OMB No. 10024-0018

United States Department of Interior
National Park Service

National Register of Historic Places Registration Form

This form is for use in nominating or requesting determinations for individual properties and districts. See instructions in *How to Complete the National Register of Historic Places Registration Form* (National Register Bulletin 16A). Complete each item by marking "x" in the appropriate box or by entering the information requested. If an item does not apply to the property being documented, enter "N/A" for "not applicable." For functions, architectural classification, materials, and areas of significance, enter only categories and subcategories from the instructions. Place additional entries and narrative items on continuation sheets (NPS Form 10-900A). Use a typewriter, word processor, or computer, to complete all items.

1. Name of Property

historic name Minuteman ICBM Launch Control Facility Delta-01 and Launch Facility Delta-09, Ellsworth Air Force Base
other names/site number Minuteman Missile National Historic Site (MIMI)

2. Location

street & number Minuteman Missile National Historic Site (MIMI), Delta-01: W side Jackson CR CS23A, approx. .5 mi. N of I-90, Exit 127
city or town Cottonwood **Vicinity** X
state South Dakota **code** SD **county** Jackson **code** 071 **zip code** 57775
(see continuation sheet)

3. State/Federal Agency Certification

As the designated authority under the National Historic Preservation Act, as amended, I hereby certify that this X 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 X meets _ does not meet the National Register criteria. I recommend that this property be considered significant _X_ nationally statewide _locally. (_ See continuation sheet for additional comments.)

Signature of certifying official/Title Date

State or Federal agency and bureau

In my opinion, the property _X_ meets _ does not meet the National Register criteria.
(_ See continuation sheet for additional comments.)

Signature of commenting official/Title Date

State or Federal agency and bureau

Minuteman ICBM Launch Control Facility Delta-01 and Launch Facility Delta-09, Ellsworth Air Force Base	Jackson and Pennington	South Dakota
Name of Property	County and State	

4. National Park Service Certification

I hereby certify that the property is:

__ entered in the National Register. ___ See continuation sheet.		
__ determined eligible for the National Register. ___ See continuation sheet.		
__ determined not eligible for the National Register. ___ See continuation sheet.		
__ removed from the National Register.		
__ other, (explain:)		
	Signature of the Keeper	Date of Action

5. Classification

Ownership of Property (check as many boxes as as apply)

	private
	public-local
	public-State
X	public-Federal

Category of Property (Check only one box)

	building(s)
X	district
	structure
	site
	object

Number of Resources within Property (Do not include previously listed resources in the count)

Contributing	Noncontributing	
4	0	buildings
2	0	sites
17	0	structures
0	0	objects
23	0	total

Name of related multiple property listing:
(Enter "N/A" if property not part of a multiple property listing.
N/A

Number of contributing resources previously listed in the National Register
0

6. Function or Use

Historic Functions
(Enter categories from instructions)
DEFENSE/Air Facility

Current Functions
(Enter categories from instructions)
RECREATION AND CULTURE/Museum

7. Description

Architectural Classification
(Enter categories from instructions)
OTHER/ICBM Launch Facility and Launch Control Facility

Materials
(Enter categories from instructions)

foundation	Concrete
walls	Concrete, Metal
roof	Concrete
other	Asphalt

Narrative Description

(Describe the historic and current condition of the property on one or more continuation sheets.)

8. Statement of Significance

Applicable National Register Criteria
(Mark "x" in one or more boxes for the criteria qualifying the property for the National Register listing.)

X A Property is associated with events that have made a significant contribution to the broad patterns of our history.

_ B Property is associated with the lives of persons significant in our past.

X C Property embodies the distinctive characteristics of a type, period, or method of construction or represents the work of a master, or possesses high artistic values, or represents a significant and distinguishable entity whose components lack individual distinction.

_ D Property has yielded, or is likely to yield, information important in prehistory or history.

Criteria Considerations
(Mark "x" in all the boxes that apply.)

Property is:

_ A owned by a religious institution or used for religious purposes.

_ B removed from its original location.

_ C a birthplace or grave.

_ D a cemetery.

_ E a reconstructed building, object, or structure.

_ F a commemorative property.

X G less than 50 years of age or achieved significance within the past 50 years.

Areas of Significance
(Enter categories from instructions)

Military
Engineering

Period of Significance

1963-1993

Signifiant Dates

1963 1993
1973
1991

Significant Person
(Complete if Criterion B is marked)

N/A

Cultural Affiliation

N/A

Architect/Builder
Ralph M. Parsons Company, Los Angeles, CA (engineer)
Peter Kiewit Sons' Inc., Omaha, NE (builders)
U.S. Army Corps of Engineers (engineers/builders)

Narrative Statement of Significance
(Explain the significance of the property on one or more continuation sheets.)

9. Major Bibliographic References

(Cite the books, articles, and other sources used in preparing this form on one or more continuation sheets.)

Previous Documentation on File (National Park Service):

- preliminary determination of individual listing (36 CFR 67) has been requested
- X previously listed in the National Register (11/29/99)
- previously determined eligible by the National Register
- designated a National Historic Ellsworth Air Force Base landmark
- recorded by Historic American Buildings Survey #
- X recorded by Historic American Engineering Record #SD-50

Primary location of additional data:

- X State Historic Preservation Office
- Other State Agency
- X Federal Agency
- Local government
- University
- Other

Name of repository:

South Dakota

10. Geographical Data

Acreage of Property Launch Control Facility Delta-01, 6.4 acres, and Launch Facility Delta-09, 90 acres
Total: approximately 96.4 acres

UTM References (Place additional UTM references on a continuation sheet.)

Delta-01

	Zone	Easting	Northing
1	14	262170	4862280
3	13	727495	4868340

Delta-09

	Zone	Easting	Northing
2	13	727680	4868340
4	13	728110	4867500

☒ See Continuation Sheet

Verbal Boundary Description (Describe the boundaries of the property on a continuation sheet)

Boundary Justification (Explain why the boundaries were selected on a continuation sheet)

11. Form Prepared By

name/title Christina Slattery, Emily Schill, and Amy R. Squitieri, Architectural Historians
This document is adapted from a draft National Historic Landmark Nomination prepared for the U.S. Air Force by John F. Lauber and Jeffrey A. Hess, Hess Roise and Company in 1996.
organization Mead & Hunt, Inc. **date** October 2003
street & number 6501 Watts Road **telephone** 608.273.6380
city or town Madison **State** WI **zip code** 53719

Minuteman ICBM Launch Control Facility Delta-01 and Launch Facility Delta-09, Ellsworth Air Force Base	Jackson and Pennington	South Dakota
Name of Property	County and State	

Additional Documentation

Submit the following items with the completed form:

Continuation Sheets

Maps A USGS map (7.5-or 15-minute series) indicating the property's location.
A sketch map for historic districts and properties having large acreage or numerous resources.

Photographs Representative black-and-white photographs of the property.

Additional Items (Check with the SHPO or FPO for any additional items)

Property Owner

(Complete this item at the request of SHPO or FPO.)

name/title	U.S. Department of the Interior, National Park Service				
organization	Minuteman Missile National Historic Site (MIMI)			**date**	26 June 2003
street&number	Badlands National Park, P.O. Box 6			**telephone**	605.433.5552
city or town	Interior	**state**	SD	**zip code**	57750

Paperwork Reduction Act Statement: This information is being collected for applications to the National Register of Historic Places to nominate properties for listing or determine eligibility for listing, to list properties, and to amend existing listings. Response to this request is required to obtain a benefit in accordance with the National Historic Preservation Act, as amended (16 U.S.C. 470 et seq.).

Estimated Burden Statement: Public reporting burden for this form is estimated to average 18.1 hours per response including time for reviewing instructions, gathering and maintaining data, and completing and reviewing the form. Direct comments regarding this burden estimate or any aspect of this form to the Chief, Administrative Services Division, National Park Service, P.O. Box 37127, Washington, DC 20013-7127; and the Office of Management and Budget, Paperwork Reductions Projects, (1024-0018), Washington, DC 20503.

Delta-09

street & number Minuteman Missile National Historic Site (MIMI), Delta-09: W side Pennington CR T512, approx. .6 mi. W and S of I-90, Exit 116
city or town Quinn **Vicinity** X
state South Dakota **code** SD **county** Pennington **code** 103 **zip code** 57775

Description

Overview of Complex

Historically a part of Ellsworth Air Force Base, the Minuteman Intercontinental Ballistic Missile (ICBM) Launch Control Facility Delta-01 and Launch Facility Delta-09 are located in rural South Dakota about 50 miles east-southeast of Rapid City, South Dakota. Built in accordance with the Air Force dispersal strategy, the Launch Control Facility and the Launch Facility lie approximately 10 miles apart. The Launch Control Facility and the Launch Facility were originally linked by a system of blast-proof underground cables and a radio communications network, known as the Hardened Intersite Cable System (HICS). On active duty from 1963 until 1991, the Launch Control Facility and Launch Facility were part of an operational unit, collectively known as Delta Flight, consisting of one Launch Control Facility and ten missile Launch Facilities. Delta Flight was one of five flights assigned to the 66th Strategic Missile Squadron of the 44th Missile Wing, headquartered at Ellsworth Air Force Base, near Rapid City, South Dakota. By 1967, 1,000 Minuteman missiles were on alert in six separate deployment areas located throughout the north-central United States. The initial Minuteman I force was divided into five missile wings of either three of four missile squadrons per wing. Fifty missiles made up a squadron, and each squadron was further divided into five flights of ten missiles.

Delta-01 and Delta-09 were among fifteen Launch Control Facilities and 150 Launch Facilities constructed in the 13,500-square-mile Ellsworth deployment area between 1961 and 1963. The facilities were built according to standard plans prepared by the Ralph M. Parsons Company of Los Angeles. Peter Kiewit Sons' Inc. of Omaha was the general contractor for the project. The American Bridge Division of U.S. Steel, Los Angeles, fabricated steel components for the installations. The Malkin Company of Omaha was the mechanical subcontractor, and the Hirsch Company of Columbus, Ohio, was the electrical subcontractor. The Boeing Company of Seattle provided ground support equipment.[1] Delta-01 and Delta-09 were turned over to the Strategic Air Command on 30 June 1963, making them among the first Minuteman sites to be activated at Ellsworth.

In succeeding years, the Air Force introduced two major modifications of the Minuteman missile. To differentiate the various versions of technology, missile installations were designated, or redesignated, as Minuteman I, Minuteman II, and Minuteman III. The Ellsworth missile field became a Minuteman II installation in the early 1970s. No major structural modification was necessary for this conversion with Delta-09 modified only minimally by 1973. Over the years, Delta-01 and Delta-09 have seen only a limited amount of new construction and remodeling. Consequently, the facilities at both sites still strongly recall their era of construction and retain historic integrity. In September 1991, all 450 of the nation's Minuteman II missiles, including Launch Control Facility Delta-01 and Launch Facility Delta-09, were taken off alert. Delta-01 and Delta-09 were deactivated in early 1993 and thereafter remained on "caretaker status." In 1993 deactivation activities included the removal of

[1] Ed Niciejewski, "Minuteman Work Speeding," *Rapid City Daily Journal*, 13 December 1961. Subsequent references to the *Rapid City Daily Journal* will be identified with the abbreviation *RCDJ*.

the Minuteman II missile from Delta-09, the severing of the HICS, and the removal of classified electronic equipment, hazardous materials, and environmentally sensitive materials from both Delta-01 and Delta-09. When at all possible, Delta-01 and Delta-09 were left to appear as they had when the facilities were taken off of alert in 1991. Today, the sites, including the landscape components and cultural materials, remain largely as they were during their use by the Air Force. The retention of the sites' landscape and cultural materials will be significant to their future interpretation.

In 1993 the Air Force and the Rocky Mountain Regional Office of the National Park Service selected Delta-01 and Delta-09 for completion of a Special Resource Study examining the feasibility of preserving and interpreting the facilities as a historic site and their suitability for becoming a unit of the National Park Service. The property was also chosen for nomination as a National Historic Landmark symbolizing U.S. participation in the Cold War. The National Historic Landmark nomination was not submitted to the Keeper of the Register pending the outcome of the designation of the facility as a National Historic Site. In 1999 Delta-01 and Delta-09 were designated a National Historic Site by the United States Congress. With the establishment of the Minuteman Missile National Historic Site, the property was listed in the National Register of Historic Places (National Register). This National Register nomination provides documentation for the listed property. It is adapted from the draft National Historic Landmark Nomination prepared by Jeffrey A. Hess and John F. Lauber of Hess Roise and Company in 1996.

With the designation of the Minuteman Missile National Historic Site and the transfer of Delta-01 and Delta-09 from the Air Force to the National Park Service, the sites remained largely unchanged, retaining the same appearance as when they were taken off of alert in 1991. Delta-01 and Delta-09 were deactivated in 1993, with minimal modifications to the sites, and were placed in caretaker status in anticipation of the transfer. Both sites contain cultural materials left by the Air Force, such as furnishings and equipment that play a key role in interpreting the history of the site and defining its character. In National Register terms, Delta-01 and Delta-09 comprise a discontiguous district of two sites that encompass twenty-three contributing resources and associated features and landscape elements that are located both above (topside) and below ground. This property has no noncontributing resources. Associated features, including recreational equipment, mechanical and electrical equipment, historic objects, furnishings, and landscape elements, of Delta-01 and Delta-09 are important components of the overall site and are described in the site descriptions.[2] Based on a records review at the South Dakota State Historical Society State Historic Preservation Office and Archaeological Research Center, there are no other known historic or archeological sites within the historic boundaries of Delta-01 and Delta-09. The future identification of archeological sites at Delta-01 and Delta-09 are unlikely because of the construction methods

[2] These associated features are viewed as important elements of the overall site, but are not individually counted as a part of the National Register resource count.

employed at the sites. A list of resources of Delta-01 and Delta-09 is found below, followed by a description of the individual resources and associated features.[3]

Minuteman ICBM Launch Control Facility Delta-01 and Launch Facility Delta-09

Launch Control Facility Delta-01

Launch Control Facility Delta-01	Contributing Site
Recreation Resources – volleyball court, basketball hoop, horseshoe pit	*Associated Features*
Code Burner	*Associated Feature*
Flagpole	*Associated Feature*
Security Fence and Entrance Gate	*Associated Features*
Support Facilities – storage tanks, water well, gas pump, utility poles	*Associated Features*
Landscape elements, historic furnishings and objects, and equipment	*Associated Features*
Launch Control Facility Support Building	Contributing Building
Launch Control Center	Contributing Building
Heated Vehicle Storage Building	Contributing Building
Hard HF Transmit Antenna	Contributing Structure
Hard HF Receive Antenna	Contributing Structure
Hardened UHF Antenna	Contributing Structure
Survivable Low Frequency Communication System Antenna	Contributing Structure
Cathodic Protection Rectifier	Contributing Structure
Sewage Lagoon	Contributing Structure
Helicopter Pad	Contributing Structure
ICBM Super-High-Frequency Satellite Terminal Antenna	Contributing Structure
Television Satellite Dish	Contributing Structure
Hardened Intersite Cable System	Contributing Structure

[3] Physical descriptions of Delta-01 and Delta-09 are based on a number of sources, including field inspections by John Lauber and Jeffrey Hess in November 1993. The most comprehensive general description of the facilities at Ellsworth Air Force Base appears in a technical manual on file at the Ellsworth's Environmental Management Office (28 CES/CEVC). See "Weapon System Operation Instructions," T.O. 21M-LGM30F-1-13, 5 September 1991. Project blueprints and original site delivery documents on file at the Missile Engineer's Office (28 CES/CEL) at Ellsworth furnish detailed information about construction of the facilities. In addition, Lauber and Hess gleaned valuable information on the operation of the two sites from Tim Pavek and Lt. Mark Bowen. Pavek worked as a civilian missile engineer at Ellsworth, beginning in the early 1980s. He was interviewed by John Lauber at Ellsworth on 5 and 8 November 1993, and subsequently by telephone on 28 February 1994, 11 March 1996, and 29 October 1996. Bowen, who worked as a launch crew training specialist at Ellsworth, was interviewed by Lauber at the installation on 5 November 1993. The status of a "discone antenna" depicted on a 1994 Historic American Engineering Record drawing of Launch Control Facility Delta-01 is uncertain (HAER No. SD-50, sheet 1). Part of the facility's surveillance system, the antenna originally consisted of a network of underground cables attached to an aboveground superstructure. The superstructure had been removed by the mid-1980s, but the condition of the underground cables is unknown. Christina Slattery and Erin Pogany conducted site visits of Delta-01 and Delta-09 in November 2002 and January 2003 to update descriptive information.

Launch Facility Delta-09

Launch Facility Delta-09	Contributing Site
Security Fence and Entrance Gate	*Associated Features*
Support Facilities – utility poles, outer zone security antenna foundations	*Associated Features*
Landscape elements, equipment, and historic objects	*Associated Features*
Missile Launcher	Contributing Structure
Launch Facility Support Building	Contributing Building
Improved Minuteman Physical Security System Antenna	Contributing Structure
Hard UHF Antenna	Contributing Structure
Cathodic Protection Rectifier	Contributing Structure
Azimuth Markers	Two Contributing Structures
HICS Markers	Contributing Structure

Launch Control Facility Delta-01 **Contributing Site** **1963**

The Launch Control Facility Delta-01 site occupies an open, grassy tract of land on the west side of the Jackson County Road CS 23A, approximately 0.5 miles north of Interstate Highway 90, Exit 127. The entire site is 6.4 acres with approximately 1.9 acres located inside the security fence. Delta-01 is located in a rural setting and the site's access road, Jackson County Road, is an improved gravel road. The landscape surrounding Delta-01 is open agricultural land of native grasses. A couple of small agricultural outbuildings are located to the east of the site. From the site, a distant view of Interstate 90 and a billboard is visible to the south.

Delta-01 includes fourteen contributing resources – the Delta-01 site, Launch Control Facility support building, Launch Control Center, heated vehicle storage building, hard HF transmit antenna, hard high-frequency (HF) receive antenna, hardened ultra-high frequency (UHF) antenna, survivable low frequency communication system antenna, cathodic protection rectifier, sewage lagoon, helicopter pad, ICBM super-high frequency satellite terminal antenna, television satellite dish, and HICS. Delta-01 does not include any noncontributing resources. Terrain at the site rises gradually toward the north. A chain-link security fence, topped with strands of barbed wire, encloses the site's buildings and structures. Access to the site is provided by a gently curving gravel driveway on the west side of the county road. The driveway passes over a steel cattle guard and through a remote-controlled, chain-link, sliding gate in the security fence. The Launch Control Facility support building and the vehicle storage building are located just inside the security fence, and an asphalt drive and parking area are located in front of them. The Launch Control Center, accessed from the Launch Control Facility support building, is located below ground and is not visible.

The remaining area inside the security fence is covered with native grass that was routinely mowed by the Air Force. The area inside the security fence includes a variety of electronic, mechanical, and recreational features to support the facility, including a volleyball court, horseshoe pit, underground diesel storage tank, aboveground

diesel storage tank, water well, gas pump, basketball hoop, flagpole, and utility poles.[4] A code burner is located in the grassy area near the volleyball court. This open metal drum mounted on metal legs was used to burn security codes. These associated features and landscape elements provide insight into the use of the facilities by the Air Force and are significant elements of the site. The HF transmit antenna, hard HF receive antenna, hardened UHF antenna, survivable low-frequency communication system antenna, ICBM super-high-frequency satellite terminal antenna, and television satellite dish are located within the security fence. The cathodic protection rectifier is located outside the security fence along the access road. The underground HICS is not visible at the site. A concrete helicopter pad and two sewage lagoons are located outside of the security fence to the south. The area outside of the security fence features native grasses. A barbed-wire fence with wooden posts surrounds the facility's two sewage lagoons in the southeast corner of the site.

The Minuteman ICBM Launch Control Facility Delta-01 contains a wealth of historic objects, furnishings, and technical equipment that reflect the successive use of the facilities by the Air Force. Delta-01, complete with its contents, was transferred from the Air Force to the National Park Service. The historic objects, furnishings, and equipment provide valuable insight into the use of this facility by the Air Force. The contents of Delta-01 are important and are considered associated features of the site.

Launch Control Facility Support Building Contributing Building 1963
The Launch Control Facility support building is the most prominent surface feature at the site. Located inside the sliding security gate, the support building provided accommodations for eight Air Force personnel, served as a security control center for the entire flight, and housed environmental, mechanical, and electrical systems for the underground Launch Control Center where the two-man missile combat crew pulled their duty. Two missile combat crew members were stationed in the underground Launch Control Center. Initially the missile combat crew members served a thirty-six to forty hour alert tour with two eight to twelve-hour shifts on alert in the Launch Control Center, separated by rest periods in the Launch Control Facility support building. In 1977 the shift was changed to a single twenty-four hour shift, with the crew being replaced by a new missile combat crew dispatched from Ellsworth Air Force Base. Eight additional crew members, including two flight security controllers, two two-person armed alert response teams, a cook, and a facility manager, worked three-day shifts in this topside support building.

The Launch Control Facility support building remains largely as it did when Air Force personnel left the site following deactivation of the Minuteman II missiles. The interior remains fully furnished and looks almost as if personnel just left and locked the doors – magazines from the early 1990s remain in the magazine rack, salt shakers are on the table of the dining booth, and the EMDAS (Expanded Minuteman Data Analysis System) log

[4] The gas pump and flagpole are currently in temporary storage in the garage and will be returned to their original locations in the near future. A second underground diesel storage tank was located next to the vehicle storage building, but was removed during the deactivation of the site.

remains on the desk in the facility manager's bedroom. These cultural artifacts are significant associated elements of the site and will aid in the future interpretation of the site.[5]

The support building is an unpretentious, one-story, ranch-form structure. It is conventional wood-frame construction, and has a low-pitched, side-gabled roof. The building is oriented along a northeast-southwest axis, with its principal side facing toward the southeast. A wide, asphalt-paved parking/turnaround area extends along its southeast side. The main portion of the building is rectangular in plan, measuring approximately 33 feet wide and 128 feet long. The southeast wall projects forward near the northeast end to form a wide bay for the installation's security center. A gabled-roof, one-story mechanical wing extends from the building's northeast side and is rectangular in plan, measuring approximately 21 feet deep and 34 feet wide.

The support building rests atop a concrete slab foundation. The outer walls are sheathed with wide-lap, steel, clapboard-style siding embossed with a wood-grain pattern. The siding is painted tan. It was installed between the mid-1970s and early 1980s to replace the original cement-asbestos siding. The roof has minimal overhangs, and is covered with brown, asphalt, T-lock shingles.[6] Large sheet-metal ventilator hoods are located on the roof and back wall of the mechanical wing, and several smaller ventilator hoods project from the roof of the main building above the kitchen and utility room areas. There are steel, ogee-profile gutters at the eaves. Fascia boards, gutters, and verge rafters are painted dark brown.

Windows in the support building are one-over-one, double-hung, vinyl-clad wood sash fitted with white combination storm/screen units. These windows were installed in 1976 to replace the building's original wood sash windows. Although most of the windows are arranged in groups of two or three, the security-center windows are placed closely together, forming a nearly continuous band that extends across the southeast wall and wraps around both sides of the bay.

The southeast side of the Launch Control Facility support building has a communication equipment room, water treatment room, and boiler room that are accessed through exterior doors. The boiler room can also be entered from the interior of the building. The rear of the support building has an attached VHF antenna and an air conditioner. The support building's main entrance is located on the main facade, adjacent to the security bay. A doorway on the northeast side of the main entrance hall opens directly into the security control center. This room

[5] Various inventories and lists have been prepared by the Air Force to identify the equipment and historic objects and furnishings of Delta-01 and Delta-09. In addition a video tape inventory was completed of the sites. The inventories and video tape are currently in the files of Tim Pavek, Civil Engineer, 28th Civil Engineering Squadron, Ellsworth Air Force Base, S.Dak. The National Park Service plans to conduct to catalog the cultural materials at Delta-01 and Delta-09 in the Automated National Catalog System (ANCS+) database.

[6] John F. Lauber and Jeffrey A. Hess, "Minuteman II ICBM Launch Control Facility D-1 and Launch Facility D-9, Ellsworth Air Force Base Draft National Historic Landmark Nomination," prepared for the U.S. Air Force, 1996. The draft National Historic Landmark Nomination cites the replacement of the siding in 1976, while project drawings date to 1983. Drawings on file at the office of Tim Pavek, Environmental Engineer, 28 CES/CEVR, Ellsworth Air Force Base, S.Dak.

served as headquarters for the Air Force security police who maintained a constant vigil over the facilities of Delta Flight. Positioned beneath the windows inside the center is a desk-like console containing telephone and radio equipment. Guards seated at this console had a direct view of the main entrance gate and the road. The guards operated the entrance gate, checked the credentials of visitors to the site, and monitored radio transmissions. An expanded metal cage set into one corner of the room provided storage space for weapons. A small enclosed vestibule behind the security center served as the sole access point to the underground Launch Control Center (description of the Launch Control Center follows).

The support building includes both residential spaces, such as the day room, bedrooms, exercise room, and kitchen, and operational and mechanical spaces, such as the security control center, water treatment room, boiler room, diesel generator room, and environmental support rooms. The interior finishes of the residential spaces at Delta-01 largely date to the late 1980s. Interior spaces in Ellsworth's Launch Control Facility support buildings were decorated and furnished by the people who occupied them. As part of an ongoing “self help” program, the base supplied materials such as paint, tile, and wall paneling, and Delta Flight personnel supplied the labor required to put the materials into place.

The Launch Control Facility’s main entrance hall leads into the spacious day room area. The day room provided dining and recreational space for topside support personnel. The day room furnishings include couches, a television (temporarily placed in storage), and both dining tables and booths. The day room walls are covered with wainscoting of pre-finished hardboard or varnished wood. The east wall of the day room is decorated with a large mural depicting a woodland scene. The day room and other rooms in the residential area have suspended acoustical tile ceilings with recessed fluorescent lighting fixtures. A dedication plaque, dating to November 1966, is located inside the day room and reads “as a tribute to the goodwill and mutual understanding between the citizens of this community and the Air Force.”

A kitchen and pantry are located off the day room. The kitchen and pantry feature metal cabinets and industrial kitchen appliances. The wall of the pantry retains a menu and price list of food items available for purchase by the staff. The kitchen walls are covered with melamine panels and the floors are vinyl. A doorway off of the day room opens into a long central hallway flanked by seven bedrooms, men's and women's latrines, a boiler room, and a utility closet. The women's latrine was added in the mid-1980s, when the Air Force began to assign women to the duty roster at Minuteman sites.[7] The bedrooms feature carpeted floors, walls finished with fabric-covered sound board, and suspended acoustical ceiling tiles with recessed fluorescent lighting fixtures. The bedrooms were furnished with beds or bunk beds, a desk, and freestanding wardrobe closets. The facility manager and VIP guests were the only personnel to receive their own bedroom. The two bedrooms assigned to security personnel were outfitted with blackened windows and were provided with sound insulation to allow security personnel to

[7] Although women were assigned to "topside" duty at Ellsworth's fifteen Launch Control Facilities beginning in the mid-1980s, the underground Launch Control Centers continued to be staffed entirely by men until August 1989, when the base's first mixed-gender crew completed an alert at Launch Control Facility India-01. See Dirk Jameson, "Wing Nears Last Chapter in History," *The Plainsman*, 15 April 1994.

sleep during the day. The bedroom for security personnel includes a locker for weapons and a secured can to dummy fire weapons into to verify that they are unloaded.

The wing on the east end of the support building originally contained a single-stall garage and two mechanical equipment rooms. Floors in the mechanical rooms and utility areas are covered with vinyl, vinyl-asbestos, or asphalt tile. Interior walls throughout the mechanical rooms and utility areas of the support building are sheathed with gypsum wallboard. The garage was enclosed in 1975 and was converted into an exercise room for staff. The equipment rooms contain a diesel-fueled generator for emergency power, as well as air conditioning and filtration equipment for the Launch Control Center.

Launch Control Center **Contributing Building** **1963**

Buried in the earth approximately 32 feet beneath the Launch Control Facility support building is the Launch Control Center. This blast-hardened structure served as the command post for the ten dispersed missiles of Delta Flight. The Launch Control Center is entered from the Launch Control Facility support building through a 10-foot-square, reinforced-concrete access shaft that descends from a small vestibule at the back of the security center. The shaft contains a small elevator and a steel-rung ladder surrounded by an open safety cage. The base of the shaft opens into a low-ceilinged vestibule that provides room for a bank of lockers and swing space for an 8-ton, steel-and-concrete blast door that seals the entrance to the control center. One wall of the vestibule is painted with art work depicting a missile labeled “USAF” blasting through the flag of the former Soviet Union.

A small sign on the wall of the vestibule and a yellow line painted across the floor demarcate the beginning of the control center's high-security "no-lone zone, two-man concept mandatory." Any person entering the restricted area had to be accompanied or observed by a second person who was trained to detect erratic behavior, improper activity, or sabotage attempts. Launch control officers carried side arms to protect the nuclear resources controlled from within the "no-lone zone," and use of "deadly force" was authorized. A piece of art work on the blast door serves as a darkly humorous reminder of the Launch Control Center's defining purpose. Emblazoned on the door's outer face is a crudely painted depiction of a red, white, and blue pizza delivery box, labeled "Minuteman II." A hand-lettered legend framing the illustration reads: "World-wide delivery in 30 minutes or less, or your next one is free."[8]

The blast door can be opened only from inside the Launch Control Center. The door is secured by twelve hydraulically operated latchpins placed around its perimeter. When these pins retract, the door swings open on massive roller-bearing hinges to reveal a low, tunnel-like passageway leading to the Launch Control Center. The Launch Control Center itself consists of two separate structural elements, nestled one inside the other. On the outside is a protective shell, shaped like an enormous gelatin capsule. Oriented along an east-west axis, the shell measures 29 feet in diameter and 54 feet in length (outside dimensions). It is constructed of heavily reinforced

[8] The illustration on the blast door was painted in 1991 by Tony Gatlin. See "Ellsworth Air Force Base, 44th Strategic Missile Wing, Blast Door Art," on file in the office of Tim Pavek, Civil Engineer, 28th Civil Engineering Squadron, Ellsworth Air Force Base, S.Dak.

concrete, with walls 3-4 feet thick. Its interior surface is lined with a 1/4-inch-thick steel plate. Suspended inside the shell is a box-like acoustical enclosure containing the launch control consoles, communications equipment, missile monitoring equipment, and spartan accommodations for the two-person Air Force launch crew. The acoustical enclosure is rectangular in plan, measuring approximately 12 feet wide and 28 feet long. It rests atop a 12-foot-by-32-foot, steel-framed platform. The corners of the platform are suspended by a large pneumatic cylinder called a "shock isolator." The shock isolators hang from heavy chains attached to the ceiling of the shell, and are designed to let the enclosure bounce as much as 2 feet in any direction without major damage.

An articulated, steel-plate bridge spans the gap between the platform and the access tunnel. The floor of the acoustical enclosure is made of removable steel plates covered with sheet vinyl. A strip of light brown carpet lies over the floor plates. Compartments beneath the floor contain survival equipment, emergency batteries, and a motor generator. The walls and ceilings of the enclosure are made of hollow-walled, perforated-steel panels filled with sound-absorbing material.[9] A beige fabric headliner is attached to the ceiling framework with Velcro. The headliner was installed in 1990 to help reduce noise levels inside the enclosure. Four recessed fluorescent lighting fixtures centered in the ceiling illuminate the enclosure's interior. Emergency task lighting is provided by adjustable spotlights mounted on the ceiling. Virtually every surface inside the enclosure is painted pale green. "It's a color we've learned to detest," observed one Ellsworth launch crew member in 1964.[10]

The Launch Control Center contains two desk-like consoles placed about 12 feet apart. Positioned in front of each console is a swiveling, high-backed, aircraft seat fitted with seat belts and a shoulder harness. The launch control (commander's) console is located at the east end of the acoustical enclosure, directly opposite the entrance. It has an illuminated panel that allowed the crew commander to continually monitor the operational and security status of each of the ten missiles and launchers in Delta Flight. The communications control (deputy commander's) console is centered against the south wall of the enclosure. It contains an array of radio and telephone equipment that enabled the crew to communicate with other Launch Control Facilities, base headquarters, and the Strategic Air Command. At the side of each console is a small panel containing a spring-loaded, key-operated launch switch. The keys to these switches were kept in a double-padlocked, red steel box mounted above the deputy commander's console. If crew members had received an order to launch their missiles, they first would have unlocked their padlock on the red steel box and taken their launch keys and preset authenticators out of the red box. Then, if the Emergency War Order had been determined to be authentic, the officers would have inserted the codes they had received into the enabling panel, inserted the keys into the switches, and turned them in unison. If their launch command was verified by a second Launch Control Center, one to ten Minuteman missiles would have blasted out of their silos and streaked toward preassigned targets halfway around the world.

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[9] One early visitor to the Ellsworth facilities reported that the noise inside the Launch Control Center was "almost overwhelming -- a high electrical whine. It was comforting proof that all equipment was working, but my ears rang for hours after I left the capsule." See Richard B. Stolley, "How It Feels to Hold the Nuclear Trigger," *Life* 57 (6 November 1964): 38.

[10] Stolley, "How It Feels," 38.

Lining the walls of the acoustical enclosure are heavy aluminum electronic racks containing computer equipment, radio transmitters and receivers, a telephone relay system, and a power control panel. The acoustical enclosure is also equipped with a stainless steel latrine, a small refrigerator/microwave oven unit, and a curtained sleeping compartment. Installed in 1991, the sleeping compartment replaced a military cot that had occupied the same space. Virtually everything in the Launch Control Center is securely attached or strapped down, including the coffee pot.

The Launch Control Center ordinarily used commercial electrical power to run its motor generator, and drew its clean and cool air supply from air conditioning equipment located aboveground in the Launch Control Facility support building. However, the center was also capable of operating for sustained periods of time without any support from topside. In the event of a nuclear attack or higher state of readiness, an automatic blast valve system was designed to seal the capsule off from the surface. The storage batteries and motor generator beneath the floor would provide emergency electrical power and an emergency air conditioning unit would prevent vital electronic equipment from overheating. For extended periods of time crew members would then activate a hand-pumped oxygen regeneration unit to obtain breathable air.

Crew members trapped in the capsule after an attack could theoretically reach the surface through a 3-foot-diameter, corrugated-steel escape tube that angles upward from the east end of the Launch Control Center. To maintain rigidity, the tube is sand-filled and plugged at its lower end. To make their exit, crew members would have removed the plug, dug out the sand, and climbed up the tube to ground level.

Heated Vehicle Storage Building Contributing Building 1968

Standing near the northwest corner of the Launch Control Facility support building is a large vehicle storage building. This structure was erected in 1968 to provide heated parking for vehicles, including a front-end loader intended for snow removal. The heated vehicle storage building is a one-story, three-stall, wood-frame garage with a low-pitched, front-gabled roof. Resting on a concrete slab, the building is rectangular in plan, measuring approximately 32 feet by 40 feet. Its outer walls are sheathed with wide-lap, steel, clapboard-style siding embossed with a wood-grain texture and painted tan. The roof has slight overhangs and brown asphalt T-lock shingles. In the building's principal (southeast) facade is a large central garage door opening flanked by two slightly smaller openings. Each of the three openings contains an insulated-steel, overhead door with horizontal flush panels.

The building's interior walls are sheathed with hardboard panels. The ceiling is insulated but not finished. Steel pipe columns between the bays provide additional structural support for the roof. A small enclosed furnace room is in the building's west corner. An enclosed tool storage room, built about 1986, adjoins the rear (northwest) wall.

Hard HF Transmit Antenna Contributing Structure 1963
Near the east side of the compound, about 140 feet due south of the access road, is a blast-hardened or underground protected, HF transmit antenna. This structure consists of an underground, reinforced-concrete cylinder, approximately 21 feet in diameter and 50 feet deep (outside dimensions). The well of the cylinder contains a telescoping, four-sided radio antenna originally capable of extending to a maximum height of 120 feet. It was deactivated in the mid-1970s.

Hard HF Receive Antenna Contributing Structure 1963
The hard HF receive antenna is set into the ground about 160 feet south-southeast of the Launch Control Facility support building. This structure consists of a reinforced-concrete cylinder measuring approximately 16 feet in diameter and 37 feet deep (outside dimensions). The cylinder is covered by a concrete cap. Distributed evenly around the perimeter of the structure are five small ports. Each port contained a slender, ballistically actuated, steel, monopole antenna. This antenna system was deactivated in 1987-88. When it was still in use, one monopole extended from the cylinder at all times. If the exposed antenna were to have been damaged during an attack, a replacement could have been quickly deployed through the detonation of an explosive squib in an adjacent port.

Hardened UHF Antenna Contributing Structure 1976
The hardened UHF antenna stands near the southwest corner of the Launch Control Facility support building. Records indicate that this antenna was installed by the Motorola Company in 1976 to provide "unprecedented reliability to radio communications between the base and the missile field."[11] The hardened UHF antenna consists of a massive, cast-steel frustum or partial cone, bolted to a thick, reinforced-concrete slab 16 feet square. Surmounting the frustum is a conical, white fiberglass weather dome.

Survivable Low Frequency Communication System (SLFCS) Antenna
Contributing Structure 1968
Buried in the ground about 140 feet east of the Launch Control Facility support building, this antenna is not visible from the surface. The SLFCS is part of the Emergency War Order communication system.

Cathodic Protection Rectifier Contributing Structure 1963
Located just inside the security fence on the north side of the access road is the cathodic protection rectifier, an electronic device designed to protect underground features such as fuel tanks from corrosion. The aboveground portion of the rectifier consists of a white-painted steel electrical box mounted on a wood pole. The below ground portion consists of a well approximately 220 feet deep, containing eleven graphite anodes.

[11] "Chronology of the 44th Strategic Missile Wing, 1976," on file at the 44th Missile Wing History Office, Ellsworth Air Force Base, S.Dak. The 44th Strategic Missile Wing was inactivated in 1994, records from the 44th Missile Wing History Office have been sent to the Air Force Historical Research Agency at Maxwell Air Force Base, Montgomery, Ala.

Sewage Lagoon **Contributing Structure** **1963, 1970-71**
Located just outside the security fence, approximately 240 feet southeast of the Launch Control Facility support building, are two large sewage lagoons used for treating waste materials produced at the Launch Control Facility. The original sewage lagoon is an open settling basin, 118 feet square, surrounded by an 8-foot-high earthen berm. In 1970-71 an additional lagoon was appended to the southeast corner of the original structure. Although it is similar in construction to the original pond, the new overflow lagoon is irregular in plan, and is considerably larger than the earlier basin.

Helicopter Pad **Contributing Structure** **1970-71**
Helicopters from Ellsworth Air Force Base were often used to transport personnel and equipment between the Launch Control Facility and the main base. A large helicopter pad located outside the security fence south of the Launch Control Facility support building provided a safe landing area for these aircraft. The helicopter pad consists of a flat concrete slab 50 feet square, surrounded on all sides by a wide shoulder of coarse gravel. The pad was built in 1970-71 to supplant a smaller landing area constructed in 1966 located on the north side of the access road.

ICBM Super-High-Frequency Satellite Terminal (ISST) Antenna
Contributing Structure **c.1992**
The ISST Antenna was installed at the rear of the Launch Control Facility support building at the same time missile sites were being deactivated in the 66th Strategic Missile Squadron.

Television Satellite Dish **Contributing Structure** **1987-88**
The television satellite dish is located in the grassy area in front of the Launch Control Facility support building.

Hardened Intersite Cable System (HICS) **Contributing Structure** **1963**
The HICS is an underground communications link that connected the Launch Control Center at Delta-01 with all ten Delta-Flight Launch Facilities, including Delta-09. The HICS is buried between four and eight feet below ground and is approximately 1,732 miles long. The system employed a double-walled cable, pneumatically pressurized so that ruptures could be readily identified. To demonstrate compliance with the *Treaty Between the United States of America and the Union of the Soviet Socialist Republics on the Reduction and Limitation of Strategic Offensive Arms* (START Treaty) agreement, the HICS link was permanently disabled by severing and removing small portions of the cable. The majority of the system still remains underground in its original location, setting, and design remain allowing it to be a contributing feature of the property.

Launch Facility Delta-09 **Contributing Site** **1963**
The Launch Facility Delta-09 site is located approximately 10 miles west-northwest of Launch Control Facility Delta-01. The Launch Facility occupies part of an open, grassy tract of land straddling Pennington County Road T512, about 0.6 miles west and south of Interstate 90 Exit 116. The 90 acre site includes 10 acres that were in exclusive use by the Air Force including 1 acre within the security fence and 80 acres that were in concurrent use

by the Air Force. The Delta-09 site includes nine contributing resources – the overall site, the missile launcher, the Launch Facility support building, the improved Minuteman physical security antenna, the hard UHF antenna, the cathodic protection rectifier, two azimuth markers, and a HICS cable marker – and no noncontributing resources. Delta-09 is surrounded on the north, west, and south sides by Buffalo Gap National Grassland property under ownership of the United States Forest Service. The launch structures are concentrated inside a rectangular area surrounded by a chain-link security fence. A double gate is located on the east side of the security fence. A gravel access drive leads from the double gate to the nearby county road.

The area inside the enclosure has been graded to form a level, earthen platform that is elevated a few feet above the surrounding terrain. The platform has a gravel surface, and was specifically planned to provide maneuver space for the truck-like transporter-erector vehicles that hauled and emplaced the Minuteman missiles. The area surrounding the platform is native grass and the area was routinely mowed by the Air Force. The missile launcher and Launch Facility support building are located near the southern end of the maneuver space platform, with most of their structural elements underground. A smaller rectangular area at the north end of the platform outlined by four, low, small concrete corner pylons served as a landing pad for helicopters. Floodlights mounted atop two wooden utility poles at opposite corners of the maneuver space provided illumination for nighttime maintenance activities at the site. Two remnants of the concrete-base pad from the earlier outer zone security system antennas remain at the site: a square concrete pad with four reflector mount pedestals is located to the southwest (rear) of the missile launcher and a clutter monument and footing of the antenna pedestal are located to the rear (south) of the Launch Facility support building.

The Minuteman ICBM Launch Facility Delta-09 contains historic objects and technical equipment that reflect the successive use of the facilities by the Air Force. Delta-09, complete with its contents, was transferred from the Air Force to the National Park Service. The historic objects and equipment provide valuable insight into the use of this facility by the Air Force. The contents of Delta-09 are important and are considered associated features of the site.

Missile Launcher **Contributing Structure** **1963/2002**

The missile launcher was designed to serve as a temperature- and humidity-controlled, long-term storage container, protective enclosure, support facility, and launch pad for a Minuteman ICBM. The launcher consists of an underground launch tube (silo), surrounded by a cylindrical equipment room and covered by a hardened, ballistically actuated closure door. A heavily secured hatchway connected to the equipment room allowed Air Force personnel to enter the launcher for routine maintenance activities.

The launch tube is essentially a reinforced concrete cylinder, lined with a 1/4-inch steel plate, 12 feet in diameter (inside dimension) and approximately 80 feet deep. The tube rests atop a 4-foot thick, reinforced-concrete foundation, with its lower 52 feet encased in approximately 14 inches of heavily reinforced concrete. A 2-inch thick steel plate on the floor of the tube serves as a blast deflector for the missile's exhaust.

Welded to the walls of the launch tube, about 21 feet above the floor, are pulley blocks for the three-point suspension system that supported the installation's Minuteman missile. The suspension system consists of a free-floating, steel, missile support ring attached to three wire cables. The cables pass over the pulley blocks and fasten to large, coil spring-type shock absorbers fixed to the base of the silo. Encircling the upper portion of the launch tube is a cylindrical, two-level equipment room, built of heavily reinforced concrete with a steel liner. The equipment room is about 30 feet in diameter and 28 feet deep, with a 4-foot thick slab foundation, and walls 2 feet thick. A 6-inch wide "rattle space" between the equipment room and the launch tube allows the two structures to move independently.

The lower level of the equipment room contains a motor generator and supports for twelve large storage batteries. The batteries themselves were removed from the missile launcher during deactivation. An electrical surge arrestor room is located on the southeast exterior wall of the lower level. The numerous surge arrestors inside were designed to prevent electronic equipment inside the launcher from being damaged by electromagnetic pulses resulting from nuclear explosions. On the south side of the lower level, the cylindrical ballistic actuator that opens the launcher closure door during the launch sequence stands upright and extends through the upper level floor.

The upper level of the equipment room consists of a steel-framed platform covered with a rolled-steel deck plate. Cast into the east outer wall is a narrow, steel-faced bench, calibrated with compass bearings. Part of a complex optical alignment system, the bench originally supported an "autocollimator" (no longer in place) that was used to align the missile's guidance system. Directly above the bench is a canted cylindrical porthole (sight tube) glazed with bulletproof glass now permanently welded shut. This sight tube is aligned so as to point through the open access hatch, which allowed guidance technicians to establish visual references to a pair of azimuth markers (surveyors' benchmarks) located on the surface outside of the security fence.[12]

The northwest one-third of the upper-level floor is suspended from a series of coil-spring shock struts attached to the ceiling. Attached to the shock-mounted floor are racks of electronic equipment used to monitor and troubleshoot the missile, communicate with the Launch Control Center, and conduct the countdown. Mounted on the wall adjacent to the equipment racks are two cylindrical, stainless-steel chemical tanks. These tanks originally contained a sodium chromate solution for cooling the Minuteman missile's guidance system. Maintenance workers could gain access to the missile and the bottom of the silo by removing the hatch plates from the side of the launch tube, lowering the access door or "diving board," and installing a motorized cage. The two-person work cage could reach the circumference of the launch tube and also could lower workers 60 feet to the bottom of the silo.

[12] For a concise explanation of the autocollimator system, see C.M. Plattner, "First SAC Crews Controlling Minuteman," *Aviation Week and Space Technology*, 78 (7 January 1963): 62-63; and Rolf Winterfelt, "Minuteman System is 'Most Reliable,'" *Missiles and Rockets*, 8 (27 February 1961): 39, 53.

The underground launch tube and equipment room are covered by a massive, reinforced-concrete roof slab, known as the launcher closure. The top of the slab is level with the surface of the maneuver area. The roof slab is roughly teardrop-shaped in plan, with its apex pointing toward the northwest. The reinforced-concrete closure door is 3 1/2 feet thick and weighs more than 80 tons. There is a concrete approach apron on the north side of the launcher closure with steel transporter erector pylons and transporter erector jack pads to align and support the transporter erector when emplacing the missile. Transporter erector landing gear pads are also located just north of the apron.

The area directly south of the missile launcher is approximately 3 1/2 feet lower than the gravel maneuver area, exposing the south edge of the roof slab. Cast into the southern edge of the roof slab is a pocket-like opening for the launcher's horizontally sliding closure door. A low, buttressed concrete wingwall on each side of the door opening separates the maneuver area from the ground below. A concrete track apron is directly behind the launcher closure with a center track rail and side closure or maintenance tracks. The launcher closure rolls open on two wide steel tracks mounted atop deep reinforced-concrete beams cantilevered out from the launcher. The closure door's steel-sheathed leading edge is shaped like the cowcatcher on a steam locomotive, and is designed to clear debris from the tracks when the ballistic actuator flings the door aside. The grade slopes slightly south from the apron to provide drainage away from the launcher. If the missile or one of its major components had to be removed or replaced, maintenance workers would use a hydraulic pipe pusher mounted on a cogged rail in the middle of the track apron to jack the closure door open.

For more routine maintenance activities, workers entered the silo through the personnel access hatch in the northeast corner of the roof slab. The access hatch is a heavily reinforced, steel-and-concrete vault door, operated by two hydraulic cylinders. The door opens into a cylindrical shaft that descends to the lower level of the equipment room. Fitted into the shaft is the "B-plug," a piston-like, steel security door operated by an electro-mechanical actuator. The silo cannot be entered until the B-plug is retracted.

Slight modifications have been made to Delta-09 to prepare it for interpretation as a static display. The launcher closure has been permanently fixed in a partially open position and a glass viewing enclosure was installed over the opening in 2002. The glass and aluminum viewing enclosure is a domed structure over the opening of the missile launcher. A deactivated training missile was installed in the launch tube in 2001. The open launcher closure with glass viewing enclosure will allow visitors to the site to see down into the launcher to view the training missile. The viewing enclosure and training missile are noncontributing features of the missile launcher.

Launch Facility Support Building **Contributing Building** **1963**
Located adjacent to the missile launcher on the southeast is the Launch Facility support building, which contains an array of mechanical, electrical, and environmental support equipment. The Launch Facility support building is a box-like underground structure, with its roof about 1 foot above ground level. Constructed entirely of reinforced concrete, the building is rectangular in plan, measuring roughly 16 feet wide, 25 feet long, and 11 feet deep. At the north end of the structure is a narrow rectangular areaway, covered with steel grating and a steel

entry hatch. A ladder mounted on the interior wall provides access through the hatch down into the building. Two removable steel hatches in the middle of the roof of the support building allowed maintenance crews to quickly install or remove large pieces of equipment for repairs.

The support building contains electrical distribution equipment; a diesel-fueled emergency generator that supplied electrical power when the commercial source was unavailable; a brine chiller unit that provided cold water to the launch equipment room air handler, which in turn, provided the electronic racks and launcher with temperature and humidity-controlled air; a hydraulic pump for the personnel access hatch; a temperature control air compressor; and various panels for mechanical, security, and communications systems. During the course of deactivation and preparation of the sites for interpretation, some electrical panels have been added that are not historically associated with the Launch Facility support building.

Improved Minuteman Physical Security System (IMPSS) Antenna
Contributing Structure 1989

Rising from the base of the roof slab on the east side of the closure-door opening is a white fiberglass monopole antenna. This antenna is part of the IMPSS that was installed at the site in 1989. IMPSS is a microprocessor-based surveillance system designed to detect outer zone intruders at the launch site. It replaced troublesome older security systems so sensitive that they could be set off by "elk, rabbits, [or] even high-jumping grasshoppers."[13] The IMPSS replaced the original outer zone security antenna.

Hard UHF Antenna **Contributing Structure** **1968 (plans 1970)**

The hard UHF antenna is located a few feet to the northwest of the silo opening. It was installed about 1968 to link the Launch Facility with the Strategic Air Command's airborne Launch Control Center.[14] The UHF antenna rests atop a 13-foot-diameter, reinforced-concrete base, shaped like an inverted saucer. The antenna itself is housed inside a cast steel frustum capped with a conical, white fiberglass weather dome.

Cathodic Protection Rectifier **Contributing Structure** **1982-83**

A cathodic protection rectifier is located on the south side of the access drive, approximately 160 feet east of the security fence. The rectifier protects below ground structures, such as fuel tanks, from corrosion. The aboveground portion consists of a galvanized steel electrical box mounted on a wood pole protected with a small fence. The below ground portion consists of a well approximately 220 feet deep, containing eleven graphite anodes.

[13] Stolley, "How It Feels," 38. The IMPSS system is described in Aida E. Roig-Coepton, "1991 Annual Brief History, 44th Missile Wing," 2, on file at the 44th Missile Wing History Office, 44th Strategic Missile Wing, Ellsworth Air Force Base, S.Dak. The 44th Strategic Missile Wing was inactivated in 1994, records from the 44th Missile Wing History Office have been sent to the Air Force Historical Research Agency at Maxwell Air Force Base, Montgomery, Ala.

[14] The UHF antenna is described in an unattributed site activation document on file at the Ballistic Missile Organization History Office at Norton Air Force Base, Calif.; see "Wing II -- Ellsworth Air Force Base, S.Dak.," 2. Henceforth, materials from this archive will be cited as BMO, with appropriate locators.

Azimuth Markers **Two Contributing Structures** **1963**

The azimuth markers are surveyors' benchmarks that were used in conjunction with the autocollimator to align the Minuteman guidance system. Delta-09 has two azimuth markers. One is located approximately 1,000 feet to the north-northwest of the Missile Launcher, and the other is located approximately 1,000 feet to the north-northeast. Each azimuth marker consists of a cylindrical concrete pylon, 3 feet in diameter and 8 feet deep, set vertically into the ground. The visible portion of each pylon is approximately 18 inches in diameter and 4 feet high. A disc-shaped aluminum alloy survey plate is set into the top of each pylon.

HICS Markers **Contributing Structure** **1963**

Two HICS cable marker posts are located to the south and southeast of the missile launcher approximately 91 feet from the chain link security fence. The wooden posts are about 12 feet tall. The post to the southeast has three orange bands around the top, a directional arrow to delineate the location of the underground HICS cable, and a warning sign that there is an underground buried cable. The second post to the south has two orange bands at the top and two directional arrows.

Discussion of Integrity of Delta-01 and Delta-09

During the time that Delta-01 and Delta-09 served as an active Minuteman ICBM installation, the complex changed very little in terms of its original configuration and construction. Most changes were limited to equipment upgrades and minor remodeling and redecorating. Early changes at Delta-01 included the construction of a freestanding vehicle storage building in 1968 to replace the earlier garage in the wing of the support building. The support building garage was converted to an exercise/game room. A helicopter pad and an additional sewage lagoon were added to the facility in 1970.

Between 1971 and 1973, facilities were modified slightly when Ellsworth replaced its arsenal of Minuteman I missiles with the Minuteman II. The most important changes associated with this conversion were contained within the missiles themselves, since Minuteman II featured a more powerful propulsion system and a more accurate guidance system than its predecessor. Changes included installation of new electronic ground-support equipment in existing racks at both the Launch Control Facility and the Launch Facility; and the installation of electronic filters, seals, and circuit-breaking equipment at both sites to protect the facilities against damage from the electromagnetic pulses released by atomic blasts. Because the Minuteman II was slightly longer than the Minuteman I, the missile support ring inside the Launch Facility silo was lowered by lengthening suspension cables. The optical alignment system was adapted to work with the new missile by welding stops to the autocollimator bench to limit the instrument's range of motion. The retractor mechanism for the umbilical cable was relocated, and several other cables and fluid lines within the missile launcher were rerouted. No structural changes were required at either the Launch Facility or the Launch Control Facility for the new missile.[15]

[15] The changes to convert the facilities are outlined in "What's 'Force Mod?,'" *Minuteman Service News*, 23 (November-December 1965): 11. This article pre-dating the conversion noted that water tanks would be buried at Ellsworth's LCFs to help cool the environmental control systems. According to Ellsworth missile engineer Tim Pavek, the tanks were never installed. Pavek interview, 29 October 1996.

After conversion to Minuteman II, Delta Flight experienced only minor modifications as it continued to fulfill its mission. Changes at the Launch Control Facility support building included new steel siding and replacement windows, the addition of a women's latrine, air conditioning, and interior redecorating. Alterations to the Launch Control Center included the installation of carpet, Velcro-attached fabric acoustical ceiling panels, a modular bed storage unit, and a redecorated latrine and privacy curtain. Following the Minuteman II's being taken off of alert in 1991, the missile was removed from Delta-09. These changes were all made during the period of significance (1963-1993) and do not compromise the historic integrity of the complex.

Additional changes occurred at Delta-01 and Delta-09 during deactivation, beginning in 1993. Classified electronic equipment, hazardous fluids and other environmentally sensitive materials were removed from both sites; underground fuel storage tanks were removed or filled with sand at Delta-01; storage batteries were removed from the Launch Facility; and the ballistic actuator was disconnected from the silo closure door at Delta-09. When classified electronic equipment was removed, the cover plates on the rack system were retained to allow for the appearance of the original equipment. In compliance with the START Treaty, the HICS link was permanently disabled by severing and removing small portions of the cable. Although the deactivation activities had a profound impact on the operational status of Delta-01 and Delta-09, they did not significantly affect the complex's original design and workmanship.

To date, minor improvements have occurred to Delta-01 and Delta-09 in preparation for their opening as a Minuteman Missile National Historic Site. Delta-01 remains largely the same as it was when it was deactivated and care has been taken to keep as much of the original materials and furnishings at the site. New security and fire detection/suppression systems were installed at Delta-01 and Delta-09. To convert Delta-09 to a static display, the launcher closure was permanently fixed into a partially opened position and a glass viewing enclosure was constructed over the opening. These minor modifications of the sites do not diminish the overall integrity of Delta-01 and Delta-09 sites and its ability to convey its use as a Minuteman I and II facility.

Minimally modified in terms of their original design, workmanship, and construction, Delta-01 and Delta-09 are well-maintained facilities that retain a high degree of historic integrity. The sites largely reflect the appearance, setting, and design of the Minuteman II sites as they were in 1991, when they were taken off of alert, and remained until 1993 when deactivation procedures began and other Minuteman II sites were dismantled and imploded. Deactivation activities and conversion of Delta-01 and Delta-09 to a unit of the National Park Service has not diminished their ability to convey their historic use and appearance as Minuteman missile facilities used by the Air Force from 1963 to 1993.

Statement of Significance

This Statement of Significance consists of three major sections. It begins with an overview that examines the significance of Launch Control Facility Delta-01 and Launch Facility Delta-09 in terms of relevant National Register Criteria. It then presents an extended historical narrative that places the significance of Delta-01 and Delta-09 in the context of American Cold War strategic planning and in particular the nation's Intercontinental Ballistic Missile (ICBM) program. Finally, it concludes with a comparative analysis that examines the significance of Delta-01 and Delta-09 in relation to other American land-based ICBM installations.

I. Overview

Launch Control Facility Delta-01 and Launch Facility Delta-09 were established as the Minuteman Missile National Historic Site in1999 through the "Minuteman Missile National Historic Site Establishment Act of 1999" passed by Congress on 29 November 1999 and later signed by President Bill Clinton. The national historic site was established:

1. To preserve, protect, and interpret for the benefit and enjoyment of present and future generations the structures associated with the Minuteman II missile defense system;
2. to interpret the historical role of the Minuteman II missile defense system—
   a. as a key component of America's strategic commitment to preserve world peace; and
   b. in the broader context of the Cold War; and
3. to complement the interpretive programs relating to the Minuteman II missile defense system offered by the South Dakota Air and Space Museum at Ellsworth Air Force Base.[16]

Since the establishment of Minuteman Missile National Historic Site, Delta-01 and Delta-09 have been transferred from the Air Force to the National Park Service. With the establishment of the Minuteman Missile National Historic Site, the property was listed in the National Register in 1999. This nomination is being prepared to provide the background documentation for the listed property.

The Minuteman ICBM Launch Control Facility Delta-01 and Launch Facility Delta-09 are nationally significant applying National Register Criterion A: History and Criterion C: Engineering. The period of significance for the Minuteman ICBM Launch Control Facility Delta-01 and Launch Facility Delta-09 encompasses the period of use by the Air Force beginning in 1963 when the missiles were activated and ending in 1993 when the sites were deactivated. By 1973 the Minuteman I sites were converted to Minuteman II sites and in 1991 the Minuteman II missiles were taken off alert and the removal of the missiles began. Following the removal from alert, the Launch Control Facilities and Launch Facilities otherwise remained intact and were placed on "caretaker status," until

[16] *Minuteman Missile National Historic Site Establishment Act of 1999*, Public Law 106-115, 106th Cong., 1st sess. (29 November 1999).

deactivation procedures began in 1993. Delta-01 and Delta-09 remained in caretaker status until they were transferred to the National Park Service.

Criterion A: History

Minuteman ICBM Launch Control Facility Delta-01 and Launch Facility Delta-09 represent the only remaining intact examples of the original Minuteman configuration, which was developed specifically to implement the massive retaliation deterrent strategy that characterized American nuclear policy during the early Cold War period. Consequently, the complex has achieved national significance under National Register Criterion A as important tangible evidence of American participation in the Arms Race and the Cold War.

When the Soviet Union extended its boundaries and increased its military strength after World War II, many American leaders ascribed these activities to a deep-seated and innately hostile Soviet expansionism. The Soviets would be satisfied, they believed, only when the American economic and political system had been destroyed and the entire world had been converted to Communism. To frustrate these perceived intentions, the United States adopted a policy of "patient but firm . . . containment of Russian expansive tendencies."[17] By the early 1950s, however, it had become apparent that any attempt to confront Soviet power using conventional military forces would be logistically impossible and politically unacceptable. Faced with these prospects, American leaders formulated a new strategy. Henceforth, United States military planners would attempt to deter Communist aggression by developing an ability to respond to an enemy attack with immediate and massive retaliation. Nuclear weapons and new delivery systems would be essential to achieving this capability.

As the nation mobilized to implement the massive retaliation strategy during the 1950s, the Air Force was called upon to develop and deploy an entirely new type of weapon capable of delivering thermonuclear warheads to targets half a world away- the ICBM. According to General Bernard A. Schriever, who directed the effort, the ICBM project was "the largest military development program ever undertaken by this nation in peacetime."[18] By the early 1960s, the missile program had helped to make the "military-industrial complex" a fact of American economic and social life. Billions of American dollars, hundreds of thousands of American workers, and more than 2,000 American companies were directly involved in the effort to develop an effective ICBM.

The Air Force initially concentrated its efforts on developing and deploying a succession of powerful liquid-fueled ICBMs, including the Atlas series, as well as the Titan I and Titan II missiles. These weapons gave the United States a formidable deterrent force. However, the extraordinarily complex liquid-fueled ICBMs were expensive and difficult to produce in large quantities. This, coupled with their need for constant maintenance, made widespread deployment impractical. Recognizing the limitations of liquid-fueled missiles, the Air Force had also been experimenting with solid-propellant ICBM technology during the late 1950s and the Minuteman weapon system was the result of this endeavor. Simpler in design than their liquid-fueled antecedents, the Minuteman was

[17] "The Sources of Soviet Conduct," *Foreign Affairs* 25 (July 1947): 575.

[18] General Bernard A. Schriever, "The USAF Ballistic Missile Program," *Air University Quarterly Review* 9 (Summer 1957): 5.

relatively inexpensive to build, lent itself to mass production, and required much less maintenance in the field. With these advantages, the Minuteman weapon system promised to give the United States a capability for massive retaliation based on sheer strength of numbers.

Beginning in 1962, the Air Force deployed 1,000 Minuteman missiles in hardened underground launch silos dispersed throughout the north-central United States. For the next three decades, this force remained on continuous alert -- forming what the *New York Times* described as "the backbone" of the American nuclear arsenal, and serving as a pivotal instrument of American diplomacy.[19] With its ability to unleash apocalyptic destructive power on an enemy at a moment's notice, the Minuteman helped make "hot war" unthinkable, thereby helping to make the protracted standoff of the Cold War possible.

The first two Minuteman installations, each equipped with 150 missiles, were activated at Malmstrom Air Force Base in Montana and Ellsworth Air Force Base in South Dakota in 1962-1963. These identical installations were configured specifically to implement the massive retaliation strategy. In contrast, facilities at all subsequent Minuteman deployment areas were configured to implement a new "controlled response" strategy initiated by the Kennedy administration in 1961. The controlled response strategy called not only for the possibility of a limited or controlled American nuclear response, but also consequently for post-attack missile survivability and was demonstrated in the upcoming Minuteman II design.

After their original activation, the Minuteman facilities at Malmstrom were partially rebuilt to further protect them from nuclear blast effects and to accommodate a more powerful missile known as the "Minuteman II." Although the Ellsworth missile field also received the new weapon -- and hence became a "Minuteman II" installation -- its existing facilities were not structurally modified. At Malmstrom, for example, the launch facilities were altered by the addition of 10 inches of borated concrete to the silo closure doors. But at Ellsworth, apparently because engineers suspected that soil conditions might not support the weight of additional structural materials, the original silos were left intact.[20]

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[19] Bernard Weintraub, "U.S. Predicts Threat to its Missile Force," *New York Times*, 6 November 1977. Subsequent references to the *New York Times* will be identified by the abbreviation *NYT*. The nation's Cold War-era defense strategy was built around a "triad" of nuclear weapons, consisting of land-based intercontinental ballistic missiles, a fleet of nuclear weapon-carrying conventional aircraft, and an array of sea-launched ballistic missiles. By basing nuclear weapons on land, sea, and air, military planners sought to preserve the integrity of the American deterrent by making it virtually impossible for an enemy to destroy the nation's entire nuclear force by launching a first strike. Noting that the land-based component of the triad included not only 1,000 Minutemen, but also 54 liquid-fueled Titan II ICBMs, Weintraub described the Minuteman as "the most advanced missile," and called the Minuteman force the "backbone of the United States missile arsenal."

[20] See "Minuteman Deployment and Modification Matrix," *Minuteman Weapon System: History and Description* (Hill Air Force Base, Utah: Ogden Air Logistics Center, 1990): 33. The limiting effect of soil stability on silo modification at Ellsworth was noted by Ellsworth missile engineer Tim Pavek in a telephone interview with John Lauber, 29 October 1996.

Following the dissolution of the Soviet Union in 1991, President George Bush ordered the immediate deactivation of the nation's entire Minuteman II force. The 150 previously altered launchers at Malmstrom were scheduled for further modifications to accommodate the Minuteman III missile system. The launchers at Ellsworth were slated for demolition in accordance with the terms of the START Treaty. In March 1994 the Air Force began to implode the Minuteman Launch Facilities at Ellsworth Air Force Base, and by mid-September 1996, 149 of the 150 silos originally associated with the base had been destroyed. As the sole survivors of the Ellsworth Minuteman II missile field, Launch Control Facility Delta-01 and Launch Facility Delta-09 are the nation's only remaining facilities that represent the original Minuteman configuration. In terms of engineering, they are the most pristine expression of the ICBM component of the massive retaliation deterrent strategy that so strongly shaped American military posture during the early Cold War period.

Criterion C: Engineering
Minuteman ICBM Launch Control Facility Delta-01 and Launch Facility Delta-09 have achieved national significance under National Register Criterion C: Engineering as the country's most intact remaining example of the original Minuteman configuration and illustrate a major breakthrough in American missile technology. The complex is the only remaining Minuteman II example in the country that includes both the Launch Control Facility and Launch Facility.

The ICBM's value as a deterrent was contingent upon its ability to retaliate instantly even after a nuclear attack. The Air Force realized quite early that in order to preserve that capability, it would have to devise a basing system that could protect the missile and its crew during an attack and that could continue to function perfectly afterwards. By 1955, nearly five years before the United States actually deployed its first ICBM, military planners had already determined that the ideal basing configuration would allow American missiles to be deployed on individual, remote-controlled launchers dispersed across a broad geographic area. Such a highly decentralized distribution of the weapons would make it virtually impossible for an enemy to destroy the entire United States deterrent force by launching a first strike. To ensure that the United States could make good on its threat to retaliate with massive force following an attack, planners determined that the missiles and their crews should be housed in hardened facilities belowground, so that a thick layer of soil would shield them from the effects of the blast and radiation.

As several generations of American ICBMs were activated during the early 1960s, engineers moved progressively closer to the goal of basing the systems in fully hardened facilities. The first Atlas missiles were designed to be installed on aboveground launchers that provided minimal protection from blast effects. The next generation of ICBMs -- the Titan I missiles -- were stored on elevators in underground silos and raised out of the ground for launch. By the time the first Titan II ICBMs were activated in the early 1960s, they were capable of being both stored in, and launched from, fully hardened underground silos.

The goal of full dispersal, however, took longer to achieve. The Atlas, Titan I, and Titan II missiles all used liquid-fueled propellant systems that required constant attention from on-site crews. To meet this requirement, the

Atlas and Titan I missiles were deployed in "clusters," each consisting of several individual launchers grouped closely around a single, fully staffed control center. The drawback to this arrangement was that an enemy could destroy the entire cluster with a single direct hit. In contrast, the Titan II ICBMs were deployed in a "unitary" configuration in which the missiles were housed in individual underground silos, each directly attached to its own fully staffed, underground Launch Control Center. Although this configuration theoretically allowed for a greater degree of dispersal, in actuality the system's considerable cost prevented full-scale deployment. When deployed in limited numbers (as was the case), the Titan II was strategically vulnerable, since a direct hit could take out the launcher and its control center.[21]

With the activation of the original Minuteman missiles at Malmstrom and Ellsworth Air Force Bases in 1962-1963, military engineers finally achieved the dual goals of basing ICBMs in fully dispersed, hardened Launch Facilities. The relatively inexpensive, solid-fueled Minuteman was much easier to store and maintain than its predecessors. The Minuteman did not require constant attention from on-site crews, the missiles could be installed in fully hardened, individual underground silos dispersed across a wide geographic area. A single, two-person launch crew quartered in a separate, hardened underground facility could by remote control monitor and launch a "flight" of ten Minuteman missiles dispersed several miles away. An enemy hit on any individual launcher would have no effect on the remaining missiles in the flight. With some refinements, the basing system first used at Malmstrom and Ellsworth would remain the standard for all subsequent land-based American ICBMs, accommodating three generations of Minuteman missiles, as well as the later solid-fueled Peacekeeper missile.[22]

A shift in American strategic policy from the massive retaliation concept of the 1950s to the controlled response concept of the 1960s led to changes in the four Minuteman deployment areas completed after Ellsworth. During several decades of service, facilities at five of the nation's six Minuteman installations received structural

[21] Activated at approximately the same time as the Minuteman, the nation's fifty-four Titan II missiles were based in underground silos linked to individual underground control modules. The Titan IIs used storable liquid propellants that gave them a faster response time than the Atlas and Titan I missiles. Within a month of their activation, however, Titan II missiles at two operational sites had developed potentially dangerous leaks caused by acids formed when oxidizer combined with moisture in the atmosphere. Despite a rigorous and continuous maintenance program, the volatile liquid propellants continued to cause problems with the Titan IIs. By 1980 there had been so many accidents that some people living near the silos "were convinced that the Titan II missiles that are supposed to help them sleep better at night pose more dangers . . . than the Russians." After a 1980 explosion at a Titan II site in Damascus, Arkansas sent a nine-megaton thermonuclear warhead into a cornfield near one Titan II site, politicians and defense department officials alike began to call for their retirement. Deactivation began in July 1982 and was completed by late summer 1987. The solid-fueled Minuteman, in contrast, was relatively inexpensive and easy to maintain. "With Minuteman," wrote one observer in 1967, "the thing sits in a hole unattended. When you need it you hit the button and away she goes." See John F. Lauber and Jeffrey A. Hess, "Glenn L. Martin Company, Titan Missile Test Facilities," 1993, HAER No. CO-75, HABS/HAER Collection, Library of Congress, Washington, D.C., 64-66. The first quote is from "Titan a Big Threat," *U.S. News and World Report* 89 (29 September 1980): 8. The second quote is from Mark Bearwald, "Requiem for the Titans," *Denver Post,* 26 February 1967.

[22] The nation's entire complement of fifty solid-fueled Peacekeeper ICBMs was deployed in modified Minuteman silos at F.E. Warren Air Force Base, Wyo. in 1986. See "Minuteman Deployment and Modification Matrix," 26.

upgrades intended to increase the hardness of their launch silos and accommodate advances in missile technology. Because the Ellsworth sites alone were excluded from the reconstruction program (although their missiles were upgraded to Minuteman II), their original structural features remained virtually unaltered. In the mid-1990s, 149 of the original 150 Ellsworth missile silos were destroyed in conformance with the provisions of the START Treaty, signed by the United States and the Soviet Union at the beginning of the decade. Consequently, Launch Control Facility Delta-01 and Launch Facility Delta-09 comprise the only complete Launch Complex remaining at Ellsworth. As such, they have achieved exceptional national significance as the most intact example of the first ICBM basing system to meet the dual goals of full dispersal and full hardening. This basing system, as exemplified by Delta-01 and Delta-09, served as the paradigm for all of the nation's subsequent land-based ICBMs.

Criteria Consideration G: Property Achieving Significance Within the Last Fifty Years
Properties less than fifty years old are not ordinarily eligible for designation in the National Register. However, National Register Criteria Consideration G allows for exceptions to this rule under certain conditions. According to *National Register Bulletin 15*, a property less than fifty years old may be eligible for National Register designation if it can be demonstrated that the property has achieved "exceptional importance."[23] *National Register Bulletin 22* also notes that some resources by their very nature are subject to circumstances that destroy their integrity before they reach fifty years of age, and that such resources may warrant exceptions to the fifty-year rule. Both exceptions apply in the case of the Minuteman ICBM Launch Control Facility Delta-01 and Launch Facility Delta-09.

The effort to develop, build, deploy, and maintain an effective ICBM force spawned an unprecedented peacetime defense mobilization that deeply affected American economic, technological, and political life for more than four decades following World War II. The Minuteman complex at Ellsworth was an important product of that effort.

Despite the overwhelming national significance of the American ICBM program, however, changing technology and international treaty requirements have brought about a dramatic reduction in the number of ICBM-related resources that remain in the United States. All of the Atlas and Titan I sites were deactivated and dismantled during the late 1960s, and only one of the nation's fifty-four Titan II installations remains intact. A similar fate awaits the nation's Minuteman installations. Since 1991, 450 of the nation's original 1,000 Minuteman Launch Facilities have been deactivated and slated for demolition, and more than 230 of those have already been destroyed. The 550 Minuteman launchers that remain on active duty have been substantially modified to accommodate the advanced Minuteman III and Peacekeeper weapon systems that constitute the nation's post-Cold War deterrent force. The Minuteman complex at Ellsworth is the only remaining ICBM site in the nation that still

[23] *National Register Bulletin 15: How to Apply the National Register Criteria for Evaluation*, (Washington, D.C.: National Park Service, U.S. Department of the Interior, 1991): 41-43. Also see *National Register Bulletin 22: Guidelines for Evaluating and Nominating Properties That Have Achieved Significance Within the Last Fifty Years*, (Washington, D.C.: National Park Service, U.S. Department of the Interior, n.d): 4-5.

retains the essential features of the original Minuteman basing system deployed during the early Cold War period. The exceptional national importance of the ICBM program, and the ephemeral nature of its artifacts were formally recognized in 1993 when the Titan II ICBM Launch Complex associated with Davis-Monthan Air Force Base near Tuscon, Arizona, was successfully nominated as a National Historic Landmark.[24] Although it was only thirty years old at the time of its nomination, this property was deemed exceptionally significant as the nation's only remaining Titan II site. The remaining Minuteman Launch Complex at Ellsworth Air Force Base, South Dakota, is worthy of the same consideration.

II. Historical Narrative

Introduction

On 7 January 1954, President Dwight D. Eisenhower delivered his first State of the Union Address to a joint session of Congress. He began his speech with a lengthy discussion of foreign affairs and defense policy. After stating his belief that "American freedom is threatened so long as the Communist conspiracy exists in its present scope, power and hostility," he outlined his plans for defending the nation against that threat. "We will not be aggressors," he said, "but we . . . have and will maintain a massive capability to strike back."[25] Eisenhower's comments -- which were translated into the catch phrase massive retaliation -- reflected the doctrinal basis behind much of the nation's strategic planning during the Cold War era.

The Origins of the Arms Race[26]

Eisenhower's view of the Soviet Union was similar to one that had first been articulated nearly eight years earlier by George Kennan, a diplomat at the United States Embassy in Moscow. Watching the Soviets surround themselves with a "buffer zone" that included much of eastern Europe following World War II, Kennan had warned that these moves resulted from a fanatical Soviet "expansionism" that was ultimately bent on disrupting American society and breaking the international authority of the American nation. The only way to deal with this threat, Kennan suggested, was for the United States to adopt a policy of "patient, but firm and vigilant containment of Russian expansive tendencies."[27]

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[24] David K. Stumpf, "National Historic Landmark Nomination: Titan II ICBM Missile Site 8 (571-7)," TMs, 1993. On file at the National Park Service, Rocky Mountain Regional Office, Division of Cultural Resources, Denver, Colo.

[25] "The Text of President Eisenhower's Message to Congress on the State of the Union," *NYT*, 8 January 1954.

[26] Much of the ensuing discussion of American strategic planning during the Cold War is derived from Lauber and Hess, "Glenn L. Martin Company."

[27] Kennan discussed Soviet expansionism in a 1946 telegram to the State Department. See Kennan, George. "The Kennan 'Long Telegram,'" in *Origins of the Cold War: the Novikov, Kennan, and Roberts "long telegrams" of 1946*, ed. Kenneth M. Jensen (Washington, D.C.: United States Institute of Peace, 1991), 28. His formulation of the containment policy appeared in "The Sources of Soviet Conduct," 575.

Although containment sounded good in theory, it eventually proved nearly impossible to put the policy into practice. In order to truly contain the pervasive Soviet threat, observed one top Eisenhower administration official in 1954, the nation would have needed to prepare for combat "in the arctic and in the tropics; in Asia, in the near East and in Europe; by sea, by land and by air."[28] Such vigilance would have required an enormous and well-equipped army. In contrast to the Soviets, who had mounted a massive effort to rebuild their army and replenish their supply of conventional weapons after World War II, the Americans had been demobilizing their armed forces at a dizzying rate. Exploiting its position as sole possessor of the atomic bomb, the United States had pursued a "bargain-basement" defense policy, using nuclear weapons as stand-ins for infantry battalions.

After the Soviets broke the American nuclear monopoly by developing an atomic bomb of their own in 1949, American policymakers responded with an even more powerful weapon -- a thermonuclear device that used a small atomic trigger to initiate a fusion reaction in hydrogen isotopes. When the United States successfully tested its first hydrogen bomb in 1952, the weapon promised to reestablish the nation's nuclear superiority once and for all. But at the end of August 1953, the Soviets exploded a sophisticated hydrogen bomb (H-bomb) of their own. Many American military experts believed that the new Russian weapon was capable of being delivered by an ICBM. For the first time, the Soviet Union seemed poised to take the lead in the Arms Race.

The Origins of the American Arms Race

American military planners had initiated several attempts to develop ballistic missiles immediately after World War II. During the late 1940s, however, the nation's nuclear superiority had seemed secure, and the missile programs were allowed to languish. The Soviet H-bomb abruptly ended this complacency, and prompted two independent organizations to reevaluate the strategic importance of the ICBM.

One study was initiated by Dr. Bruno Augenstein, a RAND Corporation physicist who believed that "if the Soviet Union beat the United States in a race for the ICBM, the consequences would be catastrophic."[29] At about the same time, the Air Force assembled a committee of eminent scientists headed by Dr. John von Neumann, a Princeton University mathematics professor. Von Neumann's group, code-named the "Teapot Committee," was explicitly ordered to investigate "the impact of the thermonuclear [bomb] on the development of strategic missiles and the possibility that the Soviet Union might be somewhat ahead of the United States."[30] The RAND and Teapot Committee reports were released just a month after Eisenhower's 1954 State of the Union Address. Both studies reached essentially the same conclusions: recent advances in thermonuclear technology made an ICBM

[26] Secretary of State John Foster Dulles, as quoted in H. W. Brands, Jr., *Cold Warriors* (New York: Columbia University Press, 1988), 16.

[29] Fred Kaplan, *Wizards of Armageddon* (Stanford, Calif.: Stanford University Press, 1991), 112.

[30] Dennis J. Stanley and John J. Weaver, "An Air Force Command for R & D, 1949-1976. The History of ARDC/AFSC," Office of History, Headquarters, Air Force Systems Command, N.C.," n.d., 22, in United States Air Force Historical Research Agency, Maxwell Air Force Base, Montgomery, Ala., Document K234.04-39. Hereafter, materials from this archive will be cited as HRA, with appropriate locators.

practical. Furthermore, such a device "could be developed and deployed early enough to counter the pending Soviet threat *if* exceptional talents, adequate funds, and new management techniques suited to the urgency of the situation were authorized."[31]

The Air Force quickly made the ICBM its top priority. By mid-May 1954, officials had mapped out a development plan for the new weapon, and at the end of June, Air Force Vice Chief of Staff, General Thomas D. White, ordered the Air Research and Development Command "to proceed with the development of an ICBM at the highest speed possible, limited only by the advancement of technology in the various fields concerned."[32] In July the Air Force established a special project office to administer the program. The new agency was to be based on the West Coast, and was consequently called the Western Development Division. The organization's mission was considered so important to the national security that "even its initials, WDD, were classified beyond top secret."[33]

A newly promoted, forty-three year-old brigadier general named Bernard A. Schriever was selected to head the new agency. By 1960 the young officer was expected to place a fully operational ICBM weapon system into the hands of the Strategic Air Command (SAC), the military command responsible for the Air Force's strategic nuclear weapons. To accomplish this task, writes ICBM chronicler and journalist Roy Neal, Schriever had to create an entire new industry from the ground up:

> Tens of thousands of industrial and Air Force managers, engineers, and workers [had] to be trained. New machine tools and test facilities [had to] come into being. . . . Literally, he [had to] change the face of America, the make-up of the Armed Forces and the industries that support them.[34]

On 5 August 1954, Schriever and a small group of military officers converged on an abandoned parochial school in the Los Angeles suburb of Inglewood. To avoid arousing the curiosity of nearby residents, the officers had been instructed to leave their uniforms home and to arrive at their new headquarters in civilian clothes. Neal describes what they found when they got there:

> No sign identified the white schoolhouse as the Western Development Division. . . . The windows were frosted and heavily barred. All outside doors, except one, were locked. The only entrance was across a chain-link fenced parking lot. A security guard manned the door. . . Some of the old-timers recall . . . the comment of the school boy who was sauntering by the school building. Eying the frosted glass and steel-barred windows, he said to a chum, 'Boy am I glad I don't go to school here.'[35]

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[31] Robert L. Perry, "The Atlas, Thor, Titan, and Minuteman," in *The History of Rocket Technology; Essays on Research, Development, and Utility*, ed. Eugene Emme (Detroit: Wayne State University Press, 1964), 144.

[32] "Air Force Ballistic Missile Test Program," 1957, 1, in BMO, Norton Air Force Base, San Bernardino, Calif., in Box L-1.

[33] Kaplan, *Wizards*, 116.

[34] Roy Neal, *Ace in the Hole* (Garden City, N.Y.: Doubleday & Company, Inc., 1962), 48.

[35] Neal, *Ace in the Hole*, 64-65.

In this inconspicuous but carefully secured setting, the handpicked staff of the Western Development Division began organizing the effort to build an effective ICBM.

The First Generation: Atlas and Titan

The Western Development Division staff started by reviving a missile project that had originated shortly after World War II. In 1946 the U.S. Army Air Force had awarded the Convair Corporation a contract to design and test a long-range ballistic missile called the MX-774. Like many of the post-war missile projects, the MX-774 lost most of its government funding after only one year. But instead of simply dropping the project, Convair continued to fund the research on its own, steadily advancing the state of missile technology. In 1951 the Air Force acknowledged these efforts by hiring the company to develop preliminary plans for a more advanced missile, called the Atlas.

In concept, the Atlas was essentially a highly evolved version of the German V-2 missile that had been used against the Allies during the waning years of World War II. Like the V-2, the Atlas was powered by rocket engines that burned a mixture of liquid fuel and oxidizer. But while the V-2 had an effective range of only a few hundred miles, the Atlas was expected to deliver its payload to a target more than 5,000 miles away. Convair could have attempted to meet this requirement by building the Atlas as an enormous version of the V-2. Instead, Convair engineers sought a more sophisticated solution. Realizing that they could greatly extend a missile's range by reducing its weight, the engineers decided to equip the Atlas with an innovative, ultra-light airframe. The missile was assembled from rings of paper-thin stainless steel, stacked together like stovepipes and welded at the seams to form a seemingly flimsy cylinder. This cylinder was then inflated with nitrogen gas to give the missile its structural integrity.

By 1954 the Atlas was the nation's most advanced ballistic missile. Nonetheless, the missile was still years away from production. No prototype had ever been flight tested, and some skeptics feared that when the Atlas's powerful engines were fired for the first time, its thin-skinned airframe would simply buckle in on itself, leaving America's hopes for an ICBM lying on the launch pad like a gigantic ball of tin foil.

General Schriever and his staff were well aware of these concerns. So while they rushed ahead with the Atlas program, they also began looking for a backup system. During the fall of 1954, the Western Development Division asked several aircraft manufacturers to investigate the feasibility of building an alternate ICBM. The studies were completed by Christmas, and in January 1955, General Schriever presented their findings to his superiors. By the end of April the Air Force had authorized the Western Development Division to proceed with the development of a backup missile. In October 1955, the Glenn L. Martin Company was given a contract to produce a new ICBM called the Titan. Like the Atlas, the new Titan would use liquid propellants, but its advanced two-stage design would allow the missile to utilize a conventional -- and more reliable -- airframe. Before either of America's two ICBMs got off the ground, however, the Soviets struck another blow.

Strength in Numbers: The Missile Gap

On 4 October 1957, the Soviet Union announced that it had used a liquid-fueled ICBM to launch a 185-pound artificial satellite called "Sputnik" into orbit around the Earth. This demonstration of Russian technological prowess caused many American scientists and politicians to fear that the Soviet Union had opened a significant "Missile Gap" that would give them a commanding lead in the Arms Race. "If the Reds can put a 185-pound object into space," they reasoned, "they also have the ability to fire long-range missiles."[36] Within a few months, American journalists and intelligence analysts began to assert that the Soviet missile force could outnumber the American arsenal by as much as sixteen to one by 1960.[37] America's growing sense of insecurity was not lost on Soviet officials, who gleefully boasted that their factories were turning out missiles "like sausages."[38]

Facing severe criticism for allowing the United States to fall behind the Soviets in the Arms Race, the Eisenhower administration responded that its missile programs had never been intended to merely "put something together" in a hurry. The programs were carefully designed, said a spokesperson, first to "attain perfection," and then to "develop the ability to produce in volume once that perfection is achieved."[39]

But America's first-generation ICBMs were neither perfect nor mass producible. In fact, observed the *Wall Street Journal* a few weeks after Sputnik, "their weaknesses are so profound that . . . generals are sure [the missiles] will be discarded altogether after the first half-dozen years."[40] The Atlas and Titan missiles were extraordinarily complex, hand-crafted machines, containing as many as 300,000 components, each of which had to be maintained in perfect operating condition in order for the missile to successfully complete its mission. The liquid propellants that powered their engines were volatile and corrosive, and could not be placed into the missiles' tanks until immediately before launch. The fueling process itself could take as long as two hours. Consequently, instead of being "stable weapons in a state of permanent readiness," these early ICBMs would "require the desperate and constant attention accorded a man receiving artificial respiration. A missile unit will be no pushbutton affair but will require a highly-trained crew . . . several times as large as the largest bombing crew." Many of these problems could be solved, the *Wall Street Journal* suggested, by developing a greatly simplified "second generation" of missiles powered by solid-fuel rocket engines.[41]

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[36] "Russia's Moon," *Wall Street Journal*, 7 October 1957. Subsequent references to this publication will be identified by the abbreviation *WSJ*.

[37] As Rutgers University political scientist Roy Licklider has correctly observed, these estimates were based more on fear than on fact, for "the missile gap . . . never developed." See Roy Licklider, "The Missile Gap Controversy," *Political Science Quarterly* 85 (December 1979): 601, 605.

[38] John Prados, *The Soviet Estimate* (New York: Dial Press, 1982): 77.

[39] Prados, *The Soviet Estimate*, 77.

[40] "Myths and Missiles," *WSJ*, 21 November 1957.

[41] "Myths and Missiles."

Weapon System "Q"

The solid propellants available in the mid-1950s could not provide the power needed to hurl a heavy warhead across an ocean. "A lot of work had been done on solids prior to the initiation of the ICBM program in 1954," recalled Schriever in a 1973 interview, "but there were a number of things that ruled against using solids at that time."[42] Solids were difficult to manufacture. They were often hard to ignite, and once ignited, there was no way to control their combustion or direct their thrust. With these constraints, liquid-fueled missiles, despite their "volatile, hard to handle" propellant mixtures, presented "the only immediate way to go ahead" in 1954.[43]

However, the Air Force did not entirely abandon its efforts to develop a viable solid-propellant missile. In 1956 General Schriever had reluctantly approved a low-level research program "aimed toward the evolution of a high-thrust . . . solid-fuel rocket." The person he selected to head the program was Colonel Edward Hall, Chief of Propulsion Development for the Western Development Division. According to Air Force historian Robert Perry, Hall was a "near-fanatic" about the potential of solid-fueled missiles.[44]

Despite the Air Force's half-hearted support for the solid-fuel development program, Hall and others diligently pursued their research, and within two years, most of the technical problems involved with solid-fueled rocket engines had been solved. In August 1957 the Air Force asked Hall to help develop a medium-range, solid-fuel missile that would serve as a land-based counterpart to the Navy's submarine-launched, solid-fuel Polaris which was currently under development. Within two weeks Hall had drawn up specifications for a remarkable new missile whose range could be varied by simply assembling its three interchangeable propulsion stages in different combinations. The new missile, dubbed "Weapon System Q," was "the first strategic weapon capable of true mass production," writes Duke University historian George Reed. "To Hall, the new missile was the perfect weapon for a defense policy characterized by minimum expenditure and massive retaliation; and he urged that this be its chief selling point." Sputnik made it considerably easier for him to make the sale. A few days after the Soviets launched their satellite, Hall went to the Pentagon with Schriever to begin building support for the new missile. As they ascended through the ranks of the military hierarchy, Hall continued to refine his plans. By the end of the year, he had determined that "the ICBM version of Weapon System Q would be a three-stage, solid-fuel missile approximately 65 feet long, weighing approximately 65,000 pounds, and developing approximately 100,000-120,000 pounds of thrust at launch." The missile would be stored in underground silos and "would accelerate so quickly that it could fly through its exhaust flames and not be significantly damaged."[45]

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[42] General Bernard A. Schriever, interviewed by Major Lyn R. Officer and Dr. James C. Hasdorff, Washington, D.C., 20 June 1973, 6-7. HRA K239.0512-676.

[43] Neal, *Ace in the Hole*, 27.

[44] Perry, "The Atlas, Thor, Titan, and Minuteman," 155, 157.

[45] George Reed, "U.S. Defense Policy, U.S. Air Force Doctrine and Strategic Nuclear Weapon Systems, 1958-1964: The Case of the Minuteman ICBM," Ph.D. diss., Duke University, 1986, 58-59.

At the beginning of February 1958, Hall and Schriever presented the System Q concept to the Secretary of the Air Force and the Secretary of Defense. "We got approval of [the] program within 48 hours," Schriever remembered many years later.[46] The officers immediately gave the project a new name. On 28 February 1958, the *New York Times* reported that the Air Force had been authorized "to produce an advanced type of ballistic missile . . . called Minute Man."[47] The missile program was named the “Minute Man” as a symbolic reminder of the country’s military past and to reflect the quick response time designed into the missile system.

Minuteman

By the end of March 1958, at least seven of the nation's foremost aircraft manufacturers were competing for the opportunity to build the new missile. The Seattle-based Boeing Airplane Company was one of them. Although the company had produced many of the nation's largest strategic bombers, it had virtually no experience with missiles. Recognizing that it needed to break into this burgeoning field in order to remain competitive in the defense industry, Boeing mounted an all-out effort to win the Minuteman contract, assigning more than 100 key employees to work on the project. The effort paid off handsomely. When the contractor selection board met to examine the proposals, recalled one top Air Force official, "there was no question . . . that Boeing was the right company for the job."[48] In October 1958, Boeing won the contract to assemble and test the new missile.

During the next few months, the other members of the Minuteman team were also put into place. The Thiokol Chemical Company of Brigham City, Utah; the Aerojet General Corporation of Sacramento, California; and the Hercules Powder Company of Magna, Utah, all won contracts to work on the missile's propulsion stages. The contract for the missile's guidance and control systems went to the Autonetics Division of North American Aviation in Downey, California, and the AVCO Corporation of Boston was hired to build the Minuteman's thermonuclear warhead.[49]

Much of the development work for the Minuteman took place in northern Utah. Both Thiokol and Hercules already operated plants in the area, and within a few months, Boeing had moved into an enormous new assembly plant occupying 790 acres at Hill Air Force Base near Ogden. By the beginning of 1960, Boeing was beginning to put all the pieces together, and *Time* magazine reported that the desert north of Salt Lake was "boiling" with activity:

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[46] Schriever interview, 20 June 1973, 6-7.

[47] Jack Raymond, "500 to 5,500-Mile Missile is Approved for Air Force," *NYT*, 28 February 1958.

[48] Neal, *Ace in the Hole*, 113. Neal attributes the comment to Colonel Otto Glasser, who administered the Minuteman program from 1958 to 1959.

[49] Neal, *Ace in the Hole*, 113.

> Strange lights glare in the night, making the mountains shine, and a grumbling roar rolls across the desert. By day enormous clouds of steam-white smoke billow up . . . and drift over hills and valleys. Monstrous vehicles with curious burdens lumber along the roads. All these strange goings-on mark the development of the Minuteman, the solid-fuel missile that its proponents confidently expect will ultimately replace the liquid-fuel Atlas as the U.S.'s standard ICBM.[50]

By the end of 1960, the first complete Minuteman was taken to Cape Canaveral, Florida, for flight testing. The compact new missile was only six feet in diameter and 53 feet high -- about half the size of a Titan. Its three cylindrical, steel-cased propulsion stages were stacked one atop the other, with each stage slightly smaller in diameter than the one beneath it. Each stage was filled with a rubbery mixture of fuel and oxidizer, molded around a hollow, star-shaped core. The star-shaped core allowed for the propellant to have an initial large burning surface and therefore, an increased thrust, and to decrease as the points burned away. The Minuteman's inertial guidance system, designed to deliver a single warhead to a preprogrammed target, occupied a small compartment above the third stage. The "reentry vehicle" at the tip was identical to the nose cone that would eventually contain the missile's thermonuclear warhead.

Following two aborted launch attempts, the missile was successfully fired at 11 o'clock in the morning on 1 February 1961. Even the most experienced missile watchers found the event to be "a dazzling spectacle." The difference was apparent from the very beginning. First there was a loud bang when the Minuteman's first-stage engine ignited. Then the missile rose on a column of flame and smoke. Unlike the Atlas or Titan missiles, which left the ground "like a fat man getting out of an easy chair," the new Minuteman leaped off its launch pad and "shot up like a skyrocket."[51] And the missile performed flawlessly once it left the ground. Its three propulsion stages completed their burns precisely on schedule, then detached themselves and plummeted back to earth, while the unarmed warhead hurtled on toward its assigned destination. Twenty-five minutes after liftoff, the nose cone splashed down in the Atlantic Ocean squarely on target -- 4,600 miles from where it had started out. From his office in Washington, Air Force Chief of Staff General Thomas D. White described the launch as "one of the most significant steps this nation has ever taken toward gaining intercontinental missile supremacy." But an engineer who witnessed the event firsthand put it another way: "Brother," he said, "there goes the missile gap."[52] The missile gap was the perception that the Soviet Union had gotten ahead of the United States in missile development and production.

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[50] "Home of the Minuteman," *Time* 75 (25 January 1960): 48.

[51] Wesley S. Griswold, "Minuteman, Our Ace in the Hole," *Popular Science* 179 (July 1961): 62.

[52] "Closing the Gap," *Time* 77 (10 February 1961): 16. General White is quoted in Neal, *Ace in the Hole*, 41. While the Minuteman program was underway, the Air Force also continued its efforts to develop a viable liquid-fueled ICBM. In May 1960 the Glenn L. Martin Company was awarded a contract to develop an advanced version of the original Titan missile. The company responded by designing the Titan II, a second-generation ICBM that was considerably larger, more powerful and more accurate than the Titan I. The Titan II was also designed to utilize liquid propellants that could be stored for long periods at ordinary temperatures in the missile's own tanks. By eliminating the need to load tanks with propellants when an alert was sounded, this change made it possible to

The Underground Air Force

By the time the flight test took place, plans for deploying the Minuteman were already well underway. According to missile historian Jacob Neufeld, the Air Force had first described its ideas for an ideal ICBM base in March 1955, during the early days of the Atlas program:

> the missile would be sited inside fixed, underground facilities; it was to have a quick launch reaction; it was to be stored in a launching position; the launch site would require minimal support; and the launch units were to be self-supporting for two weeks.[53]

Turning these ideas into reality, however, proved to be an arduous task. The first operational Atlas missiles, hastily activated at the height of the Missile Gap hysteria in 1959, were simply set upright on the launch pads at Vandenberg Air Force Base, California. Later these missiles were stored horizontally in "coffins," -- concrete-walled, aboveground enclosures with open tops. Before the missiles could be fired, they had to be tilted to a vertical position and filled with propellants. The next improvement, in the Atlas "E" series missiles, placed the coffins in earthen berms covered with retractable, reinforced-concrete doors designed to provide a modest measure of protection against nuclear blasts. As a further refinement, the Titan I and Atlas "F" series missiles were stored upright in underground, concrete and steel silos capped with massive, double, "clamshell" doors. These installations were designed to withstand blast pressures of 100 pounds per square inch. Concerned that vibration from the rocket engines would shake the missiles to pieces before they left the ground, engineers equipped each silo with an elevator that raised the missile to the surface for firing. Although the missiles were stored with their tanks full of fuel, they still needed to be loaded with volatile liquid oxygen so that the fuel could be ignited. This loading process could only be done after the missiles had been raised to the surface, and it was a slow, delicate operation that increased the weapon's vulnerability and restricted its reaction time.[54]

The Air Force took an important step toward achieving its ideal basing system in 1960, when it began to develop the Titan II -- a second-generation missile that was designed to use completely storable liquid propellants. These missiles could be kept ready with fully loaded propellant tanks and could be quickly fired directly from their hardened underground silos. Nonetheless, the Titan IIs were still highly complex machines that required constant attention from on-site crew members. Consequently, each missile silo had to be connected to its own adjacent Launch Control Facility.

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launch the Titan II in approximately two minutes, following the command. See Lauber and Hess, "Glenn L. Martin Company," 59-61.

[53] Jacob Neufeld, *The Development of Ballistic Missiles in the United States Air Force, 1945-1960* (Washington, D.C.: Office of Air Force History, 1990), 176.

[54] Neufeld, *Development of Ballistic Missiles*, 192.

It was not until the Minuteman missile was added to the American arsenal that the ICBM basing program realized its cherished ideals of protected storage, minimal maintenance, and instantaneous response. Writes Air Force missile historian Ernest Schwiebert:

> The Minuteman could hide in its lethal lair like a shotgun shell, ready for instant firing. The operational launcher could be unmanned, underground, and hardened to withstand the surface burst of a nuclear weapon. Each launcher housed a single weapon and the equipment necessary to support and fire it, and required only periodic maintenance. The missiles could be fired . . . at a moment's notice.[55]

Deployment and Site Selection

The original Minuteman deployment plan, drafted in 1959, called for the creation of a single, immense, "missile farm," equipped with as many as 1,500 missiles. Planners soon determined, however, "that for reasons of economy 150 launchers should be concentrated in a single area, whenever possible, and that no area should contain fewer than 50 missiles."[56] Consequently, the nation's Minuteman force was organized into a series of administrative units called "wings" -- each comprised of either three or four 50-missile "squadrons." Each squadron was further subdivided into five smaller units, called "flights." A flight consisted of a single, manned, underground Launch Control Center, linked to ten unmanned, underground Facilities (silos). The silos were physically separated from the control center and from each other by a distance of several miles. The Air Force initially considered deploying the Minuteman as far south as Georgia, Texas, and Oklahoma, but when it became apparent that the early models of the missile would fall short of their intended 5,500-mile range, planners quickly determined that they could solve the problem by selecting sites "in the northern part of the United States relatively close to the Soviet Union."[57]

By early 1960 the Air Force had decided to locate the first Minuteman deployment area on the high plains around Great Falls, Montana. This small city offered virtually everything the planners had been looking for. It was the home of Malmstrom Air Force Base, which could provide crucial logistical support for the new installation. The area's low population density meant that civilian casualties in the event of an accident or attack would be minimized. The region had an established network of improved roads, and there was an abundance of easy-to-acquire public land.[58]

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[55] Ernest G. Schwiebert, *A History of the U.S. Air Force Ballistic Missiles* (New York: Frederick A. Praeger, 1965), 137.

[56] Clyde R. Littlefield, *The Site Program-1961*, AFSC Historical Publications Series 62-24-4, 68, BMO. The missile farm concept is described in Neal, *Ace in the Hole*, 132. The Air Force also considered basing the Minuteman on specially built railroad cars. After spending more than $108 million to develop the mobile deployment plan, the federal government abandoned the idea in December 1961. See Jack Raymond, "Plan for Missile on Rails Killed in Favor of Underground Sites," *NYT*, 14 December 1961.

[57] Littlefield, *The Site Program*, 68.

[58] For background on the Malmstrom selection, see Neal, *Ace in the Hole*, 154-55.

Construction of the Malmstrom complex began on 16 March 1961. The work progressed ahead of schedule, and in the spring of 1962, the Associated Press reported that the Montana silos were being "rushed to completion," and that the first missiles, each loaded with "one megaton of death and destruction," would be in place by "late summer."[59] Air Force crews began to lower the weapons into their silos at the end of July, and Malmstrom's first, ten-missile flight was hurriedly activated on 27 October 1962, at the height of the Cuban Missile Crisis.

Minuteman Comes to Ellsworth Air Force Base

In June 1960, while the plans for the Malmstrom missile field were still on the drawing board, the Air Force received authorization to add another 150 missiles to the Minuteman force. Planners immediately began looking for appropriate sites, and by early October, the search had been narrowed to three locations in North and South Dakota. The selection committee reached its decision at the end of December, and on 5 January 1961, U.S. Senator Francis Case of South Dakota announced that Ellsworth Air Force Base had been selected as headquarters for the nation's second Minuteman deployment area.[60] Located on the open prairies about 12 miles east of Rapid City, Ellsworth had been established in December 1941 as the Rapid City Army Air Base -- one of several airfields built by the Air Corps for training B-17 bomber crews. The installation also served as home base for many of the nation's largest strategic bombers. In addition, Ellsworth had been selected as headquarters for one of the nation's Titan I missile squadrons.[61]

Although the Defense Department had not yet officially approved the South Dakota Minuteman installation, Senator Case indicated that the land acquisition process would begin immediately, so that there would be "no loss of valuable time" once the project was approved. Area ranchers did not share Case's sense of urgency. Fearing that the federal government would use the high-priority status of the missile program as an excuse to pay below-market value for their property, the ranchers established the Missile Area Landowners' Association to negotiate fair land prices. The Association was careful to assure fellow citizens that their actions did "not necessarily slow the national defense effort."[62] While real estate negotiations were underway, the South Dakota State Highway Department used $650,000 from the Federal Bureau of Public Roads to improve 327 miles of gravel roads leading to the prospective missile sites. By mid-June 1961, Boeing was also busy with infrastructure improvements. Anticipating that the project would bring more than 3,000 workers into the area, the company raced to erect mobile-home camps and cafeterias near Wall, Sturgis, Belle Fourche, and Union Center, as well as in Rapid City.[63]

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[59] Jack Zygmond, "Montana Minuteman Silos Near Completion," *RCDJ*, 25 March 1962.

[60] "Here Comes the Minuteman," *RCDJ*, 5 January 1961.

[61] For background on the base, see Gordon Hanson, "Fifty Years of War and Pace at Ellsworth Air Force Base," and "Base Units Soared in Enemy Skies," both in *RCDJ*, 24 July 1992.

[62] Dick Rebbeck, "Missile Area Landowners Refuse to Sign Present Rights of Entry," *RCDJ*, 4 May 1961.

[63] See the following articles in *RCDJ*: "Roads to Missile Sites Get Crash Program Rush," 4 May 1961; "Minuteman Missile Schedule Here Revealed," 14 June 1961.

By early summer, more than three-quarters of all area landowners had agreed to give the government access to their land.[64] Once the sites had been finalized, the Ralph M. Parsons Company, an architectural/engineering firm from Los Angeles, began to prepare detailed plans for the South Dakota installations. The Air Force had assigned responsibility for actual construction of the Minuteman facilities to the U.S. Army Corps of Engineers Ballistic Missile Construction Office. In mid-June, the Corps sent out a request for construction bids, and within a month four of the nation's largest contracting firms had submitted proposals for the project. The low bid came from Peter Kiewit Sons' Company of Omaha, whose estimate of $56,220,274 was nearly $10 million below government projections.[65] On 1 August, the Corps gave Kiewit a fixed-price contract for "digging and pouring 150 underground silos 12 feet in diameter and 80 feet deep, plus fifteen control centers."[66] The construction sites would be distributed across an area of nearly 13,500 square miles located to the east, north, and northwest of Rapid City. Kiewit set to work immediately, hiring construction crews and moving heavy equipment onto the job sites.

A Silo a Day

The official groundbreaking ceremony for Ellsworth's Minuteman complex took place at Site Lima-06 near Bear Butte on 11 September 1961. The festivities started with a bang. While the Sturgis High School band played in the background, representatives from Boeing, Kiewit, the Corps of Engineers, and Ellsworth Air Force Base set off an explosive charge to begin the excavation.[67]

Despite extreme cold, high winds and heavy snowfall, construction activity proceeded at a furious pace through the winter of 1961-62. At a press briefing in mid-December, a Corps of Engineers spokesman told reporters that "men are working seven days a week, three shifts a day on Minuteman construction.... Crews …. are able to dig five silo emplacements simultaneously. Each takes from four to ten days [depending on soil conditions]." Work on the first squadron, near Wall, was "well underway," he said, and work on the second squadron, near Union Center, had already been started.[68]

The *Rapid City Daily Journal* explained how a hardened silo was built:

> Conventional earthmoving equipment scoops an open cut 12 feet deep. A backhoe perches on the edge of a large hole in this cut and digs a hole 20 feet deeper. The remaining 52 feet of depth is 'mined' by a

[64] "75 Per Cent Sign for Minuteman Entry," *RCDJ*, 3 July 1961.

[65] "Kiewit Lowest Bidder on Minuteman Project," *RCDJ*, 25 July 1961.

[66] "Minuteman Contract Awarded to Kiewit," *RCDJ*, 2 August 1961. For background on the Peter Kiewit Sons' Company, see Harold B. Meyers, "The Biggest Invisible Builder in the World," *Fortune* 73 (April 1966): 146-51, 197-98, 200.

[67] "Minuteman Job Formally Started Near Bear Butte," *RCDJ*, 11 September 1961.

[68] Niciejewski, "Minuteman Work Speeding."

> clamshell.... When each hole is at the full depth of 84 feet, a steel 'can' 12 feet in diameter is carefully positioned in it. Reinforced concrete is poured between the can and earth.[69]

In February 1962, General Delmar Wilson told the Rapid City Chamber of Commerce that despite an ongoing labor dispute between Peter Kiewit Sons' and the Ironworkers Union, South Dakota's missile program had suffered less work stoppage than any missile program in the nation. "We're all out… to assure that our way of life is maintained," said Wilson. He continued, "This missile project . . . is the number one project in the country today. If this guy in Russia wants to start a show, we'll be there to put a hole in him to the best of our ability."[70]

The construction continued at Ellsworth for another year and a half with the construction of Delta-09 was completed in late 1962. By early summer of 1963, the steel fabrication was finished at all 165 sites, and crews were completing the launchers at the rate of one per day.[71] On the last day of June, Ellsworth's first twenty launchers were turned over to the Strategic Air Command. On 23 October, the nation's second wing of Minuteman ICBMs was declared fully operational. The work had been completed nearly three weeks ahead of schedule.[72]

A Shift in Policy: From Massive Retaliation to Controlled Response

While the Ellsworth complex was under construction, work was also underway on several other Minuteman installations. When the full schedule was completed in 1967, the nation had 1,000 Minuteman missiles on alert in six separate deployment areas located throughout the north-central United States. In addition to the original installations at Malmstrom and Ellsworth, there were Minuteman complexes at Minot and Grand Forks Air Force Bases in North Dakota; Whiteman Air Force Base in Missouri; and F.E. Warren Air Force Base in Wyoming. Another squadron had also been installed at Malmstrom. As each new installation was put into place, the Air Force continued to improve and refine the Minuteman operational system.

One of the first significant improvements resulted from a policy change instituted during the early days of the Kennedy administration. Air Force historian Clyde Littlefield explains:

> During the first half of 1961, the national strategic concept completed a shift from massive retaliation to controlled response. In consonance with the earlier concept, the Air Force had designed the Minuteman as a quick reacting mass attack weapon.... A combat crew would fire a minimum of ten missiles. In order to conform to the new concept, engineering changes had to be made to allow a combat crew in a control center to switch targets and to fire one or more missiles selectively, conserving the remainder for

[69] Niciejewski, "Minuteman Work Speeding."

[70] "Wilson Lauds S.D. Missile Work," *RCDJ*, 16 February 1962.

[71] "Minuteman Missile Steel Work is Now Completed," *RCDJ*, 14 June 1963.

[72] "Ellsworth Takes Over First 20 Minutemen, " *RCDJ*, 1 July 1963; "Minuteman Wing Here Operational," *RCDJ*, 23 October 1963.

> later use.... Greater flexibility in targeting and firing required a significant extension to the limited survival time [of each operational site]. The [original] Minuteman facility design did not provide for the protection of the power supply.... At a control center, power generators were above the ground…. When and if these generators stopped functioning, the operational potential of the system would be reduced to only six hours. Revised strategic concepts required that the weapon survive at least nine weeks after an initial enemy attack.[73]

To meet the requirement of greater survivability, the Air Force decided to install the power generators at Minuteman sites in hardened underground capsules located next to each of the control centers. Although the Air Force investigated the feasibility of incorporating hardened generator capsules into the facilities at Ellsworth, construction had already started there by the time the decision was made, making the change impractical. Consequently, the generator capsules were introduced with the third Minuteman deployment area at Minot Air Force Base, North Dakota. Thus, the only Minuteman sites to reflect fully the nation's original Cold War strategy of massive retaliation were those at Malmstrom and Ellsworth.

Minuteman II

By the time planning began for the final Minuteman deployment area, the Air Force had developed a vastly improved version of the missile itself. The new missile, called the Minuteman II, offered improved range, greater payload, more flexible targeting, and greater accuracy, leading one Air Force spokesperson to estimate that its "kill capacity" was "eight times that of Minuteman I."[74] In early 1964, Secretary of Defense Robert McNamara told the House Armed Services Committee that the Defense Department was planning to upgrade the first five deployment areas by replacing their Minuteman I missiles with the more advanced Minuteman IIs.[75] The project was approved in the spring of 1965, and the first of the new missiles were deployed at Grand Forks Air Force Base, North Dakota, in 1966. In the fall of that year, South Dakota Congressman E.Y. Berry announced that the retrofit program would also be employed at Ellsworth. According to Berry, the new missiles would help Ellsworth maintain its position as "one of the nation's most important military installations."[76] The new missiles arrived in South Dakota in October 1971, when Boeing began to refit the Ellsworth silos to accommodate the Minuteman II system. The project was completed on 13 March 1973.[77]

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[73] Littlefield, *The Site Program*, 80-81.

[74] "Minuteman II Emplacement Cost to Top $1 Billion," *Missiles and Rockets* 16 (24 May 1965): 12.

[75] Hal Taylor, "McNamara Voices Some Optimism Over Nike-X, Tells Minuteman Plans," *Missiles and Rockets* 14 (3 February 1964): 20.

[76] "Minuteman Updating Due Soon," *RCDJ*, 19 September 1966.

[77] "Fact Sheet, 44th Missile Wing," Media Relations Department, Ellsworth Air Force Base, June 1992. Also see "Chronology 44th Strategic Missile Wing, 44th Combat Support Group, 1 January through 31 December 1973." Both documents are on file at the 44th Missile Wing History Office, Ellsworth Air Force Base, S.Dak.

Minuteman III

Meanwhile, the Air Force was already planning for yet another version of the Minuteman. In May 1964 the Soviet Union had put a battery of anti-ballistic missiles on display in Moscow's Red Square, prompting concern about the vulnerability of Minuteman I and II missiles.[78] Consequently, in 1965, the Air Force began to develop an advanced version of the missile called the Minuteman III. By late summer of 1968, the new missile was ready for testing.

Longer and more powerful than its predecessors, the Minuteman III was equipped with an improved guidance system that could be retargeted in a matter of minutes. But according to the *New York Times*, the missile's "most telling advantage" lay in its "revolutionary new warhead -- the MIRV, for multiple independently targeted reentry vehicle." This new warhead could deliver three hydrogen bombs to widely scattered targets, a capability that would "render current and contemplated antimissile defense systems largely inadequate," and would thus "thrust the world into a new era of weapons for mass destruction."[79]

The Minuteman III was deployed in existing silos at F.E. Warren, Minot, Grand Forks, and Malmstrom Air Force Bases. Unlike the Minuteman II modification, which was basically a matter of reequipping existing facilities, the Minuteman III upgrade involved some structural reconstruction. At the launch silos, a new suspension system was installed to hold the missile absolutely motionless during the aftershock of a nuclear attack. In addition, the silo closure doors were rebuilt with a ten-inch-thick layer of borated concrete to protect the missile from radiation, and the ballistic actuators that opened the doors were rebuilt to handle the extra load. The refurbished silos were also equipped with a system of seals, filters, and surge arrestors designed to prevent sensitive electronic equipment from being damaged by the powerful electromagnetic waves generated during nuclear explosions.[80] When the last of the nation's 550 Minuteman III missiles was lowered into its silo at Malmstrom Air Force Base, Montana, in July 1975, only 450 Minutemen II remained in the American arsenal -- at Malmstrom, Ellsworth, and Whiteman Air Force Bases. This force structure of 1,000 ICBMs remained intact for nearly two decades.[81]

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[78] Reed, "Case of the Minuteman," 267.

[79] "Two New Missiles to Get Test Today," *NYT*, 16 August 1968.

[80] The Minuteman III modifications are discussed in detail in Barry Miller, "ICBMs Get Major Modification," *Aviation Week and Space Technology* 104 (10 May 1976): 67-70. Minuteman II changes included installation of new electronic ground support equipment in existing racks at both the launch control and launch facilities, and the installation of electronic filters, seals, and circuit-breaking equipment at both sites to protect the facilities against damage from the electromagnetic pulses released by atomic blasts. Because the Minuteman II was slightly longer than the Minuteman I, the missile support ring inside the launch silo was lowered by lengthening suspension cables. The optical alignment system was adapted to work with the new missile by welding stops to the autocollimator bench to limit the instrument's range of motion. The retractor mechanism for the umbilical cable was relocated, and several other cables and fluid lines within the Missile Launcher were rerouted. No structural changes were required at either the launch facility or the launch control facility to accommodate the new missile. See "What's 'Force Mod?,'" *Minuteman Service News* 23 (November-December 1965): 11.

[81] Fifty Minuteman IIIs at F.E. Warren Air Force Base were replaced with Peacekeeper (MX) missiles in 1986, as described in "Minuteman Deployment and Modification Matrix," 26.

Reduction and Deactivation

During the late 1980s, the world saw unmistakable signs that the lengthy Cold War period was coming to an end. By the end of the decade, the Berlin Wall had been dismantled, Germany had been reunified, and a number of former Eastern Bloc nations had replaced their Communist regimes with democratically elected governments. As the new decade began, the Soviet Union disintegrated rapidly as its constituent republics declared their independence one by one. When the Warsaw Pact was dissolved in March 1991, the enemy that President Ronald Reagan had once called "the evil empire" essentially ceased to exist.[82] Four months later, on 31 July 1991, President George H.W. Bush and Soviet Leader Mikhail Gorbachev signed the *Treaty Between the United States of America and the Union of the Soviet Socialist Republics on the Reduction and Limitation of Strategic Offensive Arms* (START Treaty), which placed a limit on the number of ICBMs and prescribed a process for the destruction of their Launch Facilities.

The START Treaty coincided with growing Air Force disenchantment with escalating costs associated with repairing and maintaining the older Minuteman II system. Rather than upgrade Minuteman II facilities with Minuteman III, the Pentagon decided to deactivate the entire Minuteman II force to help comply with provisions of the arms-reduction treaty. On 27 September 1991, Bush appeared on national television to announce a dramatic "plan for peace," designed to reduce the tensions of the nuclear age. As one component of his plan, he called for "the withdrawal from alert within 72 hours, of all 450 Minuteman II intercontinental ballistic missiles," including the missiles at Ellsworth Air Force Base.[83]

Five weeks later, on 3 December 1991, an Air Force crew arrived at Launch Facility Golf-02, located near Red Owl, about 60 miles northeast of Rapid City. They had come to remove the first of Ellsworth's 150 Minuteman IIs:

> Disarmament began with snow shovels at dawn, . . . as Airman 1st Class James Comfert and his colleagues cleared the launch-door rail. . . . Six hours later, a Minuteman II intercontinental ballistic missile was stored safely in its transporter/erector truck. G-2 was just a high-tech hole in the ground.[84]

According to the *Rapid City Daily Journal*, the Ellsworth deactivation process would continue for at lease three more years:

> First, warheads and guidance systems [will be] removed. Then the missiles will be pulled. . . . The headframes of the missile silos will be destroyed and the tubes will be filled with rubble. The launch

[82] For a concise summary of these events, see "End of the Cold War," *The CQ Researcher* 2 (21 August 1992): 721.

[83] Aida E. Roig-Compton, "1991 Annual Brief History, 44th Missile Wing," 1992, 1. On file at the 44th Missile Wing History Office, Ellsworth Air Force Base, S.Dak. The 44th Strategic Missile Wing was inactivated in 1994, records from the 44th Missile Wing History Office have been sent to the Air Force Historical Research Agency at Maxwell Air Force Base, Montgomery, Ala.

[84] Bill Harlan, "ICBM Silo Becomes Hole in the Plains," *RCDJ*, 4 December 1991.

control capsules will be buried under rubble and a thick concrete cap. The land and aboveground buildings at launch control centers will be sold.[85]

By late 1996, 149 of the original 150 Launch Facilities at Ellsworth had been imploded in accordance with terms of the START Treaty. Only one Launch Complex remained intact, consisting of Minuteman ICBM Launch Control Facility Delta-01 and Launch Facility Delta-09.[86] These sites were spared with the intention of converting them into interpretive museum facilities open to the general public.

III. Significance of Delta-01 and Delta-09 as Compared to Other ICBM Sites

Comparison to Other Land-Based ICBM Installations

Other sites relating to the Minuteman ICBM Delta-01 Launch Control Facility and Delta-09 Launch Facility include the first and second generation ICBMs -- Atlas, Titan I, and Titan II. All of the first-generation ICBM Atlas and Titan I sites were deactivated by the Air Force by the end of 1965. These missile sites were then partially dismantled and many were sold to entrepreneurs. Two second-generation, liquid-fueled Titan II sites have survived. The first, Site 571-7, now operated by the Titan Missile Museum, is located near Tuscon, Arizona, and has been designated a National Historic Landmark.[87] The other Titan II Site, 395 Charlie, is located within Vandenberg Air Force Base, where Titan missiles were tested and where missiles were maintained on alert for a short period of time.

The Minuteman missile introduced several notable technological advances over earlier ICBMs, including fuel type, reliability, accuracy, and mass-producibility. In addition, the basing systems for the Minuteman and the Titan were substantially different. The Minuteman had one Launch Control Center linked to ten missiles. Each Titan II control center, in contrast, could launch only one missile. Therefore, Delta-01 and Delta-09 represent technological advancements from earlier ICBMs, such as Atlas, Titan I, and Titan II are significant as representatives of the next generation of ICBMs.

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[85] Bill Harlan, "South Dakotans Grew Up with Aged Minuteman," *RCDJ*, 4 December 1991.

[86] Donald Meuschke, Natural Resource Manager, Whiteman Air Force Base, Mo., telephone interview with John Lauber, 22 October 1996.

[87] Stumpf, "National Historic Landmark Nomination: Titan II ICBM Missile Site 8 (571-7)," TMs, 1993. On pages 18 and 19 of his nomination, Stumpf specifically mentioned the proposal to preserve Ellsworth sites Delta-01 and Delta-09. Noting that "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," he stated that, in his opinion, both the Titan II and Minuteman ICBMs "possess exceptional national significance for which representative sites would be worthy of NHL designation."

Comparison to Other Minuteman Sites
When the nation's Minuteman force reached full strength in 1967, it consisted of 1,000 Minuteman I and Minuteman II missiles, divided among six deployment areas, as follows:

200 missiles at Malmstrom Air Force Base, Montana (Wing I)
150 missiles at Ellsworth Air Force Base, South Dakota (Wing II)
150 missiles at Minot Air Force Base, North Dakota (Wing III)
150 missiles at Whiteman Air Force Base, Missouri (Wing IV)

200 missiles at F. E. Warren Air Force Base, Wyoming (Wing V)
150 missiles at Grand Forks Air Force Base, North Dakota (Wing VI)

The Minuteman missiles for each flight were housed in individual, hardened underground silos (Launch Facilities) located several miles apart. A network of buried cables connected the ten silos in each flight to a central underground command post (Launch Control Facility). Each command post was staffed at all times by a two-person Air Force launch crew. An aboveground support building at each Launch Control Facility provided accommodations for security guards and other personnel.

Facilities at the six deployment areas were originally built according to three similar, yet clearly distinguishable, standard plans, each reflecting a distinct phase in the evolution of both strategic policy and missile technology. The nation's first two Minuteman deployment areas, activated at Malmstrorm Air Force Base, Montana, in 1962 and at Ellsworth Air Force Base in 1963, were designed specifically to implement the massive retaliation strategy formulated by the Eisenhower administration during the early Cold War period. The facilities at Minot, Whiteman, and Warren Air Force Bases, activated in 1964 and 1965, incorporated a number of design refinements required by the Kennedy administration's shift to a "controlled response" strategic policy in 1961. The facilities at Grand Forks Air Force Base, activated in 1966, and at a fifty-missile unit (Squadron 20) added to the Malmstrom deployment area in 1967, also conformed to the requirements of the controlled response policy, but were designed specifically to accommodate the Minuteman II weapon system.[88]

Under the massive retaliation policy, combat crews were expected to respond to an attack by immediately launching all of the missiles under their control, sending them to pre-selected targets. Because the entire Minuteman flight was expended in one swift action, there was no need to protect the facilities for an extended period of time following the launch. Therefore, power generation equipment necessary for launch could be located in unhardened facilities located aboveground. Facilities constructed in accordance with the "controlled response" policy, however, were required to survive an attack and remain operational for up to nine weeks so that crews could retarget and selectively launch one or more missiles as battle conditions dictated. To make sure that the installations could retain their launch capability for an extended period of time, power generation

[88] "Minuteman II Emplacement Cost to Top $1 Billion," 12.

equipment was placed in hardened enclosures beneath the surface. Physical facilities erected at the six deployment areas clearly reflect the change in policy. At Ellsworth and Malmstrom, mechanical support equipment for the Launch Control Facilities and Launch Facilities was housed in "soft" buildings located at ground level. At all subsequent sites, this equipment was installed in blast-proof "hardened" enclosures underground.

In 1966, the Air Force began to replace the nation's entire Minuteman I arsenal with an improved version of the missile called the Minuteman II. This "Force Modernization Program," completed at Ellsworth Air Force Base in 1973, required no major structural modifications to existing facilities.[89] A more significant change was initiated in 1971, when the Minuteman II launchers at Minot, Grand Forks, F. E. Warren, and Squadron 20 at Malmstrom were rebuilt to accommodate the more advanced Minuteman III missile. By 1975, 550 silos in these deployment areas had been equipped with new electronic ground support equipment and missile suspension systems, and their closure doors had been reinforced with nearly twenty tons of additional concrete. Closure doors on the remaining Minuteman II launchers at Whiteman and Malmstrom were reinforced at about the same time. The facilities at Ellsworth, however, remained unaltered, apparently because there was some question whether soil conditions would properly support the added weight of the modifications. After the Minuteman III modifications were completed at the other bases, the 150 Launch Facilities and 15 Launch Control Facilities at Ellsworth remained the only facilities representing the original Minuteman configuration.

Following the dissolution of the Soviet Union in 1991, President George H. W. Bush ordered the immediate deactivation or upgrade of all 450 remaining Minuteman II sites, divided equally among Ellsworth, Malmstrom, and Whiteman Air Force Bases. The 150 Minuteman II launchers at Malmstrom Air Force Base were scheduled for conversion to the Minuteman III system, and the necessary missiles were eventually transferred from the Grand Forks Minuteman III installation, which in turn was deactivated. The Minuteman II launchers at Ellsworth and Whiteman Air Force Bases were slated for demolition instead of upgrade.[90]

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[89] The Force Modernization Program was authorized in 1963, and was implemented at the nation's 800 Minuteman I sites over the next ten years. As military historian Michael Binder observed in his 1993 HAER study of Ellsworth Sites Delta-01 and Delta-09, the generic program included improved electromagnetic pulse protection and physical strengthening of launch facilities against nuclear attack; installation of advanced electronic equipment in launch facilities and Launch control centers for command, status, and monitoring of the new Minuteman II; extended survivability (new batteries); and silo upgrades. At Ellsworth, however, "not all of the program's components were implemented. For example, the electromagnetic pulse hardening went only halfway. Another feature unique to Ellsworth was the partial ... silo upgrade, meaning that, compared to the other five Minuteman wings, Ellsworth's silos did not receive the same degree of hardening. For example,… extra concrete was *not* added to the top of the launcher closure and closure surround, perhaps due to the 'soft' ground in which many of Ellsworth's silos sat." Because of the limited alterations at the South Dakota installations, Binder concludes that the Ellsworth sites are the least modified of all the six Minuteman wings, and "therefore the wing is most closely representative of the original Minuteman I deployment." See Michael S. Binder, "Thirty Minutes to Armageddon," Draft Historic American Engineering Record, WS-133A-M, Ellsworth Air Force Base, Launch Control Facility D-1, and Launch Facility D-9, 1993.

[90] Chuck Haga, "A Missile Leaves the Prairie -- Quietly," *Minneapolis Star-Tribune*, 9 June 1996.

By late 1996, 149 of the original 150 Minuteman Launch Facilities at Ellsworth had been imploded in accordance with the terms of the START Treaty. A single Launch Complex, consisting of Launch Control Facility Delta-01 and Launch Facility Delta-09, was kept intact for purposes of future historical interpretation for the general public. At Whiteman Air Force Base, all 150 of its Minuteman II Launch Facilities were imploded by 1997.[91] The underground Launch Control Center, Oscar-01, located on Whiteman Air Force Base, was retained for public interpretation and is available to tour.

A comparison of the Whiteman facility and former Ellsworth facility reveals some significant differences. First, Oscar-01 at Whiteman reflects the "controlled response" era of Minuteman design, with its ground support facilities hardened belowground. In contrast, the Delta Flight Launch Complex, formerly of Ellsworth, belongs to the earlier period of massive retaliation, as indicated by the "soft" siting of its support facilities aboveground. Second, the Whiteman site is located on the Air Force Base proper, instead of being dispersed, like the Ellsworth sites, in a remote missile field, as was more typical of the Minuteman basing configuration. Third, Whiteman's Oscar-01 is not a complete Launch Complex. Not only does it lack a silo Launch Facility, but it also lacks an aboveground Launch Facility support building. In a typical Minuteman Launch Complex, such as represented by the former Ellsworth Site Delta-01, the Launch Control Facility support building provided accommodations for Air Force personnel stationed in the missile field, and served as a security control center. Since the surrounding air base provided Whiteman's Oscar-01 with these services, a separate Launch Control Facility support building was considered unnecessary.

Conclusion

The significance of Minuteman ICBM Launch Control Facility Delta-01 and Launch Facility Delta-09 has been recognized through the establishment of the Minuteman Missile National Historic Site. The Delta Flight Launch Complex, originally associated with Ellsworth Air Force Base, is the only remaining formerly operational intact example of the original Minuteman basing configuration, designed to implement the Cold War policy of massive retaliation. The Delta Flight complex is also the only intact Minuteman II site remaining in the United States that contains a Launch Control Facility and Launch Facility. The complex is nationally significant under Criterion A in the area of history as a representation of the United States early Cold War policy of massive retaliation. The complex, originally designed as Minuteman and updated to Minuteman II, physically represents policies and products of the Cold War. Technologically the complex is nationally significant under Criterion C: Engineering as an intact example of the Minuteman I system and for its ability to demonstrate major technological advancements in missile technology.

[91] Donald Meuschke, telephone interview with John Lauber, 22 October 1996 and "Last Minuteman II missile silo imploded," *Air Force News*, n.d., <http://www.af.mil/news/Dec1997/n19971222_971628.html> (19 March 2003).

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Geographical Data

UTM References (continued):

Delta-09

5	13	728780	4867500
	Zone	Easting	Northing

6	13	727605	4867680
	Zone	Easting	Northing

Verbal Boundary Description:
The Minuteman ICBM Launch Complex is a discontiguous historic district including two sites, Launch Control Facility Delta-01 and Launch Facility Delta-09. The boundary of Delta-01 includes 6.4 acres within the northeast quarter of the northeast quarter of Section 16, Township 2 South, Range 18 East including legal tracts FD-100, FD-103, FD-104 and FD-100E-1. The boundary of Delta-09 includes 90 acres within the northeast quarter of Section 26, Township 1 South, Range 16 East, including the south half of the northeast quarter of the northeast quarter, the southeast quarter of the northeast quarter, the east half of the east half of the southwest quarter of the northeast quarter, the southeast quarter of the southeast quarter of the northwest quarter of the northeast quarter, the northeast quarter of the northeast quarter of the southeast quarter, the east half of the northwest quarter of the northeast quarter of the southeast quarter, and the northwest quarter of the northwest quarter of the northeast quarter of the southeast quarter. The Minuteman ICBM Launch Complex encompasses a total of approximately 96.4 acres. The boundaries of Delta-01 and Delta-09 are delineated on the historic boundary maps entitled “Minuteman ICBM Launch Control Facility Delta-01” and “Minuteman ICBM Launch Control Facility Delta-09.”

Boundary Justification:
The boundary of the Minuteman ICBM Launch Control Facility Delta-01 and Launch Facility Delta-09, Ellsworth Air Force Base encompasses the areas that were historically used by the Air Force to operate Delta-01 and Delta-09. The boundary at Delta-01 corresponds to the 6.4 acre parcel that was transferred from the Air Force to the National Park Service. The boundary at Delta-09 was delineated to encompass the 90 acres of the site historically used by the Air Force. Ten acres were in an exclusive use area and included the area within the security fence. The remaining 80 acres, in concurrent use, were under ownership of the United States Forest Service and operated by the Air Force under a Memorandum of Understanding. The concurrent use area includes the azimuth markers located approximately 1,000 feet to the northeast and northwest of the missile launcher, the HICS markers south of the security fence, and the cathodic protection rectifier on the southside of the access road.

Photographs

The following information pertains to the photographs:

Minuteman Launch Control Facility Delta-01
West side of Jackson County Road CS23A, approximately .5 miles north of Interstate-90, exit 127
Jackson County, South Dakota

Minuteman Launch Facility Delta-09
West side of Pennington County Road T512, approximately .6 miles west and south of Interstate-90, exit 116
Pennington County, South Dakota

Historic American Engineering Record (HAER) photographs (SD-50) taken by Robert Lyon, November 1992 and January 1993.
HAER negatives in the collection of the Library of Congress.

Other photographs taken by Christina Slattery, Mead & Hunt, November 2002.
Negatives in the collection of the National Park Service.

Photo 1 of 42
Minuteman Launch Control Facility Delta-01
Aerial view
View facing north
HAER photograph SD-50-A-2

Photo 2 of 42
Minuteman Launch Control Facility Delta-01
Aerial view
View facing west
HAER photograph SD-50-A-1

Photo 3 of 42
Minuteman Launch Control Facility Delta-01
Support building, main facade
View facing northwest

Photo 4 of 42
Minuteman Launch Control Facility Delta-01
Support building, main facade
View facing north

Photo 5 of 42
Minuteman Launch Control Facility Delta-01
Entrance gate and east wall of support building
View facing west

Photo 6 of 42
Minuteman Launch Control Facility Delta-01
Security Control Center
View facing north

Photo 7 of 42
Minuteman Launch Control Facility Delta-01
Support building, rear side
View facing west

Photo 8 of 42
Minuteman Launch Control Facility Delta-01
Heated vehicle storage building
View facing northwest

Photo 9 of 42
Minuteman Launch Control Facility Delta-01
Code burner with hard HF transmit antenna in background
View facing northeast

Photo 10 of 42
Minuteman Launch Control Facility Delta-01
Helicopter pad
View facing southwest

Photo 11 of 42
Minuteman Launch Control Facility Delta-01
Support building interior, day room
View facing west

Photo 12 of 42
Minuteman Launch Control Facility Delta-01
Support building interior, facility manager bedroom
View facing southwest

Photo 13 of 42
Minuteman Launch Control Facility Delta-01
Diesel generator room, diesel motor generator, diesel fuel day tank at right rear
View facing northwest
HAER photograph SD-50-A-47

Photo 14 of 42
Minuteman Launch Control Facility Delta-01
Security Control Center
View facing east
HAER photograph SD-50-A-50

Photo 15 of 42
Minuteman Launch Control Facility Delta-01
Reinforcing steel and forms for egg of Launch Control Center
View facing northwest
HAER photograph SD-50-24
Photographic copy of photograph (c. 1962, original print in possession of Peter Kiewit Sons' Co., Omaha, Nebraska. Photographer unknown)

Photo 16 of 42
Minuteman Launch Control Facility Delta-01
Launch Control Center, nearly buried
View facing southeast
HAER photograph SD-50-30
Photographic copy of photograph (c. 1962, original print in possession of Peter Kiewit Sons' Co., Omaha, Nebraska. Photographer unknown)

Photo 17 of 42
Minuteman Launch Control Facility Delta-01
Launch Control Center, exterior side of blast door
View facing southeast

Photo 18 of 42
Minuteman Launch Control Facility Delta-01
Launch Control Center, exterior side of blast door
View facing southeast

Photo 19 of 42
Minuteman Launch Control Facility Delta-01
Launch Control Center, interior side of blast door
View facing north
HAER photograph SD-50-A-56

Photo 20 of 42
Minuteman Launch Control Facility Delta-01
Launch Control Center interior
View facing east

Photo 21 of 42
Minuteman Launch Control Facility Delta-01
Launch Control Center, communications control (deputy commander's) console
View facing southeast

Photo 22 of 42
Minuteman Launch Control Facility Delta-01
Launch Control Center, launch control (commander's) console
View facing east

Photo 23 of 42
Minuteman Launch Control Facility Delta-01
Interior of launch Control Center, commanders launch control console, plexiglass shield up
View facing east
HEAR photograph SD-50-A-69

Photo 24 of 42
Minuteman Launch Control Facility Delta-01
Interior of Launch Control Center, escape hatch
View facing southeast
HAER photograph SD-50-A-84

Photo 25 of 42
Minuteman Launch Facility Delta-09
Aerial view
View facing southwest
HAER photograph SD-50-C-1

Photo 26 of 42
Minuteman Launch Facility Delta-09
General view
View facing east

Photo 27 of 42
Minuteman Launch Facility Delta-09
General view
View facing southwest

Photo 28 of 42
Minuteman Launch Facility Delta-09
General view
View facing south

Photo 29 of 42
Minuteman Launch Facility Delta-09
Viewing enclosure
View facing west

Photo 30 of 42
Minuteman Launch Facility Delta-09
Viewing enclosure and support building
View facing west

Photo 31 of 42
Minuteman Launch Facility Delta-09
Viewing enclosure and access hatch
View facing southwest

Photo 32 of 42
Minuteman Launch Facility Delta-09
Access hatch
View facing southwest

Photo 33 of 42
Minuteman Launch Facility Delta-09
Viewing enclosure and launcher closure detail
View facing northeast

Photo 34 of 42
Minuteman Launch Facility Delta-09
Missile silo detail with launcher closure
View facing southeast

Photo 35 of 42
Minuteman Launch Facility Delta-09
Missile enters the transporter/erector
View facing north
HAER photograph SD-50-C-18

Photo 36 of 42
Minuteman Launch Facility Delta-09
Personnel access ladder
View from upper level of underground Launch Facility looking up to personnel hatch
HAER photograph SD-50-C-24

Photo 37 of 42
Minuteman Launch Facility Delta-09
Upper level, alignment/autocollimator ring
View taken in interior of upper level of Launch Facility
HAER photograph SD-50-C-35

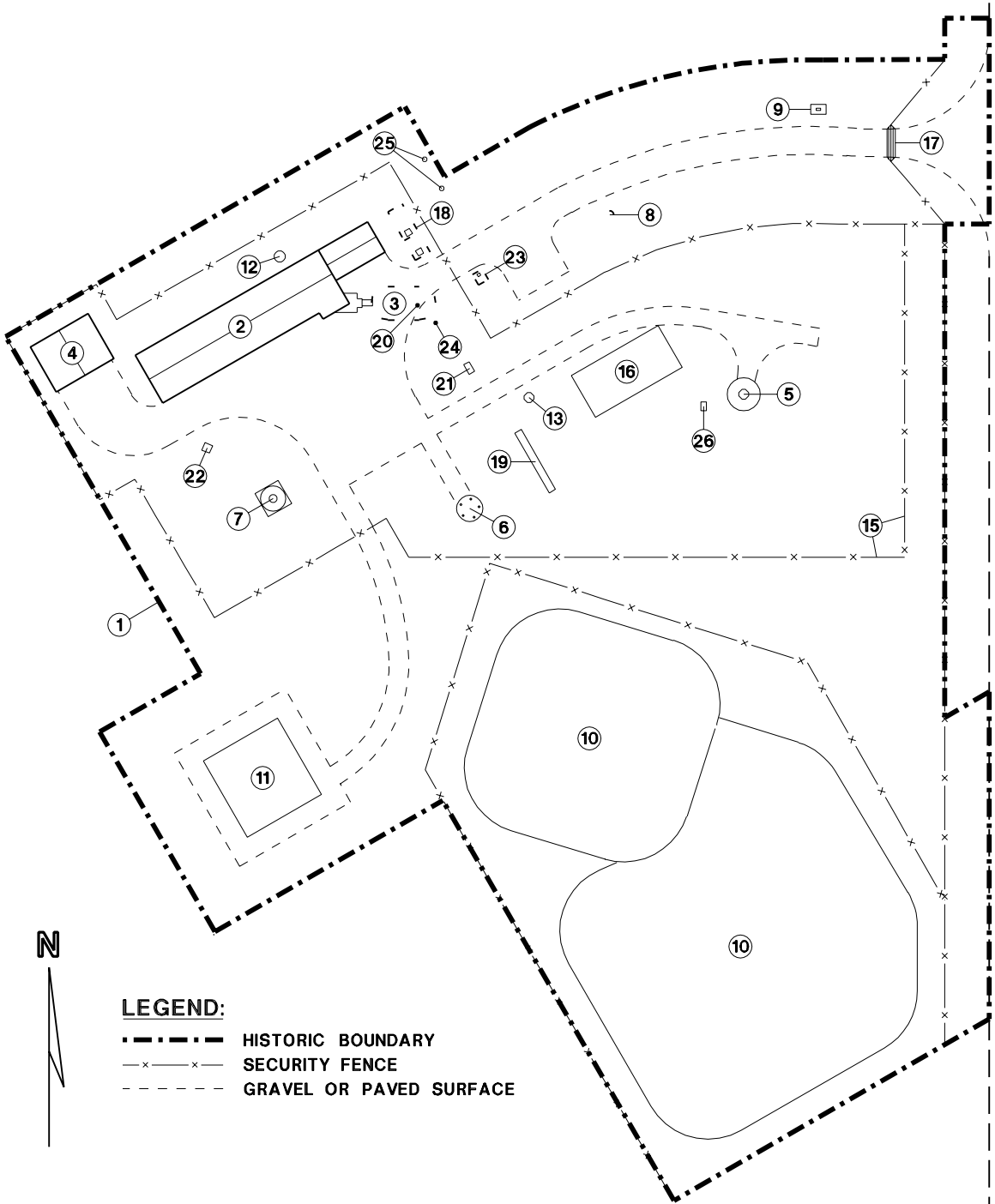
Photo 38 of 42
Minuteman Launch Facility Delta-09
Upper Level, electronic racks (Left to right – status command message processing group, UHF radio, IMPSS rack security, power supply group rack)
View taken in interior of upper level Launch Facility
HAER photograph SD-50-C-40

Photo 39 of 42
Minuteman Launch Facility Delta-09
Lower level, ballistic gas generator at left, LDB panel at right
View taken in interior of upper level Launch Facility
HAER photograph SD-50-C-33

Photo 40 of 42
Minuteman Launch Facility Delta-09
Support building
View facing southeast

Photo 41 of 42
Minuteman Launch Facility Delta-09
Launch interior
Diesel motor generator at center left, diesel electric unit at upper center, batteries at bottom center
View facing northwest
HAER photograph SD-50-C-55

Photo 42 of 42
Minuteman Launch Facility Delta-09
Northeast azimuth marker (outside of security fence)
View facing southwest



MAP KEY:

CONTRIBUTING RESOURCES:

1. LAUNCH CONTROL FACILITY DELTA-01 SITE
2. LAUNCH CONTROL FACILITY SUPPORT BUILDING
3. LAUNCH CONTROL CENTER
4. HEATED VEHICLE STORAGE BUILDING
5. HARD HF TRANSMIT ANTENNA
6. HARD HF RECEIVE ANTENNA
7. HARDENED UHF ANTENNA
8. SLFCS ANTENNA
9. CATHODIC PROTECTION RECTIFIER
10. SEWAGE LAGOON
11. HELICOPTER PAD
12. ISST ANTENNA
13. TV SATELLITE DISH
14. HICS (UNDERGROUND - NOT MAPPED)

ASSOCIATED SITE FEATURES:

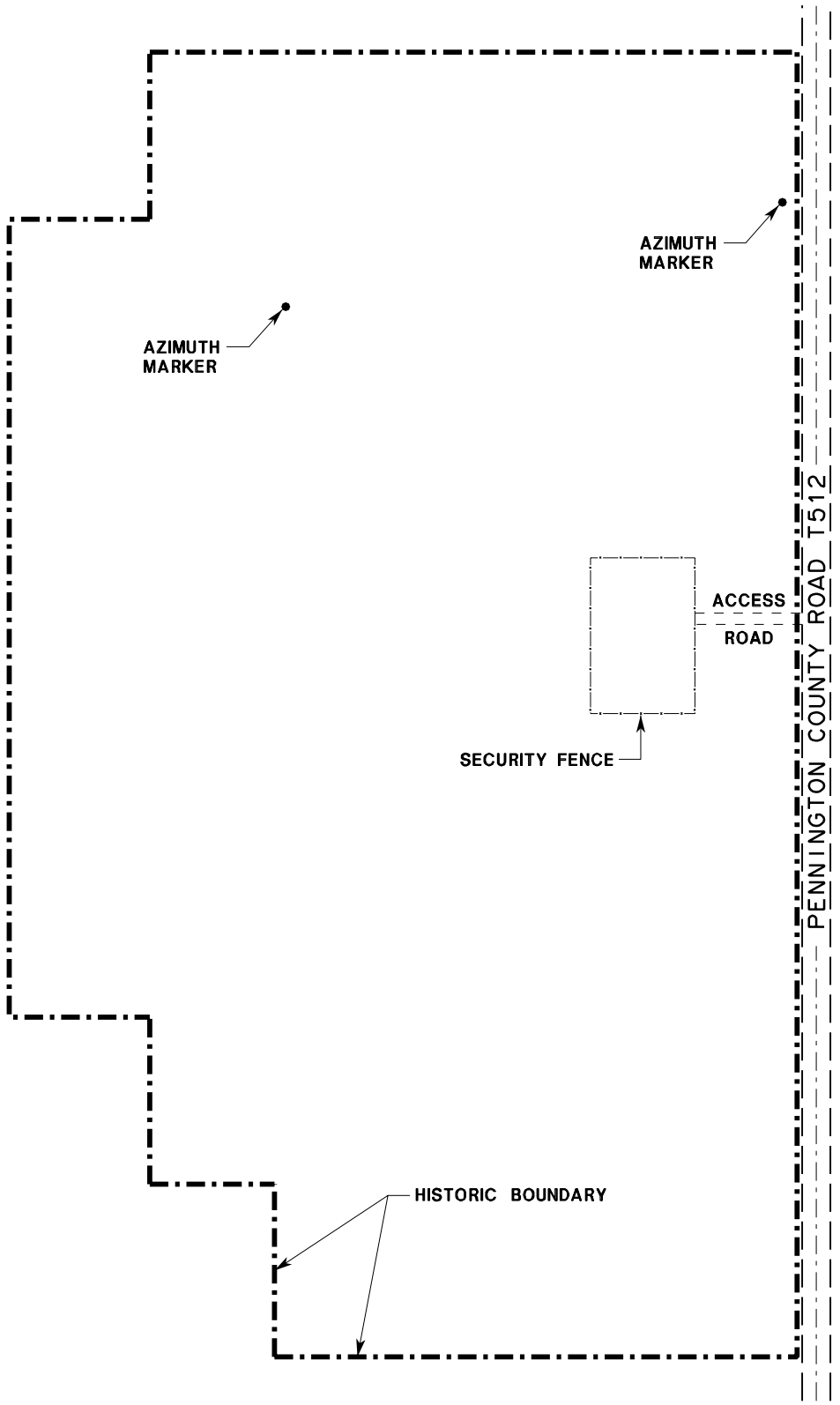
15. SECURITY FENCE
16. VOLLEYBALL COURT
17. CATTLE GUARD
18. UNDERGROUND DIESEL STORAGE TANK
19. HORSESHOE PIT
20. BASKETBALL HOOP
21. ABOVEGROUND DIESEL TANK
22. WATER WELL
23. GAS PUMP
24. FLAGPOLE
25. UTILITY POLES
26. CODE BURNER

MINUTEMAN ICBM LAUNCH CONTROL FACILITY DELTA-01

MINUTEMAN MISSILE NATIONAL HISTORIC SITE
SITE PLAN
JACKSON COUNTY, SOUTH DAKOTA

FEET
0 25 50 100
(approximate scale)

SOURCE:
National Park Service, Modified by Mead & Hunt, Inc.



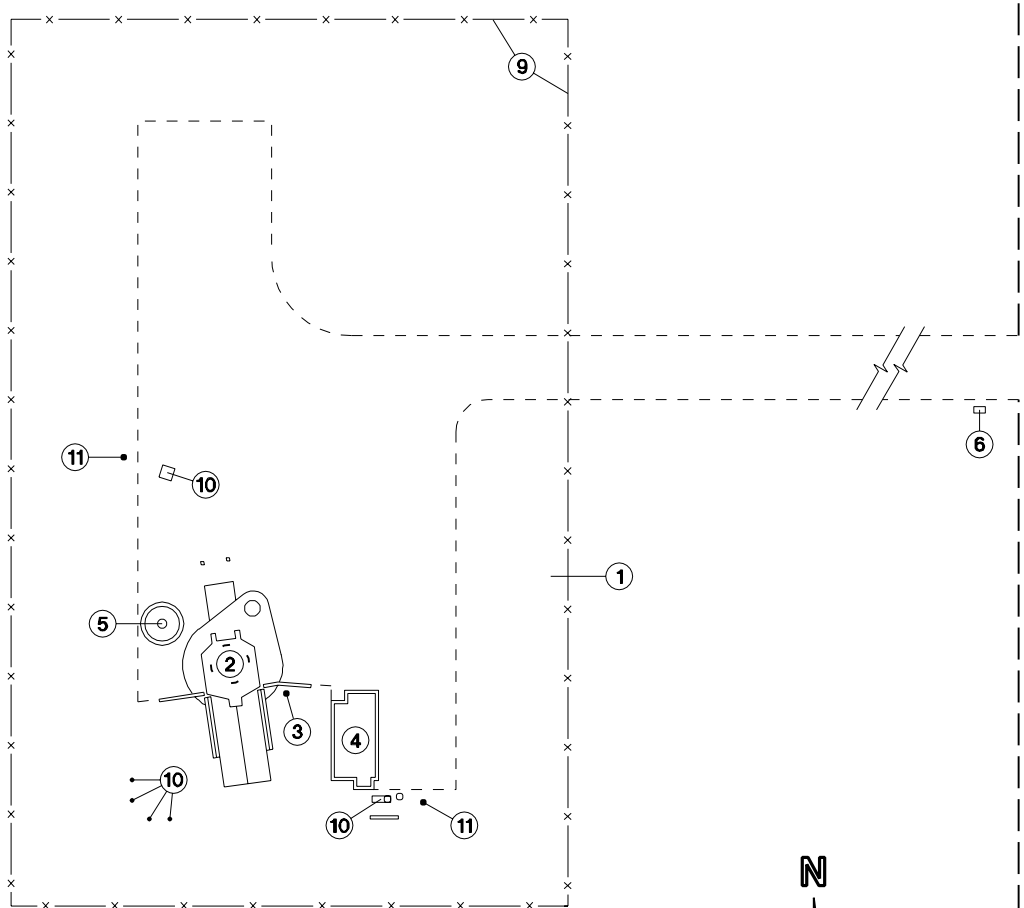
N

NOT TO SCALE

MINUTEMAN ICBM LAUNCH FACILITY DELTA-09

MINUTEMAN MISSILE NATIONAL HISTORIC SITE
HISTORIC BOUNDARY MAP
PENNINGTON COUNTY, SOUTH DAKOTA

SOURCE:
National Park Service, Modified by Mead & Hunt, Inc.



MAP KEY:

CONTRIBUTING RESOURCES:

1. LAUNCH FACILITY DELTA-09 SITE
2. MISSILE LAUNCHER
3. IMPSS ANTENNA
4. LAUNCH FACILITY SUPPORT BUILDING
5. HARD UHF ANTENNA
6. CATHODIC PROTECTION RECTIFIER
7. TWO AZIMUTH MARKERS (APPROX. 1000' FROM LAUNCHER)
8. HICS MARKERS

ASSOCIATED SITE FEATURES:

9. SECURITY FENCE
10. OUTER ZONE SECURITY ANTENNA FOUNDATIONS
11. LIGHT FIXTURES

LEGEND:

—×——×— SECURITY FENCE

- - - - - - GRAVEL OR PAVED SURFACE

MINUTEMAN ICBM LAUNCH FACILITY DELTA-09

MINUTEMAN MISSILE NATIONAL HISTORIC SITE

SITE PLAN

PENNINGTON COUNTY, SOUTH DAKOTA

FEET
0 15 30 60
(approximate scale)

SOURCE:
National Park Service, Modified by Mead & Hunt, Inc.