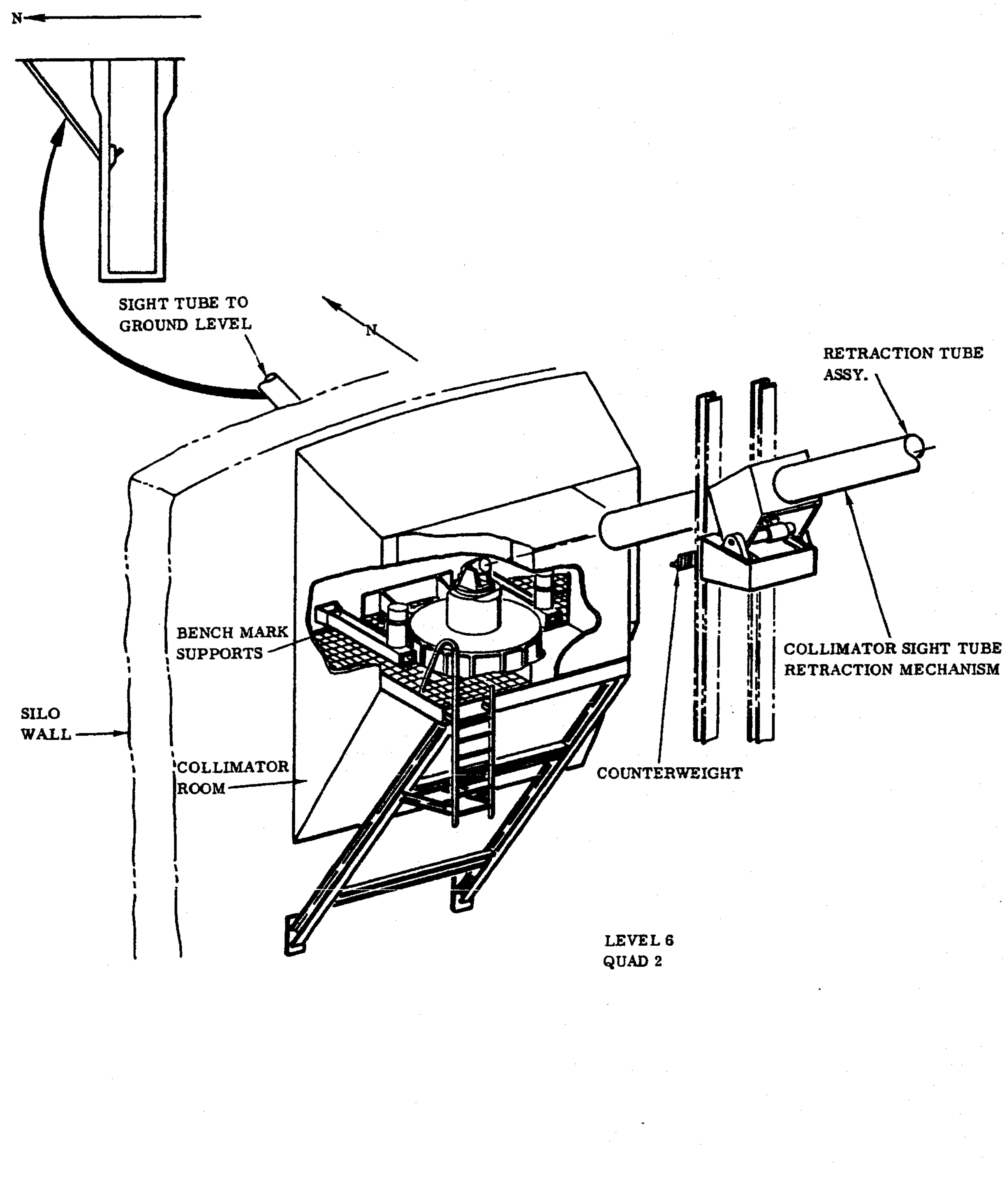



A SUPPLIES
B READY ROOM & STORAGE AREA
C KITCHEN & MESS
D TOILET
E JANITOR
F HEATING, VENTILATING & AIR CONDITIONING EQUIPMENT ROOM
G BAT. ROOM
H OFFICE
J LAUNCH CONTROL ROOM

LAUNCH CONTROL CENTER ELECTRICAL-EQUIPMENT

## GUIDANCE SYSTEM GSE

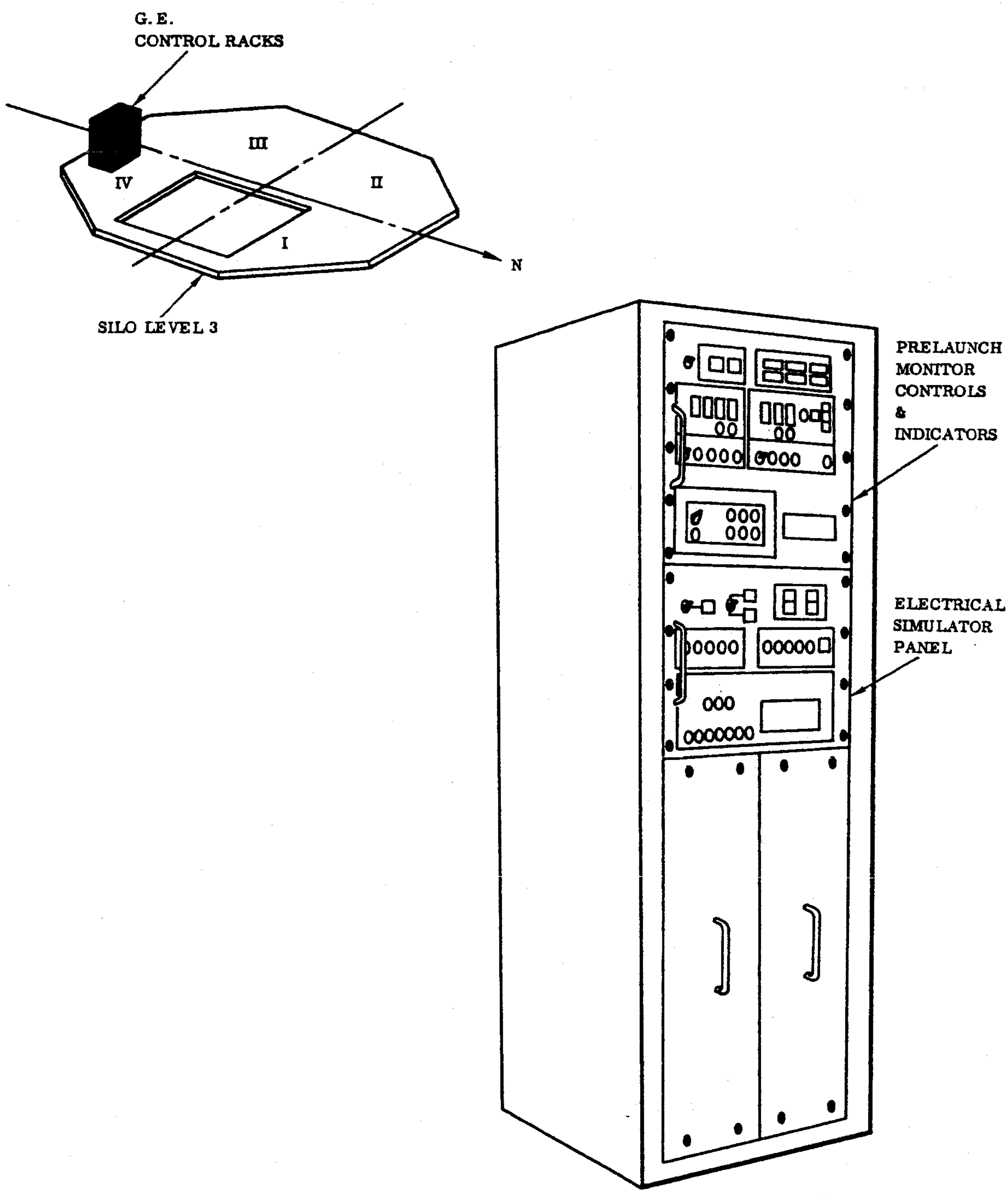
The guidance system GSE includes a collimator room and two sight tubes. The collimator room, an insulated light-tight chamber, is mounted on the north side of the silo wall at crib level No. 6. Inside the chamber are a collimator assembly and two bench marks. A sight tube leads from ground level down to the north side of the collimator room providing a light path between the collimator and the star Polaris. Periodic fixes made on Polaris and the two bench marks keep the collimator in alignment. The other sight tube leads upward from the opposite side of the collimator room to the missile guidance pod. This tube provides a path for an orienting light beam sent from the collimator to the inertial guidance reference platform aboard the missile. The portion of the tube which extends into the launcher platform enclosure is hinged, and swings out of the way when the missile is raised.




GUIDANCE SYSTEM GSE

## RE-ENTRY VEHICLE GSE

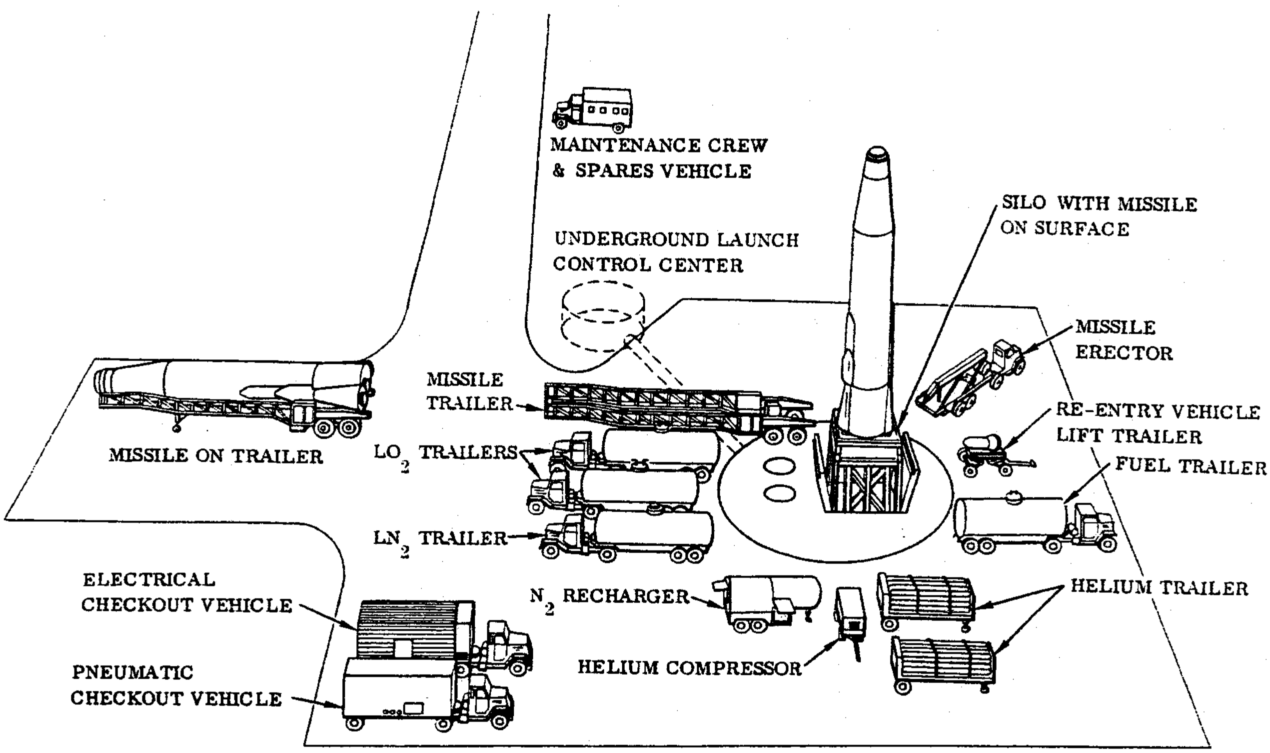
The re-entry vehicle GSE consists of the cabinet shown in the accompanying illustration. The logic units in this cabinet simulate the re-entry vehicle during checkout operations and monitor it during standby and countdown activities.




RE-ENTRY VEHICLE GSE

## MOBILE GSE

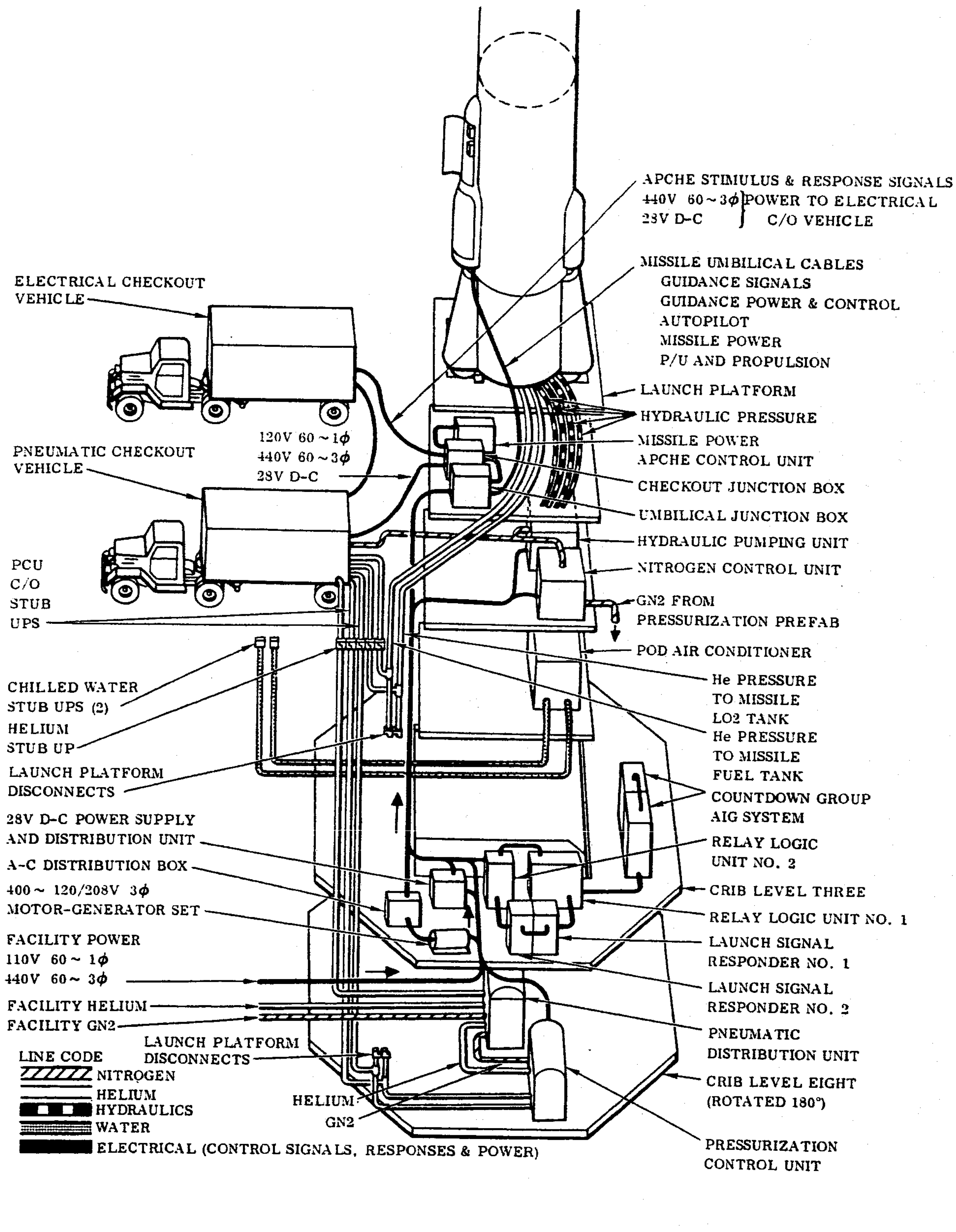
The mobile ground support equipment used at a launch complex consists of the trucks, trailers and handling equipment shown on the opposite page. This equipment is stored at the Squadron Maintenance Area when not in use at the launch complex.


MAINTENANCE CREW
& SPARES VEHICLE
SILO WITH MISSILE
ON SURFACE
UNDERGROUND LAUNCH
CONTROL CENTER
MISSILE
ERECTOR
MISSILE
TRAILER
RE-ENTRY VEHICLE
LIFT TRAILER
MISSILE ON TRAILER
$LO_2$ TRAILERS
FUEL TRAILER
$LN_2$ TRAILER
ELECTRICAL
CHECKOUT VEHICLE
$N_2$ RECHARGER
HELIUM TRAILER
PNEUMATIC
CHECKOUT VEHICLE
HELIUM COMPRESSOR

MOBILE GSE

## MISSILE SYSTEMS CHECKOUT AT LAUNCH SITE

Checkouts of the systems aboard a silo-based missile can be performed at the launch complex without removing the missile from the launcher platform. Checkouts are performed using equipment housed in two trailers, which are brought to the launch complex from the Squadron Maintenance Area. One of the trailers, the pneumatic checkout vehicle, contains tanks and other equipment which simulate both normal and abnormal missile tank pressures. The electrical checkout vehicle contains automatic programed checkout equipment which controls and monitors both the pneumatic checkout vehicle and the missileborne systems under test.



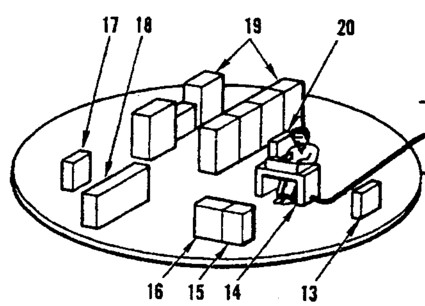

MISSILE SYSTEMS CHECKOUT AT LAUNCH SITE

## LAUNCH CONTROL SYSTEM

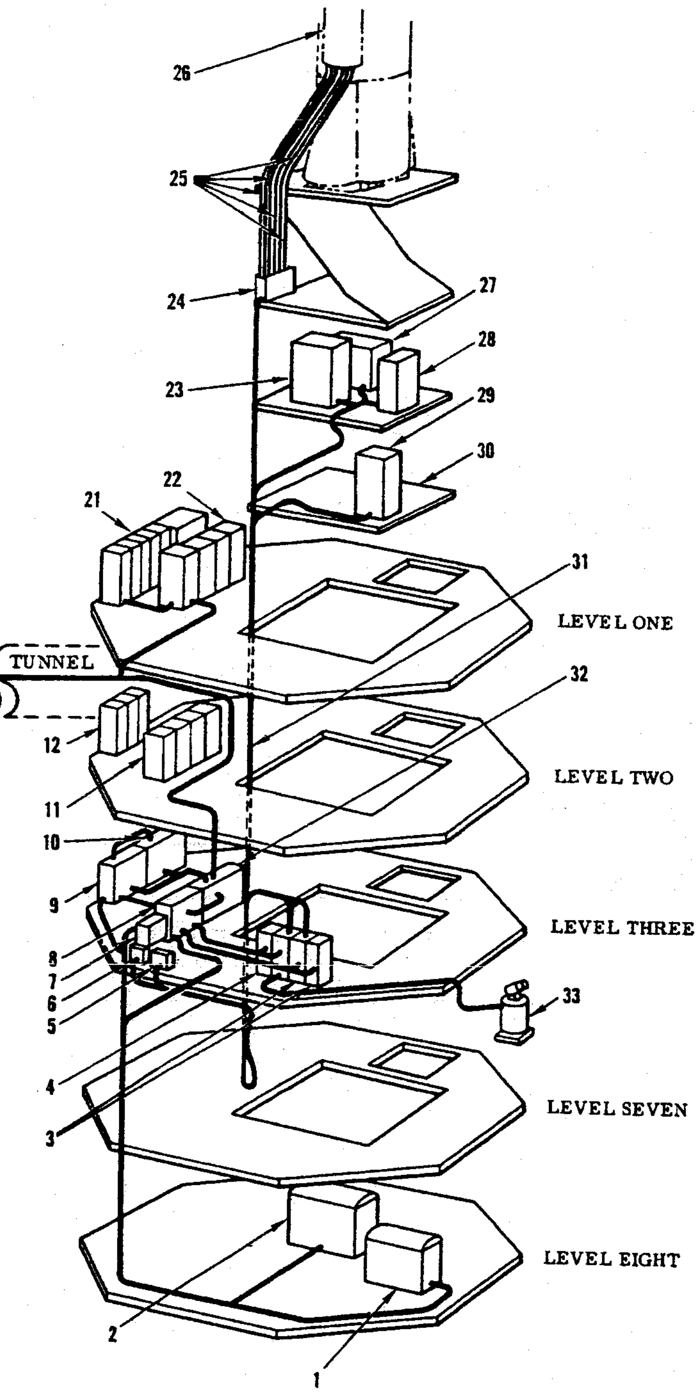
The launch control system consists of control cabinets and cabling in the silo, and a launch control console in the launch control center. This system continuously monitors the countdown readiness of the missile and its ground support equipment and controls and monitors their operation during a countdown.

EQUIPMENT KEY

1 PRESSURIZATION CONTROL UNIT
2 PNEUMATIC DISTRIBUTION UNIT
3 RE-ENTRY VEHICLE PRE-LAUNCH MONITOR & CONTROL GROUP
4 COUNTDOWN GROUP (AIG)
5 JUNCTION BOX FOR POD AIR CONDITIONING UNIT
6 JUNCTION BOX FOR HYDRAULIC PUMPING UNIT
7 FACILITY INTERFACE CABINET
8 RELAY LOGIC UNIT NO. 1
9 LAUNCH SIGNAL RESPONDER NO. 1
10 LAUNCH SIGNAL RESPONDER NO. 2
11 NON-ESSENTIAL BUS CONTROL CENTER
12 ESSENTIAL BUS CONTROL CENTER
13 POWER REMOTE CONTROL PANEL (REF.)
14 LAUNCH CONTROL CONSOLE
15 SURVEILLANCE TV MONITOR (REF.)
16 GATE TV MONITOR (REF.)
17 BATTERY CHARGER (REF.)
18 BATTERIES FOR TELEPHONE SYSTEM (REF.)
19 COMMUNICATION (TELEPHONE) EQUIPMENT (REF.)
20 FACILITY REMOTE CONTROL PANEL (REF.)
21 AMF MOTOR CONTROL CENTER
22 AMF LOGIC RACKS




LAUNCH CONTROL CENTER 2nd LEVEL



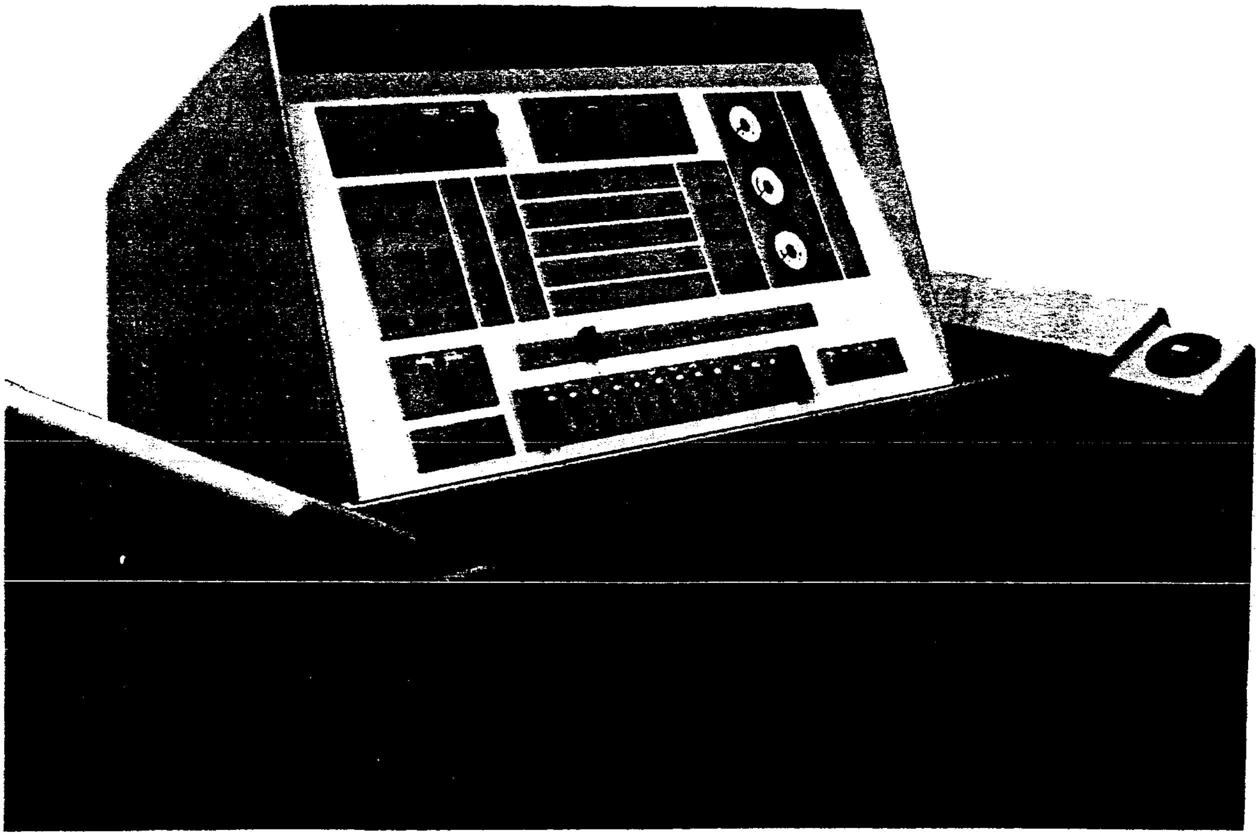

MISSILE SILO

23 NITROGEN CONTROL UNIT
24 UMBILICAL JUNCTION BOX
25 MISSILE UMBILICAL CABLES
GUIDANCE SIGNAL
GUIDANCE POWER & CONTROL
AUTOPILOT
R/V
MISSILE POWER
P/U & PROPULSION
26 MISSILE POD
27 HELIUM CHARGE UNIT
28 HYDRAULIC PUMPING UNIT
29 POD AIR CONDITIONING UNIT
30 LAUNCH PLATFORM
31 CABLE LOOP
32 RELAY LOGIC UNIT NO. 2
33 PLATFORM SENSING ALIGNMENT GROUP

LAUNCH CONTROL SYSTEM

## LAUNCH CONTROL CONSOLE

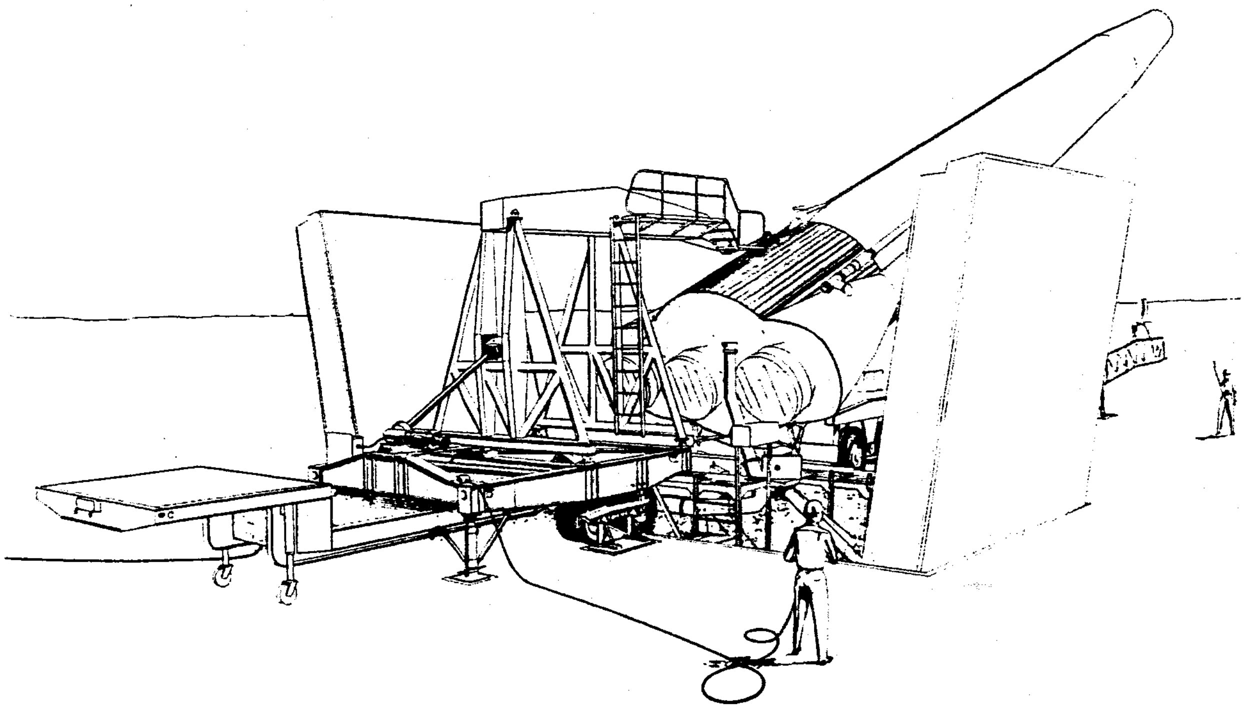
The launch control officer monitors and operates the missile and its ground support equipment from the launch control console located on the lower level of the Launch Control Center (see opposite page). The indicators and controls on the panel show the countdown-ready status of missileborne and silo-mounted systems; pushbuttons are provided for the emergency control of missile tank pressures. In the upper left corner of the panel are guidance system indicators and controls. At the top center of the panel is a digital clock. During a countdown, this clock indicates the time remaining before missile launch. When the ready-for-countdown indicator is green, a countdown can be started by depressing the start button below it. Indicators to the right of this button show the progress of the countdown. When the ready-for-commit indicator turns green, depressing the button to the right of that indicator causes the missile to be raised out of the silo and launched. If a malfunction occurs during a countdown, the sequence can be reversed to the ready-for-countdown point by depressing the start abort button to the right of the precommit indicators. Other controls on the panel include buttons for the launch complex telephone and public address systems.



LAUNCH CONTROL CONSOLE

## MISSILE ERECTION SYSTEM

The missile erection system consists of a trailer-mounted erector and four trailer alignment rails. The erector essentially is a walking beam actuated by an electrically driven jackscrew. Before missile erection or removal, the trailer alignment rails are anchored in pairs to steel plates, which are embedded in the silo cap at opposite sides of the launcher platform opening. The missile handling trailer is backed onto one pair of alignment rails, and the erector trailer is backed onto the other pair. With the launcher platform raised to the proper height above ground, one side of the missile thrust section is attached to pivots on the launcher; the other side is attached to a hinged fitting on the walking beam of the erector. Then the erector's jackscrew either retracts the beam for missile erection or extends it for missile removal.



MISSILE ERECTION SYSTEM

# VI. GLOSSARY

## GLOSSARY

Terms used in this manual are defined below in the sense in which they apply to base activation.

AMC--Air Material Command of the U.S. Air Force, the logistic service agency, which controls the purchase of weapons and other property for the Air Force.

ARDC--The Air Research and Development Command of the U.S. Air Force. The service agency directing the development of Air Force weapon systems.

ASSOCIATE CONTRACTOR--A civilian contracting organization working with Astronautics in the activation of a complete missile base.

BMD--The Ballistic Missile Division of the U.S. Air Force. The service agency directly responsible for and in charge of the Ballistic Missile Program, including the Atlas Program, for which BMD is the Project Office.

BOD (Beneficial Occupancy Date)--The date on which the facility is accepted by the Air Force at which time Astronautics and its associate contractors and subcontractors can commence installing ground support and other equipment.

COMPLEX--A complex is comprised of a silo, launch control center, paving, fences, underground storage tanks, etc., necessary to the protection maintenance and launching of single Atlas Series F missile.

CONFIGURATION--The physical sum of all the component structures, equipment instrumentation, and other property which comprises a complete weapon system.

COORDINATION--The synchronization of two or more parallel but independent actions all of which are needed to accomplish a single thing.

EID--A four-digit numerical representation of the work description of an end item configuration.

END ITEM--A final combination of parts, assemblies and installations comprising a product which is ready for its intended use, either along or in conjunction with other end items.

FACILITY--The structures, machinery, instruments, and equipment built, provided, and installed by the Corps of Engineers' contractors in accordance with architect and engineer drawings and specifications.

FUNCTION--A Base Activation term which is used to define a grouping of components used principally for the same purpose and validated as an individual operational entity. It may define a complete system or only part of a system.

GSE (Ground Support Equipment)--All mobile or installed equipment, instruments, and the like, employed in the weapon system which is neither facility nor missile. (See severable items.)

INSTALLATION & CHECKOUT (I&C) SCHEDULE--A schedule chart showing flow and span time of GSE installation, validation and integration tasks necessary to activate an Atlas missile launch complex.

INSTALLATION--The placement and securing of the item. It does not necessarily mean that the item will be completely hooked up mechanically and electrically unless the planning card so describes it.

INTEGRATION--The action necessary to interconnect two or more functions and check out the resulting configuration.

INTEGRATED FACILITY ITEMS--Facility items which are included in activation functions.

INTERFACE--Within silo systems, any point where facility and GSE installations meet.

ITEM--An incremental collection of work tasks that will be accomplished in a given period of time. In most cases in activation, an item corresponds to an OIL.

JOD (Joint Occupancy Date)--A date (prior to BOD) agreed upon by Astronautics BMD and Corps of Engineers. It allows certain I&C tasks to commence before the facility is completed and accepted by the Air Force.

OIL (Operations Inspection Log)--A document produced by IBM data processing methods, compiling the identifying numbers of the planning cards related to a particular group of work, usually an item.

PLANNING CARD--The paper form used to spell out in detail the operations to be accomplished during activation. References to procedures, drawings, etc., are included.

SEVERABLE ITEMS--Items of property which may be readily moved from one location to another. Examples: desks, hand tools, motor vehicles, laboratory equipment, calibration instruments.

SPECIFICATIONS--The detailed book of specifications prepared under the Corps of Engineers for Facility protions of each base.

SURVEILLANCE PLAN--An instrument wherewith men and material are provided and deployed in such manner as to ensure complex and continuing observation of all phases of work involved in activating an Atlas missile silo launch base.

TAB CARD--A special-paper IBM card with perforations corresponding to coded numbers and letters representing status data, which is extracted from the card by electronic data processing machines. The accumulated data from all cards in a "run" is printed out by the machines in any desired, predetermined form of summation or analysis of project status.

VALIDATION--The action of determining that a system or other prescribed portion of the base can and will serve the purpose for which it was created.

WEAPON SYSTEM CONTRACTOR--The agency accepting over-all responsibility for production of the weapon system. Design criteria, surveillance, coordination, quality control and final selloff are facets of this task. Astronautics is the weapon system contractor for the Atlas weapon system.

**REFERENCE 13**

# SAFETY SUPPLEMENT

## OPERATION MANUAL

USAF SERIES

## HGM-16F

MISSILE

THIS PUBLICATION SUPPLEMENTS T.O. 21M-HGM16F-1 DATED 1 APRIL 1964 (PRE-HEAT AND RED HEAT) AND REPLACES INTERIM SAFETY SUPPLEMENTS T.O. 21M-HGM16F-1SS-3 DATED 19 JULY 1964 AND T.O. 21M-HGM16F-1SS-4 DATED 29 JULY 1964. Reference to this supplement will be made on the title page of the basic publication by personnel responsible for maintaining the publication in current status.

COMMANDERS ARE RESPONSIBLE FOR BRINGING THIS SUPPLEMENT TO THE ATTENTION OF ALL AFFECTED AIR FORCE PERSONNEL.

PUBLISHED UNDER AUTHORITY OF THE SECRETARY OF THE AIR FORCE



29 JULY 1964

During a PLX or maintenance countdown using LN2 in place of LO2 and the STORAGE AREA OXYGEN 19 PER CENT indicator on the FRCP illuminates red from "START COUNTDOWN" to MISSILE LIFT UP AND LOCKED INDICATOR AMBER", and a TV camera is positioned on Level Seven to scan all LO2 transfer lines and valves on Level Seven outside the MEA, the countdown may be continued at the discretion of the MCCC, only if it can be determined by visual observation and by logic and pressure indications that there is no evidence of LN2 leakage or spillage. If leakage or spillage is evident, MCCC shall initiate abort in accordance with Table 4-2, Item 6C. If the countdown is continued, the following procedures shall apply:

1. After MISSILE LIFT UP AND LOCKED indicator illuminates green, and ABORT INDICATOR illuminates red, perform ACTION 1, Step 1 of Table 4-2, Item 6C.

2. After ABORT EXTERNAL INDICATOR illuminates amber, perform steps 2 through 6, Table 4-2, Item 6C.



AF SBAMA AUG 64 1300

## 1-7. LAUNCH CONTROL CENTER.

1-8. The launch control center (figures 1-4 and 1-5) consists of two floor levels (crib) that are suspended from the ceiling of a concrete structure and air-cushioned to absorb ground shocks. The suspension system is composed of four air cylinder spring supports attached from the ceiling of the structure to the first floor level and four level-detecting devices mounted between the second floor level and the concrete base. Should the floor level lower or tilt, the level detecting devices sense the change. Solenoid-operated valves are then actuated to allow compressed air to enter or to bleed air from the respective air cylinders. (See figure 1-6.) The first level (upper floor) contains a medical supply room; rest room; heating, ventilation, and air conditioning equipment room; and a training-briefing room. The second level (lower floor) containing the launch control center is divided into four main rooms; a battery room, office, communications equipment room, and a launch control room. Entrance to the launch control center is gained through a blast door and stairway. An escape hatch is also provided for emergency exit. The launch control room contains the equipment to monitor and control countdown and launch of the missile and equipment to monitor power, hazardous conditions, and facility status. Controls and monitoring equipment consist of panels, consoles, and television. The television monitors missiles condition within the silo or may also be connected to external (above ground) cameras.

## 1-9. LAUNCH CONTROL CONSOLE.

1-10. The launch control console is located on the second level of the launch control center in the launch control room. A panel on the console (figure 1-7) contains the controls and indicators necessary for the missile combat crew commander (MCCC) to initiate a countdown and launch the missile. Arranged in various functional platches, the indicators display the summary status of the aerospace ground equipment (AGE) and missile systems at standby and during a countdown. The information displayed enables the MCCC to monitor the progress of a countdown, maintain a safe missile condition, and make the required decisions in the event of a subsystem malfunction. A communications subpanel provides the various telephone line connections required by the MCCC.

1-11. During countdown, all relay logic subsystems are remotely controlled from the launch control console. Signals from the console energize circuits in the countdown panels (figure 1-8) of the countdown control system. The countdown control system, in turn, energizes and controls circuits in the other relay logic systems. Signals from the control-monitor group 1 and 2 of 4 then actuate and control the airborne and AGE systems. The responses are interlocked in the relay logic unit as required for comparison and further sequencing. Certain critical status responses are displayed on the front panels of the control-monitor group 1 and 2 of 4 to provide information for fault isolation and local control operations. Control-monitor group 1 and 2 of 4 send summary status signals to the launch control console for display.

## 1-11A. PNEUMATIC LOCAL CONTROL PANEL.

1-11B. The pneumatic local control panel (PLCP), located on the left side of the launch control console, contains the controls and indicators to sequence the pneumatics end-to-end (PETE) test. (See figure 1-100.) The PETE test is conducted periodically and verifies the functional integrity of missile pneumatic and pressurization systems, both ground and airborne. Indicators on the panel display the operation and sequencing of missile system valves, pressure switches, and regulators while the PETE test is being performed.

## 1-12. GROUND COMMUNICATIONS.

1-13. The ground communications systems available at the launch complex include the following: the direct line telephone, the research and development system (OSTF-2), the administrative dial telephone, the missile flight safety system (Vandenberg AFB), the public address (PA), and the launch maintenance conference network. (See figure 1-9.) The direct line communications system is the primary mode of communication used during missile countdown and launch. It provides direct communication between consoles and from consoles to other specific stations, with no switchboard intervening. Depressing a line selected pushbutton on a console connects the attendant's headset to the direct line station selected. The command post and the alternate command post console operators can, by depressing



0002

1 TELEPHONE TERMINAL CABINET
2 SIGNALLING SYSTEM CABINET
3 MAIN DISTRIBUTION FRAME
4 INTERIM PA BAY & LES CONTROL BOX
5 L/M BAY
6 D/L BAY
7 COMM RACKS
8 COMMUNICATIONS PANEL C
9 LES "J" BOX
10 ANNUNCIATOR PANEL
11 UHF AND VHF SYSTEMS
12 JUNCTION BOX
13 BLAST DETECTION CABINET
14 COMMUNICATIONS CONSOLE
15 FIRE ALARM BATTERY BOX
16 FIRE ALARM PANEL
17 NOTIFIER PANEL
18 COMM ANNUNCIATOR
19 FRCP
20 COMMUNICATIONS DISCONNECT PANEL
21 PRCP
22 $LO_2$ TANKING PANELS 1 & 2
23 LC CONSOLE
24 CSMOL
25 TV MONITOR
26 ENTRAPMENT TV MONITOR
27 GATE AND DOOR CONTROL PANEL
28 DISTRIBUTION PANEL "A"
29 480-VOLT CONTROL CENTER
30 DISTRIBUTION PANEL "D"
31 440-VOLT TRANSFORMER
32 BATTERY BANK
33 CHARGER BAY

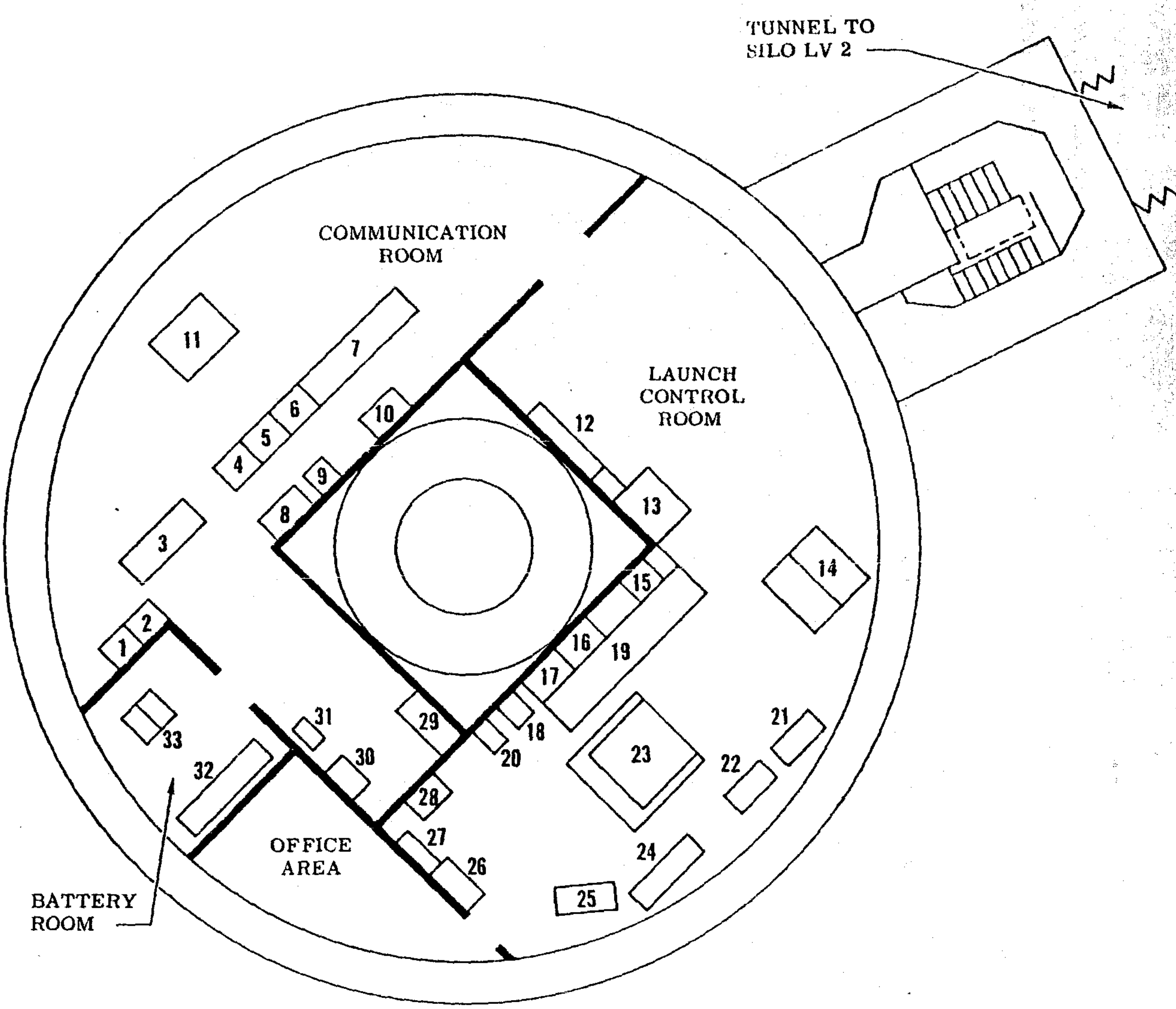



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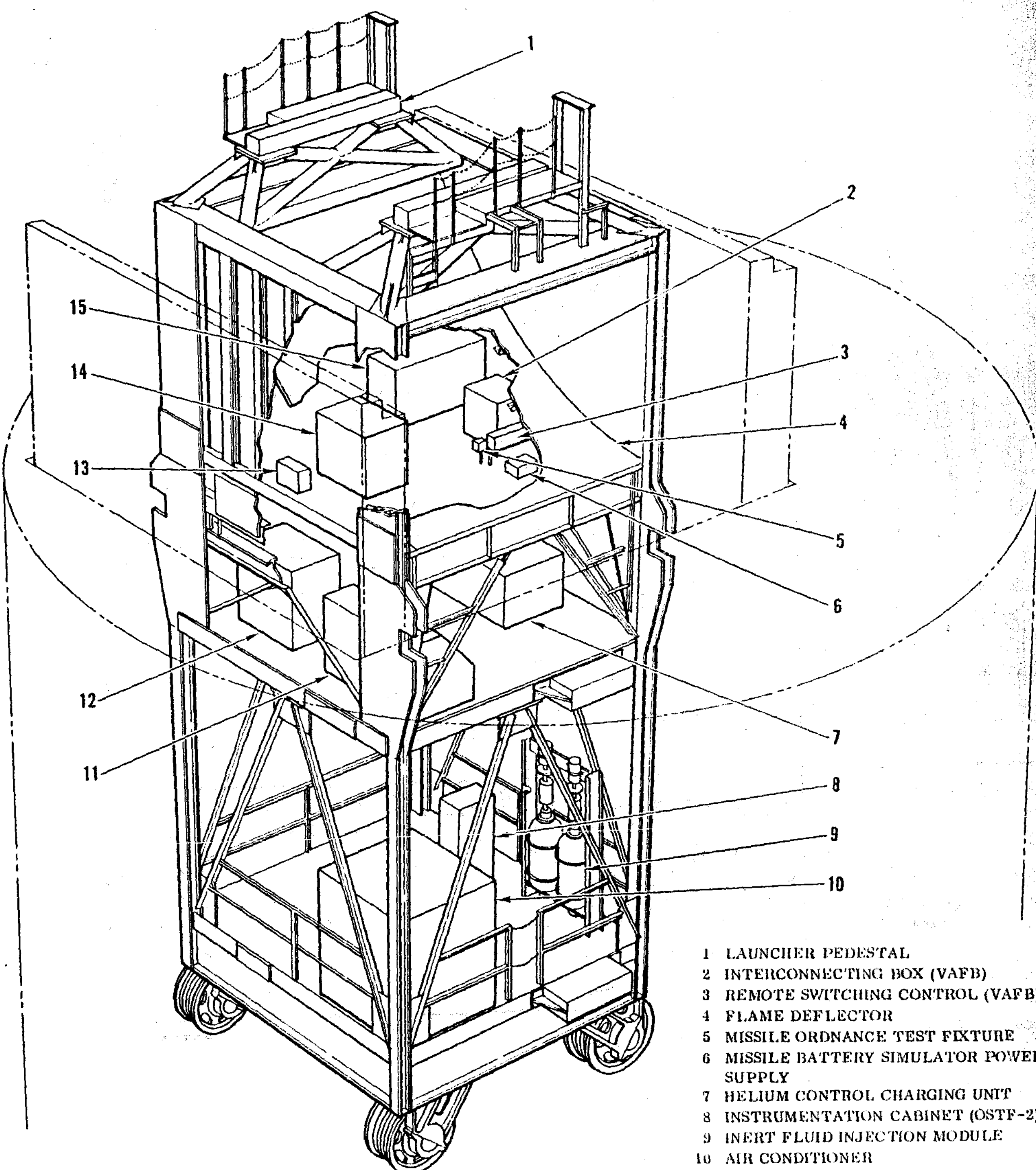
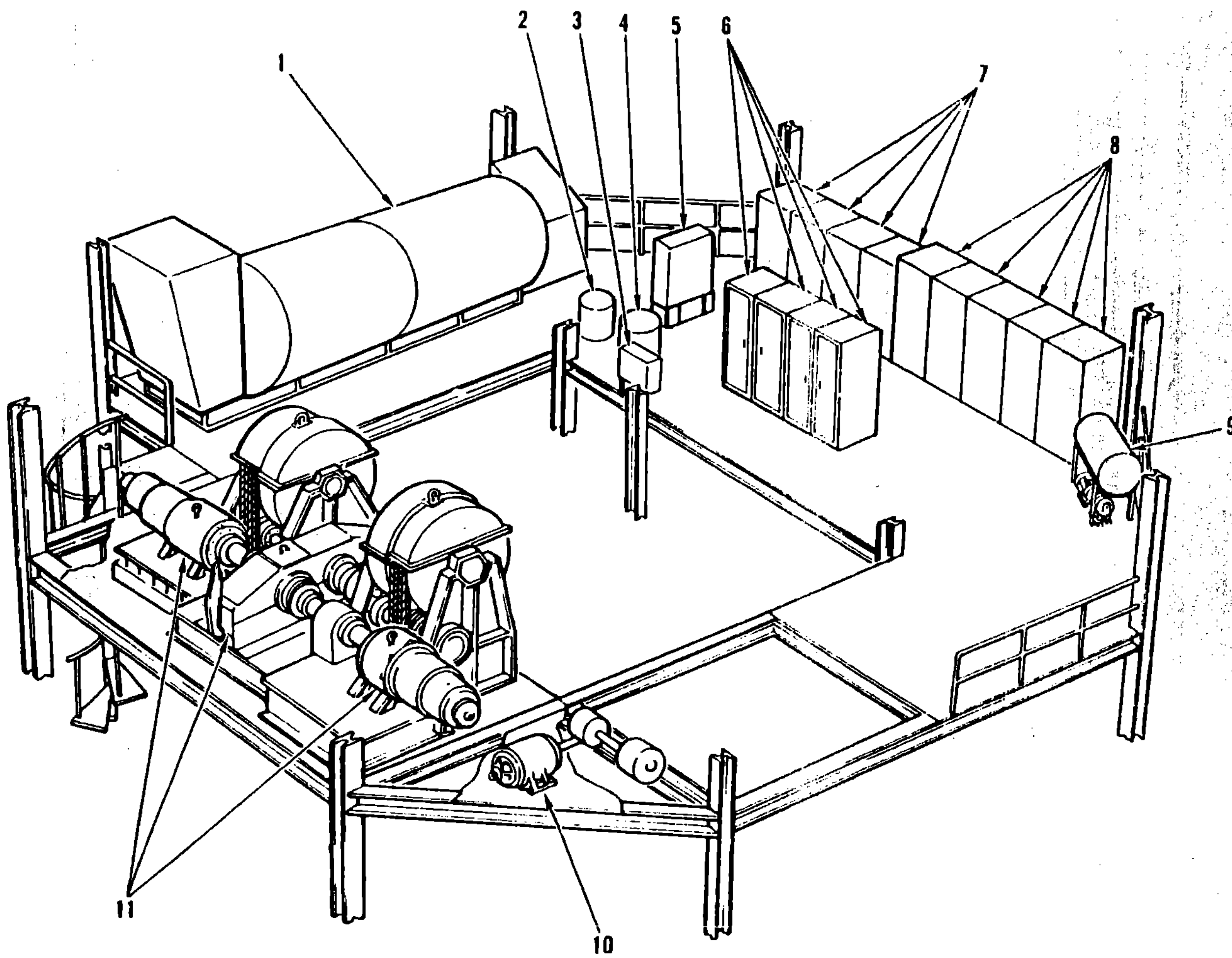
Figure 1-4. Launch Control Center (Typical)




1 LAUNCHER PEDESTAL
2 INTERCONNECTING BOX (VAFB)
3 REMOTE SWITCHING CONTROL (VAFB)
4 FLAME DEFLECTOR
5 MISSILE ORDNANCE TEST FIXTURE
6 MISSILE BATTERY SIMULATOR POWER SUPPLY
7 HELIUM CONTROL CHARGING UNIT
8 INSTRUMENTATION CABINET (OSTF-2)
9 INERT FLUID INJECTION MODULE
10 AIR CONDITIONER
11 HYDRAULIC PUMPING UNIT
12 NITROGEN CONTROL UNIT
13 INTERCONNECTING BOX
14 INSTRUMENTATION CABINET (OSTF-2)
15 INTERCONNECTING BOX

40.10-15(600)B

Figure 1-22. Guided Missile Silo Launcher Platform

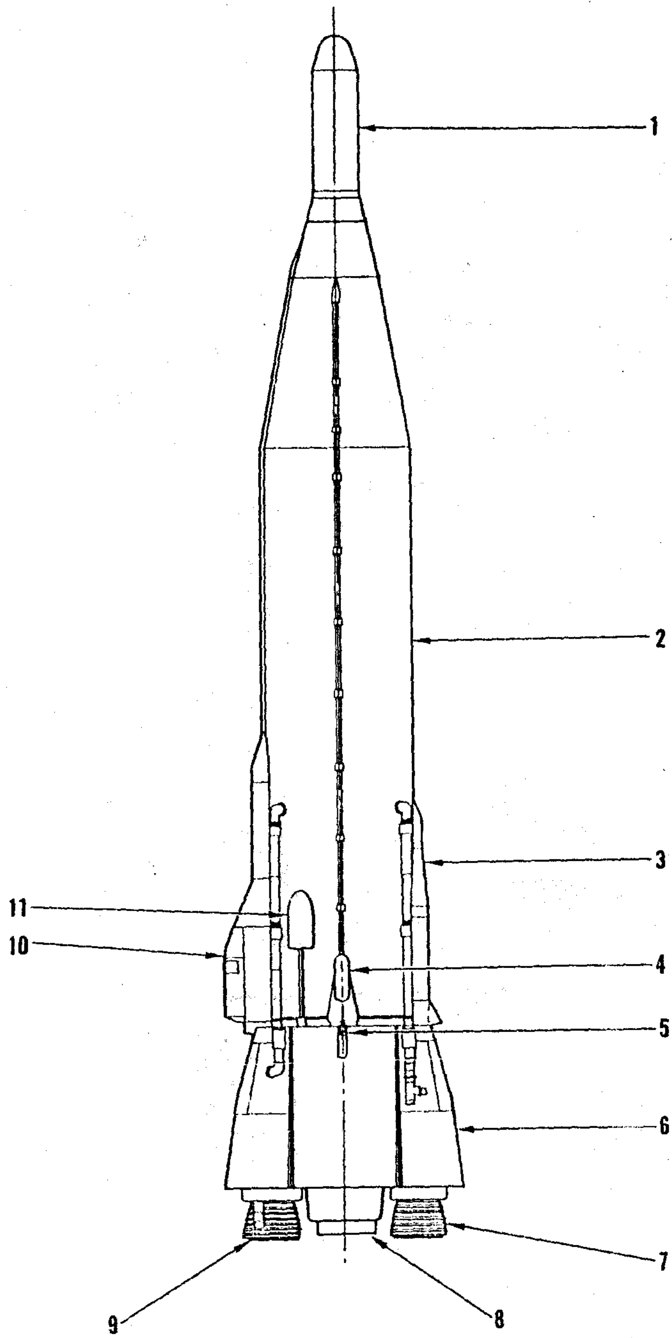



LEVEL 1

1 FRESH AIR DUST COLLECTOR, PUMP, AND WASHER
2 DUST COLLECTOR WATER MAKEUP TANK
3 OVERSPEED CONTROL BOX
4 CHILLED WATER EXPANSION TANK
5 INTERCONNECTING JUNCTION BOX
6 ELECTRICAL MISSILE LIFTING CONTROL SYSTEM
7 MISSILE LIFT SYSTEM MOTOR CONTROL CENTER
8 LAUNCH PLATFORM MISSILE LIFTING DRIVE ASSEMBLY CABINETS
9 DEMINERALIZED WATER STORAGE TANK AND PUMP P-90
10 FACILITY ELEVATOR DRIVE
11 MISSILE LIFTING LAUNCH PLATFORM DRIVE ASSEMBLY

40.10-60 (600) A

Figure 1-65. Silo Level 1 Equipment Location




1 RE-ENTRY VEHICLE
2 TANK SECTION
3 EQUIPMENT POD
4 VERNIER RETARDING ROCKET
5 VERNIER ENGINE
6 BOOSTER SECTION
7 BOOSTER ENGINE
8 SUSTAINER ENGINE
9 BOOSTER ENGINE
10 EQUIPMENT POD
11 DECOY POD

40.10-4(600)B

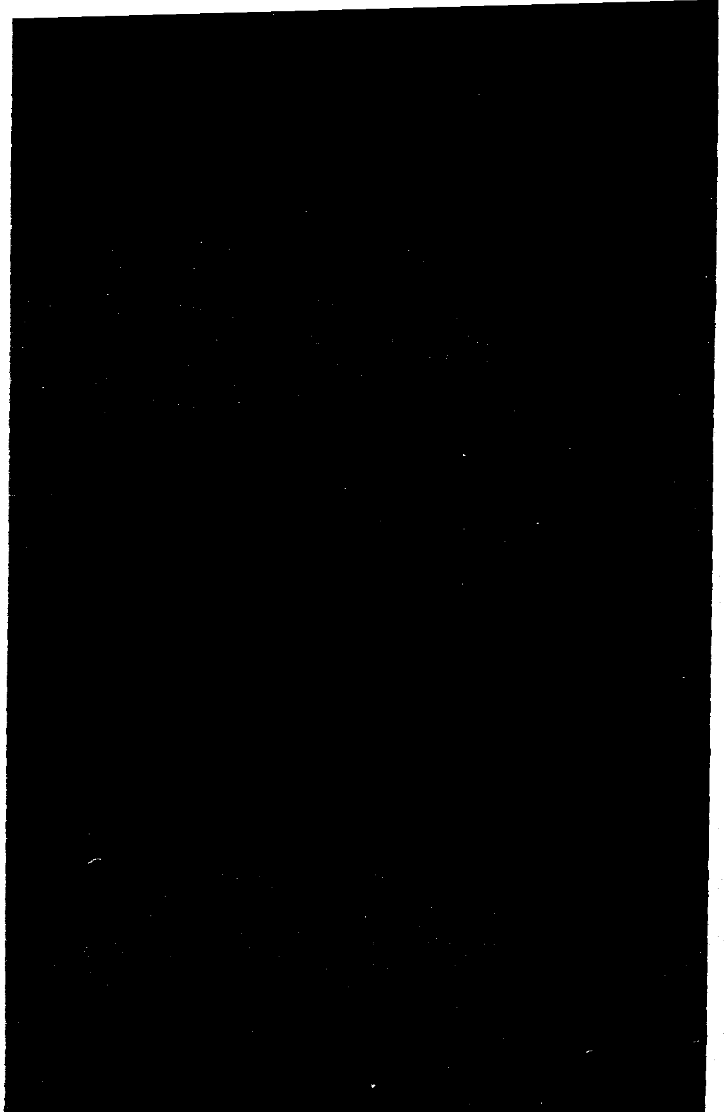
Figure 1-75. HGM16F Strategic Missile

REFERENCE 14

# SILO:

*a guide for base activation personnel*

GENERAL DYNAMICS | ASTRONAUTICS



# PREFACE

Altus Air Force Base
Site #6 - Creta

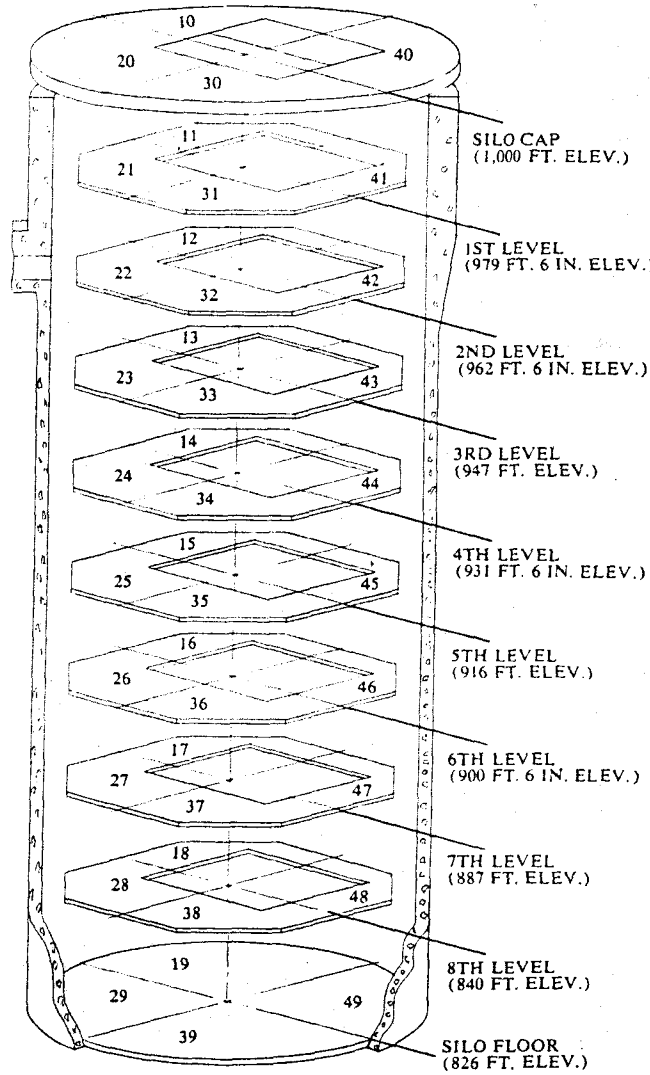
*This manual has been prepared for information of base activation personnel, to serve as a reference guide for a general description of the fundamental structural and functional items associated with a typical Atlas missile silo launching complex. The information contained within is basic only and is not to be used as contractual or authoritative data.*

The silo concept of a missile launcher permits the missile to be maintained in a partially serviced condition, in the hard state while under nuclear attack, without preventing prompt execution of the mission of a strategic squadron.

The silo is a cylindrical hole, 52 ft. in diameter and 174 ft. in depth with a concrete wall varying in thickness from 2 ft. to 9 ft. Within the silo an octagonal structural steel crib divided into eight levels is suspended by a system of mechanical springs. Mounted within the crib are the numerous systems necessary to launch the missile, as well as a spiral staircase and a personnel freight elevator. The silo also contains electric generating and associated auxiliary and control equipment, heating, ventilation, and air-conditioning equipment necessary for proper functioning of the missile support system.

Located within the crib is a 21-ft. square enclosed, insulated vertical shaftway containing a launcher platform weighing approximately 270,000 lb. The launcher platform is suspended by a cable system and serves as the elevator to lift the missile to launch position. It is divided into four levels which contain the equipment to service the missile up to the rise-off period. Retractable work platforms are located within the shaftway for access to the missile. The total suspended weight of the crib and launch platform with equipment is over 1,500 tons.

Located approximately 100 ft. away, also underground, is the launch control center (LCC). The LCC is a reinforced, concrete, cylindrical-shaped room approximately 44 ft. in diameter and 33 ft. high, containing a steel crib, divided into two levels, which is supported by an air-cushioned suspension system. The LCC contains missile launch control equipment, facility control equipment, communication facilities and batteries for their operation. It also contains an operational office, ready room, storage area, heat, ventilating and air-conditioning equipment, kitchen, messing and sanitary facilities for the operating personnel. The LCC houses a normal launch crew of three and in emergen-




SEE "SILO ORIENTATION" IN NOTES (LAST PAGE)

ATTITN

cies, there are provisions for support of twenty men and continuous complex operation for up to ten days after complete isolation. A tunnel with a blast resistant closure, protects the crew in the LCC from any explosions that may occur within the silo. Personnel access to the complex is through an opening at ground level to descending staircase equipped with blast door. Except for command communication, each unitary silo is operationally independent of the other silos of the squadron.

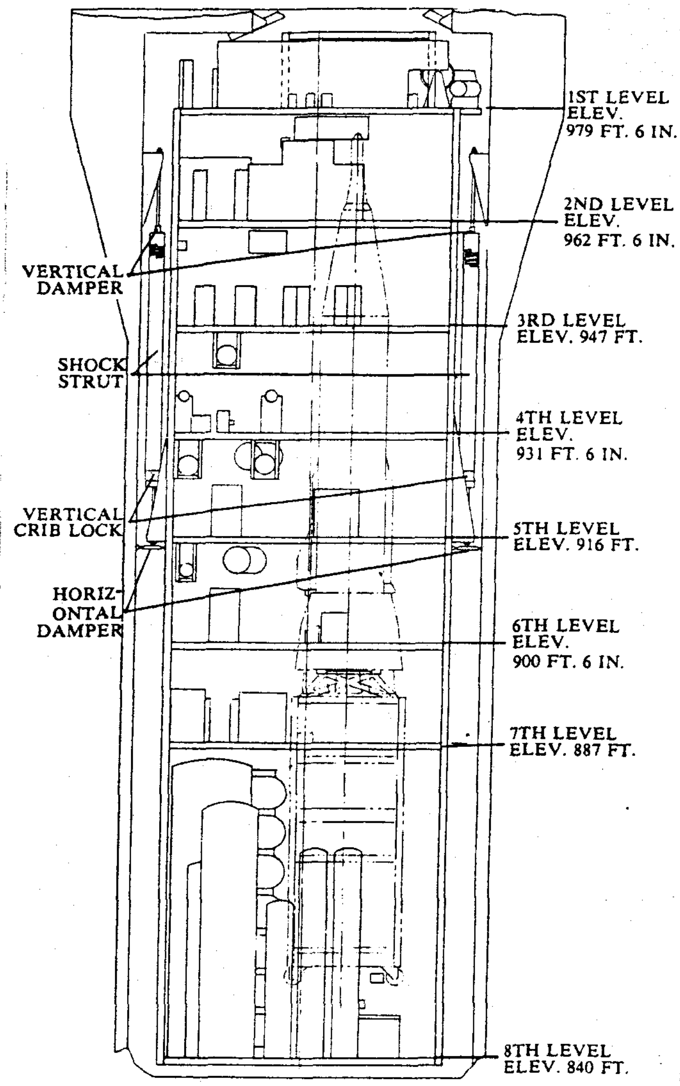
Reinforced concrete silo cap doors approximately 30 in. thick provide adequate protection for the missile and permit safe personnel access to the silo after a near miss by a nuclear weapon. Blast closures operated by a blast light sensing device located above ground, cover the air intakes, air exhausts, and theodolite sight tube, also furnishing protection. The silo complex is protected from intruders by a fence with a remote controlled gate, floodlights and surveillance TV cameras. Personnel safety during servicing and maintenance of the missile is provided by emergency showers, eyewash fountains, alarm systems and so on. The LCC is provided with a sand-filled emergency escape hatch through which escape may be made after the releasing of the sand.

## CRIB & LAUNCH PLATFORM

The crib and launch platform are designed for "stick"-type construction. Individual beams will be cut to length and predrilled before being shipped to the site. The beams will be bolted together in the silo starting with the eighth or bottom level, which is constructed upon temporary shoring. The structural members are mated and facility equipment installed before the seventh level is constructed. This procedure is followed through the construction of the fifth level after which equipment may be installed when the crib structure is completed.

The launch platform is erected in two separate sections on pads adjacent to the silo. The GSE components will be installed and the plumbing interconnects will be made before placing the launch platform into the silo. The lower half will be first lowered into the silo and set on temporary shoring. The upper section will then be lowered and the sections joined at the splice area.

To further comply with the prefabrication concept, all piping shall be detailed. In the area of tubing runs where this concept may not be the most expeditious for a particular run, production samples will be developed. These production samples will be derived from the full-scale mockup article. The mock-up is also used as an engineering check tool for details. This prefabricated plumbing as well as electrical interconnecting assembly approach, calls for the establishment of an accurate foot print and interface pattern. The facilities interface are to be designed to permit quick connection of GSE components. Because of cleaning problems, minimum working area and tight construction schedules, welding of pipe or tubing is to be kept to a minimum in the silo. Welding of brackets and other small non-critical items, is permitted. Spooling pieces are used in runs of large rigid pipes where it is mandatory to insure a proper fit. The crib is suspended within the silo shell



by a system of shock mounts attaching at the top to inserts embedded in the silo wall. The suspension system is fastened to the crib at the lower end. The system consists of four wall brackets and eight shock struts, paired into four pairs spaced around the periphery of the crib. Each strut consists of a centered spring capsule, made up of regular mechanical springs, with 5-in. dia. centered strut rod at each end. An 18 in. rattle space is provided between the crib and the silo shell, including top and bottom, to allow for the displacement of crib structure when ground shock is experienced. Horizontal and vertical dampers are provided to damp out motion between crib and silo. Prior to operation of the launch platform, it is necessary to lock the suspended crib structure to prevent its moving out of line. The locking system is remote controlled from the LCC and is a part of the countdown procedure. The launch platform is roller mounted on three vertical guide rails and is supported by a series of cables, tension equalizers, rollers and sheaves. A series of counter weights weighing approximately 565,000 lb. are installed to assist in the launch platform vertical movement. Positive locking provisions are provided for locking of the launch platform in both the fully extended and retracted positions.

## SILO CRIB

*This section is devoted to the listing of major GSE and facility installed equipment with a brief functional description of each.*

### *LEVEL No. 8*

$LO_2$ TANK (FACILITY)

Storage of missile liquid oxygen supply until tanking period, during countdown.

$LO_2$ TOPPING FACILITY

Supplies top off $LO_2$ to missile to replenish boil-off losses during extended hold periods.

$LN_2$HE STORAGE AND HEAT EXCHANGER (FACILITY)

Chills helium gas to missile storage bottles and supplies the helium bottle shrouds in missile with $LN_2$ refrigerant to maintain low helium temperature in bottles during countdown.

THRUST SECTION HEATER (FACILITY)

Supplies heated air during countdown to maintain components and small hydraulic lines at proper operating temperature in the presence of $LO_2$ and $LN_2$.

HE GROUND PRESSURIZATION TANK (FACILITY)

Pressurize missile tanks for launch (including hold period) de-tanking, etc., after an abort.

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**HE GROUND PRESSURIZATION TANK (FACILITY)**
Pressurize missile tanks for launch (including hold period) de-tanking, etc., after an abort.

**HE INFLIGHT NO. 1 (FACILITY)**
One load inflight requirement, high pressure checkout to DCU, emergency pressurization system.

**HE INFLIGHT NO. 2 (FACILITY)**
One load inflight requirement. Checkout missile pneumatic system.

**PRESSURIZATION CONTROL UNIT (GSE)**
Maintains required missile tank pressures during all phases of operation, before switch over to internal pressurization at L/P rise.

**PNEUMATIC DISTRIBUTION UNIT (GSE)**
Controls gas flow to PCU, HCU and chilled helium fill system.

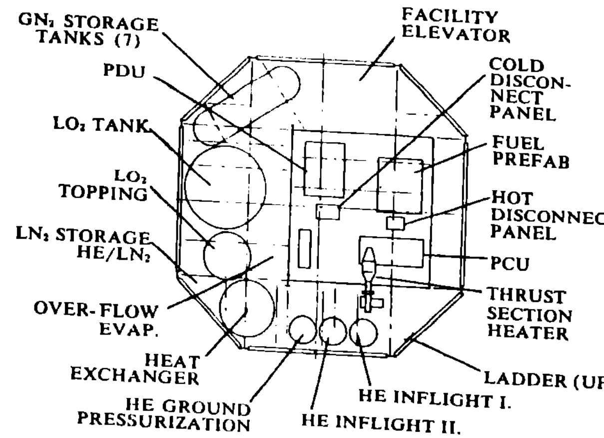
**$LN_2$ EVAPORATOR TANK (GSE)**
Evaporator tank for warmed up $LN_2$ already passed through the shrouds on lines and bottles.

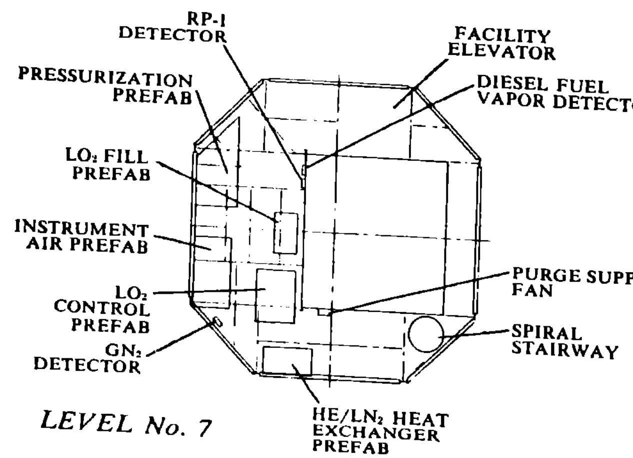
**COLD DISCONNECT PANEL (GSE)**
Contains fuel and $LO_2$ tanks, pressure lines, He charge line, $GN_2$ to NCU, $GN_2$ to slug unit, $GO_2$ vent from slug unit and $LO_2$ to slug unit disconnects.

**HOT DISCONNECT PANEL (GSE)**
Contains thrust section heater disconnect, water inlet and return for pod cooling disconnect, and fuel fill disconnect.

**FUEL LOAD PREFAB (GSE)**
Unit contains necessary valves, lines, etc., for monitoring the transfer of hydrocarbon fuel to missile.

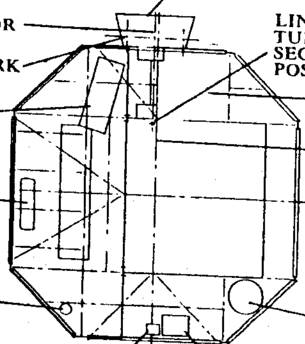
*LEVEL No. 8*



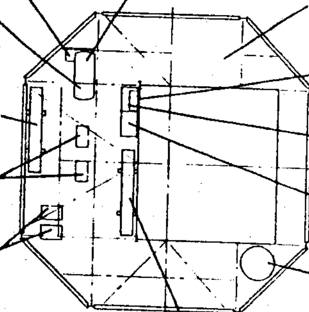




*LEVEL No. 7*

*LEVEL No. 6*




*LEVEL NO. 4*

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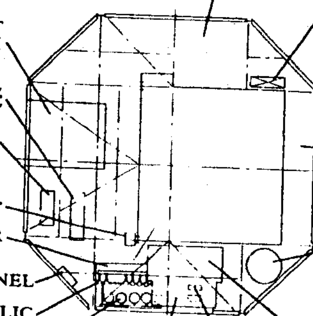


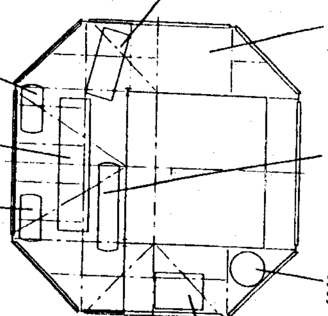


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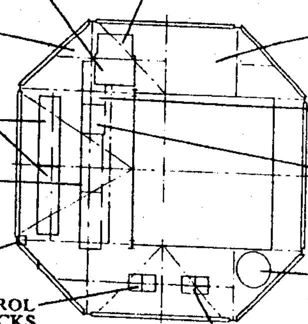
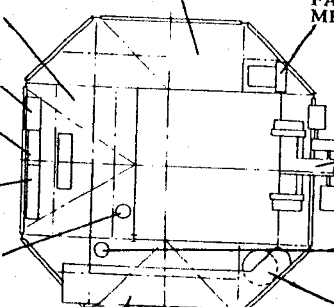
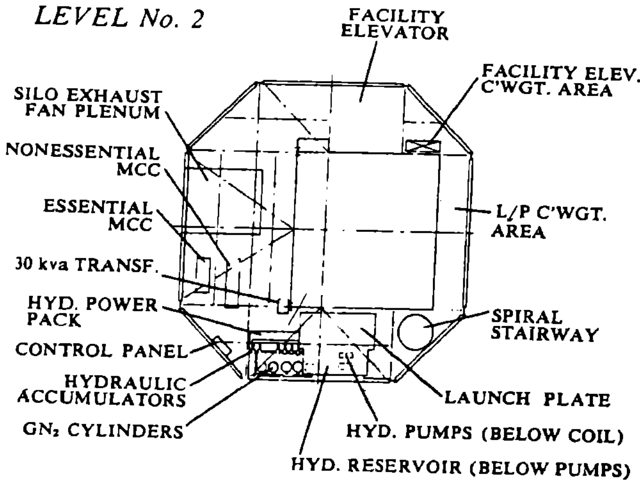


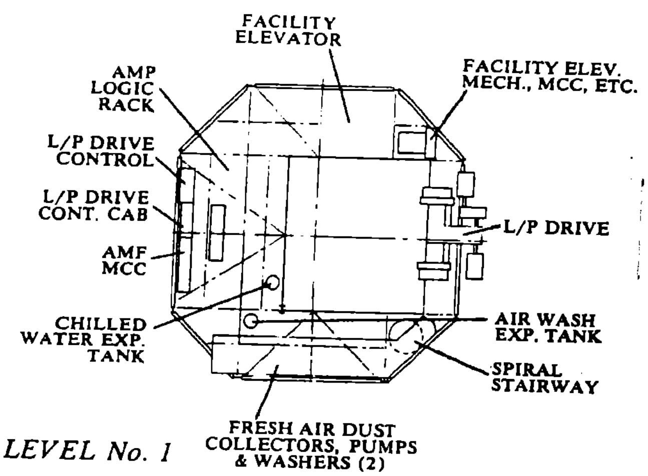

*LEVEL NO. 3*




*LEVEL No. 1*

*LEVEL No. 2*




*LEVEL No. 1*

*LEVEL No. 7*

$LO_2$ CONTROL PREFAB (FACILITY)
Monitors, controls servicing of missile with $LO_2$. Controls venting of $LO_2$ storage tank.

$LO_2$ FILL PREFAB (FACILITY)
Monitors, controls filling of $LO_2$ storage vessels; controls venting of topping tank during standby.

PRESSURIZATION PREFAB (FACILITY)
Controls filling of gaseous nitrogen storage, distribution of gaseous nitrogen to the $LO_2$ storage, topping and slug tanks, to the fuel prefab, NDU and various other components as required.

$LN_2$ PREFAB (FACILITY)
Monitors, controls the fill and transfer operations in the $LN_2$ units.

INSTRUMENT AIR PREFAB (FACILITY)
Compressed air system for complex instrument air, diesel engine starting air, and operating of blast closure mechanism.

RP-1 DETECTOR (FACILITY)
System shall be capable of sampling, analyzing and actuating the specified alarms when concentrations of RP-1 excess vapors are present in the areas serviced by the sampling stations.

DIESEL FUEL VAPOR DETECTOR (FACILITY)
Same function as RP-1 detector, for diesel vapors.

OXYGEN DETECTOR (FACILITY)

Same function as RP-1 detector, for excessive oxygen.

*LEVEL No. 6*

DIESEL GENERATOR (FACILITY)

Facility a-c power requirement is provided by diesel driven synchronous generators (one is located on Level 5). Only one will be operaating during ready condition. The standby generator is remotely controlled from the LCC as required, by failure of the operating generator or for periodic maintenance. Both will be operating during countdown.

AIR START TANK (FACILITY)

Compressed air storage tank for engine starting air.

48 V BATTERY (FACILITY)

Used with constantly operated electrical equipment, switch gear, LCC control, etc. Also supplies current for emergency light if generators fail.

48 V CHARGER (FACILITY)

Charger provides for normal current drain, plus a rapid recharge after use.

HEAT RECOVERY SILENCER (FACILITY)

Engine cooling and waste heat recovery system for space heating of launcher, silo and LCC.

AIG SYSTEM COLLIMATOR AND BENCH MARKS

Optical alignment equipment utilized in orienting the sensing platform to the selected target azimuth. The bench mark supports, collimator support platform and collimator is housed in a special room, attached to the silo wall between the sixth and seventh levels. The self closing light tight door to the room is located approximately eight feet above crib level and is reached by a special ladder.

*LEVEL No. 5*

DIESEL GENERATOR (FACILITY)

Explained with Level.No. 6.

HEAT RECOVERY SILENCER (FACILITY)

Explained with Level No. 6.

LUBE OIL TANK (FACILITY)

Lube oil storage tanks, one for clean oil and one for dirty oil transferred from the sump.

FUEL OIL DAY TANK (FACILITY)

Tank capacity is sufficient for 24 hr. and is maintained by a continuous topping operation from underground storage.

480 V SWITCH GEAR (FACILITY)

Contains synchronization and control equipment for diesel generator sets, as well as main circuit breakers for the 480 v bus power from switch gear supports 480 v motor control center of silo and LCC.

*LEVEL No. 4*

UTILITY WATER PUMP (FACILITY)

The utility water supply system consists of a turbine type utility water pump, a centrifugal fog spray pump and a hydropneumatic tank with necessary valves, fittings, etc. Used for fire protection etc.

UTILITY WATER TANK (FACILITY)

Hydropneumatic tank for above system.

WATER CHILLER UNIT (FACILITY)

Reciprocating type water chiller, consisting of hermetic reciprocating compressors and motors, control system, and other necessary equipment to furnish chilled air to the air wash in the air-conditioning system and pod air cooler.

HOT WATER EXPANSION TANK AND PUMPS (FACILITY)

Hot water in a closed loop is pumped to the heat recovery silencers where it is re-heated and circulated to thrust section heater, launch platform heat coil, and the LCC.

CHILLED WATER PUMP (FACILITY)

Electrically driven, single stage, enclosed impeller type water pumps, for circulating the chilled water.

COOLING TOWER PUMP (FACILITY)

Condenser water pumps circulate cooling water from cooling tower to the diesel generators, condenser units and instrument air prefab and returns to cooling tower.

FOG PUMP (FACILITY)

Supplements the utility water pump when large demand drops the pressure in the hydropneumatic tank.

*LEVEL NO. 3*

400 A-C MOTOR GENERATOR SET (GSE)

Supplies 400 cps, 120/208v 3 phase power to launch control GSE.

28V D-C BATTERY (GSE)

Emergency 28v d-c in the event of 20v d-c power supply unit failure.

28V D-C SUPPLY (GSE)

Supplies 28v d-c to launch control GSE.

L/C LOGIC RACKS (GSE)

The relay logic units contain the relays, comparators, delay devices, and wiring to perform operations required for a missile launching.

SIGNAL RESPONDER (GSE)

The responders contain the relays, simulators, delay devices, and wiring to simulate the circuitry of the missile and associated GSE.

ARMA CONTROL RACK (GSE)

Guidance system checkout equipment to test the inertial guidance system.

GE LAUNCH MONITOR (GSE)

Re-entry vehicle, pre-launch monitor and control group.

30 KVA TRANSFORMER (FACILITY)
(ALSO ON LEVEL NO. 2)
One transformer supplies 120/208 v, 3 phase power to energize 120/208v distribution panel which supports the launch control 60 cps power supply panel.

*LEVEL No. 2*

HYDRAULIC POWER PACK (GSE)
Hydraulic system consists of reservoir, pump assembly, accumulators, $GN_2$ bottles, and control panel and is source of power to operate door closures, platforms, locks, etc.

COUNTER WEIGHT (GSE)
Series of counter weights contributing to launch platform vertical movement.

AIR HANDLING UNIT (FACILITY)
Silo exhaust fan and plenum for controlling the ventilation within the silo structure.

ESSENTIAL MOTOR CONTROL CENTER (GSE)
Electrical power from the 440v MCC essential bus is necessary to support the instrument air system, air compressor, 30 kva transformers, d-c power supply unit, missile pod refrigeration equipment, thrust section heater, HPU, 400 cps motor generator and distribution system, 48v d-c battery rectifier (charger) water chiller unit and chilled water pumps, gas detectors and emergency water pump.

NON-ESSENTIAL MOTOR CONTROL CENTER (GSE)
Non-essential power is necessary to support main air and silo supply fans, hot water heater, main exhaust fan, exhaust vent blast closures, sump pump, spray pumps, $LO_2$ vacuum pumps, and so on.

*LEVEL No. 1*

L/P DRIVE MECHANISM (GSE)
Mechanism consists of two identical 125 hp electric motors. One motor is used for high-speed hoisting; the other for low-speed hoisting. With the necessary gearing, clutch assembly, brace assembly, sheaves, etc., to perform their required function.

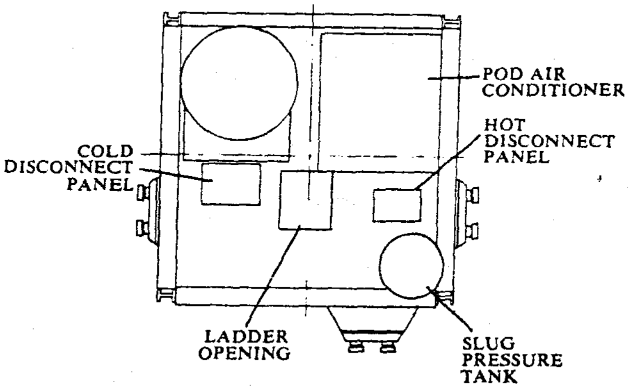
L/P DRIVE CONTROL CABINET (GSE)
Cabinets containing control circuitry amplifiers, transformer, reactors and resistors for controlling the drive mechanism.

AMF LOGIC RACK (GSE)
Contains relays, comparators, delay devices and circuitry to control and sequence; the launch platform locks, launch platform rise, and silo doors, prior to launching.

AIR WASH DUST COLLECTOR UNIT (FACILITY)
Supply air entering the silo is passed through an air washer and wet impingement type dust collector.

FACILITY ELEVATOR DRIVE MECHANISM (FACILITY)
Contains controls, cables, sheaves, etc., for operating the freight and personnel elevator.

## LAUNCH PLATFORM




*L/P LEVEL NO. 4*

POD AIR-CONDITIONER (GSE)

Provides cooling air to missile equipment pod while in the silo. To dissipate heat buildup due to electronic equipment operation.

$LO_2$ SLUG TANK (GSE)

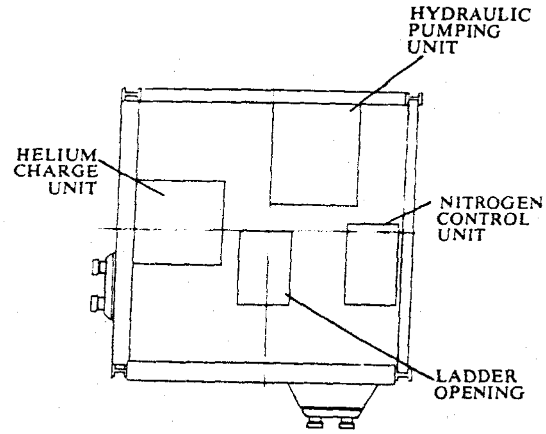
Provides final slug of subcooled $LO_2$ to propulsion system to prevent pump cavitation at engine start and maintain full $LO_2$ supply in missile during elevator rise.

SLUG PRESSURE TANK (GSE)

Supports the slug tank with pressure.

DISCONNECT PANELS (GSE)

Missileborne hydraulic, pneumatic, liquid oxygen and nitrogen supply disconnects.




*L/P LEVEL No. 3*

HELIUM CHARGE UNIT (GSE)

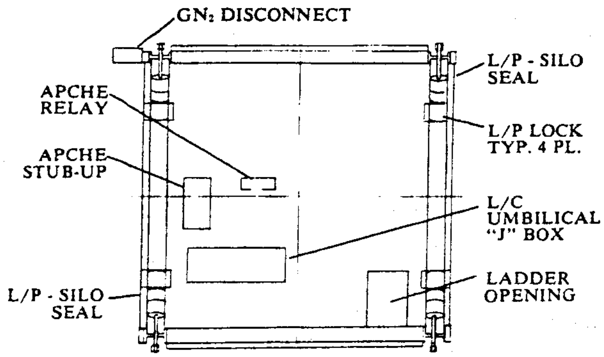
Controls helium source to missile spheres during platform rise.

NITROGEN CONTROL UNIT (GSE)

Regulates and controls nitrogen for charging, testing and purging operation.

HYDRAULIC PUMPING UNIT (GSE)

Provides an oil supply for filling and bleeding hydraulic system and provides hydraulic power for missile hydraulic system or auto-pilot system C/O and for missile requirements during active countdown, until the time air-borne equipment over-rides and takes over.



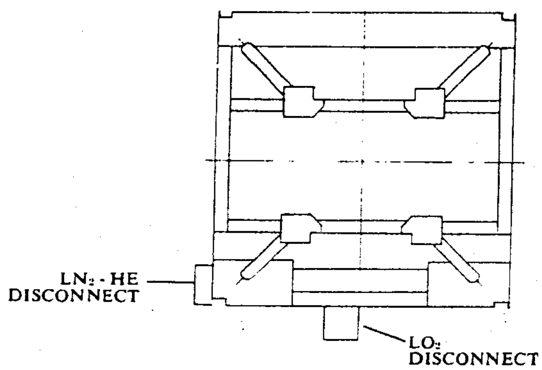

*L/P LEVEL No. 2*

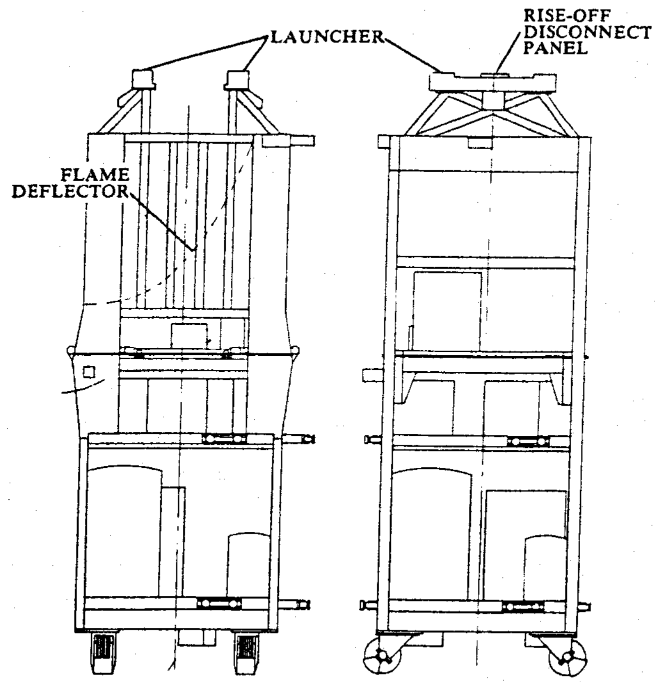
UMBILICAL JUNCTION BOX (GSE)

Serves as the junction point for missile umbilical cables and launch control checkout cables.

FLAME DEFLECTOR

A dry-type flame deflector is located between first and second floor.




Elevation looking at quadrants II & III diagonal structural members deleted for clarity

Elevation looking at quadrants III & IV diagonal structural members deleted for clarity

← *L/P LEVEL No. 1*

LAUNCH PEDESTAL (GSE)

Launch pedestal and missile support assembly.

## SMA

*SQUADRON MAINTENANCE AREA*

The SMA provides the necessary facilities for support maintenance requirements of the missile squadron. The SMA is composed of three separate buildings supporting the various operations.

A missile assembly building (MAB) with missile maintenance area and adjacent shop areas for system and component checkout and repair. These areas include: engine maintenance area, inertial guidance system area, hydraulic - pneumatic area, electrical - electronic area, instrument area, component area, power room and supplementary work shops and tool cribs.

A munition section strategic missile squadron (MSSMS), provides facilities for maintenance, repair and checkout of re-entry vehicles, hypergols, explosives, etc., required to support the weapon system.

An administration and storage building (ASB) will be located adjacent to the MAB. The squadron command headquarters housed in the ASB has the capability to activate the launch capability of any or all of the launchers, (alternate command post is also established in one of the complex LCC). The ASB also provides storage facilities for administration and space for weapon system maintenance and service supplies.

## *NOTES*

ALTUS AFB:

SITES 6, 7, & 8
CHIEF COMPLEX "C" - TERRY HERRMAN

CLIFF RICHARDS
SITE 6 SUP. - ~~"NICK" NIXON~~

ACT. ENG A/S - DWIGHT STONE ←

AAFB
OPERATIONS CHIEF: JACK CHAPIN

ELECT.
SHOP SUP. - BOB MOORE - E. BRANDENBURG

INSPECT. SUP. - PAUL FERGUSON

SATAF - CAPT. DAVID SWEENEY U.S.A.F.

JIM DEARING
SITE 6 ASSIST. SUP - ~~CLIFF RICHARDS~~

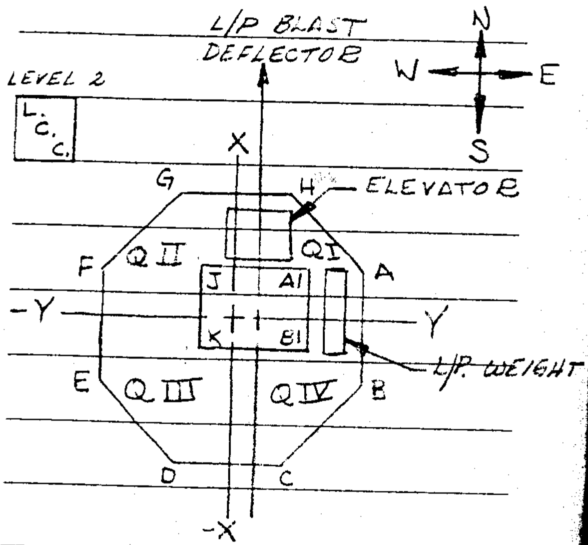
[illegible]CH. SHOP SUP - GILLIAM & EARL JURY

(L/P)
ENGINEERS SITE 6: REED HUME, FRANK (AIR-COND) BURIANEK, JOE KILGORE (P.L.S.), TOM RHOADES (P.L.S), [illegible] BRANNAGAN (M.L.S. ELECT.), DICK AUSTIN (4&1 MAPCHE ELECT.), ELDON [illegible]AGER (DES. LAISON), KEN WARDER (DESIGN LAISON), DICK ROBERTS (L/C & MLS ELECT)

ALTUS AIR FORCE BASE

SITE #1: LONE WOLF, OKLA.
SITE #2: SNYDER, OKLA.
SITE #3: CACHE, "
SITE #4: FREDRICK, "
SITE #5: FARGO, TEXAS
SITE #6: CRETA, OKLA.
SITE #7: HOLLIS, "
SITE #8: ROSSEL, "
SITE #9: WILLOW, "
SITE #10: HOBART, "
SITE #11: MANITOU, "
SITE #12: GRANITE, "

## SILO ORIENTATION




L.C.C. = LAUNCH CONTROL CENTER
L/P = LAUNCH PLATFORM
Q = QUADRANT

ZONE ≡ QUAD – LEVEL
(I to IV) (1 to 9)

[redacted]

**REFERENCE 15**

# ATLAS MISSLE SITE TOUR

0900 — 1200

24 MARCH 1962

# INFORMATION BULLETIN

## HISTORY

The decision to build the Atlas Launching Facilities in this area was reached in early January 1960 at which time the Albuquerque District Office was requested to perform soils investigation to determine whether or not the geological conditions in this area would support the proposed installation. This investigation was accomplished by the Spencer J. Buchanan Company and by Gordon Herkenhoff & Associates with favorable results.

Design was initiated in early March after completion of the investigation, and the facility was advertised for bids on 16 May 1960, and bids were opened on 15 June 1960. The construction contract, in the amount of $22,115,828.00, was awarded to a Joint Venture consisting of Macco Corporation, Raymond International, Inc., The Kaiser Company, and Puget Sound Bridge & Drydock Company on 16 June 1960. Notice to Proceed was issued on 20 June 1960, and work was initiated on 23 June 1960.

The Roswell Area Office was activated on 15 May 1960 with a nucleus of people and has been expanded to a strength of 8 Officers and 165 Civilians.

## CONSTRUCTION FEATURES

The Launching Facility consists of a launching silo which has a 26 ft. 1 in. inside radius and is 178 ft. deep, and a Launch Control Center which has a 40 ft. inside diameter and a 27 ft. clear height. The launching silo has 2 ft. - 6 in. thick concrete walls up to a point approximately 55 ft. below the top of the silo at which point the wall flares out to a total thickness of 9 ft. The LCC also has 2 ft. - 6 in. thick walls with 3 ft. - 6 in. floor and a 3 ft. - roof.

On the interior of the silo is a steel crib which is suspended from four shock mounts and supports all of the facilities inside the silo. The Launch Control Center has two suspended floors on which all equipment, etc. is mounted. The LCC and silo are connected by an underground tunnel.

There is a total of six Atlas "F" launching facilities being constructed nationwide, and a determination was made that all of these facilities would be identical insofar as practical. To accomplish this, and to assure delivery of critical material in sufficient time, the Government entered into contracts for fabrication of what is known as the standardized equipment. This equipment consists of the Propellant Loading System prefabs and interconnecting piping, the shock hangers, the door actuating mechanisms, the shock suspension systems, heating, ventilating, and air conditioning systems, and blast door closures.

These contracts have been assigned to the prime contractors, and they are responsible for the delivery and installation of these items of equipment.

One of the critical features of construction of these facilities is the cleanliness requirements for the Propellant Loading System. The systems are subject to temperature variations from a minus 308° F. to 120° F. and pressures exceeding 3500 lbs. per square inch. All portions of the Propellant Loading System and its component parts must be absolutely cleansed of all foreign particles and hydrocarbon larger than 150 microns as the presence of foreign substances, particularly hydrocarbons, can result in violent explosion and void the function of the facility.

The facility is a hardened facility designed to withstand nearby atomic detonations and still retain its effectiveness. It has a capability of sustaining operations for a period of up to ten days without outside support. This "button-up" period is principally for periods of inclement weather that would preclude normal delivery.

The construction is being accomplished under the philosophy of "concurrency", i.e., concurrent with the development of the weapons system.

## SEQUENCE OF CONSTRUCTION

The construction of the Atlas Launching Facilities at Walker Air Force Base was accomplished under the supervision of the Area Engineer of the U. S. Army Corps of Engineers acting as the construction agent for the U. S. Air Force.

EXCAVATION: Open cut for mass excavation to a depth of approximately 38 feet was of the open pit type, large enough for silo and launch control center construction, work space, and a ramp leading down to this area. Solid material was broken up by dynamite placed in drilled holes and lighter material was ripped by bulldozer. Haulage to a waste area was by conventional powered scrapers. After this open mass excavation was completed, the silo shaft was excavated to a depth of 178' below original ground surface. The method employed was to drill blast holes to depths of 12', loading these holes with dynamite and break up about 10' to 15' of material at one time. This material was then removed by means of 45-55 ton cranes using a clam shell bucket on the first 35-40' and thereafter the contractor utilized a large muck bucket and dump trucks. It was necessary to lower and raise a front end loading tractor weighing about 22 tons into the shaft for each 15' of excavation. Concurrent with shafting was the placement of a series of steel ring beams spaced at 5' vertically. Containment of the silo wall surface area was by means of wire mesh and gunite concrete. Wood lagging was used on silos with heavy water seepage when considered necessary.

CONCRETE PLACEMENT: (Approximately 6,000 Cu Yds per Site). The major placement consisted of silo concrete which started on 6 September 1960 at Site #2 and was completed on 15 February 1961 at Site #7, with exception of the silo cap. The secondary concrete placement was for the Launch Control

Center and miscellaneous smaller pours continued until the completion date of 15 March 1962. The above 3 items were dovetailed together as the construction progressed. The last large pour was the silo cap which was actually completed after the silo crib steel was in place. Above ground surface pours were formed on both the inside and outside. Only a 1" plus or minus tolerance was allowable on the interior surface of the silo concrete. This tolerance applied to an 178' overall plumb height and a 52' 2" diameter. Concrete was placed by cranes using a 2 Cu Yd buckets. Tremies were used within the forms. Pneumatic vibrators were used to consolidate the type #V concrete. Heated water was required in the concrete batch in the winter and ice added in the hot summer months to control the temperature of the concrete at placement. The top 40' of construction was heavily re-inforced including $2\frac{1}{4}$" ribbed bars closely spaced in both horizontal and vertical planes.

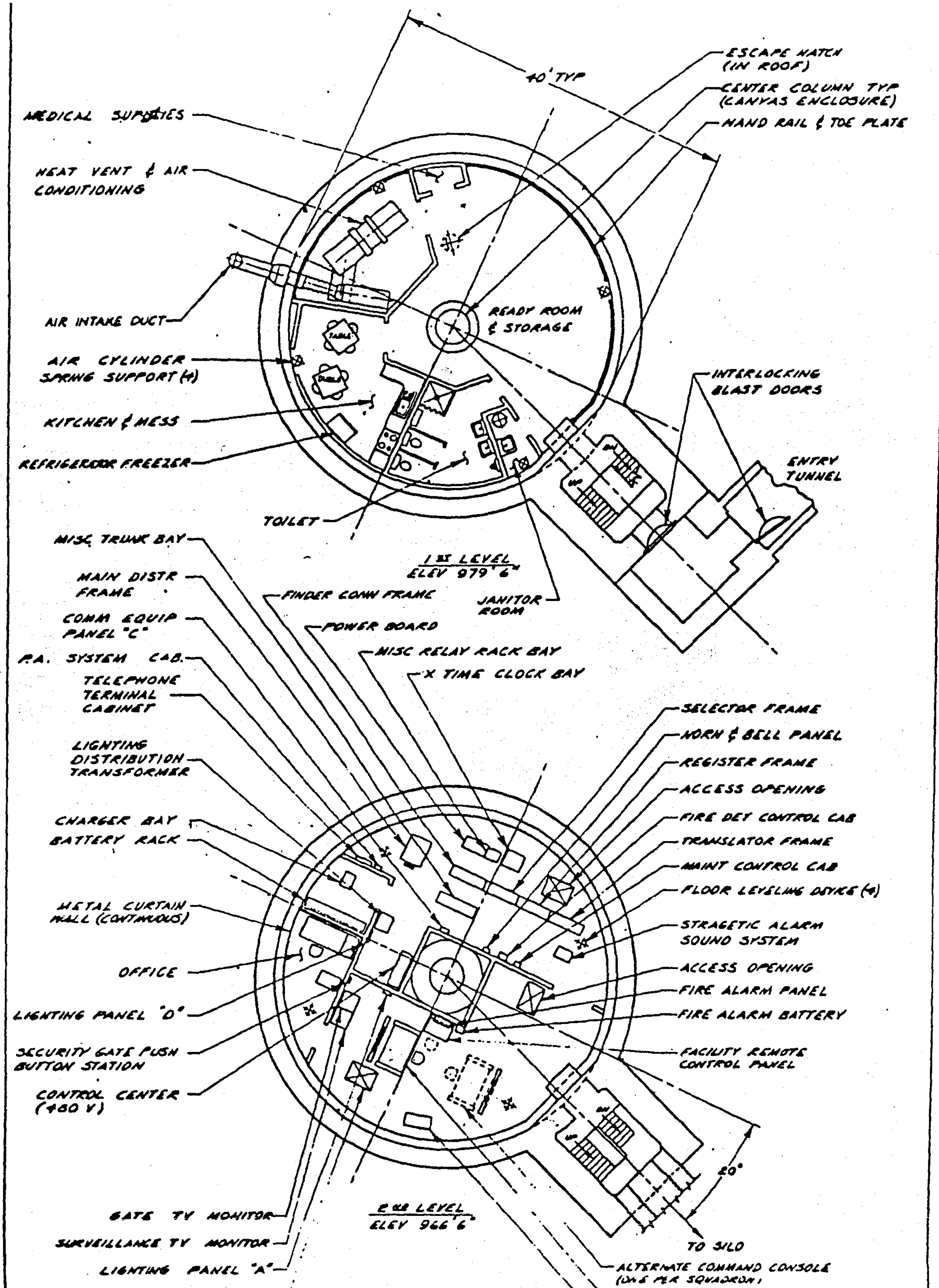
CRIB STEEL: Erection of structural crib steel was one of the major tasks under the direction of the Corps of Engineers. Macco Corporation erected all of the Launch Control Center cribs and 5 of the silo cribs. Owl Transportation and Trucking Company erected 7 of the silo cribs. Methods of erection was to pre-assemble the long columns into bents on the ground surface and then lower the complete unit into the silo. These units were connected by individual beams and braces as the work progressed. Installation of cryogenic, high pressure vessels and diesel generators proceeded con-currently with erection of Crib Steel. Delays in delivery of some of the above vessels caused extra work due to difficulty of drifting and placing these units after a major portion of the crib steel was in position. Grating, handrails and other miscellaneous iron were added per schedule. When the crib steel was erected through the 3rd level it was swung from its supports onto the shock strut hangers located at four points on the silo wall. Tolerances on the silo crib steel were extremely close. The tolerances required was 1/8" on alignment and 1/4" on elevations for each level. Backfill of the Mass Excavation proceeded con-currently with the erection of crib steel.

MECHANICAL AND ELECTRICAL: Installation of piping, pumps and related equipment proceeded after the initial erection of crib steel. Pre-assembled piping and units were connected together, controls added, the units pressure tested, and in the final stages these units were validated for operating efficiency. The Electrical installation for use on the support facilities was con-currently constructed with the mechanical units which included the air conditioning system. Very close co-ordination was required by all crafts and trades to construct the interior of the silo. Good cooperation was the normal attitude and only minor interferences were noted. Improvements were made in plans as the work progressed and these changes in turn needed to be incorporated into the finished product.

The propellant loading system (PLS) was constructed con-currently with the other systems. As previously noted this feature required meticulous care due to close tolerances and requirements of the contract.

In summation, and to lend some idea of the magnitude of the construction effort that is reflected in the construction of one Atlas "F" silo are the following: Approximately 48,000 cubic yards of material was excavated by open cut method. This was followed by approximately 24,000 cubic yards of material excavated by silo shafting. The sum total of those two, 72,000 cubic yards, was used during backfill operations. A total of approximately 6,000 cubic yards of portland cement concrete has been placed. The crib steel alone weighs approximately 600 tons, and when suspended and balanced on the eight suspension springs the weight of the crib steel, the various fueling vessels, motor generators, propellant loading skids, etc., the total weight accumulates to approximately 1,800,000 pounds. Using average job figures, the direct payroll paid to skilled and semi-skilled workmen employed at this site is in the magnitude of 3/4 million dollars. This does not include the salaries of the professional personnel, and workers at various fabricating factories. It reflects only the salaries of the workmen actually employed at Complex No. 4. The construction phase is complete and the site now passes to the second phase that of installation and checkout. Many more items of hardware will be placed within the silo and the Launch Control Center. Many more manhours of effort will be expended prior to the time when the missile is actually housed in the silo.

Any individual questions concerning the construction effort will be answered in detail during the morning tour of the site.




LAUNCH CONTROL CENTER
PLAN VIEWS
SCALE $\frac{1}{60}$

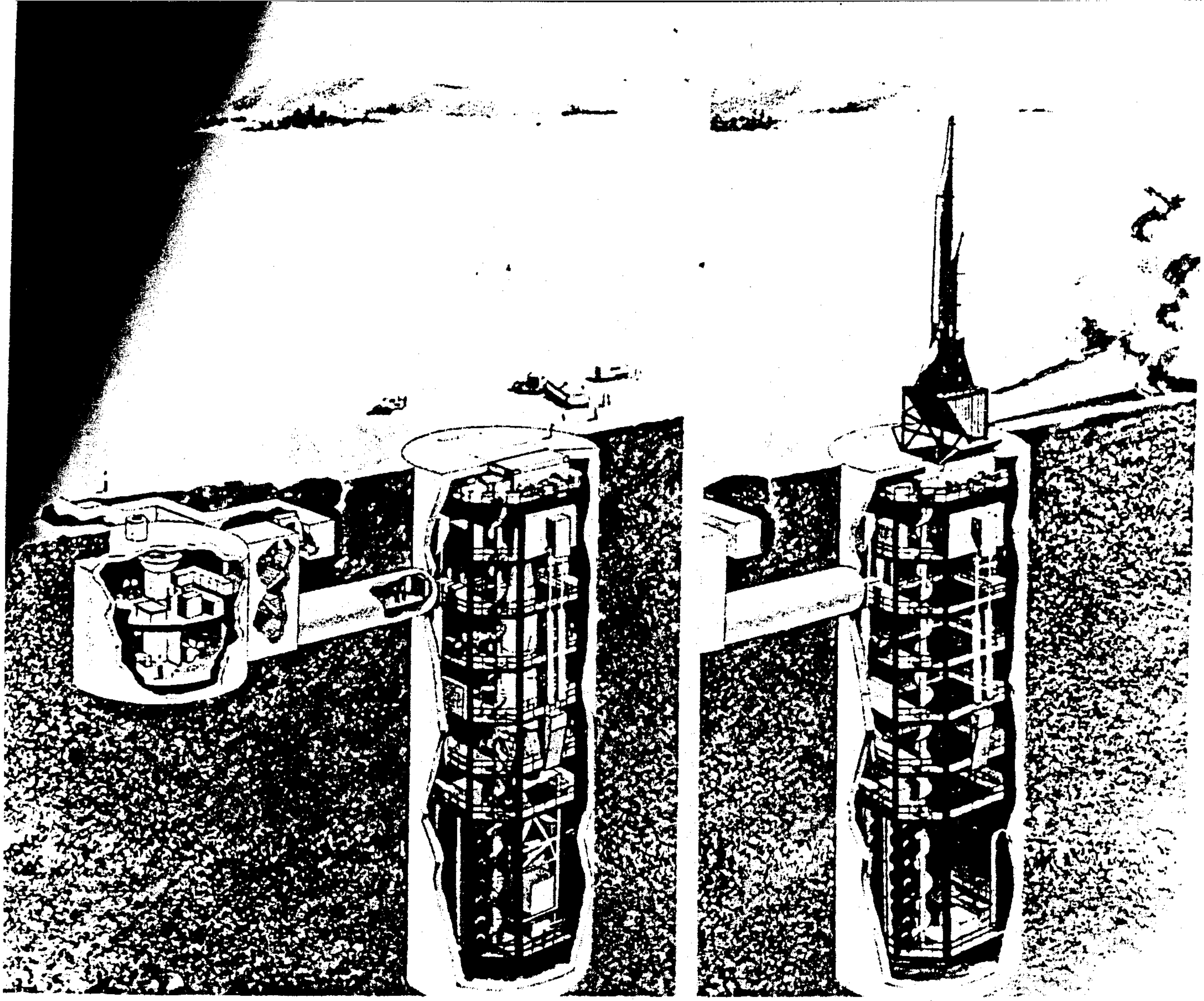
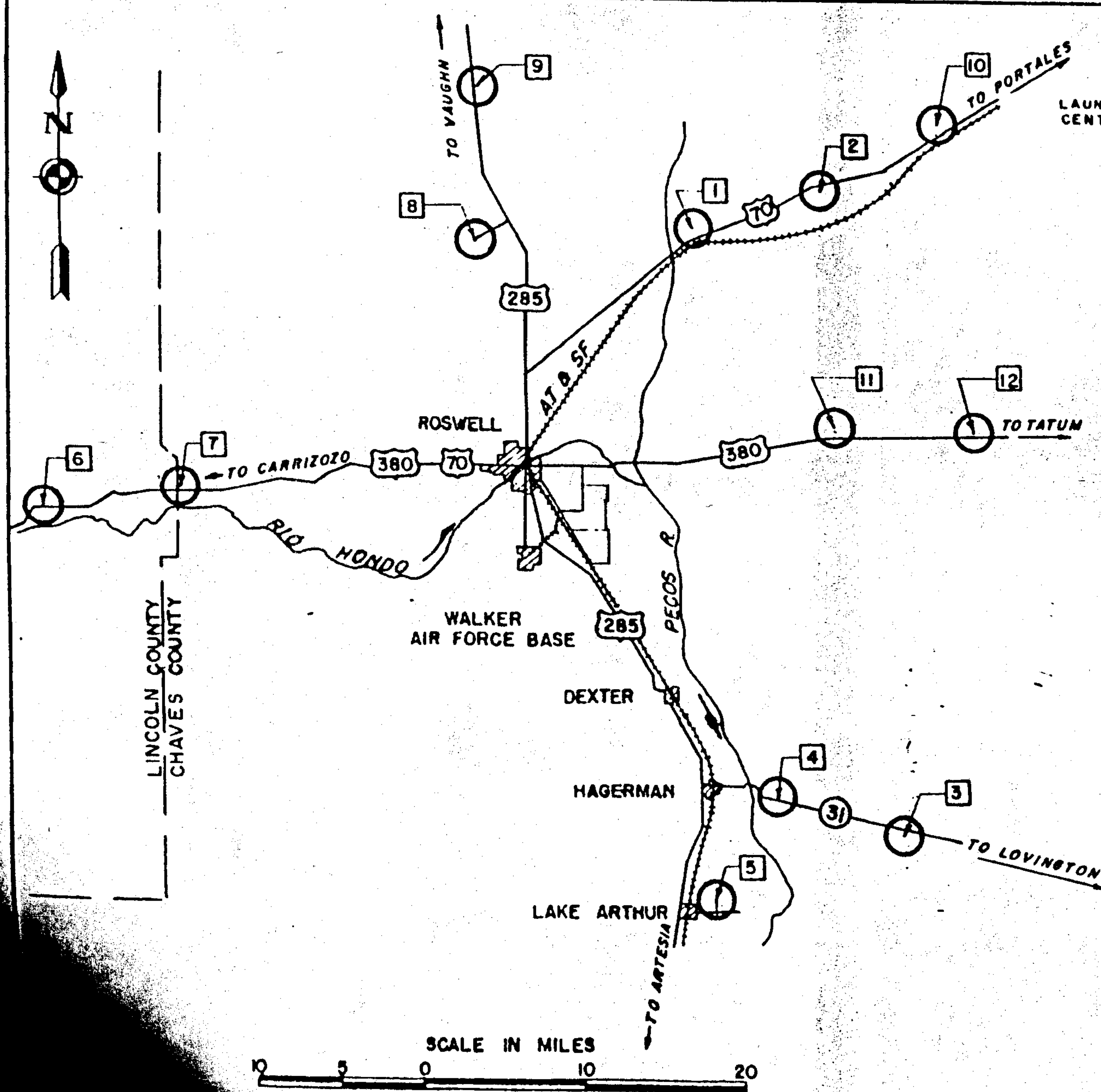
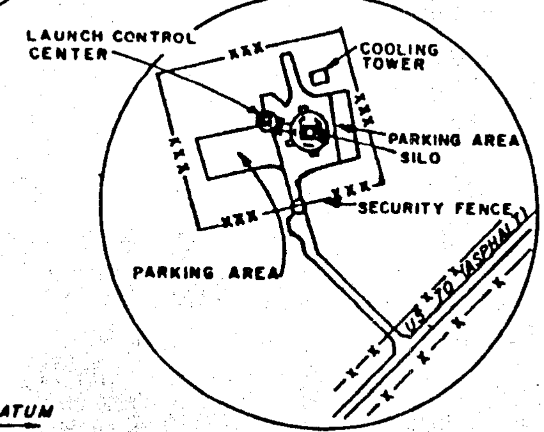


ILLUSTRATION OF AN ATLAS-F MISSILE COMPLEX.




GENERAL CONFIGURATION-SITE 1

## MILES TO SITES

LOCATION OF CROSSROADS, INTERSECTION OF HIGHWAY'S 380 AND 285

| SITE | FROM WALKER | FROM CROSSROADS |
|---|---|---|
| 1 | 25.3 | 19.2 |
| 2 | 33.9 | 27.8 |
| 3 | 36.6 | 43.2 |
| 4 | 27.5 | 34.1 |
| 5 | 31.7 | 38.3 |
| 6 | 36.2 | 30.1 |
| 7 | 27.2 | 21.1 |
| 8 | 21.4 | 15.3 |
| 9 | 30.1 | 24.0 |
| 10 | 42.2 | 36.1 |
| 11 | 25.1 | 19.0 |
| 12 | 32.9 | 26.8 |

WALKER AIR FORCE BASE
ROSWELL, NEW MEXICO

VICINITY PLAN

# REFERENCE 16

SBAMA

EQUIPMENT REMOVAL PLAN

ATLAS " F " SERIES SILO

REPORT NO. 692 - 02 - 65 - 8

DATED: 5 MARCH 1965

CONTRACT NO. AF04 ( 607 ) - 9649

REVISION SYMBOL

0001

| GENERAL DYNAMICS ASTRONAUTICS SAN DIEGO, CALIFORNIA | CODE IDENT NO. 05342 | SIZE A | DRAWING NO. 692 - 02 - 65 - 8 | |
|---|---|---|---|---|
| | SCALE | RELEASED | | SHEET |

PACKAGE NO.

A2613 (REV. 6-63) DISTR CODE

**BLOCK NUMBER:** 24

**BLOCK TITLE:** Drain MLS hydraulic system

**GENERAL DESCRIPTION OF BLOCK ACTION:**

This block defines a method of draining the MLS hydraulic system of hydraulic fluid and establishes a sequence for dismantling the various elements of the hydraulic system.

**TIME REQUIRED:** 5 days

**MANPOWER REQUIRED:**

a. 1 electrician
b. 3 hydraulic technicians

**SPECIAL TOOLS AND EQUIPMENT REQUIRED:**

a. Six 55 gallon drums
b. K bottle and 15 feet of hose (FSN 4730 80 37666, MS28741-4-1800 or equivalent)
c. Four 10 gallon cans

**TASK DETAILS:**

- CAUTION -

Do not flame or torch cut any hydraulic lines. Failure to comply may result in fire or explosion and injury or death to personnel.

A. Verify the following conditions.

1. L/P down
2. Inching tool installed (MLS)
3. Manual brake release system installed
4. L/P locks retracted
5. Horizontal and vertical locks retracted
6. Stanchions installed
7. Silo doors open and secured
8. All work platforms retracted
9. All electrical power to MLS off. Insure that both blocks 10 and 15 have been completed.

REVISION SYMBOL A

TASK DETAILS, BLOCK NO. 24 (Continued)

B. **Initial Drain**

1. Verify that all pressure gages on the Local Control Hydraulic Panel indicate 0 psig.

2. Verify hydraulic reservoir level is below "MAX DRAIN LEVEL".

3. Open drain valves VM-143, VM-154, and VM-135 located on the HPU and reservoir.

4. Remove the following components from the hydraulic accumulator and GN2 pressure tank rack:
   Filters FR-501, FR-503, and FR-505;
   Valves VA-951, VA-965, and VA959; and
   Check Valves CK-982, CK-984, and CK-983.

NOTE: As hydraulic components are removed from the system, all ports should be capped with suitable protective closures.

5. Hook up pneumatic hose (FSN 4720 80 37666 or equivalent) from K bottle to the open line on the air side of each accumulator rack and apply 50 psig pneumatic pressure. Hold pressure until the reservoir oil level stabilizes.

6. Remove pneumatic charge and disconnect K bottle and hose. Cap air side of each accumulator assembly.

7. Open VM-404 on hydraulic reservoir and drain reservoir into a suitable container.

NOTE: As much as 200 gallons of hydraulic oil can be expected.

8. Open drain valve on FR-10? filter assembly and drain filter housing.

9. Remove calibration plug above GA-122 on LCHP and install hose from port into suitable container.

10. On the LCHP, open VM-172 and VM-173 to connect gage circuit.

11. Remove two bleed valves on rod end of door cylinders.

C. L/P and Umbilical Drain

1. Remove spreader bar located nearest to the bottom of the umbilical loop.

2. Position 55 gallon drums under the lowest point in each of the hydraulic hoses and shroud hoses with plastic sheets to control oil spray.

3. Cut the bottom side of each hose and drain.

REVISION SYMBOL A

## INTRODUCTION

### SBAMA EQUIPMENT REMOVAL PLAN - ATLAS "F" SERIES SILO

### SCOPE

This plan provides a controlling sequence of operations, and procedures for these operations, to remove all equipment from an Atlas "F" Series silo site, except the crib steel, facility elevator, sump pumps, and lights.

The entire package includes a flow chart, a procedure for each block on the flow chart, an equipment and materials list, and a cumulative list of manpower and material requirements. The plan has been designed, as requested, to suit existing USAF capabilities as much as practicable.

### GENERAL EXPLANATION OF FLOW CHART

The flow chart shows the earliest time at which given operations may be performed safely. The principal flow is as follows:

The site is verified to be inactivated (1) according to the plan proofed at SAC Site 5, Altus AFB. If this has not been accomplished, it must be done (2). However, installation of vinyl covering and dessicants need not be accomplished as equipment will be removed from the silo.) Subject to the limitations called out in the individual block procedures, the following actions may then proceed simultaneously: Prepare Diesels for removal (3), drain fuel loading prefab (4), open and secure silo doors (5), bleed down GN2 and helium (3), prepare LCC and tunnel equipment for removal (7), dismantle cooling tower (11).

An important sequence following (4) and (5) is to drive the launch platform into the uplocks (9), modify the top of the launch platform as a staging platform (13), install horizontal crib shoring (14), and drive the L/P down to level 7 (16). Then the L/P is prepared for drive-up using the inching tool (17), (19), (23). Counterweight shoring can be installed (20), and the uplock area can be cleared (21) at this time. All Level 7 equipment is disconnected and removed (18) to the L/P staging platform for crane lift-out of the silo. Meanwhile, the silo hydraulic system is drained (24), the umbilicals (25), and MLS controls (48) are removed. The L/P is moved to Level 6 (28) and Level 6 equipment (27), (29), (49), except the Diesel D-61, is removed. This general operation proceeds through Levels 5,4,3,2, and 1 (30 thru 37).

Heavy rigging operations begin with door cylinder removal (39), and continue through dismantling and removal of the L/P (38), L/P drive mechanisms (40), (41), (42); missile enclosure area equipment from Level 8 (43); Diesels from Levels 5 and 6 (50); storage vessels from Level 8 (44).

Finally, the silo is secured (46), and the silo doors are closed, leaving the crib steel and minimum electrical circuits for pumps, facility elevator, and some lights.

REVISION SYMBOL

| GENERAL DYNAMICS ASTRONAUTICS SAN DIEGO, CALIFORNIA | CODE IDENT NO. 05342 | SIZE A | DRAWING NO. 692-02-65-8 |
|---|---|---|---|
| | SCALE | RELEASED | SHEET i |

PACKAGE NO.

A2613 (REV. 6-63) DISTR CODE

**REFERENCE 17**

A/3c ..., A.L.
54130D
ATLAS F

STUDENT STUDY GUIDE

AIR TRAINING COMMAND

ALL F SERIES COURSES

# INTRODUCTION TO WS 107A-1

January 1962

SM-65F SERIES
TECHNICAL TRAINING

FOR INSTRUCTIONAL PURPOSES ONLY

and the British used them against Fort McHenry, Maryland, in the War of 1812. Our National Anthem mentions the rockets.

The first significant American contribution to rocketry came from Dr. Robert H. Goddard, who built and flew his own liquid propellant rocket near Roswell, N. M., in the 1920's.

Hitler, looking for a super weapon, took the rocket and developed the V-2 with the help of such noted scientists as Christoph Geisler and Werner von Braun. This was the first long range rocket in history, and it was from this vehicle that the lagging Russians and Americans launched their military rocket development.

Missiles have come a long way since World War II. The progress made can be attributed mostly to the independent research and development accomplished in such fields as electronics, rocketry, jet propulsion and aerodynamics. The future outlook for missiles, although presenting many obstacles to be overcome, is that they will be the main weapon of war.

## ATLAS DESCRIPTION

Atlas, the SM-65 Missile (Figure 1-1) is the first operational intercontinental ballistic missile (ICBM) in the arsenal of the Strategic Air Command. Comparable in size and weight to a diesel locomotive, Atlas is the nucleus of the organization of men, missiles, and machines that constitutes the SM-65F (silo) Missile Weapon System.

Designed as a deterrant to hostile enemy action, the SM-65F missile can place a thermonuclear warhead into a ballistic trajectory that will intersect a target more than 5500 nautical miles away. Effective retaliatory capability requires immediate operational readiness of the weapon system. It is therefore maintained with fuel stored in the missile tank during standby. In this status, the missile is ready for launching as soon as liquid oxygen has been loaded and the various countdown sequences have occurred.

The Atlas is 75 feet long, and its 10 foot diameter flares to 16 feet at the nacelles. In contrast to such impressive size, the skin thickness of the Atlas is measured in thousandths of an inch. This tough, lightweight stainless steel skin is fabricated into a cylindrical tank structure containing no internal supporting framework. Rigidity is maintained through constant application of pneumatic pressure to the interior of the two missile propellant tanks. While being transported, and during standby, the tanks are pressurized with gaseous nitrogen. During flight, helium is used.

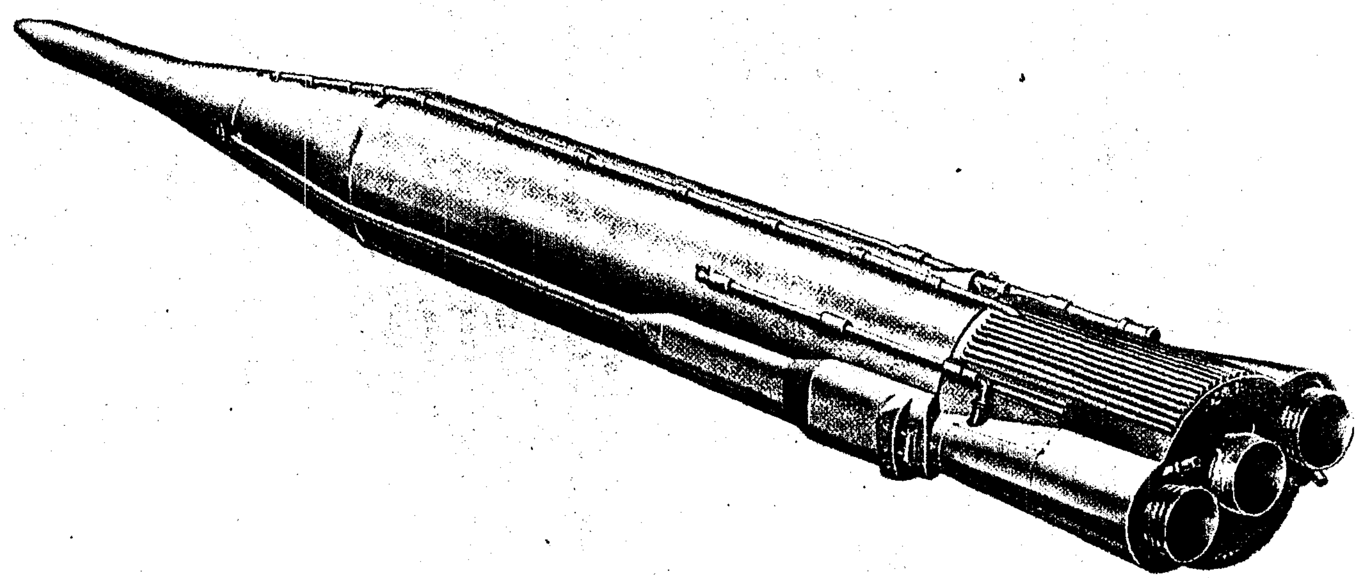


Figure 1-1 **COMPLETE MISSILE**

Equipment pods, containing electronic and electrical equipment, are attached to the tank section skin. Electrical, instrumentation, flight control, and guidance equipment is contained in these equipment pods.

The Atlas system, with its unique one-and-one-half staging, differs from other modern missiles in that it has several engines but only one propellant tank structure. This permits igniting all engines, including the upper stage (sustainer) engine, on the ground. There is no risk that the missile will abort through failure to achieve ignition of a second stage many miles in the air. Missile reliability is remarkably improved. Movable thrust chambers mounted on gimbals provide directional control from commands from the flight control system. Vernier engines are used to obtain precise velocity and attitude adjustments just prior to re-entry vehicle separation.

Atlas is propelled by five rocket engines. The booster engines, which provide the greatest amount of thrust (330,000 lbs), consist of two thrust chambers, fuel and interconnecting piping. The sustainer engine with a single thrust chamber and related pumps, pipes and valves, develops a thrust of 57,000 pounds. Two small vernier engines, individually gimbaled and supplied with fuel and oxidizer by the sustainer pumping system, each develop 1,000 pounds of thrust.

After the missile has been lifted into the first part of its trajectory, a substantial portion of the fuel has been consumed and the missile, greatly reduced in weight, is in thin air high above the earth. The booster engines have then performed their function in boosting the missile to high altitude, and the entire booster section, including pumps, thrust chambers, and the housing for these parts, is jettisoned. Thrust from the sustainer and vernier engines is then sufficient to continue accelerating the missile to the desired final velocity. (See Figure 1-2.)

## SM-65F STRATEGIC MISSILE SQUADRON CONFIGURATION

A typical "F" series missile weapon system base consists of twelve launch complexes surrounding a centrally located Squadron Maintenance Area (SMA). (See Figure 1-3.) The separation between launch complexes is in the order of 15 to 25 miles and a distance from the SMA to any launch complex varies from 25 to 60 miles. This configuration is referred to as the 12 x 1 unitary Strategic Squadron.

There are four separate buildings in the Squadron Maintenance Area (Figure 1-4); the Missile Assembly Building (MAB); the Surveillance and Inspection Building (S & I); the Administration and Storage Building (ASB) and the Paint and Combustable Storage Building.

## RE-ENTRY VEHICLE ADAPTER

Starting at the forward end of the tank section is the first component to be discussed. It is the re-entry vehicle adapter. It is as its name implies, the structure that joins or adapts the re-entry vehicle to the tank section. It is fabricated of aluminum sheet in the shape of a frustum. It is connected to the tank section at airframe station 502.00. (Figure 3-2)

## TANK SECTION

Following the re-entry vehicle adapter is the tank section proper. It is primarily designed as a propellant container. The tank section is used to support the following: the re-entry vehicle, equipment pods, sustainer engine and booster section. It may be described as a large, cylindrical, metal balloon. As air pressure is used to shape a balloon, gas pressure (nitrogen and helium) is used to maintain the shape of the tank section. There will be times, as you shall learn, when the tank section is stretched to either supplement or replace this gas pressurization. This pressurization and/or stretch is required to maintain the structural integrity of the tank skins. The tank section is of pure monocoque-type construction; that is, there is no internal framework to support the tank on the ground or to counteract accelerative and aerodynamic loads in flight.

The material most extensively used in constructing the tank section is stainless steel. The most common abbreviation used for it is CRES, which stands for corrosion resistant steel. The main quality that this material possesses is its high strength to low weight ratio. This allows tank skins to be very thin yet very strong when under pressure. The minimum tank skin thickness is 0.011 in. and the maximum thickness is 0.038 in.

### Liquid Oxygen Tank

The forward part of the tank section makes up the liquid oxygen tank. The tank has a maximum capacity of 18,725 gallons. About 18,500 gallons of liquid oxygen is loaded into this tank. Within the liquid oxygen tank there is a 200 lb aluminum structure. It is called the antisloshing structure. Its primary purpose is to stop any large degree of sloshing of liquid oxygen. If it were not there, the liquid oxygen might slosh severly enough to unbalance the missile to the point where it would be impossible for the gimbaling thrust chambers to control it.

## Fuel Tank

The after part of the tank section is the RP-1 or fuel tank. It has a maximum capacity of 11,653 gallons. Into this tank is loaded about 11,200 gallons of RP-1. Within the RP-1 tank are 2 components. One is the vernier RP-1 tank, which is a propulsion system component. The other is a thin sheet of perforated aluminum, which is mounted across the tank at airframe station 1133. It is called the antivortexing membrane bulkhead. Its function is to prevent the vortexing action of RP-1. Vortexing is that action of a liquid similar to the swiveling effect created as water is drained from the sink or bathtub. Without the antivortexing membrane bulkhead it is possible that the vortexing could be severe enough to produce propellant pump cavitation and, therefore, premature burnout during flight.

## Other Bulkheads of the Tank Section

In addition to the antivortexing membrane bulkhead there are 4 other bulkheads that can be mentioned here.

1. Forward Bulkhead

This is ellipsoidal in shape and forms the roof of the liquid oxygen tank. It contains an access door, which permits entry into the liquid oxygen tank. The access door also provides the mounting for the pneumatically operated liquid oxygen boiloff valve.

2. Intermediate Bulkhead

This is located at about airframe station 960. It is ellipsoidal in shape and forms the floor of the liquid oxygen tank.

3. Aft Conical Bulkhead

This is located at the aft end of the tank section and is made of stainless steel. It is the floor of the RP-1 tank. Part of its structure is a forged-aluminum piece called the thrust cone. It is bolted to the bulkhead and supports the sustainer engine gimbal. Its removal allows acces to the inside of the RP-1 tank.

**REFERENCE 18**

4-23-90

Site Visit Summary
Atlas #8 365-2096

Caral Jackson
John Jackson
3656206

Current owner Lake Arthur Water Co-op, Corp.
P.O.C. John Nelson, 365-2092, Lake Arthur, N.M.

This site was visited ~~by~~ on 4-20-90 by Richard Bornitz. I met w/ Mr. Nelson who accompanied me to the site. This site is currently used by L.A.W.C. for water supply. 2 wells are currently used to supply water to Lake Arthor. The site is not used for any other reason (ie. storage, etc.)
All openings to underground structures were closed at time of visit. Mr. Nelson indicated that trespassers were a big problem for a long time. Recently, a house was moved out to the site and set up on one of the old quonset hut foundations. Mr. Nelson said this has eliminated the problem of trespassers. The site is still surrounded by chain link security fence.
All above ground openings have been sealed with concrete or mounded over with dirt. The septic tanks have been removed and the hole filled. Mr. Nelson said the old diesel fuel tank was removed when the site was sold by DOD. He said the only water storage tanks he knew of were 2 circular above-ground tanks next to the well + pump house. These were also removed. The LCC entrance is covered with dirt.

(Atlas #8 Site Visit, cont.)

Mr. Nelson said water samples are taken quarterly from both wells and sent to Clovis for analysis by the State. He said these wells are approx. 1130' deep and the tests have never indicated any unacceptable levels of contaminants.

Mr. Nelson expressed no concern over further investigation of the site and it does not appear that any further investigation or remediation is necessary. Mr. Nelson had no knowledge of any hazards currently at the site.

See photos and photo log.

**REFERENCE 19**

4-17-90

Contacted John Nelson, President of Lake Arthur Water Co-op, Corp (365-2092) about Atlas #8. He did not know of any hazards. He said all salvageable mat'l was scrapped out long ago, and all entrances sealed up. He said trespassers were a problem - that they would open & enter the LCC. For this reason, he said Water Coop concreted all entrances shut. He said big silo is still closed.

He said some septic tanks were still on the site but were filled in by water Co-op. He said a man has moved a house out to the site and set it up on an old slab. This has stopped problem of trespassers. He said we could look at the site at any time and offered to accompany us if we wished.

John Nelson (LA Water Co-op)

- No known hazards
  Wrecked it out - salvaged tanks & all salvageable matl. Was there when salvaged. In bottom, not much.
- Have sealed it off completely with concrete. Had trouble w/ trespassers - completely sealed it off.
- knows of nothing there.

- <u>Permission</u> ??!!

- Were some septic tanks - but they filled them in.

- 3 wells drilled by A.F. - had a distillery.

- ~~Soon~~ 2 east of Hagerman had piped in water.
- Some east of Roswell had piped
- NE of - well
  N of Roswell - well
- W of " - well.

- had sumps working constantly.

(Nelson, cont.)

- LCC. (circular) sealed w/concrete
- Silo doors still welded shut
- Not using LCC at all - sealed up tight.
- Man living there now - house moved in on old foundations
- 2 Main doors couldn't be opened without some special winch.
- .

No problem - to look at.

- check down at city hall
- 1 block N of Post Office

Will be glad to escort but can go alone if want to.

Atlas 8 Lake Arthur Water Coop

All is underground - pumping water from old well and piping it to Lake Arthur.

For permission call:

Mr. Charles Foster ← (V.P., L.A. water Coop)
365-2165
after 5:00 p.m.
works in Artesia

Tried 4-17, 7:00 AM already @ work
try

John Nelson - 365-2092 (Pres. L.A. Water Coop)

91

~~VEW~~
VIFW

1+411

Co-op
Lake Arthur Water Cooperative Corp.

365-2900
365-2900

call back Fri. A.M. 9:00

DERP

FUDS (old) IRP (active)

atlas missile site -

**REFERENCE 20**

**INTERVIEW SUMMARIES**

**PRELIMINARY ASSESSMENTS**
**OF**
**12 FORMER ATLAS "F" MISSILE SILOS**
**579th SMS, WALKER AIR FORCE BASE**
**ROSWELL, NEW MEXICO**

## TABLE OF CONTENTS

**Section** **Page**



## LIST OF TABLES

**Page**

**INTERVIEW SUMMARIES**
**PRELIMINARY ASSESSMENT INVESTIGATION**

**FORMER ATLAS "F" MISSILE SILOS**
**579th STRATEGIC MISSILE SQUADRON**
**WALKER AIR FORCE BASE**
**ROSWELL, NEW MEXICO**

# 1.0 INTRODUCTION

HydroGeoLogic, Inc. (HGL) received Purchase Order No. 42236 QP from Shaw Environmental, Inc. to conduct preliminary assessments of twelve former Atlas "F" missile silos associated with the 579$^{th}$ Strategic Missile Squadron (SMS), Walker Air Force Base (WAFB), Roswell, New Mexico. As part of its preliminary assessment investigation, HGL located six former missile crewmen and maintenance officers of the 579$^{th}$ SMS, and conducted formal interviews with these individuals regarding their knowledge of operations and maintenance activities in the Atlas "F" missile silos. In addition, these individuals were asked about their knowledge of the events surrounding the accidents at three of the Atlas "F" missile silos. A list of individuals interviewed and their positions with the 579$^{th}$ SMS are presented in Table 1. Refer to Section 2.0 for the interview summaries.

**Table 1**
**List of Interviewees**

| Interviewee | Position | Time Period of Involvement |
|---|---|---|
| Orville L. Doughty, Lt. Col., USAF Ret. | Maintenance Control Officer, Maintenance Squadron | 1962-1963 |
| Gene Lamb | Deputy Combat Crew Command | 1961-1965 |
| Jack Lundgard | Deputy Combat Crew Command | 1961-1965 |
| Phil Moore | Deputy Combat Crew Command | 1961-1965 |
| Jerry Nelson | Deputy Combat Crew Command | 1962-1965 |
| George Ziegler | Section Maintenance Officer, Maintenance Control Unit | 1962-1965 |

## 2.0 INTERVIEW SUMMARIES


**Orville Doughty**
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On January 7, 2005, Lisa Contreras-Hendler and Stephanie Hester of HGL interviewed Orville Doughty, Lieutenant Colonel, U.S. Air Force (USAF), Retired, in person at the Titan Missile Museum in Tucson, Arizona, regarding his knowledge of the Atlas "F" missile silos (Atlas silos) associated with the 579th Strategic Missile Squadron (SMS), which was attached to Walker Air Force Base (WAFB), Roswell, New Mexico.

Mr. Doughty was stationed with the 579th SMS at WAFB from approximately January 3, 1962 to July 1963. Mr. Doughty was the Maintenance Control Officer for the 579th SMS. His office was located in the Missile Assembly and Maintenance Services (MAMS) building at WAFB. While at WAFB, he supervised the maintenance staff, including George Ziegler.

When he reported to duty in January 1962, four Atlas silos had already been installed. The remaining eight missile silos were installed while he was stationed with the 579th SMS. Mr. Doughty said once the contractor turned over the silos to the USAF, he was responsible for conducting an inventory of the equipment in the silos, including documenting the equipment's serial numbers. After the USAF took custody of the silos, it put the warhead onto the missiles and installed the guidance and target systems. The silos went into the alert status soon thereafter.

Mr. Doughty provided details on the maintenance of the silos. Scheduled maintenance was performed every 30, 60, 90, and 120 days, plus annually. In addition to the scheduled maintenance, the maintenance crew was sent out to the silos when items broke. He was responsible for dispatching the maintenance crew to the silos. Mr. Doughty said the typical problems at the silos included issues with the malfunctioning of equipment, door problems, and facility problems. He said the work involved a lot of "R & R," also known as "Remove & Replace."

Mr. Doughty recalled the largest problem at the silos dealt with the diesel generators, which dripped occasionally. These generators were located one level above the liquid oxygen (LOX) tanks. To resolve the potential hazard of the fluid coming into contact with the LOX, the maintenance crew placed a 4-inch deep drip pan beneath the diesel generators. Any diesel problems occurred in the silo itself, while any electronic issues that arose usually occurred in the Launch Control Center (LCC).

The maintenance department was in charge of supplying diesel fuel to the Atlas silos. Mr. Doughty recalled sending a tanker out to the silos once every month. This department also supplied the hydraulic oil, which was used for the elevators within the silos. Mr. Doughty was asked if he could recall other substances used in the Atlas silos. He believed that "MEK" (also known as methyl ethyl ketone) may have been used on the silo property to clean parts and remove grease. If MEK was used, Mr. Doughty said that it would have been in relatively small amounts. He also mentioned the LOX, which was an oxidizer, and the RP1 fuel, which was a crude kerosene product. He does not think that "Tric" was used at the silos, but it was used at WAFB. Mr. Doughty confirmed that his definition of "Tric" was trichloroethene. A hazardous management manual listed the chemicals that were used in the silos.

Regarding storage of material on silo property, Mr. Doughty said that very little material was stored at the silo. The maintenance crews brought any material it needed to do a repair or maintenance check out to the silo with them. The diesel was stored on-site, but he did not recall the size of the tanks. He recalled that two gallons of hydraulic fluid was stored on-site as back-up. The Atlas silos typically operated on diesel during normal operations instead of being electrically powered. Diesel power was relied upon totally during missile exercises. LOX was replenished after any missile exercises since it was vented during the exercise, but the RP1 fuel typically did not require refilling.

Mr. Doughty was asked about the Quonset huts on the silo property. He said these huts were removed once the contractors left. Although he did not go into the Quonset huts, he believed that the huts contained various shops, possibly plumbing and electrical shops. The huts were government-owned and he suggested contacting the Civil Engineering Department of the USAF for further details.

Mr. Doughty stated that he was the first person from the 579th Maintenance Section to arrive at Silo 1, the site of the first silo explosion. The doors of the silo had been blown off, and USAF staff was unable to get into the silo until the following day due to the fire. Mr. Doughty recalled seeing soot everywhere within the silo, but the LCC remained clean. He recalled seeing a 1/2-cup of coffee in the LCC that was not even disturbed. Mr. Doughty was asked if he was able to describe any hazardous conditions in the silo following the accident. He said the biggest hazard was the physical damage to the equipment in the silo. He added that polychlorinated biphenyls (PCB) were not present in oil at this time so this contamination did not exist.

Regarding overall operations of the silos, Mr. Doughty could not think of any operations that occurred at the silos that would cause an environmental problem.

After leaving WAFB, Mr. Doughty was assigned to the Strategic Air Command headquarters in Omaha, Nebraska, and continued to work in the capacity of missile maintenance. He subsequently became MAMS Commander for the missile squadron assigned to Davis-Monthan Air Force Base. Mr. Doughty remained in the USAF for 34 years and retired with the rank of Lieutenant Colonel.

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On October 1, 2004, Lisa Contreras-Hendler and Stephanie Hester of HGL interviewed Mr. Gene Lamb via telephone regarding his knowledge of the Atlas "F" missile silos (Atlas silos) associated with the 579th Strategic Missile Squadron (SMS), which was attached to Walker Air Force Base (WAFB), Roswell, New Mexico.

Mr. Lamb, a 1st Lieutenant in the Air Force, was the Deputy Crew Commander for Silos 1 and 5. His primary assignment was at Silo 1, but he worked at other silos when additional crewmen were needed. Generally, the composition of the missile crew changed as individuals went into and out of military service. Each silo had two crew commanders, and each crew commander had to have the rank of Captain or higher. Congress required that a non-commissioned officer or NCO was stationed on every crew because the crew had access to sensitive documents that could launch the missiles. In addition to the Crew Commander and Deputy Crew Commander, other missile crewmen included the Ballistic Missile Analyst Technician (BMAT), Missile Facility Technician (MFT), and the Electric Power Production Technician (EPPT).

By September 1961, none of the silos associated with the 579th SMS were in operation, but the site activation task force was in place. The silos had been dug and the military was in the process of installing equipment. During this period, Mr. Lamb was stationed at the squadron headquarters at WAFB, assembling training folders.

The crew in a silo was called the "Stand Board" crew. The Strategic Air Command (SAC) required the crewmen to initially become certified prior to being assigned to the missile crew. This certification process involved performing drills associated with missile operations. Periodically, about once per year, the crewmen had to be recertified. The part of the recertification process involved conducting the propellant loading exercises. For an average shift, Mr. Lamb's crew would report to duty, walk the silo with the prior crew, settle into the operations, and then conduct tests that the SAC had given the crew. His crew name was "Skybird."

Both Crew Commanders at the silo wore the launch code in a sealed, plastic case around their necks and a firearm to protect the launch code. The code changed frequently, even during the course of a shift. Each Crew Commander had to separately de-code the messages, and then switch with each other and come to an agreement on the messages. Mr. Lamb noted it was difficult to open the plastic container containing the launch code.

Maintenance activities at the silos were on-going. Mr. Lamb explained that the silo was filled with motors and valves, which not only made the silo a very noisy place to be, but also always provided something to fix. Generally, maintenance issues dealt with support equipment. Much of the maintenance involved vacuum pumps that were used for silo operations and the launch vehicles. Silo equipment, referred to as Real Property Installed Equipment or "RPIE," requiring repairs included valves, motors, and hand equipment. Maintenance efforts also addressed computer failures.

The missile crew during its "walk around" was able to perform some manual and/or minor adjustments on the support equipment. A crewman, for example, can adjust the equipment to keep the temperature within a certain range. The crew also added oil to vacuum pumps when the crew looked through the "sight glass" and noticed that the oil was getting low. More extensive maintenance was conducted by personnel out of WAFB. Mr. Lamb thought this maintenance crew was part of the maintenance squadron of the 579th SMS. This maintenance crew conducted both scheduled maintenance and addressed problems as they arose. Most of the maintenance work occurred in the silo instead of the launch control center (LCC). The missile crew always had two crewmen in the silo to observe the activities of the maintenance crew.

Two diesel generators were located in the silos. Mr. Lamb did not recall many problems with these generators. Diesel was stored in underground storage tanks with a grating covering it. Mr. Lamb believed that the diesel was pumped into the silos, but he did not know if a smaller tank was located in the silo.

Regarding the use of chemicals or spills in the silo, Mr. Lamb recalled oil spills, specifically hydraulic fluid, from machines and pumps. Occasionally during maintenance activities, lubricating oil from a motor or the vacuum pump would spill. Mr. Lamb also remembered that the silo had water leaks, which would collect in the sump at the bottom of the silo. The sump would then be pumped out.

RP1 fuel, a kerosene-based material, was always stored on the Atlas missile. The LOX was stored outside of the missile, and was loaded onto the missile during a launch or a propellant loading exercise. After an exercise, the LOX was then unloaded off the missile. Occasionally, the Atlas missile itself had to be replaced as part of routine maintenance. When this event occurred, Mr. Lamb thought that the RP-1 fuel had to be removed from the missile prior to moving it. He suspected that the RP-1 fuel may have been traded out when this event occurred.

Mr. Lamb did not recall the flushing of lines in the silos. However, he did remember changing out the LOX once and using a non-hydrocarbon cleaner to clean out the line. He thought trichloroethylene may have been used. Mr. Lamb suggested that HGL contact a MFT regarding the use of solvents in the silos as this crewman would have observed the activities of the maintenance personnel out of WAFB. He recommended Don Hajek, a MFT who used to live in Colorado Springs, Colorado, as a potential interview candidate. Mr. Lamb thought that small cans or bottles of solvents might have been used in the silos, but he did not recall any spills or the names of any solvents.

Mr. Lamb recalled that the silo complexes had two Quonset huts, which he believed were used for equipment storage. He did not recall observing any activity associated with these huts.

He provided a description of the events surrounding the explosion at Silo 1. The missile exploded while it was still in the silo. The LOX fire that caused the explosion was started in the fill line that led from the LOX storage tank into the missile. According to Mr. Lamb, an internal fire was started and burned through the valve, causing the LOX to spill onto the floor of the silo and catch on fire as well. Silo 1 was shut down after the explosion.

Regarding the Silo 5 explosion, Mr. Lamb recalled that his missile crew was preparing for the propellant loading exercise at Silo 5. They encountered some problems and had to fix it before the exercise. During the course of drilling for the exercise, his crew's shift ended and they had to return to WAFB to be debriefed while the replacement crew was put in place to execute the propellant loading exercise. He recalled driving back to the Silo 5 in his personal car to watch the exercise. During the exercise, the LOX started to spill out and fall into the silo, causing the fire. He subsequently read that the LOX valve was partially open, which caused the LOX to start dripping into the silo. He drove about two or three miles from the silo and stopped traffic. The missile exploded and he recalled feeling a concussion on his chest. The missile crew in Silo 5 stayed in the LCC during the exercise. He thinks that the guards were also in the LCC during the exercise and that no one was on the silo cap. Silo 5 also ceased operations after the explosion.

Mr. Lamb did not recall any activities, operations or events at the silos that would be environmentally significant other than the explosions at the silos.

Mr. Lamb left WAFB when the Atlas silos were being shut down in 1965. He left the military, but was re-called back into service after two years and went to Germany. He remained in the military for 22 years.

Regarding research avenues, Mr. Lamb did not have any documentation available although he suggested the following individuals as a potential source of information:

- Pete Cummins - Crew Commander at WAFB, possibly residing in Las Vegas, Nevada.
- Jack Lundgard – Crew Commander stationed at Silo 3, Command Control.
- Don Hajek – MFT who was living in Colorado Springs, Colorado.
- Professor Terry Isaacs - Professor at South Plains College, Loveland, Texas. According to Mr. Lamb, Professor Isaacs said that the military wanted to get the Atlas "F" ready because the Jupiter missile was going out of commission.
- Phil Moore – Former missile crewman, who subsequently went to Cape Canaveral to launch missiles.
- Linda Irvine – Compiled a list of 579$^{th}$ SMS personnel for reunion purposes. Mr. Lamb will e-mail Ms. Irvine about HGL's research.

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On October 7, 2004, Lisa Contreras-Hendler and Stephanie Hester of HGL interviewed Mr. Jack Lundgard via telephone regarding his knowledge of the Atlas "F" missile silos (Atlas silos) associated with the 579th Strategic Missile Squadron (SMS), which was attached to Walker Air Force Base (WAFB), Roswell, New Mexico.

Mr. Lundgard was one of the first officers to report to duty to the 579th SMS. He arrived in Roswell in October 1961 and was a member of the site acceptance team. This team worked with the silo construction team, and his responsibilities included observing the construction crew's activities. By late 1961, most of the silo sites had been completed. The silos associated with WAFB had 12 missiles. He mentioned that the Atlas silos at the New York location only had 11 silos.

Shortly after arriving at WAFB, Mr. Lundgard was sent to missile or "ORT" school at Vandenberg Air Force Base (AFB) where he received instruction on how to launch the missiles. He was also taught about the maintenance of the silos and support equipment. He completed the school and returned to WAFB in the Spring 1962.

The missile crew consisted of the following five-man crew: Combat Crew Commander, Deputy Combat Crew Commander, Ballistic Missile Analyst Technician (BMAT), Missile Facility Technician (MFT), and the Electric Power Production Technician (EPPT). In addition, two guards were stationed on top of the silo at all times. Mr. Lundgard was the Deputy Missile Combat Crew Commander (DMCCC) and he worked out of Silo 2 and then finished up at WAFB at Silo 3. He believed that he may have also been located at Silo 5 for a period of time. He explained that Silo 3 was the Command Post for all the silos. It had VHF and UHF to allow for more communication to the outside world from the silo in the event of a wartime scenario. Although each silo had the ability to launch its own missile, Silo 3 had a relay to the other silos that could launch their missiles as well. The Atlas "F" missiles were five mega-ton weapons. Mr. Lundgard said that the military needed missiles with a large impact because the accuracy of the missiles during that era was poor; consequently, it needed a missile that took out more territory.

During the course of the 24-hour shift of the missile crew, the DMCC never went on topside because the DMCC held the top secret code for launching the missiles. The missiles had a decoy system, which Ford Motor Company made. He recalled one occasion when this company's technical representative came to the silo to repair the system.

Mr. Lundgard described certain features of the silo. The silo was equipped with an access tunnel that served as a doorway from the launch control center (LCC) to the silo. He said that there was a silo cap and a domed-object that was used for a retractable antenna. The silo had sensors that popped up and detected a nuclear explosion. If an explosion was detected, the outlets to the exterior of the silo would be closed. The silo also had an escape hatch and a perimeter fence. The silo library contained about 10 to 12 feet of maintenance books. He said that the library contained "Tucker Prints," which depicted the electrical and plumbing lines throughout the silos. He did not know where the silo's water supply was located, but he suspected it came from a well on-site. Mr. Lundgard said that silo operations did not require the use of much water. The Quonset huts were used during the silo construction phase, but he did not know for what purpose. He believed the huts were removed once the silos became operational.

He recalled two diesel generators in the silos, and that the diesel was stored in tanks on top of the silo cap. Although he did not know if the diesel fuel storage was underground or aboveground, the diesel was piped from the storage tanks into holding tanks inside the silos. Mr. Lundgard suggested that the Dash-1 manual may provide details about the use and storage of diesel. Silo operations switched back and forth between commercial power and diesel power. The cooling towers at the silo were used for the two diesel generators. He said that diesel power was used as back-up and he did not know if these generators operated on a daily basis. He recalled, however, that the generators were very noisy.

Regular and continuous maintenance was performed on the silo equipment to ensure that the missile never went off "alert" status. Checklists were used for the maintenance process. Mr. Lundgard observed some minor maintenance tasks, such as the changing of a light bulb. The MFT oversaw major maintenance conducted by the maintenance crew out of WAFB. During major maintenance, he would be stationed inside of the LCC monitoring the system. The maintenance crew from WAFB was out at the silo on a daily basis, and they were part of the 579$^{th}$ SMS.

Mr. Lundgard identified the following materials associated with the Atlas "F" missile operations: liquid nitrogen, liquid oxygen (LOX), gaseous helium, and RP-1. The RP-1 is a hydrocarbon-based fuel that, along with the LOX, was used as a rocket propellant. He did not know if the RP-1 was ever recycled. It was a stable material, and it had microorganisms growing in it. He did not recall whether the RP-1 fuel required replenishment.

Mr. Lundgard provided a description of the launch procedures and the events that led to one silo explosion. The bottom half of the missile had RP-1 fuel in it and the top half of the missile contained instrument or pressurized air. Mr. Lundgard described the missile like an aluminum balloon. During launch procedures, the top half of the missile filled with LOX as the doors to the silo opened. When the hot sun beat down on the missile, its contents heated up causing the LOX to expand and burst a seam. The LOX caught a flicker and then exploded. All the missiles that exploded blew up during the propellant loading exercise (PLE). The military placed a warhead that weighed the same as the nuclear warhead on the missiles during the PLE. Mr. Lundgard recalled being in Silo 3 with the Inspector General when Silo 5 exploded. His crew turned the cameras on top of Silo 3 in the direction of Silo 5 and noticed a column of smoke. When asked if he knew of any environmental issues associated with any of the silo explosions, Mr. Lundgard said that he thought the accidents took out "everything" as they were catastrophic.

He said that the military tried to minimize any spills at the silos, but he thought that the hydraulic oil presented a bigger problem instead of the diesel. Mr. Lundgard said the hydraulic oil used inside of the silo would drip down to the sump at the bottom of the silo. The sump was pumped out, but Mr. Lundgard did not know whether the pumped material was put inside a container or pumped onto the ground or into a drainage ditch. He said that minimal amount of oil would drip into the sump. He did not recall any spills of diesel.

Mr. Lundgard did not know whether lines on missile were flushed or whether the missiles were washed down with any substance. He indicated that he did not think it was necessary for missiles to be washed down. He also did not know about any solvent use at the silos.

While he was still stationed at WAFB, he recalled seeing the missiles being pulled out the silos, but he did not know what occurred with the silos themselves. Mr. Lundgard left WAFB in the Fall 1965 and went into the military intelligence school. He worked in photo intelligence during the Vietnam War and then later worked on the SR-71 in Japan and in Germany. Mr. Lundgard retired as a Colonel in the U.S. Air Force and he was 70 years old on the date of this interview.

Regarding other information avenues, Mr. Lundgard said that he conducted an interview with a professor who later wrote a book about the Atlas "F" missile. He gave this individual his documents, including the Dash-1 and the checklist he used while in the LCC. He recalled that Richard Wade was an MFT. Mr. Wade's telephone numbers are (813) 996-1022 (home) and (813) 732-2784 (cell). Other potential information sources included the Air University at Maxwell AFB and Wright Patterson AFB.

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On October 4, 2004, Lisa Contreras-Hendler and Stephanie Hester of HGL interviewed Mr. Phil Moore by telephone regarding his knowledge of the Atlas "F" missile silos (Atlas silos) associated with the 579th Strategic Missile Squadron (SMS), which was attached to Walker Air Force Base (WAFB), Roswell, New Mexico.

Mr. Moore was stationed with the 579th SMS, and he arrived at WAFB in October 1961 and departed 1965. He was the Deputy Crew Commander and his rank while there was 2nd and 1st Lieutenant. Later, Mr. Moore was promoted Major. Other crew men in the silo included three enlisted men, including a Sergeant and two Airmen. The Crew Commanders were either Captains or Majors.

In 1961, the Site Activation Task Force (SATF), under the Air Force Systems Command, oversaw the construction of the silos. He recalled the U.S. Army Corps of Engineers being involved. He never saw the silos under construction, but he recalled that while construction was occurring he was waiting for a slot to open at missile school. On February 2, 1962, he went to missile school.

Each silo had its own library which contained at least one copy of the technical orders. Mr. Moore did not think that crewmen had individual copies of the technical orders. The Dash-1 was a technical manual that was similar to an operator's manual that typically came with a car. The manual addressed how to operate the missile and its equipment, but it did not address how the systems were repaired or maintained. Mr. Moore thinks that most of the contents of the library were thrown away once the military left the silo properties. He recalled seeing a large number of manuals left in the silo libraries at the time of deactivation. He said that these manuals were not classified. Rather, the launch code and the procedures to go through to launch were the classified material.

He was assigned to Silo 1 until that silo exploded. Mr. Moore was on leave when the explosion at that silo occurred. He was then located at Silo 7, which he called his home site. Mr. Moore worked at other silos when they needed additional staffing. Specifically, he was on duty at Silo 2 when it exploded, but that was the only time he was assigned to this silo.

After the explosion in Silo 1, Mr. Moore recalled that the launch control center (LCC) had smoke damage and the rest of the silo was also damaged. The silo began to fill up with water. He said that this silo was located near an underground river that was located at a depth of six feet. A corrugated metal conduit was used to stop water from rising in the silo, and the silo hole was deepened to accommodate the conduit. The explosion blew open the conduit. He believed that another silo had an underground conduit associated with it, but he could not recall the specific silo.

As a Deputy Crew Commander of a missile crew, Mr. Moore was responsible for operating the silos. The crewmen did some maintenance, but personnel out of WAFB conducted most of the maintenance. His crewmen oversaw the WAFB maintenance crew as they performed their duties. He occasionally oversaw some maintenance activities because he was interested. He said that the squadron had a large number of maintenance personnel who specialized in certain areas. Mr. Moore described the silos as a busy place with many people there. He only recalled one or two occasions when there were no maintenance crews in the silos. Most of the maintenance issues in the silos dealt with support equipment, and did not involve the missiles themselves.

Mr. Moore did not know if the LOX lines on the missiles, which were made of stainless steel, had to be cleaned out. He said, however, that these lines were extremely sanitary and remained sealed at all the times. Some equipment had filters, which were pulled out and changed occasionally. Anything on the outside of the equipment was cleaned off immediately.

Material stored on-site included diesel fuel used to operate the diesel generator. Diesel was stored in a "day tank" inside the silo, which contained a day's worth of diesel to operate the generator. A larger diesel tank with associated piping was located aboveground. Liquid oxygen (LOX) was also stored in large amounts in an oxidizing tank inside the silo. He estimated that about 19,000 gallons of LOX was stored in the silo. The LOX was one of the missile's fuel supplies. RP1, a high-grade form of kerosene, was also stored in a fuel tank inside the silos. Mr. Moore said that 12,000 gallons of RP-1 fuel was stored, and he did not recall that this fuel had to be replenished. Other materials included helium gas and hydraulic fluid. The hydraulic fluid was used to operate the silo doors and crib locks. These locks had to be in place prior to a launch. The hydraulic fluid was under extremely high pressure, about 3,000 pounds per square inch. Mr. Moore said that the hydraulic fluid was occasionally refilled because of leaks. A small tank was located inside the silo to store extra hydraulic fluid. This fluid was a standard oil hydrocarbon.

Mr. Moore said there were many leaks in the silo. Types of leaks included diesel, hydraulic fluid, and water. A lot of diesel leaked from the generators, the lines, and joints. Typically, the leaks involved seepage and did not constitute large spills of diesel or hydraulic fluid. However, some of the leaks were larger and resulted from personnel forgetting to turn off the switch when filling the day tank. If an overspill occurred on the diesel fuel's day tank, the military had to be cautious resolving the problem since the LOX lines were located a few levels below the day tank.

He did not recall using solvents to clean any spills, but he said it was a possibility. Mr. Moore had worked in aircraft manufacturing, specifically Douglas Aircraft Company in Tulsa, Oklahoma, during the late 1950s and he recalled using a lot of TCE in that job. TCE could have been used in the silos for spill clean up since it was not a petroleum-based material and therefore was not incompatible with the LOX.

The Dash-1 manual (TO 21M-HGM-16F-1, Section 4, pg 4-15, 4.101-4.102) contained emergency procedures for spills. Based on visual inspection, if a spillage of RP-1, diesel, or hydraulic fluid is noted, the fan and the water were to be turned on. He said that the missile had a Fog system that involved a water spraying system, which needed to be cleaned up afterwards.

A sump pump was located at the bottom of the silo, which pumped the liquid out to the top. Mr. Moore did not know where this liquid went, but he suspected that the liquid was pumped onto the ground. He said the sump was greasy, stating it was the only thing in the silo that was not cleaned. If a gas spill occurred in the silo, the air conditioning unit would suck it up.

When each of the silos exploded, there was a huge amount of RP-1 fuel released. However, the explosions resulted in a fire that lasted for hours, and he believed that the fuel was probably burned away.

Mr. Moore believed that the alkaline water in the pipes of Silo 11 caused problems by creating residue in this silo's pipes. Acid was put into the pipes to eat out the residue. At Silo 11, he recalled that acid was poured into the cap, which caused a lot of damage to the electrical equipment. This event occurred at the end of the Atlas "F" program.

The LCC was relatively clean. The military conducted household-type of cleaning in the LCC and occasionally painted items using enamel paint. The floors were mopped and the kitchen scrubbed using normal household cleaners. Dust from the LCC control panels was wiped off with a damp cloth.

Regarding other areas associated with the silo property, Mr. Moore suspected that some spills or dumping might have occurred on the top surface, including spillage in the diesel tank area. He said that not many spills occurred in the LCC itself.

According to Mr. Moore, the Quonset huts were used to store spare parts. He said the huts were used during the construction phase as well as during the missile operations.

Mr. Moore described the events surrounding the explosion at Silo 2. He said that he had the accident report for this explosion. Silo 2 was under evaluation by the Standboard crew when it exploded. This silo always had problems with the missile lift system because it would always stick. Mr. Moore said the system was warped. The count down during the propellant launching exercise was completely normal. The missile rose to the top, but it became stuck and could not be lowered. Pressure was building up in the missile. This pressure was not released immediately because the Standboard crew conducting the evaluation would not allow the Standard crew on duty to do it. Mr. Moore said if this pressure was released at the right time, the missile would not have exploded. The missile tumbled down three levels and every gas in the silo was released, taking out all of the diesel and hydraulic lines. Mr. Moore said that the cable attached to the elevator froze from the LOX, became brittle, and the weight of the missile broke the cable and made it fall.

Mr. Moore later learned that the LOX and RP-1 fuel tanks fell to the bottom of the silo and started to fill up the ducts, which contained grease. The fire started in the ducts and went through the vent system. A power surge went through the LCC as a result of the burning, which blew out a monitor in the LCC. Flames from the ensuing explosion rose 200 feet high in the air, and the fire burned for hours.

Mr. Moore estimated about 18 individuals were inside the LCC when Silo 2 exploded, including one civil service employee and someone from the San Bernardino Air Material Command. They used the field phone to communicate outside of the LCC. When they were informed that it was safe to evacuate because no more flying debris was observed, they ran out of the silo as the fire burned. Mr. Moore had the only key to the perimeter gate, but the gate was already open. When the explosion occurred, it shook the LCC and knocked Mr. Moore down; however, the shock absorbers performed well and the LCC stayed intact. Smoke began to fill up the LCC though.

When the Atlas silos were deactivated, the RP-1 fuel was drained out of the tanks.

After leaving the 579th SMS, he was in the Vietnam War and continued to work with missiles.

Mr. Moore estimated that he had about two suitcases full of information regarding the Atlas program. He also suggested the following individuals as potential interviewees:

- Jerry Lundgard
- Wayne Peatley – Mr. Peatley has Alzheimer's Disease
- Bob Pittman – Mr. Pittman may not be interested in speaking with HGL.
- Bob Caplan – Mr. Caplan worked in maintenance while stationed at WAFB. Mr. Caplan is involved in a Missile Talk Forum. His contact information is bobcapl@pacbell.net.
- Les Hayls
- Bill Bergelin – Mr. Bergelin worked in maintenance while stationed at WAFB. His contact information is wbergelin@compuserv.com.
- George Ziegler – Mr. Ziegler was assigned to the maintenance squadron.

**Jerry Nelson**
**4570 Ocean Beach Blvd**
**Unit #46**
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On September 21, 2004, Lisa Contreras-Hendler and Stephanie Hester of HGL interviewed Mr. Jerry Nelson via telephone regarding his knowledge of the Atlas "F" missile silos (Atlas silos) associated with the 579th Strategic Missile Squadron (SMS), which was attached to Walker Air Force Base (WAFB), Roswell, New Mexico.

Mr. Nelson was stationed with the 579th SMS from 1962 until the Atlas "F" missiles were decommissioned in 1965. He was a crew member at Silo 9 and the Deputy Crew Commander (DCC) for Silo 6. The DCC was the second in command of the five-man missile crew. It required two members of the missile crew to launch the nuclear weapons. Mr. Nelson explained that the missile crew worked a 24-hour shift and had a 2- to 3-day break between shifts. Two crewmen had to be awake at all times during the shift. The crewmen typically got about four hours of sleep during the 24-hour shift. During the course of a shift, crewmen made about two or three inspections within the silo. They would be responsible for recording instrument readings. If the silo's system light was green, everything was operational. If the system light was red, a malfunction occurred and the crewmen would call maintenance if they were unable to resolve the problem.

As a crewman, Mr. Nelson maintained the missile launch readiness and performed some minor maintenance, such as removing light bulbs in the launch control center (LCC). The maintenance crew out of WAFB performed any major maintenance at the silo. Mr. Nelson was not able to recall the type of major maintenance that occurred, but said it was conducted in the silos. Any maintenance on the Atlas "F" warhead was conducted at WAFB. The WAFB maintenance crew occasionally conducted modifications and maintenance in the LCC. He thought the maintenance crew came out to the silos on a relatively infrequent basis. Mr. Nelson added that scheduled maintenance at the silos also occurred.

Mr. Nelson was asked if trichloroethene (TCE) was used in the silos or the LCC. He did not recall using TCE in the LCC, but did not know whether it was used in the silos. Mr. Nelson did not know if any other chemicals were used in either the silo or the LCC. He mentioned that hydrocarbon solvent was incompatible with the liquid oxygen (LOX); consequently, the military was reluctant to use this type of substance in the silos.

Mr. Nelson stated that the diesel generators were located inside the silos, but he did not know where the diesel fuel was stored. The silos were equipped to use commercial power, but since the military wanted the silos to remain independent, diesel was mostly relied upon for silo operations.

Mr. Nelson did not know what the evaporation ponds were used for at the silos.

He did not know what activities occurred in the Quonset huts. Mr. Nelson said that the Quonset huts were used during the construction phase of the silos, and remained on-site after construction was completed. These buildings were not generally occupied while he was at the silos. Mr. Nelson explained that the personnel at the silo property consisted of the five-membered missile crew and two security guards located at the front gate.

Mr. Nelson did not know of any fuel spills or accidents at the silos to which he was assigned. However, explosions occurred at three other silos. For one of these explosions, the missile had been raised up and then became stuck. The missile exploded because it was unable to be lowered in order to drain off the LOX. Mr. Nelson did not know what occurred with the other two silo explosions. As a description of the standard process, he explained that the LOX is put into the missile during the last few minutes prior to raising the missile up. It took a few minutes to raise the Atlas "F" missile up to its launch position, and even a longer period of time to lower the missile.

After leaving WAFB, Mr. Nelson worked on the Saturn 5 fabrication in New Orleans and the Saturn 5 launch at Cape Canaveral. Later, he worked at Cape Cod inside another LCC.

Mr. Nelson provided suggestions on other research avenues. He recommended interviewing Chief Warrant Officer Ziegler. Mr. Ziegler worked in maintenance out of WAFB. He also suggested Gene Lamb, another missile crewman. Mr. Lamb organized the last reunion for the 579$^{th}$ SMS. Regarding document sources, Mr. Nelson said many documents, such as technical orders (TOs), were housed inside the LCC. These documents were classified and they described all the equipment contained in the LCC and silos. He had given Gary Baker a copy of the TO. HGL confirmed with Mr. Nelson that it was the same TO that Mr. Baker provided to HGL on a prior visit. Mr. Nelson did not know where HGL could locate "As-Built" drawings, but mentioned that General Dynamics may be one source to explore for these documents.

**George Ziegler**
**2001 W. Rudasill, Apt 9101**
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**(520) 297-9384**

On October 11, 2004, Lisa Contreras-Hendler and Stephanie Hester of HGL interviewed Mr. George Ziegler via telephone regarding his knowledge of the Atlas "F" missile silos (Atlas silos) associated with the 579th Strategic Missile Squadron (SMS), which was attached to Walker Air Force Base (WAFB), Roswell, New Mexico.

George Ziegler reported to duty to the 579th SMS at WAFB in March 1962. He was assigned to the Maintenance Control Unit, and he mostly worked out of WAFB. At the time of his arrival, the silos were still under construction. Mr. Ziegler remained at WAFB for three months, working in the Reports and Analysis Section. He then went to missile school and did not return to WAFB until December 1962. While in school, Mr. Ziegler went through general missile comprehension courses and learned about all missile operations.

Upon his return to the 579th SMS at WAFB, Mr. Ziegler supported plans and scheduling. He also worked in the Real Property Installed Equipment Section, which dealt with the water treatment facilities at the silos. He said every three silos had a water treatment facility.

Mr. Ziegler was asked if his responsibilities required him to go to the Atlas silo locations. He estimated that he went to the silos about once or twice a week for a period of time. He thought that he may have only visited about 4 or 5 of the 12 silos while stationed at WAFB. Mr. Ziegler indicated that the maintenance crew out of WAFB generally performed work on the silo equipment. Occasionally, maintenance was conducted on the missile itself. The maintenance crew ran scheduled diagnostic tests on different systems of the missile operations throughout the year.

Mr. Ziegler did not recall the specific types of maintenance conducted at the silos. He explained the missile system was so complex and it required several types of work. He recalled that the maintenance crew worked on the diesel generators on a regular basis. These generators were the primary source of energy for the silos. Mr. Ziegler thought that diesel fuel storage tanks were located on the same level as the diesel generators in the silo. Mr. Ziegler was unable to recall if any chemicals or cleaning agents were used within the silos, including specifically trichloroethene also referred to as TCE. He also did not know if the liquid oxygen (LOX) lines were cleaned at the silos or at some other location.

Technical orders (TOs) were used for the maintenance and cleaning that occurred in the silos. Mr. Ziegler said that the maintenance crew was in strict compliance with the TOs, but he did not know if the TOs addressed solvent usage. Each silo had its own library and he suspected that a similar library existed at WAFB. He knew that the maintenance shops at WAFB had copies of the relevant TOs. These shops were located in the (MAMS). The entire administration section of the 579th squadron was also located in the MAMS building.

When asked about Quonset huts on the silo properties, he recalled seeing these huts and he believed that these huts were used during the construction phase of the silos. He suspected that after construction ended, the huts were used for storage. Mr. Ziegler never went into the huts and did not know what they housed.

Mr. Ziegler did not have any knowledge of the accidents that occurred at three of the Atlas silos in New Mexico.

Mr. Ziegler remained with the 579th SMS at WAFB until approximately July 1965 when the Atlas "F" program became deactivated. When he left the U.S. Air Force, Mr. Ziegler's rank was Chief Warrant Officer (CWO-4).

**REFERENCE 21**

SUBJECT: Proposed Revision to SAC SM 66-2

FROM: DEMC

31 Dec 58 Comment No. 2
Mr. Bousha/ehm/21137

1. The proposed SAC SM 66-2 does not appear applicable to installation engineering functions. This staff memorandum is devoted to operational maintenance of the missile and missile system and does not involve maintenance of the real property items such as block house, launch pad, missile maintenance buildings.

2. SAC SM 66-2 contains information which would be desired by field units and recommendation is made to publish this data as a SAC letter or regulation for wider coverage.

1 Incl
1 cy w/d

Control

DRAFT

SAC SM 66-2

STAFF MEMORANDUM )
*
NUMBER 66-2 )

HEADQUARTERS STRATEGIC AIR COMMAND
Offutt Air Force Base, Nebraska

MAINTENANCE - ENGINEERING

Strategic Missile Weapon Systems

1. PURPOSE. This memorandum:

a. Establishes Strategic Air Command policy for the maintenance of strategic missile weapon systems.

b. Provides guidance to all Strategic Air Command staff agencies for use in preparing planning documents for specific missile systems in accordance with AFR 5-57, i.e., operational, logistics, installation, technical, and crew training plans.

2. GENERAL. a. The strategic missile weapon systems presently include the SM-62, SM-65, SM-68, SM-73, SM-75, SM-78 and SM-80. Additional weapon systems will come under the purview of this regulation as their development progresses.

b. Strategic missile squadron launch sites may be located in an isolated area. Transportation will be required between the squadron launch sites and its supporting base, a distance no less than eighteen miles (see inclosure 1).

(1) The supporting base will be an active military installation which will provide the maximum support within its capability. This support includes housekeeping, supply, and certain maintenance support to the assigned missile squadrons. Normally, the squadron RIM/MAB building and squadron/wing headquarters will be located on this base.

(2) The geographical location of the missile squadrons, the operational requirements for multiple launching with a

* Supersedes SAC SM 66-2, 19 December 1956

minimum of delay, and the requirement to maintain a maximum number of missiles in commission predetermines basic criteria for a maintenance plan.

3. POLICY. A maintenance plan must be included in appropriate weapon system planning documents (AFR 5-47) for each strategic missile weapon system during the early development of these documents. Certain policies must govern, and to some extent dictate, maintenance procedures and plans in supporting a missile weapon system.

a. Establishment of a maintenance plan for each strategic missile system and its inclusion in the operational plan will facilitate:

(1) Acceptance of a missile system into the SAC inventory.

(2) Development of equipment and support plans designed specifically for SAC operations.

(3) Design and construction of maintenance facilities.

(4) Preparation of individual (technical) and integrated weapon system (crew) training plans, manning documents, programming, and selection of personnel.

(5) Establishment of requirements for ground support equipment and logistical support.

b. The maintenance plan is designed primarily to assure maximum support of operational readiness.

c. To permit accomplishment of the operational plan, strategic missile squadrons normally must have a self-sufficient combat capability. In geographical areas that contain two or more missile squadrons the maintenance control function and the maintenance support area will be consolidated under a wing organization, and located on the support base. Missile squadrons and wings will be equipped and manned to perform maximum repair consistent with time, parts, equipment, and technical ability.

d. Missiles will not be removed from the missile squadron/wing area except for depot/contractor level maintenance that cannot be performed at this area.

e. Development of missiles and support systems should support and not compromise the maintenance plan.

f. SAC missile maintenance procedures are established in SACM 66-9, Strategic Missile Maintenance Management Manual.

g. The maintenance structure of a strategic missile organization must be developed to insure maximum capability with the most efficient use of personnel. The current organizational maintenance structure for a strategic missile squadron is shown in SAC Manual 66-9, Strategic Missile Maintenance Management Manual.

4. MAINTENANCE DEFINITIONS. For a mutual understanding to terminology, a set of definitions specifically tailored to the systems concept of maintenance has been established. These definitions apply to hydraulic, electrical, mechanical, or electronic equipment. These definitions are shown in inclosure 2, using an autopilot system as an example, and again in inclosure 3 using an auxiliary power system as an example.

5. MAINTENANCE RESPONSIBILITIES.

a. The missile squadron/wing is responsible for all organizational and field levels of maintenance on missiles and support equipment. This responsibility includes normal squadron functions, such as pre-launch, daily, and storage inspections; routine launch site servicing and preventive maintenance; removal and replacement of specific components; bench maintenance; assembly of missiles; periodic inspections; recycle maintenance; technical order compliance; reclamation and repair of components and parts.

b. The Air Materiel Command is responsible for all depot level maintenance, both contract and USAF. This includes the provisions for mobile depot teams to assist using command at the site, if possible, to accomplish work beyond their resources and capability. This may include, but is not limited to, major modifications and repairs, mass assembly of missiles, major overhauls, and storm or explosive damage.

c. To assist in determination of items which can be repaired at organizational and field level, AMC, in collaboration with ARDC and SAC, will develop by missile type, master repair lists for strategic missiles. The authorized maintenance lists will be published by AMC in appropriate technical orders.

6. ORGANIZATIONAL AND FIELD LEVEL MAINTENANCE. Three functional areas, launch complex, periodic maintenance and bench repair, are interacting and interdependent at the organizational level.

a. Launch Complex Maintenance

(1) Launch complex maintenance is that maintenance performed on the missile, launcher facilities, GSE, and ground guidance station equipment and communications.

(2) Launch complex maintenance consists of:

(a) Performing preventive maintenance and servicing of missile and each system while installed in the missile. Preventive maintenance on the launcher, ground support equipment, facilities, communications and ground guidance equipment within the launch enclosure will be the responsibility of the operation/maintenance personnel of the launch emplacement, augmented when necessary by specialists dispatched from the squadron maintenance area (SMA).

(b) Testing missile, ground guidance equipment, facilities, communications, and ground support equipment to determine if all minimum performance standards are met.

(c) Performing trouble shooting and isolating the malfunction to the smallest removable unit, replacing unit, and interval basis to insure the operational readiness of the missile and ground support equipment. Periodic maintenance will be performed at the launch complex when practical. Other time interval inspections on the missile, ground support equipment, facilities and ground guidance station equipment will be accomplished at the launch complex by the operational/maintenance crews utilizing the installed checkout equipment. Specialists will be dispatched from the general maintenance building to assist the operation/maintenance crews as required.

(2) Periodic maintenance consists of:

(a) Performing maintenance on unit equipment at predetermined time intervals and upon initial receipt from depot or contractor.

(b) Scheduled inspection, cleaning, lubrication and preservation as necessary, thorough performance checks and alignment of the missile, installed systems and ground support equipment.

(c) Replacement of time-change proposals.

(d) Remating the missile on the launcher after periodic inspection. The periodic crew will be assisted in mating the missile stages by the operation/maintenance crew of the launch complex.

(3) Periodic inspection and maintenance procedures will be developed through adaptation of the present planned inspection procedure (TO 00-20E-1 and other appropriate Technical Orders) to missile weapon systems.

c. Bench Maintenance

(1) Bench maintenance is that maintenance performed in the checkout

and repair of components, assemblies, etc., submitted from the launch area. Bench maintenance will be accomplished in the squadron maintenance area. Bench maintenance will include initial inspection and serviceability checks as required on components received.

(2) Bench maintenance consists of:

(a) Isolating malfunctions in components submitted from the launcher enclosure or periodic maintenance area to an assembly, subassembly, plug-in unit, detail part, etc., the repair of the malfunctioning assembly, subassembly, plug-in unit, detail part, etc., and the performing of any necessary alignments, adjustments, or calibrations required as a result of such repair, replacement or reconditioning.

(b) Performing calendar inspections and checkout of components using appropriate checkout test equipment to insure that the repaired, reconditioned or inspected components and assemblies meet established standards.

(c) Operating and maintaining all system maintenance test benches assigned to the squadron.

(d) Performing technical order compliances on components that are assigned to the squadron.

(e) Repairing and calibration of assigned peculiar (non AF standard) test equipment consistent with time, ability and tools available. (AFS test equipment repairing and calibration will be accomplished by the air base support unit in accordance with AFR 74-2 and SAC SUP-1 thereto.)

(f) Performing functional acceptance checks on equipment received from depot facilities.

(3) Bench maintenance will require special test benches and consoles and Air Force standard test equipment (scopes, signal generators, vacuum-tube voltmeters, spectrum analyzers, etc.). An adequate quantity of repair parts (bench stocks) must be maintained to repair components.

(4) Bench maintenance repairmen will require a knowledge of theory, system function, circuit anlaysis, stage by stage, and a high degree of repair capability.

(5) Technical data must be presented to the repairman in appropriate size (8½ x 11) technical manuals and will include detail component schematics, with necessary descriptive narrative to enable him to accomplish his job.

7. DEPOT LEVEL MAINTENANCE. Depot level maintenance is that maintenance beyond the capability of the missile squadron and falls into two categories; weapon system and non-weapon system support.

a. Depot level maintenance on weapon system items will be the responsibility of the logistic support manager and may be accomplished in contractor facilities, AMA's or at the squadron by means of mobile maintenance teams.

b. Depot level maintenance on non-weapon system items will be supported through the normal Air Force channels.

8. PROCEDURES. To preserve a high degree of support for missile units, it is necessary that the following supply and support procedures be implemented:

a. The missile squadron will be supported for maintenance items through a weapon system account located on the squadron site. This weapon system supply account will requisition direct from the logistic support manager, receive, process, inventory, and issue all items required to support the missile.

**REFERENCE 22**

25 SEP 1980



# TECHNICAL MANUAL

## *CLEANLINESS STANDARDS*

# CLEANING AND INSPECTION PROCEDURES FOR BALLISTIC MISSILE SYSTEMS

F41608-80-D-A006

PUBLISHED UNDER AUTHORITY OF THE SECRETARY OF THE AIR FORCE

0001

15 JUNE 1965

ATTITN

CHANGE 10 – 15 JULY 1980

# SECTION IV
# ATLAS, THOR, AND TITAN I WEAPON SYSTEMS

## 4-1. GENERAL.

4-2. SCOPE. This section includes specific policies and procedures for cleaning all components and systems used in the Atlas, Thor, and Titan I weapon systems. General cleaning procedures are specified in Section III, General Cleaning Procedures.

4-3. RESPONSIBILITY. Prior to the start of and during the cleaning operation, the supervisor in charge will ensure that proper procedures and materials are being used as specified herein. The supervisor will obtain necessary coordination with appropriate base organizations to ensure use of safe practices (reference Sections II and III).

4-4. CLEANING FACILITIES. Typical Titan I and Atlas cleaning facility equipment layouts are shown in Figures 4-1 and 4-2, respectively. The cleaning area is divided into the pre-clean (or rough clean) area and the final cleaning area. The cleaning supervisor will ensure that cleanliness requirements are met. All tools used in the final cleaning area will be cleaned and maintained at the same standards as specified for the parts, components, or assemblies to be cleaned. When equipment is not available at the Base for the accomplishment of required precleaning or final cleaning tasks, the contaminated item shall be returned to the depot for processing.

## 4-5. GENERAL CLEANING REQUIREMENTS.

4-6. PROCESSING COMPONENT PARTS. Instructions outlining the general processes for cleaning components are shown in Figures 3-2 through 3-9. Figure 3-1 has been included as a guide for selecting applicable cleaning procedures.

**CAUTION**

Use extreme caution when handling machined parts (seats, poppets, etc) and filter elements. Arrange items in such a manner as to prevent their striking one another, since any damage may be sufficient to render the part unserviceable.

4-7. Component Parts -

4-8. Parts or tools shall never be laid on floors or on uncleaned surfaces. Lay parts on clean table top or on clean polyethylene sheet.

4-9. Never touch interior of components with bare hands. If it is necessary to wipe off flanges or interior of parts, wear alcohol or solvent-resistant polyvinyl gloves and use a clean line-free cloth (Federal Specification CCC-C-46 Type I) moistened with methylene chloride (Dichloromethane, Military Specification MIL-D-6998, Grade A).

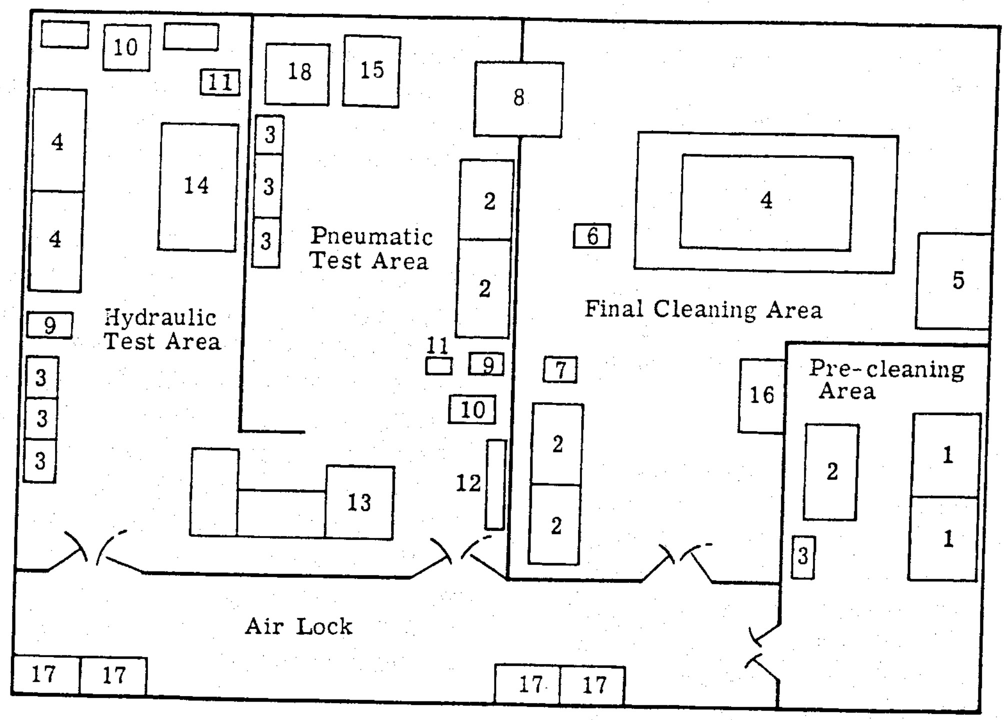
4-10. Components shall be cleaned, dried, reassembled, inspected, and packaged in the final cleaning area only.

4-11. Corrosion Removal - Metal parts which are found to be corroded must be treated to remove the existing corrosion and to retard further corrosion prior to being taken into the clean room. Parts that have been plated or anodized, and which have been damaged to such an extent that the base metal has corroded, shall not be cleaned (with the exception of painted parts). Also, if the strength or function of a part will be impaired by the corrosion removal process, the part shall not be cleaned. For such unclean parts, the supervisor shall request disposition instructions from the responsible depot.

4-12. Painted Parts -

**WARNING**

Paint remover produces dangerous and noxious fumes. Avoid breathing the fumes over a protracted period of time or in confined spaces. Always provide for adequate ventilation. Wear alcohol or other solvent-resistant polyvinyl gloves during the cleaning process. As an added precaution, wear an approved face mask. Failure to take proper precautions can result in serious injury or death.




LEGEND

1 Detergent/Rinse Tanks
2 Work Benches
3 Cabinets
4 Vapor Degreaser
5 Deionized $H_2O$ Rinse
6 Solvent Reclaimer
7 Sonic Cleaner
8 Pass-thru Oven
9 Sink
10 Plastic Dip
11 Electric Oven
12 CTU Hose Rack
13 CTU
14 CTU Adapter Set
15 Cryogenic Test Stand ("D" Series)
16 Handling Cart
17 Smock Racks
18 Liquid Nitrogen Cart ("D" Series)

Figure 4-2. Typical Atlas Cleaning Facility Layout (MAMS)

Painted parts, which require cleaning, shall have the paint completely removed by applying paint remover (Military Specification MIL-R-25134) with a long-handled, non-metallic brush to the painted surface until all paint has softened and lifted. Rinse thoroughly with filtered (10 micron, nominal) Solution I (Paragraph 3-30) and allow part to dry thoroughly. Continue the cleaning process per Section III.

**4-13. PROPELLANT LOADING SYSTEMS (PLS).**

4-14. PLS CLEANLINESS STANDARDS AND INSPECTION. These cleanliness standards and inspection techniques are applicable to the systems and components of the missile and ground support system containing, or used in connection with RP-1 fuel, liquid oxygen, liquid nitrogen, and pneumatic gases.

4-15. Component Standards and Inspections - The contamination limits for the propellant and pneumatic subsystem components are shown in Figures 4-3 and 4-4. Cleanliness of components shall be determined by the procedures of Inspections No. 1, 2, 3, 4, 5, and 6, as applicable and as described in Paragraphs 9-12 through 9-35. Inspections No. 1 and 2 shall be utilized for checking test fluids and final-cleaning solvents. They shall also be used as a quality control technique for the verification of component cleaning process and where system maintenance manuals require a particle count for cleanliness certification of specific components. Inspections No. 3, 4, and 5 shall be utilized as the general methods for verification of component cleanliness. Inspection No. 6 shall be conducted as a referee inspection by the Depot or other qualified test agency where the level of hydrocarbon contamination is questioned after completion of Inspections No. 4 or 5. The results from Inspection No. 6 shall be final and binding when a significant difference exists in the interpretation of the results of other inspections. Only components of the liquid oxygen, nitrogen, and helium subsystems need to be certified as LOX clean (no hydrocarbons) by Inspections No. 4 and 5. Ultraviolet inspection of hydraulic and fuel system components is commonly used as a means of hydrocarbon detection; however, since these systems employ hydrocarbon-base fluids, the presence of hydrocarbons shall not be cause for rejection.

4-16. System Standards and Inspection - Propellant and gas systems shall be judged clean if the contamination limits specified in this section have not been exceeded. The liquids or gases used during cleanliness testing shall comply with the latest issue of applicable military or other cited specifications. All propellant liquids and gases used during cleanliness testing, except RP-1 fuel, shall be filtered through 10 micron nominal, or less, filter units. RP-1 fuel shall be passed through a 40 micron absolute, or less, filter/dewatering unit.

4-17. Liquid Oxygen, Liquid Nitrogen, Gaseous Nitrogen, and Helium Systems - Cleanliness is determined by gas blowdown test, Inspection No. 10. The contamination permitted entrapped on the filter pad of a blowhorn (or equal), during testing of a dry system, or in the test fluid effluent of a pressure bomb sample is shown in Figure 4-5. The filter pad will be inspected with black light. Fluorescence resulting from fibers and solid particles which do not exceed the maximum size criteria will not be cause for system recleaning. Fluorescence of filter pad stains or entrapped globules will be cause for recleaning the system.

**4-18. HYDRAULIC SYSTEMS.**

4-19. HYDRAULIC SYSTEMS CLEANLINESS STANDARDS AND INSPECTIONS. Cleaning of hydraulic systems includes cleaning of components and piping for missile, ground facilities systems, and maintenance ground equipment. Hydraulic components and piping systems will be cleaned using the detailed processes and the applicable standards indicated in this manual, and in accordance with the detailed disassembly and reassembly procedures contained in the applicable weapons system technical manuals.

4-20. Titan I systems and Maintenance Ground Equipment (MGE) requiring component and piping cleaning are:

a. Missile hydraulic systems - Stage I and II.

b. Hydraulic pumping unit - Missile MGE.

**9-42. INSPECTION NO. 9-WATER CONTENT DETERMINATION, MINUTEMAN THRUST VECTOR CONTROL SYSTEM.**

9-43. The maximum water content shall be 20 ppm (0.002% by wt.) when tested in accordance with the ASTM D1364 and ASTM D1533 methods (Reference Document Item 51, Section XI) as applicable (Karl Fischer reagent titration method).

**9-44. INSPECTION NO. 10-SERVICE FLUID SCREENING.**

9-45. SERVICE FLUID SAMPLING FROM SYSTEMS. Samples of the service fluids used to certify system (subsystem, piping and skid units) cleanliness shall be obtained and tested. The service fluid used for the final rinse or purge shall be flowed through the system for a minimum of two minutes at maximum operational flow rates whenever possible. For gas blowdowns, nitrogen gas conforming to MIL-P-27401 or clean dry air with moisture and hydrocarbon content equivalent to limits established for nitrogen in MIL-P-27401 shall be introduced into the system. A two minute blowdown with a minimum of 100 ft/sec gas velocity in the largest diameter pipe section being sampled will be acceptable, except that the maximum velocity attainable through the permanently installed system and approved sampling device may be used where 100 ft/sec cannot be obtained. The sampled effluent shall be passed through a 50 mesh sieve (ASTM Designation E11-61, Fine Series #50); except for Titan I and Atlas, the effluent is passed through the filter pad of a blowhorn (or equal). After the test, the screen (filter pad) is carefully removed from the sampling unit and sealed in a clean polyethylene bag until it is examined.

9-46. SERVICE FLUID SAMPLING FROM TANKS. For storage, transport, and holding tanks, a fill and drain cleanliness inspection method can be used, although Inspection No. 10 is preferred when size permits. The sampler is installed in the drain line and all of the effluent is passed through a 50 mesh stainless steel screen. The screen is carefully removed from the sampling unit and sealed in a clean polyethylene bag until it is examined.

9-47. SERVICE FLUID SCREENING INSPECTION. The 50 mesh seive samples shall be inspected with a 10 power magnifying glass (FSN 6650-526-4239). If no particulate matter remains on the screen, the equipment shall be certified for use. If any particulate matter remains on the screen other than that specified in Section VI or VII as applicable, collect the contamination in an appropriate sampling fluid (Paragraph 9-15 - Reagent Fluid) using the Significant Surface Sampling technique specified in Paragraph 9-14 and perform a Total Filterable Solids Determination (Paragraph 9-22).

**9-48. INSPECTION NO. 11-TANK VACUUM CLEANING.**

9-49. Missile propellant tanks shall be visually inspected after final assembly is completed and prior to system checkout. Other tanks may be inspected by this method after the final cleaning and drying operations. Inspection shall consist of vacuum cleaning all places where contamination entrapment could occur. The vacuum cleaning operation shall in no way affect the structural or functional integrity of the tanks or any related component or subsystem. The debris vacuumed away shall be collected on a 100 mesh screen, and examined by the Service Fluid Screening Inspection (Paragraph 9-47). If the particulate matter does not exceed the applicable limits of Sections IV, V, VI and VIII the tanks shall be certified for use. If these limits are exceeded, repeat the cleaning and drying operations and the vacuum cleaning inspection. If re-entry into the tank is made subsequent to this inspection, the vacuum inspection shall be repeated.

**REFERENCE 23**

# PHASE-OUT OF THE ATLAS E AND F AND TITAN I WEAPON SYSTEMS

November 1964 – June 1966

by WILBUR E. CLEMMER

Historical Research Division
Air Force Logistics Command
Wright-Patterson Air Force Base, Ohio

October 1966

AFLC Historical Study No. 350

working arrangements were left up to the two commands, with primary responsibility lodged in AFLC.

The two commands soon agreed as follows: The deactivation program would be accomplished in three phases. Phase I, the responsibility of SAC units, covered the removal and preparation for shipment of the re-entry vehicle; missile; classified components; excess mobile equipment; and SAC re-utilization save list, if any; and the disposal of missile propellants and gases. Custody of each site or complex was to be turned over to the air base group or squadron when Phase I tasks were completed. Phase II, under the direction of an AFLC appointed executive manager, included the turn-off of all unnecessary power, protection and preservation of equipment, and the maintenance of those systems that were to remain operable. It also involved the removal and disposition of organizational materiel and equipment, communications-electronics-meteorological equipment and real property installed equipment. In Phase II the AFLC executive manager was to be responsible for controlling all disposal processes relating to organizational materiel, including RPIE. SAC was to furnish equipment and manpower to accomplish Phase II tasks. Phase III consisted of reporting sites to the General Services Administration as excess and providing care and custody of the sites. The host support base (SAC, ATC or TAC) was to provide the care and custody. Real property disposal actions in that phase were to be the responsibility of the Army Corps of Engineers and GSA. Phase III would were concerned with the disposition of Atlas and Titan I sites. One called for disposing of all Atlas E sites--sites that were too soft for any envisioned Air Force use; another, for disposing of Atlas F and Titan I sites adjacent to Larson, Lincoln, and Schilling AFB's--bases scheduled for early phase-out; and a third, for preserving and holding the remaining sites indefinitely--so Headquarters USAF could determine their potential for Air Force re-utilization purposes. Mr. Zuckert listed cost figures to support the recommended actions and asked for funds and manpower to accomplish them. (32)

On 15 January 1965 Secretary McNamara approved funds in the following amounts to carry out the plan: $3.1 million for first year storage of the missiles; $5.3 million for disposal of 26 Atlas E, 24 Atlas F, and 3 Titan I sites; and $8.8 million for the preservation of the remaining sites. Concurrently he approved manpower spaces to carry out the plan. (90) Spaces approved for the over-all deactivation program were 3,058 military and 219 civilian. Twenty five hundred of these were for the equipment disposal task and 558 for storage of 59 complexes.*

DTAF's most pressing tasks were to get the missiles to Norton and to store them at SBAMA and nearby Mira Loma. The first order of business, then, was to fund for those tasks. AFLC set up

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* Ltr., Chief, Ops. Div., Dir., Prod. & Prog., Hq. USAF, to Chief, Hist. Liaison Office, Hq. USAF, 23 Nov. 1965.

fund programs as follows:* (167)

| | | |
|---|---|---|
| Missile Deactivation and Storage** | | $ 303,300 |
| Missile Transportation*** | | 1,378,920 |
| Travel and Per Diem | | 173,124 |
| | Total | $1,855,344 |

Budget estimates for fiscal 1966 were $429,000 for missile deactivation and storage, $258,740 for travel and per diem, and none for missile transportation. The latter task would be completed in FY 1965. (168)

On 16 June, after the missile movement was complete, the Site Deactivation Management Group at Norton reported to Headquarters DTAF on the cost of moving the 148 missiles which had been surface transported. Data for the report were obtained from the commerical carriers, who reported the actual charges they were billing the government. In sum, those changes amounted to $1,122,996. This, however, cannot be regarded as a final figure. The charges had to be audited by the carriers and the Interstate Commerce Commission before they could be processed to the Army Finance Center for payment. And even after payment, they were still subject to change six months to a year later, after final audit by the General Accounting Office. (266)

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* Interview with Mr. Atherton, 29 Sept. 1965.

** Deactivation, as used here, refers to deactivating the missiles themselves, not to site deactivation.

*** Of this amount, $71,125 was for reimbursing MATS' industrial fund for airlift of nine missiles [Budget Proj. No. P433 ASIF (MATS) 2220] and $1,307,795 for over-the-road transportation of 149 missiles [Budget Proj. No. P433 Surface 2250 Transportation]. (Doc. 65)

In this connection, the contributions of the SBAMA Deactivation Task Force at Norton AFB deserves special mention. Through careful transportation planning it had kept the operation ahead of schedule and within estimated costs. Through modification of commercial flatbeds to accomodate Titan I missiles, it had facilitated the movement of those missiles. And through competent and timely overhaul of each Atlas trailer after each trip from bases to Norton, it had assured expeditious movement of the Atlas E's and F's. (Doc. 147)

## Preservation of Installed Materiel

During the interval between the deactivation of Atlas E and F sites and Titan I complexes and the dismantlement and removal of equipment in silos and related structures, protective measures had to be taken to preserve and maintain that equipment in optimum condition for later re-utilization. Early in 1965, therefore, SBAMA engineers and technicians developed procedures and techniques for the preservation of that equipment. In developing those procedures and techniques, the technical people had to take into account the marked variations in temperature, humidity, airborne dust and dirt, and so forth, at widely dispersed missile sites and complexes. After prototyping the preservation techniques and procedures at specific locations, the remaining silos and related facilities were placed in a preservation status for an indefinite period.

The principal preservation techniques included circulation of hot air through the silos to reduce moisture to an acceptable level, the relief of all high pressures from the various systems, the use of special preservative oil in the diesel generators, and the use of vinyl draping material to protect equipment from condensation and dust. The task of preserving the equipment was accomplished with personnel of the Strategic Air Command, the Tactical Air Command, and the Air Training Command. SBAMA DTAF teams made periodic inspections to determine the adequacy of preservation procedures and techniques.

The total cost of preserving materiel at all sites and complexes was $642,820. (Doc. 147)

## Utilization of Facilities

On 28 September 1964, even before DOD's decision to phase-out the Atlas E and F and the Titan I, General Gerrity* created an Air Staff Study Group to study and evaluate potential Air Force uses for phase-out ICBM facilities. On 16 November the group recommended that 59 sites--44 Atlas F and 15 Titan I--should be retained in a preserved status while an evaluation was being made of possible uses for the facilities.** (Doc. 143)***

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* Lieutenant General Thomas P. Gerrity, DCS/S&L, Hq. USAF.

** There was one launch facility for each Atlas F site and three launch facilities per Titan site, making a total of 89 launch facilities to be retained.

*** This document is Rpt. No. 3 (FINAL), Atlas E, F and Titan I Fac. Util. Proposals, by Air Staff Study Gp., 15 Sept. 1965. The supporting papers, TABS A through T, were not reproduced for this history. The entire report is filed in the AFLC Hist. Archives.

recipients; however, obligated (save-list) items were to be removed prior to transfer of a site to any recipient.

As of 6 May 1966 five Titan I, two Atlas E, and three Atlas F sites were being retained by the Air Force. The General Services Administration had earmarked one Titan I, eleven Atlas E, and six Atlas F sites for non-Air Force use. Of the sites being retained by the Air Force, six were earmarked for future AF missions. One was scheduled to be loaned to a contractor to perform a metal research project for AFSC. After completion of the project, in approximately six months, that site was to revert back to SAC. Three sites, located within the confines of Vandenberg Air Force Base, were retained as integral parts of that base.

The chart opposite this page indicates disposition of the retained sites.* It also provides unclassified information on utilization of the sites.**

## Utilization of Equipment

Much of the equipment at Atlas E and F and Titan I sites was needed elsewhere within the Air Force and other government agencies. It was good equipment--like new, in most cases; and much of it was very expensive. Here was an opportunity to save

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* Background Summary: Deactivation and Phase-Out of the Atlas E and F and Titan I ICBM's and the Equipment Re-Utilization and Disposal Program, prep. by SBAMA and Hq. AFLC Offices of Information, 3 May 1966.

** Users of this history who have a "need to know" what utilization was to be made of the Chico "C" and 725C Titan sites may obtain that information from the Aerospace Division, Directorate of Supply, Headquarters AFLC.

tax dollars on a grand scale and the Air Force was determined to take full advantage of it. Beginning in December 1964, the AMA's started screening available assets against Air Force operational requirements. In March 1965 other services and federal agencies began screening their requirements for materiel against brochures--catalogs describing available equipment--and sent their requisitions for needed equipment to SBAMA.* For the most part the work was completed on target--31 July 1965. (Doc. 143) Some screening went beyond that date, as indicated at a later point in this study.

To help the Air Force and other agencies in their equipment screening, an Atlas F site near Lincoln, Nebraska, was dismantled and the equipment was displayed at Lincoln AFB. This will be discussed later under a separate topic heading.

For the most part, screening was done within a procedural framework developed by DTAF in cooperation with Headquarters USAF, GSA, and SAC. Large diesel generators and air conditioners, however, were handled in an exceptional manner. Those items, too, will be discussed at a later point.

Vehicles, also, were requisitioned and redistributed outside DTAF's screening and redistribution procedures. Since they were not considered part of the weapon system packages, their disposal was governed by the provisions of AFM 67-1, which required

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* Brochures are discussed in greater detail later on in this study.

the requester was Air Force, other DOD, or non-defense.* Requisitions for components to satisfy firm programs were to be given precedence, however, over those for complete systems or subsystems to satisfy potential programs. (193, 227)

All screening was substantially completed by 31 July 1965. As of that date figures showed that the USAF had earmarked 42 per cent of surplus items from Atlas sites and 5.8 per cent from Titan I sites for re-utilization. Those figures, however, do not tell the whole story. Additionally, approximately 15,000 line items were being transferred to Base Supply and the AFSC Test Wing account at Vandenberg AFB in the Atlas booster program. Further, many Titan I site items were being retained for use in the Titan II program and were being transferred to the Titan II account. (287)

In August the Office of Assistant Secretary of Defense, Installations and Logistics, directed all agencies to take another look at the excesses, and DTAF accordingly extended the screening period to 15 October 1965. This OSD re-emphasis on screening and the extension of the screening period provided a more intensive, detailed second screening by DOD agencies, with greater assurance that all requirements would be considered. By 3 June 1966, as a result of this and previous screening, $923.5 million worth of equipment, including missiles, was being re-utilized by and/or earmarked for USAF, Army, Navy, DSA, GSA, the National Aeronautics

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* Removal of one or more components of a system or subsystem would make it functionally worthless.

and Space Administration, and so forth. This represented 70 per cent of the original cost of the equipment controlled by DTAF.*

## Diesel Generators

Redistribution of large surplus diesel power generators was handled on an exceptional basis. They were placed under special distribution control by Headquarters USAF, with the Directorate of Civil Engineering given responsibility for redistributing them for use in Air Force and other construction programs over a period of approximately five years. Some were immediately required for Southeast Asian, European, and other destinations.

On 15 January 1965 the Directorate of Civil Engineering, USAF, announced that power generator units of 100 kilowatt-hour capacity and over were to be tested; disassembled; inspected; removed from sites; rehabilitated as required; temporarily stored, if necessary; and redistributed to Air Force and DOD activities.** Division of labor for accomplishing the testing, teardown, shipment, storage, and redistribution tasks was as follows: Headquarters USAF was to direct, monitor, and control the program; specify what generators were to be shipped and where; and issue

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* Re-utilization of RPIE and CEM equipment was higher than AGE because those items were more easily applied to other programs and because most of them were standard commercial items. AGE, however, was peculiar to a particular missile and therefore was more difficult to adapt in follow-on programs. (Interview with R. L. Hunkeler and E. E. Wilson, 3 June 1966.)

** Actually, only generators of 500 kilowatt-hour capacity and greater were involved in the redistribution program.

diesels by lifting them through the resulting hole. All four diesels at Larson AFB were removed in that manner.

A new, easier method for removing diesels from Titan I installations was subsequently developed, however, after it was decided that some of the diesels would be completely dismantled for overhaul. The diesels were dismantled into five major segments and brought to the surface through the elevator shaft by use of special cranes. This latter method was adopted for removal of the remaining diesels at Titan installations.*

Removal of generators from sites began at Complex A at Larson in June 1965. As of 2 August 36 generators had been removed: 4 from Larson, 12 from Warren, 18 from Dyess, and 2 from Lincoln. (285) By 3 June 1966 a total of 218 diesel generators ranging from 500 kilowatt-hour capacity to 1,020 kilowatt-capacity had been declared excess and were available for redistribution. Of these, 196 had been removed from sites and complexes for shipment to various destinations--97 of which were earmarked for Southeast Asia.**

## Large-Capacity Air Conditioners

Large air conditioners, as indicated previously, were also handled in an exceptional manner through Headquarters USAF. In all, there were thirty-six large-capacity units--twenty-four 150-ton units and twelve 250-ton units--all within Titan I complexes.

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* Interview with R. L. Hunkeler and E. E. Wilson, 3 June 1966.
** Interview with R. L. Hunkeler and E. E. Wilson, 3 June 1966.

As of 8 June 1966 the Directorate of Civil Engineering, Headquarters USAF, had directed DTAF to retain four of the 150-ton units at Titan I "retention" complexes and to distribute the remaining twenty to other Air Force activities. That organization had also directed DTAF to retain six of the twelve 250-ton units at Lowry AFB sites and to redistribute the remaining six--five to Kelly AFB, Texas, and one to the AF Aero Propulsion Laboratory, Research and Technology Division, Wright-Patterson AFB, Ohio.

Units under 100-ton capacity were distributed by SBAMA, through brochured requests. One hundred and forty-two 40-ton units at Atlas F sites were distributed to various Air Force bases for use in military construction projects. Smaller units, from Atlas E sites, went to the Army, Navy, Air Force, Atomic Energy Commission, and to various donees.*

## Site Dismantlement

The complexity of the sites, with most of the equipment deep in the silos, made it infeasible to permit each claimant to arrange for and remove the property he wanted. Permitting such removals could have resulted in inadvertent damage or destruction to property required by other claimants. Thus the decision was made that all claimant requirements had to be considered as a whole so that the removal of the property from each

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* Telephone interview with Mr. John A. Sowell, SBAMA ICBM Task Force, 8 June 1966.

site would be accomplished as one removal action. Also, this would require less time, manpower, and money. (Doc. 46, Atch. 2)

Site dismantlement efforts are discussed below under two headings: (1) Lincoln AFB Prototype Dismantlement for Equipment Display and Data Development and (2) Dismantlement Plans and Contractual Instruments. As the title of the first topic implies, one purpose of the dismantlement effort at Lincoln was to provide prospective customers with an opportunity to look equipment over to determine what they could use. This was touched upon in the section above on "Screening." As indicated by the latter part of the title, however, this was not the sole purpose. A lot of information could be obtained as to how many man and machine hours were involved in dismantling given items of equipment, as to the order in which items should be removed, as to costs, and so forth. Such information is the basis of industrial engineering and it would be highly useful when general dismantling began after 31 July 1965.

The second topic is concerned with whether the work should be done organically or contracted out; and if contracted out, what instrument or instruments should be used. It is also concerned with testing out the principal type of contractual instrument selected to see if it was actually the best type to use.

Lincoln AFB Prototype Dismantlement for Equipment Display and Data Development

Early in March 1965 SAC and AFLC jointly decided to dismantle equipment at a missile site near Lincoln, Nebraska, and it was concluded that DLSC would assume responsibility for contracting for services to dismantle the missile sites for property required by any authorized recipient. (Doc. 146, Atch. 3)

In March 1965 the AFLC ICBM Deactivation Task Force developed plans for dismantlement and removal of equipment at Atlas E and F and Titan I missile sites by contract. In developing those plans, DTAF took into consideration the fact that sites were of two categories--"retained" and "disposal." Retained sites were those earmarked for follow-on use. Disposal sites were those for which there was no follow-on requirement--those which would be turned over to the General Services Administration for disposition.

On 30 March Headquarters DTAF presented its plans to the Air Staff. Those plans envisioned three contractual arrangements for dismantling and removal of required equipment prior to the turn-over of those sites to follow-on users within the Government, to donee organizations, or to GSA for sale. The first contractual method proposed was by Service Contract wherein the contractor would be required to remove needed equipment from any given launch facility for a negotiated fee. The second proposed method was by Service and Salvage contract wherein the contractor would remove all required equipment and be granted salvage rights to the residual equipment and material. The government would retain title to the real property and take eventual disposal action through GSA. The contractor would pay the government a negotiated fee for salvage rights. The third was by Service and Real Estate contract, which would generally follow the guidelines of the Service and Salvage proposal, except that title to the real estate would also pass to the contractor.

DTAF recommended that the Service and Salvage type of contractual arrangement, with contracts administered by DLSC, should be the primary method used for dismantling and removal of the equipment at the "disposal" sites. That method would attract contractors whose primary concern was the acquisition and sale of salvage material.* Further, it would result in no "out-of-pocket" costs to the government--a highly important consideration in AFLC's drive to keep costs to the absolute minimum.** (210, Doc. 147)

On 15 April 1965 the Air Staff formally approved DTAF's proposal, in writing, after having given oral approval on 31 March. In the interval DTAF had negotiated an agreement with DSA and GSA whereby those agencies would assume the necessary contract administration and sales functions. And as soon as the written approval was received the agreement was signed. (211, 231)

DSA, for its part, agreed that its Defense Logistics Services Center would administer the Service and Salvage contracts.

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* The Service and Real Estate contract method held no special attraction to salvage contractors as their interests did not lie in the acquisition of real estate.

** [Hq. SAC] Hist. of Atlas & Titan I Phase-out, 1 June 1965, p. 92. Doc. not reproduced.

For its part, GSA agreed to sell the remaining property and real estate. And for its part, the Air Force agreed to provide liaison for and technical assistance to DSA and GSA. Among other things, AFLC was to assist DLSC in the preparation of contractual work statements and Invitations for Bid.*

DTAF felt that suitable sites should be selected to develop experience in the application of the Service and Salvage concept. AFLC recommended Sites 3 and 9 at Plattsburgh, New York, for that prototyping effort. Those sites were recommended for three reasons: First, water leakage at the sites made their further use questionable. Second, connection of commercial electric power to those sites, a prerequisite for continued retention, would be too expensive. And third, no agency had expressed an interest in utilizing either site. Experience gained would be applied to the follow-on program. (242)

On 14 May 1965 the Air Staff approved the prototyping effort at Plattsburgh. By 31 July the IFB's had been mailed out, with bid opening scheduled for 31 August. (283) During the ensuing months the prototype effort was carried out and other contracts were let. The last Service and Salvage contract--for removal of equipment from nine sites at Walker AFB, New Mexico--was expected to be awarded on 17 June 1966.**

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* [Hq. SAC] Hist. of Atlas and Titan I Phase-out, 1 June 1965, pp. 92-93.

** The Norton Newscone, 3 June 1966.

**REFERENCE 24**

COORDINATION AND FILE COPY

FILE DESIGNATION

Allied Effort

6Q18127

**USAF Plan of Action for Phaseout of Atlas E, F and Titan I Weapon Systems**

| COORDINATION | |
|---|---|
| OFFICE SYMBOL | LAST NAME |
| CINC | |
| VC | |
| CS | |
| DCS | |
| PRO | |
| POLAD | |
| DAS | |
| Mail/Rcrd | |
| Publ | |
| DCR | |
| Admin | |
| Plans | |
| Budget | |
| Mgt Anlys | |
| Acct/Fin | |
| Sys/Svcs | |
| DE | |
| Dev | |
| Engr | |
| Ops | |
| Hsg | |
| DI | |
| Air Est | |
| Tgt Mat | |
| Sys Div | |
| Tgts | |
| 544 ARTW | |
| DM | |
| Log | |
| Sup | |
| Wpn Maint | |
| Trans | |
| Proc | |
| DO | |
| PL | |
| CO | |
| CE | |
| OT | |
| RQ | |
| SD | |
| WE | |
| DP | |
| Off | |
| Amn | |
| Mil | |
| Svcs | |
| Civ | |
| DPP | |
| DPL | |
| Prog | |
| Plans | |
| M&O | |
| CINCSAC REP | |
| DXI | |
| Hist | |
| CH | |
| IG | |
| IGI | |
| IGS | |
| JA | |
| OA | |
| SU | |

DM3 Wesson

DM4e Powell DM4 ~~Deitte~~

DM6 ~~[illegible]~~

DM5 Wall

Note: Questions recommended 4 DM5

| RETURN TO: | OFFICE SYMBOL | ORIGINATOR'S NAME AND GRADE | PHONE NO. | TYPIST'S INITIALS | DATE TYPED | ADMIN SERVICES (For Dispatch) |
|---|---|---|---|---|---|---|
| | DM4C1 | LC Steiner | 4458 | | | |

FORM 96a, JUN 64 PREVIOUS EDITION IS OBSOLETE.

# ATLAS "F" EQUIPMENT/FACILITY BREAKOUT

1. Operational Missile Area Sub-System (Ground)

Included in this broad category are two basic subdivisions: The Operational Ground Equipment which must operate successfully with the missile during readiness, count down, and launch; and the Maintenance Ground Equipment which is required to receive, service, maintain and verify the missiles and related equipment.

a. Operational Ground Equipment (OGE)

Launch Control Equipment (Located in ICC)

Missile Lift System

Hydraulic Supply System

Propellant Loading System

Pressurization Control System

Inertial Guidance System Checkout Equipment

Communications Equipment (Launch Essential)

Ground Power Equipment (Launch Essential)

b. Maintenance Ground Equipment (MGE)

MAPCHE Checkout Equipment

Re-entry Vehicle Checkout Equipment

Propulsion System Checkout Equipment (In MAMS)

Missile Handling and Service Equipment (In MAMS)

Guidance Maintenance Equipment

Communications Equipment (non launch essential)

Gas and Propellant Servicing Equipment

Miscellaneous Tools and Test Equipment

Pneumatic Checkout Equipment

Calibration Equipment

Work Platforms

2. Communications

a. Support Communications: This system includes the base switching facility, the base nontactical radio service, off-base trunking facilities, tie lines, fire, crash, maintenance expediting and all required navigational and meteorological aids.

b. Intra Complex Communications: This system consists of the conference networks, communications panels, TV Systems, direct line circuits and termination, which provide these communications functions necessary to erect, checkout and launch a missile including all circuits required for facilities and supporting operations during count down.

c. Inter-Complex Communications: These are the point-to-point systems that connect launch complexes with each other and with the support base. Systems may be government owned or commercially leased and consist of a cable or microwave radio or a combination of both:

3. RPIE Sub-Systems are identified as follows:

a. Air Conditioning, heating and ventilation.

b. Power generation and distribution.

c. Water pumping and distribution.

d. Utility air system.

**REFERENCE 25**

Form WR-23 FIELD ENGR. LOG

STATE ENGINEER OFFICE

# WELL RECORD

INSTRUCTIONS: This form should be executed in triplicate, preferably typewritten, and submitted to the nearest district office of the State Engineer. All sections, except Section 5, shall be answered as completely and accurately as possible when any well is drilled, repaired or deepened. When this form is used as a plugging record, only Section 1A and Section 5 need be completed.

Section 1

(Plat of 640 acres)

(A) Owner of well Gordon Herkenhoff + Asso. Inc.

Street and Number 302 Eighth St. NW W2 Site

City Albuquerque State New Mexico

Well was drilled under Permit No. ______ and is located in the ___ ¼ ___ ¼ ___ ¼ of Section ___ Twp. ___ Rge. ___

(B) Drilling Contractor Stroek Drilling Co. License No. WD15

Street and Number 1101 Mann Ave.

City Artesia State New Mexico

Drilling was commenced Aug. 4 1960

Drilling was completed Aug. 19 1960

Elevation at top of casing in feet above sea level ______ Total depth of well 1110 ft

State whether well is shallow or artesian Artesian Depth to water upon completion 92 ft

Section 2

## PRINCIPAL WATER-BEARING STRATA

| No. | Depth in Feet From | Depth in Feet To | Thickness in Feet | Description of Water-Bearing Formation |
|---|---|---|---|---|
| 1 | | | | |
| 2 | | | | |
| 3 | | | | |
| 4 | | | | |
| 5 | | | | |

Section 3

## RECORD OF CASING

| Dia in. | Pounds ft. | Threads in | Depth Top | Depth Bottom | Feet | Type Shoe | Perforations From | Perforations To |
|---|---|---|---|---|---|---|---|---|
| 8 5/8 | 24 | 8 | | | 1040 | Regular | Texas Pattern | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

Section 4

## RECORD OF MUDDING AND CEMENTING

| Depth in Feet From | Depth in Feet To | Diameter Hole in in. | Tons Clay | No. Sacks of Cement | Methods Used |
|---|---|---|---|---|---|
| | | | | | Cementing by Halliburton to top |
| | | | | | |
| | | | | | |
| | | | | | |

Section 5

## PLUGGING RECORD

Name of Plugging Contractor ______ License No. ______

Street and Number ______ City ______ State ______

Tons of Clay used ______ Tons of Roughage used ______ Type of roughage ______

Plugging method used ______ Date Plugged ______ 19___

Plugging approved by:

______
Basin Supervisor

Cement Plugs were placed as follows:

| No. | Depth of Plug From | Depth of Plug To | No. of Sacks Used |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |

FOR USE OF STATE ENGINEER ONLY

Date Received STATE ENGINEER OFFICE DISTRICT II ROSWELL, N. MEX. 1960 AUG 30 AM 8:1

Survey Location

File No. RA-4199-S Use Public works sanitary Location No. 15.26.51.22334

Renumbered RA-633-AS

0001

Section 6

# LOG OF WELL

| Depth in Feet | | Thickness in Feet | Color | Type of Material Encountered |
|---|---|---|---|---|
| From | To | | | |
| 0 | " | 5 | | Soil |
| 5 | " | 25 | | Clay |
| 25 | " | 35 | | Gyp rock |
| 35 | " | 110 | Red | Bed |
| 110 | " | 250 | | Anhydrite |
| 250 | " | 260 | | Shallow water |
| 260 | " | 295 | | Anhydrite |
| 295 | " | 335 | | Clay |
| 335 | " | 390 | | Anhydrite |
| 390 | " | 410 | Blue | Clay |
| 410 | " | 555 | | Anhydrite |
| 555 | " | 605 | | Clay & Anhydrite stratas |
| 605 | " | 665 | Red | Clay |
| 665 | " | 724 | | Anhydrite |
| 724 | " | 734 | | Clay |
| 734 | " | 765 | | Anhydrite |
| 765 | " | 825 | Grey | Lime |
| 825 | " | 830 | Red | Sand |
| 830 | " | 865 | | Anhydrite |
| 865 | " | 875 | | Lime |
| 875 | " | 885 | | Clay |
| 885 | " | 935 | | Lime |
| 935 | " | 1020 | Red | Bed |
| 1020 | " | 1065 | | Lime |
| 1065 | " | 1070 | | Possibly water |
| 1070 | " | 1110 | | Lime |

The undersigned hereby certifies that, to the best of his knowledge and belief, the foregoing is a true and correct record of the above described well.

J. E. Shrock
Well Driller

Form WR-23 FIELD ENGR. LOG

STATE ENGINEER OFFICE

# WELL RECORD

INSTRUCTIONS: This form should be executed in triplicate, preferably typewritten, and submitted to the nearest district office of the State Engineer. All sections, except Section 5, shall be answered as completely and accurately as possible when any well is drilled, repaired or deepened. When this form is used as a plugging record, only Section 1A and Section 5 need be completed.

Section 1

(Plat of 640 acres)

(A) Owner of well Gordon Herkenhoff & Assc.
Street and Number 302 Eighth NW
City Albuquerque State New Mexico
Well was drilled under Permit No. ________ and is located in the ____ ¼ ____ ¼ ____ ¼ of Section ____ Twp. ____ Rge. ____
(B) Drilling Contractor Shrock Drilling Co License No. [illegible]
Street and Number 1101 Mann Ave
City Artesia State New Mexico
Drilling was commenced Nov. 12 1960
Drilling was completed Nov 30 1960

Elevation at top of casing in feet above sea level ________ Total depth of well 1110
State whether well is shallow or artesian Artesian Depth to water upon completion Flowing

Section 2 PRINCIPAL WATER-BEARING STRATA

| No. | Depth in Feet From | Depth in Feet To | Thickness in Feet | Description of Water-Bearing Formation |
|---|---|---|---|---|
| 1 | | | | |
| 2 | | | | |
| 3 | | | | |
| 4 | | | | |
| 5 | | | | |

Section 3 RECORD OF CASING

| Dia in. | Pounds ft. | Threads in | Depth Top | Depth Bottom | Feet | Type Shoe | Perforations From | Perforations To |
|---|---|---|---|---|---|---|---|---|
| 8 | 24 | 8 | | | 1046 | Drive | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

Section 4 RECORD OF MUDDING AND CEMENTING

| Depth in Feet From | Depth in Feet To | Diameter Hole in in. | Tons Clay | No. Sacks of Cement | Methods Used |
|---|---|---|---|---|---|
| | | | | | Cemented By Sexton |
| | | | | | |
| | | | | | |
| | | | | | |

Section 5 PLUGGING RECORD

Name of Plugging Contractor ________ License No. ________
Street and Number ________ City ________ State ________
Tons of Clay used ________ Tons of Roughage used ________ Type of roughage ________
Plugging method used ________ Date Plugged ________ 19__
Plugging approved by:

________
Basin Supervisor

Cement Plugs were placed as follows:

| No. | Depth of Plug From | Depth of Plug To | No. of Sacks Used |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |

FOR USE OF STATE ENGINEER ONLY

Date Received

ROSWELL N. MEX. STATE ENGINEER OFFICE 1960 DEC 20 AM 8:21

Survey Location

File No. RA-4199-S-2 Use Public works & Sanitary Location No. 15.26.21.22334

Renumbered RA-633-A

0002

# LOG OF WELL

| Depth in Feet From | Depth in Feet To | Thickness in Feet | Color | Type of Material Encountered |
|---|---|---|---|---|
| 0 | " | 5 | | Soil |
| 5 | " | 35 | | Clay |
| 35 | " | 35 | | gyp rock |
| 35 | " | 110 | Red | Bed |
| 110 | " | 250 | | Anhydrite |
| 250 | " | 290 | | Anhydrite & Clay Stratas |
| 390 | " | 335 | | Clay |
| 335 | " | 390 | | Anhydrite |
| 390 | " | 410 | Blue | Clay |
| 410 | " | 555 | | Anhydrite |
| 555 | " | 605 | | Anhydrite & Clay Stratas |
| 605 | " | 665 | Red | Clay |
| 665 | " | 724 | | Anhydrite |
| 724 | " | 734 | | Clay |
| 734 | " | 765 | | anhydrite |
| 765 | " | 825 | grey | lime |
| 825 | " | 830 | Red | Sand |
| 830 | " | 865 | | Anhydrite |
| 865 | " | 875 | | Lime |
| 875 | " | 885 | | Clay |
| 885 | " | 935 | | Lime |
| 935 | " | 1020 | Red | Bed |
| 1030 | " | 1065 | | Lime |
| 1065 | " | 1075 | | Water Rock |
| 1075 | " | 1110 | | Lime |

The undersigned hereby certifies that, to the best of his knowledge and belief, the foregoing is a true and correct record of the above described well.

J. E. Schrock
Well Driller

Form WR-23

FIELD ENGR. LOG

STATE ENGINEER OFFICE

# WELL RECORD

INSTRUCTIONS: This form should be executed in triplicate, preferably typewritten, and submitted to the nearest district office of the State Engineer. All sections, except Section 5, shall be answered as completely and accurately as possible when any well is drilled, repaired or deepened. When this form is used as a plugging record, only Section 1A and Section 5 need be completed.

Section 1

(Plat of 640 acres)

(A) Owner of well USA Corps of Engineer Site U #5

Street and Number Federal Building

City Albuquerque State N.M.

Well was drilled under Permit No. RA-4199-S and is located in the SW ¼ NW ¼ NE ¼ of Section 21 Twp. 15 S. Rge. 26 E.

(B) Drilling Contractor ________ License No. ________

Street and Number ________

City ________ State ________

Drilling was commenced ________ 19____

Drilling was completed ________ 19____

Elevation at top of casing in feet above sea level ________ Total depth of well 1110'

State whether well is shallow or artesian ________ Depth to water upon completion ________

Section 2

## PRINCIPAL WATER-BEARING STRATA

| No. | Depth in Feet From | Depth in Feet To | Thickness in Feet | Description of Water-Bearing Formation |
|---|---|---|---|---|
| 1 | | | | |
| 2 | | | | |
| 3 | | | | |
| 4 | | | | |
| 5 | | | | |

Section 3

## RECORD OF CASING

| Dia in. | Pounds ft. | Threads in | Depth Top | Depth Bottom | Feet | Type Shoe | Perforations From | Perforations To |
|---|---|---|---|---|---|---|---|---|
| 8 | 24 | | 0 | 1020 | 1020 | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

Section 4

## RECORD OF MUDDING AND CEMENTING

| Depth in Feet From | Depth in Feet To | Diameter Hole in in. | Tons Clay | No. Sacks of Cement | Methods Used |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

Section 5

## PLUGGING RECORD

Name of Plugging Contractor ________ License No. ________

Street and Number ________ City ________ State ________

Tons of Clay used ________ Tons of Roughage used ________ Type of roughage ________

Plugging method used ________ Date Plugged ________ 19____

Plugging approved by:

________
Basin Supervisor

Cement Plugs were placed as follows:

| No. | Depth of Plug From | Depth of Plug To | No. of Sacks Used |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |

FOR USE OF STATE ENGINEER ONLY

Date Received ________

Survey Location

File No. RA-4199-S Use ________ Location No. 15.26.21.22334

0003

ATNMSE

FIELD ENGR. LOG

"W" site

**SAMPLE LOG - SITE 5 - 8" WELL**

| | |
|---|---|
| 0- 100 | Red top soil, gray clay, caliche and red and gray shale |
| 100- 430 | Red and gray shale, gypsum and anhydrite |
| 430- 440 | Shale, gray, sandy, limy |
| 440- 762 | Red and gray shale, gypsum, anhydrite |
| 762- 780 | Limestone, tan, dense, crystalline |
| 780- 805 | Anhydrite |
| 805- 840 | Sand, red, very fine grained, silty |
| 840- 897 | Anhydrite |
| 897- 928 | Limestone, tan to brown, dense, crystalline, very hard |
| 928-1020 | Sand, red, very fine grained, silty |
| 1020-1110 | Limestone, gray to tan to brown, dense, solution porosity from 1040 to 1110 |

Total Depth - 1110

Casing - 1020' of 8" 24 lb. API Casing, cement circulated to surface

Open hole - 1020 to 1110

**REFERENCE 26**

## Table DP-1. Profile of General Demographic Characteristics: 2000

Geographic area: Lake Arthur town, New Mexico

[For information on confidentiality protection, nonsampling error, and definitions, see text]

| Subject | Number | Percent |
|---|---|---|
| **Total population** | **432** | **100.0** |
| **SEX AND AGE** | | |
| Male | 231 | 53.5 |
| Female | 201 | 46.5 |
| Under 5 years | 42 | 9.7 |
| 5 to 9 years | 50 | 11.6 |
| 10 to 14 years | 43 | 10.0 |
| 15 to 19 years | 41 | 9.5 |
| 20 to 24 years | 26 | 6.0 |
| 25 to 34 years | 62 | 14.4 |
| 35 to 44 years | 59 | 13.7 |
| 45 to 54 years | 33 | 7.6 |
| 55 to 59 years | 12 | 2.8 |
| 60 to 64 years | 18 | 4.2 |
| 65 to 74 years | 33 | 7.6 |
| 75 to 84 years | 10 | 2.3 |
| 85 years and over | 3 | 0.7 |
| Median age (years) | 28.6 | (X) |
| 18 years and over | 266 | 61.6 |
| Male | 135 | 31.3 |
| Female | 131 | 30.3 |
| 21 years and over | 252 | 58.3 |
| 62 years and over | 60 | 13.9 |
| 65 years and over | 46 | 10.6 |
| Male | 24 | 5.6 |
| Female | 22 | 5.1 |
| **RACE** | | |
| One race | 426 | 98.6 |
| White | 272 | 63.0 |
| Black or African American | - | - |
| American Indian and Alaska Native | 2 | 0.5 |
| Asian | 3 | 0.7 |
| Asian Indian | - | - |
| Chinese | - | - |
| Filipino | - | - |
| Japanese | - | - |
| Korean | - | - |
| Vietnamese | - | - |
| Other Asian [1] | 3 | 0.7 |
| Native Hawaiian and Other Pacific Islander | - | - |
| Native Hawaiian | - | - |
| Guamanian or Chamorro | - | - |
| Samoan | - | - |
| Other Pacific Islander [2] | - | - |
| Some other race | 149 | 34.5 |
| Two or more races | 6 | 1.4 |
| ***Race alone or in combination with one or more other races:*** [3] | | |
| White | 278 | 64.4 |
| Black or African American | 3 | 0.7 |
| American Indian and Alaska Native | 5 | 1.2 |
| Asian | 5 | 1.2 |
| Native Hawaiian and Other Pacific Islander | 1 | 0.2 |
| Some other race | 151 | 35.0 |

| Subject | Number | Percent |
|---|---|---|
| **HISPANIC OR LATINO AND RACE** | | |
| **Total population** | **432** | **100.0** |
| Hispanic or Latino (of any race) | 303 | 70.1 |
| Mexican | 190 | 44.0 |
| Puerto Rican | - | - |
| Cuban | - | - |
| Other Hispanic or Latino | 113 | 26.2 |
| Not Hispanic or Latino | 129 | 29.9 |
| White alone | 125 | 28.9 |
| **RELATIONSHIP** | | |
| **Total population** | **432** | **100.0** |
| In households | 432 | 100.0 |
| Householder | 134 | 31.0 |
| Spouse | 76 | 17.6 |
| Child | 177 | 41.0 |
| Own child under 18 years | 144 | 33.3 |
| Other relatives | 27 | 6.3 |
| Under 18 years | 19 | 4.4 |
| Nonrelatives | 18 | 4.2 |
| Unmarried partner | 9 | 2.1 |
| In group quarters | - | - |
| Institutionalized population | - | - |
| Noninstitutionalized population | - | - |
| **HOUSEHOLD BY TYPE** | | |
| **Total households** | **134** | **100.0** |
| Family households (families) | 107 | 79.9 |
| With own children under 18 years | 63 | 47.0 |
| Married-couple family | 76 | 56.7 |
| With own children under 18 years | 39 | 29.1 |
| Female householder, no husband present | 23 | 17.2 |
| With own children under 18 years | 18 | 13.4 |
| Nonfamily households | 27 | 20.1 |
| Householder living alone | 24 | 17.9 |
| Householder 65 years and over | 11 | 8.2 |
| Households with individuals under 18 years | 72 | 53.7 |
| Households with individuals 65 years and over | 33 | 24.6 |
| Average household size | 3.22 | (X) |
| Average family size | 3.62 | (X) |
| **HOUSING OCCUPANCY** | | |
| **Total housing units** | **149** | **100.0** |
| Occupied housing units | 134 | 89.9 |
| Vacant housing units | 15 | 10.1 |
| For seasonal, recreational, or occasional use | 1 | 0.7 |
| Homeowner vacancy rate (percent) | 3.4 | (X) |
| Rental vacancy rate (percent) | 12.0 | (X) |
| **HOUSING TENURE** | | |
| **Occupied housing units** | **134** | **100.0** |
| Owner-occupied housing units | 112 | 83.6 |
| Renter-occupied housing units | 22 | 16.4 |
| Average household size of owner-occupied units | 3.23 | (X) |
| Average household size of renter-occupied units | 3.18 | (X) |

- Represents zero or rounds to zero. (X) Not applicable.

[1] Other Asian alone, or two or more Asian categories.

[2] Other Pacific Islander alone, or two or more Native Hawaiian and Other Pacific Islander categories.

[3] In combination with one or more of the other races listed. The six numbers may add to more than the total population and the six percentages may add to more than 100 percent because individuals may report more than one race.

Source: U.S. Census Bureau, Census 2000.

## Table DP-2. Profile of Selected Social Characteristics: 2000

Geographic area: Lake Arthur town, New Mexico

[Data based on a sample. For information on confidentiality protection, sampling error, nonsampling error, and definitions, see text]

| Subject | Number | Percent |
|---|---|---|
| **SCHOOL ENROLLMENT** | | |
| **Population 3 years and over enrolled in school** | **125** | **100.0** |
| Nursery school, preschool | 15 | 12.0 |
| Kindergarten | 4 | 3.2 |
| Elementary school (grades 1-8) | 62 | 49.6 |
| High school (grades 9-12) | 28 | 22.4 |
| College or graduate school | 16 | 12.8 |
| **EDUCATIONAL ATTAINMENT** | | |
| **Population 25 years and over** | **204** | **100.0** |
| Less than 9th grade | 45 | 22.1 |
| 9th to 12th grade, no diploma | 49 | 24.0 |
| High school graduate (includes equivalency) | 54 | 26.5 |
| Some college, no degree | 34 | 16.7 |
| Associate degree | 12 | 5.9 |
| Bachelor's degree | 5 | 2.5 |
| Graduate or professional degree | 5 | 2.5 |
| Percent high school graduate or higher | 53.9 | (X) |
| Percent bachelor's degree or higher | 4.9 | (X) |
| **MARITAL STATUS** | | |
| **Population 15 years and over** | **269** | **100.0** |
| Never married | 71 | 26.4 |
| Now married, except separated | 141 | 52.4 |
| Separated | 6 | 2.2 |
| Widowed | 20 | 7.4 |
| Female | 10 | 3.7 |
| Divorced | 31 | 11.5 |
| Female | 18 | 6.7 |
| **GRANDPARENTS AS CAREGIVERS** | | |
| **Grandparent living in household with one or more own grandchildren under 18 years** | **14** | **100.0** |
| Grandparent responsible for grandchildren | 11 | 78.6 |
| **VETERAN STATUS** | | |
| **Civilian population 18 years and over** | **248** | **100.0** |
| Civilian veterans | 24 | 9.7 |
| **DISABILITY STATUS OF THE CIVILIAN NONINSTITUTIONALIZED POPULATION** | | |
| **Population 5 to 20 years** | **114** | **100.0** |
| With a disability | 10 | 8.8 |
| **Population 21 to 64 years** | **204** | **100.0** |
| With a disability | 55 | 27.0 |
| Percent employed | 47.3 | (X) |
| No disability | 149 | 73.0 |
| Percent employed | 76.5 | (X) |
| **Population 65 years and over** | **31** | **100.0** |
| With a disability | 13 | 41.9 |
| **RESIDENCE IN 1995** | | |
| **Population 5 years and over** | **349** | **100.0** |
| Same house in 1995 | 232 | 66.5 |
| Different house in the U.S. in 1995 | 109 | 31.2 |
| Same county | 33 | 9.5 |
| Different county | 76 | 21.8 |
| Same state | 52 | 14.9 |
| Different state | 24 | 6.9 |
| Elsewhere in 1995 | 8 | 2.3 |

| Subject | Number | Percent |
|---|---|---|
| **NATIVITY AND PLACE OF BIRTH** | | |
| **Total population** | **400** | **100.0** |
| Native | 337 | 84.3 |
| Born in United States | 337 | 84.3 |
| State of residence | 238 | 59.5 |
| Different state | 99 | 24.8 |
| Born outside United States | - | - |
| Foreign born | 63 | 15.8 |
| Entered 1990 to March 2000 | 23 | 5.8 |
| Naturalized citizen | 35 | 8.8 |
| Not a citizen | 28 | 7.0 |
| **REGION OF BIRTH OF FOREIGN BORN** | | |
| **Total (excluding born at sea)** | **63** | **100.0** |
| Europe | - | - |
| Asia | - | - |
| Africa | - | - |
| Oceania | - | - |
| Latin America | 63 | 100.0 |
| Northern America | - | - |
| **LANGUAGE SPOKEN AT HOME** | | |
| **Population 5 years and over** | **349** | **100.0** |
| English only | 149 | 42.7 |
| Language other than English | 200 | 57.3 |
| Speak English less than "very well" | 78 | 22.3 |
| Spanish | 200 | 57.3 |
| Speak English less than "very well" | 78 | 22.3 |
| Other Indo-European languages | - | - |
| Speak English less than "very well" | - | - |
| Asian and Pacific Island languages | - | - |
| Speak English less than "very well" | - | - |
| **ANCESTRY (single or multiple)** | | |
| **Total population** | **400** | **100.0** |
| *Total ancestries reported* | *362* | *90.5* |
| Arab | - | - |
| Czech[1] | - | - |
| Danish | - | - |
| Dutch | - | - |
| English | 14 | 3.5 |
| French (except Basque)[1] | - | - |
| French Canadian[1] | - | - |
| German | 27 | 6.8 |
| Greek | - | - |
| Hungarian | - | - |
| Irish[1] | 35 | 8.8 |
| Italian | - | - |
| Lithuanian | - | - |
| Norwegian | 2 | 0.5 |
| Polish | - | - |
| Portuguese | - | - |
| Russian | - | - |
| Scotch-Irish | 2 | 0.5 |
| Scottish | - | - |
| Slovak | - | - |
| Subsaharan African | - | - |
| Swedish | - | - |
| Swiss | - | - |
| Ukrainian | - | - |
| United States or American | 20 | 5.0 |
| Welsh | - | - |
| West Indian (excluding Hispanic groups) | - | - |
| Other ancestries | 262 | 65.5 |

-Represents zero or rounds to zero. (X) Not applicable.
[1]The data represent a combination of two ancestries shown separately in Summary File 3. Czech includes Czechoslovakian. French includes Alsatian. French Canadian includes Acadian/Cajun. Irish includes Celtic.

Source: U.S. Bureau of the Census, Census 2000.

## Table DP-3. Profile of Selected Economic Characteristics: 2000

Geographic area: Lake Arthur town, New Mexico

[Data based on a sample. For information on confidentiality protection, sampling error, nonsampling error, and definitions, see text]

| Subject | Number | Percent |
|---|---|---|
| **EMPLOYMENT STATUS** | | |
| **Population 16 years and over** | **257** | **100.0** |
| In labor force | 151 | 58.8 |
| Civilian labor force | 151 | 58.8 |
| Employed | 144 | 56.0 |
| Unemployed | 7 | 2.7 |
| Percent of civilian labor force | 4.6 | (X) |
| Armed Forces | - | - |
| Not in labor force | 106 | 41.2 |
| **Females 16 years and over** | **116** | **100.0** |
| In labor force | 58 | 50.0 |
| Civilian labor force | 58 | 50.0 |
| Employed | 57 | 49.1 |
| **Own children under 6 years** | **66** | **100.0** |
| All parents in family in labor force | 23 | 34.8 |
| **COMMUTING TO WORK** | | |
| **Workers 16 years and over** | **141** | **100.0** |
| Car, truck, or van - - drove alone | 104 | 73.8 |
| Car, truck, or van - - carpooled | 19 | 13.5 |
| Public transportation (including taxicab) | 2 | 1.4 |
| Walked | 9 | 6.4 |
| Other means | 2 | 1.4 |
| Worked at home | 5 | 3.5 |
| Mean travel time to work (minutes)[1] | 22.8 | (X) |
| **Employed civilian population 16 years and over** | **144** | **100.0** |
| **OCCUPATION** | | |
| Management, professional, and related occupations | 16 | 11.1 |
| Service occupations | 33 | 22.9 |
| Sales and office occupations | 19 | 13.2 |
| Farming, fishing, and forestry occupations | 14 | 9.7 |
| Construction, extraction, and maintenance occupations | 30 | 20.8 |
| Production, transportation, and material moving occupations | 32 | 22.2 |
| **INDUSTRY** | | |
| Agriculture, forestry, fishing and hunting, and mining | 26 | 18.1 |
| Construction | 16 | 11.1 |
| Manufacturing | 11 | 7.6 |
| Wholesale trade | 2 | 1.4 |
| Retail trade | 5 | 3.5 |
| Transportation and warehousing, and utilities | 6 | 4.2 |
| Information | 2 | 1.4 |
| Finance, insurance, real estate, and rental and leasing | - | - |
| Professional, scientific, management, administrative, and waste management services | 18 | 12.5 |
| Educational, health and social services | 40 | 27.8 |
| Arts, entertainment, recreation, accommodation and food services | 3 | 2.1 |
| Other services (except public administration) | 15 | 10.4 |
| Public administration | - | - |
| **CLASS OF WORKER** | | |
| Private wage and salary workers | 110 | 76.4 |
| Government workers | 24 | 16.7 |
| Self-employed workers in own not incorporated business | 6 | 4.2 |
| Unpaid family workers | 4 | 2.8 |

| Subject | Number | Percent |
|---|---|---|
| **INCOME IN 1999** | | |
| **Households** | **125** | **100.0** |
| Less than $10,000 | 15 | 12.0 |
| $10,000 to $14,999 | 22 | 17.6 |
| $15,000 to $24,999 | 32 | 25.6 |
| $25,000 to $34,999 | 27 | 21.6 |
| $35,000 to $49,999 | 12 | 9.6 |
| $50,000 to $74,999 | 15 | 12.0 |
| $75,000 to $99,999 | - | - |
| $100,000 to $149,999 | 2 | 1.6 |
| $150,000 to $199,999 | - | - |
| $200,000 or more | - | - |
| Median household income (dollars) | 22,386 | (X) |
| With earnings | 91 | 72.8 |
| Mean earnings (dollars)[1] | 30,834 | (X) |
| With Social Security income | 39 | 31.2 |
| Mean Social Security income (dollars)[1] | 9,348 | (X) |
| With Supplemental Security Income | 8 | 6.4 |
| Mean Supplemental Security Income (dollars)[1] | 4,050 | (X) |
| With public assistance income | 8 | 6.4 |
| Mean public assistance income (dollars)[1] | 2,213 | (X) |
| With retirement income | 17 | 13.6 |
| Mean retirement income (dollars)[1] | 8,729 | (X) |
| **Families** | **97** | **100.0** |
| Less than $10,000 | 9 | 9.3 |
| $10,000 to $14,999 | 17 | 17.5 |
| $15,000 to $24,999 | 29 | 29.9 |
| $25,000 to $34,999 | 19 | 19.6 |
| $35,000 to $49,999 | 8 | 8.2 |
| $50,000 to $74,999 | 13 | 13.4 |
| $75,000 to $99,999 | - | - |
| $100,000 to $149,999 | 2 | 2.1 |
| $150,000 to $199,999 | - | - |
| $200,000 or more | - | - |
| Median family income (dollars) | 22,679 | (X) |
| Per capita income (dollars)[1] | 8,496 | (X) |
| ***Median earnings (dollars):*** | | |
| Male full-time, year-round workers | 26,875 | (X) |
| Female full-time, year-round workers | 15,179 | (X) |

| Subject | Number below poverty level | Percent below poverty level |
|---|---|---|
| **POVERTY STATUS IN 1999** | | |
| **Families** | **24** | **24.7** |
| With related children under 18 years | 18 | 32.1 |
| With related children under 5 years | 13 | 41.9 |
| **Families with female householder, no husband present** | **9** | **39.1** |
| With related children under 18 years | 9 | 56.3 |
| With related children under 5 years | 7 | 87.5 |
| **Individuals** | **98** | **24.6** |
| 18 years and over | 51 | 20.6 |
| 65 years and over | 2 | 6.5 |
| Related children under 18 years | 47 | 31.1 |
| Related children 5 to 17 years | 25 | 25.0 |
| Unrelated individuals 15 years and over | 11 | 23.9 |

-Represents zero or rounds to zero. (X) Not applicable.

[1]If the denominator of a mean value or per capita value is less than 30, then that value is calculated using a rounded aggregate in the numerator. See text.

Source: U.S. Bureau of the Census, Census 2000.

**Table DP-4. Profile of Selected Housing Characteristics: 2000**

Geographic area: Lake Arthur town, New Mexico

[Data based on a sample. For information on confidentiality protection, sampling error, nonsampling error, and definitions, see text]

| Subject | Number | Percent | Subject | Number | Percent |
|---|---|---|---|---|---|
| **Total housing units** | **140** | **100.0** | **OCCUPANTS PER ROOM** | | |
| **UNITS IN STRUCTURE** | | | **Occupied housing units** | **128** | **100.0** |
| 1-unit, detached | 87 | 62.1 | 1.00 or less | 116 | 90.6 |
| 1-unit, attached | 3 | 2.1 | 1.01 to 1.50 | 8 | 6.3 |
| 2 units | - | - | 1.51 or more | 4 | 3.1 |
| 3 or 4 units | - | - | | | |
| 5 to 9 units | - | - | **Specified owner-occupied units** | **61** | **100.0** |
| 10 to 19 units | - | - | **VALUE** | | |
| 20 or more units | - | - | Less than $50,000 | 54 | 88.5 |
| Mobile home | 50 | 35.7 | $50,000 to $99,999 | 5 | 8.2 |
| Boat, RV, van, etc | - | - | $100,000 to $149,999 | 2 | 3.3 |
| | | | $150,000 to $199,999 | - | - |
| **YEAR STRUCTURE BUILT** | | | $200,000 to $299,999 | - | - |
| 1999 to March 2000 | 4 | 2.9 | $300,000 to $499,999 | - | - |
| 1995 to 1998 | 9 | 6.4 | $500,000 to $999,999 | - | - |
| 1990 to 1994 | 6 | 4.3 | $1,000,000 or more | - | - |
| 1980 to 1989 | 44 | 31.4 | Median (dollars) | 40,200 | (X) |
| 1970 to 1979 | 30 | 21.4 | | | |
| 1960 to 1969 | 6 | 4.3 | **MORTGAGE STATUS AND SELECTED** | | |
| 1940 to 1959 | 21 | 15.0 | **MONTHLY OWNER COSTS** | | |
| 1939 or earlier | 20 | 14.3 | With a mortgage | 28 | 45.9 |
| | | | Less than $300 | 2 | 3.3 |
| **ROOMS** | | | $300 to $499 | 13 | 21.3 |
| 1 room | 2 | 1.4 | $500 to $699 | 9 | 14.8 |
| 2 rooms | 1 | 0.7 | $700 to $999 | 4 | 6.6 |
| 3 rooms | 15 | 10.7 | $1,000 to $1,499 | - | - |
| 4 rooms | 23 | 16.4 | $1,500 to $1,999 | - | - |
| 5 rooms | 52 | 37.1 | $2,000 or more | - | - |
| 6 rooms | 30 | 21.4 | Median (dollars) | 488 | (X) |
| 7 rooms | 11 | 7.9 | Not mortgaged | 33 | 54.1 |
| 8 rooms | 2 | 1.4 | Median (dollars) | 172 | (X) |
| 9 or more rooms | 4 | 2.9 | | | |
| Median (rooms) | 5.1 | (X) | **SELECTED MONTHLY OWNER COSTS** | | |
| | | | **AS A PERCENTAGE OF HOUSEHOLD** | | |
| **Occupied housing units** | **128** | **100.0** | **INCOME IN 1999** | | |
| **YEAR HOUSEHOLDER MOVED INTO UNIT** | | | Less than 15.0 percent | 32 | 52.5 |
| 1999 to March 2000 | 28 | 21.9 | 15.0 to 19.9 percent | 7 | 11.5 |
| 1995 to 1998 | 28 | 21.9 | 20.0 to 24.9 percent | 4 | 6.6 |
| 1990 to 1994 | 18 | 14.1 | 25.0 to 29.9 percent | 9 | 14.8 |
| 1980 to 1989 | 38 | 29.7 | 30.0 to 34.9 percent | - | - |
| 1970 to 1979 | 9 | 7.0 | 35.0 percent or more | 9 | 14.8 |
| 1969 or earlier | 7 | 5.5 | Not computed | - | - |
| | | | | | |
| **VEHICLES AVAILABLE** | | | **Specified renter-occupied units** | **27** | **100.0** |
| None | 7 | 5.5 | **GROSS RENT** | | |
| 1 | 39 | 30.5 | Less than $200 | 3 | 11.1 |
| 2 | 52 | 40.6 | $200 to $299 | 5 | 18.5 |
| 3 or more | 30 | 23.4 | $300 to $499 | 12 | 44.4 |
| | | | $500 to $749 | - | - |
| **HOUSE HEATING FUEL** | | | $750 to $999 | 2 | 7.4 |
| Utility gas | 76 | 59.4 | $1,000 to $1,499 | - | - |
| Bottled, tank, or LP gas | 31 | 24.2 | $1,500 or more | - | - |
| Electricity | 16 | 12.5 | No cash rent | 5 | 18.5 |
| Fuel oil, kerosene, etc | - | - | Median (dollars) | 325 | (X) |
| Coal or coke | - | - | | | |
| Wood | 2 | 1.6 | **GROSS RENT AS A PERCENTAGE OF** | | |
| Solar energy | - | - | **HOUSEHOLD INCOME IN 1999** | | |
| Other fuel | 3 | 2.3 | Less than 15.0 percent | 12 | 44.4 |
| No fuel used | - | - | 15.0 to 19.9 percent | - | - |
| | | | 20.0 to 24.9 percent | 3 | 11.1 |
| **SELECTED CHARACTERISTICS** | | | 25.0 to 29.9 percent | - | - |
| Lacking complete plumbing facilities | 4 | 3.1 | 30.0 to 34.9 percent | 2 | 7.4 |
| Lacking complete kitchen facilities | - | - | 35.0 percent or more | 5 | 18.5 |
| No telephone service | 7 | 5.5 | Not computed | 5 | 18.5 |

-Represents zero or rounds to zero. (X) Not applicable.

Source: U.S. Bureau of the Census, Census 2000.

REFERENCE 27

COPY

**HydroGeoLogic, Inc. - Confirmation Notice**
**Atlas Missile Silo Preliminary Assessment**

**Auto ROC ID#** 131

Print Record

☑ **Phone** ☐ **Research/Doc Collection** ☐ **Interview**

| **Name of Person Contacted** | **Title Position** | **Company/Agency Name** |
|---|---|---|
| Gina Levario | Water Clerk | Town of Lake Arthur |

| **Street Address** | **City** | **State** | **Zip Code** |
|---|---|---|---|
| | Lake Arthur | NM | |

| **Phone Number** | **Fax Number** | **E-Mail** |
|---|---|---|
| 505-365-2109 | | |

**Contact Made by:** Clark Limoges

**Date (s):** 1/13/2005

**Time:** 10:00 AM

☐ **Contact Initiated** ☑ **Contact Received**

**Summary**

Ms. Levario returned my call from last week. I asked her if the Town of Lake Arthur had any type of wellhead protection plan. Ms. Levario stated that they did not have any type of wellhead protection plan in place.

**U.S. Army Corps of Engineers-HTRW CX**

**REFERENCE 28**

Data Origin: http://www.seo.state.nm.us/water-info/gis-data/ose-wells.zip **Silo 8 Domestic Well Analysis**
Extracted Data Source: X:\Phoenix\Graphics\Atlas (SHA002)\Data\Shape\Atlas-Wells-02-05.shp

| OBJECTID | ID | X COORD | Y COORD | DB FILE NB | USE | DIVERSION | POD REC NB | WELL NUMBE | TWS | RNG | SEC | Q | Q2 | Q3 | ZONE | X | Y | EASTING | NORTHING | START DATE | FINISH DAT | DEPTH WELL | DEPTH WATE | Dup |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 81560 | 165561 | 557699 | 3653077 | RA 00225 | DOM | 0.00 | 165561 | RA 00225 | 15S | 26E | 18 | 3 | 2 | 1 | | | | 557749 | 3652874 | | 6/20/1908 | 0 | 0 | |
| 81837 | 166071 | 558616 | 3652174 | RA 00470 | DOM | 3.00 | 166071 | RA 00470 | 15S | 26E | 19 | 2 | 2 | | | | | 558666 | 3651971 | | 10/9/1909 | 0 | 0 | |
| 81838 | 166076 | 558616 | 3652174 | RA 00471 | DOM | 0.00 | 166076 | RA 00471 | 15S | 26E | 19 | 2 | 2 | | | | | 558666 | 3651971 | | 10/9/1909 | 0 | 0 | |
| 84186 | 123335 | 558616 | 3652174 | RA 01927 | DOM | 3.00 | 123335 | RA 01927 | 15S | 26E | 19 | 2 | 2 | 0 | | | | 558666 | 3651971 | | 3/1/1941 | 83 | 0 | |
| 84257 | 123130 | 558002 | 3653176 | RA 01995 | DOM | 3.00 | 123130 | RA 01995 | 15S | 26E | 18 | 0 | 0 | | | | | 558052 | 3652973 | 12/16/1942 | 12/16/1942 | 75 | 0 | |
| 84294 | 128956 | 558002 | 3653176 | RA 02033 | DOM | 3.00 | 128956 | RA 02033 | 15S | 26E | 18 | 0 | 0 | | | | | 558052 | 3652973 | 2/18/1943 | 2/18/1943 | 59 | 0 | |
| 84338 | 128846 | 559329 | 3651673 | RA 02077 | DOM | 0.00 | 128846 | RA 02077 | 15S | 26E | 20 | 1 | 4 | 3 | | | | 559379 | 3651470 | | | 0 | 0 | |
| 84395 | 165648 | 558712 | 3652476 | RA 02133 | DOM | 0.00 | 165648 | RA 02133 | 15S | 26E | 18 | 4 | 4 | 4 | | | | 558762 | 3652273 | | | 0 | 0 | |
| 84407 | 129624 | 559636 | 3651568 | RA 02145 | DOM | 3.00 | 129624 | RA 02145 | 15S | 26E | 20 | 0 | 0 | | | | | 559686 | 3651365 | | 2/1/1946 | 40 | 40 | |
| 84431 | 165827 | 561314 | 3657350 | RA 02161 | DOM | 0.00 | 165827 | RA 02161 | 14S | 26E | 33 | 4 | 3 | 3 | | | | 561364 | 3657147 | | | 125 | 0 | |
| 84441 | 127959 | 559022 | 3652175 | RA 02168 | DOM | 3.00 | 127959 | RA 02168 | 15S | 26E | 20 | 1 | 1 | | | | | 559072 | 3651972 | | 1/10/1945 | 159 | 50 | |
| 84449 | 164831 | 558202 | 3653384 | RA 02176 | DOM | 0.00 | 164831 | RA 02176 | 15S | 26E | 18 | 2 | 3 | | | | | 558252 | 3653181 | | | 200 | 0 | |
| 84462 | 123552 | 559529 | 3651673 | RA 02186 | DOM | 3.00 | 123552 | RA 02186 | 15S | 26E | 20 | 1 | 4 | 4 | | | | 559579 | 3651470 | | 5/20/1946 | 50 | 0 | |
| 84497 | 123882 | 558894 | 3655509 | RA 02220 | DOM | 3.00 | 123882 | RA 02220 | 15S | 26E | 8 | 1 | 1 | 1 | | | | 558944 | 3655306 | | 10/1/1946 | 120 | 0 | |
| 84512 | 126687 | 559404 | 3655012 | RA 02238 | DOM | 0.00 | 126687 | RA 02238 | 15S | 26E | 8 | 1 | 4 | 0 | | | | 559454 | 3654809 | | | 0 | 0 | |
| 84623 | 125153 | 557096 | 3652466 | RA 02349 | DOM | 0.00 | 125153 | RA 02349 | 15S | 25E | 13 | 4 | 4 | 4 | | | | 557146 | 3652263 | | | 100 | 0 | |
| 84642 | 164700 | 565201 | 3650922 | RA 02367 | DOM | 0.00 | 164700 | RA 02367 | 15S | 26E | 23 | 4 | 4 | 4 | | | | 565251 | 3650719 | | | 150 | 0 | |
| 84683 | 164727 | 560501 | 3657750 | RA 02395 | DOM | 0.00 | 164727 | RA 02395 | 14S | 26E | 33 | 3 | 1 | 3 | | | | 560551 | 3657547 | | | 120 | 0 | |
| 84684 | 164728 | 559711 | 3654713 | RA 02396 | DOM | 0.00 | 164728 | RA 02396 | 15S | 26E | 8 | 4 | 1 | 1 | | | | 559761 | 3654510 | | | 60 | 0 | |
| 84733 | 127957 | 557291 | 3653883 | RA 02442 | DOM | 3.00 | 127957 | RA 02442 | 15S | 26E | 18 | 1 | 1 | 1 | | | | 557341 | 3653680 | 11/1/1948 | 11/1/1948 | 136 | 51 | |
| 84911 | 125979 | 559747 | 3650466 | RA 02563 | DOM | 3.00 | 125979 | RA 02563 | 15S | 26E | 29 | 2 | 1 | 3 | | | | 559797 | 3650263 | | 5/1/1950 | 0 | 0 | |
| 84920 | 123458 | 562781 | 3650281 | RA 02571 | DOM | 3.00 | 123458 | RA 02571 | 15S | 26E | 27 | 1 | 4 | 2 | | | | 562831 | 3650078 | | 10/20/1950 | 630 | 0 | |
| 85011 | 128032 | 564339 | 3657375 | RA 02646 | DOM | 0.00 | 128032 | RA 02646 | 14S | 26E | 35 | 3 | 4 | 4 | | | | 564389 | 3657172 | | | 0 | 0 | |
| 85012 | 126563 | 564339 | 3657375 | RA 02646 REPAR | DOM | 3.00 | 126563 | RA 02646 REPAR | 14S | 26E | 35 | 3 | 4 | 4 | | | | 564389 | 3657172 | 9/10/1955 | 9/13/1955 | 150 | 0 | |
| 85016 | 129721 | 563755 | 3655565 | RA 02650 | DOM | 0.00 | 129721 | RA 02650 | 15S | 26E | 11 | 1 | 1 | 1 | | | | 563805 | 3655362 | | | 0 | 0 | |
| 85027 | 123047 | 558512 | 3652476 | RA 02665 | DOM | 0.00 | 123047 | RA 02665 | 15S | 26E | 18 | 4 | 4 | 3 | | | | 558562 | 3652273 | | | 0 | 0 | |
| 85218 | 124561 | 563571 | 3652313 | RA 02848 | DOM | 3.00 | 124561 | RA 02848 | 15S | 26E | 22 | 2 | 2 | 2 | | | | 563621 | 3652110 | 3/3/1952 | 3/10/1952 | 99 | 0 | Y-1 |
| 85375 | 127036 | 558515 | 3652273 | RA 03014 | DOM | 3.00 | 127036 | RA 03014 | 15S | 26E | 19 | 2 | 2 | 1 | | | | 558565 | 3652070 | 2/25/1953 | 3/1/1953 | 125 | 0 | |
| 85561 | 124700 | 557718 | 3650455 | RA 09856 | DOM | 3.00 | 124700 | RA 03194 S | 15S | 26E | 30 | 1 | 2 | 3 | | | | 557768 | 3650252 | 3/28/1974 | 4/3/1974 | 60 | 0 | Y-1 |
| 85584 | 126571 | 557718 | 3650455 | RA 03204 | DOM | 0.00 | 126571 | RA 03204 | 15S | 26E | 30 | 1 | 2 | 3 | | | | 557768 | 3650252 | | | 0 | 0 | |
| 85604 | 129996 | 557276 | 3656305 | RA 03228 | DOM | 0.00 | 129996 | RA 03228 | 15S | 26E | 6 | 3 | 1 | 1 | | | | 557326 | 3656102 | | | 0 | 0 | |
| 85620 | 129668 | 559776 | 3647633 | RA 03244 | DOM | 3.00 | 129668 | RA 03244 | 15S | 26E | 32 | 4 | 3 | 3 | | | | 559826 | 3647430 | 7/26/1955 | 7/30/1955 | 213 | 12 | |
| 85621 | 128735 | 559747 | 3650466 | RA 03245 | DOM | 0.00 | 128735 | RA 03245 | 15S | 26E | 29 | 2 | 1 | 3 | | | | 559797 | 3650263 | | | 0 | 0 | |
| 85634 | 127787 | 562240 | 3655450 | RA 03261 | DOM | 3.00 | 127787 | RA 03261 | 15S | 26E | 10 | 1 | 1 | 0 | | | | 562290 | 3655247 | 6/19/1954 | 6/26/1954 | 160 | 0 | |
| 85712 | 129127 | 560103 | 3657340 | RA 03347 | DOM | 3.00 | 129127 | RA 03347 | 14S | 26E | 32 | 4 | 4 | 3 | | | | 560153 | 3657137 | 11/2/1955 | 11/5/1955 | 100 | 0 | |
| 85734 | 124105 | 560812 | 3656840 | RA 03371 | DOM | 0.00 | 124105 | RA 03371 | 15S | 26E | 4 | 1 | 0 | 0 | | | | 560862 | 3656637 | | | 0 | 0 | |
| 85793 | 124789 | 559868 | 3648543 | RA 03447 | DOM | 3.00 | 124789 | RA 03447 | 15S | 26E | 32 | 2 | 3 | | | | | 559918 | 3648340 | 8/20/1955 | 8/24/1955 | 213 | 8 | |
| 85794 | 128666 | 559863 | 3648948 | RA 03448 | DOM | 3.00 | 128666 | RA 03448 | 15S | 26E | 32 | 2 | 1 | | | | | 559913 | 3648745 | 8/25/1955 | 8/27/1955 | 180 | 6 | |
| 85795 | 129806 | 559852 | 3650163 | RA 03449 | DOM | 3.00 | 129806 | RA 03449 | 15S | 26E | 29 | 2 | 3 | | | | | 559902 | 3649960 | 8/29/1955 | 8/31/1955 | 143 | 8 | |
| 85796 | 122996 | 559047 | 3649348 | RA 03450 | DOM | 3.00 | 122996 | RA 03450 | 15S | 26E | 29 | 3 | 3 | | | | | 559097 | 3649145 | 9/5/1955 | 9/9/1955 | 213 | 12 | |
| 85797 | 124156 | 559848 | 3650567 | RA 03451 | DOM | 3.00 | 124156 | RA 03451 | 15S | 26E | 29 | 2 | 1 | | | | | 559898 | 3650364 | 9/7/1955 | 9/9/1955 | 93 | 8 | |
| 85801 | 123818 | 559560 | 3648441 | RA 03460 | DOM | 3.00 | 123818 | RA 03460 | 15S | 26E | 32 | 1 | 4 | 4 | | | | 559610 | 3648238 | 7/20/1955 | 7/26/1955 | 233 | 8 | |
| 85927 | 123694 | 559608 | 3654801 | RA 03659 | DOM | 3.00 | 123694 | RA 03659 | 15S | 26E | 8 | 0 | 0 | | | | | 559658 | 3654598 | 11/28/1956 | 12/6/1956 | 150 | 73 | |
| 86208 | 186726 | 559325 | 3652075 | RA 04015 | DOM | 0.00 | 186726 | RA 04015 | 15S | 26E | 20 | 1 | 2 | 3 | | | | 559375 | 3651872 | | | 100 | 0 | |
| 86256 | 127170 | 557402 | 3652169 | RA 04065 | DOM | 3.00 | 127170 | RA 04065 | 15S | 26E | 19 | 1 | 1 | | | | | 557452 | 3651966 | 7/24/1959 | 7/29/1959 | 155 | 35 | |
| 86356 | 124213 | 561353 | 3652096 | RA 04199 | DOM | 3.00 | 124213 | RA 04199 | 15S | 26E | 21 | 2 | 1 | 3 | | | | 561403 | 3651893 | 4/18/1960 | 5/4/1960 | 1105 | 0 | |
| 86553 | 126064 | 560550 | 3651479 | RA 04376 | DOM | 3.00 | 126064 | RA 04376 | 15S | 26E | 21 | 3 | 1 | 1 | | | | 560600 | 3651276 | 4/9/1961 | 4/10/1961 | 95 | 451 | |
| 86708 | 128232 | 555490 | 3652243 | RA 04541 | DOM | 3.00 | 128232 | RA 04541 | 15S | 25E | 23 | 2 | 2 | 2 | | | | 555540 | 3652040 | 11/4/1961 | 12/4/1961 | 240 | 55 | |
| 87284 | 124964 | 557399 | 3652573 | RA 05091 | DOM | 3.00 | 124964 | RA 05091 | 15S | 26E | 18 | 3 | 3 | | | | | 557449 | 3652370 | 3/30/1965 | 5/15/1965 | 395 | 115 | |
| 87362 | 186280 | 557313 | 3650249 | RA 05153 | DOM | 3.00 | 186280 | RA 05153 | 15S | 26E | 30 | 1 | 3 | 1 | | | | 557363 | 3650046 | | | 0 | 0 | |
| 87584 | 123734 | 561980 | 3649265 | RA 05389 | DOM | 3.00 | 123734 | RA 05389 | 15S | 26E | 28 | 4 | 4 | 4 | | | | 562030 | 3649062 | 10/20/1967 | 10/22/1967 | 86 | 40 | |
| 87586 | 128249 | 559321 | 3652478 | RA 05391 | DOM | 3.00 | 128249 | RA 05391 | 15S | 26E | 17 | 3 | 4 | 3 | | | | 559371 | 3652275 | 10/24/1967 | 10/31/1967 | 220 | 59 | |
| 87695 | 125585 | 559309 | 3654104 | RA 05527 | DOM | 3.00 | 125585 | RA 05527 | 15S | 26E | 8 | 3 | 4 | 3 | | | | 559359 | 3653901 | 8/1/1969 | 8/1/1969 | 122 | 101 | |
| 87797 | 129911 | 556497 | 3652257 | RA 05639 | DOM | 3.00 | 129911 | RA 05639 | 15S | 25E | 24 | 2 | 1 | 1 | | | | 556547 | 3652054 | 3/9/1971 | 3/11/1971 | 106 | 48 | |
| 88066 | 126178 | 561911 | 3657760 | RA 05922 | DOM | 3.00 | 126178 | RA 05922 | 14S | 26E | 33 | 4 | 2 | 4 | | | | 561961 | 3657557 | 12/10/1975 | 2/18/1976 | 110 | 80 | |
| 88283 | 128995 | 562222 | 3657458 | RA 06151 | DOM | 3.00 | 128995 | RA 06151 | 14S | 26E | 34 | 3 | 3 | | | | | 562272 | 3657255 | 7/11/1977 | 7/19/1977 | 155 | 125 | |
| 88378 | 185814 | 557091 | 3653274 | RA 06251 | DOM | 3.00 | 185814 | RA 06251 | 15S | 25E | 13 | 2 | 4 | 4 | | | | 557141 | 3653071 | | | 160 | 55 | |
| 88421 | 129922 | 555386 | 3652952 | RA 06293 | DOM | 3.00 | 129922 | RA 06293 | 15S | 25E | 14 | 4 | 2 | 3 | | | | 555436 | 3652749 | 4/26/1978 | 5/4/1978 | 117 | 77 | |
| 88448 | 128490 | 555690 | 3652450 | RA 06319 | DOM | 3.00 | 128490 | RA 06319 | 15S | 25E | 13 | 3 | 3 | 3 | | | | 555740 | 3652247 | 6/7/1978 | 6/9/1978 | 76 | 62 | |
| 88473 | 124983 | 565102 | 3651023 | RA 06346 | DOM | 3.00 | 124983 | RA 06346 | 15S | 26E | 23 | 4 | 4 | 4 | | | | 565152 | 3650820 | 7/8/1978 | 8/13/1978 | 175 | 30 | |
| 88488 | 127993 | 560313 | 3655121 | RA 06361 | DOM | 3.00 | 127993 | RA 06361 | 15S | 26E | 8 | 2 | 4 | 2 | | | | 560363 | 3654918 | 9/18/1978 | 10/4/1978 | 150 | 90 | |
| 88497 | 186167 | 561027 | 3654630 | RA 06370 | DOM | 3.00 | 186167 | RA 06370 | 15S | 26E | 9 | 3 | 2 | | | | | 561077 | 3654427 | | | 0 | 0 | |
| 88672 | 127914 | 564229 | 3657884 | RA 06583 | DOM | 3.00 | 127914 | RA 06583 | 14S | 26E | 35 | 3 | 2 | | | | | 564279 | 3657681 | 10/14/1979 | 11/11/1979 | 115 | 80 | |
| 88677 | 123708 | 563230 | 3657666 | RA 06590 | DOM | 3.00 | 123708 | RA 06590 | 14S | 26E | 34 | 4 | 0 | | | | | 563280 | 3657463 | 5/7/1982 | 5/10/1982 | 112 | 76 | |
| 88718 | 123737 | 560515 | 3655329 | RA 06659 | DOM | 3.00 | 123737 | RA 06659 | 15S | 26E | 9 | 1 | 1 | 3 | | | | 560565 | 3655126 | 5/27/1980 | | 50 | 0 | |
| 88769 | 129670 | 562128 | 3656556 | RA 06755 | DOM | 3.00 | 129670 | RA 06755 | 15S | 26E | 3 | 1 | 3 | 3 | | | | 562178 | 3656353 | 2/16/1981 | 2/24/1981 | 125 | 100 | |
| 88879 | 186446 | 565904 | 3652664 | RA 06857 | DOM | 0.00 | 186446 | RA 06857 | 15S | 26E | 13 | 3 | 4 | | | | | 565954 | 3652461 | | | 0 | 0 | |
| 89199 | 183337 | 557313 | 3650049 | RA 07182 | DOM | 3.00 | 183337 | RA 07182 | 15S | 26E | 30 | 1 | 3 | 3 | | | | 557363 | 3649846 | 3/14/1981 | 4/11/1981 | 255 | 200 | |

Data Origin: http://www.seo.state.nm.us/water-info/gis-data/ose-wells.zip

**Silo 8 Domestic Well Analysis**

Extracted Data Source: X:\Phoenix\Graphics\Atlas (SHA002)\Data\Shape\Atlas-Wells-02-05.shp

| OBJECTID | ID | X COORD | Y COORD | DB FILE NB | USE | DIVERSION | POD REC NB | WELL NUMBE | TWS | RNG | SEC | Q | Q2 | Q3 | ZONE | X | Y | EASTING | NORTHING | START DATE | FINISH DAT | DEPTH WELL | DEPTH WATE | Dup |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 89290 | 183552 | 562208 | 3658270 | RA 07269 | DOM | 0.00 | 183552 | RA 07269 | 14S | 26E | 34 | 1 | 3 | | | | | 562258 | 3658067 | | | 0 | 0 | |
| 89291 | 183554 | 562208 | 3658270 | RA 07270 | DOM | 0.00 | 183554 | RA 07270 | 14S | 26E | 34 | 1 | 3 | | | | | 562258 | 3658067 | | | 0 | 0 | |
| 89479 | 184131 | 564244 | 3657075 | RA 07451 | DOM | 0.00 | 184131 | RA 07451 | 15S | 26E | 2 | 1 | 2 | | | | | 564294 | 3656872 | | | 0 | 0 | |
| 89506 | 184286 | 562125 | 3657155 | RA 07477 | DOM | 0.00 | 184286 | RA 07477 | 15S | 26E | 3 | 1 | 1 | 1 | | | | 562175 | 3656952 | | | 0 | 0 | |
| 89528 | 125849 | 559509 | 3654104 | RA 07499 | DOM | 3.00 | 125849 | RA 07499 | 15S | 26E | 8 | 3 | 4 | 4 | | | | 559559 | 3653901 | 2/4/1986 | 2/7/1986 | 93 | 60 | |
| 89599 | 127043 | 563944 | 3656770 | RA 07567 | DOM | 3.00 | 127043 | RA 07567 | 15S | 26E | 2 | 1 | 3 | 2 | | | | 563994 | 3656567 | 1/15/1986 | 2/1/1987 | 111 | 80 | |
| 89601 | 128438 | 559397 | 3655818 | RA 07569 | DOM | 3.00 | 128438 | RA 07569 | 15S | 26E | 5 | 3 | 4 | | | | | 559447 | 3655615 | 1/4/1987 | 1/9/1987 | 107 | 70 | |
| 89732 | 128620 | 562618 | 3657868 | RA 07701 | DOM | 3.00 | 128620 | RA 07701 | 14S | 26E | 34 | 3 | 2 | | | | | 562668 | 3657665 | 2/20/1989 | 3/3/1989 | 115 | 70 | |
| 89943 | 125797 | 562825 | 3658061 | RA 07908 | DOM | 3.00 | 125797 | RA 07908 | 14S | 26E | 34 | 3 | 2 | | | | | 562875 | 3657858 | 6/10/1991 | 6/17/1991 | 135 | 105 | |
| 90977 | 124349 | 559296 | 3656720 | RA 08956 | DOM | 3.00 | 124349 | RA 08956 | 15S | 26E | 5 | 1 | 4 | 1 | | | | 559346 | 3656517 | 3/23/1995 | 5/1/1995 | 151 | 75 | |
| 689 | 128864 | 559525 | 3652075 | RA 09090 | DOM | 3.00 | 128864 | RA 09090 | 15S | 26E | 20 | 1 | 2 | 4 | | | | 559575 | 3651872 | 2/26/1996 | 3/1/1996 | 113 | 35 | |
| 828 | 183579 | 558936 | 3650660 | RA 09232 | DOM | 3.00 | 183579 | RA 09232 | 15S | 26E | 29 | 1 | 1 | 1 | | | | 558986 | 3650457 | | | 0 | 0 | |
| 884 | 129595 | 562125 | 3657155 | RA 09288 | DOM | 3.00 | 129595 | RA 09288 | 15S | 26E | 3 | 1 | 1 | 1 | | | | 562175 | 3656952 | 10/1/1996 | 10/3/1996 | 150 | 100 | |
| 887 | 124333 | 555683 | 3653862 | RA 09291 | DOM | 3.00 | 124333 | RA 09291 | 15S | 25E | 13 | 1 | 1 | 1 | | | | 555733 | 3653659 | 10/5/1996 | 10/8/1996 | 250 | 100 | |
| 1613 | 169857 | 560098 | 3657946 | RA 10039 | DOM | 3.00 | 169857 | RA 10039 | 14S | 26E | 32 | 4 | 2 | 1 | | | | 560148 | 3657743 | 4/16/2001 | 4/20/2001 | 180 | 80 | |
| 1638 | 170736 | 558715 | 3652273 | RA 10068 | DOM | 3.00 | 170736 | RA 10068 | 15S | 26E | 19 | 2 | 2 | 2 | | | | 558765 | 3652070 | 7/5/2001 | 8/10/2001 | 114 | 55 | |
| 1675 | 172413 | 558436 | 3649545 | RA 10112 | DOM | 3.00 | 172413 | RA 10112 | 15S | 26E | 30 | 4 | 0 | | | | | 558486 | 3649342 | 9/21/2001 | 9/24/2001 | 200 | 40 | |
| 1678 | 172934 | 564037 | 3657673 | RA 10116 | DOM | 3.00 | 172934 | RA 10116 | 14S | 26E | 35 | 3 | 0 | | | | | 564087 | 3657470 | 5/1/2002 | 5/8/2002 | 95 | 80 | |
| 1760 | 176368 | 563020 | 3657872 | RA 10209 | DOM | 3.00 | 176368 | RA 10209 | 14S | 26E | 34 | 4 | 1 | | | | | 563070 | 3657669 | 5/9/2002 | 5/17/2002 | 115 | 95 | |
| 1819 | 179253 | 557802 | 3652574 | RA 10271 | DOM | 3.00 | 179253 | RA 10271 | 15S | 26E | 18 | 3 | 4 | | | | | 557852 | 3652371 | | | 140 | 0 | |

*RA 03636, RA 03636 CLW, and RA 01927 were listed as municipal wells upon download from the OSE website.

Investigation of the well numbers through the OSE iWATERS database shows that well numbers RA 03636 and RA 03636 CLW are monitoring wells for the Pecos Valley Artesian Conservation District.

Well Number RA 01927 was retained for domestic use through a permit filed May 17, 1966.

**REFERENCE 29**

U.S. Census Bureau 10 Years on the Web

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# New Mexico QuickFacts

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Place Search

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Chaves County, New Mexico

Further information

Want more? Browse data sets for Chaves County

| People QuickFacts | Chaves County | New Mexico |
|---|---|---|
| Population, 2003 estimate | 60,591 | 1,874,614 |
| Population, percent change, April 1, 2000 to July 1, 2003 | -1.3% | 3.1% |
| Population, 2000 | 61,382 | 1,819,046 |
| Population, percent change, 1990 to 2000 | 6.1% | 20.1% |
| Persons under 5 years old, percent, 2000 | 7.2% | 7.2% |
| Persons under 18 years old, percent, 2000 | 29.1% | 28.0% |
| Persons 65 years old and over, percent, 2000 | 14.7% | 11.7% |
| Female persons, percent, 2000 | 51.0% | 50.8% |
| | | |
| White persons, percent, 2000 (a) | 72.0% | 66.8% |
| Black or African American persons, percent, 2000 (a) | 2.0% | 1.9% |
| American Indian and Alaska Native persons, percent, 2000 (a) | 1.1% | 9.5% |
| Asian persons, percent, 2000 (a) | 0.5% | 1.1% |
| Native Hawaiian and Other Pacific Islander, percent, 2000 (a) | 0.1% | 0.1% |
| Persons reporting some other race, percent, 2000 (a) | 21.2% | 17.0% |
| Persons reporting two or more races, percent, 2000 | 3.1% | 3.6% |
| Persons of Hispanic or Latino origin, percent, 2000 (b) | 43.8% | 42.1% |
| White persons, not of Hispanic/Latino origin, percent, 2000 | 52.1% | 44.7% |
| | | |
| Living in same house in 1995 and 2000', pct age 5+, 2000 | 55.6% | 54.4% |
| Foreign born persons, percent, 2000 | 11.2% | 8.2% |
| Language other than English spoken at home, pct age 5+, 2000 | 33.4% | 36.5% |
| High school graduates, percent of persons age 25+, 2000 | 72.6% | 78.9% |

| | | |
|---|---|---|
| Bachelor's degree or higher, pct of persons age 25+, 2000 | 16.2% | 23.5% |
| Persons with a disability, age 5+, 2000 | 12,614 | 338,430 |
| Mean travel time to work (minutes), workers age 16+, 2000 | 17.1 | 21.9 |
| | | |
| Housing units, 2002 | 25,948 | 805,293 |
| Homeownership rate, 2000 | 70.9% | 70.0% |
| Housing units in multi-unit structures, percent, 2000 | 10.6% | 15.3% |
| Median value of owner-occupied housing units, 2000 | $61,000 | $108,100 |
| | | |
| Households, 2000 | 22,561 | 677,971 |
| Persons per household, 2000 | 2.66 | 2.63 |
| Median household income, 1999 | $28,513 | $34,133 |
| Per capita money income, 1999 | $14,990 | $17,261 |
| Persons below poverty, percent, 1999 | 21.3% | 18.4% |

| **Business QuickFacts** | **Chaves County** | **New Mexico** |
|---|---|---|
| Private nonfarm establishments with paid employees, 2001 | 1,479 | 42,686 |
| Private nonfarm employment, 2001 | 14,837 | 553,357 |
| Private nonfarm employment, percent change 2000-2001 | -2.2% | 0.7% |
| Nonemployer establishments, 2000 | 2,381 | 81,398 |
| Manufacturers shipments, 1997 ($1000) | D | 17,906,091 |
| Retail sales, 1997 ($1000) | 411,020 | 14,984,454 |
| Retail sales per capita, 1997 | $6,569 | $8,697 |
| Minority-owned firms, percent of total, 1997 | 13.8% | 28.5% |
| Women-owned firms, percent of total, 1997 | 23.0% | 29.4% |
| Housing units authorized by building permits, 2002 | 29 | 12,066[1] |
| Federal funds and grants, 2002 ($1000) | 336,561 | 17,477,521 |

| **Geography QuickFacts** | **Chaves County** | **New Mexico** |
|---|---|---|
| Land area, 2000 (square miles) | 6,071 | 121,356 |
| Persons per square mile, 2000 | 10.1 | 15.0 |
| Metropolitan Area | None | |
| FIPS Code | 005 | 35 |

1: Includes data not distributed by county.

Download delimited tables | Download Excel tables

(a) Includes persons reporting only one race.
(b) Hispanics may be of any race, so also are included in applicable race categories.

FN: Footnote on this item for this area in place of data
NA: Not available
D: Suppressed to avoid disclosure of confidential information
X: Not applicable
S: Suppressed; does not meet publication standards
Z: Value greater than zero but less than half unit of measure shown
F: Fewer than 100 firms

Data Quality Statement
What do you think of QuickFacts?

Source U.S. Census Bureau: State and County QuickFacts. Data derived from Population Estimates, 2000 Census of Population and Housing, 1990 Census of Population and Housing, Small Area Income and Poverty Estimates, County Business Patterns, 1997 Economic Census, Minority- and Women-Owned Business, Building Permits, Consolidated Federal Funds Report, 1997 Census of Governments

Last Revised: Friday, 09-Jul-2004 09:01:02 EDT

**REFERENCE 30**

# HydroGeoLogic, Inc. - Confirmation Notice
# Atlas Missile Silo Preliminary Assessment



**Auto ROC ID#**
184

Print Record

☑ Phone ☐ Research/Doc Collection ☐ Interview

| Name of Person Contacted | Title Position | Company/Agency Name |
|---|---|---|
| John Jackson | | |

| Street Address | City | State | Zip Code |
|---|---|---|---|
| | | | |

| Phone Number | Fax Number | E-Mail |
|---|---|---|
| 505-365-2096 | | |

**Contact Made by**
Stephanie Hester

**Date (s)**
5/4/2005

**Time**
9:30 am

☐ Contact Initiated ☑ Contact Received

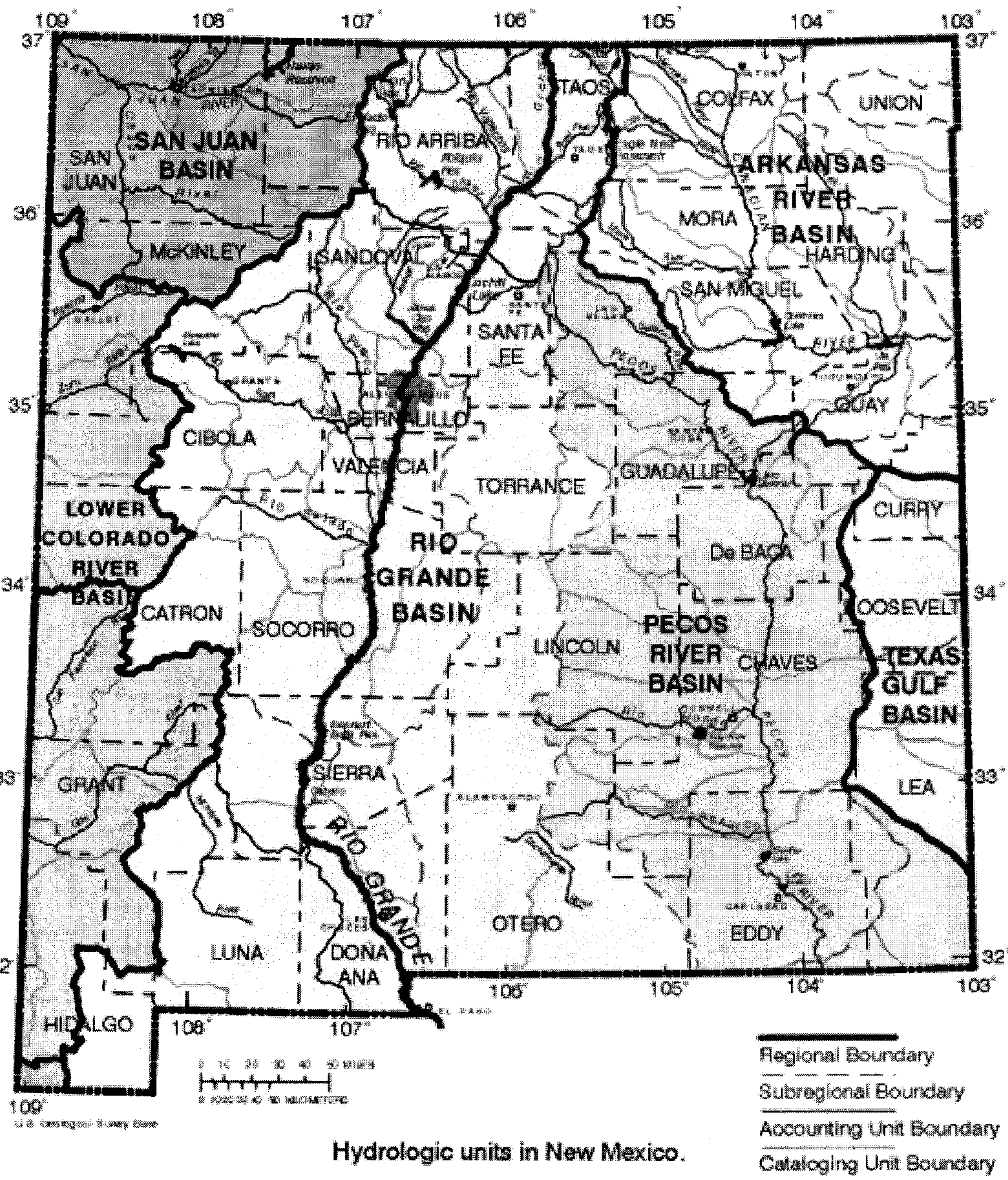
**Summary**
John Jackson returned my call and confirmed that they do not have a private well on their property. They receive their water from the Lake Arthur Water Cooperative Corporation.

**REFERENCE 31**

USGS
science for a changing world

*125 years of science for America* ★ ★ ★ ★ ★ 1879–2004

# BASINS IN NEW MEXICO




Hydrologic units in New Mexico.

## What is a Basin?

A large or small depression in the surface of the land, which may or may not drain into the ocean.

## More Information About Basins

0001

**REFERENCE 32**


KEY TO MAP

SPECIAL FLOOD HAZARD AREA — ZONE A

## EXPLANATION OF ZONE DESIGNATIONS

| ZONE | EXPLANATION |
|---|---|
| A | Areas of 100-year flood; base flood elevations and flood hazard factors not determined. |
| C | Areas of minimal flooding. (No shading) |
| D | Areas of undetermined, but possible, flood hazards. |
| V | Areas of 100-year coastal flood with velocity (wave action); base flood elevations and flood hazard factors not determined. |

NOTES TO USER

Certain areas not in the special flood hazard areas (zones A and V) may be protected by flood control structures.

This map is for flood insurance purposes only; it does not necessarily show all areas subject to flooding in the community or all planimetric features outside special flood hazard areas.

For adjoining map panels, see separately printed Index To Map Panels.

INITIAL IDENTIFICATION:
JUNE 13,1978

FLOOD INSURANCE RATE MAP EFFECTIVE:
FEBRUARY 2 1983

Refer to the FLOOD INSURANCE RATE MAP EFFECTIVE date shown on this map to determine when actuarial rates apply to structures in the zones where elevations or depths have been established.

To determine if flood insurance is available in this community, contact your insurance agent, or call the National Flood Insurance Program at (800) 638-6620.

APPROXIMATE SCALE
2000 0 2000 FEET

NATIONAL FLOOD INSURANCE PROGRAM

# FIRM
## FLOOD INSURANCE RATE MAP

CHAVES COUNTY,
NEW MEXICO
(UNINCORPORATED AREAS)

PANEL 1350 OF 1625
(SEE MAP INDEX FOR PANELS NOT PRINTED)

COMMUNITY-PANEL NUMBER
350125 1350 B

EFFECTIVE DATE:
FEBRUARY 2,1983

Federal Emergency Management Agency

PDF Create Date: 10/25/2004 (created not at scale and type D)

**REFERENCE 33**

Water Resources

Data Category: Real-time   Geographic Area: New Mexico   go

# USGS 08396500 PECOS RIVER NEAR ARTESIA, NM

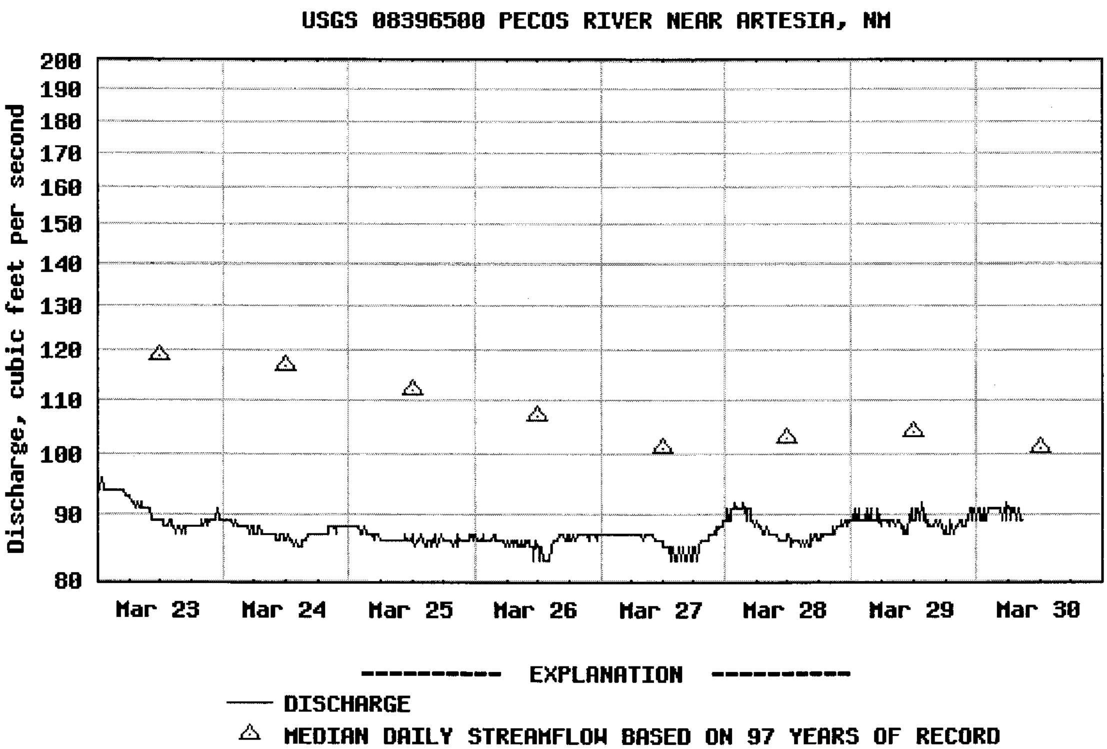
## PROVISIONAL DATA SUBJECT TO REVISION

**Available data for this site** Real-time GO

| Available Parameters | Output format | Days | |
|---|---|---|---|
| All 2 parameters available at this site<br>00060 Discharge (DD 05)<br>00065 Gage height (DD 09) | Graph | 7<br>(1-31) | get data |

### Discharge, cubic feet per second

Most recent value: 89 03-30-2005 08:30




Download a presentation-quality graph Parameter Code 00060; DD 05

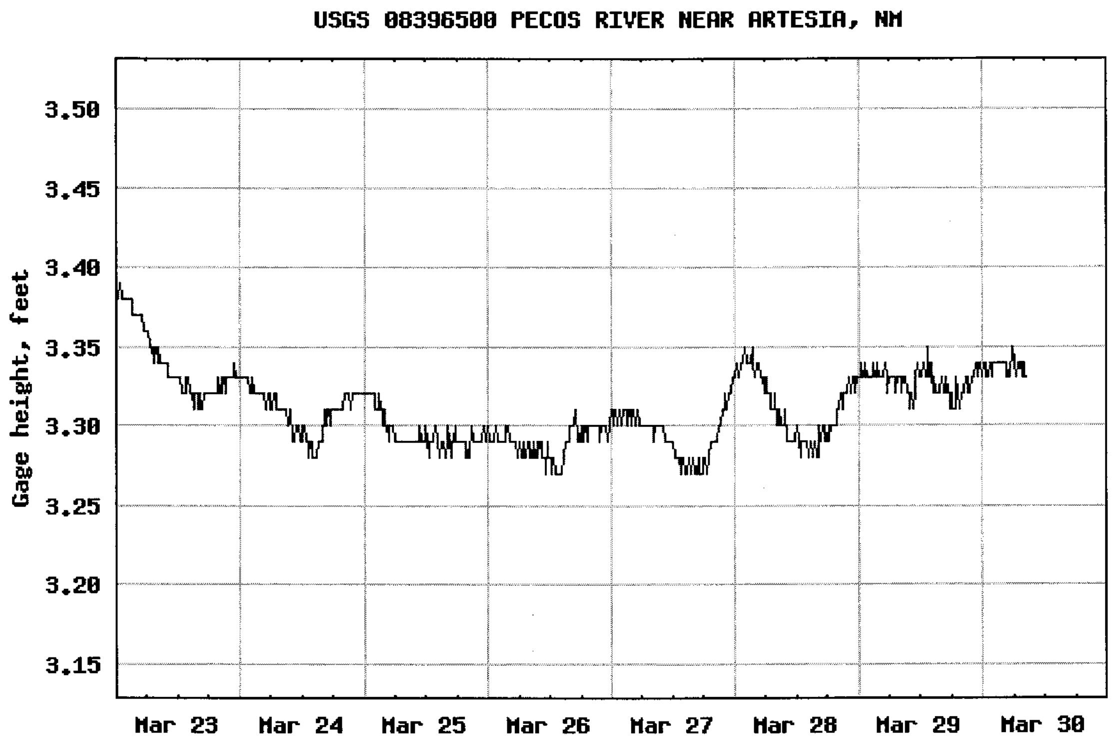
**Daily mean flow statistics for 3/30 based on 97 years of record in $ft^3/sec$**

| Current Flow | Minimum | Mean | Maximum | 80 percent exceedance | 50 percent exceedance | 20 percent exceedance |
|---|---|---|---|---|---|---|
| 89 | 7.1 | 184 | 1,360 | 36.6 | 101 | 233 |
| Percent exceedance means that 80, 50, or 20 percent of all daily mean flows for 3/30 have been greater than the value shown. | | | | | | |

### Gage height, feet

0001

Most recent value: 3.33 03-30-2005 08:30




Download a presentation-quality graph Parameter Code 00065; DD 09

---

Questions about data New Mexico NWISWeb Data Inquiries
Feedback on this website New Mexico NWISWeb Maintainer
Top
Explanation of terms

**USGS Real-Time Water Data for New Mexico**
**http://waterdata.usgs.gov/nm/nwis/uv?**

**Retrieved on 2005-03-30 13:13:51 EST**
**Department of the Interior, U.S. Geological Survey**
**USGS Water Resources of New Mexico**
**Privacy Statement || Disclaimer || Accessibility || FOIA**
2.55 1.99 sd

0002

**REFERENCE 34**

## HydroGeoLogic, Inc. - Confirmation Notice
## Atlas Missile Silo Preliminary Assessment

**Auto ROC ID#** 133

Print Record

☑ **Phone** ☐ **Research/Doc Collection** ☐ **Interview**

**Name of Person Contacted:** Lisa Brown

**Title Position:**

**Company/Agency Name:** NM Drinking Water Bureau

**Street Address:**

**City:** Roswell

**State:** NM

**Zip Code:**

**Phone Number:** 505-762-3728

**Fax Number:**

**E-Mail:**

**Contact Made by:** Clark Limoges

**Date (s):** 1/18/2005

**Time:** 10:00 AM

☑ **Contact Initiated** ☐ **Contact Received**

**Summary**

Contacted Ms. Brown and asked her a few specific questions about drinking water intakes for surface water. I told her we were doing some research for USACE in Chaves and Lincoln counties and part of the research entailed locating any drinking water intakes 15 miles downstream from the potential point of entry. Ms. Brown told me that there are no public entities that are drawing from surface water in Chaves county or the east side of Lincoln county off the Rio Hondo (location of silo 9).

I asked Ms. Brown what criteria were set for a well being considered a public drinking water intake. Her response was that in order to be considered part of the public water system a well must service 15 connections or 25 people, and they must be connected at least 60 days out of the year.

**REFERENCE 35**

# New Mexico Species of Concern - Chaves County



| Common Name | SCIENTIFIC NAME | FWS ESA | NM WCA | FS R3 | BLM NM | NM Sen | FWS SOC |
|---|---|---|---|---|---|---|---|
| Mexican Tetra | Astyanax mexicanus | - | T | s | - | - | - |
| Rio Grande Chub | Gila pandora | - | - | - | - | s | - |
| Rio Grande Shiner | Notropis jemezanus | - | - | - | s | s | s |
| Pecos Bluntnose Shiner | Notropis simus pecosensis | T hgm | T | - | - | - | - |
| Suckermouth Minnow | Phenacobius mirabilis | - | T | s | - | - | - |
| Gray Redhorse | Moxostoma congestum | - | T | s | - | - | - |
| Headwater Catfish | Ictalurus lupus | - | - | s | s | s | s |
| Pecos Pupfish | Cyprinodon pecosensis | g | T | - | - | - | s |
| Pecos Gambusia | Gambusia nobilis | E mg | E | - | - | - | - |
| Greenthroat Darter | Etheostoma lepidum | - | T | - | - | - | s |
| Bigscale Logperch | Percina macrolepida (Native pop.) | - | T | - | - | - | - |
| Texas Horned Lizard | Phrynosoma cornutum | - | - | s | s | - | - |
| Sand Dune Lizard | Sceloporus arenicolus | C | T | - | s | - | - |
| Desert Kingsnake | Lampropeltis getula splendida | - | - | s | - | - | - |
| Arid Land Ribbon Snake | Thamnophis proximus diabolicus | - | T | s | - | - | - |
| Brown Pelican | Pelecanus occidentalis carolinensis | E | E | s | - | - | - |
| Neotropic Cormorant | Phalacrocorax brasilianus | - | T | s | - | - | - |
| American Bittern | Botaurus lentiginosus | - | - | s | - | - | - |
| Least Bittern | Ixobrychus exilis exilis | - | - | s | - | - | - |
| Great Egret | Ardea alba egretta | - | - | s | - | - | - |
| Snowy Egret | Egretta thula brewsteri | - | - | s | - | - | - |
| Green Heron | Butorides virescens | - | - | s | - | - | - |
| Black-crowned Night-Heron | Nycticorax nycticorax hoactli | - | - | s | - | - | - |
| White-faced Ibis | Plegadis chihi | - | - | s | s | - | - |
| Osprey | Pandion haliaetus carolinensis | - | - | s | - | - | - |
| White-tailed Kite | Elanus caeruleus majusculus | - | - | s | - | - | - |
| Mississippi Kite | Ictinia mississippiensis | - | - | s | - | - | - |
| Bald Eagle | Haliaeetus leucocephalus | AD,T mg | T | s | - | - | - |
| Northern Goshawk | Accipiter gentilis | - | - | s | s | s | s |
| Swainson's Hawk | Buteo swainsoni | - | - | s | - | - | - |
| Ferruginous Hawk | Buteo regalis | - | - | s | s | - | - |
| American Peregrine Falcon | Falco peregrinus anatum | DM,m | T | s | - | - | s |
| Arctic Peregrine Falcon | Falco peregrinus tundrius | DM | T | s | - | - | s |
| Lesser Prairie-Chicken | Tympanuchus pallidicinctus | C | - | - | s | s | - |
| Sora | Porzana carolina | - | - | s | - | - | - |
| Western Snowy Plover | Charadrius alexandrinus nivosus | - | - | s | - | - | - |
| Mountain Plover | Charadrius montanus | PT | - | s | - | s | - |
| Black-necked Stilt | Himantopus mexicanus | - | - | s | - | - | - |
| Upland Sandpiper | Bartramia longicauda | - | - | s | - | - | - |
| Long-billed Curlew | Numenius americanus americanus | - | - | s | - | - | - |
| Interior Least Tern | Sterna antillarum athalassos | E mg | E | s | - | - | - |
| Black Tern | Chlidonias niger surinamensis | - | - | - | s | - | s |
| Common Ground-dove | Columbina passerina pallescens | - | E | s | - | - | - |
| Yellow-billed Cuckoo | Coccyzus americanus occidentalis | - | - | s | - | s | s |
| Burrowing Owl | Athene cunicularia hypugaea | - | - | - | s | - | s |
| Belted Kingfisher | Ceryle alcyon | - | - | s | - | - | - |
| Southwestern Willow Flycatcher | Empidonax traillii extimus | E h | E | s | - | - | - |
| Loggerhead Shrike | Lanius ludovicianus | - | - | - | s | s | s |
| Bell's Vireo | Vireo bellii | - | T | s | - | - | s |

# NEW MEXICO SPECIES of CONCERN

## STATUS & DISTRIBUTION

**STATE OF NEW MEXICO: THREATENED, ENDANGERED, SENSITIVE, ENDEMIC**

**USFWS: THREATENED, ENDANGERED, CANDIDATE, PROPOSED, SPECIES OF CONCERN**

**US BUREAU OF LAND MANAGEMENT: SENSITIVE**

**US FOREST SERVICE: SENSITIVE**

**EXTIRPATED FROM NEW MEXICO**

**EXTINCT**



**TABLE KEY**

| | |
|---|---|
| FWS ESA | US FISH & WILDLIFE SERVICE; ENDANGERED SPECIES ACT |
| NM WCA | NEW MEXICO; WILDLIFE CONSERVATION ACT |
| FS R3 | US FOREST SERVICE; REGION 3, NEW MEXICO & ARIZONA (old list, revision in progress) |
| BLM NM | US BLM, NEW MEXICO (old list, revision in progress) |
| NM Sen | NEW MEXICO; SENSITIVE (INFORMAL) and/or ENDEMIC TO NM |
| FWS SOC | US FISH & WILDLIFE SERVICE; SPECIES OF CONCERN (INFORMAL) |
| E | ENDANGERED |
| T | THREATENED |
| P | PROPOSED |
| C | CANDIDATE |
| R | RESTRICTED |
| s | SENSITIVE or SPECIES OF CONCERN (SOC) |
| g | Cooperative Agreement |
| n | ENDEMIC TO NEW MEXICO |
| h | Federal "Critical Habitat" designated |
| m | Recovery or Management Plan |
| DM | Delisted from ESA List but monitoring continuing (FWS ESA) |
| AD | Proposed Delisting (FWS ESA) |
| EXPN | Nonessential Experimental Population (FWS ESA) |
| () | In progress or draft |