AREA ENGINEER, ELLSWORTH
U. S. ARMY CORPS OF ENGINEERS
BALLISTIC MISSILE CONSTRUCTION OFFICE
P. O. BOX 8
ELLSWORTH AIR FORCE BASE, SOUTH DAKOTA

HISTORY

OF

TITAN I

ELLSWORTH AREA ENGINEER OFFICE

U. S. ARMY, CORPS OF ENGINEERS

8 DECEMBER 1959 - 31 MARCH 1962

APPROVED BY

LT. COLONEL EDWARD W. SMITH, JR. Edward W. Smith, Jr.
AREA ENGINEER

COLONEL CARLIN H. WHITESELL _____
DIRECTOR, TITAN I, CEBMCO

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F O R E W A R D

The history of the Ellsworth Titan I Area, U. S. Army, Corps of Engineers, CEBMCO, is a complete and factual summary report of the construction activities and contract administration phases encountered by the Area Engineer Office in the construction of the three (3) Titan I ICBM Complexes and support facilities at Ellsworth Air Force Base and Rapid City, South Dakota vicinity, during the latter part of 1959, through 1960, 1961 and early part of 1962. The Area office had its origin as the Rapid City Area Office, Omaha District, Corps of Engineers, in June 1951. The Ellsworth Titan I Area Office, a field agency of the Ballistic Missile Construction Office, Titan I Directorate, Los Angeles, California, was established at Ellsworth Air Force Base, South Dakota, upon transfer from the Omaha District Engineer to CEBMCO, 1 October 1960.

It provides a concise history of the construction progress, and a background on contract administration actions. This history also includes but is not limited to the following areas of interest - - scope of work, personnel and organization of Area Office and SATAF, delays, unusual and unforseen events and their impact, major accidents with recommendation for prevention of same, special events, visits by VIP's and ceremonies, relations with SATAF, problem areas, conclusions and recommendations. Incorporated are photos, charts and other information for clarity.

The Area successfully completed twelve (12) construction contracts totaling approximately 58 million dollars on schedule by 15 December

1961, the official contract completion date, despite over 300 major modifications involving thousands of changes as the result of research and development and design being accomplished concurrent with the construction. Other factors overcome in meeting the final completion date included the 1959 national steel strike, various local labor strikes, walkouts and joint occupancy in congested areas caused by the concept of concurrency of installation and checkout of equipment during the construction phase. Some additional work involving minor changes was completed by 28 February 1962.

During the peak work load, the maximum Area strength was seven (7) Army Engineer officers and 120 Corps of Engineers employees. These personnel supervised construction contractors with a work force of approximately 2500 personnel.

The military and civilian personnel of the Area worked as a closely knit team and maintained high spirits and superior morale in their successful accomplishments. On 31 March 1962, all construction work having been accomplished, all modifications and claims substantially settled and closed out, all property and buildings and personnel transferred, the Ellsworth Titan I Area was closed out.

It is hoped that a better appreciation and understanding of the various problems encountered in the Titan I construction program at Ellsworth Air Force Base will be felt by the reader upon review of this history.

As a matter of interest, we must take note of the key organizations that made the construction at Ellsworth possible; there were five (5) main agencies involved in this missile construction and

installation program, of which three were military and two were civilian. Each one had a definite and unique function:

a. U. S. Army Corps of Engineers, Omaha District, directly supervised the initial construction of the three (3) Titan I complexes during the latter part of 1959, continuing until the fall of 1960.

b. U. S. Army Corps of Engineers Ballistic Missile Construction Office (CEBMCO) Los Angeles, California -- through the Titan I Directorate -- directly supervised the remaining construction until the project was completed.

c. U. S. Air Force, Site Activation Task Force (SATAF), Ballistic Systems Division and related agencies as the -- "Purchasing or Using" Agencies.

d. Leavell-Scott & Associates -- The Prime Contractor, a Joint Venture, who physically did the facility construction phases of the project which is covered under the Construction and Propellant Loading System sections of this history.

e. The Martin Company and Related Weapons System Associated Contractors -- designed the Titan I ICBM and were to install it, after the facility construction phases were completed.

It must be pointed out that this history covers only those phases applicable to the facility construction features, the activities of the U. S. Air Force and their Contractors are not included.

Edward W. Smith, Jr.

EDWARD W. SMITH, JR.
Lt. Colonel, Corps of Engineers
Area Engineer, Ellsworth

I N D E X

I N T R O D U C T I O N

The Titan I ICBM project built in a 30 mile radius of Rapid City and at Ellsworth Air Force Base consisted of three individual launch complexes, each providing facilities for launching and guidance of three Titan I Intercontinental Ballistic Missiles and the support facilities required to back up the mission of launching the missile.

All three complexes were built concurrently with completion dates being thirty days apart -- in other words, the third complex was completed 60 days after the first one; support facilities were constructed concurrently.

The launch complexes are of the hardened type; i.e., all the essential facilities are built of heavily reinforced concrete and are buried underground. When completed, only essential doors covering the entrance portal, missile and antenna silos will be at ground level, and therefore, exposed. These doors are of massive concrete construction, heavily reinforced and designed to withstand blast.

All of the underground operating facilities are connected by personnel and utility tunnels. Each complex contains all necessary service facilities and utilities, and is, as far as possible, a self-contained operation.

The following comparisons will give some idea of the magnitude of each of these complexes and the vast amount of material required to construct such a facility:

a. Before construction is started, a tremendous amount of excavation was required. About 600,000 cubic yards of earth were

removed, and after completion, most of this dirt was moved back in place again to cover the facility. Six hundred thousand cubic yards of dirt would make a column one yard square and about 340 miles high.

b. In the construction of each complex, 52,000 barrels of cement were used. This makes up into 35,000 cubic yards of concrete, enough to lay a 3-foot sidewalk 4" thick and 189 miles long, or to pour the basements for about 1375 average 5-room houses.

c. To reinforce the concrete and make the tunnel sections, etc., about 6,900 tons of steel was required for each complex. This amount of steel would fill a train of freight cars more than 1 1/4 miles long.

d. Two hundred fifty miles of high strength wire was used to prestress the concrete grade beams on which the Control Center domes were built.

e. Each complex will generate enough electricity to supply over 400 normal houses, and contains enough ventilating and air conditioning capacity to completely air condition 200 of these houses.

The foregoing are a few examples of what went into such a facility. Not mentioned are the miles of wire, thousands of feet of pipe and tubing, hundreds of feet of ductwork and the miltitude of other types of equipment and materials, paint, paneling, flooring, etc., that makes up the completed installation.

Finally, the missiles themselves and their direct support equipment must be considered. The missile systems, extremely sensitive and intricate, call for precision and reliability almost beyond imagination.

Building such facilities, from shoveling dirt to calibrating the electronic computer, is a tremendous undertaking requiring unusual technical skill and above all, wholehearted teamwork and cooperation of all Government agencies and contractors concerned.

CONGRATULATORY MESSAGES

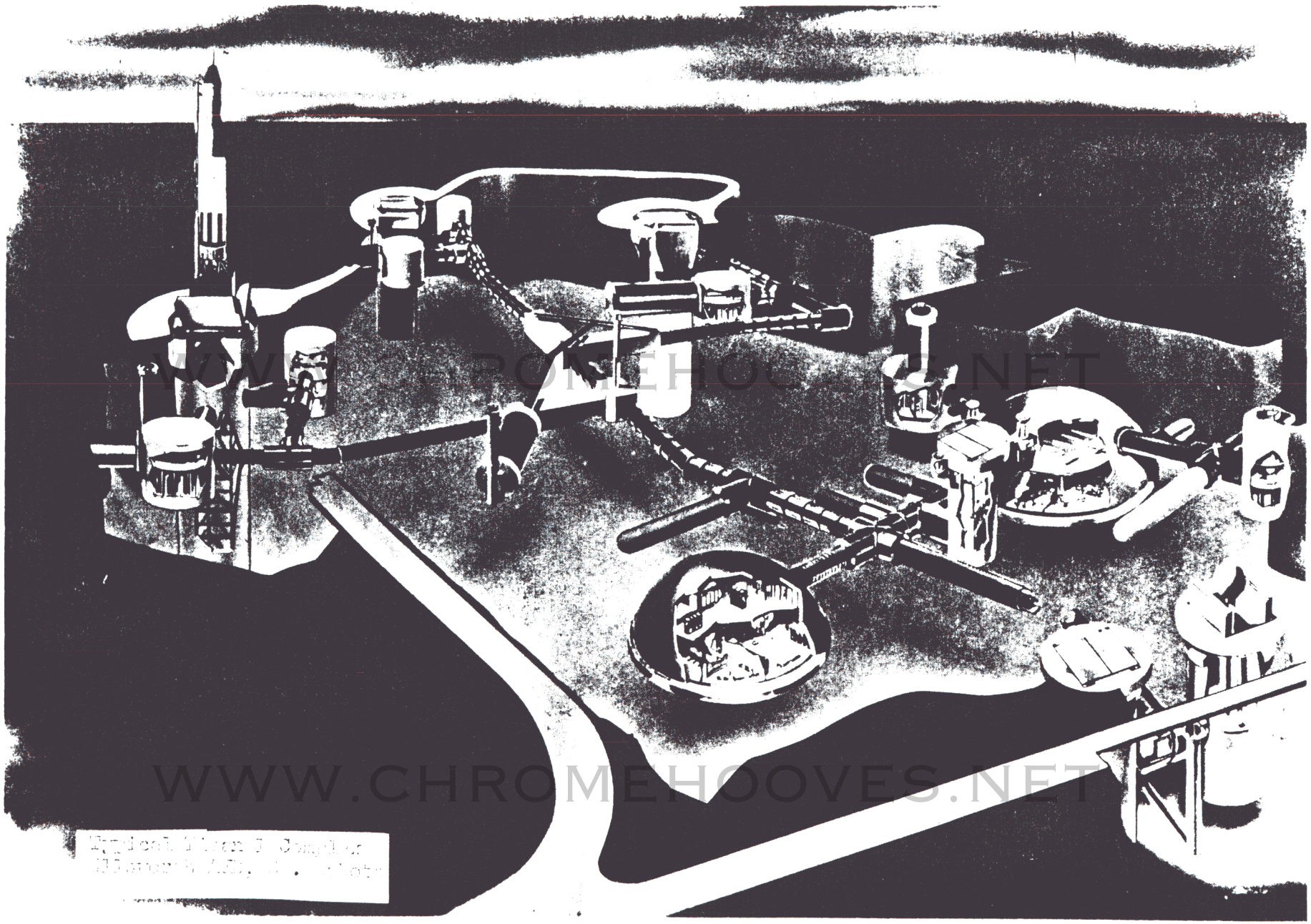
Upon the completion of the facility construction phases, the following congratulatory messages were received:

From Colonel Whitesell, Titan I Director to Area Engineer and Staff:

> "Whitesell to Smith. Congratulations to you and your staff on a job well done. Despite the pressures, harassment and troubles aimed your way, you have met final completion dates that were established more than two years ago. I am impressed and grateful."

From Lt. General Walter K. Wilson, Chief of Engineers to Area Engineer and Staff:

> "Congratulations to you and your staff on the successful completion and turnover of Ellsworth Missile Base to the Air Force. The combined efforts of all concerned to effect this timely completion greatly contributed to our National Defense effort and the security of our nation."



JOINT VENTURE CONTRACTOR FOR

DA-25-066-ENG-5919
WS-107A-2 TECHNICAL FACILITIES
SQUADRON I, TITAN I
ELLSWORTH AIR FORCE BASE, SOUTH DAKOTA

Work under this contract was performed by a Joint Venture, trading as the Leavell-Scott & Associates. Set forth below are the names of the eight Joint Venturers, together with an indication of percentages of responsibilities under the contract. In view of the fact that the C. H. Leavell Company and the Scott Company together held a majority of interest, these two companies were designated as sponsors of the Joint Venture.

COMPANY	PERCENTAGE INTEREST
C. H. Leavell and Company, El Paso, Texas	35
The Scott Company of Northern California Oakland, California	20
The Morrison-Knudsen Company, Inc., a Delaware Corporation	12
Paul Hardeman, Inc. of Stanton, California	10
MacDonald Construction Company, Saint Louis, Missouri	10
Johnson, Drake, and Piper, Inc., Minneapolis, Minnesota	5
Olson Construction Company, Lincoln, Nebraska	5
F. E. Young Construction Company, San Diego, California	3

At page VI is a copy of the Abstract of Bid - Construction, listing Leavell-Scott & Associates their Estimate of Bid, and other companies that submitted bids on the construction of the Titan I facilities at Ellsworth.

ABSTRACT OF BIDS - CONSTRUCTION

SHEET NO. 1 OF 1

INVITATION FOR BIDS NO. DACW25-066-60-1

OFFICE: Omaha District, Corps of Engineers, Department of the Army, Omaha 2, Nebraska

ISSUED: 20 October 1959

BIDS TO BE OPENED: 2:00 P.M., M.S.T., 4 December 1959

PUB.: WS 107A-2 Technical Facilities, Ellsworth Air Force Base, Rapid City, South Dakota

GOVERNMENT ESTIMATE
- ☐ HIRED LABOR ESTIMATE
- ☐ REASONABLE CONTRACT ESTIMATE (without profit)
- ☐ REASONABLE CONTRACT ESTIMATE (including profit)

ITEM NO.				GOVERNMENT ESTIMATE		BID NO. 6 Leavell-Scott & Associates 1900 Wyoming Street El Paso, Texas		BID NO. 8 Kaiser - Raymond - Morrison - Puget Sound 1974 Broadway Oakland, California (A JOINT VENTURE)		BID NO. 1 WESTERN CONTR. CORP., Sioux City, Iowa, BARZINA CONSTR.CO. INC., Rapid City, So. Dakota, J.F. WHITE ENGINEERING CORP., Englewood, Colorado. (A JOINT VENTURE)		BID NO.		BID NO.		BID NO.	
1.	Missile Silo.	9	Each	705,980.00	6,353,820.00	666,400.00	5,998,600.00	780,000.00	7,020,000.00	620,000.00	5,580,000.00						
2.	Equipment Terminal.	9	Each	370,445.00	3,334,005.00	333,401.00	3,000,609.00	275,000.00	2,475,000.00	322,000.00	2,898,000.00						
3.	Propellant Terminal.	9	Each	413,751.00	3,723,759.00	368,899.00	3,317,391.00	480,000.00	4,320,000.00	403,000.00	3,627,000.00						
4.	Control Center.	3	Each	433,451.00	1,300,353.00	544,003.00	1,632,009.00	400,000.00	1,200,000.00	432,000.00	1,296,000.00						
5.	Antenna Site.	6	Each	119,006.00	714,036.00	165,220.00	991,320.00	100,000.00	600,000.00	135,000.00	810,000.00						
6.	Steel Ring Beams, Rods and Lagging (for Bracing and Shoring Shaft Excavations for 3 Complexes.)	Job	L.S.		408,806.00		250,000.00		600,000.00		500,000.00						
7.	Powerhouse. Complete with Air Intake and Exhaust Structures, and Tunnel Junctions Nos. 11, 13 & 14.	3	Each	2,390,138.00	7,170,414.00	1,838,833.00	5,516,499.00	1,900,000.00	5,700,000.00	2,100,000.00	6,300,000.00						
8.	Portal Site.	3	Each	282,054.00	846,162.00	264,825.00	794,475.00	150,000.00	450,000.00	245,000.00	735,000.00						
9.	Communications Antenna.	Job	L.S.		9,961.00		25,494.00		25,000.00		8,000.00						
10.	Launcher Area Filtration Structure.	3	Each	99,080.00	297,240.00	64,843.00	194,529.00	60,000.00	180,000.00	70,000.00	210,000.00						
11.	Steel Tunnels:																
	a. Type "A" Tunnels (for 3 Complexes.)	Job	L.S.		1,441,797.00		1,005,956.00		1,200,000.00		1,310,000.00						
	b. Type "B" Tunnels (for 3 Complexes.)	Job	L.S.		438,965.00		810,563.00		350,000.00		190,000.00						
	c. Type "C" Tunnels (for 3 Complexes.)	Job	L.S.		158,135.00		119,329.00		80,000.00		175,000.00						
	d. Type "D" Tunnels complete with 6'-6" Diameter Offset Tunnels to Missile Silos and 9'-6" Diameter Exhaust Tunnel Structures (for 3 Complexes.)	Job	L.S.		1,160,792.00		1,051,382.00		850,000.00		675,000.00						
	e. Type "E" Tunnels (for 3 Complexes.)	Job	L.S.		55,801.00		414,121.00		75,000.00		40,000.00						
12.	Tunnel Junctions Nos. 1, 2, 4, 5, and 7. (5 Each.)	Job	L.S.		481,748.00		588,133.00		800,000.00		700,000.00						

THE U. S. AIR FORCE

ELLSWORTH SITE ACTIVATION TASK FORCE (SATAF)

AND

RELATIONSHIP WITH THE AREA ENGINEER

The Ellsworth Site Activation Task Force (SATAF) as all other similar organizations is essentially an Air Force management team. Formed in August 1960, the SATAF is responsible to insure that the construction of facilities, the installation and checkout of the weapons system and associated equipment and the turnover of completed, operational Titan missile launching and support facilities to the Strategic Air Command are performed in a timely and economical manner. All these facilities when completed will be turned over to the 850th Strategic Missile Squadron (SAC).

The SATAF Commander is responsible for activation of the site, including construction, installation, checkout and its turnover to SAC in an acceptable operational condition in accordance with official program schedules. He is also responsible for base support to the integrating and associate contractors. As the Commander, he exercises operational control, including assignment of tasks, designation of objectives and necessary direction over the different Air Force detachments that comprise the SATAF.

Difficulty also was experienced in regards to interpretation of the contract as to the turning over of a completed facility. The major area of disagreement was the concept of what constituted a completed facility. Local SATAF repeatedly refused to accept substantially completed structures until almost every minor deficiency was corrected and until practically every item of electrical and mechanical equipment was fully operational. Such equipment operation depended upon completion of the various utilities, systems and other structures. The other structure was either incomplete or its utilities were undergoing design change modifications which prevented operation. The situation was partially relieved by inaugurating use of Beneficial Occupancy Agreements after agreements on formal transfer was unobtainable. The overall effect was that the facility contractor was required to perform maintenance and repair on certain structures for several months, although this contract work was completed except for operational adjustments to utilities and although the structure was predominately occupied by AF facilities contractor workmen.

Lastly, in some instances, they questioned the manner in which work had been performed or specifications interpreted, but would not state exactly what they desired or thought was required. They also interpreted test procedures in the same manner.

In conclusion, however, it can be stated that since the inception of this joint organization, through the early difficulty situations and to the end of the facility construction aspects, our relationship continued to be excellent, amicable and workable.

RELATIONSHIP BETWEEN SATAF AND AREA ENGINEER

In addition to the title and duties of Area Engineer, the Area Engineer was designated the Deputy for Construction for the SATAF on 1 July 1961. Prior to this integration of functions, after and throughout this program, there were some problem areas with respect to coordination:

All design changes or resolution of conflicts or discrepancies which the Area Office considered to be necessary were required to be approved by SATAF. Obtaining SATAF concurrence or non-concurrence was time consuming and added to the time which the contractor was delayed. In many instances, several weeks passed awaiting reply to our correspondence to SATAF.

After experiencing the long delay in receiving replies from SATAF, it was necessary for the Area office to set up a suspense log of each letter written and continually push by telephone calls and follow-up letters in order to obtain a reply.

In dealing with SATAF on interpretation of specifications, it was found they were inclined to read into the specification requirements which were not included. They failed in some cases to analyze the specifications completely but instead, based their case on only one portion of the specifications. These differences in interpretation of certain specific contract conditions were resolved by joint conference and always resulted in either a design change modification or a directive to the contractor to proceed under the appropriate clause of the contract.

SECTION I

MISSION, ESTABLISHMENT, ORGANIZATION AND FUNCTIONS OF ELLSWORTH TITAN I AREA ENGINEER OFFICE