1. NAME OF PROPERTY

Historic Name: Air Force Facility Missile Site 8 (571-7) Military Reservation

Other Name/Site Number: Titan II ICBM Missile Site 571-7

2. LOCATION

Street & Number: 1580 West Duval Mine Road Not for publication: N/A

City/Town: Green Valley Vicinity: N/A

State: AZ County: Pima Code: 019 Zip Code: 85622

3. CLASSIFICATION

Ownership of Property
Private: ___
Public-Local: ___
Public-State: ___
Public-Federal: X

Category of Property
Building(s): ___
District: ___
Site: X
Structure: ___
Object: ___

Number of Resources within Property

Contributing	Noncontributing	
___	1	buildings
___	___	sites
8	___	structures
38	___	objects
46	1	Total

Number of Contributing Resources Previously Listed in the National Register: 15

Name of Related Multiple Property Listing: None

4. STATE/FEDERAL AGENCY CERTIFICATION

As the designated authority under the National Historic Preservation Act of 1966, as amended, I hereby certify that this ____ nomination ____ request for determination of eligibility meets the documentation standards for registering properties in the National Register of Historic Places and meets the procedural and professional requirements set forth in 36 CFR Part 60. In my opinion, the property ____ meets ____ does not meet the National Register Criteria.

_____ _____
Signature of Certifying Official Date

_____
State or Federal Agency and Bureau

In my opinion, the property ____ meets ____ does not meet the National Register criteria.

_____ _____
Signature of Commenting or Other Official Date

_____
State or Federal Agency and Bureau

5. NATIONAL PARK SERVICE CERTIFICATION

I hereby certify that this property is:

_X_ Entered in the National Register
___ Determined eligible for the National Register
___ Determined not eligible for the National Register
___ Removed from the National Register
___ Other (explain): _____

_____ _____
Signature of Keeper Date of Action

6. FUNCTION OR USE

Historic: Defense Sub: Air Facility (USAF ICBM Facility)

Current: Recreation and Culture Sub: Museum

7. DESCRIPTION

ARCHITECTURAL CLASSIFICATION: Other: Missile launch complex

MATERIALS:

Foundation: concrete, steel
Walls: concrete, steel
Roof: concrete, steel
Other: concrete, steel

Describe Present and Historic Physical Appearance.

Summary

Titan II Missile Site 8 (571-7) is now the home of the Titan Missile Museum which opened on May 21, 1986.[1] It consists of the restored above and below ground facilities and equipment of the U.S. Air Force Titan II Intercontinental Ballistic Missile Site Number 8 (571-7) of the 571st Strategic Missile Squadron, 390th Strategic Missile Wing, that was headquartered at Davis-Monthan Air Force Base (AFB), Tucson, Arizona, from 1962 to 1984. [See Figures #1 & #2] Site 571-7 has been preserved in a manner that reflects its appearance during the period that Titan II missiles were on alert. To provide visitors with a better understanding of the overall activities involved, the below ground areas have been configured to maintain the Launch Control Center as it would be with a Missile Combat Crew on alert while the above ground areas reflect a maintenance effort called a "missile recycle" with the necessary large equipment and rolling stock. [See Figures #3 & #4, and Photograph #1]

Titan II Missile Site 571-7 has 46 contributing resources proposed for National Historical Landmark designation; two of these are non-contiguous. The nominated resource also has one noncontributing resource: the museum building, which was added

[1]The U.S. Air Force leases the site to the Pima County Government (Lease Number DACA 09-1-86-322) which then subleases it to the Tucson Air Museum Foundation.

in 1989. [See Photographs #2 & #3] This recent addition straddles the original security fence line.

Description of Resources

The overall Titan II Missile Site 571-7 was comprised of an approximately 10-acre circular military reservation enclosed by a four-strand barbed wire fence. Within this reservation is the actual missile site--a 3.3 acre parcel surrounded by a 6.5' security fence (chain link fence topped with barbed wire).[2] Two important contributing resources (objects) are located outside of the 3.3 acre secured area. These are the high frequency discage antenna used for communications with other Air Force facilities nationwide and the inter-complex radio communications system used for communications with the wing command post and the other 17 silos around the Tucson area.[3] [See Figure #1 and Photograph #6]

Enclosed within the nominated boundary are 44 above and below ground contributing resources (8 structures and 36 objects). Only four of the structures are above ground: the access (entrance) portal, the silo closure door with associated equipment pads, and two concrete propellant transfer trailer pads.

The access portal is the normal entry point to the below ground facilities. It provides entry to the entrapment area, a security "cage" where Missile Combat Crew members were temporarily isolated for identification by audio and visual means prior to access to the blast lock area. [See Figures #3 & #4 and Photographs #7 & #8] This 35'-deep buried structure is constructed of heavily reinforced concrete. The access portal structure includes the entrance stairwell, a communications antenna for the radio-type maintenance network system, and the elevator.

The huge silo closure door provided blast and environmental protection to the launch duct. [See Photograph #4] It is constructed of 740 tons of concrete and steel mounted on two pairs of tracks. The silo closure door is currently fixed in a half open position. An observation window (added in 1985-6) covering the partially opened silo closure door permits visitors to view the missile (the 10th Titan II produced) poised in the silo as if on alert. [See Photograph #5]

The two large rectangular concrete trailer pads, located approximately 50' from the silo closure door, were level surfaces

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[2]The Air Force owned 9.9 acres but only 3.3 acres were secured.

[3]All silo specific information has been taken from USAF Technical Order 21M-LGM25C-1 "USAF Model LGM-25C Missile Weapon System Operation."

for parking the propellant tank trucks. [See Figure #2 and Photograph #4]

The remaining four contributing structures within the secured area are located below ground--the Blast Lock Area, the Launch Control Center, the Cableway Structure, and the Missile Silo. [See Figures #1, #3, and #4]

Fifty-five steps and 35' down from the top of the access portal is Blast Door Six, the entrance to the Blast Lock Area. [See Photograph #8] Blast Door Six, one of four identical doors in the Blast Lock Area, weighs 6000 pounds and is made of concrete and steel. The blast doors were built to withstand an overpressure of well over 300 pounds per square inch.[4] Blast Door Six was interlocked with Blast Door Seven, the pair enclosing an approximately 10' long room. Blast Door Seven permits access to the inner blast lock area from which the crew could open Blast Door Eight and enter the Launch Control Center, or open Blast Door Nine and enter the cableway which gave access to the missile silo. The blast doors also protected the underground complex from chemical and biological attack.

The Launch Control Center is an approximately 41' diameter, three-level structure that is shock isolated from the surrounding earth by eight sets of isolation springs (4' tall, 3' diameter) that suspend it from the concrete and butt-welded steel outer shell.[5] [See Photograph #9 and Figures #3 & #4] The crew living quarters is located on the first, or uppermost, floor. It is divided into three wedge-shaped rooms, which contain a two-bunk sleeping area, a food preparation area, and a lavatory/shower area. [See Photograph #10] The second, or middle, floor contains the missile facility monitoring and launch center. [See Photograph #9] From this location, the missile was constantly monitored for readiness and the actual launch process conducted. The third, or lower, level houses the air intake, air conditioning equipment, escape hatch, communications equipment, radio filters, sewage storage tank and discharge pumps, electrical power distribution equipment, and battery back-up systems for the Launch Control Center.

Blast Doors Eight and Nine isolate the Launch Control Center from a propellant explosion in the silo structure. Connecting Blast Door Nine and the silo is a 205' long, 9.5' in diameter, cableway structure that provides access to the silo equipment areas and launch duct as well as carrying the power lines, chilled water for air conditioning, and electronic communications between the

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[4]An overpressure above 2 pounds per square inch is sufficient to severely damage standard domestic housing construction. Samuel Glasstone, and P.J. Dolan, The Effects of Nuclear Weapons, (U.S. Government Printing Office, 1977) p. 221.

[5]The cylinder walls are 2.5 feet thick and tapered to 1.5 feet at the top of the dome.

Launch Control Center and the missile silo.[6] [See Photograph #11]

The missile silo structure is constructed as two concentric, cylindrical, reinforced concrete shells. [See Figure #4 and Photographs #5 & #12] The outer shell, called the silo equipment area, is 55′ in diameter and 153.5′ deep with eight levels. The inner cylinder, called the launch duct, is 26.5′ in diameter and 146′ deep. The launch duct housed the missile in a controlled environment at 60 degrees F. The launch duct had nine levels with retractable work platforms available on six levels.

The site includes 36 contributing objects. [See Figures #1 & #2 and Photograph #1] They are: a propellant transfer equipment display (including an oxidizer holding trailer, two propellant conditioning trailers, a rocket fuel handlers′ equipment trailer, a propellant transfer system command trailer, and a portable foam vapor suppression system trailer) with each vehicle fully equipped; three utility vehicles (two crew-cab trucks and one van); a first stage engine display; a Mark VI re-entry vehicle on its transport trailer; a Titan II missile; a UH-1 "Huey" helicopter;[7] one Delta-Tee air temperature inversion layer sensing pole; one wind speed and direction pole; one warning siren pole; one warning light beacon pole; ten 7′ tall TPS (territorial protection system) antennas grouped in pairs adjacent to each corner of the silo closure door and one pair at the fresh air intake; one high-frequency discage antenna (non-contiguous), plus its corresponding "pop-up" antenna;[8] one buried low-frequency antenna; one intercomplex radio communications system (IRCS) antenna (non-contiguous), plus its two pop-up antennas; one ultra-high frequency (UHF) antenna that was hardened and required no back up; one radio-type maintenance network (RTMN) antenna; and the surrounding security fence.[9] The multiplicity of antennas reflects the fact that Titan II was a retaliatory weapon and might well have been launched after a nearby nuclear blast. Thus the use of a wide variety of radio frequencies and hence antennas.

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[6]A shorter cableway of 45′ connects the Launch Control Center and Blast Door #8.

[7]The helicopter was used for airborne surveillance of convoy operations and rapid response transportation.

[8]Pop-up antennas were housed in small silos to protect against attack and severe weather. They could be commanded to "pop-up" to permit reestablishment of communications.

[9]An additional fence abutting a portion of the original security fence was appended south of the museum building site in 1985-6. The new fence is not within the proposed NHL boundary. Two short sections of the original security fence have been removed to accommodate the addition of the new museum building and the restrooms.

All equipment displayed above ground is authentic Titan II system equipment. The below ground facilities are almost fully restored to their appearance prior to Site 571-7 going off alert. They contain essentially all of the original equipment intact.[10] The major below ground contributing object is the missile. The missile silo contains a Titan II missile (with attached re-entry vehicle) with umbilicals connected as if the missile was ready to launch.[11] The silo also includes the minor equipment which was in place at the time the site was retired, including the water chillers, back-up diesel generator, and all air conditioning and ventilation equipment. In 1985-6, two viewing windows were cut into the launch duct at Level 2 to facilitate close-up viewing of the missile. With the exception of the missile, all of the equipment below ground is authentic to the site at the time of deactivation.[12]

Site Integrity

Modifications to the site have been kept to an absolute minimum. The construction of the museum building (1989), which straddles the proposed NHL boundary, resulted in the loss of a small section of the original security fence. [See Figure #1] The restroom facilities (added in 1987) are located immediately outside of the proposed NHL boundary, but another short section of the original security fence was removed to provide visitor access from the launch area. Above ground, asphalt pathways for the escorted tours and wheel chair ramps for the handicapped have been recently added. Below ground, the museum has installed ramps to facilitate wheelchair visitors and installed two viewing windows in the launch duct structure. The original access portal elevator has been certified for use in transporting handicapped visitors to and from the below ground areas.

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[10]Immediately following the deactivation of the site, equipment that could be used at the other Titan II sites at McConnell AFB and Little Rock AFB was removed and sent to the appropriate site. Virtually all of this equipment has been returned.

[11]The 1st and 2nd stage engines are removed; no propellants were ever in this missile; the reentry vehicle contains no warheads; and, in compliance with National Security Council requirements, holes have been cut into each propellant tank and the reentry vehicle to ensure that this missile will never again become an active weapon.

[12]The missile is an authentic Titan II ICBM that was used for training, but is nonetheless an authentic missile in every aspect. While an estimated 99% of the original equipment remains in place above and below ground, the Titan Museum continues to locate and obtain artifacts pertinent to the launch function.

The most important modifications were accomplished by the Air Force to assure various government agencies that the site could no longer be used as an active launch facility. The placement of concrete blocks (4′ x 4′ x 4′) on the silo closure door tracks prevents the complete opening of the silo closure door, as required by an agreement with the National Security Council. Additionally, the exhaust vanes on either side of the launch ducts were covered with 1.5′ of concrete to provide a smooth surface for viewing the launch duct interior. A bullet proof skylight was added over the half-open area of the launch duct to provide environmental protection and to permit satellite observation.

8. STATEMENT OF SIGNIFICANCE

Certifying official has considered the significance of this property in relation to other properties: Nationally: X Statewide: ___ Locally: ___

Applicable National Register Criteria: A X B ___ C X D ___

Criteria Considerations (Exceptions): A ___ B ___ C ___ D ___ E ___ F ___ G X

NHL Criteria: 1 & 4

NHL Exception: G

NHL Theme(s): IX Political and Military Affairs after 1945
XVIII:E Technology: Military Fortification

Areas of Significance: Military
Engineering

Period of Significance: 1962-1982

Significant Dates: 1962 (construction began)
1963 (missile site activated, on alert)
1979 (guidance system updated)
1982 (missile site taken off alert)

Significant Person(s): NA

Cultural Affiliation: NA

Architect/Builder: Ralph M. Parsons Company (Engineer) /
Jones, Teer and Winkelman (Builder)

State Significance of Property, and Justify Criteria, Criteria Considerations, and Areas and Periods of Significance Noted Above.

SIGNIFICANCE

Titan II Missile Site 8 (571-7) is the sole remaining Titan II Intercontinental Ballistic Missile (ICBM) complex of the 54 that were "on alert" during the Cold War between 1963 and 1987.[13] As such, it is of exceptional national significance as the single remaining example of the liquid-fueled ICBM missile launch

[13]The only other Titan II launch complex that remains is 395-C at Vandenberg Air Force Base, California. While open to the public, this site was a launch training facility and, except for a short period, was not on operational alert.

facilities utilized by the Strategic Air Command. Titan II carried the largest single warhead used in the ICBM program and was capable of destroying targets that Atlas, Titan I, and Minuteman I and II could not.[14] Built in response to the "missile gap" panic of the late 1950s and early 1960s, Titan II Missile Site 571-7 provides a unique window into the design, construction, and operation of a weapon system built to survive a first-strike nuclear attack and be able to launch its missile if so ordered.[15] The site has retained, or assembled, all of the above and below ground command and control facilities as well as the missile silo itself, which contains a Titan II missile.

Unlike the first generation Atlas or Titan I ICBMs, or the Thor and Jupiter Intermediate Range Ballistic Missiles (IRBM), Titan II utilized storable liquid propellants. Fully fueled at all times, the Titan II was ready for launch at a moments notice. From the turn of the launch keys to lift-off took slightly less than one minute. Approximately 35 minutes and 6000 miles later, the Mark VI re-entry vehicle would have detonated on target as either an air or ground burst.

Nowhere else in the United States is there such a facility open for public inspection and education. Access to Titan Missile Site 571-7 represents a rare opportunity to educate people about the much-feared prospects of the conduct of nuclear war and the government's efforts to deter its occurrence.

HISTORIC CONTEXT

The decision to build an ICBM weapon system originated in the late 1940s but was shelved due to budgetary constraints.[16] After the Korean War, and following the detonation of the first thermonuclear bomb by the Soviet Union in 1953, the U.S. Government became convinced of the need for an ICBM weapon system, despite the cost. Valuable time had been lost and the Soviet Union was thought to be well ahead of the United States in the development of ICBMs. In 1954, Dr. John von Neumann presented the summary report of the Teapot Committee which had

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[14]While details of the warhead yields may be available elsewhere, this information is considered classified by the U.S. Air Force. For purposes of comparison, the Titan II warheads were 5 to 50 times more powerful than the various Minuteman warheads, and 2.5 to 5 times more powerful than the Atlas and Titan I missile warheads.

[15]Titan II was a retaliatory weapon. U.S. national policy precluded a first-strike attack and thus, the silo had to be able to withstand attack and then launch its missile when commanded to do so.

[16]Edmund Beard, Developing the ICBM, (Columbia University Press, New York, 1976), p. 67.

been formed the previous year to review the feasibility of strategic offensive missiles. The Teapot Committee urged the rapid development of both IRBMs and ICBMs. The need was urgent, and while money was not to be wasted, the committee recommended that time was of the essence and no effort should be spared.[17]

The First Generation: Atlas, Titan I, Thor, and Jupiter

Atlas

Two development tracks were recommended in the Teapot Committee report. The first was the ICBM program. In 1954, the Atlas ICBM weapon system was initiated as a 1-1/2 stage missile. Concerns about the ability to ignite a rocket engine at high altitude had led to the conservative Atlas design where all three main engines would ignite at liftoff; at staging, two of the three would drop away. Propelled by engines using liquid oxygen and RP-1 (kerosene), the Atlas missile was stored with the RP-1 on board. The liquid oxygen tank was kept inflated with pressurized helium prior to oxidizer loading.[18] In its final form, Atlas F, it took a minimum of 15-20 minutes to load the liquid oxygen onto the missile, open the silo doors, and bring the missile to the surface.[19]

Blast protection for Atlas missile facilities improved during the life of the program. For the earliest deployed Atlas D missiles, protection was virtually non-existent; for Atlas F, storage in hardened silos provided significant protection but the missiles still had to be elevated to the surface for launch. The early Atlas models utilized radio-inertial guidance, but Atlas E and F were equipped with stand alone inertial guidance systems.[20]

The first Atlas D of the 576th Strategic Missile Squadron was placed on alert at Vandenberg AFB, California, on October 31, 1959. By the end of 1962, four Atlas D, three Atlas E, and six

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[17]G. Harry Stine, ICBM, (Orion Books, New York, 1990), p. 166. IRBMs were defined as missiles with ranges of 1,000 to 2000 miles; ICBMs had ranges of 5,000 to 7,000 miles.

[18]Jacob Neufeld, Ballistic Missiles in the United States Air Force: 1945-1960, (U.S. Government Printing Office, 1990), pp. 202-203.

[19]The Atlas ICBM was deployed in three variants; D, E and F. The times given in the text reflect the Atlas F system.

[20]Radio-inertial guidance required tracking information from ground stations, while stand alone systems did not.

Atlas F squadrons were operational, encompassing a total of 132 missiles.[21]

Titan I

Concurrent with the development of the Atlas ICBM, the Titan I ICBM program began in May 1955 as a hedge against catastrophic failure of the Atlas design. Titan I used the same propellants (liquid oxygen and RP-1) as Atlas but had a rigid airframe design which permitted much easier maintenance and faster propellant loading procedures. Incorporated in Titan I were many design "upgrades" that could not be installed on operational Atlas missiles, including a true second stage. Radio-inertial guidance was the only guidance system installed on operational Titan I missiles. Finally, and perhaps most important, Titan I silos would be much easier to harden.[22]

Titan I ICBMs were placed on alert April 20, 1962 at the 724th Strategic Missile Wing, Lowry AFB, Colorado. By the end of 1962, six squadrons of Titan I ICBMs, a total of 56 missiles, were on alert.

Thor and Jupiter

In 1955, one of the major stumbling blocks to ICBM development was that of an accurate long-range guidance system. While the first inertial guidance systems were showing promise, they were still far from generating the accuracy necessary over the 6,000 mile, or greater, ICBM range. They could, however, give excellent accuracy over a range of 1,500 miles. The Teapot Committee thus urged that a shorter range ballistic missile, the IRBM, with inertial guidance, be developed to counter immediate Soviet capabilities. Two IRBM systems were developed and deployed: Thor and Jupiter. Thor was the Air Force IRBM and Jupiter was developed by the Army but deployed by the Air Force. Neither system was hardened against nearby nuclear blasts; both were fueled with liquid oxygen and RP-1. The most important drawback was the need to be "forward" based outside the United States due to the limited range of this class of missiles. Sixty Thor IRBMs were deployed in the United Kingdom from June 1960 to November 29, 1962; after which they were gradually taken off alert and removed during the following ten months.[23] Thirty Jupiter IRBMs were deployed in Italy from April 1961 to April

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[21]Major Francis X. Ruggiero, "Missileers' Heritage," Student Research Report 2065-81, (Air Command and Staff College, 1981), p. 90.

[22]Neufeld, p. 189.

[23]The deployment dates for Thor and Jupiter are from Neufeld, p. 226.

1963.[24] Jupiter IRBMs were deployed in Turkey from March 1962 to April 1963.[25] Both Thor and Jupiter carried the same warhead as the Atlas D ICBM.

First Generation Phase Out

On May 24 1963, the Air Force approved phase-out of Atlas D and E, as well as Titan I, between 1965 and 1968. One year later, the Secretary of Defense directed the acceleration of the phase-out of Atlas E and Titan I, with removal to be complete by 1965. In November 1964, Atlas F was added to this phase-out program.[26]

In May 1962, after a thorough review of the Thor and Jupiter IRBM program, Secretary of Defense McNamara informed the British Government that the United States would terminate support for the Thor program in 1964. The first Thor squadrons were removed from alert on November 29, 1962 and the final squadron deactivated on August 15, 1963.[27]

The Jupiter missiles in Italy and Turkey were removed from alert in April 1963, and the last of the equipment was removed from both countries in July 1963.

The Second Generation: Minuteman and Titan II[28]

Minuteman

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[24]Ibid.

[25]Ibid.

[26]Office of the Historian, Headquarters, SAC, SAC Missile Chronology 1939-1988, (May 1, 1990), pp. 40, 44-45. This was in large part due to the difficulty and expense of maintaining these first generation missiles that utilized liquid-oxygen. Liquid-oxygen was difficult to handle and store safely.

[27]Neufeld, p. 232. Ironically, the presence of Jupiter missiles in Italy and Turkey were a key topic during the Cuban Missile Crisis of 1962. While already slated for removal, their presence was perceived as an unacceptable threat to the Soviet military establishment. These missiles became a bargaining chip in the conflict's resolution.

[28]The term "first generation" refers to those ballistic missiles that used liquid oxygen as oxidizer, i.e., Atlas, Titan I, Thor, and Jupiter. The term "second generation" refers to those ballistic missiles with storable propellants such as Titan II, Minuteman, Peacekeeper, and the Navy's Polaris, Poseidon, and Trident missiles. This basis of the historical assessments in this study are confined to missiles in the U.S. arsenal at the time of the Titan II deactivation.

In early 1956, Navy research scientists achieved a breakthrough in solid rocket fuel technology that quickly blossomed into the Navy submarine-based Polaris and the Air Force Minuteman land-based missiles. Smaller, lighter, and significantly cheaper to build and maintain, the Minuteman study program began in early 1955.[29]

Minuteman I was a three-stage missile with a range of 6,000 miles. Minuteman I was armed with a single warhead and re-entry vehicle, as had been the case on the first generation missiles. With the final Minuteman III design, three multiple independently targeted re-entry vehicles, plus decoys, could be carried.[30] Long-range inertial guidance systems were utilized in all Minuteman missiles. In 1963, the first Minuteman I squadron was made operational. By April 21, 1967, 1000 Minute I and II missiles were on alert. The Minuteman modernization program was completed on January 26, 1975, resulting in a force of 450 Minuteman II and 550 Minuteman III missiles.[31]

Titan II

In 1958, the Martin Company, designers of Titan, proposed the development of a second generation of the Titan missile, designated Titan II.[32] Aerojet-General proposed using virtually the same engines as Titan I but substituting nitrogen tetroxide (oxidizer) and unsymmetrical dimethyl hydrazine (fuel) as the propellants. These liquids were hypergolic, i.e., they ignited on contact, greatly increasing reliability. More importantly, unlike liquid oxygen, the nitrogen tetroxide oxidizer was noncryogenic,[33] permitting both propellants to be stored at 60 degrees Fahrenheit for an indefinite period on board the missile. Instead of taking 15 to 20 minutes to raise, fuel, and launch Atlas or Titan I missiles, the Titan II could be launched from the underground silo in less than one minute. Titan II contained an all-inertial guidance system and had a range of 6000 miles.[34]

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[29]Neufeld, p. 227.

[30]Minuteman II and III were also three-stage missiles. While the later versions of Minuteman carried multiple warheads, each was of a significantly lower yield (by at least a factor of 10) than the single warhead carried by Titan II.

[31]Minuteman Ia and Ib series missiles were replaced by Minuteman II missiles in the 1970s.

[32]Stine, p. 229.

[33]Cryogenic refers to temperatures at which gases condense to liquid; in the case of liquid oxygen this is -297 degrees Fahrenheit.

[34]Ruggiero, p. 26.

In October 1959, Headquarters USAF approved the development of Titan II.[35] Three locations were chosen for its deployment. Two Strategic Missile Squadrons of nine missiles each were deployed to the 390th Strategic Missile Wing at Davis-Monthan AFB, Tucson, Arizona; the 381th Strategic Missile Wing at McConnell AFB, Wichita, Kansas; and the 308th Strategic Missile Wing, Little Rock AFB, Little Rock, Arkansas.

Construction of the first of 18 silos at Davis-Monthan AFB began in December 1960. The 570th Strategic Missile Squadron Missile Site 570-2 was first placed on alert on March 31, 1963.[36] The 571st Strategic Missile Squadron Missile Site 571-1 was the last placed on alert on November 30, 1963. The entire Titan II system was on alert by December 31, 1963.[37]

Titan II Launch Site Operation

Each Titan II launch facility was manned by a four person Missile Combat Crew: a Missile Combat Crew Commander and a deputy (both officers), a Ballistic Missile Analyst Technician, and a Missile Facilities Technician. Rules required one officer to man the launch console at all times, but both officers were required to initiate a launch. The crew was on duty at the silo for 24 hours and then back at the base for 48 hours before repeating the cycle. A typical day, after crew change, consisted of two daily shift verifications, where a team of two carried out a visual inspection of critical systems; monitoring radio traffic and responded to higher command requests; and daily facility upkeep. While provided with sufficient technical manuals and equipment to conduct minor repairs to critical systems, the Missile Combat Crew usually referred such work to the maintenance personnel who would travel from the base to the launch facility as required.

Titan II System Deactivation

In October 1981, President Reagan announced the start of the Strategic Forces Improvement Program. Included in this plan was the decision to modernize the land-based ICBM forces by retiring

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[35]Office of the Historian, p. 23.

[36]The 390th Strategic Missile Wing was composed of the 570th and 571st Strategic Missile Squadrons.

[37]Ruggiero, p. 63. Missile Site 571-7 was the twelfth silo to be placed on alert in the 390th Strategic Missile Wing and the fourth in the 571st Strategic Missile Squadron. These dates are taken from a 390th Site Map displayed at the museum.

the Titan II system and replacing it with a more advanced system.[38] The Salt I Treaty, signed by President Nixon and Premier Brezhnev, limited the United States to 1054 ICBMs. Thus the removal of the 52 remaining Titan II missiles would permit the United States to substitute a much more modern missile such as the MX (Peacekeeper).[39] The Peacekeeper missile was selected as the next ICBM for the Air Force Strategic Missile Force based on its ability to carry 10 warheads with even greater accuracy than Minuteman III. This greater accuracy permits the use of warheads with smaller yields and hence each missile can cover many targets. The Navy upgraded its ballistic missile submarines with Trident I and II missiles for basically the same reasons.[40]

Titan II Missile Site Deposition

With the exception of Titan II Missile Site 571-7, all of the Titan II missile sites were destroyed over a five year period beginning in 1982. The first Titan II silo taken off alert was Site 570-9 of the 570th Strategic Missile Squadron at Davis-Monthan AFB. Site 571-7 was the third silo deactivated. On May 5, 1987, the last Titan II silo, 373-8, part of the 373rd Strategic Missile Squadron, Little Rock AFB, was taken off alert, 24 years after Titan II became operational.[41] Facility destruction included implosion of the silos, filling the access portal and escape tunnel with concrete, and welding the first blast door shut. None of the 53 demolished silos can be easily refurbished for any purpose. Each missile was removed at the time of deactivation and was transported to Norton AFB, California, for storage. The Air Force has used the refurbished missiles as satellite launch vehicles over the past six years.[42]

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[38]Headquarters, Strategic Air Command, Environmental Assessment for the Proposed Deactivation of the Titan II Missile System, (Department of the Air Force, August 1992), p. 2.

[39]Two accidents had caused one silo at both McConnell and Little Rock to be permanently taken off alert.

[40]Details on the accuracy, yield, and penetration aids for the warheads of each of these missiles are not readily available. Estimates have been published, and one such report indicates the accuracy of the Minuteman III at 0.1 nautical miles, Peacekeeper at 0.05 nautical miles, and Trident II at 0.08 nautical miles. Air Force Magazine, (February 1988), p. 40.

[41]Edward B. Goodson, Lt. Col. USAF, "Assessment of 390th SMW Inactivation," pp. 3-4. No date given. On file at Titan II Museum. Official "deactivation" began with the removal of Site 571-6 from alert on September 29, 1982.

[42]Approximately 12 of these missiles have been converted for satellite launch, with the remainder awaiting conversion to Titan IV space launch vehicle configuration, principally by the

ENGINEERING SIGNIFICANCE

The engineering significance of Site 571-7 rests primarily in underground features which were designed to insure that launch control could be maintained and operated under extraordinary circumstances. Buried underground, Titan II launch facilities were designed to withstand the nearby explosion of large yield thermonuclear warheads. Design considerations centered around the need to mitigate shock effects on launch critical equipment while simultaneously allowing for rapid launch if necessary. The overall concept was called "hardening." To accomplish the necessary degree of hardening, shock isolation principles along with blast locks were employed.

The Launch Control Center is a three-story, cylindrical concrete and steel structure within which a three-story building is suspended on massive springs.

The Blast Lock structure protects the Launch Control Center from damage due to either a nearby nuclear explosion or from a missile propellants explosion. Each blast door weighs three tons and the doors were interlocked in pairs so that at least one door of each pair was closed and locked at all times.

Two 9.5′ diameter underground cableways connect the missile silo and Launch Control Center to the blast lock area.[43] While the cableways were not shock mounted, large "bellow" welds permitted a limited range of motion during an attack. A large, inverted U-shaped steel rack carrying umbilical control lines, chilled water supply and return pipes for air conditioning, and facility electrical power cables is suspended from the cableway ceiling and was shock mounted using 54 pairs of large springs.

The missile silo was covered by a 740 ton silo closure door to protect the missile from nearby blast, radiation, or inclement weather. This massive door could roll back 30′ in 20 seconds to permit missile launch. To be capable of operation after a first-strike attack, the silo closure door was designed to operate with up to six feet of dirt and debris resting on it. Launch critical equipment within the silo is suspended by springs. Within the launch duct, the missile is shock isolated by 20′ spring assemblies supporting an 18′ thrust mount upon which the missile sits.

Since the Titan II was designed to be launched from within its silo without first being lifted to the surface, unlike all previous liquid-fueled ICBM and IRBM missiles, the silo design required several unique engineering solutions. Among these

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addition of solid fuel rocket booster motors.

[43]A 50′ cableway extends to the Launch Control Center and a 200′ cableway extends to the missile silo.

problems was the dissipation of the 5000 degree F engine exhaust gases, and the reduction of the tremendous acoustical energy generated by rocket engine operation within an enclosed space. Huge ducts and a water deluge sound suppression system prevented the missile from self-destruction due to accoustical energy.

COMPARATIVE SITES

Comparable sites to Titan II ICBM Missile Site 571-1 would include the first generation, liquid-fueled Atlas and Titan I ICBM sites constructed in the early 1960s. The Thor and Jupiter IRBM sites are not comparable since they were not hardened against first-strike attack. In addition, no operational sites for those missiles existed in the United States, just training facilities.[44] The Minuteman ICBM was solid-fueled and hence its silos construction is very different.

All of the first generation ICBM sites, as represented by Atlas and Titan I, were decommissioned by the end of 1965.[45] Several were sold to entrepreneurs, but none of these first generation silos remain in original condition.[46]

With the exception of this site, all other Titan II launch facilities that were operational during the Cold War have been demolished. While Titan II missiles were launched during training operations from several silos at Vandenberg Air Force Base, California, none of these training silos were ever placed on alert status and are thus not historically comparable to Titan II Missile Site 571-7. Therefore, as the last extant Titan II Missile Site, the nominated resource represents the culmination of underground silo design for liquid-fueled ICBM's.

The surviving launch sites associated with the solid-fueled Minuteman missile would be most comparable to the level of national significance of the Titan II missile. In addition to representing important differences in missile technology (fuel type; warhead yield, cost, accuracy), these two ICBMs were based in completely different manners.[47] The Minuteman had one launch

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[44]The Atlas and Titan missiles were the only other liquid-fueled ICBMs and were deployed from the early to mid-1960s. After Titan II, the Air Force used only solid-fueled ballistic missiles.

[45]Personal communications with Dr. Martin Hagopian, Historian, Vandenberg Air Force Base, California, June 1993.

[46]Ibid.

[47]A simple comparison between Minuteman and Titan II is difficult. One missile was not necessarily "better" than the other. The Titan II missile system was deployed concurrently with the Minuteman. The solid fueled Minuteman was cheaper to

control center per 10 missiles, and it was three or more miles from the nearest silo, while the Titan II had one control center per silo, located 255' from the missile.[48] Both possess exceptional national historic significance for which representative sites would be worthy of NHL designation.[49]

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build and deploy in large numbers (1000 Minuteman missiles verses 54 Titan II missiles), but the Titan II carried a far more powerful warhead. While targeting of different missile types is still classified, one can presume that the large number of Minuteman missiles permitted targeting of a large number of "soft" above ground targets while Titan II provided the large weapon yield for underground complexes. With the improved accuracy of the Minuteman III and Peacekeeper missiles, their smaller yield warheads could, in theory, be used against all but the most hardened targets.

[48]The Minuteman I, II, and II, and Peacekeeper missile systems have launch control facilities located several miles from their nearest missile silo.

[49]In fact, recent discussions have been held at the Titan II Museum with officials of the National Park Service concerning the preservation of a Minuteman II launch control facility and missile silo (Delta 1) at Ellsworth Air Force Base, South Dakota.

9. MAJOR BIBLIOGRAPHICAL REFERENCES

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Previous documentation on file (NPS):

___ Preliminary Determination of Individual Listing (36 CFR 67) has been requested.
_X_ Previously Listed in the National Register.
___ Previously Determined Eligible by the National Register.
___ Designated a National Historic Landmark.
___ Recorded by Historic American Buildings Survey: #_____
___ Recorded by Historic American Engineering Record: #_____

Primary Location of Additional Data:

___ State Historic Preservation Office
___ Other State Agency
___ Federal Agency
___ Local Government
___ University
_X_ Other (Specify Repository): Since phase-out of the other Titan II launch facilities, and the attached military organizations, the Titan Museum has become the principle repository for over 6000 documents and plans, as well as a great many artifacts of the Titan II program.

10. GEOGRAPHICAL DATA

Acreage of Property: 3.3 acres

UTM References:	Zone	Northing	Easting
A	12	3529520	500125

Verbal Boundary Description:

Titan Missile Site Number 571-7, more particularly described as that portion of the Southeast one-quarter of Section 34, Township 17 South, Range 13 East, Gila and Salt River Meridian, Pima County, Arizona, described as follows, basis of bearings being Transverse Mercator Grid, Central Zone, Arizona:

Commencing at the Southeast corner of said section; thence North 33 degrees 55 minutes 50 second; West 1910.16 feet to the POINT OF BEGINNING; thence South 600.00 feet; thence East 60.00 feet; thence South 300.00 feet; thence West 250.00 feet; thence North 300.00 feet; thence West 410.00 feet; thence North 600.00 feet; thence East 600.00 feet to the POINT OF BEGINNING.

Boundary Justification:

The overall military reservation consists of 9.9 acres surrounded by a four-strand barbed wire fence separating it from the adjacent properties. The nominated resource includes only the 3.3 acre core of the larger reservation which accommodated the actual launch facilities and are further protected by the original chain link security fence. An additional security fence, appended to part of the original southern fence (which encloses the museum and restroom buildings), is located outside the proposed NHL boundary.

11. FORM PREPARED BY

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National Park Service/WASO/History Division (418): September 22, 1993