APPENDIX II

PHOTOGRAPHS

C O N T E N T S

OFFICIAL USE ONLY

HISTORY

OF

THE DIESS AREA OFFICE

18 April 1960 - 28 April 1962

Prepared by:
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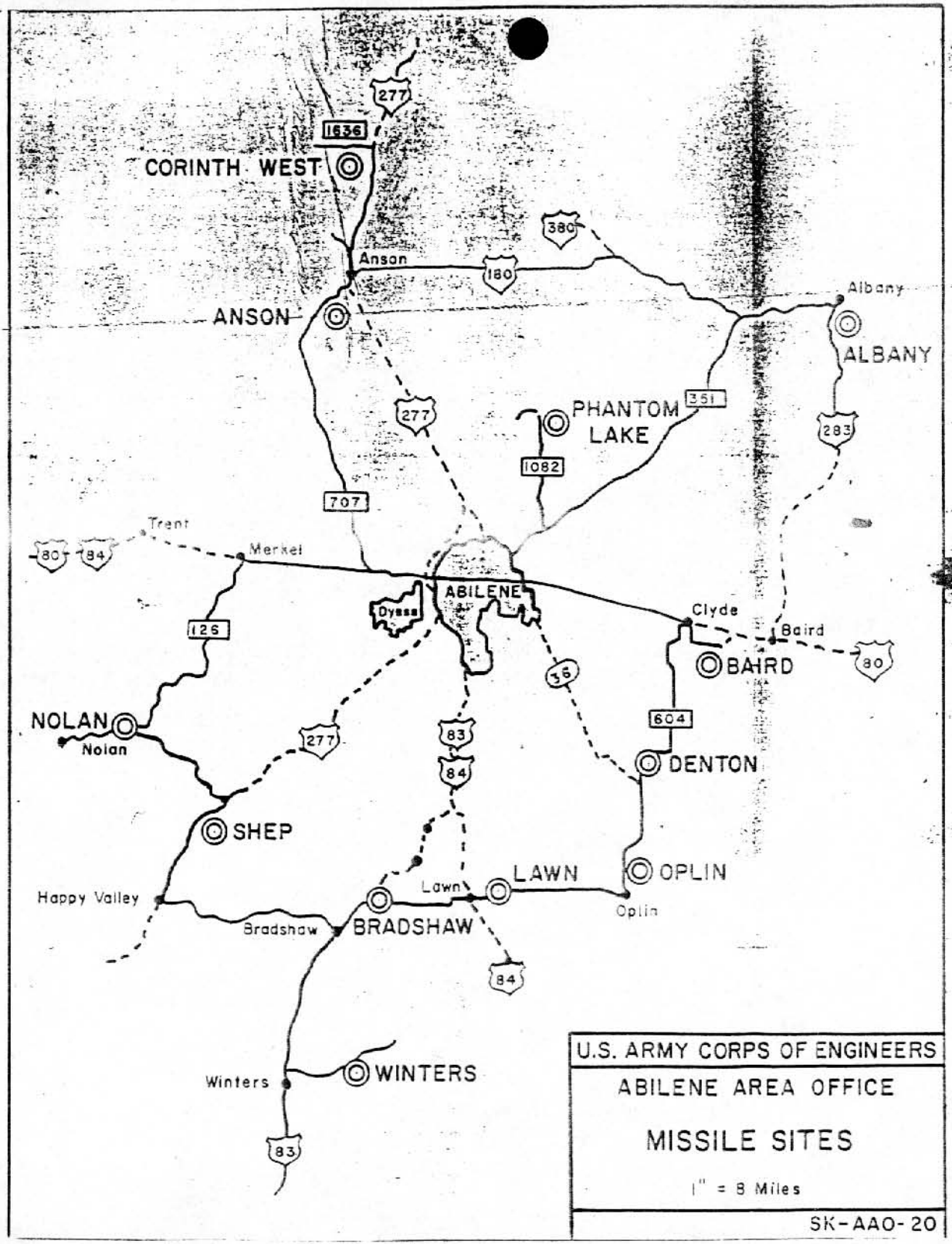
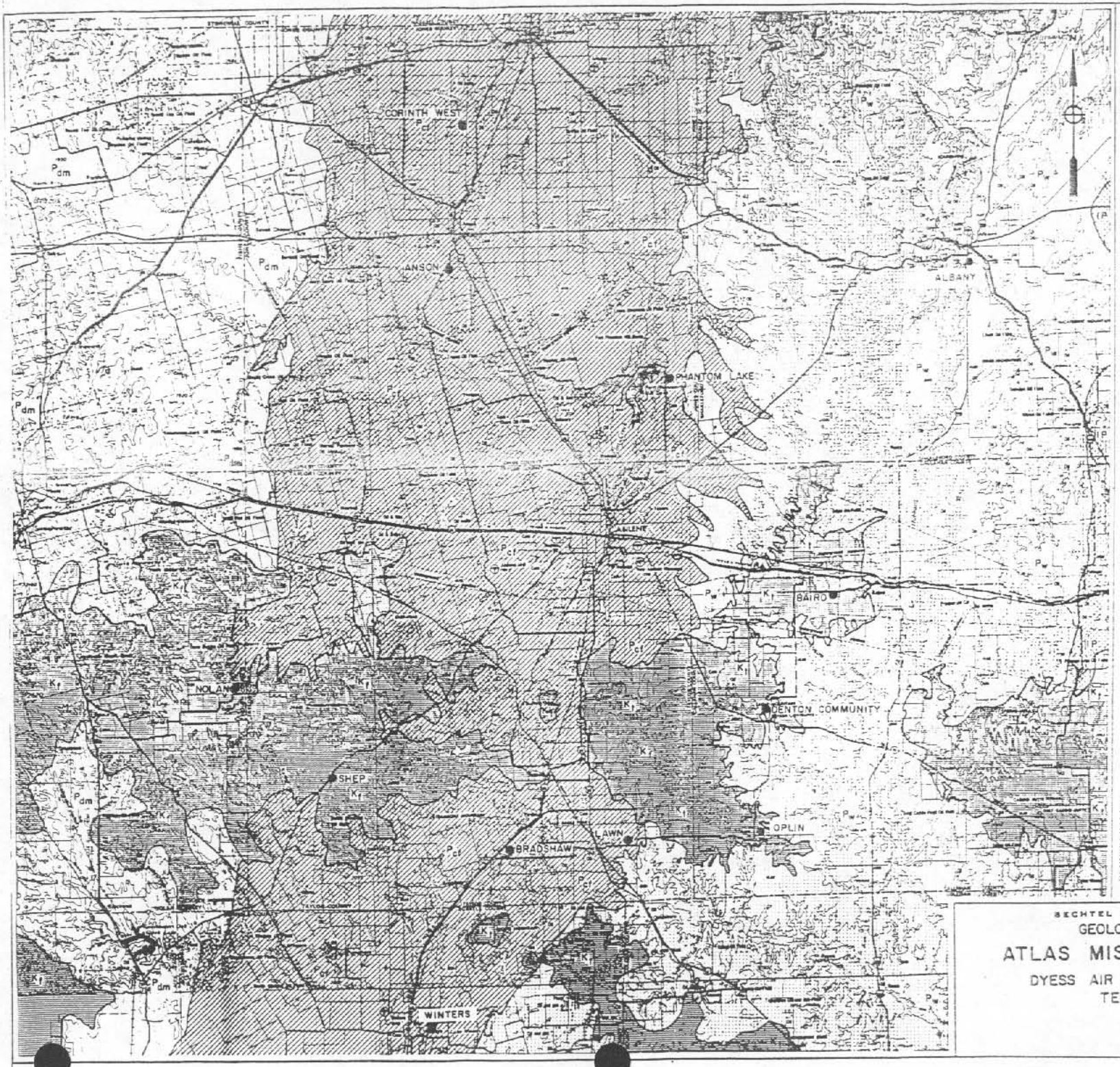
Approved by:

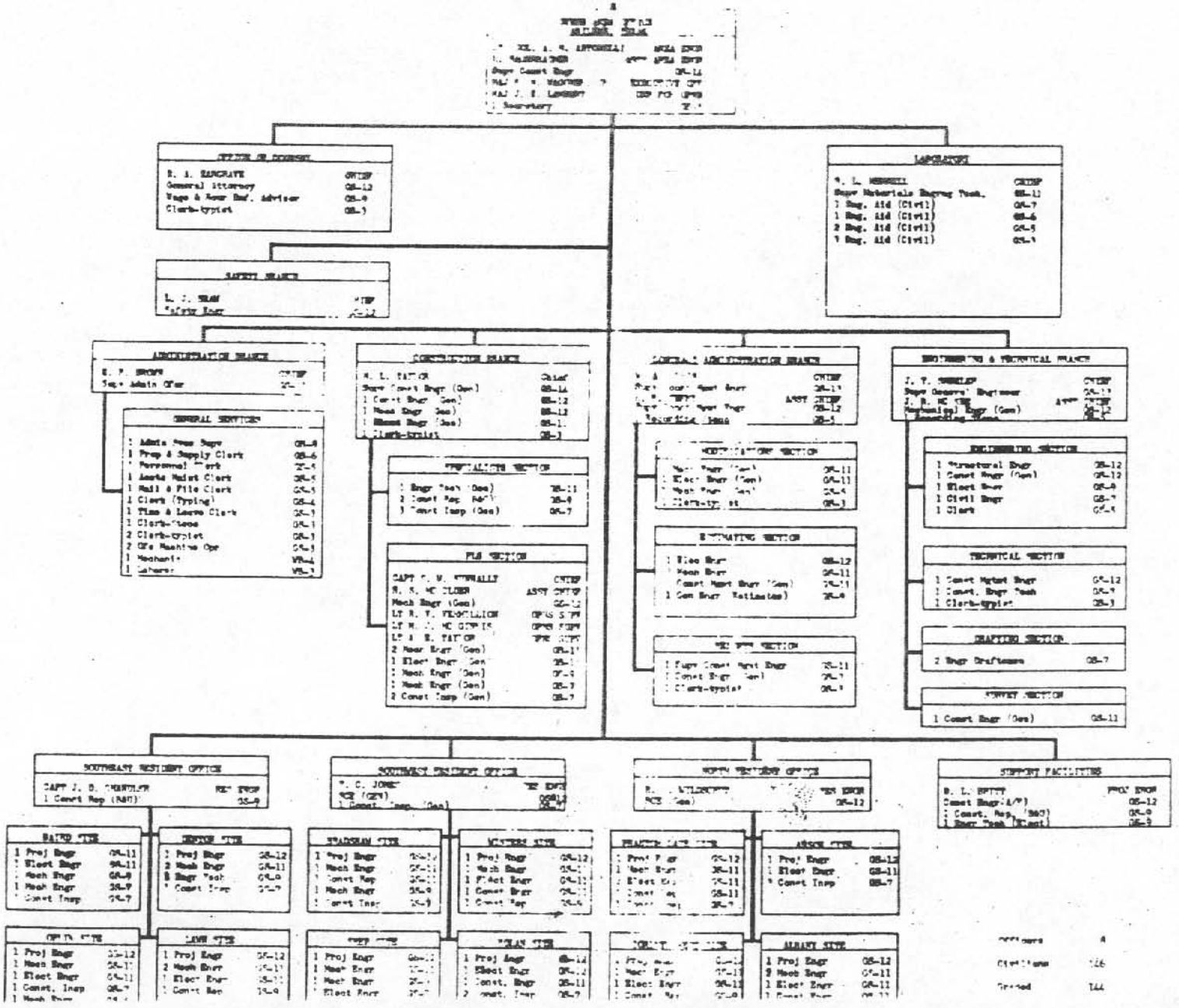
ALBERT M. ANTOMELLI, Lt. Col.
Area Engineer

6 APR 1962

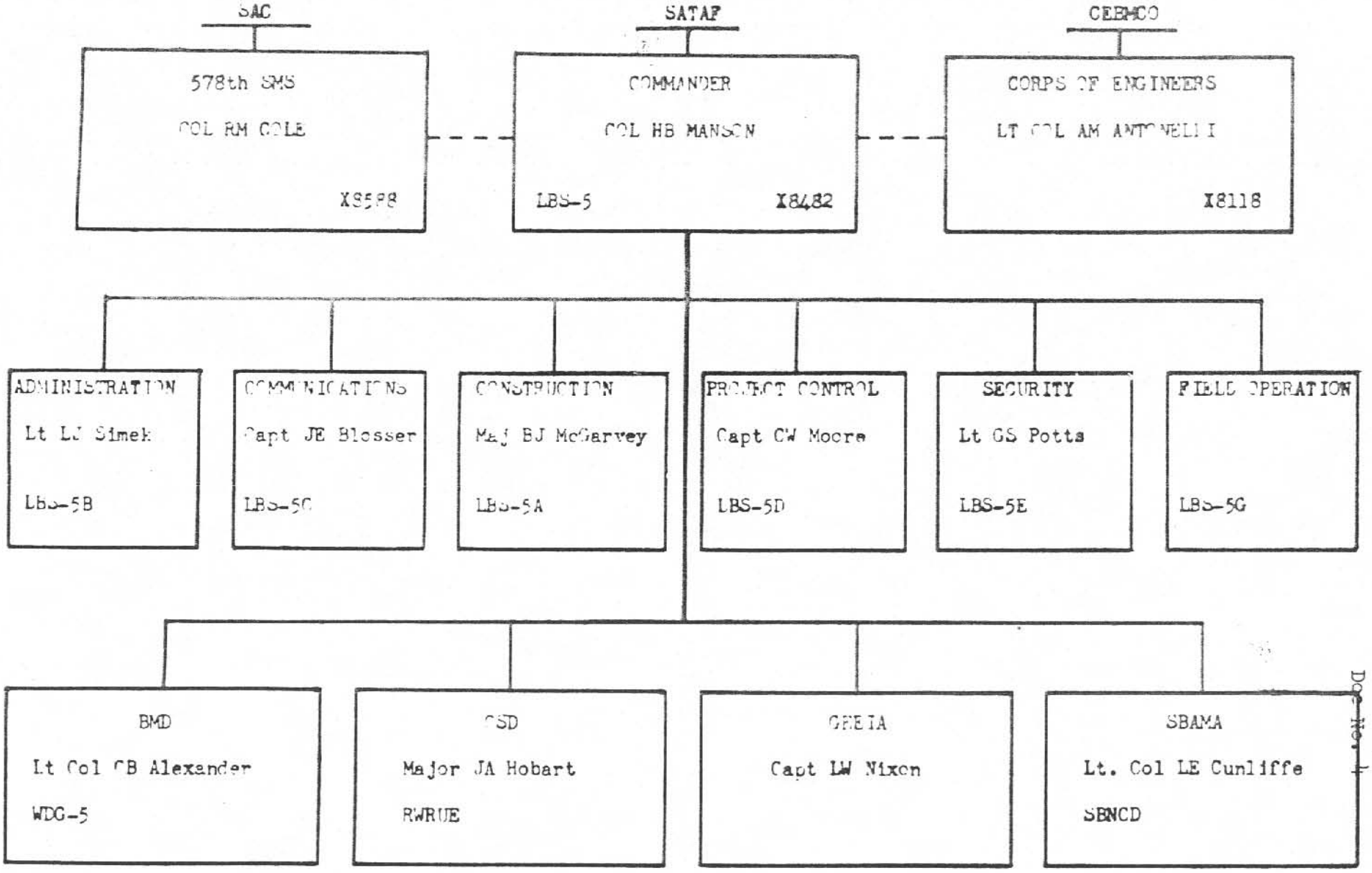
CORPS OF ENGINEERS BALLISTIC MISSILE CONSTRUCTION OFFICE


277
1636
CORINTH WEST
380
Anson
180
Albany
ANSON
ALBANY
277
PHANTOM LAKE
351
283
1082
707
Trent
80
84
Merkel
ABILENE
Dyess
Clyde
Baird
125
BAIRD
80
35
NOLAN
Nolan
277
83
84
604
DENTON
SHEP
LAWN
OPLIN
Lawn
Oplin
Happy Valley
Bradshaw
BRADSHAW
84
Winters
WINTERS
83
U.S. ARMY CORPS OF ENGINEERS
ABILENE AREA OFFICE
MISSILE SITES
1" = 8 Miles
SK-AAO-20

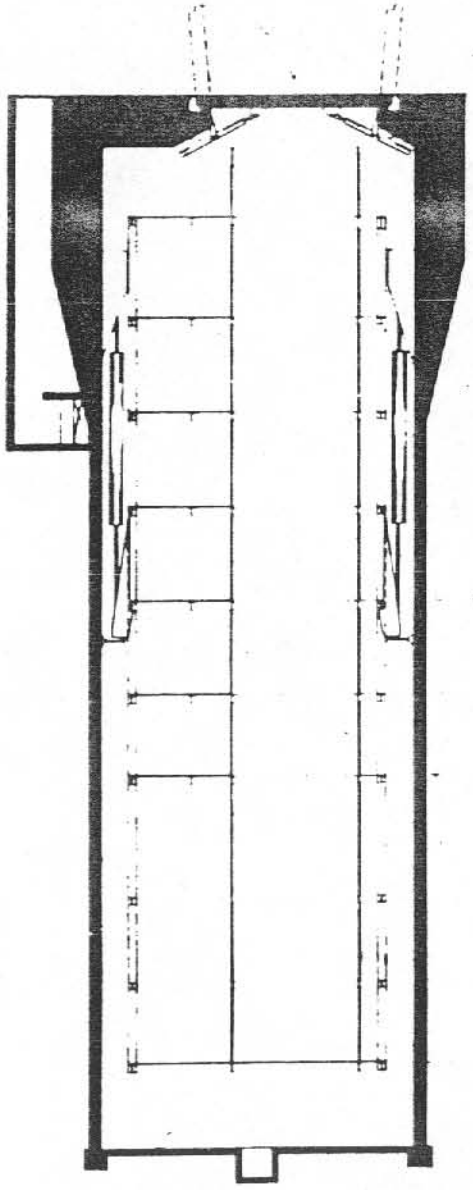

CORINTH WEST
ANSON
ALBANY
PHANTOM LAKE
ABILENE
BAIRD
NOLAN
DENTON COMMUNITY
SHEP
OPLIN
LAWN
BRADSHAW
WINTERS
GEOLOGIC COLUMN
SYSTEM
GROUP
FORMATION
CRETACEOUS
Edwards limestone
Commanche Peak limestone
Walnut limestone, clay
Fredericksburg
Trinity
Paluxy Sand sandstone, shale
UNCONFORMITY
PERMIAN
Double Mountain
Whitehorse sandstone, shale, gypsum
Blaine shale, gypsum, dolomite, sandstone
San Angelo conglomerate, sandstone, shale
Clear Fork
Choza shale
Vale shale, sandstone, dolomite
Arroyo limestone, shale
Wichita
Albany
Lueders limestone, shale
Clyde shale; limestone; sandstone
Bello Plains shale, limestone; sandstone
Admiral shale; limestone; sandstone
Putnam shale, limestone
Moran limestone, shale sandstone
PENNSYLVANIAN
BECHTEL CORPORATION
GEOLOGIC MAP
ATLAS MISSILE SITES
DYESS AIR FORCE BASE
TEXAS



Doc No. 3


SAC
578th SMS
COL RM COLE
X8598
SATAF
COMMANDER
COL HB MANSON
LBS-5
X8482
CEEHCO
CORPS OF ENGINEERS
LT COL AM ANTONELLI
X8118
ADMINISTRATION
Lt LJ Simek
LBS-5B
COMMUNICATIONS
Capt JE Blosser
LBS-5C
CONSTRUCTION
Maj BJ McGarvey
LBS-5A
PROJECT CONTROL
Capt CW Moore
LBS-5D
SECURITY
Lt GS Potts
LBS-5E
FIELD OPERATION
LBS-5G
BMD
Lt Col CB Alexander
WDG-5
CSD
Major JA Hobart
RWRUE
CREIA
Capt LW Nixon
SBAMA
Lt. Col LE Cunliffe
SBNCD

OPERATIONAL SILO



SECTION

LAUNCH PLATFORM DRIVE AND CONTROLS, DUST COLLECTORS

HYDRAULIC POWER SUPPLY, A C & VENTILATION FANS, FACILITY MOTOR CONTROL CENTER

CONTROL CABINETS, CABINET AIR CONDITIONING

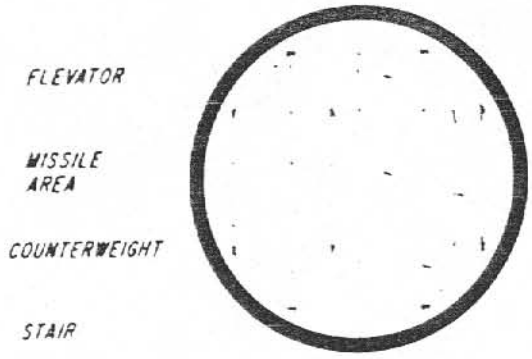
REFRIGERATION, HEATING AND UTILITY WATER EQUIPMENT

DIESEL GENERATOR AND AUXILIARY EQUIPMENT

DIESEL GENERATOR AND AUXILIARY EQUIPMENT

PROPELLANT LOADING SYSTEM CONTROL VALVE PREFABS

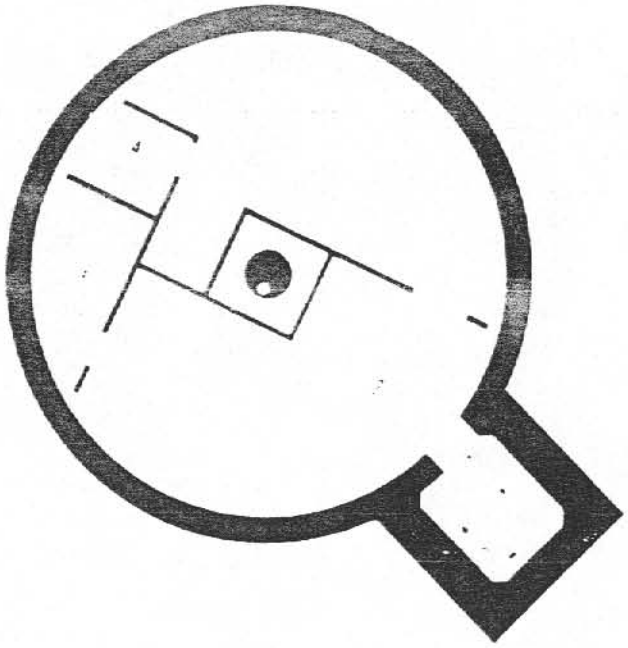
PROPELLANT LOADING SYSTEM TANKS



PLAN

Doc No. 5

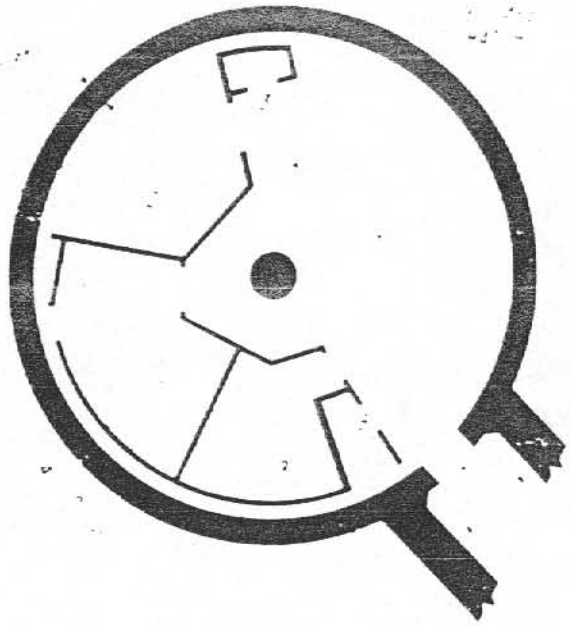
LAUNCH CONTROL CENTER — OPERATIONAL SITE



2 ND LEVEL

1 COMMUNICATION EQUIPMENT
2 LAUNCH CONTROL ROOM
3 OFFICE
4 BATTERY ROOM
5 STAIRWELL
6 STAIRWAY TO GRADE

STAIRWAY TO GRADE

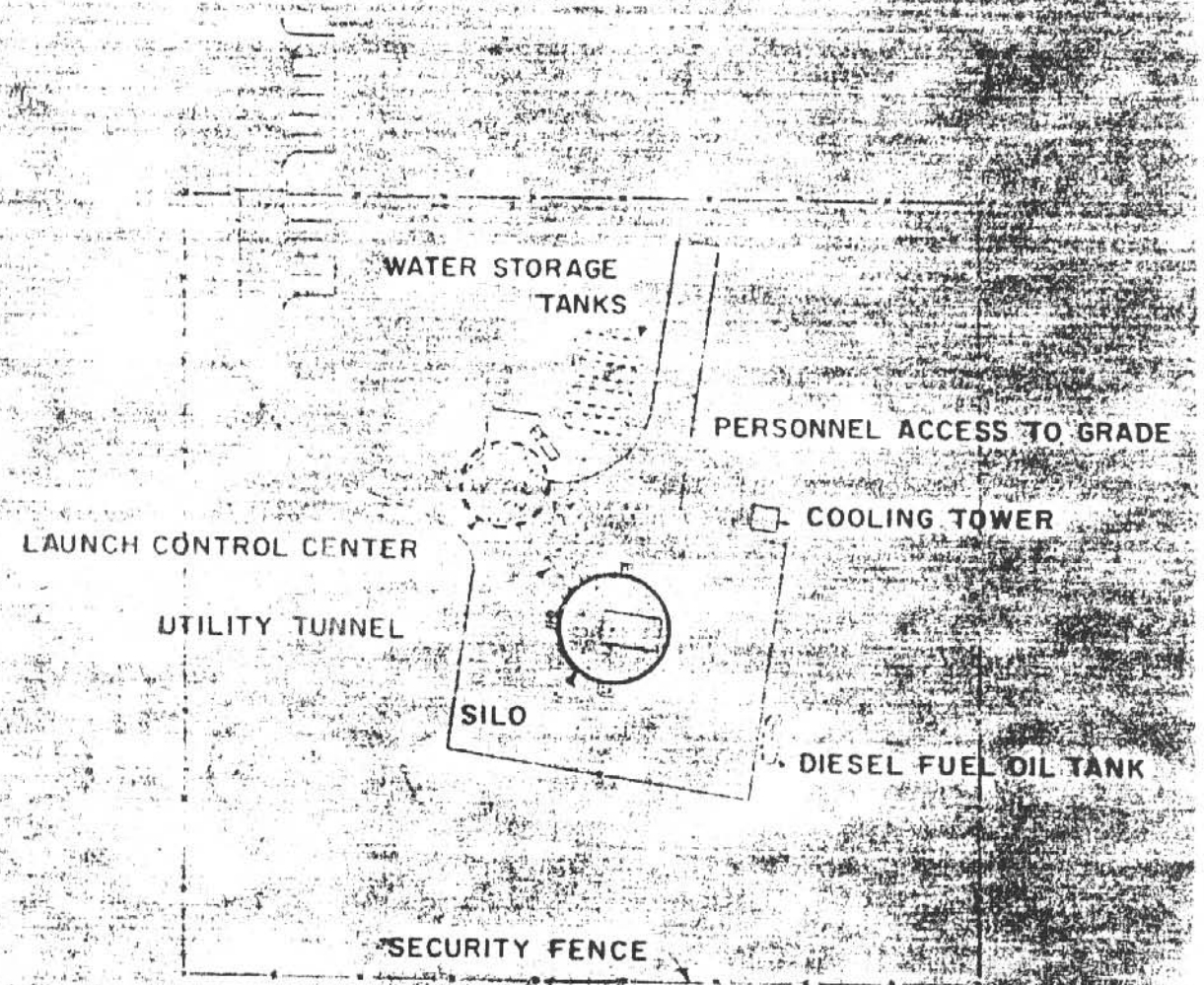


1 ST LEVEL

7 READY ROOM & [illegible]
8 JANITOR'S CLOSET
9 TOILET
10 KITCHEN & MESS
11 HALL
12 H.V. & A.C. ROOM
13 MEDICAL SUPPLIES

Doc No. 6

Doc No. V



OPERATIONAL SITE PLAN

PRINCIPAL SUBCONTRACTORS ON CONTRACT NO. DA-41-443-eng-5878 DYESS AREA OFFICE

NAME & ADDRESS	SCOPE OF WORK	AMOUNT	EFFECTIVENESS*
Industrial Television, Inc. Denver 7, Colorado	Furnished & Installed Closed Circuit TV, Tested System & Instructed Owner	$ 66,130	Above Average
Cyclone Fence Dept., American Steel & Wire Div., US Steel Corp. San Antonio, Texas	Furnished & Installed Security Fence	120,350	Above Average
Refractory Const. Co. Tulsa 12, Oklahoma	Furnished & Applied Gunite Lining to Required Areas.	233,820	Above Average
Iowa Sheet Metal Contractors, Inc. Des Moines, Iowa	Furnished & Fabricated Sheet Metal Work In Ventillating & Air Conditioning Systems	353,349	Above Average
Ceco Steel Prod. Co. Houston 10, Texas Subcontracted With G & N Corporation Houston 20, Texas	Supplied & Installed Reinforcing Steel	1,797,770	Average
Johnson Elevator Constr. Salina, Kansas	Placed, Finished & Cured all Slip Formed Concrete in Silos	297,980	Average
Barber-Colman Rockford, Illinois	Furnished & Installed Automatic Control Devices	258,280	Average

Doc No. 8
Sheet 1 of 2

PRINCIPAL SUBCONTRACTOS ON CONTRACT NO. DA-41-143-eng-5878 DYESS AREA OFFICE

NAME & ADDRESS	SCOPE OF WORK	AMOUNT	EFFECTIVENESS *
Premier Roofing Co. Montebello, Cal.	Applied Waterproofing Membrane	$ 57,830	Average
Randall H. Sharpe, Cont. Oklahoma City 14, Okla.	Painted	169,690	Average
Parker-Fallis Insul. Co. Dallas, Texas	Furnished & Installed all Insulation	243,490	Below Average

* Rated effectiveness determined by opinion survey of the Project Engineers and Area Engineer

Doc No. 8
Sheet 2 of 2

ASSIGNED SERVICE CONTRACTS		DYESS AREA OFFICE, ABILENE, TEXAS			
CONTRACT NUMBER	MAJOR FEATURE OF WORK	CONTRACTOR OR MANUFACTURER, Name & Address	AWARD DATE	ORIGINAL CONTRACT VALUE	FINAL CONTRACT VALUE
DA-22-029-eng-4241	Facility Elevators, Furnish & Install	Otis Elevator Co New York 1, N.Y.	17 Feb 60	$ 255,393	$ 342,107.10
DA-22-029-eng-4249	Switchgear & Panels	General Electric Co. Denver 1, Colo.	17 Feb 60	107,100	147,214.28
DA-22-029-eng-4266	Diesel Generators	White Diesel Eng Div White Motor Co Springfield, Ohio	26 Feb 60	748,692	999,796.98
DA-22-029-eng-4328	Blast Closures	Henry Pratt Co. Chicago 7, Ill.	25 Mar 60	104,499	139,316.01
DA-22-029-eng-4336	Air Cylinder Spring Supports	Boeing Airplane Co. Wichita, Kansas	25 Mar 60	55,206	85,320.00
DA-22-029-eng-4343	Overhead Door Hinge Assemblies	Boeing Airplane Co. Wichita, Kansas	28 Mar 60	177,039	238,932.00
DA-22-029-eng-4439	CBR Filters	Mine Safety Appl. Co. Pittsburgh 8, Pa.	6 Jun 60	6,705	
DA-41-443-eng-5713	Package Water Chiller Units & Rotary Pumps	A. M. Lockett & Co, Ltd. Dallas 1, Texas	28 Feb 60	79,938	106,732.32
DA-41-443-eng-5720	Cooling Tower	Water Cooling Equip. Co St Louis, Mo.	23 Feb 60	31,950	43,308.00

Doc No. 9
Sheet 1 of 2

ASSIGNED SERVICE CONTRACTS		DYESS AREA OFFICE, ABILENE, TEXAS			
CONTRACT NUMBER	MAJOR FEATURE OF WORK	CONTRACTOR OR MANUFACTURER, Name & Address	AWARD DATE	ORIGINAL CONTRACT VALUE	FINAL CONTRACT VALUE
DA-41-443-eng-5727	Centrifugal & Turbine Pumps	Dean Hill Corp. Indianapolis 7, Ind.	19 Feb 60	38,682	52,793.32
DA-41-443-eng-5734	Sewage Pumps	Sempco Corp. Salt Lake City 15, Utah	25 Feb 60	6,957	9,276.00
DA-41-443-eng-5741	Submersible Pumps	Wintroath Pumps, Div of Worthington Corp. Alahambra, Calif.	19 Feb 60	15,300	20,400.00
DA-41-443-eng-5748	Air Washer Dust Collector Units	Joy Manufacturing Co. Dallas 20, Texas	19 Feb 60	99,528	131,274.00
DA-41-443-eng-5755	AC Fan Coils	The Trane Co. LaCrosse, Wisconsin	25 Feb 60	28,737	38,316.00
DA-41-443-eng-5763	PLS Prefabs & Intercon. Piping	Paul Hardeman, Inc. Stanton, Calif.	29 Feb 60	1,765,089	1,[illegible]
DA-41-443-eng-5786	Centrifugal Fans	Clarage Co. Kalamazoo, Mich.	15 Mar 60	18,927	27,069.60
DA-41-443-eng-5793	Axial Flow Fans	L.J. Wing Mfg. Co. Linden, N.J.	11 Mar 60	1,980	27,240.00
DA-41-443-eng-5800	Propeller Type Fans	The Harvey P. Bertram Co. Cincinnati 22, Ohio	15 Mar 60	177,039	2,640.00

PRECIPITATION

Month	Normal (Inches) (a)	Maximum of Record (Inches) (b)	Minimum of Record (Inches) (b)	24-hour Maximum (Inches) (b)	Average No. of Days 0.01 Inch or More (b)
January	0.88	3.10	T	1.97	5
February	0.91	4.07	T	2.17	5
March	1.12	4.36	0.00	2.78	5
April	2.47	9.80	0.09	4.63	7
May	3.68	13.19	0.05	6.78	8
June	2.69	8.40	T	4.35	7
July	2.05	7.95	T	3.81	5
August	1.09	15.70	T	4.34	5
September	2.60	10.53	T	5.13	6
October	2.57	10.88	0.00	5.10	5
November	1.02	5.82	0.00	2.16	5
December	1.37	6.69	0.00	4.57	4
Annual or Extreme	22.55	15.70(1914)	0.00(1909+)	6.78(1908)	67

TEMPERATURE

Month	Normal (Degrees F) (a)	Maximum of Record (Degrees F) (b)	Minimum of Record (Degrees F) (b)
January	43.3	90	-9
February	48.1	94	-6
March	55.1	98	-7
April	64.5	102	25
May	71.7	106	33
June	79.8	110	44
July	83.1	110	54
August	82.8	111	48
September	75.5	106	35
October	66.2	100	23
November	53.7	91	13
December	45.8	89	1
Annual or Extreme	64.1	111 (1943)	-9 (1947)

(a) U. S. Weather Bureau normals for period 192[illegible] - 1950 (adjusted to present location.

(b) Period of record 1885 - 1959.

Note: Station located in Abilene 1885 - 1944, and at Abilene Municipal Airport 1935 - 1959. Records combined.

Current 18 Jan 62

MILESTONE DATES

Scheduled Completion Dates Includes:
Mod. No. 75 — Mod. No. 109
Mod. No. 78 — Mod. No. 31, Supp. No. 1
Mod. No. 83 – Part I
Mod. No. 100
Mod. No. 104
Mod. No. 106

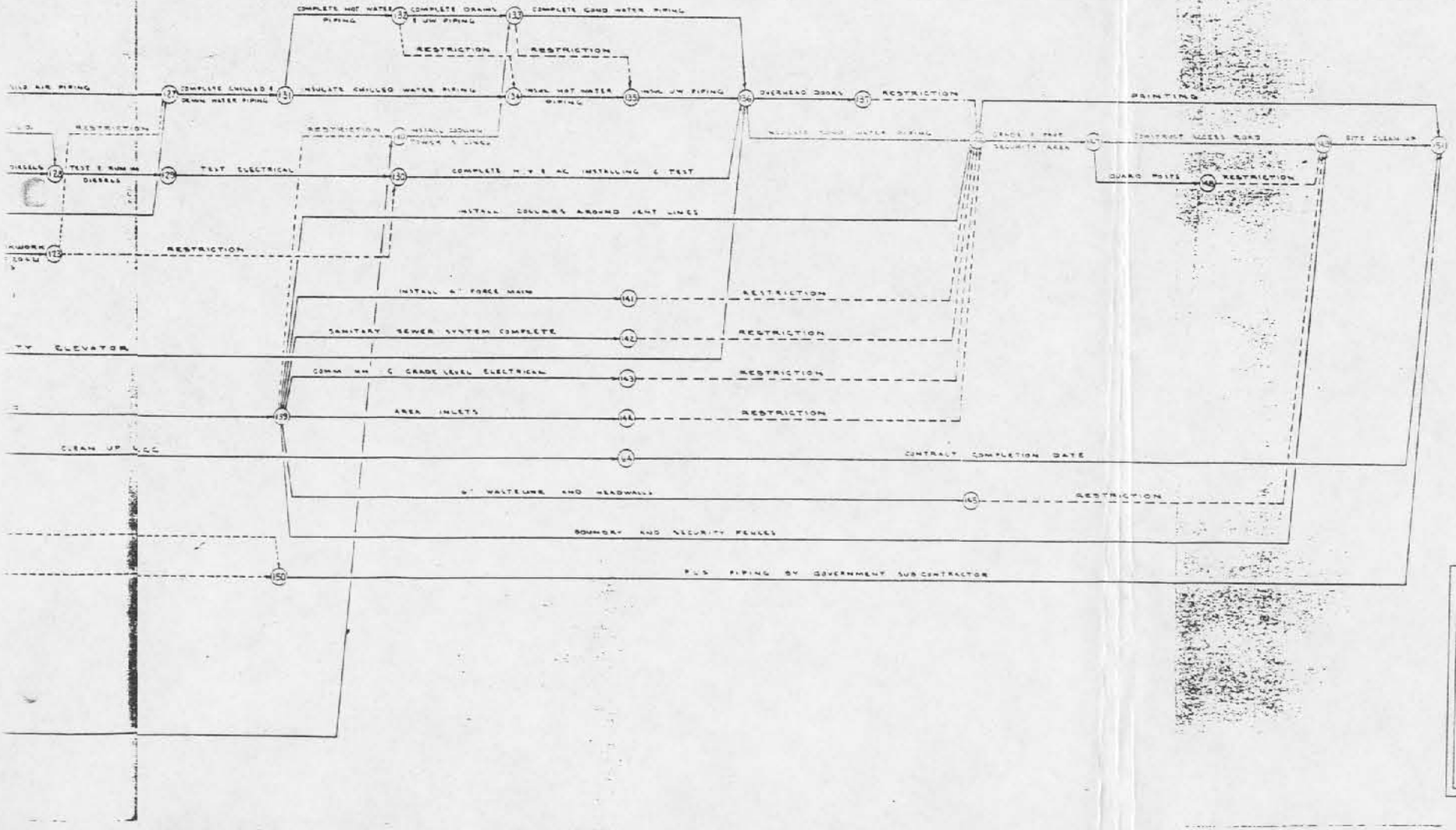
MS-107 A-I Operational Base Missile Launch Complexes
Near Dyess Air Force Base, Abilene, Texas
Contract No. DA-41-143-eng-5878

Contractor:
E. B. Zachry Co. and Brown & Root, Inc.

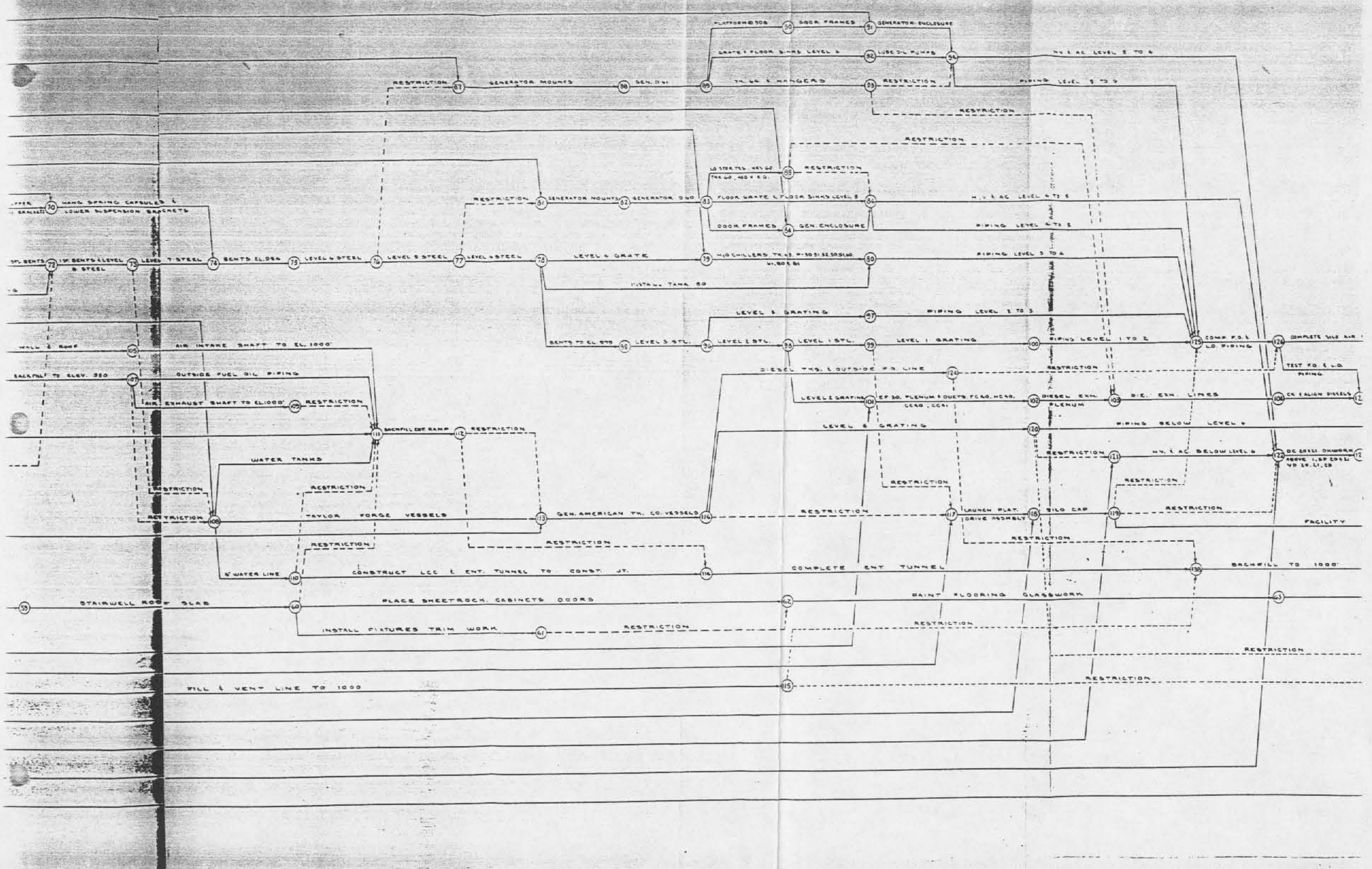
		OPLIN • Site 11	BAIRD • Site 2	DENTON • Site 3	BRADSHAW • Site 5	WINTERS • Site 12	LAWN • Site 4	NOLAN • Site 7	SHEP • Site 6	ALBANY • Site 10	PHANTOM LAKE • Site 1	CORINTH WEST • Site 9	ANSON • Site 8
1 Silo Concrete	CONTRACT	21 Nov 60	2 Dec 60	7 Dec 60	15 Dec 60	19 Dec 60	26 Dec 60	7 Jan 61	15 Jan 61	23 Jan 61	1 Feb 61	8 Feb 61	21 Feb 61
	AF Dir.	10 Jan 61	17 Jan 61	24 Jan 61	31 Jan 61	7 Feb 61	14 Feb 61	21 Feb 61	28 Feb 61	7 Mar 61	14 Mar 61	21 Mar 61	28 Mar 61
	ACTUAL	1 Nov 60	12 Nov 60	17 Nov 60	22 Nov 60	24 Nov 60	5 Dec 60	17 Dec 60	22 Dec 60	3 Jan 61	11 Jan 61	15 Jan 61	21 Jan 61
2 PLS Vessels	CONT.	10 Feb 61	21 Feb 61	26 Feb 61	6 Mar 61	10 Mar 61	17 Mar 61	24 Mar 61	31 Mar 61	7 Apr 61	14 Apr 61	21 Apr 61	27 Apr 61
	AF Dir.	10 Feb 61	17 Feb 61	24 Feb 61	3 Mar 61	10 Mar 61	17 Mar 61	24 Mar 61	31 Mar 61	7 Apr 61	14 Apr 61	21 Apr 61	28 Apr 61
	ACT.	15 Mar 61	13 Mar 61	20 Apr 61	29 May 61	31 May 61	8 Jun 61	11 Jul 61	19 Jul 61	26 Jul 61	31 Jul 61	23 Jun 61	22 Jun 61
3 Diesel Generators	CONT.	4 May 61	19 May 61	24 May 61	1 Jun 61	5 Jun 61	12 Jun 61	27 Jun 61	4 Jul 61	11 Jul 61	18 Jul 61	23 Jul 61	8 Aug 61
	AF Dir.	3 May 61	10 May 61	17 May 61	24 May 61	31 May 61	7 Jun 61	14 Jun 61	21 Jun 61	28 Jun 61	5 Jul 61	12 Jul 61	19 Jul 61
	ACT.	10 Mar 61	17 Mar 61	24 Mar 61	17 Mar 61	7 Apr 61	14 Apr 61	20 Apr 61	1 May 61	20 May 61	27 May 61	1 Jun 61	9 Jun 61
4 Cable Trays & Switchgear	CONT.	4 May 61	19 May 61	24 May 61	1 Jun 61	5 Jun 61	12 Jun 61	27 Jun 61	4 Jul 61	11 Jul 61	18 Jul 61	23 Jul 61	8 Aug 61
	AF Dir.	3 May 61	10 May 61	17 May 61	24 May 61	31 May 61	7 Jun 61	14 Jun 61	21 Jun 61	28 Jun 61	15 Jul 61	12 Jul 61	19 Jul 61
	ACT.	10 Mar 61	17 Mar 61	24 Mar 61	31 Mar 61	7 Apr 61	14 Apr 61	26 Jun 61	26 May 61	10 Jul 61	11 Jul 61	17 Jul 61	2 Aug 61
5 HV and AC	CONT.	5 Jun 61	29 Jun 61	29 Jun 61	7 Jul 61	11 Jul 61	18 Jul 61	25 Jul 61	1 Aug 61	16 Aug 61	25 Aug 61	4 Sep 61	9 Sep 61
	AF Dir.	31 May 61	7 Jun 61	14 Jun 61	21 Jun 61	28 Jun 61	5 Jul 61	12 Jul 61	19 Jul 61	26 Jul 61	2 Aug 61	9 Aug 61	16 Aug 61
	ACT.	16 May 61	30 May 61	7 Jun 61	10 Jun 61	12 Jun 61	27 Jun 61	29 Jun 61	30 Jun 61	7 Jul 61	14 Jul 61	27 Jul 61	28 Jul 61
6 LCC	CONT.	10 Apr 61	17 Apr 61	28 Apr 61	5 May 61	12 May 61	19 May 61	3 Jun 61	10 Jun 61	17 Jun 61	24 Jun 61	1 Jul 61	8 Jul 61
	AF Dir.	31 May 61	7 Jun 61	14 Jun 61	21 Jun 61	28 Jun 61	5 Jul 61	12 Jul 61	19 Jul 61	26 Jul 61	2 Aug 61	9 Aug 61	16 Aug 61
	ACT.	10 Apr 61	17 Apr 61	28 Apr 61	5 May 61	12 May 61	19 May 61	26 May 61	2 Jun 61	9 Jun 61	16 Jun 61	23 Jun 61	30 Jun 61
7 Silo Electrical	CONT.	24 Jul 61	12 Aug 61	18 Aug 61	28 Aug 61	30 Aug 61	10 Sep 61	15 Sep 61	20 Sep 61	1 Oct 61	8 Oct 61	17 Oct 61	22 Oct 61
	AF Dir.	11 Jul 61	18 Jul 61	25 Jul 61	1 Aug 61	8 Aug 61	15 Aug 61	22 Aug 61	29 Aug 61	5 Sep 61	12 Sep 61	19 Sep 61	26 Sep 61
	ACT.	2 Jun 61	13 Jun 61	25 Jul 61	24 Jul 61	7 Aug 61	15 Aug 61	22 Aug 61	29 Aug 61	5 Sep 61	12 Sep 61	19 Sep 61	26 Sep 61
8 Silo Cap & Doors	CONT.	24 Jul 61	12 Aug 61	18 Aug 61	28 Aug 61	30 Aug 61	10 Sep 61	15 Sep 61	20 Sep 61	1 Oct 61	8 Oct 61	17 Oct 61	22 Oct 61
	AF Dir.	11 Jul 61	18 Jul 61	25 Jul 61	1 Aug 61	8 Aug 61	15 Aug 61	22 Aug 61	29 Aug 61	5 Sep 61	12 Sep 61	19 Sep 61	26 Sep 61
	ACT.	2 Jun 61	6 Jun 61	25 Jun 61	21 Jun 61	7 Jul 61	12 Jul 61	21 Jul 61	2 Aug 61	9 Aug 61	9 Aug 61	12 Aug 61	16 Aug 61
9 Grading, Paving & Fencing	CONT.	7 Aug 61	26 Aug 61	1 Sep 61	11 Sep 61	13 Sep 61	24 Sep 61	1 Oct 61	6 Oct 61	15 Oct 61	22 Oct 61	31 Oct 61	5 Nov 61
	AF Dir.	30 Aug 61	6 Sep 61	13 Sep 61	20 Sep 61	27 Sep 61	4 Oct 61	11 Oct 61	18 Oct 61	25 Oct 61	1 Nov 61	8 Nov 61	15 Nov 61
	ACT.	21 Jun 61	2 Jul 61	26 Jul 61	25 Jul 61	27 Aug 61	1 Sep 61	14 Sep 61	20 Sep 61	20 Sep 61	9 Oct 61	20 Oct 61	27 Oct 61
10 Completion of Contract	CONT	7 Aug 61	26 Aug 61	1 Sep 61	11 Sep 61	13 Sep 61	24 Sep 61	1 Oct 61	6 Oct 61	15 Oct 61	22 Oct 61	31 Oct 61	5 Nov 61
	AF Dir.	30 Aug 61	6 Sep 61	13 Sep 61	20 Sep 61	27 Sep 61	4 Oct 61	11 Oct 61	18 Oct 61	25 Oct 61	1 Nov 61	8 Nov 61	15 Nov 61
	ACT	21 Jun 61	12 Jul 61	3 Jul 61	2 Aug	20 Aug	1 Sep 61	14 Sep 61	20 Sep 61	3 Oct 61	9 Oct 61	20 Oct 61	27 Oct 61

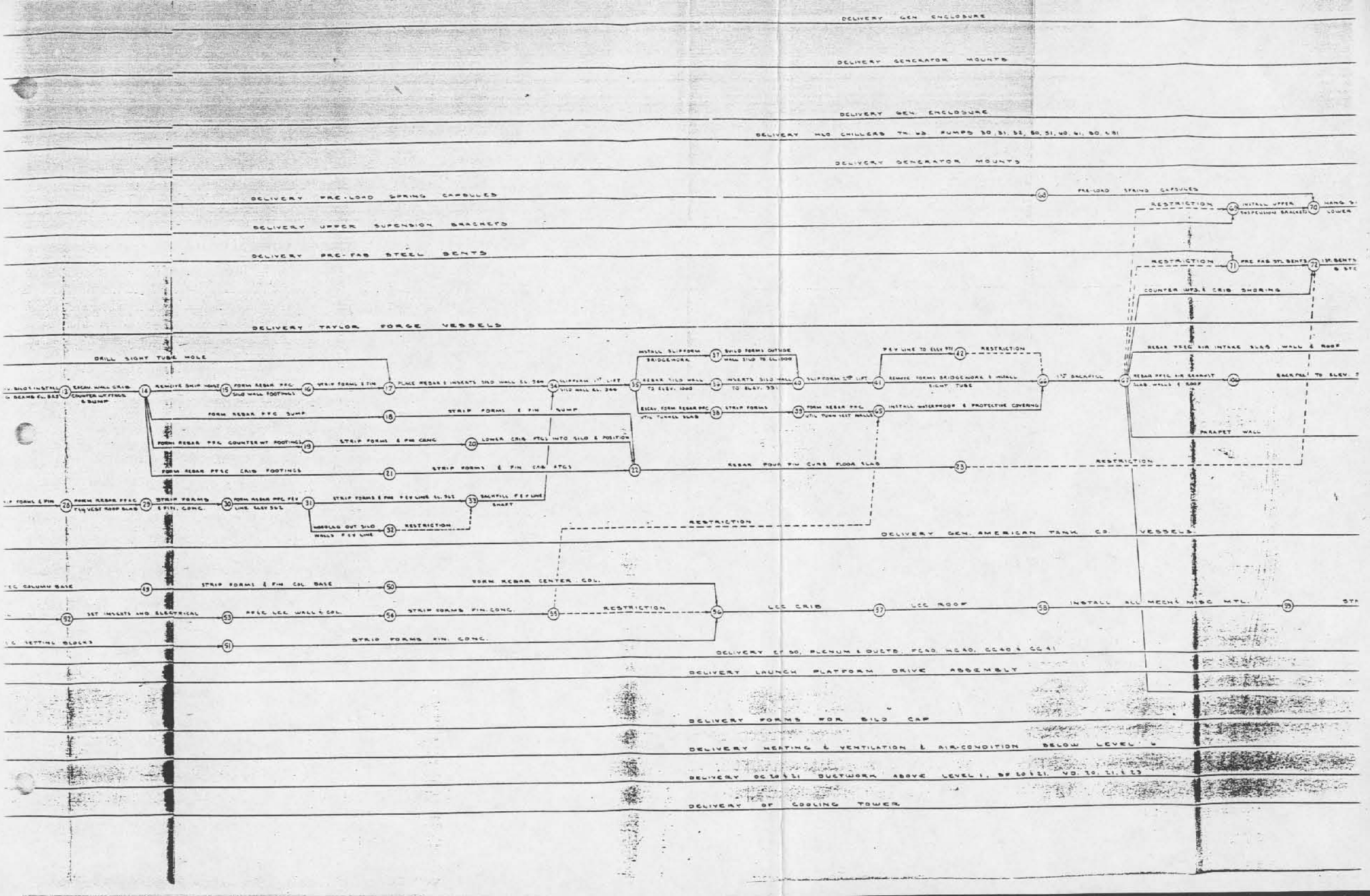
SIGNIFICANT EVENTS - SHEP

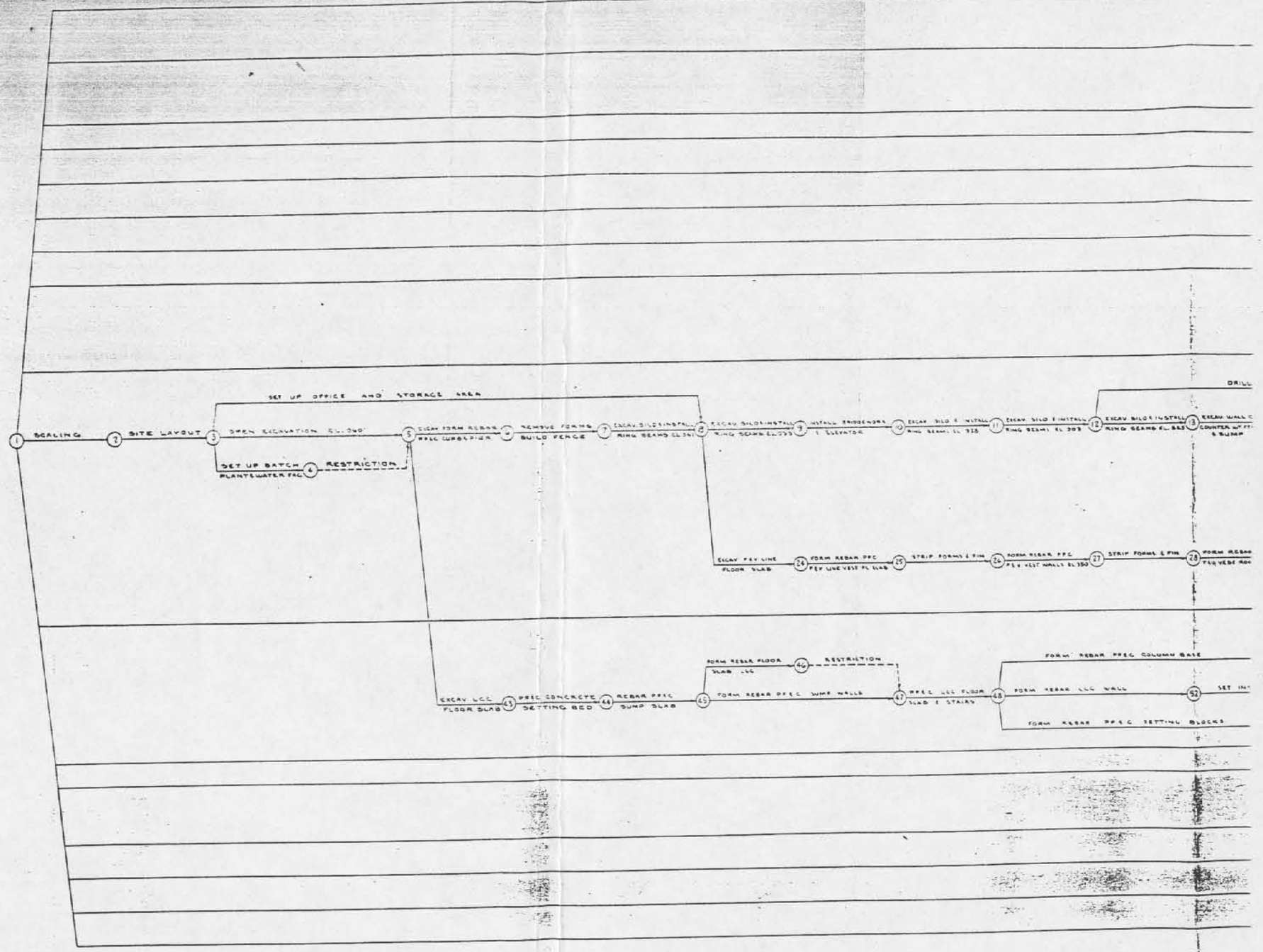
ITEM		DATE STARTED	DATE COMPLETED
1.	Open Cut	7-1-60	10-29-60
2.	Shaft Work	8-25-60	1-12-61
3.	LCC Concrete	9-30-60	12-17-60
4.	LCC	10-6-60	6-2-61
5.	Silo Re-Steel	11-3-60	1-12-61
6.	First Phase, Wall	11-4-60	12-22-60
7.	First Lift	11-20-60	11-25-60
8.	Second Phase, Wall	11-29-60	12-18-60
9.	Second Lift	12-19-60	12-22-60
10.	Silo Electrical	1-3-61	8-29-61
11.	Utility Tunnel	1-17-61	1-26-61
12.	Backfill	1-23-61	8-1-61
13.	Structural Steel	2-18-61	3-8-61
14.	Parapet Wall	2-26-61	3-4-61
15.	Roof Cap, Doors	2-26-61	8-2-61
16.	Diesel Generators	3-2-61	5-1-61
17.	Switchgear	3-2-61	5-1-61
18.	Cable Trays	3-6-61	5-26-61
19.	Sight Tube	4-1-61	5-29-61
20.	Heat, Vent & Air Conditioning	4-12-61	8-30-61
21.	Water Cooling Tower	4-11-61	6-26-61
22.	Entry Tunnel	4-12-61	4-24-61
23.	Water Treatment Building	4-13-61	6-21-61
24.	Grading, Paving & Fencing	6-30-61	9-20-61
25.	Completion of Contract Work	7-1-60	9-22-61



PROJECT
ATLAS MISSILE SITES
DYESS A.F.B., TEXAS
CRITICAL PATH NETWORK
ZACHRY - BROWN CO.
GENERAL CONTRACTORS


DOOR FRAMES
GENERATOR ENCLOSURE
GRATE & FLOOR SINKS LEVEL 6
LUBE OIL PUMPS
H.V. & AC. LEVEL 5 TO 6
RESTRICTION
GENERATOR MOUNTS
TK. 64 & HANGERS
PIPING LEVEL 5 TO 6
RESTRICTION
RESTRICTION
GENERATOR MOUNTS
FLOOR GRATE & FLOOR SINKS LEVEL 5
H.V. & AC LEVEL 4 TO 5
DOOR FRAMES
GEN. ENCLOSURE
PIPING LEVEL 4 TO 5
HANG SPRING CAPSULES &
LOWER SUSPENSION BRACKETS
LEVEL 7 STEEL
LEVEL 6 STEEL
LEVEL 5 STEEL
LEVEL 4 STEEL
LEVEL 4 GRATE
PIPING LEVEL 3 TO 4
INSTALL TANK 80
LEVEL 3 GRATING
PIPING LEVEL 2 TO 3
LEVEL 3 STL.
LEVEL 2 STL.
LEVEL 1 STL.
LEVEL 1 GRATING
PIPING LEVEL 1 TO 2
COMP. F.O. &
L.O. PIPING
WALL & ROOF
AIR INTAKE SHAFT TO EL. 1000'
OUTSIDE FUEL OIL PIPING
DIESEL TKS. & OUTSIDE F.O. LINE
TEST F.O. & L.O.
PIPING
AIR EXHAUST SHAFT TO EL.1000'
LEVEL 2 GRATING
DIESEL EXH.
PLENUM
DIE. EXH. LINES
CK & ALIGN DIESELS
BACKFILL ENT. RAMP
LEVEL 3 GRATING
PIPING BELOW LEVEL 6
WATER TANKS
H.V. & AC. BELOW LEVEL 6
TAYLOR FORGE VESSELS
GEN. AMERICAN TK. CO. VESSELS
LAUNCH PLAT.
DRIVE ASSEMBLY
SILO CAP
FACILITY
6" WATER LINE
CONSTRUCT LCC & ENT. TUNNEL TO CONST. JT.
COMPLETE ENT. TUNNEL
BACKFILL TO 1000'
STAIRWELL ROOF SLAB
PLACE SHEETROCK, CABINETS, DOORS
PAINT FLOORING GLASSWORK
INSTALL FIXTURES TRIM WORK
FILL & VENT LINE TO 1000


DELIVERY GEN ENCLOSURE
DELIVERY GENERATOR MOUNTS
DELIVERY GEN. ENCLOSURE
DELIVERY HLO CHILLERS TK 43 PUMPS 30, 31, 32, 50, 51, 40, 41, 50 & 51
DELIVERY GENERATOR MOUNTS
DELIVERY PRE-LOAD SPRING CAPSULES
DELIVERY UPPER SUPENSION BRACKETS
DELIVERY PRE-FAB STEEL BENTS
DELIVERY TAYLOR FORGE VESSELS
DRILL SIGHT TUBE HOLE
EXCAV. WALL CRIB COUNTER WT FTGS. & SUMP
REMOVE SHIP HOIST
FORM REBAR PFC SILO WALL FOOTINGS
STRIP FORMS & FIN
PLACE REBAR & INSERTS SILO WALL EL 364
SLIPFORM 17' LIFT SILO WALL EL. 369
INSTALL SLIPFORM BRIDGEWORK
SILO FORMS OUTSIDE WALL SILO TO EL 1000
REBAR SILO WALL TO ELEV. 1000
INSERTS SILO WALL TO ELEV. 931
SLIPFORM 12' LIFT
P&V LINE TO ELEV 971
RESTRICTION
REMOVE FORMS BRIDGEWORK & INSTALL SIGHT TUBE
12' BACKFILL
REBAR PFC AIR INTAKE SLAB, WALL & ROOF
REBAR PFC SLAB, WALLS & ROOF
BACKFILL TO ELEV.
FORM REBAR PFC SUMP
STRIP FORMS & FIN SUMP
ESCAV. FORM REBAR PFC UTIL TUNNEL SLAB
STRIP FORMS
FORM REBAR PFC UTIL TUNN TEST WALLS
INSTALL WATERPROOF & PROTECTIVE COVERING
PARAPET WALL
FORM REBAR PFC COUNTER WT FOOTINGS
STRIP FORMS & FIN CONC
LOWER CRIB FTGS INTO SILO & POSITION
FORM REBAR PFC CRIB FOOTINGS
STRIP FORMS & FIN CRIB FTGS
REBAR POUR FIN CURB FLOOR SLAB
RESTRICTION
FORM & FIN
FORM REBAR PFC FIN VEST ROOF SLAB
STRIP FORMS & FIN. CONC.
FORM REBAR PFC P&V LINE ELEV 362
STRIP FORMS & FIN P&V LINE EL 362
BACKFILL P&V LINE SHAFT
UNDERLAG OUT SILO WALLS P&V LINE
RESTRICTION
DELIVERY GEN. AMERICAN TANK CO. VESSELS
PFC COLUMN BASE
STRIP FORMS & FIN COL BASE
FORM REBAR CENTER COL.
SET INSERTS AND ELECTRICAL
PFC LCC WALL & COL.
STRIP FORMS FIN. CONC.
RESTRICTION
LCC CRIB
LCC ROOF
INSTALL ALL MECH'L MISC MTL.
PFC SETTING BLOCKS
STRIP FORMS FIN. CONC.
DELIVERY EF 50, PLENUM & DUCTS, FC 40, HC 40, CC 40 & CC 41
DELIVERY LAUNCH PLATFORM DRIVE ASSEMBLY
DELIVERY FORMS FOR SILO CAP
DELIVERY HEATING & VENTILATION & AIR-CONDITION BELOW LEVEL
DELIVERY OC 20 & 21 DUCTWORK ABOVE LEVEL 1, EF 20 & 21, VD 20, 21, & 23
DELIVERY OF COOLING TOWER


SET UP OFFICE AND STORAGE AREA
1 SCALING
2 SITE LAYOUT
3 OPEN EXCAVATION EL. 340'
SET UP BATCH PLANT & WATER FAC.
4 RESTRICTION
5 EXCAV FORM REBAR PREC SUBSTRUCTURE
6 REMOVE FORMS BUILD FENCE
7 EXCAV SILO & INSTALL RING BEAMS EL 343'
8 EXCAV SILO & INSTALL RING BEAMS EL 333'
9 INSTALL BRIDGEWORK & ELEVATOR
10 EXCAV SILO & INSTALL RING BEAMS EL 323'
11 EXCAV SILO & INSTALL RING BEAMS EL 303'
12 EXCAV SILO & INSTALL RING BEAMS EL. 283'
13 EXCAV WALL & COUNTER WT FT & SUMP
EXCAV F&V LINE FLOOR SLAB
24 FORM REBAR PFC F&V LINE VEST FL SLAB
25 STRIP FORMS & PIN
26 FORM REBAR PFC F & V EXT WALLS EL 350
27 STRIP FORMS & PIN
28 FORM REBAR T&B VERT WALLS
EXCAV LCC FLOOR SLAB
43 PREC CONCRETE SETTING BED
44 REBAR PREC SUMP SLAB
45 FORM REBAR PREC SUMP WALLS
FORM REBAR FLOOR SLAB LCC
46 RESTRICTION
47 PREC LCC FLOOR SLAB & STAIRS
48 FORM REBAR LCC WALL
FORM REBAR PREC COLUMN BASE
FORM REBAR PREC SETTING BLOCKS
52 SET IN

Doc No. 14

PROGRESS, MANPOWER, AND EQUIPMENT REPORT
DYESS MISSILE BASE

SITE _____ REPORTED BY _____ DATE _____

WORK IN PROGRESS OR COMPLETED

	SILO	LCC	OTHER
SHIFT 1			
SHIFT 2			
SHIFT 3			

MAJOR EQUIP. AND CRAFTS	QUANTITY SHIFT 1	QUANTITY SHIFT 2	QUANTITY SHIFT 3
Cranes			
F. E. Loaders			
Wagon Drills			
Welding Mach			
Conc. Trucks			
_____			
_____			
Carpenters			
Ironworkers			
Welders			
Pipefitters			
Electricians			
Eqpt Oper.			
Tool Oper.			
Truck Dr.			
Surveyers			
Mechanics			
Oilers			
Laborers			
Masons			
Painters			
Office			
Watchman			
TOTAL EMPLOYEE			
SHIFT LENGTH (hours)			

DELAYS AND CAUSES

MAJOR EQPT. OR MATR RECD

SAFETY

CONTRACTOR'S PLANS FOR IMMEDIATE FUTURE OR COMMENTS

☐ PRE POUR
☐ POST POUR

SITE ANSON

Date —

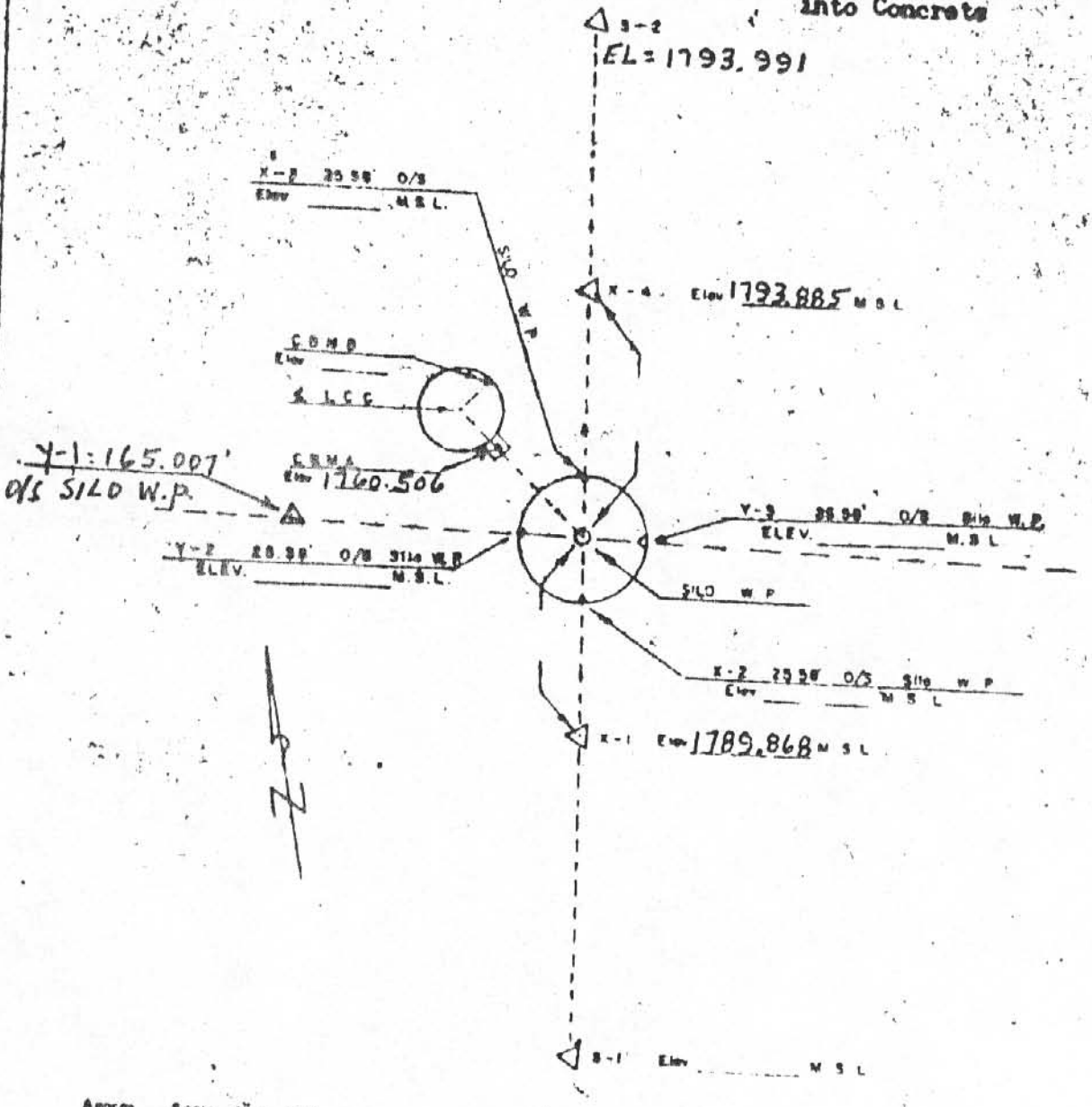
NOTE:

Top SILO M.S.L. Elev. =
Top SILO Reference Elev. = 1000.000

S-1 S-2 X-1 and X-4 = Conc. Mon. = Standard C.O.E. Bronze Disc in Conc. Post

X-2 X-3 Y-2 and Y-3 = Standard C.O.E. Bronze Disc Star Drilled into Concrete

C.B.M. "A" & C.B.M. "B" = Standard C.O.E. Bronze Disc Star Drilled into Concrete

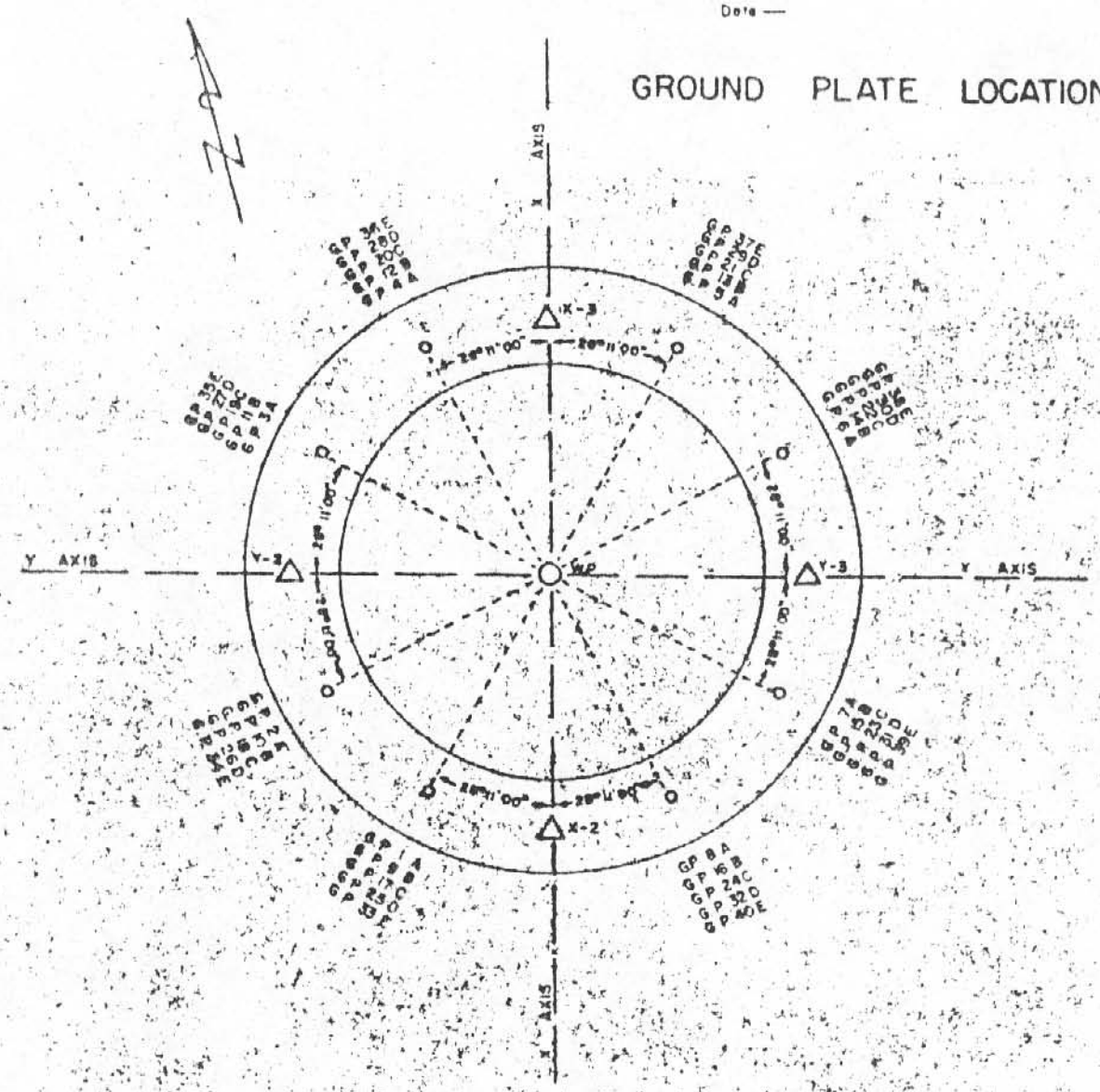


Approx Scale 1" = 100

SITE

Date —

GROUND PLATE LOCATIONS



NOTE: Ground Plate 1-A is nearest to bottom of wall, and 9B, 17C, 25D and 33E should be in numerical order up the wall, and directly above 1-A. (This is typical of each group of ground plates.)

SITE

Date —

GROUND PLATE ANGLES AND ELEVATIONS				
Ground Plate Number	Call	Actual	Call Elev.	Actual Elev.
—	0°-00'-00" Δ - X - 2			
G.P.1A	28°-11'-00" Rt.			
G.P.9B	" Rt.			
G.P.17C	" Rt.			
G.P.25D	" Rt.			
G.P.33E	" Rt.			
	0°-00'-00" Δ - X - 2			
G.P.8A	28°-11'-00" Lt.			
G.P.16B	" Lt.			
G.P.24C	" Lt.			
G.P.32D	" Lt.			
G.P.40E	" Lt.			
	0°-00'-00" Δ - X - 3			
G.P.4A	28°-11'-00" Lt.			
G.P.12B	" Lt.			
G.P.20C	" Lt.			
G.P.28D	" Lt.			
G.P.36E	" Lt.			
	0°-00'-00" Δ - X - 3			
G.P.5A	28°-11'-00" Rt.			
G.P.13B	" Rt.			
G.P.21C	" Rt.			
G.P.29D	" Rt.			
G.P.37E	" Rt.			

SITE

Ground Plate Number	Call	Actual	Call Elev.	Actual Elev.
	0°-00'-00" Δ = Y - 2			
G.P.2A	28°-11'-00" Lt.			
G.P.10B	" Lt.			
G.P.18C	" Lt.			
G.P.26D	" Lt.			
G.P.34E	" Lt.			
	0°-00'-00" Δ = Y - 2			
G.P.3A	28°-11'-00" Rt.			
G.P.11B	" Rt.			
G.P.19C	" Rt.			
G.P.27D	" Rt.			
G.P.35E	" Rt.			
	0°-00'-00" Δ = Y - 3			
G.P.6A	28°-11'-00" Lt.			
G.P.14B	" Lt.			
G.P.22C	" Lt.			
G.P.30D	" Lt.			
G.P.38E	" Lt.			
	0°-00'-00" Δ = Y - 3			
G.P.7A	28°-11'-00" Rt.			
G.P.15B	" Rt.			
G.P.23C	" Rt.			
G.P.31D	" Rt.			
G.P.39E	" Rt.			

PRE POUR
POST POUR

SITE Anson

DATE - 23 DEC. 1960

RADIAL DIST. 26'1/16"
BOLT HOLES PLUMB WITHIN 1/8"

COLLIMATOR
SILO

5 5/8"

ACTUAL 906.601
CALL 906.615

ACTUAL 906.822
CALL 906.818

1/8" LT.
FLAT
1/8" LT.

ACTUAL 903.392
CALL 903.410

Insert Plates No 8 ACTUAL 903.402
Elev 903-1 CALL 903.210

B M Insert Plates ACTUAL
Elev 897 - 11 CALL

ACTUAL 895.456
CALL 895.458

Elev 895 - 4 (4 1/4") ACTUAL
CALL

FLAT 2
1/8" LT.

ACTUAL 891.464
CALL 891.472

Insert Plates No 7 & 7A ACTUAL 891.4
Elev 891 4 1/8" CALL 891.47

ACTUAL 886.402
CALL 886.396

ACTUAL 886.402
CALL 886.396

FLAT 2

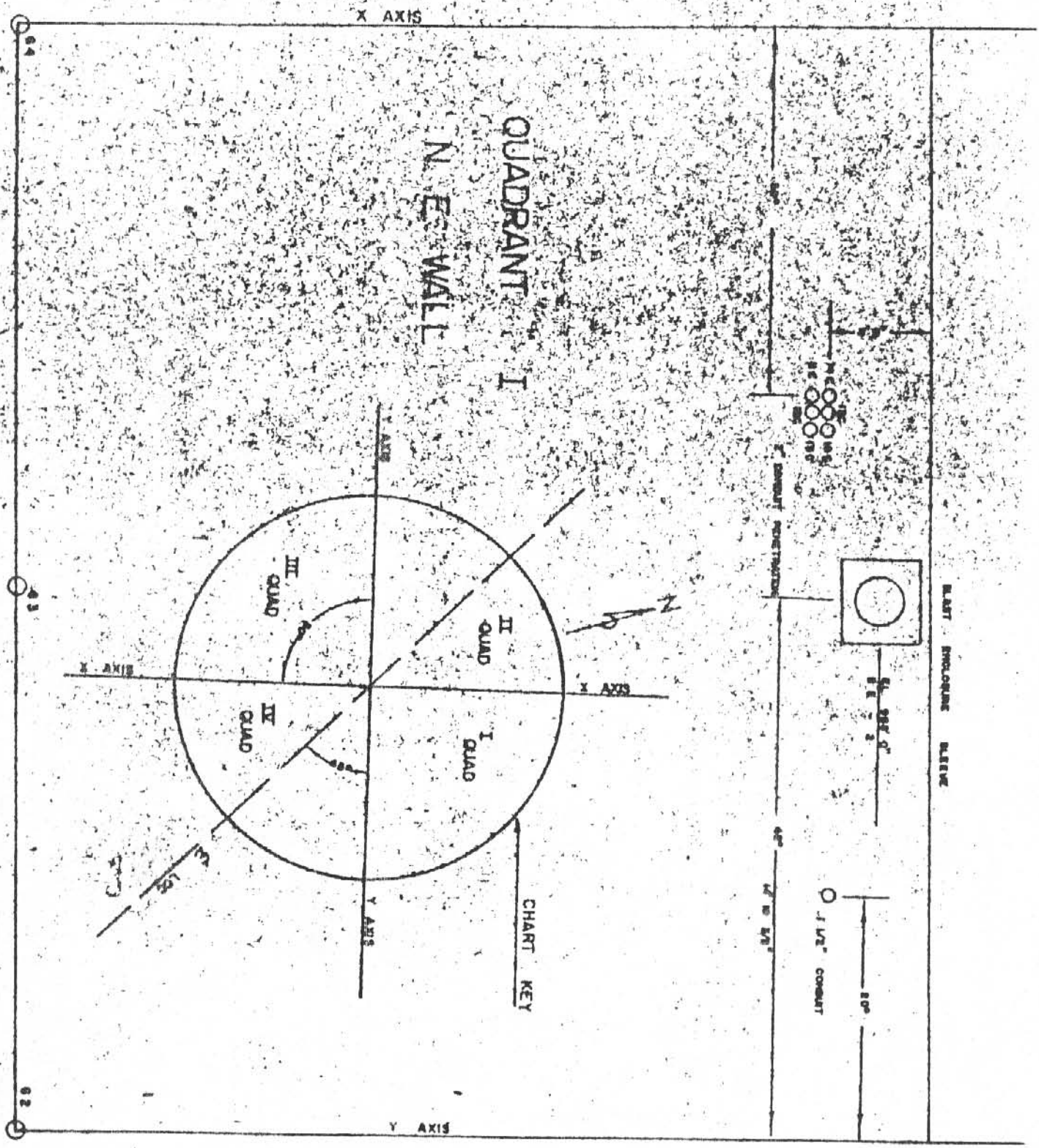
ACTUAL 884.175
CALL 884.193

Insert Plates No 6 ACTUAL 884.80
Elev 884 2 5/16 CALL 884.19

COLLIMATOR BENCH MARK & ALIGNMENT STATION HOUSING INSERT PLATES

SITE ALBANY

DATE 24 JAN

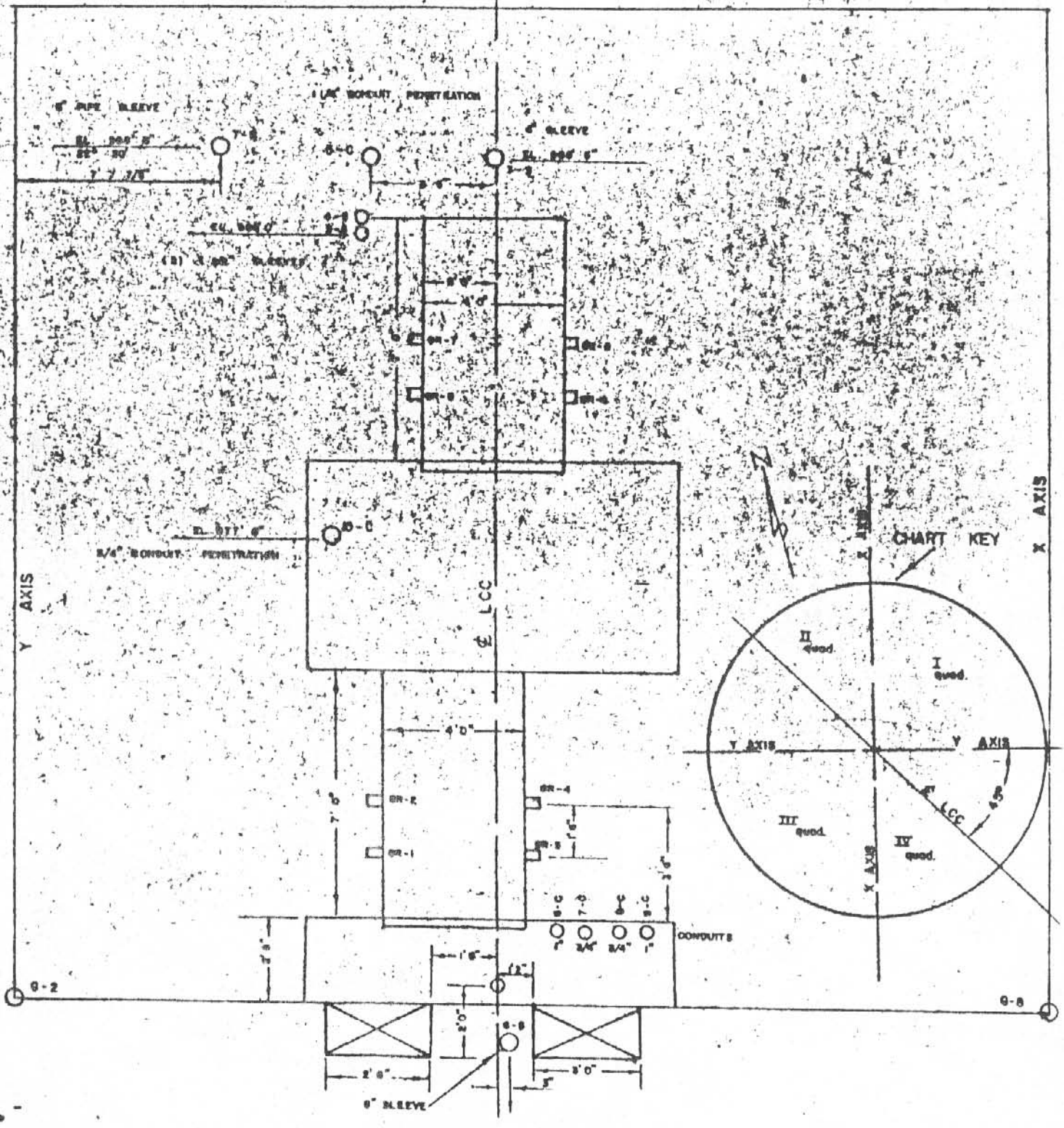


SITE ALBANY

DATE 24 JAN 196

Doc No. 15
Sheet 7 of 13

QUADRANT (IV) | S. E. WALL



PAGE 17

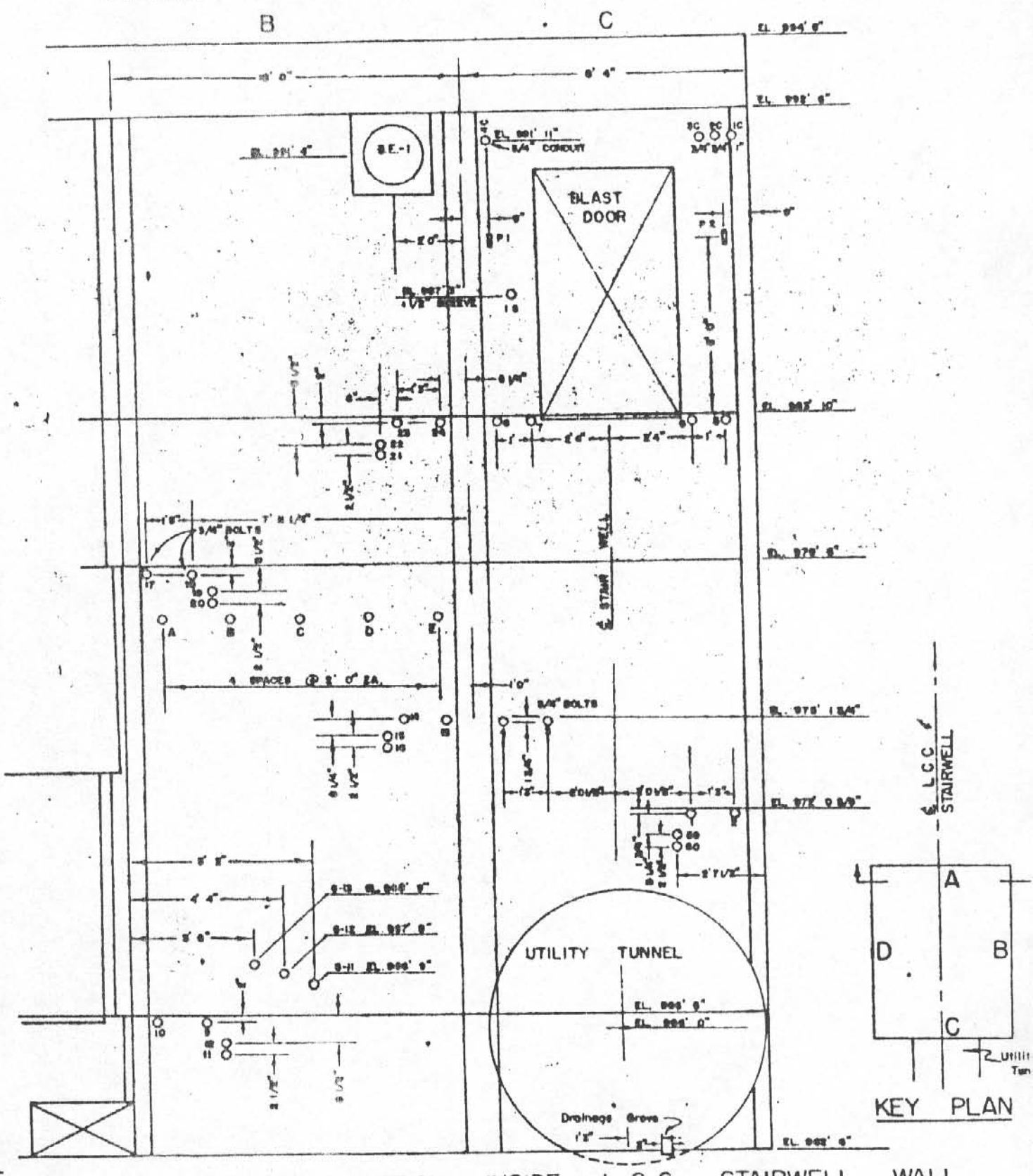
☐ PRE POUR

☑ POST POUR

Doc No. 15
Sheet 8 of 13

SITE ALBANY

DATE 1 JANUARY 1961

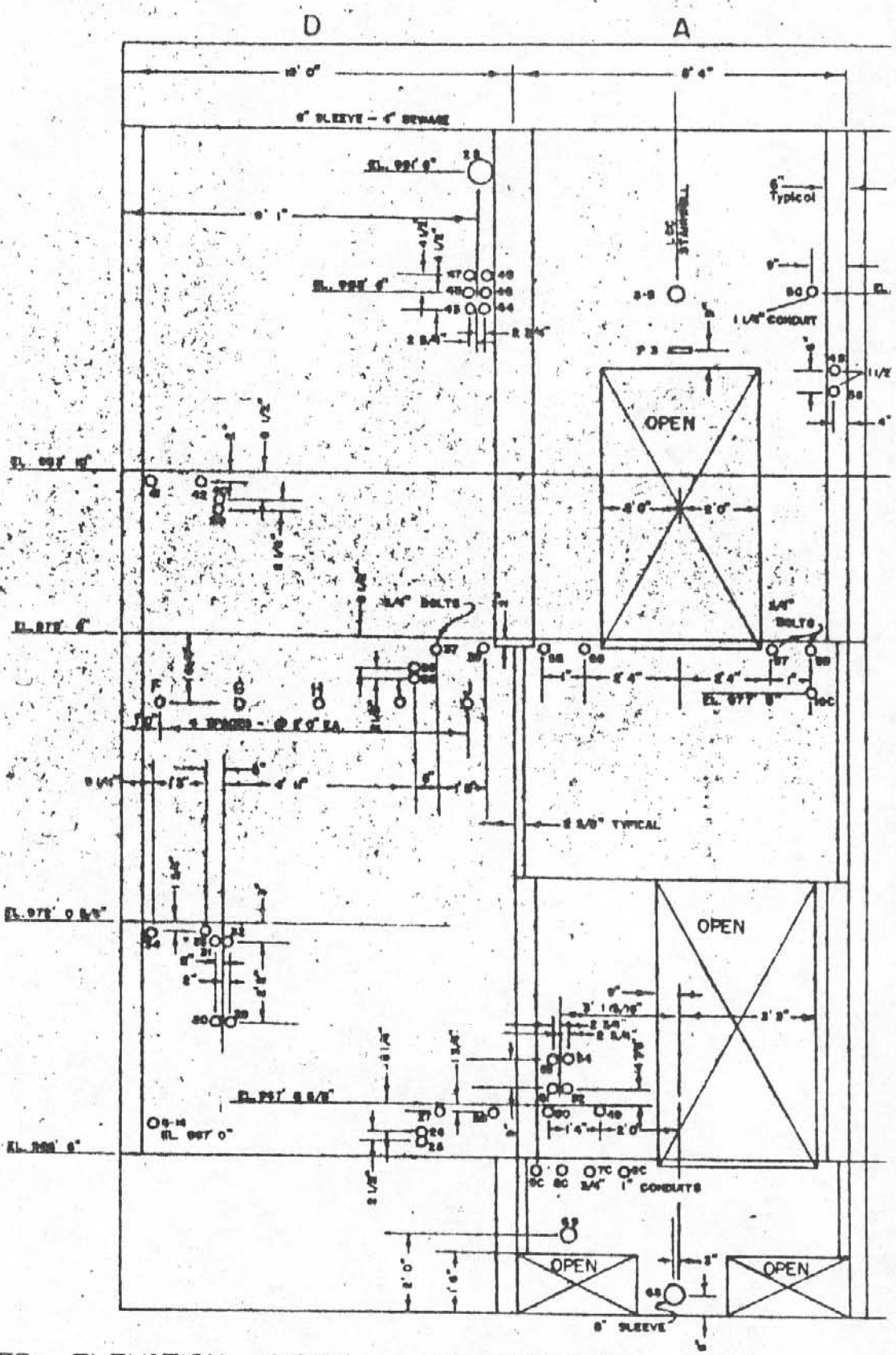


POST POUR

SITE ALBANY

Doc No. 15
Sheet 9 of 13

DATE JANUARY

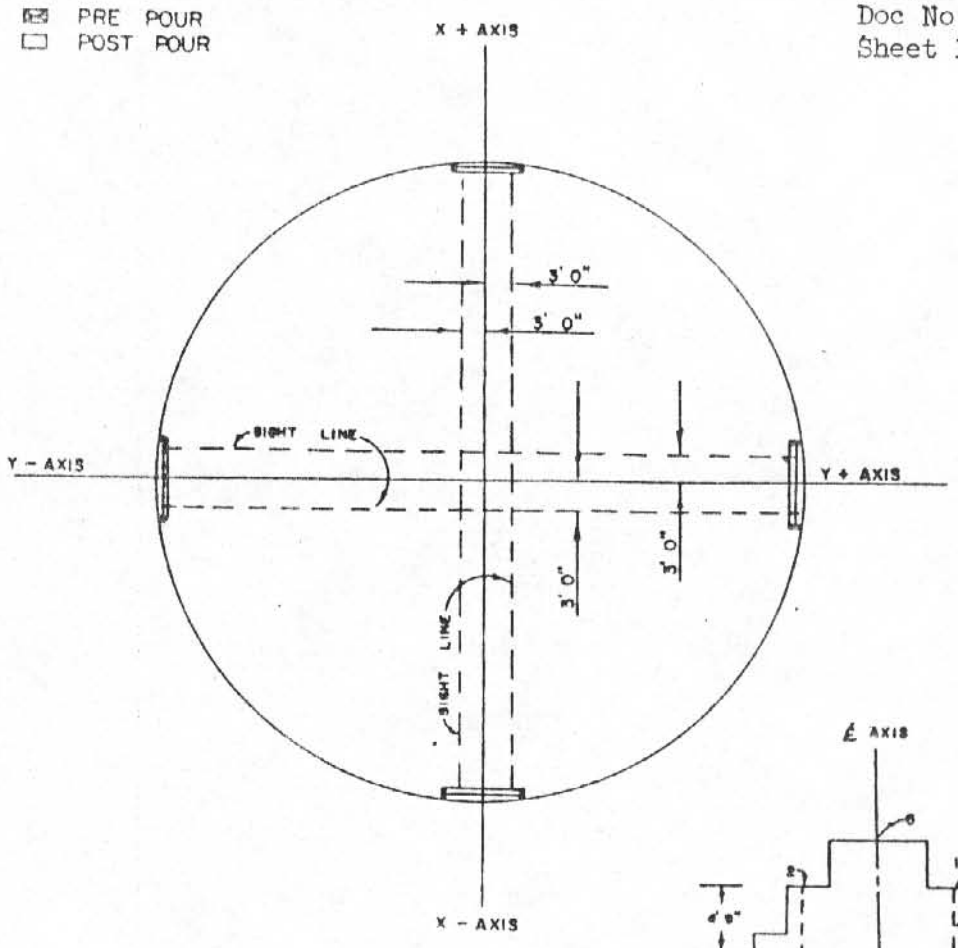


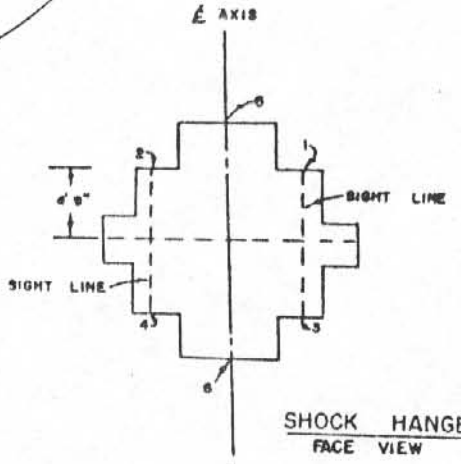
DEVELOPED ELEVATION INSIDE LCC STAIRWELL WALL

SITE ANNEX

DATE 16 JAN 196[illegible]
Doc No. 15
Sheet 10 of 13

☒ PRE POUR
☐ POST POUR





SHOCK HANGER
FACE VIEW

KEY

HORZ. DISTANCE FROM SILO W P TO POINTS
① ② ③ ④ = [illegible]

HORZ. POSITION 5 6 6 = DISTANCE TO RT OR LT. OF ℄ SILO AXIS

SHOCK HANGER	[illegible] ①	[illegible] ②	[illegible] ③	[illegible] ④	HORZ. POSITION ⑤	HORZ. POSITION ⑥
X + AXIS	26' 1 1/2"	26' 1 1/4"	26' 1 3/16"	26' 1 1/16"	1/8" RT.	℄
X - AXIS	26' 1 7/16"	26' 1 1/16"	26' 1 1/4"	26' 1 1/4"	5/16" RT.	5/16" RT.
Y + AXIS	26' 1 3/4"	26' 1"	26' 1 1/16"	26' 0 15/16"	5/16" RT.	7/8" RT.
Y - AXIS	26' 0 7/8"	26' 0 3/4"	26' 0 7/8"	26' 0 3/4"	7/16" LT.	3/16" RT.

CONTRACT CALL RADIUS = 26' 1"

SEE PG # [illegible] FOR ELEVATION

SWF 420(OT)-3
31 Oct 60

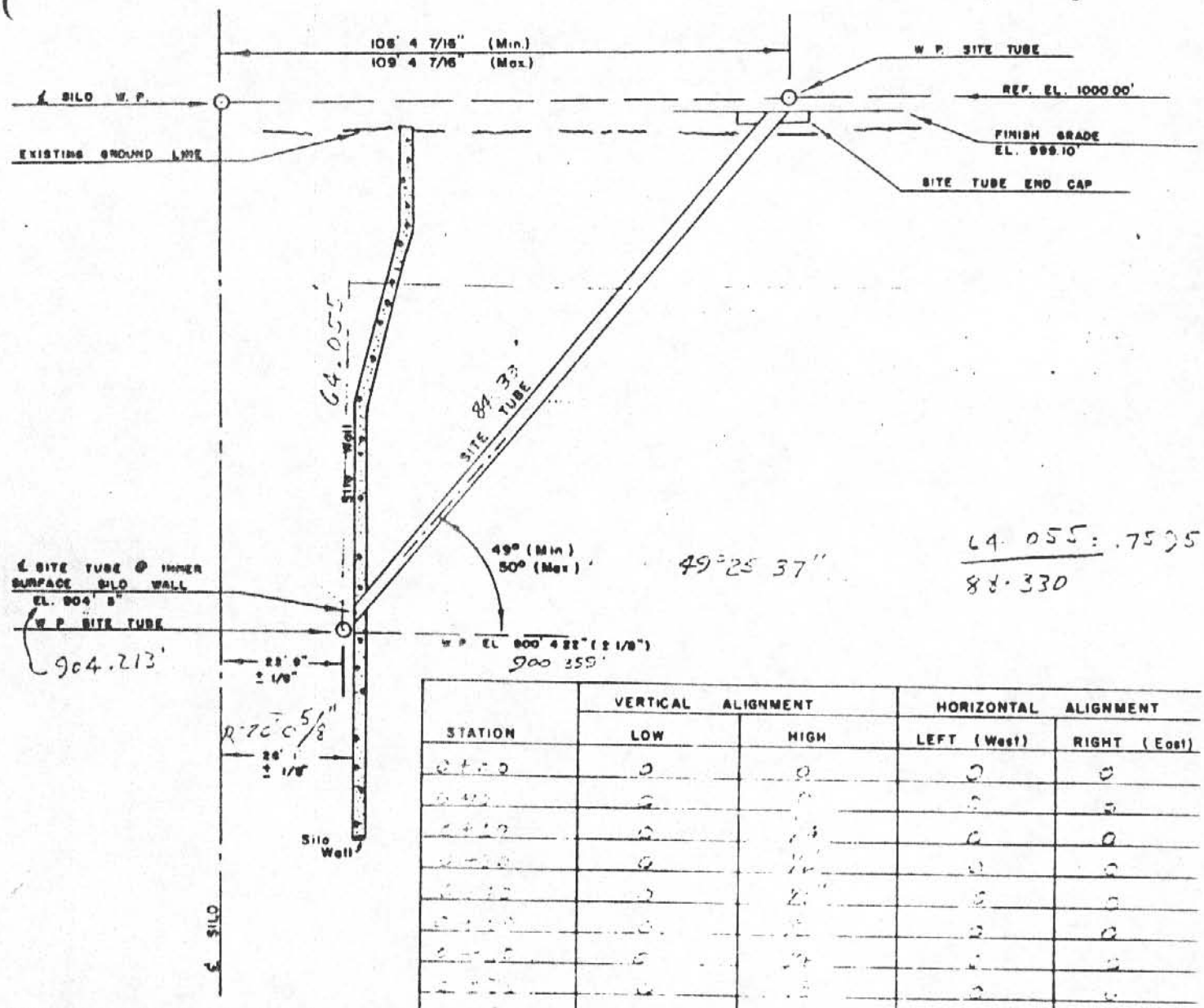
SITE Anson

DATE

Doc No. 15
Sheet 11 of 13

☐ PRE POUR
☐ POST POUR

SITE TUBE



NOTE: Sta. 0+00 of Site Tube is @ Inner Surface of Silo Wall

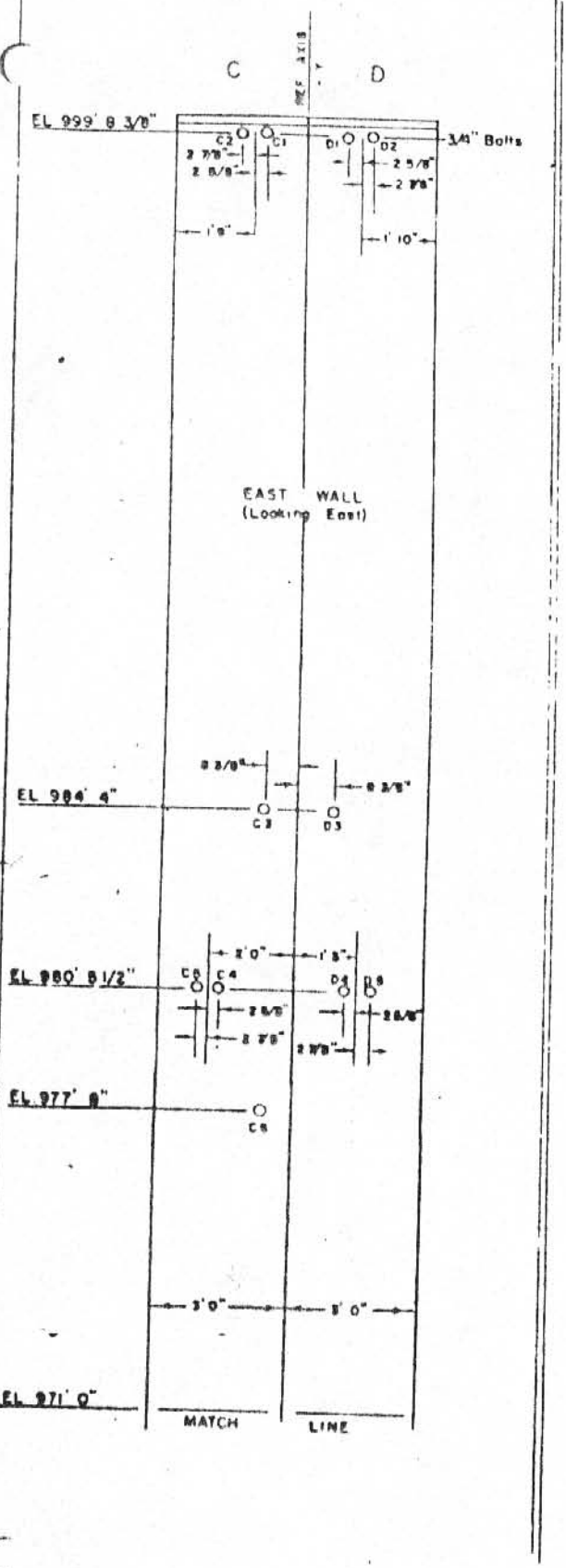
STATION	VERTICAL ALIGNMENT		HORIZONTAL ALIGNMENT	
	LOW	HIGH	LEFT (West)	RIGHT (East)

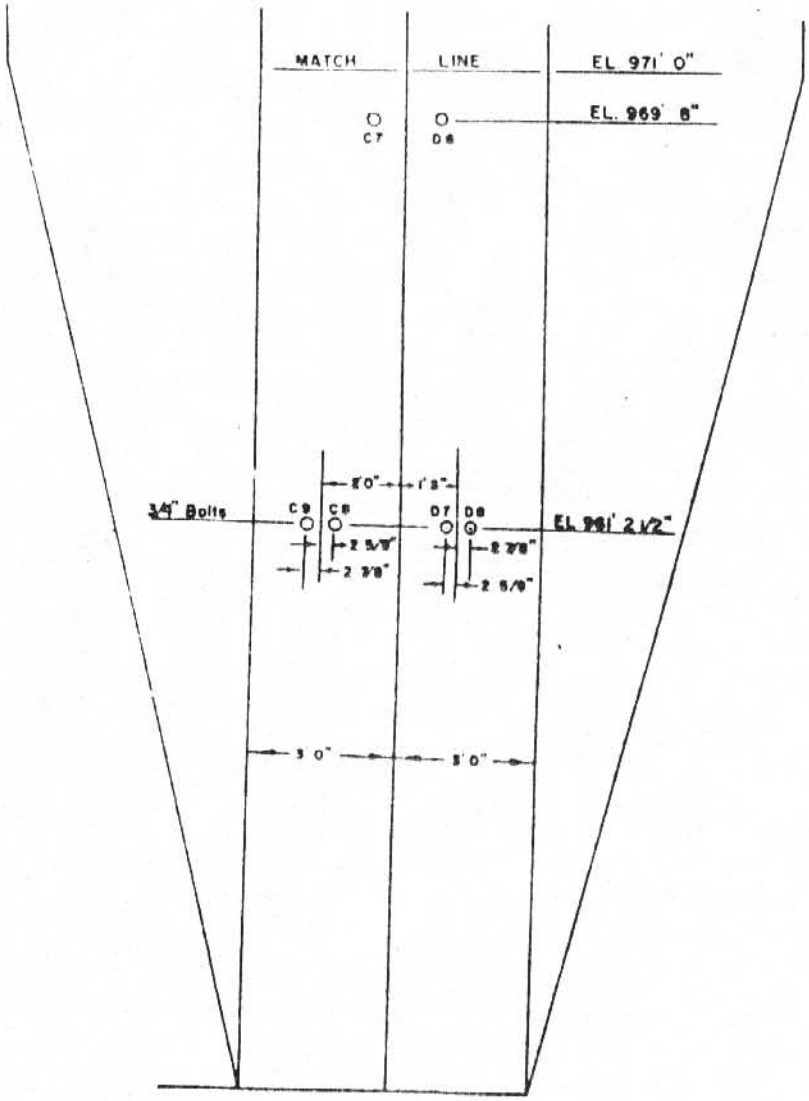
SWF 420(OT)-4
31 Oct 60

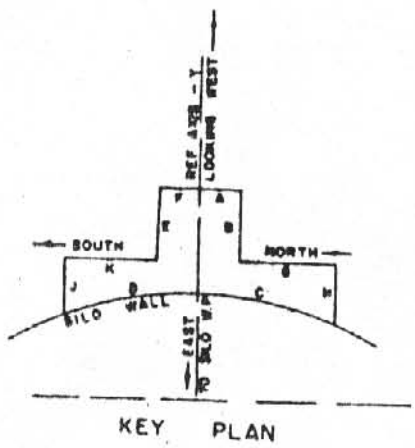
PAG

Developed Elevation & Position Embedded Items Inside Walls — FILL & VENT SHAFT

Doc No. 15
Sheet 12 of 13





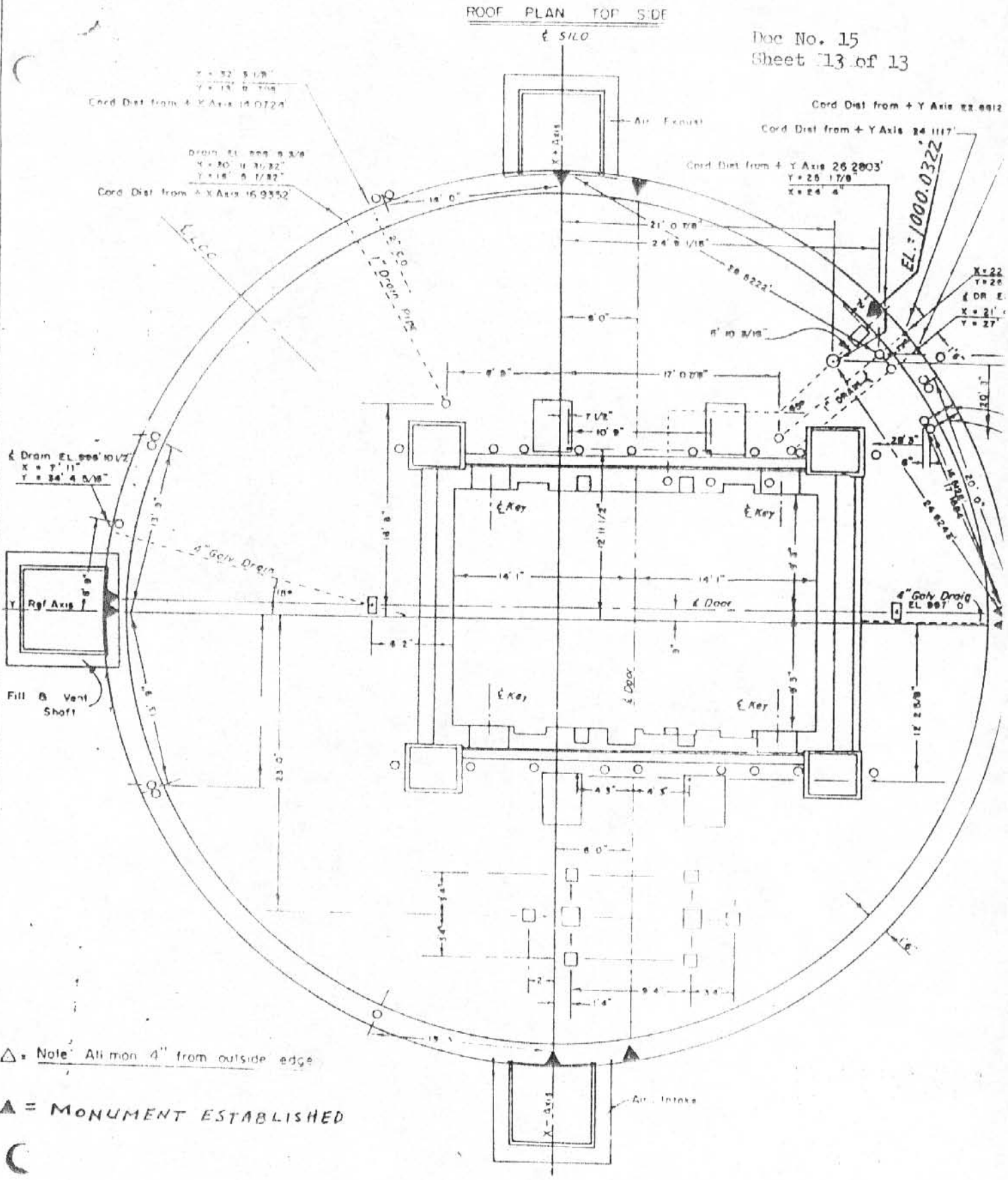


KEY PLAN

SITE ANSON

DATE 3-29-61

Doc No. 15
Sheet 13 of 13



△ = Note: All mon 4" from outside edge

▲ = MONUMENT ESTABLISHED

The Abilene Reporter-News

ABILENE, TEX., THURS. EVENING, APRIL 20, 1961

EDITORIALS

Doc No. 16

If we desire to secure peace . . . it must be known that we are at all times ready for war, George Washington to Congress, 1793.

A Bow to Dyess Missile Project

This is not a game of tiddlywinks, the Cold War which pits democracy against communism. It should be soaking in on us that there is a grim issue of survival which overshadows.

We face an enemy who is determined, ruthless and possessed of scientific skill and the new tools of warfare its science and its monolithic government can produce.

We have great skill and knowhow. We put them to work with varying degrees of determination.

The U.S. is building, at various places about the nation, installations in which to place ballistic missiles. Once in place, the missiles will be a powerful new deterrent. With them aimed at its heart, the Kremlin would think long and hard before committing suicide.

All common sense tells us to rush the missile installations as rapidly as possible. Yet—at 19 of these projects work stoppages the last eight months have cost 23,400 man-hours of work.

The missile complex here around Dyess is one of the two in the nation which has not been slowed by wrangles and disputes.

We cannot speak too highly, the nation cannot speak too highly of these men who have kept the local work churning. There have been no work stoppages because of labor dispute, no jurisdictional strikes. The American taxpayers are getting a fine job for the money—and getting it on schedule.

H. B. Zachry and Brown and Root combined to be the prime contractor on preparation of the silos. Now Convair will shortly begin putting the Atlas missiles in place.

According to the latest report we have, 978 persons are employed on the local missile projects. Of these, 469 have local (Abilene or other area towns) permanent addresses. They are homefolk. In all, 946 with permanent addresses have been employed on the jobs at one time or another.

The Dyess missile projects have meant much to local communities. But their importance is more than local.

The Air Force, in carrying out its missile assignment, is rushing to get the Atlas, the Titan, the Minuteman of the not too-distant future in place to protect this nation.

The AF is performing mightily in the face of the complexities of a new science — and in the face of some manmade complexities.

The contractors, the workers, the Air Force, all those involved in bringing the Dyess projects smoothly into being deserve the nation's deepest bow of gratitude. This is a most serious business and these people seem to realize it.

Oplin Base First Done 'On Time'

By ROB PHILLIPS
Reporter-News Staff Writer

OPLIN — A tall, gray-haired man who looks more like a Baptist preacher than a contractor smiled broadly Wednesday morning as he turned a set of keys over to an officer from the Corps of Engineers.

H. B. Zachry of San Antonio, one of the prime contractors on the 12 Atlas missile launching sites ringing Abilene and Dyess AFB, had reason to be proud as he formally turned the Oplin missile site over to Lt. Col. A. M. Antonelli of the Corp of Engineers Ballistic Missile Construction Office.

The Oplin site is the first Atlas site in the nation to be completed on the original contract date. The date could have been changed because of changes and modifications ordered after the work got underway, but it was originally scheduled for June 30, 1959 — today and delivery was made.

Col. Antonelli used a pair of office shears to clip the white strip of satin ribbon across the entrance to the launch control center after the open doors of the 100-foot deep silo. Then turning the keys over to Col. Hoyt W. Hottel, Site Activation Task Force Commander at Dyess AFB, who opened the doors for a number of military and civilian visitors.

THE CHRISTIAN SCIENCE MONITOR

Saturday, March 18, 1961

Oplin Number One

Bustle at Missile Site

By Robert H. Reuss

Abilene, Texas

"WE'RE GOING TO MAKE a good crop this year. Look at the color of that wheat!" Larry Moore was talking, leaning back at ease, driving a white Ford that skimmed along on the way to Oplin Number One.

Sure enough, the wheat was fresh green, just beyond the mossy stage on the black earth. But most of the west central Texas we could see seemed dusty, with the mesquite not budding yet, stark and crooked. Now and then a Hereford stood motionless, blinking under a scrub oak.

Yet with it all there was an idyllic air, for spring is on its here with the occasional red bud purple in the sun. At this place and time Oplin Number One seems incredible, and what it stands for. Simply put, Oplin Number One is a hole in the ground. Militarily, Oplin Number One is a missile site—18th Air Force, Strategic Air Command, 819th Air Division, Brig. Gen William B. Yancey, commanding. When finished Oplin will be an Atlas ballistic missile ready to fire.

On-the-Job Leader

Larry Moore, a man who works in the sun year round, is the job superintendent. He's youngish, and the important thing about Larry Moore here is that he can talk concrete, reinforced steel, backfill, cranes, not to mention to steelworkers, carpenters, and electricians. He's from Magnolia, Ark., and he's helped build dams, highroads, power plants, and munitions depots.

Now it's a concrete missile underground silo and accouterments. It will hold an Atlas missile which is almost as long as a city block. When installed in its "hard" site, it could slowly rise from this 170-foot deep underground concrete casing after the two interlocked blast doors about three feet thick had swung open. It could rise into outer space and free a nuclear zone that could fly half the earth and the North Pole and drop a fireball killing millions.

This Texas country proudly carries such names as Mud, Mustang, Otter and Sweetwater Creeks; the Brazos, Buffalo Gap, Cisco. Now there are pear trees white with blossoms. And the night before in Abilene at the Sands Bowl, Arena on Highway 80. Me and the kids were cheering Dad as the ball went down the alley and clobbered them up.

Teams were bowling—Abilene Mexican Foods versus Alkire Photos, Foremost Dairies versus Morris Mill Homes, and Jones Cleaners versus Abilene Abstract. Their shirts were salmon pink and turquoise. The delightful Texas accent lit the conversation. Lots of laughs. And when not watching the children played tag, in the background, an oldster bragged a bit as is the Texan right: "The thing about west Texas is that you can sure see over yonder."

Missile in Repose

Now "over yonder" has a new and strange meaning for Abilene, young and old. "Yander" is the North Pole and beyond. They've all seen a missile looming, even though on its side, looking almost useless, on a trailer on Walnut between Second and Third in the middle of town.

They had a good look and no doubt came away impressed. But it's difficult for them to gather the significance of these weapons, for few have had the time, or access to the information, that would help them to understand the debates now going on about "the deterrent," the capability to fight limited wars. What a "hard" site is and what a "soft" site is. They have lives to live in the rows of neat homes, each with its lawn, on such streets as Lexington, Magnolia, and Main.

But out at Oplin Number One, 25 miles southeast of town, work goes forward, driving up, you see a crane towering above the concrete hole, dangling a 34-foot tank. A sunburned type in a silver hat waggles signals, and down it goes into the hole and to the bottom. It will hold liquid oxygen, once in place and pipes set.

Peek Inside Big Hole

About 60 men are on the outside and the inside of the concrete silo showing only its lip. They seem to be doing 60 different things—crawling through the steel structure inside or holding sputtering acetylene torches in showers of sparks against massive girders. Another has a pencil poised over a column of numbers. Some pound nails. Someone carries a hot water heater into place.

Clambering up the lip and over into the 17-story concrete hole you gingerly step down—down from level to level. There is a maze of girders, pipes, hoses, grids, pulleys, wires. At each of the eight levels there is a spatter of blueprints.

Most of these men are Texans, because the contractors, both H. B. Zachry and Bown and Root, are from Texas. These lanky men are hard, brown, a bit [illegible], with hard hats and a white grin. Larry Moore kids, "It's all right if you're doing nothing, just do it well." This is hardly the [illegible], since they're working hard.

But what a conglomeration of stuff and things! Behind it all is "concurrency." This means that the missiles—Atlas, Titan, and the Minuteman—are being developed at the same time that the missile sites—the holes—are dug and equipped.

This not only means that everything whenever possible is done at once on the hole, but also there are changes. Larry Moore [illegible], "[illegible] modifications, and then modifications to the modifications." That's when it begins to get complicated with the tearing out of what was put in before and what this does to other [illegible] equipment and structures. (But this is the price of security, and in other articles this will be discussed.)

The Abilene Cluster

[illegible] job. The job is not [illegible] One, but 12 [illegible] a 300-mile drive to visit them. [illegible] rough circle in the Abilene region. [illegible] town is 25 miles; the farthest, 51 miles [illegible].

Spread over this land of [illegible] cotton, wheat, buttes, and farms [illegible] are about 1,000 men with the torches [illegible] wrenches, the pliers, and the hammers.

Multiply Oplin's organized chaos [illegible] get some idea of Larry Moore's [illegible]. Very occupied he is, and helped by [illegible] Cooper, who is a walking slide rule, and [illegible] Col. A. M. Antonelli and [illegible] staffmen of the Army Engineers, plus a crew from Convair, the men who are building the Atlas. Above all, he will slyly remind you that he has a big brother—an electronic computer in San Antonio that tells him what to do next in his planning.

And standing aside and coordinating the whole 12-site shooting bang is Air Force Col. [illegible]son. He's self-effacing in his way. He says he spends most of his time just listening to [illegible], and he has several walls covered with charts with zooming lines touching up every bolt and girt in the shop. (Construction at the 12 sites is about 70 per cent done.) Above all, he has a [illegible] that sounds in Inglewood, Calif., in the [illegible] missile division, his command. That [illegible] keep the hurry-up job hurrying.

At Inglewood is where the Abilene missile [illegible] and those in 14 other states, where there are [illegible] site clusters like this one of 12 outside Abilene, are commanded. Two missile complexes are ready for action, the others being built.

All of this is "the new [illegible]," [illegible] like word, but the sites are being built in a [illegible] setting, involving lives and [illegible] of bureaucracy, the system of work [illegible]. You could call it democracy.

WINTERS EXCAVATION BEGINS

Digging 180-Foot Silos Begins Today at 1st Site

Drilling of the 180-foot-deep silo which will house an Atlas missile begins Friday at the missile complex site near Oplin, D. V. (Larry) Moore, project engineer for the H. B. Zachry Co., said Thursday.

The site, located about two miles north of Oplin in southwestern Callahan County, is the first of 12 sites to be ready for the huge digging operation.

The shaft will be about [illegible] feet in diameter, placed near the center of a sloping excavation dug to a depth about [illegible] feet below the earth's surface.

There is no estimate available as to when the shaft will be completed.

Meanwhile, excavation work at two other sites will be completed by this weekend, making the sites ready for drilling scheduled next week.

Moore said surface excavation at the site near Baird and another near Dudley Valley will be finished Friday and shaft work will begin possibly Monday.

Surface excavation work at the Lawn and Bradshaw sites will be completed Tuesday. Drilling should begin during the [illegible] three to four weeks, Moore said.

At the site near Winters, Moore said open excavation got underway Thursday. At Shep, the site is staked, access roads are being built and exploratory drilling operations for the open cut excavation began Thursday.

Work at the remaining sites is limited to some staking at the sites, Moore said. All have [illegible] barricades and warning signs.

Moore explained that the open cut excavation calls for the removal of about [illegible] cubic yards of earth and rock sloping down to a depth of about [illegible] feet.

[illegible]

Moore said there are now about 120 workers [illegible] mostly heavy equipment [illegible] operators [illegible]

The 12-missile [illegible] to form a ring [illegible] diameter [illegible] being built jointly [illegible] contract by H. B. Zachry [illegible] and Brown & Root [illegible]

Construction of [illegible] expected to take [illegible] Moore said the current [illegible] work is on schedule.

Doc No. 20

THE ABILENE REPORTER-NEWS
Abilene, Texas, Monday Evening, September 19, 1960

Three Atlas Sites Beating Schedule

By H. V. O'BRIEN
Reporter-News Military Editor

A major milestone in construction of the 12 Atlas missile launching systems is in the making here this week.

With completion of the silo at the Oplin site looming soon, the contractors will be about 15 days ahead of the contract schedule on the first three sites, Lt. Col. A. M. Anton[illegible], area Corps of Engineers chief, said.

Giant buckets of two yards of cement each began going down into the 180-foot silo hole at the Oplin site last Tuesday night and the walls of the silo began coming up.

The first [illegible] continuous pour was being finished at a height of some [illegible] feet [illegible].

Utilizing a device [illegible] the "slip-form," [illegible] under direction of [illegible] [illegible] Co. [illegible] the walls [illegible]. They have been raised at [illegible] rate of about [illegible] [illegible], A. E. [illegible] engineer, said.

Approximately [illegible] yards of high strength [illegible] went into the first section [illegible] some [illegible] tons of reinforced steel.

The second [illegible] silo [illegible] walls up [illegible] with a wall thickness of [illegible] inches [illegible].

Purpose of the [illegible] the top is to support the missile-holding cradle device in the silo. The missiles are launched from atop the underground silos.

Some 2,500 cubic feet of cement and 70 tons of reinforced steel will go into the upper section which will have its top surface at ground level.

Based on the designers and builders measure of the top of the silo represented by the figure 1,000 and the bottom by 0, the first pour will rise to point [illegible].

At the Baird site, digging is finished, the silo is bottomed out and the walls of the launch-control center have been poured.

Denton is bottomed out and reinforced steel is going into the launch-control center. Slip-form operations are expected to begin there Thursday or Friday.

Digging is expected to be completed at the Lawn site Thursday or Friday, and the steel in the launch center is now going up.

At Bradshaw the steel is in place. As soon as the Oplin equipment pouring is finished, the plant will be moved to Bradshaw for work there.

At Winters, the silo [illegible] bottom out Thursday or Friday. Steel is going up and when the Baird concrete work is done, equipment will be moved to [illegible].

Friday the [illegible] site [illegible] about 45 feet. [illegible] [illegible] feet down and the [illegible] and Albany sites [illegible] down.

Shaft excavation is expected to begin at the Anson and [illegible] sites about Wednesday of next week.

By BOB BRUCE
Reporter-News Military Editor

A happy crowd of more than [illegible] men pressed close to the one remaining barrier in a scene two miles south of Anson Friday afternoon, their sense of pride undampered by nippy winds.

Flash bulbs popped as a 20-foot [illegible] ribbon was snipped apart. [illegible] One of Abilene's 12-site Atlas missile [illegible] — construction — was complete.

Then the group, led by Air Force Maj. Gen. Thomas P. Gerrity and the construction contractor, H. B. Zachry, [illegible] up to the launch control [illegible].

There another ceremony took place.

[illegible] construction supervisor for [illegible] Zachry Co., passed the [illegible] to Lt. Col. Albert M. Antonelli of the Army Corps of Engineers, who in turn handed them to Air Force Col. Hugh W. Manson, commander of the [illegible] Task Force Activation Force.

Both Zachry and Col. Antonelli were honored at Dyess AFB Friday night with awards from Gen. Gerrity, commander of the Ballistic Systems Division, Los Angeles, Calif.

The second part of the Atlas [illegible] began at 5 p.m. Friday as [illegible] guards were placed on the Atlas site by the [illegible] contractor, General Dynamics.

[illegible] General Dynamics [illegible] C [illegible] and SATAF [illegible] will [illegible] before turning them over to the Strategic Air Command.

Gen. Gerrity, who was accompanied to Abilene by his deputy, [illegible] Maj. General [illegible], said at the late Friday afternoon:

"These are the first [illegible] anywhere, [illegible]

[illegible] program at other locations originally intended for completion [illegible] before Dyess."

At the awards dinner in the [illegible] quarters, Gen. Gerrity presented Zachry with a certificate of appreciation and Col. Antonelli with the Air Force Commendation Medal.

Gen. Gerrity's job in Los Angeles encompasses not only the Air Force's Atlas program, but those of the Titan and Minuteman, two other intercontinental ballistic missiles.

He explained the Atlas and Titan as "building blocks" in America's ICBM program. The Minuteman is a "second generation" missile, he said.

"All our previous knowledge has gone into the Minuteman," he said.

[illegible]

Turning back to the final Atlas [illegible], he said, "I think it's important to come out and recognize a milestone such as this. [illegible] people, military and civilian, have done a great job in a relatively short period of time."

The Atlas sites have been either ahead of or on schedule since construction began in June of 1959. The original turnover date was Nov. [illegible].

All sites, on a precision timetable, were turned over to GD and SATAF to begin checkout. The 11th site, Corinth West, changed hands about two weeks ago.

The operational date on which the 12 sites will be turned over to Col. Ray Cole's [illegible] Strategic Missile Squadron [illegible], Gen. Gerrity said, [illegible] the site.

"[illegible] next year," he said.

Following the [illegible] of the site, the group toured the [illegible] for about [illegible] minutes. Then they returned to Dyess [illegible].

He [illegible] Col. Antonelli for operating in the dual capacity of [illegible] and [illegible] Zachry for his "conscientious personal attention to job."

Other Air Force bases where [illegible] underground Atlas [illegible] are located are Walker AFB, [illegible]; [illegible] AFB, Kans.; Plattsburgh AFB, N.Y.; Altus AFB, Okla.; and Lincoln AFB, Neb.

Gen. Gerrity and Gen. [illegible] [illegible] flight to the West Coast headquarters [illegible] Saturday.


ARMY ENGINEERS
BALLISTIC MISSILE CONSTRUCTION OFFICE

OFFICIAL USE ONLY

GLOSSARY

CEBMCO	Corps of Engineers Ballistic Missile Construction Office
BACMV	Site Activation Team, Air Force
CSC	Change Order Conference
DD Form 1354	Document used for transfer of completed facility from construction agency to using agency
FLS	Propellant Loading System
GFPE	Real Property Installed Equipment
Modified Proctor Curve	Curve formed on a graph when results of laboratory densities are plotted against moisture content of material tested
AFBMD	Air Force Ballistics Missile Division
DA	Department of the Army
ENG	Engineering
GC	Special Conditions of the Contract Specifications
LCC	Launch Control Center
KVA	Kilovolt Amperes
I & C	Installation and Check-out
ICBM	Intercontinental Ballistic Missile

FOREWORD

In response to a national need for offensive potential in the event of nuclear war, a method of delivery of nuclear weapons by intercontinental ballistic missiles has been developed by the Armed Forces of the United States in the 1950's and early 1960's. In order to house the delivery weapons with a maximum of protection, a minimum of pre-launching time and a minimum of construction time for the housing, a series of vital construction projects was undertaken by the U. S. Army Corps of Engineers in close conjunction with the U. S. Air Force.

The series began with "soft" installations, above ground, proceeded through "semi-hard" installations, coffin type structures built just below ground level, and evolved into the "hard" concept of housing for the ballistic missile and the necessary propellant loading system, mechanical and electrical systems and control facilities. As the series progressed, the problems involved in the construction of the launch facilities became more and more difficult and the construction methods used became more complex and unique.

The Corps of Engineers was authorized to build six launcher complexes for the Atlas F type ballistic missile in widely separated areas of the United States. It is with the construction of one such launcher complex that this historical report is concerned.

PART I

ACTIVATION - MISSION - ORGANIZATION

ACTIVATION

The Dyess Area Office of the Corps of Engineers was activated 18 April 1960 under the U. S. Army Engineer District, Fort Worth, Col. Walter J. Wells, U. S. Army, District Engineer. Lt. Col. Albert M. Antonelli, U. S. Army, assumed command of the area office, 26 April 1960, as Acting Area Engineer, a designation which was changed to Area Engineer 27 June 1960. Lt. Col. Antonelli retained command of the Dyess Area Office throughout the ICBM Construction Program. On 1 December 1960 the Dyess Area Office became a component of Corps of Engineers Ballistic Missile Construction Office, Los Angeles, California, Brig. General Alvin C. Welling, U. S. Army, Commanding. Col. Woodrow W. Wilson, U. S. Army, Director, Atlas F Construction Directorate, succeeded as Contracting Officer. The U. S. Army Engineer District, Fort Worth, continued to furnish administrative support under Col. Roland P. West, U. S. Army, District Engineer, who had succeeded Col. Wells, 7 July 1960. Col. Thomas B. Hayes, U. S. Army, succeeded Gen. Welling as Commander, CEBMCO, 20 June 1961.

At this writing the office is in a phase-out condition with three small contracts under construction. It is anticipated that the office will be officially closed on 30 April 1962 and any remaining workload transferred to Albuquerque District.

The Dyess Area Office was responsible for the construction of twelve (12) hardened weapon system launch and control facilities. The area office provided supervision, inspection, engineering control and technical assistance to the construction contractors. This mission was unique in that this type of construction was new to nearly all personnel involved and had heavy emphasis placed on construction to very close tolerances within a short construction period.

The twelve launcher sites were located in a circular pattern through six counties in West Central Texas with Dyess Air Force Base, near Abilene, Texas, as the approximate hub.[1] The sites were, generally, located near small cities or communities and were named for them. All of the sites were accessible from paved roads with the contractor having only short access roads to construct and maintain during the construction period. The location of the sites made it comparatively easy for the contractor to obtain utilities with a minimum investment of money and time. Electrical power was supplied from nearby public utility lines. Construction water came from wells the contractor drilled at three sites,[2] from city mains at one site,[3] and was pumped from ponds, lakes or streams at the remaining sites.

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1. Site Location Map DOC 1.
2. Site No. 2 (Baird), Site No. 3 (Denton) and Site No. 7 (Nolan).
3. Site No. 10 (Albany)

The geology of the area varied greatly from site to site.[4] Topography was not an important factor in construction.

ORGANIZATION

The Dyess Area Office was manned by a combination of U. S. Army Corps of Engineer Officers and civilians. The functions of each branch within the Area Office are discussed elsewhere in this report. The Area Office Organization Chart for 1 May 1961 was typical of the breakdown of personnel in the Dyess Area during the maximum effort period.[5] Of necessity, day to day changes were made and the entire organization was kept flexible to meet constantly changing conditions. Since the construction contractor used "roving" crews to perform many of his more intricate operations the workload varied from site to site and the Corps of Engineers personnel were shifted in the same general sequence.

The only major change to the organization chart which is recommended by the Dyess Area Office is to increase the size and scope of the Specialists Section. It is recommended that this section be composed of individuals or teams specifically trained to inspect installation of reinforcing steel and concrete placement in major pours, installation of structural

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4. Rockhal Corporation Geologic Map DOC 2.
5. Dyess Area Office Personnel Chart DOC 3.

steel, construction of backfill, and the installation and validation of the major electrical and mechanical items. Both the Government and the construction contractor benefit from this type of specialization on the part of the inspection forces.

PART II

AREA OFFICE BRANCH FUNCTIONS

AREA ENGINEER

Directed administration, supervision and inspection of all contract construction work assigned to the Area Office. Recommended and negotiated contract modifications. Performed liaison directly with CEMCO, SASWF, and construction contractors. Directed and coordinated Area Branch activities. Enforced safety practices and conducted public relations.

ASSISTANT AREA ENGINEER

Assisted the Area Engineer and acted as the Area Engineer when the Area Engineer was absent from the Area. Provided direction to the technical and advisory and administrative staff in all matters of a technical nature.

EXECUTIVE OFFICER

Assisted the Area Engineer and the Assistant Area Engineer in a staff capacity in delegated matters not requiring the immediate or personal attention of those officials. Normally, assumed duties which included coordination, review or approval of matters where guidelines of action had been clearly defined. Served as the focal point in all matters relating to the Administrative and Advisory staff. Coordinated matters of organization, personnel staffing and space allocations. Served as the principal Administrative Assistant to the Area Engineer.

Coordinated those matters relating to overall administration where executive action was required. Supervised military personnel administration as directed.

SAFETY BRANCH

Assisted the Area Engineer in administration of the Corps of Engineers Safety Program within the Area. Provided for frequent safety inspections at all work sites. Advised the Area Engineer of potential safety hazards on all sites which were uncorrected. Prescribed and coordinated a balanced program of safety activities. Assured prompt reporting of accidents. Prepared formal reports of findings with recommended corrective action on all accidents and serious hazards which hampered efficient uninterrupted construction progress.

OFFICE OF COUNSEL

Assisted and advised the Area Engineer and his supporting elements on legal matters except Real Estate. Rendered staff advice in the negotiation and preparation of contractual documents and reviewed all contract actions for legal sufficiency prior to execution by the Contracting Officer or his authorized representative. Prepared necessary action concerning all contractural and non-contractual claims for the Area. Processed settlement of contractural documents as delegated by the Office of Counsel, CKBMCO. Prepared action on appeals made by contractors to decisions made by the Contracting Officer's Representative.

Prepared litigation reports as required. Performed labor relations functions, assured enforcement of contract labor standards and promoted good working relationships between the Corps of Engineers, labor and contractors. Reviewed all communications to contractors which did, or could have, created monetary or other liability on the part of the government. Received, reviewed and initiated necessary action on all contractor's payrolls.

ADMINISTRATIVE BRANCH

Furnished administrative services to all elements of the Area and Project and Resident Offices as required. Processed all incoming and outgoing communications. Maintained the Area general files, and maintained special files as required. Provided for the establishment and operation of electrical communications facilities. Operated the motor pool. Monitored Security Program, Management Improvement Program, and other similar special activities as assigned. Monitored civilian personnel program for the Area, time and attendance reporting, maintenance of leave records, and other related records and reports. Handled property and supply functions, including procurement, accounting, issuance of supplies and other related activities. Supervised custodial services. Processed the Area budget, Area cost records and Area cost reporting. Provided stenographic and typist assistance to other branches when required. Monitored imprest fund and small purchase procedures for the Area. Provided reproduction services.

Prepared transportation requests, travel orders, bureau vouchers, and arranged transportation and reservations as required. Assumed initial responsibility for any function not assigned to another Branch. Initiated action and follow-up on all Government furnished equipment from commencement of construction until arrival at job site or railhead.

CONTRACT ADMINISTRATION BRANCH

Assisted the Area Engineer in the supervision of all contract administration work for the contracts assigned to the Area Office. On receipt of recommendations from the Construction Branch, higher authority, or SATAF conferences, initiated change order action with the contractor. After assuring availability of funds, prepared Government estimates when required conducted negotiations and prepared and distributed modification documents. Initiated and carried to completion administrative modifications. Prepared progress reports from information received from the Construction Branch. Reviewed specifications prior to bid openings and furnished Engineering Branch with comments for additional changes. Maintained a register of proposed Change Orders and Modifications within the Area Office. Furnished monthly to Administration Branch current and projected contractor's earnings for incorporation into Area Cost reports. Prepared reports required by ER 415-4-331. Prepared justification for additional funds when the need was generated by proposed modifications or claims. Prepared findings of fact

and resolved the contractors' claims. Assisted the Office of Counsel in processing contract terminations and negotiations of settlement. Contacted Project and Resident Engineers and other elements of the Area Office and the Atlas F Directorate as necessary in connection with processing of contract modifications.

CONSTRUCTION BRANCH

Supervised and inspected all contract construction work assigned to the Area Office. Coordinated and formulated construction schedules for effective prosecution of the work. Coordinated changes to meet existing field changes. Assisted as requested in the preparation of estimates, the negotiation of modifications, and the review and settlement of contractual claims. Compiled daily reports of work accomplished, decisions made, action taken, working conditions, comments on progress, and evaluated the current status of all construction. Coordinated closely with the Safety Branch and took expeditious action to implement safety features agreed to be necessary. Monitored as-built drawings concurrently as the work was completed. Conducted inspector training programs. Supervised the operations of Project Engineers and Resident Engineers and conducted frequent inspections of construction activities. Provided Contract Administration Branch with feeder reports upon which pay estimates and progress reports were based. Reviewed all proposed changes for construction feasibility and time and

acceleration impact, making appropriate recommendations to the Contract Administration Branch. Arranged for all transfers of construction to the Using Agency, provided Contract Administration Branch with necessary data required from the field for preparation of ENG Form 290 and related transfer documents. Promptly advised Engineering Branch of any conflicts in design deficiencies as soon as they were noted. Reviewed plans and specifications prior to bid openings and furnished comment as to desirable addendum changes to the Engineering Branch. Established and furnished to Contract Administration Branch construction completion and acceptance date. Directed the Area Survey Crew. Arranged for photographs of project features at important stages of progress. Expedited Government and contractor-supplied materials and equipment, and expedited and administered the Defense Materials System to insure timely arrival of materials and equipment. Contacted manufacturers and suppliers and assisted in obtaining delivery by required dates. Supervised the PLS Section, which was responsible for the following: Providing specialized technical advice on the installation and testing of Propellant Loading Systems; acted as the liaison element with the PLS Division of CERMCO; provided technical advice on PLS matters during the construction, installation and field operational testing stage for final acceptance; coordinated activities of PLS inspectors on operational sites and support facilities; conducted PLS inspector training; coordinated with all branches of the

Area Office in phases of their work involving PLS equipment or materials; supervised operation of PLS fluid testing laboratory; supervised operation and maintenance of Government furnished PLS test equipment used by the contractor; furnished direct surveillance of PLS field testing; provided technical assistance and advice in negotiations of contract modifications; initiated or reviewed requests for changes in design to meet existing conditions; and resolved conflicts in design and where necessary, recommended change order action.

ENGINEERING BRANCH

Provided general engineering and specialized technical services in support of construction activities. Provided for the procurement, receipt, technical review, approval and proper distribution of plans, specifications, shop drawings and material samples. Supervised contracts for services of Architect-Engineers and special consultants in connection with its field of responsibility. Furnished technical advice and assistance for special tests as required. Initiated or reviewed requests for changes in design to meet existing conditions. Prepared revised plans and specifications, Government cost estimates and other engineering data required for contract modifications. Performed emergency design and prepared supplemental drawings, layout sheets and similar material for field offices. Performed miscellaneous drafting for all

elements of the Area Office. Maintained current as-built drawings, using data obtained from Construction Branch. Furnished SATAF copies of as-being-built sketches and marked prints for silo facility contracts. Maintained the record set of contract plans and specifications. Maintained shop drawing record files. Maintained a suspense register for samples, shop drawings, test results and similar data required under each contract and insured timely receipt and approval. Supervised contracts for Architect-Engineer services or testing services in connection with its field of responsibility. Performed technical and engineering approvals of soils, concrete and other materials. Resolved conflicts in design and where necessary, recommended Change Order action to Construction Branch. Furnished estimating support to Contract Administration Branch. Assisted as requested in negotiation of modifications and the review of settlement of contractual changes. Performed engineering inspection of construction to insure adequate construction standards in compliance with all design criteria. Maintained liaison with Architect-Engineer, Using Agency, Atlas F Directorate, Supporting District, and other concerned agencies on engineering and technical matters. Maintained the Master Equipment List. Assembled, reviewed and transmitted KFLE Technical Data and Provisioning Material. Initiated action, maintained records, and prepared reports for all expediting of construction materials.

LABORATORY BRANCH

The laboratory work was accomplished by Corps of Engineer personnel in a separate laboratory branch set up under the Area Engineer. The functions of the laboratory were to make concrete mix designs and control concrete mixes at the batch plant including gradation and quality tests of aggregates and to test concrete cylinders for strength. The laboratory also took field samples of soils, sub-base and base materials and ran laboratory control Modified Proctor Curves on the several different materials. Took field compaction tests and kept records of tests and results. Tested paving aggregates prior to use.

SATAF

A condition of mutual support existed between the local SATAF organization and this office which resulted in a team effort. Efficient handling of conflicts in design and construction through change order conferences; validation of electrical, mechanical and FLS systems with disagreements quickly reconciled; and pre-final and final inspections which were smoothly and efficiently conducted, were but a few of the outward signs of the excellent relations existing between this office and SATAF. Liaison between this office and SATAF was performed primarily through the SATAF Chief of Construction, Major B. J. McCarvey, who was designated as Deputy for Acceptance. [6]

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6. See DOC 4.

CONSTRUCTION

BACKGROUND INFORMATION

Real estate acquisition for the twelve off base missile launch sites was conducted by the Fort Worth District Real Estate personnel.

For the primary contract of constructing the twelve launch silos and control facilities, the plans were standard AFBMD drawings, site adapted for the Dyess Area by Black and Veatch of Kansas City, Missouri. The standard drawings were made by the Bechtel Corporation for the Air Force. Both Bechtel Corporation and Black and Veatch had representatives in the area as a part of the SATAF group, to expedite necessary changes to the plans.

Briefly each Launch and Control Facility (launch complex) was to consist of a launcher silo constructed of reinforced concrete varying from 2' 6" to 9' 0" in thickness, 174 feet deep with a diameter of 52' 2".[7] This silo was to house 389 tons of structural steel to be suspended from the silo walls at four points through shock hangers by spring loaded rods.[8] In the silo there were to be installed two diesel generator sets to produce 1250 KVA, water chiller and air conditioning units, a dust collection system and mechanical and electrical equipment systems to operate the entire complex.[9] In addition

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7. See photos 5 thru 15.
8. See photos 16, 17, 18, 28 and 29.
9. See DOC 5.

to these standard items, there was to be installed a Propellant Loading System to be used for servicing the Ballistic Missile. The other principle structure at each facility was to be the Launch Control Center, commonly referred to as the LCC.[10] This was to be a reinforced concrete structure of two floors, completely underground.[11] As the name implies, this structure will be used to house the controls for the missile. Controls for the silo operation were to be installed by the construction contractor. Minor structures at each site were to include a water treatment building and a water cooling tower.[12] Other exterior features were to include security fencing, a paved access road, perimeter fencing, lighting and sewage disposal. Various storage tanks were to be buried underground.[13]

The contract for the construction of the twelve missile launch sites near Dyess Air Force Base was advertised to bidders on 29 April 1960 by the U. S. Army Engineer District, Fort Worth. Bids were opened at Abilene, Texas on 26 May 1960 with six (6) bids submitted. The high bid was $21,984,000 and the low bid was $20,075,000. The Government Estimate was $22,584,544.

The low bidder was a joint venture composed of M. B. Zachry Company and Brown and Root, Inc. The contract was

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10. See photos 35 thru 42.
11. See BOC 6.
12. See photo No. 28
13. See BOC 7.

awarded to them and the notice to proceed with the work issued on 27 May 1960. This contract was increased, due to modifications, to $30,179,000. Construction was started on 7 June 1960 when excavation was commenced at the Baird Site. A listing of the major sub-contractors, their scope of work, cost and rated effectiveness is included in the Support Documents Section of this report.[14] In addition to the normal type of sub-contractors employed by the prime contractor, there were assigned to him seventeen (17) contracts under the provisions of paragraph SC-42 of the Contract Specifications.[15] These assigned contracts were of both the supply and installation types and totaled $3,931,098.77.

The contractor was given the option of either shaft excavation for both the silo and the LCC beginning at approximately ground elevation or open cut excavation to elevation 960.5 and shaft excavation for the silo from that elevation. Open cut excavation was chosen. The following is a resume of the excavation process at each site:

BAIRD SITE

Contractor started excavations 6 June 1960 using three DW-20s, one Michigan dozer and one D-8 "Pusher".

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14. See DOC 8.
15. See DOC 9.

Interceptor "V" ditch to divert surface runoff from occasional rains was cut around the excavation area using a patrol grader. Several heavy rains during early stages of excavation disclosed the inadequacy of preliminary ditching work and system was extended and deepened.

On 9 June 1960, large limestone boulders were encountered at about 5 to 7 feet beneath original ground surface and the D8-80s removed from site and a North-West shovel plus three Euclid dump trucks added to the excavation operations. Localised drilling and shooting was necessary to reduce the huge boulders to sizes suitable for efficient handling by the equipment utilised.

Common open cut excavation was practically completed 11 June 1960 and open cut rock excavation started. Overburden suitable for use as backfill was stockpiled in designated waste areas on sites and large rock wasted off site by contractor.

Ground seepage water was first encountered at reference elevation 983, the top of the limestone layer and in horizontal clay seams of the limestone especially along the northern edge of the excavation. The ground water was not in sufficient quantity to interfere with open cut excavation operations. When the open cut reached working level at elevation 960.5, a V-ditch was cut in the outside perimeter at that level for conducting the water to a sump where it was pumped outside of excavation working area.

It is not considered that changed foundation conditions existed and there are no indications that contractor is making a claim.

Ground water encountered caused difficulty during backfill and foundation preparation for underground water storage tanks. The seepage water was at a level which caused excess moisture in backfill thus preventing successful efforts to obtain sufficiently firm bedding for tanks. A French drain was constructed around the tank bedding area and leading to a sump. Dewatering of sump was performed by pumping.

Open cut rock excavation was in progress from 11 June to 26 June 1960 when work area bench elevation 960.5 was reached. Limarock bed rock was encountered at reference elevation 983. Dip of the strata was to the south approximately 1 vertical to 60 horizontal or one degree. Spacing of weathered vertical joints was not recorded during operations except for statement by observers that horizontal dimensions of tabular slabs varied from 2' x 6' to 4' x 10' and were from 2' to 3' thick. Specific data regarding open cut rock drilling and blasting operations were not recorded except that following drilling and blasting of one half of excavation floor that area would be excavated while drilling operations were being performed on the other half of the area and this alternating procedure followed. Generally drill holes were spaced at approximate 5 foot centers and were 14 feet deep.

Silo shaft excavation below reference elevation 960.5 began 29 June 1960. Concentric circle line drilling was not used until elevation 904 was reached. A crane with clamshell was used to remove material from shaft, loading into dump trucks which hauled material to stockpiles adjacent the open cut area. A TD-9 loader was used at bottom of shaft excavation to pile material to be picked up by the crane. An electric hoist was placed in operation when shaft reached elevation 924, 13 July 1960. The hoist raised a loaded skip bucket on channel rails attached to the silo ring beams. The skip was dumped from a tipple into a chute discharging into trucks. The empty skip returned to bottom of shaft by gravity.

Line drilling in blasting operations began at shaft elevation 904. Holes were spaced 4 feet on centers in silo interior and 2 feet on centers around the silo wall. The depth of drilled holes varied from 12 to 21 feet. The number of holes fired and the charge per hole was not recorded. A few additional shots were fired at times to remove extra material to correct for alignment and clearance. A summary for drilling and blasting operations is presented below:

DRILLING	HOLE DEPTH	BLASTING
26 July 1960	15 ft.	27 July 1960
3 August 1960	21 ft.	4 August 1960
11 August 1960	21 ft.	13 August 1960
18 August 1960	20 ft.	19 August 1960
26 August 1960	12 - 15 ft.	27 August 1960

All over breakage or excavation beyond the required specification lines were backfilled with pneumatically placed concrete, gunite, or a combination of concrete with the gunite.

Contractor's cycle of operations. Drilling and blasting, followed by ripping and loading the skip bucket with TD-9 front end loader, this bucket being hoisted to tipple and dumped. When the loose material was removed and necessary trimming completed the ring beam was placed, followed by either lagging between the beam and the one previously placed, or with welded wire fabric and gunite in place of lagging as required by the specifications.

The rock strata encountered were essentially horizontal enough not to cause difficulty in shoring. Concreting the silo wall was successfully accomplished.

At reference elevation 846 in shaft excavation water was encountered but the amount was small and was absorbed with excavated material until excavation was completed. Following the excavation the water was occasionally removed by a sump pump.

Shaft excavation was completed 31 August 1960.

DENTON SITE

Construction operations began 4 June 1960, using one Michigan wheeled dozer and one D-8 dozer clearing the site of brush and scrub oak, which was piled and burned.

Site excavation began 9 June 1960. The equipment for initial operations was 3 motor patrol graders, 3 D-8 dozers, 2 DW-20 scrapers, 2 trucks and one front end loader.

The first three or four feet of excavation was sandy clay, changing to caliche and a layer of limestone in large pieces 14 to 30 inches thick. A single pronged ripper was used to loosen the rock but the pieces were too large to be removed with DW-20s. A front end loader and Euclid trucks were used to move the rock. Some of the larger pieces required blasting to reduce the size to handling proportions. A definite time for ending of open cut common excavation and beginning of open cut rock excavation did not occur because the change was gradual with rock increasing in size and quantity under at a depth of 18 feet it merged into a firm continuous layer of bedrock. Excavated material was stockpiled on site in waste areas indicated on contract plans.

Surface runoff water was diverted in the direction of natural drainage by utilizing a combination of levee and "V" ditching back from around the perimeter edge of the open cut excavation area. However, one very heavy rain breached a low levee section causing silo shaft excavation to be flooded to a depth of approximately nine (9) feet and delaying shafting operations for approximately 3 days.

Ground water table or ground seepage water was not encountered in open excavation in sufficient quantity to

require control. Rainfall entrapped in the open cut work area was removed by pumping from a sump pit excavated in the low work area region reference elevation 958 near the launch control center end of the excavated area.

Firm bedrock was encountered 18 feet below ground surface. The layer was essentially flat and level. Systematic drilling and blasting began at this level using wagon and crawling drills. In the open cut the drill holes were spaced approximately 5 feet on centers and 14 feet deep. The holes were loaded with 8 pounds of gelamite, using decked method. The yield per shot was 1.6 cy per pound of gelamite or 0.62 pound gelamite per cubic yard of rock.

Shafting operations in silo merged with completion of open cut operations 29 June 1960. Line drilling in silo was made in concentric circles with radius increasing 5 feet and drill holes spaced approximately 6 feet on each circle and sloped toward center 1/4 to 1. The holes were drilled 16 feet deep and loaded with 3/4 of gelamite per foot of depth. The circles were numbered according to position with No. 1 the inner circle and No. 7 the outer circle and the shots were fired, using delay action fuses so that order of firing was 1, 2, 3, 4, 5, 7 and 6. During one firing using this order there were 84 unexploded holes and it was assumed that due to circle of shots No. 7 being fired ahead of No. 6 the fuses to some of the loads in holes of circle No. 6 were cut, however, a later check disclosed

many failures of charges to explode was due to faulty wiring connections. The decking system of loading the holes did not produce the desired results so the column system was adopted. Three caps were used for each charged hole, one in bottom stick, another at center and the third two feet below surface. The ring beams on the silo wall and the position of the drill bit behind guide on driller prevented drilling and shooting a vertical wall on a neat line for placing ring beams and lagging. The contractor changed the depth of holes to 12 feet and drilled the outside circle of holes sloping towards the wall with a slope of 1 1/2 inch per foot of depth. This reduced amount of wall trimming but caused over shooting in some places to as much as three feet.

All places where overbreakage occurred along the silo walls were filled with gunite or concrete or a combination of both.

The contractor's excavation of material from silo shaft began 2 July 1960, using a crane with clamshell hoisting material from shaft after it had been placed conveniently by a front end loader in bottom of shaft. The front end or skip loader loosening the previously blasted material with ripper and picking it up with the skip and placing the material in a pile to be picked up with the clamshell. On 22 July the contractor placed a skip hoist into operation for removing material from the shaft. The front end loader placed the material in a skip or bucket at the bottom of the shaft and

the skip was hoisted out of the shaft along channel rails attached to the ring beams. The skip or bucket discharged the material from a tipple into a chute which emptied into a truck for transporting to a stockpile or a fill.

The shoring in the silo was provided by shaping wide flanged I beam sections into circular segments with end plates attached so the segments could be bolted together forming a ring and a series of these rings placed horizontally and at specified distances apart in the silo as excavation proceeded. The space or surface of silo wall between rings was braced or supported with welded wire mesh and pneumatic concrete in accordance with contract specifications.

OPLIN SITE

Contractor started common open cut excavation 13 June 60 using four DW-20 scrapers, D-8 "Cat", D-8 "Pusher" and motor patrol grader.

Interception drainage was provided by Contractor in the form of a berm around southern edge of open cut excavation area. Two sump pit located on opposite sides of work area between silo and launch control center were used to collect runoff from within the open cut excavation area. Removal of water from sumps was accomplished by pumping as necessary.

There were no changes in Contractor's operation during the open cut excavation to work area bench reference elevation 960.5. The contractor started excavation on outer edge of

excavation and carried it down on slopes required by contract drawings toward the center of the area. Scrapers were pushed by bulldozers to expedite the loading and the loosened material carried to designated stockpile areas. All material encountered in open cut could be classified as common excavation. No material was wasted.

Open cut excavation to work area reference elevation 960.5 was completed 20 June 1960.

Silo shaft excavation began 25 June 60. A front end loader with attached ripper was placed inside the concrete collar beam at reference elevation 961 to loosen material and pile it for removal by motor crane with clamshell and loading into Euclid dump trucks. This operation continued to reference elevation 912 at which point shale material encountered made it necessary to undertake drilling and blast operational methods of loosening material.

Drilling and blasting began 14 July at reference elevation 912. No detail records of operations was maintained. The first zone of material to be loosen was drilled and blasted one half of silo bottom area at a time. Three wagon drills were utilized and holes drilled 17 feet deep. The second zone of material utilized holes 15 to 17 feet deep and the whole area blasted at one time. Latter cycles utilized holes 21 feet deep with drilling in outer circle near shaft wall sloped outward toward wall approximately 18" in 21 feet. Contractor operations on early work was highly inefficient with many

instances of misfirings, unloaded drill holes and resultant poor breakage of rock and slow progress due to increased air hammer work necessary to maintain silo shaft alignment around silo walls.

Overbreakage of silo shaft wall was negligible and was filled with concrete placed monolithically with regular silo wall concrete placement.

Below reference elevation 912 all loosen material was removed by skip hoist equipment placed in operation 12 July 1960 and loaded in skip by front end loader. Between reference elevations 865 and 855 material was encountered which was soft enough to permit loosening by ripper on front end loader rather than drilling and blasting operations. When excavation reached approximately two feet below designated ring beam elevations, ring beams were hung, assembled and wedged into position against silo shaft wall and wire mesh and pneumatic concrete installed between ring beams prior to continuation of excavation.

Ground seepage was encountered beginning at approximate reference elevation 949 from a poorly consolidated conglomerate layer occurring from approximate reference elevations 949 to 945. The amount of seepage was not considered a serious problem with the flow occurring principally from the northern quadrant of the shaft wall. Cement content of pneumatic concrete shoring at this elevation was increased and although

no sluffing occurred moisture continued to bleed through so that immediately below between approximate reference elevations 944 and 938 polyethylene sheeting was placed against shaft wall prior to wire mesh and pneumatic concrete placement. The above action was confined to northerly quadrant of wall. The sloping sight tube drill hole penetrated the previous conglomerate layer and after excavation reached below reference elevation 900 evident of flow at the higher elevation decreased and drainage down the sight tube transferred the seepage problem to elevation 900. However, this division of flow amounts eased the problem so that not any further special treatment was necessary.

Silo shaft excavation was completed 15 August 1960.

LAWN SITE

Contractor started site preparation fencing and grubing 11 June 1960 and common open-cut excavation 14 June 1960 using three DW-20s, one D-8 "Pusher" and one D-8 with ripper.

Surface runoff from occasional rains was diverted from open cut excavation area by construction of dike around perimeter of excavation area.

Between approximate reference elevations 982 and 970 two strata of limestone with a sandwiched shale layer were encountered which required contractor to utilize drilling and blast procedures established at Baird and Denton Sites in order to loosen the materials. A Northwest shovel and 3 dump trucks

were used to load and remove the loosen material.

Open cut excavation to reference elevation approximately 960.5 was completed on 7 July 1960. Excavated materials were stockpiled in designated waste area to the east, west and southeast of the open cut excavation area.

Open cut rock excavation was in progress from 18 June to 2 July 1960. Limestone bedrock encountered at approximately reference elevation 982 was slightly rough, flat surfaced, massive with weather spacing 3 to 12 feet at approximately 40 foot spacing.

Silo shaft excavation below elevation 960.5 began 15 July 1960 utilizing a front end loader with ripper to loosen material for removal by clam bucket. Rock shafting operations were started 22 July 1960 when a layer of limestone was encountered at approximately reference elevation 925. Holes of 3' spacing were drilled 4 foot in depth, sixty holes, one pound powder per hole. Across center of silo, the breakage was small enough to be moved by front end loader. This test blast was sufficient in that it revealed the break up of the materials would be satisfactory, so line drilling to a depth of 12 foot was used.

Test holes at 10 foot centers were drilled to determine the depth and formation of the stone. Blasting hole depth was 12 foot vertical, 140 holes per firing using 600 pounds Hercules gelamite. Firing sequence was from center 1, 2, 3,

pitching all material to center of silo. Approximately ½ pound gelamite per cubic yard of excavated rock was utilized. Walls were cut clean, rock breakage size was small enough to permit loading with front end loader.

Over shooting and over breakage was only slight and was corrected by reducing the outer ring blast charge, and closer spacing of blast holes. Over breakage or excavation beyond required specification lines was backfilled with pneumatically placed concrete, or gunite, or a combination thereof supplemented by concrete during slip forming of silo walls.

Contractor's cycle of operations. Drilling blast holes utilizing wagon and crawling drills. Removal of drilling equipment from shaft followed by loading of holes with "gelamite" cleaning area and shooting. Lower front end loader into site shaft to load rock into skip bucket. Following removal of loose material and necessary trimming of side walls, a ring beam was placed and either lagging or welded wire fabric with pneumatically placed concrete installed between latest installed ring beam and one immediately above it.

BRADSHAW SITE

Contractor started open cut excavation 17 June 1960 using from three to five EW-20 scrapers, three dozers and two patrol graders. One dozer with ripper was used at times to

loosen material.

No interception drainage was provided by contractor although patrol graders were available for emergency construction of such facilities if needed.

Common open cut excavation to approximate reference elevation 960.5 was completed 28 June 1960. Materials loaded by Do-20 scrapers was hauled and stockpiled in designated waste areas on sites.

There were no layers of rock encountered which could be classified as bedrock in the pure structural engineering sense of the word. A firm layer of material was encountered at reference elevation 914 and a hard material resembling limestone or hard caliche from 4" to 2' thick was encountered at reference elevation 872 but contractor elected in both cases to loosen materials using ripper and paving breakers rather than drilling and blasting procedures.

Silo shaft excavation started 11 July 1960. Material was loosen and piled by TD-9 loader with ripper for clamshell removal during beginning of shaft excavation or loading into skip hoist during later stage of shaft excavation.

WINTERS SITE

Contractor started common open cut excavation 28 June 1960 using DW-20s, three dozers and a grader. Excavation was accomplished by ripping ahead and pushing DW-20 scrapers.

Interception drainage was provided by ditching on west side of cut, around north end. Drainage was to south and east. Interception not required on east side due to slope of terrain.

Open cut excavation to work area bench elevation approximately 960.5 was completed on 13 July 1960. Excavated material was stockpiled in equal piles on extreme west and east sides of site.

All strata of rock encountered were sloping from north to south, falling from one to two feet across width of silo shaft excavation.

Silo shaft excavation below approximate reference elevation 960.5 began 23 July 1960 using a "trenchvator" (front end loader with rear mounted ripper teeth) to excavate and stockpile material. Crane, PH 40 ton, with clam bucket removed material from hole. On 17 August, at elevation 904, the Contractor commenced using a bucket on the crane, which was loaded by the "trenchvator", to remove material from hole. At approximately elevation 890 the contractor installed a hoist with bucket and guide tracks for removal of material from hole. Drilling not required until elevation 882.

Upon attaining reference elevation 882 the material, gypsum, limestone, and shale, became so difficult to excavate that the contractor found it necessary to drill and shoot. Three shots were made, each 21 feet deep. Approximately 300 2-inch holes were required for each shot. Approximately 3/4 pound of Hercules gelatin dynamite was used per cubic yard of excavated

material. (Bottom of third shot at elevation 826). Firing sequence was made in circles, using No. 7, No. 8 and No. 9 delay caps with early shots at center and later on outside circles. The blasts resulted in conical pile. Shale and limestone broke down to pieces of less than 1 foot size. Gypsum seemed to absorb shock and did not fracture well. It was necessary to use cables and remove massive blocks of gypsum from hole individually. Air tools were required to trim walls.

SHEP SITE

Contractor started site grading and stripping operation 28 June 1960 utilizing DW-20s, D-8s and a patrol grader.

Because of the very limited quantities of available overburden material, no intercepting drainage was constructed to divert surface water runoff from excavation until major rains in mid-July flooded excavation area. Corrective action in the form of low dike around lip of excavation area was then constructed.

All common open cut excavation and site grading was completed 1 July 1960 and open cut rock excavation started.

Ground seepage water was encountered at approximately reference elevation 970 in the form of pockets of entrapped water from vertical and horizontal seams of surrounding limestone and drainage from cavities containing saturated

silts and clay. The inflow quantity was small and terminated rapidly so that it caused no interference with open cut rock excavation. When open cut reached work area level at reference elevation approximately 960.5 a sump was constructed to gather rainfall runoff entrapped within excavation area.

Open cut rock excavation was in progress from 29 June to 25 July 1960 when work area bench reference elevation 960.5 was reached. Dip of strata nor spacing of exposed vertical joints was not recorded. Surface of strata was virtually horizontal and exposed vertical jointing was not severly weathered. Specific data regarding open cut rock drilling and blasting operation was not clearly recorded. Apparently operational procedure varied dependent on character of exposed material and progress in removal of loosen material. At least two shots involved drilling over entire area and loosening the material in one shot while other shots involved only parts of excavation area. Approximately 2000 holes were drilled for blasting and shots involved an average of 2 sticks of dynamite per hole. The two 600 CFM air compressors and two to four wagon drills used in drilling work were moved onto site and off as needed.

Silo shaft rock excavation below elevation 960.5 began 17 August 1960 with drilling operations. A crane with clam-shell was used to remove loosen material from shaft, loading into dump trucks which hauled material to on-site stockpiles.

A TD-9 loader was used at bottom of shaft to pile material for clamshell pickup. An electric hoist was placed in operation when shaft reached elevation 917 on 13 September 1960. The hoist raised a loaded skip bucket on channel rails attached to the silo ring beams. The skip was dumped from a tipple into a chute discharging into trucks. The empty skip was returned to bottom of shaft excavation by gravity.

Concentric circle line drilling for silo shaft blasting operation began at elevation 960.5. Holes were spaced on 4 foot centers in silo interior circles and 2 foot on centers around peripheral circle with outer ring holes being fired first. The depth of drilled holes varied from 11 to 20 feet. Fragmental records indicated charge per hole varying from 4 to 8 pounds of dynamite. A few additional shots were fired at times to break extra large blocks of stone and to remove extra material along foot of walls to correct alignment and clearance.

Ground seepage water was encountered during silo shaft excavation at approximate reference elevations 950, 935 and at 906. Flow was from entrapped water pockets rather than that seepage from an entire strata of material as flow decreased in quantity with time. Removal of water was accomplished by pumping from a sump in floor of shaft excavation for 1 to 2 hours per day until reference elevation 877 was reached at which time a multi-pumping arrangement became necessary because of the increased lift requirements.

HOLAN SITE

Contractor started site preparation work on 27 June 1960 and actual common open cut excavation on 4 July 1960 using three 18 cy Euclid scrapers, two D-8 bulldozers, one D-8 "panther" caterpillar, one motor patrol grader and two service trucks.

Surface water runoff from occasional rains was diverted from open cut excavation by construction of a low dike around circumference of the area. Runoff entrapped within the open cut excavation area was collected in a sump excavated in floor of the work area bench level 960.5 and pumped up out of the excavated area.

On 9 July 1960 top of solid bedrock was reached at reference elevation 985.5 and the common open cut excavation phase of work was completed. All waste materials were stockpiled on east and west sides of the open cut in designated spoil areas with top soil and caliche material segregated from rock excavation.

Open cut rock excavation was in progress from 10 July 1960 until work area bench elevation 960.5 was cleared on 10 August 1960. Rock excavation operations were in progress 10 July to 15 July 1960. Holes for each shot averaged 185 - 211. No further excavation of consequence was performed until 23 July at which time drilling in the open cut area began. Drilling depths varied materially and no actual record of the depth

or number of holes is available. The record does indicate, however, a variance of from 40 to 350 holes and depths of from 2 feet 6 inches to some sixteen feet. Rock excavation was removed from the open cut using a power shovel for loading 3 Euclid trucks for hauling and one bulldozer for stockpile leveling and maintenance. Drilling was done by self-propelled track drills.

Silo shaft excavation started 17 August 1960 with drilling operations.

Drilling at elevation 960.5 was done in concentric circles with radius increasing at approximate four foot intervals and holes were spaced approximately four feet apart on the arcs of these circles. Seven rings of holes were drilled approximately 21 feet deep, slanting toward the center at an approximate angle of fifteen degrees. The eighth ring was drilled only 2½ feet deep. This latter four feet area was for the collar beam. Water was encountered in all holes at approximately elevation 951.0. A total of 318 holes were drilled, 206 holes were twenty-one feet deep and 112 holes were drilled 2½ feet deep. The holes were loaded on 20 August with 0.5 pounds of 40% dynamite in the 2½ foot holes and 12.5 pounds in the 21 foot holes, a total of 2600 pounds were used. The center holes were fired by instantaneous electric caps with connecting prima-cord and the concentric circles of holes were progressively fired by delayed electric caps and prima cord. The shot was made at 1930 on 20 August and with the exception of a few large boulders the rock broke very well. At elevation

940 drilling methods changed, the progressive four foot dimension for concentric circles with drilling four feet apart along the periphery together with the twenty-one foot depth was retained. However, the outer circle of drill holes was started approximately two feet from the outer edge of the excavation and holes were slanted toward the outside so that at the twenty-one foot depth the bottom of the hole would be approximately at the vertical excavation line. This method was necessary to permit the use of twelve foot drill steel and to allow the air hammer to clear the first ring beam above the bottom of the excavation. As a result quite a bit of chipping and cutting of the walls were required even to point of some secondary drilling and shooting. The second drilling started at elevation 940 required 210 holes, 21 feet deep and 1550 pounds of dynamite was used. No further record of drilling and quantities of dynamite used was maintained. However, in general the above method was used throughout the excavation.

The first water was encountered at approximately reference elevation 940 and numerous seeps were encountered during the remainder of the excavation. Even though a request was made almost daily the contractor made no effort to stop or divert this continuous drainage with exception of installing three or four small pipes through the gunite. Water fell continuously around the edges of the cut similar to a fine rain and working conditions were very bad. It is estimated that 5 - 10 gallons

per minute fell continuously from the walls.

Shaft excavation was completed 25 October 1960 being sixty days since the start of excavation or an average of 2.32 feet per day.

ANSON SITE

Contractor started operations 19 July 1960 stripping a maize crop from the work area using a maintainer. The top soil and vegetation was windrowed and on 28 July 1960 the excavation equipment for the open cut was moved onto the site with four 20 yard scrapper units and two crawler type dozers and one rubber tired pusher. The maintainer was used intermittently during this phase of the excavation. The top soil and vegetation was stockpiled separately for future replacement.

The top soil which was separately stockpiled was placed in a levee across the east and north sides of the site to divert water from the work area as the general slope of the ground at this site is to the southwest.

On 2 August 1960 free water was encountered at a depth of 19 feet in the artesian effect. Excavation was halted on 3 August due to wet conditions in the open cut at the top of the upper strata of water. On 18 August, the earth moving equipment was returned to the site after dewatering system was installed.

Open cut excavation was completed 30 August 1960. Excavated material was stockpiled in two areas designated on

the contract drawings. All excavated material from the open cut will be satisfactory for backfill.

Ground water was first encountered at 19 feet below original ground surface, reference elevation 971, flowing from a drilled hole in an artesian flow and persisted throughout the remainder of the open cut to 31 feet below surface, reference elevation 959. However, the bottom of the upper water bearing strata was passed at 26 feet depth. The inflow, measured with a Cippoletti type weir, was later determined to be 56 gallons per minute. This inflow seemed to be from all sides of the open cut and continued. The contractor attempted to control the water with a well point system established on an open cut bench ledge, 15 feet below ground surface with well points extending through the upper water strata. This method partially reduced the flow into the open cut but was only about 50% effective. No interceptor ditches were maintained during the open cut excavation operations nor was a dragline employed. The remaining material (from a depth of 20 to 30 feet) was mucked out using conventional earth moving equipment. The material thus excavated was too wet to stockpile to any depth and was spread out over the temporary construction area to dry. This disposal of excavated material was in violation of a letter written to the contractor by the Area Engineer and a verbal warning issued to the superintendent by the Project Engineer.

Silo shaft excavation operations were started 29 September 1960 with a front end loader and a crane excavating, a Euclid dump truck and a Koering Dumptor hauling. Material excavated was red shale and no blasting operations were expected. During the shafting operations, an International TD-9 and a Caterpillar 977 were used in the shaft at different times. These machines were equipped with rooter and front end loader bucket. No line drilling was used at the start of operations.

On 4 November at elevation 106 feet below original ground surface, reference elevation 884, a hard shale formation was encountered in the shaft and the contractor decided to blast very lightly to avoid breaking the grout curtain and drilled 40 holes, four feet deep. The holes were loaded with ½ stick of gelatin each and set off using a 1.5 millisecond delay.

Results were nil as no fracture occurred and the holes were just cleaned out. Re-drilled 40 holes and loaded with 3/4 stick of gelatin and obtained satisfactory results. Drilled 40 more holes in the other half of the shaft and used the same blasting procedure, obtaining satisfactory results. No noticeable increase in the inflow of water was apparent as a result of the blasting until the third charge, then water inflow approximately doubled. Normal excavation procedures were then used to continue shafting operations until on 16 November at 136 feet below original ground, reference elevation 854, more hard shale was encountered

and the contractor again decided to blast. Seventy holes were drilled to a depth of ten feet and charged with a total of 560 pounds of gelatin (60%) explosive using the delayed firing. No apparent increase in the water inflow as a result. Excavation was continued to reference elevation 843 feet when a small charge was used to break off a ledge of hard shale and selenite which was left around the perimeter of the shaft from the previous blast. On 20 November at reference elevation 840, 100 holes were drilled 14 feet deep and five sticks of gelatin were loaded into each hole. This blast successfully fractured the shale and selenite formations remaining to the bottom of the excavation and no more blasting operations were performed at this site. The amount of material successfully fractured per pound of explosive was approximately two cubic yards. The material was stockpiled for reuse in backfill and it is a shale, except for about 300 cubic yards of selenite, and will weather very quickly to a fine material. The walls were trimmed with air spades and air paving breakers.

Silo shaft excavation was completed on 25 November 1960.

CORINTH WEST SITE

Contractor started common open cut excavation 3 August 1960 using DW-20s, D-8 dozers and motor patrol grader.

Interceptor drainage was provided by contractor in the form of a sump pit dug in open cut area from which water was

pumped to a constructed channel which drained into private property on west side of site. Surface water run off beyond area of open cut excavation utilized natural drainage to east draining into an existing channel along the east property line.

Open cut excavation to work area reference elevation 960.5 was completed on 9 August 1960.

Silo shaft excavation began on 29 September 1960. A front end loader was placed inside concrete collar which formed the outside wall of the silo shaft. The front end loader with rock ripper loosened the material and placed it in piles for motor grane with clamshell to load into trucks. This operation continued to reference elevation 920 at which point the shale material became too hard to break loose and progress was slowed down considerably. The Contractor decided to begin blasting operations which was agreeable to the Project Engineer.

Blasting operations began 13 October 1960. Three wagon drills were used to drill approximately 150 holes to a depth of 21' from reference elevations 980' to 899'. Holes were spaced on 3' centers on the circumference and 5' spacing radially and began 2' inside shaft wall. Holes were drilled more or less vertical. One pound of powder was used per cubic yard of material. All holes were shot simultaneously. The loose rock was piled higher on the north side than any other side. Maximum elevation of loose material was 927'.

All material was fractured and broken up sufficiently enough so that the front end loader could load the material into one cubic yard bucket. Trimming the silo walls was the greatest task. Three jack hammers were used continuously to trim walls for shoring from reference elevations 920 to 882. At reference elevation 882 the contractor decided to drill and blast again due to the very firm shale condition which curtailed progress greatly. Drilling operations began 2 November 1960. Three wagon drills were used to drill approximately 150 holes to a depth of 20'. One pound of powder was used per cubic yard of material. Results of the blast were excellent. The center section was shot first and then the outside area which resulted in a 6' high cone of raised loose material in the center of the silo shaft. At reference elevation 847, the contractor again decided to drill and blast due to the difficulty of breaking and loosening the very firm shale strata. A total of 143 holes were drilled to a depth of 20'. The first row of holes was drilled only one foot from the silo wall instead of two feet as in previous drilling. The reason for making this change was to fracture the firm shale near the silo wall and thus lessening the amount of wall trimming required by the jack hammers. As before, one pound of powder was used per cubic yard of material. The blast was very good, breaking up the firm shale well, so excavation could proceed rapidly,

When silo shaft excavation reached reference elevation 954 water began seeping into shaft at several places. This seepage was due mostly to infiltration of antecedent rainfall of 1.28' through the brittle and fractured shale and soft seams. From reference elevations 954 to 920 firm layers of red mottled greenish-gray shale would occrue and result in perched water tables. Reference elevation 920 was the beginning of a very firm thinly bedded to massive red shale. This was definitely a permanent water table line and seepage was continuous at this elevation during the entire period of silo shaft excavation. Seepage was concentrated in two definite areas, one area being around the sight tube and the other near the fill and vent shaft. Some seepage occurred from elevations 920 to 823 due mostly to fractures in firm shale. The quantity of ground water flow would average from 3 to 4 gallons per minute during dry periods and just after rains the flow would be 10 to 15 gallons per minute. Minimum flow at completion of silo shaft excavation was 3 gallons per minute. The ground water flow was controlled by leaving openings in gunite walls and diverting the major flow into shaft by means of pipe embedded in gunite wall. During excavation a sump pit was maintained continuously to confine the water to one location and a pump was placed in sump pit. Water was pumped from sump pit to constructed drainage channel above open cut area.

PHANTOM LAKE SITE

Contractor started common overcut excavation 22 July 1960 using three 20 cy capacity scrapers, two D-8 bulldozers, two motor patrol graders and one Michigan bulldozer.

There was no change in contractors operation until common open cut excavation was completed on 28 July 1960 when rock was encountered at reference elevation 971 and contractor attempts to break the medium hard limestone ledge with a heavy duty rooter failed. Overburden suitable for use as backfill was hauled to stockpile areas designated on the contract drawings.

The type of rock encountered from reference elevation 971 to bottom of silo reference elevaton 823 was limestone separated by small layers of shale, all approximately horizontal. Shale layers had a tendency to crumble and weather rapidly following exposure. The weather had no apparent effect on the limestone.

Open cut rock excavation was in progress from 13 August 1960 after drilling and blasting operation at reference ele- 971 to 16 August 1960 when work down beneh elevation 960.5 was reached. The Contractor had planned to continue using the scrapers to excavate the blasted rock below elevation 971 but the rocks were too large. The Contractor brought in a shovel and Euclid dump trucks and used this equipment to load the rock and place it in the spoil areas. The

Contractor used a Northwest shovel, 2½ cubic yard bucket and three Euclid dump trucks. Each dump truck had a capacity of 11 cubic yards. The Contractor worked two ten hour shifts per day during the open cut rock excavation stage of work.

Silo shaft rock excavation work below 960.5 started about 22 August 1960. Actual shaft excavation was started initially with a clamshell bucket loaded by a hi-lift TD-9. This type of operation was continued until the bridge and skip hoist installation was completed on 4 October 1960 with excavation at reference elevation 900. Excavation was resumed using the TD-9 to load the skip hoist which in turn placed the material in Euclid trucks. It was then taken to the spoil bank. Concentric circle drilling was utilized on the drilling and blasting operations. A number of holes were drilled to an average depth of 20'. These were then loaded with powder and then blasted.

ALBANY SITE

The Contractor started common open cut excavation 14 July 1960 using DW-20 scrapers, D-8 bulldozer and a motor patrol grader.

Open cut excavation to work area reference elevation 960.5 was completed on 22 July 1960. All material encountered in open cut stage could be classified as common excavation and were stockpiled in areas designated on plans for reuse.

Silo shaft excavation began 5 September 1960. A front end loader with ripper placed inside concrete collar loosened the material and placed in piles for removal by motor crane with clamshell. This operation continued to reference elevation approximately 939 at which point it was necessary to start loosening of material by drilling and blasting operations.

Concentric circle pattern line drilling and blasting operations began 12 September 1960. The depth of drilled holes varied from 18 to 21 feet. Three wagon drills were utilized in drilling operations and dynamite (60%) in blasting operations.

As the excavation progressed the shafts were shored by installing wide flanged I beams shaped into circular segments and bolted together to form a continuous ring beam around the perimeter of the excavation. The ring beams were suspended one from another at specified horizontal intervals by long bolts. The space between the rings was filled with welded wire mesh and pneumatic concrete, metal or wood shoring as required by the specifications for the particular material in the wall of the excavation.

Upon completion of excavation and shoring the floor of the shaft was sealed with reinforced concrete. The reinforcing was first placed and electrically bonded, then the pour was made using a concrete bucket raised and lowered in the silo from a truck crane.[16]

Reinforcing steel for the silo walls was then installed starting at the base of the silo and proceeding to elevation 960.5. Along with the reinforcing steel the inserts were installed.[17] Inserts were "validated" first by members of the specialist section of construction for quantity and approximate location, and second by the survey team (consisting of a contract survey party with personnel from General Dynamics Astronautics Optics Section).

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16. See photo No. 8.
17. See photos No. 9 and 10.

When all of the reinforcing steel and inserts had been installed and validated, the slip form operation began.[18] The slip form itself was a circular wooden form 4' 6" high with a platform and rails to support and guide the pneumatically driven concrete buggies which placed the concrete. A second and lower platform was provided for the concrete finishers. A steel bridge system was installed at level 960.5 from which steel rods were suspended to support and raise the slip form. The steel rods were raised with manually controlled pneumatic jacks moving the slip form vertically at an average speed of 13" per hours. Horizontal position of the slip form was maintained with rails welded to the reinforcing steel in the silo walls.

Concrete for the silo walls and other features was provided by the Contractor from portable batch plants located at the site and hauled by ready mix trucks to the pour in progress. The Area Office laboratory branch provided surveillance of batch plant operations and the product with personnel and equipment in laboratories furnished by the Contractor.

Installation of the reinforcing steel between elevations 960.5 and 1,00[illegible] began as soon as the initial set of the silo walls was achieved.[19] As the installation of the reinforcing steel neared completion the exterior form was started. This

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18. See photos No. 11, 12 and 13.
19. See photos No. 14 and 15.

was followed by the installation of the bridge to hold the jack rods for the slip form. When the reinforcing steel was complete, imbedded items installed and checked and the exterior form complete; the slip form operation was started again. Slip forming was stopped at the lower edge of the silo cap. A parapet wall with pilasters to support the form bridge for the silo cap and silo doors were formed and poured at a later date.

Except for the magnitude of the work and the extremely short construction time available, the remainder of the work was routine to the Corps of Engineers. Of special interest was the check-out or validation phase of the mechanical, electrical and Propellant Loading Systems. This was accomplished by special teams for each system consisting of Contractor, Corps of Engineers, SAMSO and GD/A representatives working from check lists prepared in advance. The individual items of each test procedure were checked off and the completed test was signed and documented by all parties concerned. Without this procedure and close coordination final sign-off of the completed complexes would have been virtually impossible.

EVENTS EFFECTING COMPLETION SCHEDULES

The original contract required that all work be accomplished not later than 6 September 1961 but was extended to 5 November 1961 by modifications. The major portion of the time extensions granted were due to unusual weather conditions. The construction contractor was hindered in the proper execution of his contract by an unusual amount of precipitation for the area in which the work was being performed. Paragraph SC-7b of the contract specifications set forth the weather conditions which could be expected, this information having been taken from the 1959 "Local Climatological Data" for Abilene, Texas published by the Weather Bureau, U. S. Department of Commerce. The chart inserted in the specifications showed the normal weather for the period 1921 - 1950.[80]

For the period from 1 May 1960 through 31 October 1961, the actual rainfall recorded at the Weather Bureau at Abilene, Texas was in the amount of 31.68 inches. The thirty (30) year norm from the chart in the specifications showed a total of 37.13 inches for the same months. The difference of plus 14.55 inches amounts to a 39.2 percent increase.

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80. See DOC 10.

The Special Conditions of the contract specifications required that not only the entire contract be completed by a specified date but that nine (9) other items of the work be completed by predetermined (milestone) dates. Penalties in the form of liquidated damages, were provided for failure to meet the milestone dates as well as the completion date for the entire contract. A chart which shows the contract, actual and Air Force Directive dates for each of the milestones at each of the twelve sites is included in the appendix.[21]

In addition to the milestone dates established for the most important items of the work, there were several significant dates in the construction of each site. To avoid duplication and repetition, a chronological list of significant events has been prepared for only one of the twelve (12) sites. The site used for this list was Sharp Site, number seven (7) in numerical sequence and the data listed was taken from the Daily Log for that project office.[22]

During the course of the construction of the missile launch complexes, the sequence of completion of the various sites was changed due to delays experienced at some of the sites in some of the early features of the work and

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21. See DOC 11.
22. See DOC 12.

the completion of those features at other sites at an earlier date than was expected. As a result of these changes, Site Number 11, Oplin, became Site Number 1 and Site Number 8, Anson, became Site Number 12 in the completion sequence.

The actual completion date of Oplin Site (number 1 in sequence) was 21 June 1961 which was the date proposed for completion without time extensions. Anson Site, number 12 in sequence, was completed on 30 October 1961, six days ahead of the final date for all work which had been changed to 5 November 1961 by modification.

The only milestone which was not consistently met in the course of the construction was for the installation of the FLS vessels. These vessels were late in arriving at the job-sites but their late arrival did not materially affect the progress of the remainder of the work. However, liquidated damages in the amount of $182,200 have been assessed the contractor due to the late completion of this milestone.

The only major item of work which remained to be done after 30 October 1961 was the installation of Launch Safety Platforms in each missile silo and the scheduled completion date of these items is 22 February 1962. The safety platforms were added to the original contract by Modification No. 66 with changes being made to them by Modification No. 105 and Modification No. 108.

After final inspection of the twelfth site a "ribbon-cutting" ceremony was held on 3 November 1961 and the key

to the security gate was turned over to Colonel Hugh B. Mannon, USAF, Site Activation Task Force Commander by Lt. Colonel Albert M. Antonelli, Area Engineer, CEBMCO.[23] An open house and tour of the completed site was held for local and visiting dignitaries. At an awards dinner after the open house Major General Thomas P. Gerrity, USAF, Commander of AMC Ballistic Missiles Center awarded the Air Force Commendation Medal to Lt. Colonel Antonelli.[24]

Mr. H. B. Zachry was presented the Commander's Award by General Gerrity. As president of H. B. Zachry Company, Contract Sponsor, Mr. Zachry was given a Certificate of Appreciation for Patriotic Civilian Service to the Department of Army from the Secretary of the Army and The Department of the Army Certificate of Appreciation for Civilian Service from the Chief, Corps of Engineers awarded to H. B. Zachry Company and Brown and Root, Inc. by Colonel Thomas B. Hayes, U. S. Army, Commander, CEBMCO.[25]

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23. See photos 52.
24. See photo 53.
25. See photo 54.

In addition to the prime contract for the actual construction of the launch complexes, there were six smaller contracts awarded for support facilities in the Dyess Area.

It was determined that water for five (5) of the launch sites could be economically purchased from cities in their vicinity, while wells should be drilled to supply the remaining seven (7) launch sites. Negotiations for city water supplies provided water lines to three (3) of the five (5) city water supplied sites leaving two (2) sites to be connected with contract water lines.

All but one of the well systems had to be located at some distance from their respective sites. The over all water supply and supply line picture developed as follows:

SITE	SUPPLY SOURCE	SUPPLY LINE
Phantom Lake	City	Contract
Baird	Wells	Contract
Denton	Wells	Contract
Lamm	Wells	Contract
Breckinridge	Wells	Contract
Sharp	Wells on Site	Not required
Nolan	Wells	Contract
Anson	City	City
Corinth West	City	Contract
Albany	City	City
Oplin	Well	Contract
Winters	City	City

Contract No. DA-41-443-eng-5963 for drilling water wells for the seven (7) sites was awarded to J. R. Barnes Engineering Company of Austin, Texas on 12 October 1960, in the original amount of $169,300, modified to $185,314 by eight (8) change orders.

Contract No. DA-41-443-eng-5972 was awarded to Brodie-Enix Construction Company of Amarillo, Texas on 21 October 1960 to install the water lines to the eight (8) sites. The original amount of the contract was $175,000, but two (2) change orders modified this amount to $177,350.

A Missile Assembly Building was constructed under Contract No. DA-41-443-eng-5967 which was awarded to Rundell Construction Company of Dallas, Texas 19 October 1960 to provide a missile assembly area on Dyess Air Force Base. The amount of the original contract was $677,800 and was modified to $759,604 by eighteen (18) change orders.[26]

A Re-Entry Vehicle Building was constructed under Contract No. DA-41-443-eng-5971 which was awarded to Hawkins & Westbrook of Abilene, Texas 21 October 1960 in the amount of $69,778, modified to $77,146 by three (3) change orders.[27]

Contract No. DA-41-443-eng-5979, Liquid Oxygen Facility, was awarded to Universal Engineers and Constructors, Inc. of Tulsa, Oklahoma 28 October 1960. The original contract amount was $249,748 which was modified to $259,467 by ten (10) change orders.[28]

Contract No. DA-41-443-eng-6150, Final Catchment Tanks, was awarded to Hawkins & Westbrook 5 July 1961. The purpose of this contract was to provide a tank to empty the missile

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26. See photos 47 thru 50.
27. See photos 43 and 44.
28. See photos 45 and 46.

fuel into, if necessary, at each site. The original amount of this contract was $185,830.

All of these support facility contracts have been completed.

PART IV

MAJOR OPERATIONAL PROBLEMS AND THEIR SOLUTIONS

In the course of the construction of a project of this size, several problems of major importance are certain to be encountered and the solutions to those problems may be of possible benefit to similar problems which may be found on future construction. Several of these problems with solutions are listed below:

PROBLEM: To remove excavated material from a shaft with a minimum of equipment and time and a maximum of safety.

SOLUTION: Install a skip hoist on rails which were extended as the depth of the shaft increased.

PROBLEM: To install large quantities of reinforcing steel in the lower portions of the silo wall in the shortest period of time with the maximum of safety.

SOLUTION: Installed every fifth vertical rod and brace it plumb from the ring beams. Brought horizontal bars into the silo on a jog which was made up above ground, carried six bars at a time on three cables equipped with hooks and suspended from a curved channel beam.

PROBLEM: To transport concrete in a horizontal plane and place it inside a slip form with a minimum of wasted time and motion.

SOLUTION: A slip form was constructed with small rails running around it on a horizontal work platform and pneumatic buggies were used to transport and deposit concrete. Two pneumatic

buggies were used on each form.[29]

PROBLEM: To install the shock suspension system for the silo structural steel.

SOLUTION: The shock hanger brackets were attached to their respective embedded plates and the hanger rods were pre-tensioned and hung prior to the installation of the structural steel.[30]

PROBLEM: To install mechanical piping with a minimum of error and a maximum of efficiency.

SOLUTION: As much of the mechanical piping as could be handled was pre-fabricated in a central shop and set in place in bulk.

PROBLEM: To provide twelve (12) sites with identical electrical, mechanical and structural systems with a minimum of trained personnel.

SOLUTION: So-called roving crews were used to the maximum for such installations permitting a much smaller number of men to be trained for any specific task and giving them the benefit of repetition in their duties.

PROBLEM: To complete the backfill of each open cut area with a minimum of equipment "road time between sites.

SOLUTION: The major items which interferred with a complete

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29. See photos 12 and 13.
30. See photos 16, 17, 28 and 29.

backfill at each site at one time were the air intake and air exhaust tunnels which were suspended from the sides of the silo at different levels. In lieu of backfilling to the base of the tunnels, the tunnels were constructed on shoring prior to the start of backfill operations and when the shoring was removed, the backfill could be performed without interruption.[31]

PROBLEM: To avoid lost time due to the late delivery of Propellant Loading System vessels which were scheduled to be placed in the lower section of the silo.

SOLUTION: The structural steel in the floor of the eighth level was left out and a minimum of cross bracing was installed between levels seven and eight. The placement of the silo roof was postponed but an eighteen (18) inch parapet wall was constructed full depth (9 feet) around the top perimeter of the silo to permit completion of backfill.[32] This parapet wall was left in place and became part of the roof.

PROBLEM: To insure completion of the entire project on time and to obtain the maximum in efficiency.

SOLUTION: In the latter part of 1960 the Contractor made a study of the project and through the use of a comparatively new type of progress evaluation called "The Critical Path Method" was able to clarify his status and see the work remaining to be done. This evaluation was probably the

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31. See photo No. 15.
32. See photo No. 19.

largest single item which permitted the timely completion of the project.[33]

PROBLEM: To protect the installed equipment in the silo from weather.

SOLUTION: The first attempt to solve this problem resulted in failure as the Contractor set up tarpaulins over the silo opening in a tent arrangement, suspended from a beam which laid from one open door to the other.[34] This arrangement did not have the desired effect so the Contractor then made wooden frames which spanned the silo parallel to the open doors and covered the individual sections with polyethelene.[35] One section was made to be removable to permit the use of a crane to transport materials. This method, while not entirely effective, worked well enough and was adopted at all sites.

PROBLEM: To raise and lower silo doors with a maximum of safety and ease (hydraulic operators for the silo doors were a part of the I & C contract).

SOLUTION: Three doubled one inch cables were case in place with the concrete of the door with a loop protruding above the surface of the concrete.[36] These cables were to have been cut off after the doors were opened and anchored, but were

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33. See DOC 13.
34. See photo No. 26.
35. See photo No. 33.
36. See photo No. 34.

left in place for the use of the I & C Contractor at the request of the Air Force.

PROBLEM: To provide field personnel with office space which was as close as possible to the construction work area without conflicting with the construction operations.

SOLUTION: As specified, the original field offices which were constructed for Corps of Engineer personnel were sixteen (16) by forty (40) feet and semipermanently fixed in one location. Of necessity, these buildings had been located well away from the construction area to avoid conflict with the work. These structures were turned over to the Air Force for I & C Contractor field offices and the construction contractor furnished ready-built movable buildings for Corps of Engineer personnel. These buildings were moved from one spot to another during the course of the job to meet the needs of the work. These buildings were turned over to the Using Agency at the completion of the construction phase to serve as gate houses for the security guards.

PROBLEM: To obtain the best communications between field and office personnel at the least cost.

SOLUTION: A radio network was installed in the area with receivers and transmitters in the Area Office (with remote Telecon Units to each branch office), at each project office and in the vehicles of key personnel. This provided rapid communications with a minimum of personnel travel and lost time and a minimum of long distance toll charges for telephone

use.

PROBLEM: To keep the key personnel in the Area Office aware of shifts of contractor personnel from site to site and to provide them with a quick summation of the construction activities at each site during each working day.

SOLUTION: A brief report form was completed by field personnel for each shift worked. The information was assimilated by the project engineer and relayed to the Area Office by radio at a set time the following morning. The information was received by the reports section and consolidated for review by the key personnel of the Area Office. A copy of the form used may be found in the appendix.37

PROBLEM: To determine the accuracy of the Contractor's placement of embedded items and survey work.

SOLUTION: The survey work, including validation of embedded items, for the Dyess Area was performed by contract survey teams in conjunction with validation teams from the I & C Contractor for the Air Force. To avoid the possibility of missing any items which should have been checked and to furnish material to the survey crews which would make their task as uncomplicated as possible, sketches of the items to be validated were made on reproducible paper with all necessary information on them. These forms were used for pre-pour and post-pour

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37. See DOC No. 14.

validations and when completed, provided a swift and easy method of ascertaining the accuracy of the contractor's placement of the various items. In the case of the pre-pour validation, of course, items which might not be within the specified tolerance were found and the project engineer then took action to cause them to be relocated.[38]

In addition to the above construction problems which were recognized and solved, there were some design items which were inadvertently overlooked which might have been easily remedied during the progress of the construction of the launch and control facilities. Such items should be recognized and changed either in the design stage or by change order during construction:

PROBLEM: Water seepage around areas in the silo wall where blockouts were used for future wall penetrations.

SOLUTION: Some type of water barrier or stop should have been employed when the blockout was made as it has been found to be nearly impossible to place water tight concrete in such spaces at a later date, even using a non-shrink admixture.

PROBLEM: The location of the entry vestibule of the LCC directly over and ten (10) feet above the corrugated metal tunnel caused the tunnel to give and the vestibule to settle in varying amounts at different sites.

SOLUTION: Possible solutions to eliminate this settlement are: (1) to re-locate the entry vestibule; (2) to provide a spread

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38. See DOC 15.

footing and column arrangement to assist in supporting the weight of the vestibule or (3) to make the tunnel of reinforced concrete designed to withstand the load.

PROBLEM: Possibility of rupture of utility lines. The placement of a forty (40) foot backfill between and around structures the size and shape of the launch and control buildings is a difficult task and the uniformity of the backfill under the best of conditions is open to question. In the present case, the compaction specified was 90% of Modified Proctor. There is a definite possibility of settlement in varying degrees throughout the area and the subsequent possibility of rupture of utility and sewer lines which may be attached at one end to a rigid structure and at the other end to a manhole, vessel or headwall which is supported entirely on this fill material.

SOLUTION: The requirement for 90% compactions should be raised to 100% and the use of flexible connections should be employed where feasible.

PROBLEM: The widespread use of extra close tolerances in design.

SOLUTION: Close tolerances, particularly in embedded items, should not be employed more than is consistent with general construction practice except where unavoidable. In many instances, close tolerance was demanded of the construction contractor only to learn that the item to be installed later did not have a critical location or that shims were provided to obtain such critical location. A greater depth of research

in the design stage could eliminate many unnecessary difficulties and compliance with necessary close tolerance could be more easily obtained.

PROBLEM: The creation of possible pavement failure due to the use of a rock pit beneath the paving to catch drain water from the silo door pockets.

SOLUTION: The drain lines from the door pockets could have been run into an area drain or the lines could have been extended outside the paving line. At least two paving failures in the Dyess Area resulted when settlement occurred from water being trapped in the rock pits.

PART V

CONTRACTOR'S RELATIONS WITH LABOR

Much of the credit due the prime contractor for completing the construction of the Nyasa Missile Launch Complexes on time must be attributed to the fact that not a single work stoppage occurred on the prime contract, any sub-contract nor at the field level, on any assigned contract due to a labor dispute. This record is exceptional on two accounts; (1) no other ICBM construction project has avoided such work stoppage and (2) because a "Union" contractor, Paul Hardeman, Inc., was assigned the contract for furnishing and installing the Propellant Loading System under the prime contractor, H. B. Zachry & Brown and Root, which was non-union. It should also be noted that no work stoppages occurred on any of the construction projects for the smaller support facility contracts.

An investigation of alleged violations of the Davis-Bacon Act and the Eight Hour Law by H. B. Zachry & Brown and Root and their sub-contractor, C & M Construction Company, was begun by CHEMCO Labor Relations Forces in March 1961 and concluded in December 1961. The results of that investigation are set forth in a letter dated 19 December 1961 from Colonel W. W. Wilson, Corps of Engineers, Contracting Officer, Atlas F Construction Directorate to H. B. Zachry Company & Brown and Root, Inc., file No. XXCMC-VL-3. In brief, the final findings and determination were that the Contractor had underpayed employees a total of $4,572.70 due to improper classification

(Davis-Bacon Act violations) and $3.98 due to Eight Hour Law violations. In addition, a penalty assessment of $115.00 was made as required by the Eight Hour Law for violations thereof.

Other infractions of the labor laws were found to have been made by three sub-contractors, Johnson Elevator Construction Company, Cyclone Fence Department of American Steel & Wire Division, U. S. Steel Corporation and Refractory Construction Company. In each of these instances, adjustments were made by the sub-contractor and restitution was made to the employees concerned. Other minor violations were discovered at the project level by interviews of the Contractors' workmen by Corps of Engineer inspectors. These violations were either resolved at the site by the project engineer and the construction superintendent or in the Area Office by the Area Labor Relations Officer and the Contractor's Office Manager.

The excellent labor relations of the construction contractor were reflected in an editorial which appeared in the local newspaper, The Abilene Reporter-News 20 April 1961.[39]

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39. See EOC 16.

PART VI

CONTRACT MODIFICATIONS

The original amount of Contract No. DA-41-443-eng-5878 was $20,075,000 which did not include the amount of the contracts which were assigned under the provisions of the Special Conditions of the contract specifications.[40] These assigned contracts were added to the prime contract by two modifications, numbers 25 and 38. The total amount of the assignment was $3,898,969.03 which increased the contract to $23,973,969.03. In addition to the two modifications which added the assigned contracts to the original, there were 115 other modifications, a total of 117 modifications, 4 of which were cancelled, including groups of settled claims, which in the aggregate added $6,767,015.79 to the original sum. Subtracted from this total of $30,740,984.82 is the amount of $182,800 which was assessed for liquidated damages through failure of the contractor to meet required milestone dates on portions of his contract, primarily the installation of LCS vessels. The net total contract amount at the time of this report is $30,558,784.82 which excludes a modification which may be issued to settle two outstanding claims, but does include a new bid item for lagging of $747.30.

The two claims which are outstanding are: (1) C-60, a claim on behalf of Taylor Forge Company for approximately $1,264,083 and time extensions for performance of certain

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40. See DOC 9.

"wipe" tests on vessels prior to shipment; and (2) C-74, a claim by the prime contractor for an undetermined amount which he might have to pay as premium time for labor, i.e. time and one half for all time over forty (40) hours per week, if a pending judgement against him by the NRLB is upheld by the courts. At the present time, it appears that Claim C-74 will be dropped due to a recent decision on a similar case in Arkansas.

In addition to the two modifications issued to add the assigned contracts, twelve (12) other major (in excess of $100,000) modifications were made to the contract. In general, modifications to the contract were issued after receipt of an Air Force Directive which resulted from a Change Order Conference consisting of representatives of the Corps of Engineers, the Air Force, General Dynamics Astronautics and the design Architect-Engineer firms working for the Air Force. A resume' of each of the major modifications may be found on the succeeding pages.

One other major change to the contract was made by Supplemental Agreement Number 40 which was issued as a result of an Air Force Directive to provide on-site water treatment facilities. The Contractor's original proposal was $214,559 for the addition of these facilities which was reduced to $206,639 after negotiation.

ATLAS F

DYESS

CLAIMS SETTLED (OVER $100,000)

1. Contract No. DA-41-443-ENG-5878

2. Contractor: H. B. Zachry Co. & Brown & Root, Inc. (A Joint Venture)

3. Modification No.: 96

4. Source: Letter dated 4 Jan 61 from contractor incloaing letter dated 30 Dec 60 from Mosher Steel Co., supplier initiated claim. COC 656, 24 May 61, authorized change.

5. Date of Modification: 13 Jun 61

6. Date Received by COE: 7 Jun 61

7. Date Negotiation Completed: 28 Jul 61

8. Contractor's Value of Claim: $215,342

9. Settlement Cost: $208,410

10. Remarks: The claim involved the fact that the connections for the crib steel detailed on the supplemental design drawings were generally larger and heavier than the connections indicated by the contract drawings and specifications. The contract required that the supplemental design drawings should be used as shop drawings by the contractor. Negotiations were delayed until 28 Jul 61 due to contractor's contention that acceleration was somehow involved in the work and because of the need to resolve certain technical features of the modification.

This modification was not included in the previous CCE.

ATLAS F

DYESS

MODIFICATIONS (NEGOTIATED)

1. Source of Modification: COC 419, LR 2387, 9 Sep 60; Message EMCMA-VG-1839, 16 Sep 60; Letter EMCMA-VG-5, 5 Oct 60, Subject: "Unitary Silo (Atlas F) Electromagnetic Pulse Screen"; Letter EMCMA-VG-AB, 29 Oct 60, Subject: "Atlas Silo Squadron, Dyess AF" Contract DA-5878, Mod. No. 20 (RI-20)

2. Date: COC 419 dated 9 Sep 60

3. Date Received by Contracting Officer: 16 Sep 60

4. Date Presented to Contractor: 22 Sep 60 (preliminary); 5 Nov 60 (final)

5. Date Negotiation Completed: 16 Jan 61

6. Date Notice to Proceed: 22 Sep 60

7. Cost Estimates:

A. Available to COC 419 - $400 per silo - $4,800

B. Government Estimate at beginning of negotiations:

Amount - $36,924 (Bechtel Estimate $37,200)

Source - Prepared by Area Office

C. Contractor's Initial Proposal and Date - $120,637, 9 Dec 60

8. Negotiated Amount: $101,400

9. Remarks: The work included provision of a continuous electromagnetic pulse screen by utilizing concrete reinforcement steel as presently designed in silo walls, vestibule, tunnel and cap, and by increasing the number of grounding straps at each of the two flexible tunnel connections, and from silo cap to silo overhead door and from door leaf to door leaf. The changed work was required to be accomplished within the established completion schedule and applied to all 12 sites, with the exception that at sites 2, 3, and 11 the changes applied only above elevation 945.0 feet. No acceleration as such was authorized. The original authorization was issued on the basis of preliminary instructions, revised by a preliminary drawing and finalized on the basis of drawing No. AFBMD-1-8-45. The final Government Estimate of cost of $106,764 was higher than the original estimate because of the added grounding work at the launching doors included in the final drawing. This modification was included in the previous CCE in the amount of $101,400.

ATLAS F

DYESS

CHANGES ISSUED (OVER $100,000)

Contract No. DA-41-443-ENG-5878
Modification, Change Order No. 17 (RI-17)
H. B. Zachry Co. & Brown & Root, Inc.

1. Source of Change: COC 229, 263B, 281B, 288, 336B, 345, 371, and 299. Letter ENGMA-VG-AB, 10 Sep 60, Subject: "Modification Material to Accommodate Standardized Equipment".

2. Date: 10 Sep 60

3. Received by Contracting Officer: 14 Sep 60

4. Presented to Contractor: 15 Sep 60

5. Status of Negotiation: Scheduled for resumption of negotiations upon completion of review of Government Estimate.

6. Notice to Proceed: 15 Sep 60

7. Cost Estimates:

A. Available to CCB/COC - N/A

B. Government Estimate at beginning of negotiations:

Amount - $655,896, 29 Nov 60

Source - Prepared by Area Office

C. Latest estimate of settlement: $1,036,560.00

D. Contractor's Initial Proposal and Date: $723,478.58, 9 Dec 60

8. Remarks: The work consists of changes with respect to updating drawings and specifications to reflect current vendor print information effecting facility piping, electrical wiring, M.V. & A.C. duct work, structural steel and equipment location. An acceleration cost of $50,000 was included for ductwork. The change was required to be done within the established completion schedules. Tentative agreement was reached 3 Feb 61 on an adjustment of $653,721.78; however, the contractor has submitted a proposal on 31 July 61 for an adjustment of $1,154,197.34 on the basis of impact of the change. Government Estimate is being revised. The final Government Estimate of 27 Nov 61 is $1,038,658. The contractor has verbally on 16 Sep 61 raised his proposal to $1,208,305, but agreed to settle for $1,036,560.

ATLAS F

DYESS

CHANGES ISSUED (OVER $100,000)

Contract No. DA-41-443-ENG-5878
Modification No. 37 (U-1 and U-2) (RI-37)
H. B. Zachry Co. & Brown & Root, Inc.

1. Source of Change: COC 456B, 465A, 465C and 505. Letters, ENGMA-AB-1 dated 16 Nov 60 and 30 Nov 60 implementing findings of COC.

2. Date: U-1, 16 Nov 60; U-2, 30 Nov 60

3. Received by Contracting Officer: U-1, 21 Nov 60; U-2, 1 Dec 60

4. Presented to Contractor: U-1, 22 Nov 60; U-2, 2 Dec 60

5. Status of Negotiation: Scheduled for resumption of negotiations upon completion of review of Government Estimate.

6. Notice to Proceed: 2 Nov 60

7. Cost Estimates:

A. Available to CRB/COC - $84,000 (no estimate for COC 505)

B. Government Estimate at beginning of negotiations:

Amount - $76,104, 20 Mar 61

Source - Prepared by Area Office

C. Latest estimate of settlement: $108,108.00

D. Contractor's Initial Proposal and Date: $74,533.84, dated 23 Jan 61

8. Remarks: The work included in the change consists of modifications to facility piping, 6th level floor sink, pipe and duct hangers in the silo. No acceleration as such was authorized; however, the notice to proceed letter dated 22 Nov 60 does not mention a time adjustment. The final settlement is higher than the original proposal because of consideration of additional cost factors, such as, congestion of work areas, reduced efficiency of labor, etc. Final Government Estimate is $109,368.00. The contractor has submitted a revised proposal on 1 Aug 61 for an amount of $159,243, but agreed to settle for $108,108.

ATLAS F

DYESS

CHANGES ISSUED (OVER $100,000)

Contract No. DA-41-443-ENG-5878
Modification No. 65 (RI-74)
H. B. Zachry Co. & Brown & Root, Inc.

1. Source of Change: COC 564B, Letter ENGMA-AB-1 dated 11 Mar 61

2. Date: 19 Jan 61

3. Received by Contracting Officer: 8 Mar 61

4. Presented to Contractor: 9 Mar 61

5. Status of Negotiations: Scheduled for resumption of negotiations upon completion of review of Government Estimate.

6. Notice to Proceed: 9 Mar 61

7. Cost Estimates:

A. Available to CCB/COC - $52,000

B. Government Estimate at beginning of negotiations:

Amount - $64,502

Source - Prepared by Area Office

C. Latest estimate of settlement: $135,837

D. Contractor's Initial Proposal and Date: $513,172, dated 25 Apr 61

8. Remarks: The work included in this change consists of modification of AOC's to provide fan coil unit and chilled water pump and connecting facilities at all sites with additional structural changes at site 2 only. No acceleration was authorized. The final settlement is higher than the original proposal because of consideration of additional cost factors, such as, congestion of work areas, reduced efficiency of labor, etc. Final Government Estimate is $135,837. The contractor has submitted a revised proposal on 27 Jul 61 for an amount of $383,695, but agreed to settle for $135,837.

ATLAS F

DYESS

CLAIMS SETTLED (OVER $100,000)

1. Contract No. : DA-41-443-NEG-5878

2. Contractor: H. B. Zachry Co. and Brown & Root, Inc. (A Joint Venture)

3. Modification No.: 104

4. Source: Claim was initiated by Contractor's letter dated 10 Feb 61. Issuance of modification was authorized by Director, Atlas F 1st Ind., 14 Jun 61, on Area Letter, 14 Apr 61, subject: "C-30, Extending Work Areas Around Silos and LCCs, Contract No. 5878".

5. Date of Modification: 28 Jul 61

6. Date Received by COR: 16 Jun 61

7. Date Negotiation Completed: 28 Jul 61

8. Contractor's Value of Claim: $269,604

9. Settlement Cost: $221,200

10. Remarks: Contractor claimed that dimensions of open cut excavation on contract drawings did not permit adequate working space for his equipment. This contention was reviewed and it was found that less work room had been allowed at Dyess than at other squadrons and that the rrom allowed was inadequate.

The modification was not included in the previous CCE.

ATLAS F

DYESS

CHANGES ISSUED (OVER $100,000)

Contract No. DA-41-443-ENG-5878
Modification, Change Order No. 17 (RI-17)
H. B. Zachry Co. & Brown & Root, Inc.

1. Source of Change: COC: 229, 263B, 281B, 288, 336B, 345, 371 and 299. Letter SWDSA-VC-AE, 10 Sep 60, Subject: "Modification Material to Accommodate Standardized Equipment".

2. Date: 10 Sep 60

3. Received by Contracting Officer: 14 Sep 60

4. Presented to Contractor: 15 Sep 60

5. Status of Negotiation: Scheduled for resumption of negotiations upon completion of review of Government Estimate.

6. Notice to Proceed: 15 Sep 60

7. Cost Estimates:

A. Available to CCR/COC - N/A

B. Government Estimate at beginning of negotiations:

Amount - $685,896, 29 Nov 60

Source - Prepared by Area Office

C. Latest estimate of settlement: $1,036,560.00

D. Contractor's Initial Proposal and Date: $723,478.58, 9 Dec 60

8. Remarks: The work consists of changes with respect to updating drawings and specifications to reflect current vendor print information affecting facility piping, electrical wiring, H.V. & A.C. duct work, structural steel and equipment location. An acceleration cost of $50,000 was included for ductwork. The change was required to be done within the established completion schedules. Tentative agreement was reached 3 Feb 61 on an adjustment of $653,711.78; however, the contractor has submitted a proposal on 31 July 61 for an adjustment of $1,154,197.34 on the

basis of impact of the change. Government Estimate is being revised. The final Government Estimate of 27 November 1961 is $1,038,658. The contractor has verbally on 16 Sep 61 raised his proposal to $1,208,305, but agreed to settle for $1,036,560.

ATLAS F

DYESS

MODIFICATIONS (NEGOTIATED)

1. Source of Modification: COC 419, LR 2387, 9 Sep 60; Message EMCRA-VC-1839, 16 Sep 60; Letter EMCRA-VC-5, 5 Oct 60, Subject: "Unitary Silo (Atlas F) Electromagnetic Pulse Screen"; Letter EMCRA-VC-AB, 29 Oct 60, Subject: "Atlas Silo Squadron, Dyess AF" Contract DA-41-443-eng-5878, Mod. No. 20 (RI-20).

2. Date: COC 419 dated 9 Sep 60

3. Date received by Contracting Officer: 16 Sep 60

4. Date presented to Contractor: 22 Sep 60 (preliminary); 5 Nov 60 (Final)

5. Date negotiation completed: 16 Jan 61

6. Date Notice to Proceed: 22 Sep 60

7. Cost Estimates:

A. Available to COC 419 - $400 per silo - $4,800

B. Government Estimate at beginning of negotiations:

Amount - $36,924 (Bechtel Estimate $37,200)

Source - Prepared by Area Office

C. Contractor's Initial Proposal and Date - $180,637, 9 Dec 60

8. Negotiated Amount: $101,400

9. Remarks: The work included provision of a continuous electromagnetic pulse screen by utilizing concrete reinforcement steel as presently designed in silo walls, vestibule, tunnel and opp, and by increasing the number of grounding straps at each of the two flexible tunnel connections, and from silo opp to silo overhead door and from door leaf to door leaf. The changed work was required to be accomplished within the established completion schedule and applied to all 12 sites, with the exception that at sites 2, 3, and 11 the changes applied only above elevation 945.0 feet. No acceleration as such was

authorized. The original authorization was issued on the basis of preliminary instructions, revised by a preliminary drawing and finalized on the basis of Drawing No. AFBMD-1-8-45. The final Government Estimate of cost of $106,764 was higher than the original estimate because of the added grounding work at the launching doors included in the final drawing. This modification was included in the previous CCK in the amount of $101,400.

ATLAS F

DIESS

CHANGES ISSUED (OVER $100,000)

Contract No. DA-41-143-ENG-5878
Modification No. 37 (U-1 and U-2) (RI-37)
H. B. Zachry Co. & Brown & Root, Inc.

1. Source of Change: COC: 456B, 465A, 465C and 505. Letters, ENEMA-AB-1 dated 16 Nov 60 and 30 Nov 60 implementing findings of COC.

2. Date: U-1, 16 Nov 60; U-2, 30 Nov 60

3. Received by Contracting Officer: U-1, 21 Nov 60; U-2, 1 Dec 60

4. Presented to Contractor: U-1, 22 Nov 60; U-2, 2 Dec 60

5. Status of Negotiation: Scheduled for resumption of negotiations upon completion of review of Government Estimate.

6. Notice to proceed: 2 Nov 60

7. Cost Estimates:

A. Available to CEN/COC - $24,000 (No estimate for COC 505)

B. Government Estimate at beginning of negotiations:

Amount - $76,104, 20 Mar 61

Source - Prepared by Area Office

C. Latest estimate of settlement: $108,108.00

D. Contractor's Initial Proposal and Date: $74,533.24, dated 23 Jan 61

8. Remarks: The work included in the change consists of modifications to facility piping, 6th level floor sink, pipe and duct hangers in the silo. No acceleration as such was authorized; however, the notice to proceed letter dated 22 Nov 60 does not mention a time adjustment. The final settlement is higher than the original proposal because of consideration of additional cost factors, such as, congestion of work areas, reduced efficiency of labor, etc. Final Government Estimate is $109,368.00. The

contractor has submitted a revised proposal on 1 Aug 61 for an amount of $159,843, but agreed to settle for $108,108.

ATLAS F

DYESS

MODIFICATIONS (NEGOTIATED)

Contract No. DA-41-443-ENG-5878
Modification No. 49 (U-4)
H. B. Zachry Co. & Brown and Root, Inc.

1. Source of Modification: COC 505, LR 2458, 23 Nov 60; COC 527, letter 2462, 15 Dec 60; letter ENEMA-AB-1, 28 Dec 60, Subject: "Missile Launch Complexes, Contract 5878, Dyess AFB".

2. Date: COC 505 dated 23 Nov 60

3. Date Received by Contracting Officer:

4. Date Presented to Contractor: 5 Jan 61

5. Date Negotiation Completed: 13 Dec 61

6. Date Notice to Proceed: 5 Jan 61

7. Cost Estimates:

A. Available to COC 505 - not available; COC 527 - no cost

B. Government Estimate at beginning of negotiations:

Amount - $31,620

Source - Prepared by Area Office

C. Contractor's Initial Proposal and Date: $134,558.52, 15 Mar 61

8. Negotiated Amount: $109,514

9. Remarks: The work included correction of pipe and duct hanger details involving revision of dimensions, additions to hanger schedules, new details to support facility piping, addition of damper VD-21 and revisions of SW-3" and UW-1½" to DC-20 and DC-21 to agree with vendor furnished equipment connections. The changed work was authorized on the basis that a time extension, if applicable, would be negotiated and applied to all 12 sites. No acceleration as such was authorized. The final Government

Estimate of Cost of $109,524 was higher than the original estimate because of increased labor costs based on more experience, allowance for equipment not previously included, addition of damper VD-21, and miscellaneous additional costs for scaffolding, welding operations, etc.

ATLAS F

ATLAS

CHANGES ISSUED (OVER $100,000)

Contract No. DA-41-443-ENG-5878
Modification No. 66 (MI-74)
H. B. Zachry Co. & Brown & Root, Inc.

1. Source of Change: COC 564B, letter [illegible]-AB-1 dated 11 Mar 61

2. Date: 19 Jun 61

3. Received by Contracting Officer: 8 Mar 61

4. Presented to Contractor: 9 Mar 61

5. Status of Negotiations: Scheduled for resumption of negotiations upon completion of review of Government Estimate.

6. Notice to Proceed: 9 Mar 61

7. Cost Estimates:

A. Available to CCR/COC - $52,000

B. Government Estimate at beginning of negotiations:

Amount - $64,502

Source - Prepared by Area Office

C. Latest estimate of settlement: $135,837

D. Contractor's Initial Proposal and Date: $513,172, dated 25 Apr 61

8. Remarks: The work included in this change consists of modification of LCC's to provide ten coil unit and chilled water pump and connecting facilities at all sites with additional structural changes at Site 2 only. No acceleration was authorized. The final settlement is higher than the original proposal because of consideration of additional cost factors, such as, congestion of work areas, reduced efficiency of labor, etc. Final Government estimate is $135,837.00. The contractor has submitted a revised proposal on 27 Jul 61 for an amount of $383,695, but agreed to settle for $135,837.

ATLAS F

BYESS

MODIFICATIONS (NEGOTIATED)

Contract No. DA-41-443-ENG-5878
Modification No. 71
H. B. Zachry Co. & Brown & Root, Inc.

1. Source of Modification: COC 588, 16 Feb 61; Letter ENGMA-AB-1, 16 Mar 61, Subject: "Modification to Guide Rail Supports, New Loads on L/F to Crib Locks, and Crib Diagonal Bracing, Byess AFB, Contract 5878".

2. Date: COC dated 16 Feb 61

3. Date Received by Contracting Officer:

4. Date Presented to Contractor: 21 Mar 61

5. Date Negotiation Completed: 13 Dec 61

6. Date Notice to Proceed: 21 Mar 61

7. Cost Estimate:

A. Available to COC 588 - not available

B. Government Estimate at beginning of negotiations:

Amount - $51,612 (Bechtel Estimate $7,440)

Source - Prepared by Area Office

C. Contractor's Initial Proposal and Date: $208,886.28, 2 May 61

8. Negotiated Amount: $138,012

9. Remarks: The work included in the change consists of modification to guide rail supports, provision for new loads on L/F to crib locks and crib diagonal bracing. No acceleration was authorized. The final Government Estimate of Cost of $138,012 was higher than the original estimate because it was found by experience on the work that the labor allowances were much too small and that efficiency of labor was lowered substantially by congestion of work areas.

ATLAS F

DYESS

MODIFICATIONS (NEGOTIATED)

Contract No. DA-41-443-ENG-5878
Modification No. 88
H. B. Zachry Co. & Brown & Root, Inc.

1. Source of Modification: COC 612, 5 Apr 61; Letter ENGMA-AB-1, 16 May 61, Subject: "Modification to Air Washer Dust Collector and Duct Entrance to Blast Closure No. 3, Dyess AFB, Contract 5878".

2. Date: COC 612 dated 5 Apr 61

3. Date Received by Contracting Officer:

4. Date Presented to Contractor: 24 May 61

5. Date Negotiation Completed: 13 Dec 61

6. Date Notice to Proceed: 24 May 61

7. Cost Estimates:

A. Available to COC 612 - $64,800

B. Government Estimate at beginning of negotiations:

Amount - $60,840

Source - Prepared by Area Office

C. Contractor's Initial Proposal and Date: $438,640.20, 1 Aug 61

8. Negotiated Amount: $141,360

9. Remarks: The work included in the change consists of the addition of a volume control damper with modulating motor in duct to blast closure No. 3 and revisions of the air washer dust collector water supply piping. No acceleration was authorized. The final Government Estimate was higher than the original estimate because of inclusion of additional pipe hangers, new quotation on controls, added cost of insulation, added painting, added retesting and general increase in hours of labor due to low efficiency.

ATLAS F

DYESS

CLAIMS SETTLED (OVER $100,000)

1. Contract Number: DA-41-443-ENG-5878

2. Contractor: H. B. Zachry Co. & Brown & Root, Inc. (A Joint Venture)

3. Modification Number: 96

4. Source: Letter dated 4 Jun 61 from contractor inclosing letter dated 30 Dec 60 from Mosher Steel Co., supplier initiated claim. COC 656, 24 May 61, authorized change.

5. Date of Modification: 13 Jun 61

6. Date Received by COR: 7 Jun 61

7. Date Negotiation Completed: 28 Jul 61

8. Contractor's Value of Claim: $215,342

9. Settlement Cost: $208,410

10. Remarks: The claim involved the fact that the connections for the crib steel detailed on the supplemental design drawings were generally larger and heavier than the connections indicated by the contract drawings and specifications. The contract required that the supplemental design drawings should be used as shop drawings by the contractor. Negotiations were delayed until 28 Jul 61 due to contractor's contention that acceleration was somehow involved in the work and because of the need to resolve certain technical features of the modification.

This modification was not included in the previous CCR.

ATLAS F

DYESS

CLAIMS SETTLED (OVER $100,000)

1. Contract Number: DA-41-443-ENG-5878

2. Contractor: H. B. Zachry Co. and Brown & Root, Inc. (A Joint Venture)

3. Modification Number: 104

4. Source: Claim was initiated by contractor's letter dated 10 Feb 61. Issuance of modification was authorized by Director, Atlas F 1st Ind., 14 Jun 61, on Area Letter, 14 Apr 61, Subject: "C-30, Extending Work Areas Around Silos and LCCs, Contract No. 5878".

5. Date of Modification: 28 Jul 61

6. Date Received by COE: 16 Jun 61

7. Date Negotiation Completed: 28 Jul 61

8. Contractor's Value of Claim: $269,604

9. Settlement Cost: $221,800

10. Remarks: Contractor claimed that dimensions of open cut excavation on contract drawings did not permit adequate working space for his equipment. This contention was reviewed and it was found that less work room had been allowed at Dyess than at other squadrons and that the room allowed was inadequate.

The modification was not included in the previous COE.

ATLAS F

DRESS

MODIFICATIONS (NEGOTIATED)

Contract No. DA-41-443-ENG-5878
Modification No. 114
M. M. Zachry Co. & Brown & Root, Inc.

1. Source of Modification: Claims Nos. C-63, C-64, C-66, C-69, C-73, C-76, C-79, C-80, C-81, C-84, C-97, C-99, C-100 and C-106; DD Form 96, 8 Nov 61, Subject: "Outstanding Claims - Contract DA-5878 - Dyess".

2. Date: Claim No. C-63, 14 Jul 61; C-106, 28 Oct 61

3. Date Received by Contracting Officer: 8 Nov 61

4. Date Presented to Contractor: N/A

5. Date Negotiation Completed: 30 Nov 61

6. Date Notice to Proceed: N/A

7. Cost Estimates:

A. Available to COC - N/A

B. Government Estimate at beginning of negotiations:

Amount - $136,525.92

Source - Prepared by Area Office

C. Contractor's Initial Proposal and Date: $225,715.27 (various dates)

8. Negotiated Amount: $135,258.50

9. Remarks: The work includes settlement of 14 contractor's claims for revisions of hangers and supports, bonding and grounding of various items, revision of filter housing, provision of kick-plates, handling of Government property, waterproofing, repair or replacement of facilities, extension of conduits and provision of a vent on a tank. No acceleration was ordered for these operations, and no changes in Government Estimates were required.

ATLAS F

DYESS

MODIFICATIONS (NEGOTIATED)

Contract No. DA-41-443-ENG-5878
Modification No. 115
M. B. Zachry Co. & Brown & Root, Inc.

1. Source of Modification: Claims Nos. C-72, C-82, C-83, C-85, C-86, C-87, C-88, C-89, C-92, C-93, C-94, C-95, C-96, C-98, C-101, C-103 and C-105; ENG Form 96, 17 Nov 61, Subject: "Outstanding Claims - Contract DA-5878 - Dyess".

2. Date: Claim No. C-72, 2 Aug 61; C-105, 27 Oct 61

3. Date Received by Contracting Officer: 8 Nov 61

4. Date Presented to Contractor: N/A

5. Date Negotiation Completed: 30 Nov 61

6. Date Notice to Proceed: N/A

7. Cost Estimates:

A. Available to COC - N/A

B. Government Estimate at beginning of negotiations:

Amount - $267,899.31

Source - Prepared by Area Office

C. Contractor's Initial Proposal and Date: $370,344 (various dates)

8. Negotiated Amount: $287,533

9. Remarks: The work includes settlement of 17 contractor's claims for bonding and grounding of various items, electrical changes, additional validation procedures and resolution of interferences. No acceleration was ordered for these operations and no changes in Government Estimates were required.

ATLAS F

DYESS

MODIFICATIONS (NEGOTIATED)

Contract No. DA-41-443-ENG-5878
Modification No. 117
H. B. Zachry Co. & Brown & Root, Inc.

1. Source of Modification: Claims Nos. C-102, 7 Aug 61; C-109, 23 Oct 61; Conference in Dyess Area Office 3 Nov 61.

2. Date: Claim C-102, 7 Aug 61; C-109, 23 Oct 61

3. Date Received by Contracting Officer: 3 Nov 61

4. Date Presented to Contractor: N/A

5. Date Negotiation Completed:

6. Date Notice to Proceed: N/A

7. Cost Estimates:

A. Available to COC - N/A

B. Government Estimate at beginning of negotiations:

Amount - $2,464,000

Source - Prepared by Area Office

C. Contractor's Initial Proposal and Date: $6,909,375; 7 Aug 61 and 23 Oct 61

8. Negotiated Amount: $2,463,312.49

9. Remarks: The modification includes settlement of 2 contractor's claims for additional operations and equipment required to maintain the work on schedule during periods when no time extensions were approved, and is composed of equipment and labor over and above the requirements of the original contract. The work involves tacit acceleration in that the work was necessary to overcome excusable delays for which time extensions were not timely granted.

PART VII

MAJOR ACCIDENTS

The Dyess Area Office suffered three major accidents resulting in fatalities.

The first major fatality occurred on 9 May 1961. Time of accident was 10:25 AM. Location - Albany Site. On this date Manuel L. Arispe, a laber-helper employed by Pachry-Brown Company fell from the 5th level to the bottom of the silo, a total of 90 feet, to his death. The accident occurred while Arispe was passing a piece of angle iron to a fellow worker, his foot slipped and he fell backwards into the facility elevator shaft opening. The body struck the edge of a beam of the elevator shaft at the 6th level and continued toward the bottom of silo. Dr. Moyle (a local doctor) pronounced Arispe dead and the body was removed from the silo and taken to a local funeral parlor.

RECOMMENDATIONS FOR PREVENTION

1. Enforce the use of safety belts and life lines.
2. Install safety nets in open areas.
3. Proper safety instructions to workers.
4. All crews be provided with individual properly versed First Aid Procedures.
5. Positive communications system between silo and contractors office.

The second fatality occurred on 16 May 1961. Time of accident was 20:30 hours. Location - Oplin Site. On this date and time Mr. B. W. Ragsdale, Electrical Foreman, employed by Zachry-Brown Company was working on the essential motor control center in the silo and came in contact with a 480 volt hot bus bar. Results fatal. Mr. Ragsdale was pronounced dead on arrival at the Hendricks Memorial Hospital, Abilene, Texas by Dr. Cunrya. Death was caused by electrocution.

RECOMMENDATIONS FOR PREVENTION

1. Frequently caution employees about hazards of live electrical equipment and wires.

2. Employees not permitted to work on live unguarded electrical equipment.

3. The use of proper protective gear and extreme caution be exercised at all times.

The third fatality occurred on 26 July 1961 at 09:00 hours. Location - Anson Site. Mr. Robert A. Harralson, pipefitter employed by Paul Hoffman, Inc. The accident occurred while the deceased was working on FLS system piping on Level No. 7. The deceased was working off of a scaffold over-hanging the missile opening and fell to silo floor, a total of 61 feet. Since no one saw the deceased fall, the cause of falling can only be surmised from available information. The most logical conclusions are either that he became dizzy from lack of oxygen or was struck on the head by a small metal object and

them fell into the missile opening and down to the silo floor.

RECOMMENDATIONS FOR PREVENTION

1. The wearing of safety belts and life lines made mandatory.

2. The use of proper scaffolding.

JANUARY THRU NOVEMBER 1961 - DYESS

Personnel Injury Accidents

Total Manhours worked	2,342,845
Non-Disabling Injuries	411
Disabling Injuries	33
Fatalities	3
Time Lost Days	18,996
Frequency Rate (Number of disabling injuries/ 1,000,000 manhours)	14.09
Severity Rate	8.11

Army Motor Vehicle Accident Summary

Dyess Area	
Total Miles Driven	1,235,876
Number of Accidents	2
Frequency Rate (Number accidents/10,000 miles)	0.16
Army Costs	$ 850.00
Other Costs	$ 500.00
Property Damage	$ 1,625.00
Fire Loss	0

In order to eliminate one extremely hazardous condition common to all sites, a contract modification was issued to the construction contractor to enlarge the size of the open cut. The size of the open cut at the bottom was extended from a radius of 45 feet to 63 feet at the silo end and from 25 feet to 33 feet at the LCC end. This increased the amount of the excavation at each site by approximately 28,000 cubic yards but did permit heavy equipment to operate in a safer manner than would have been possible in the very limited space originally proposed.

PART VIII

VISITS BY VIP'S

As is normal for an office monitoring construction contracts of the scope and complexity of the contracts administered by this office, a large number of VIP's visited here for reasons varying from routine inspection to ceremonial visits for construction turnover.

The first Inspector General inspection was conducted by Lt. Colonel Eugene Morath, Jr. on the 15 and 16 February 1961. A rating of excellent was awarded this office by Colonel Morath and his comments on the various activities of the office were duly noted and augmented.

On 20 June 1961 Colonel Spencer arrived and represented the Commander of CEBMCO in the ceremonies conducted in the acceptance of the first site (Oplin No. 11).[41]

General Garrity, Commander AFBMD, General Walling, Commander CEBMCO, Colonel Hays of CEBMCO, and Colonel Wilson, Contracting Officer, were present for the acceptance ceremonies of the final site on 3 November 1961.[42] General Garrity awarded Colonel A. M. Antonelli, Area Engineer, the Air Force Commendation Medal [43] and Mr. H. R. Zachry, Representing H. R. Zachry Company and Brown and Root, Inc., the Commander's Award [44] in ceremonies

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41. See DOC 17.
42. See photo 51.
43. See photo 53.
44. See photo 54.

following the acceptance by the Air Force of the final site.[45]

Colonel C. F. Mitchim made the second I.G. inspection performed at this office on 20 November 1961. A rating of Superior was awarded to this office in Colonel Mitchim's report.

A list of VIP visits with dates and purpose is presented in the appendix.[46]

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45. See photo 12.
46. See appendix I.

APPENDIX I

DATE	NAME	ORGANIZATION	PURPOSE
6/15/60	Marriage	Ft Worth D.O.	OFF
6/20/60	Geiger	Ft Worth D.O.	Routine Inspection
6/21/60	Littrell	Ft Worth D.O.	Records Admin
6/21/60	Oliver	S.W. Div.	Routine Inspection Field
6/28/60	Miller	L.A. Field Ofc.	Routine Inspection Field
6/28/60	Kocian	S.W. Div.	Routine Inspection Field
6/28/60	Hancock	Bechtel	Shop Drawings
6/28/60	Babb	Ft Worth D.O.	Shop Drawings
6/29/60	Burnett	Ft Worth D.O.	Inspection and Property Check
6/30/60	Boatwright	Ft Worth D.O.	Inspection and Property Check
6/30/60	Brown	Ft Worth D.O.	Inspection and Property Check
6/30/60	Wright	Ft Worth D.O.	Routine Inspection Starting of Const.
6/30/60	Winall	Ft Worth D.O.	Routine Inspection Starting of Const.
7/8/60	Chapman, Major	AFRCE	Routine Inspection
7/14/60	Geiger	Ft Worth D.O.	Inspection of Construction
7/14/60	Goodall	Ft Worth D.O.	Safety Inspection
7/14/60	Boatwright	Ft Worth D.O.	Inspection of Construction

DATE	NAME	ORGANIZATION	PURPOSE
7/15/60	West, Col.	Ft Worth D.O.	Routine Inspection
7/15/60	Hansen	Ft Worth D.O.	Contractors Overhead
7/21/60	Steele	Ft Worth D.O.	Contractors Overhead
7/22/60	Webb	Ft Worth D.O.	Water Supply Investigation
7/25/60	Cary	S.W. Div.	Routine Inspection Concrete
7/29/60	Love	S.W. Div.	Routine Inspection Concrete
7/29/60	Brown	Ft Worth D.O.	Routine Inspection Concrete
7/29/60	Carroll, Col.	Ft Worth D.O.	Routine Inspection Concrete
7/29/60	Williams	LAFO-OCE	Routine Inspection Concrete
8/3/60	West, Col.	Ft Worth D.O.	Routine Inspection Area
8/8/60	Geiger	Ft Worth D.O.	Routine Inspection Construction
8/12/60	Kroeber, Col.	AFRCE	Routine Inspection
8/12/60	Reiff, Col.	S.W. Div Eng	Routine Inspection
8/12/60	Brown	Albuquerque Dist.	Safety Coordination
8/12/60	Clark	Tulsa Dist.	Safety Coordination
8/12/60	Goodall	Ft Worth Dist	Safety Coordination
8/12/60	Elkins	S.W. Div.	Safety Coordination
8/17/60	Arfsten, Col.	Albuquerque Dist.	Orientation Visit

DATE	NAME	ORGANIZATION	PURPOSE
8/17/60	Gay	S.W. Div.	Routine Inspection of Const. Activities
8/26/60	Hansen, Col	Ft Worth Dist.	Contractors OH Costs
9/1/60	Pearce, Lt Col	Ft Worth Dist.	Routine Inspection
9/12/60	Osenkorf	S.W. Div.	Orientation Slip Forms
9/14/60	Gary	Ft Worth Dist.	Labor Relations
9/15/60	Hilleker	Ft Worth Dist.	Labor Relations
9/16/60	Custer	Ft Worth Dist.	Labor Relations
9/17/60	Porter	Altus Area	Orientation Visit Construction Methods
9/17/60	Amstead	Altus Area	Orientation Visit Construction Methods
9/21/60	Hansen	Ft Worth D.O.	Contractors o/h & Change Order Costs
9/21/60	Comito	Ft Worth D.O.	Contractors o/h & Change Order Costs
9/21/60	Geiger	Ft Worth D.O.	Contractors o/h & Change Order Costs
9/21/60	Edgar	Ft Worth D.O.	Contractors o/h & Change Order Costs
9/26/60	Louden	S.W. Div.	Engr Estimate Mod. #17
9/26/60	Beeler	S.W. Div.	Engr Estimate Mod. #17
9/26/60	Hansen	Ft Worth D.O.	Engr Estimate Mod. #17
9/27/60	Bridges	Ft Worth D.O.	Engr Estimate Mod. #17
9/27/60	Cudd	Ft Worth D.O.	Engr Estimate Mod. #17

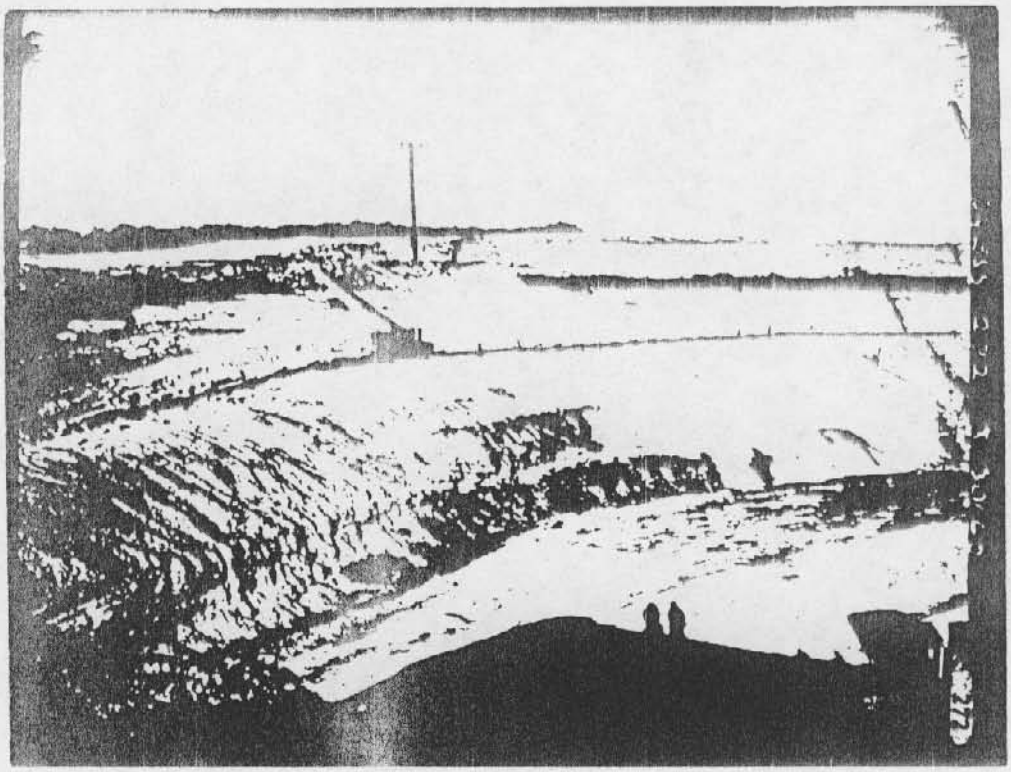
DATE	NAME	ORGANIZATION	PURPOSE
10/4/60	Wright	Ft Worth D.O.	Routine Inspection Construction
10/7/60	Welling, Gen.	CEBMCO	Routine Inspection Progress
10/7/60	Baker, Maj.	CEBMCO	Routine Inspection Progress
10/7/60	West, Col.	Ft Worth D.O.	Routine Inspection Progress
10/7/60	Love	S.W. Div.	Routine Inspection Progress
10/11/60	Webb	Ft Worth D.O.	Change Order - CE Estimate #1
10/11/60	Hansen	Ft Worth D.O.	Change Order - CE Estimate #1
10/11/60	Martins	CEBMCO	Change Order - CE Estimate #1
10/11/60	Chamberlain, Col	CEBMCO	Routine Inspection Hq AF Progress
10/11/60	Koisch, Col.	OCE	Routine Inspection Hq AF Progress
10/11/60	Suter	OCE	Routine Inspection Hq AF Progress
10/11/60	Carroll, Col.	S.W. Div.	Routine Inspection Hq AF Progress
10/11/60	Kelly, Gen.	Hq, USAF	Routine Inspection Hq AF Progress
10/11/60	Kroker, Col.	AFRCE	Routine Inspection Hq AF Progress
10/12/60	Spencer, Col.	CEBMCO	Routine Inspection
10/19/60	Gerrity, Gen.	CEBMCO	Routine Inspection
10/20/60	Kimbly, Col.	Roswell A.O.	Review of Mod. #17 (comparison)

DATE	NAME	ORGANIZATION	PURPOSE
10/20/60	Tippen	Roswell A.O.	Review of Mod. #17 (Comparison)
10/21/60	Byrnes	CERBCO	Routine Inspection Prior to CERBCO Turn over
10/24/60	Kocian	S.W. Div.	Routine Inspection Prior to CERBCO Turn over
10/24/60	Gay	S.W. Div.	Routine Inspection Prior to CERBCO Turn over
10/24/60	Gilpin	S.W. Div.	Routine Inspection Prior to CERBCO Turn over
10/25/60	Steele	Ft Worth D.O.	Pre-CERBCO Transfer Conference
10/25/60	Quay	Ft Worth D.O.	Pre-CERBCO Transfer Conference
10/25/60	Mountz	CERBCO	Pre-CERBCO Transfer Conference
10/25/60	Reynolds	CERBCO	Pre-CERBCO Transfer Conference
10/25/60	Babb	Ft Worth Dist.	Pre-CERBCO Transfer Conference
10/27/60	Lane	CERBCO	Routine Inspection of Construction Progress
11/4/60	West, Col.	Ft Worth Dist.	Routine Inspection of Construction Progress
11/4/60	Smith, Col.	S.W. Div.	Routine Inspection of Construction Progress
11/4/60	Wilson, Col.	CERBCO	Routine Inspection of Construction Progress
11/4/60	Kiltonen	Ft Worth Dist.	Routine Inspection of Construction Progress

DATE	NAME	ORGANIZATION	PURPOSE
11/4/60	Meacham	Ft Worth Dist.	Survey Check
11/4/60	Worland	Ft Worth Dist.	Survey Check
11/7/60	Quick	CERMCO	Mod. #17
11/11/60	Kroeber, Col.	USAF-AFRCE	Routine Inspection
11/15/60	Walling, Gen.	CERMCO	Status of Progress Transfer to CERMCO
11/15/60	Woofter, Lt.	CERMCO	Status of Progress Transfer to CERMCO
11/15/60	West, Col.	Ft Worth Dist.	Status of Progress Transfer to CERMCO
11/15/60	Wright	Ft Worth Dist.	Status of Progress Transfer to CERMCO
11/16/60	Boatwright	Ft Worth Dist.	Routine Inspection
11/16/60	Gates	Ft Worth Dist.	Routine Inspection
11/16/60	Moss	Ft Worth Dist.	Routine Inspection
11/18/60	Kroeber, Col.	AFRCE	Routine Inspection
11/21/60	Pierson, Col.	Ft Worth D.O.	Routine Inspection
11/21/60	Hansell	Ft Worth D.O.	Routine Inspection
12/5/60	Pierson, Col.	Ft Worth D.O.	Routine Inspection
12/8/60	Worland	Ft Worth D.O.	Chief of Engr Inspection of Const Progress
12/8/60	Kilterman	Ft Worth D.O.	Chief of Engr Inspection of Const Progress
12/8/60	Itschner, Gen.	OCE	Chief of Engr Inspection of Const Progress
12/8/60	Fleming, Gen.	S.W. Div.	Chief of Engr Inspection Const Progress

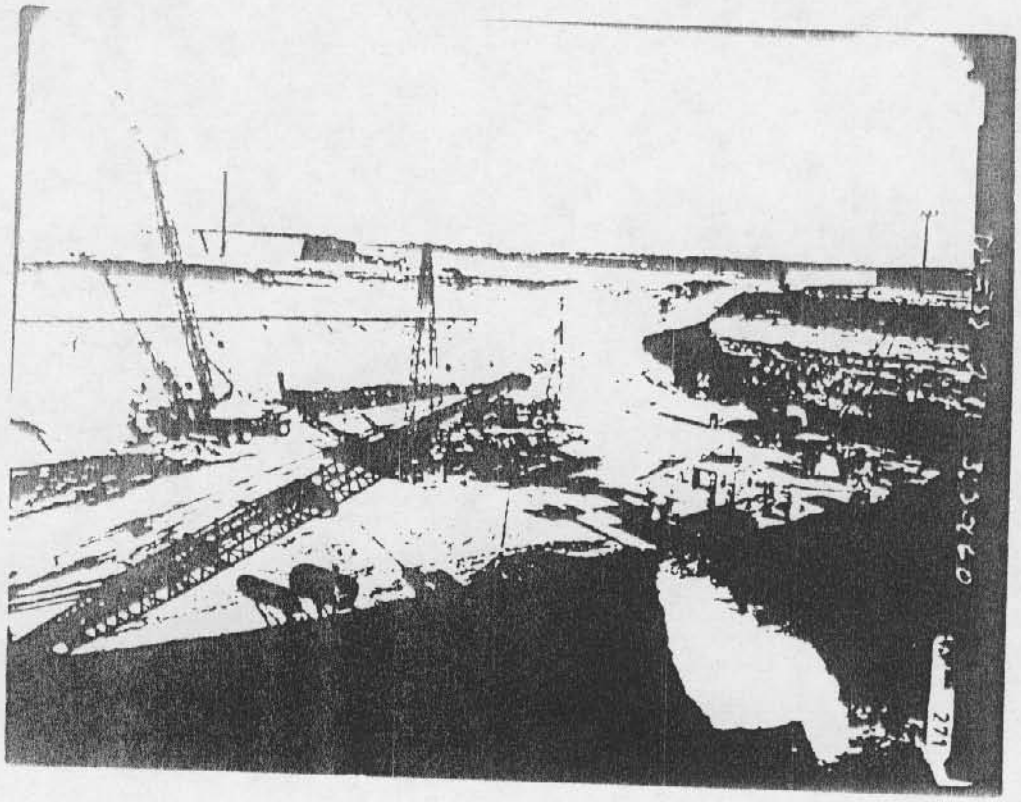
DATE	NAME	ORGANIZATION	PURPOSE
12/8/60	West, Col.	Ft Worth D.O.	Chief of Engr Inspection of Const Progress
12/28/60	Wilson, Col.	CEBMCO	Routine Inspection
1/9/61	Marnage	Ft Worth D.O.	Property Admin.
1/10/61	Kittaman	Ft Worth D.O.	Comm. Line
1/11/61	Rose	CEBMCO	Property Admin.
1/12/61	Robson, Maj.	CEBMCO	Routine Security
1/12/61	Kinerson	CEBMCO	Routine Security
1/12/61	Marks, Capt.	CEBMCO	Routine FLS
1/19/61	Biehn	CEBMCO	Routine
1/19/61	Underwahl	CEBMCO	Routine
1/30/61	Danie	CEBMCO	Routine
1/30/61	Lewis, Maj.	S.W. Div.	Routine Security
2/1/61	Edison	CEBMCO	Safety
2/10/61	Mountz	CEBMCO	FLS Mods
2/10/61	Aaron	CEBMCO	Contract Admin.
2/14/61	Robson	CEBMCO	Prep for EIG Insp.
2/15/61	Morath, Col.	Atlanta EIG	IG Insp. Annual
3/2/61	Robertson	CEBMCO	Audit
3/10/61	Welling, B.G.	CEBMCO	Routine Inspection
3/20/61	Thudum, Col.	OCE	Routine Inspection
3/20/61	Boswell, Col.	Altus	Routine Inspection
4/3/61	Wilson, Col.	CEBMCO	Routine Inspection
4/7/61	Mathom, Maj.	CEBMCO	Routine Inspection

DATE	NAME	ORGANIZATION	PURPOSE
4/20/61	Spencer, Col.	CEBMCO	Routine Inspection
6/19/61	Moore	CEBMCO	OCE Soils Team
6/19/61	Shockley	WES	OCE Soils Team
6/19/61	Mallinger	ORD Labs	OCE Soils Team
6/19/61	Sale	OCE	OCE Soils Team
6/19/61	Roberts	CEBMCO	OCE Soils Team
6/20/61	Spencer, Col.	CEBMCO	Completion First Site Turnover Ceremony
6/23/61	Roberts, Maj.	CEBMCO	IG Complaint Period
7/26/61	Hayes, Col.	CEBMCO	Routine Inspection
7/8/61	Wilson, Col.	CEBMCO	Conference
10/11/61	Gilman	OCE	Status of Project Costs
11/3/61	Garrity, Gen.	AFIRM	Final Acceptance Ceremony
11/3/61	Walling, Gen.	CEBMCO	Final Acceptance Ceremony
11/3/61	Hays, Col.	CEBMCO	Final Acceptance Ceremony
11/3/61	Wilson, Col.	CEBMCO	Final Acceptance Ceremony
11/20/61	Mitchim, Col.	CEBMCO	Annual IG



SITE 8 ANSON

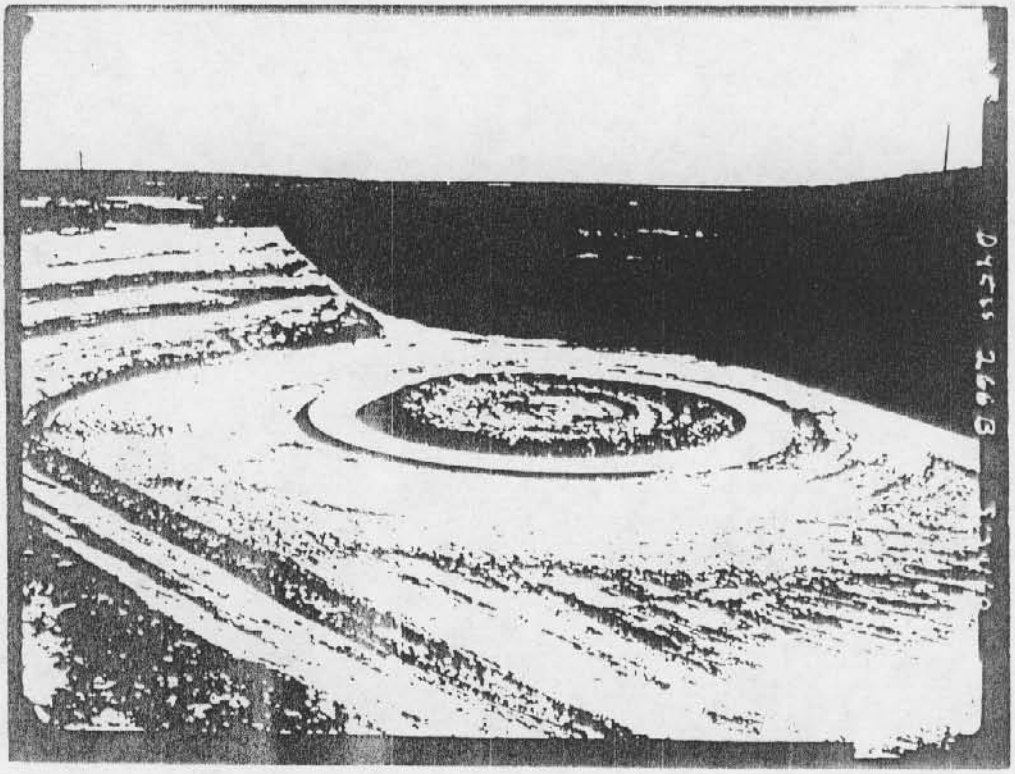
VIEW ANSON SITE WHICH WAS CONSIDERED WET. NOTE WELL POINT SYSTEM INSTALLATION ON THE BENCH OF THE OPEN CUT, AND PARTIALLY EXCAVATED OPEN DRAIN. THIS WELL POINT SYSTEM WAS UTILIZED DURING THE PERIOD OF OPEN CUT AND WAS REMOVED WHEN OPEN DRAINS WERE COMPLETE AT THE TOE OF THE OPEN CUT SLOPES.



SITE 8 ANSON

THIS VIEW OF THE ANSON SITE SHOWS THE INSTALLATION OF A GROUT CURTAIN WALL AROUND THE SILO SHAFT WHICH WAS COMPLETED PRIOR TO START OF SHAFT WORK.

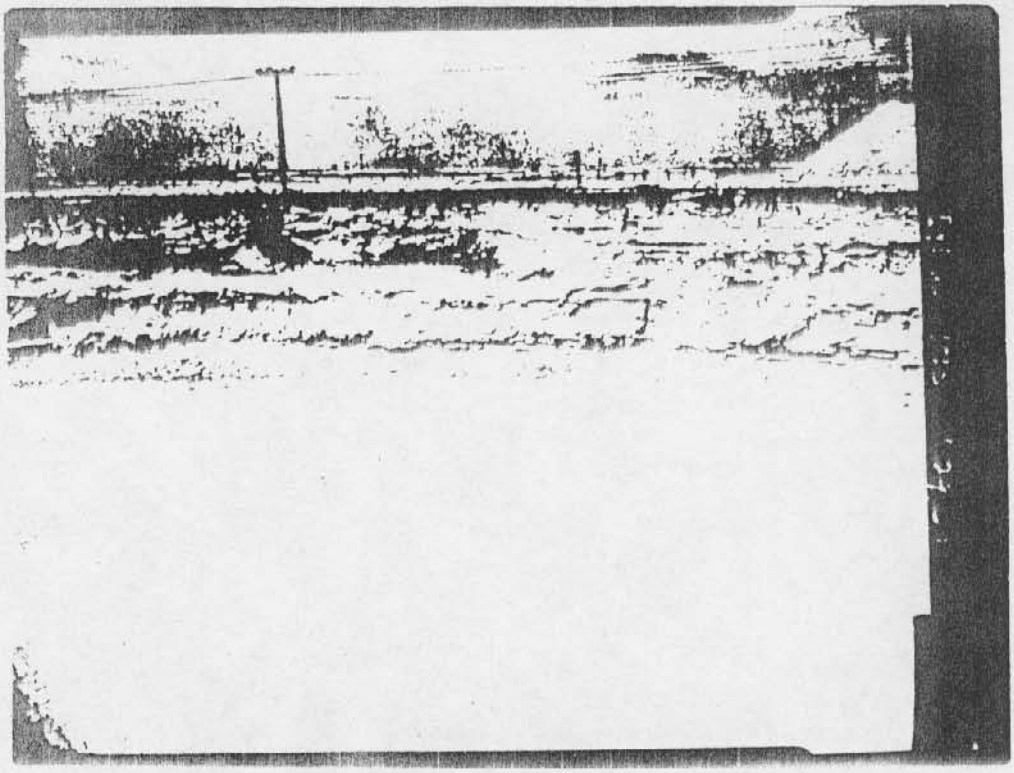
GROUT CURTAIN SEALED OFF THE SHAFT AND PERMITTED APPROX. 59gpm OF WATER DURING THE ENTIRE SHAFTING OPERATION.



OPEN CUT SITE 9 CORINTH WEST

TYPICAL NON-ROCK SITE SHOWING LAYERS OF CLAY, SHALE AND GYPSUM. SLOPE 1 1/2:1 UPPER 15 FEET AND 1:1 BELOW BENCH.

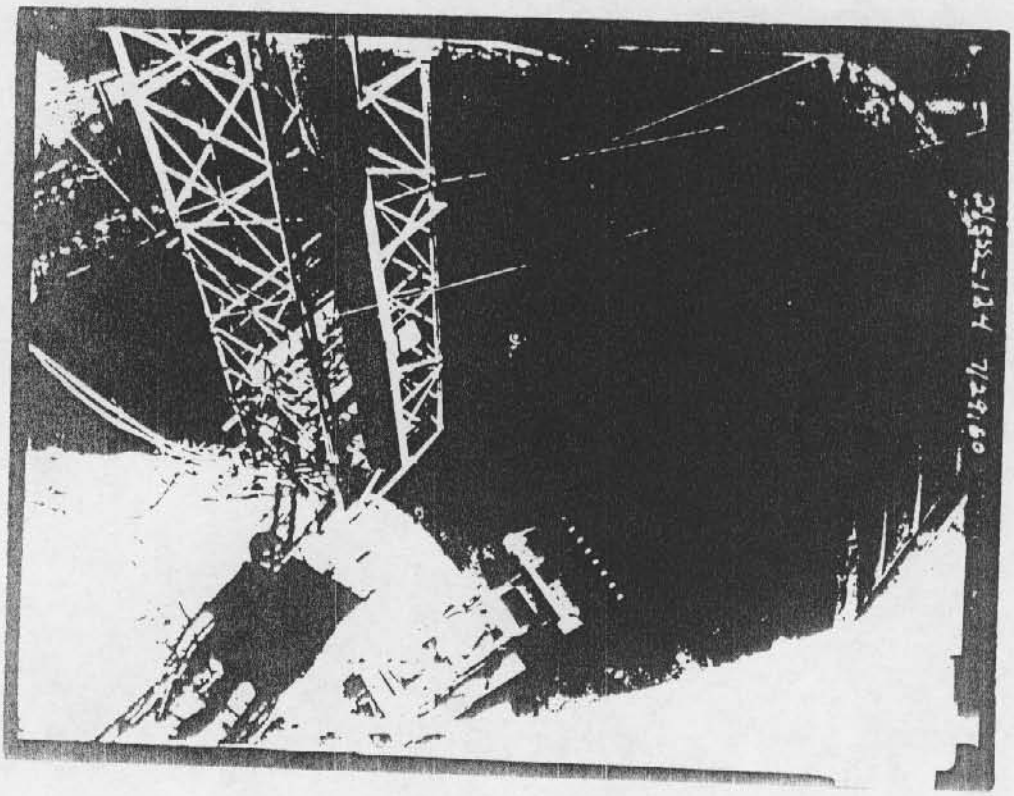
REFERENCE ELEV. OF OPEN CUT 961.5.



OPEN CUT SITE 6 SHEP

TYPICAL ROCK SITE SHOWING LAYERS OF CLAY, SHALE AND STONE. ON ROCK SITES APPROX. 1' OF OVERBURDEN WAS REMOVED, DRILLING AND BLASTING WAS REQUIRED FOR ALL OPEN CUT AREA SLOPE 1/2:1, OPEN CUT REFERENCE ELEV. 961.50.

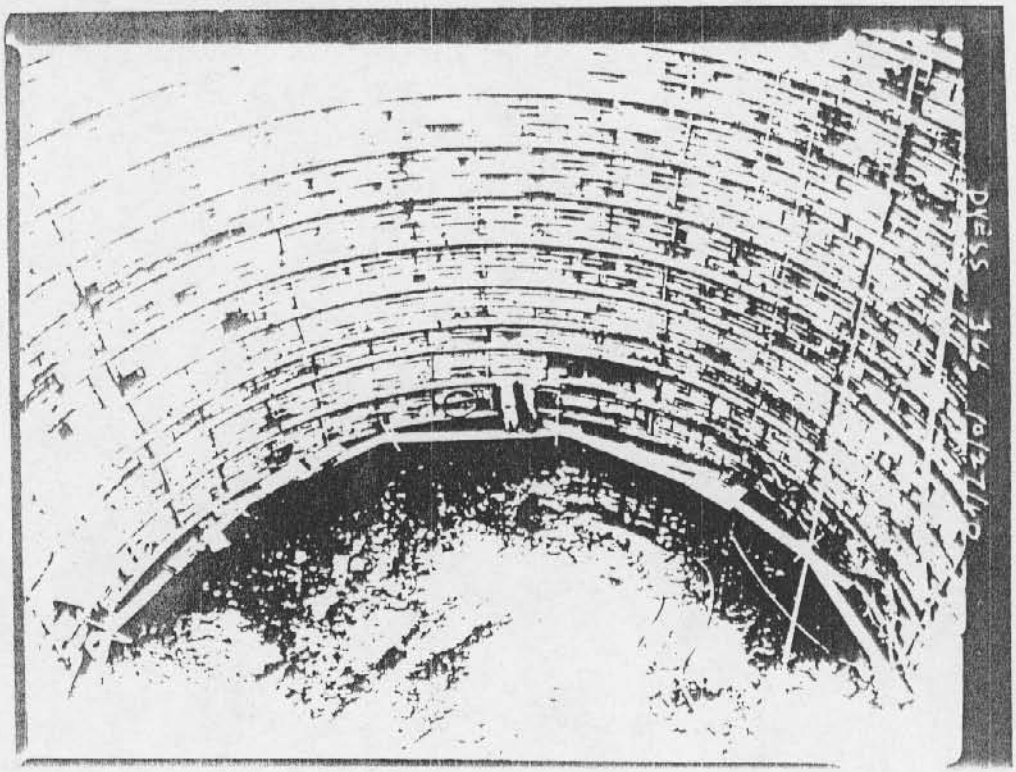
SURVEY STAKES SET FOR COLLAR BEAM AROUND SILO.



SITE 2 BAIRD

MINING OPERATION IN A TYPICAL SILO SHAFT. NOTE PNEUMATIC CONCRETE BETWEEN RING BEAMS AND PERSONNEL ELEVATOR SHAFT WITH AIR SUPPLY LINE ATTACHED. TRACTOR TD-9 EQUIPPED WITH RIPPER ON REAR AND FRONT END LOADER BUCKET.

FREQUENT TESTS WERE MADE TO DETERMINE PURITY OF AIR.

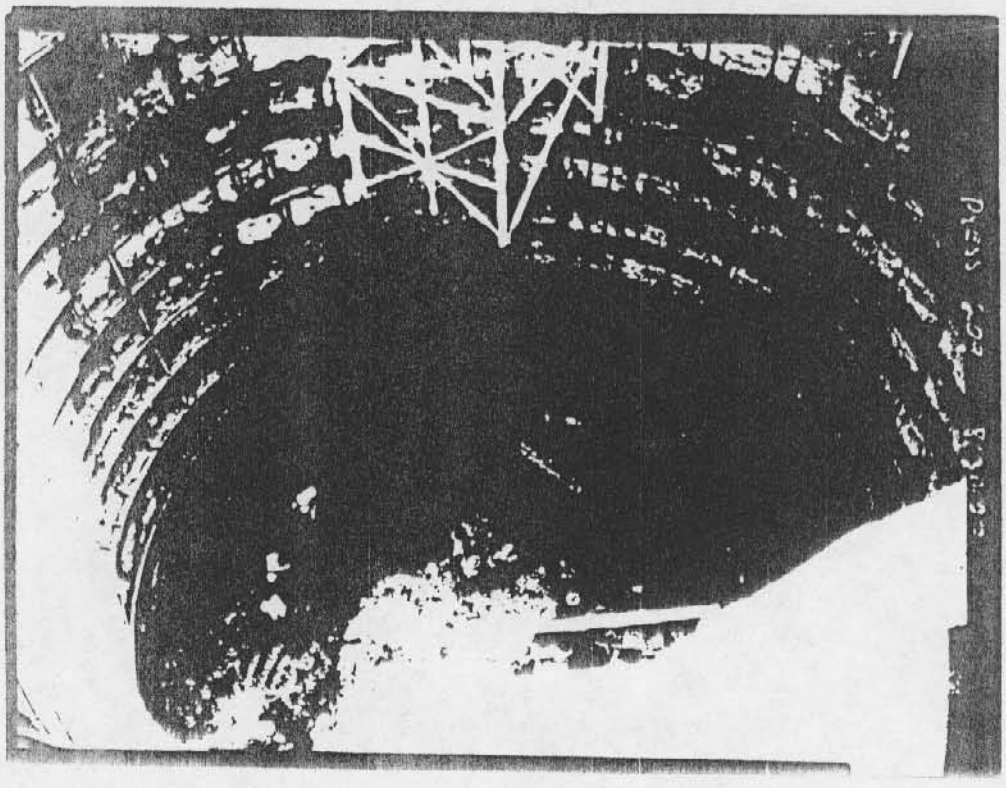


SITE 8 ANSON

A SILO SHAFT DURING THE PROCESS OF EXCAVATION AT A WET SITE.

METAL LINER PLATE INSTALLED IN LIEU OF PNEUMATIC CONCRETE.

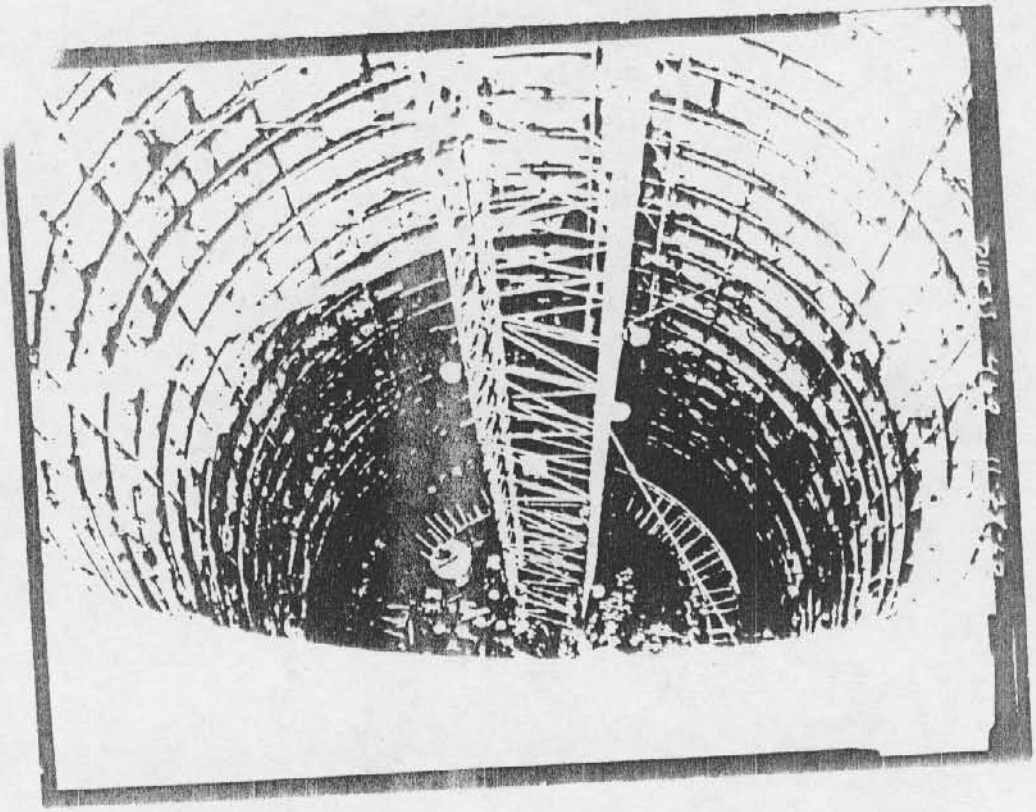
Photo No. 7



SITE 12 WINTERS

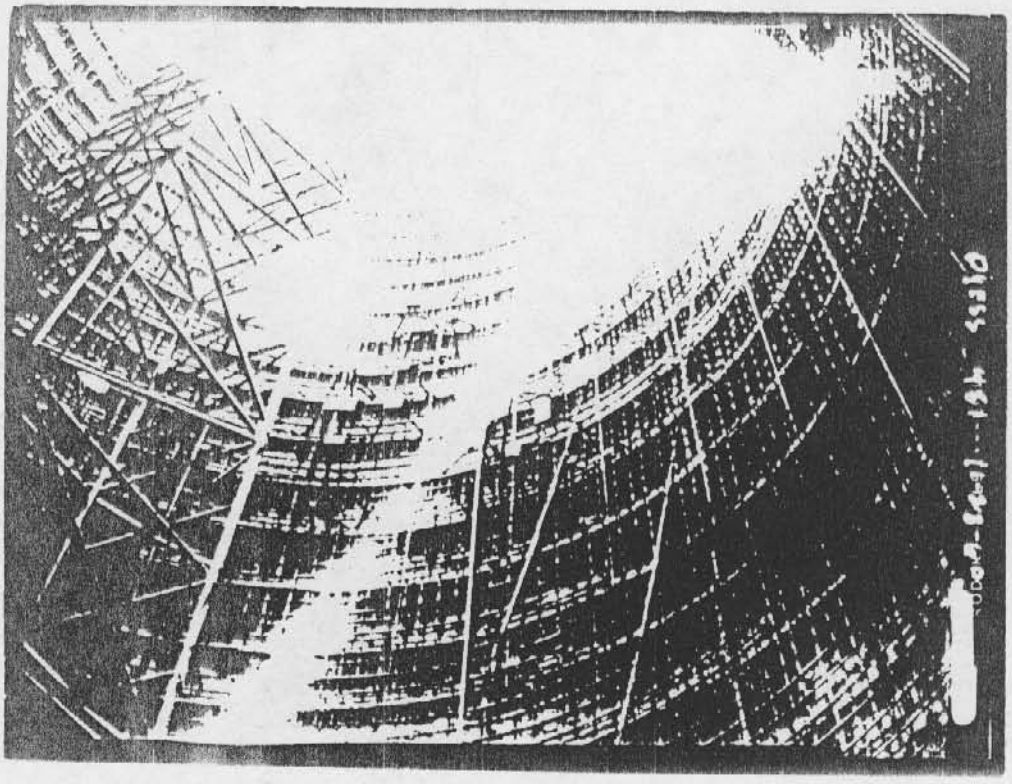
A TYPICAL SILO SHAFT BEING LOADED FOR BLASTING.

IT MAY BE NOTED THAT THE PERSONNEL ELEVATOR FRAME WORK HAS BEEN REMOVED WELL ABOVE THE BLAST AREA TO PREVENT DAMAGE.



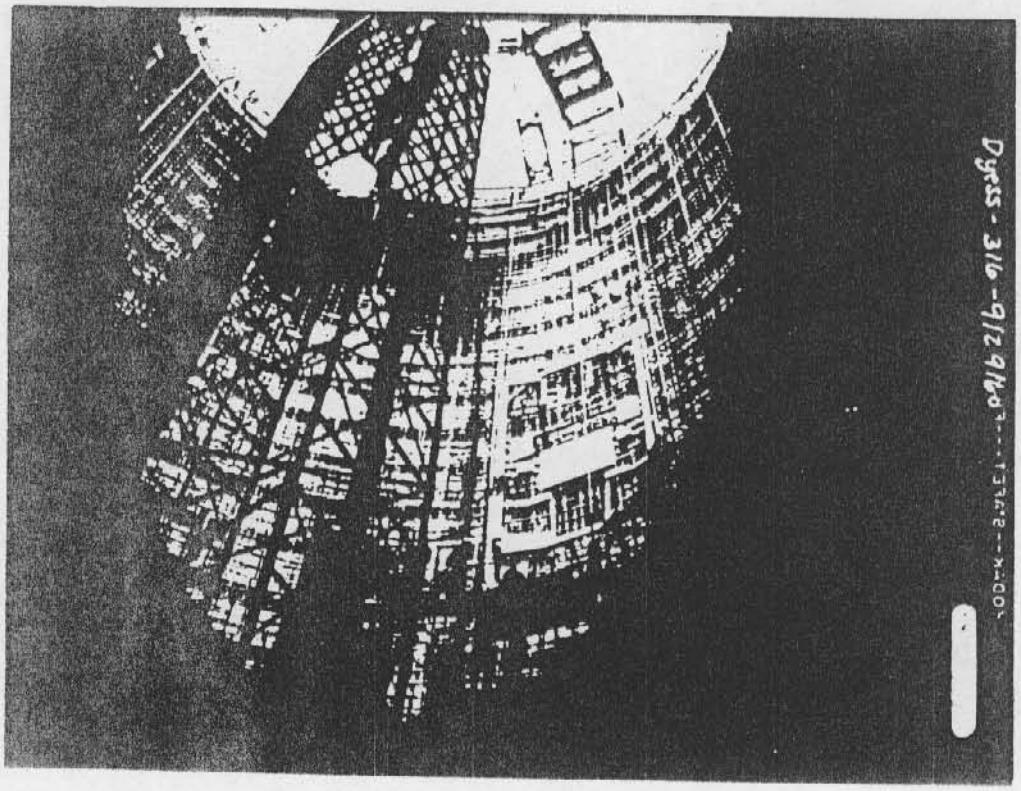
SITE 9 CORINTH WEST

A TYPICAL COMPLETED SILO SHAFT AT THE COMMENCEMENT OF CONCRETE PLACEMENT OF THE FOOTING. FLOOR SLAB (PLACED LATER) IS 6" CONCRETE ON 2'-6" CRUSHED STONE DRAINAGE FILL.



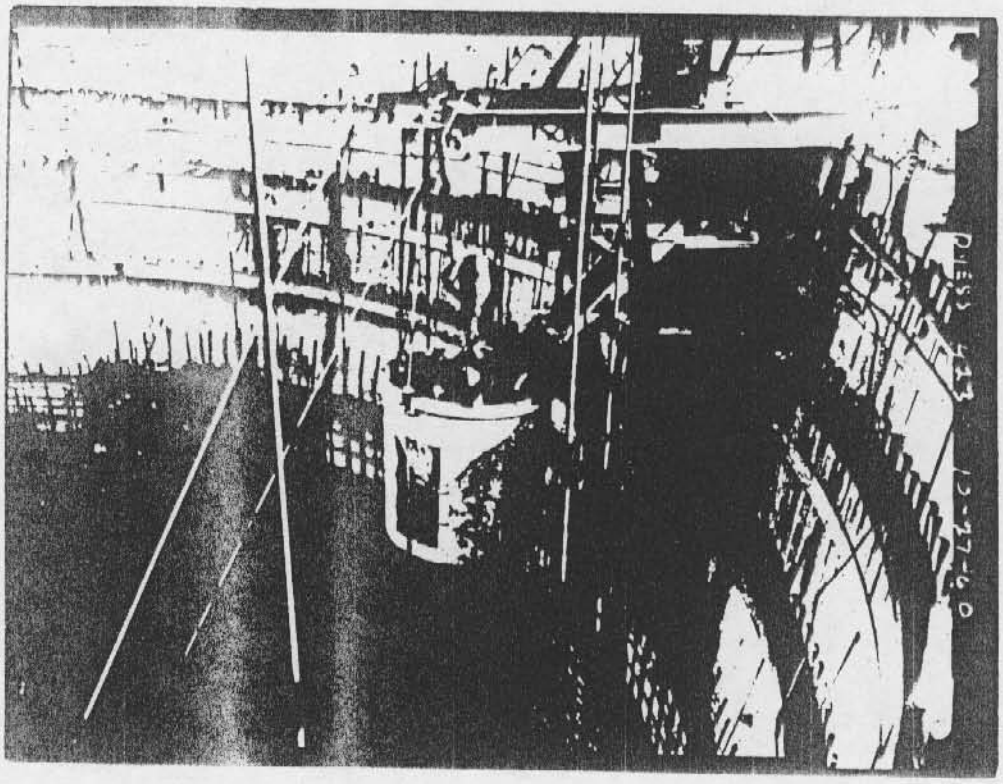
SITE 10 ALBANY

VIEW OF REINFORCING STEEL AND EMBEDDED ITEMS IN THE LOWER PORTION OF THE MISSILE SILO.



SITE 3 DENTON

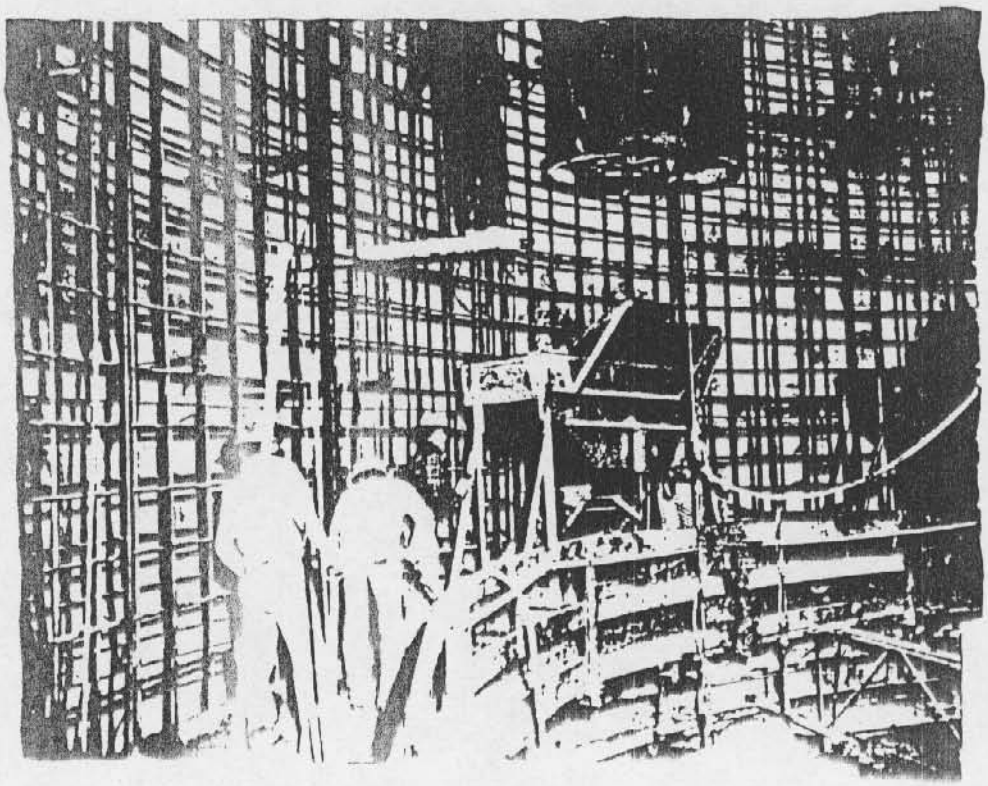
VIEW OF MISSILE SILO REINFORCING STEEL AND THE INSTALLATION OF THE COLLIMATOR PLATE, NOTE THE HIGH BRIDGE WHICH SUPPORTED THE PERSONNEL ELEVATOR.



SITE 12 WINTERS

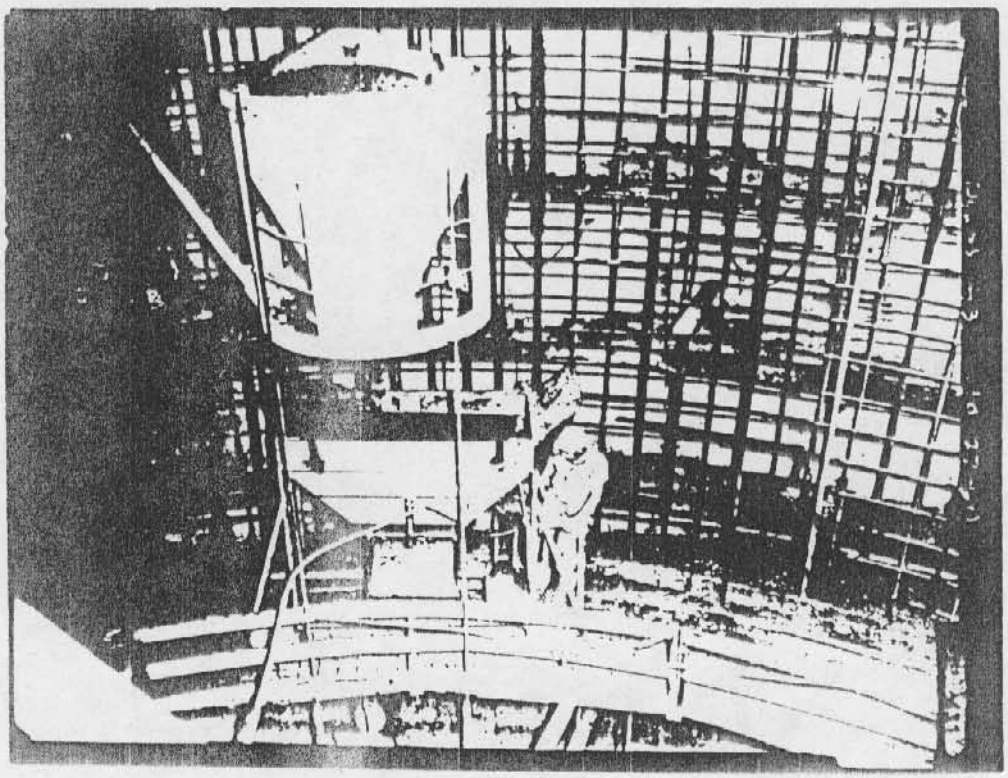
CONCRETE BUCKET BEING FILLED DURING SLIP FORM OPERATIONS. BUCKET CARRIED 2 TONS OF CONCRETE EACH TRIP.

NOTE GUIDE LINES TO WHICH THE BUCKET IS ATTACHED PREVENTING SWAY.



SITE 10 ALBANY

VIEW OF THE START OF SLIP FORM OPERATION. NOTE THE PNEUMATICALLY POWERED BUGGY USED FOR TRANSPORTING CONCRETE AROUND THE SILO WALL. CONCRETE WAS VIBRATED WITH AIR POWERED VIBRATORS.

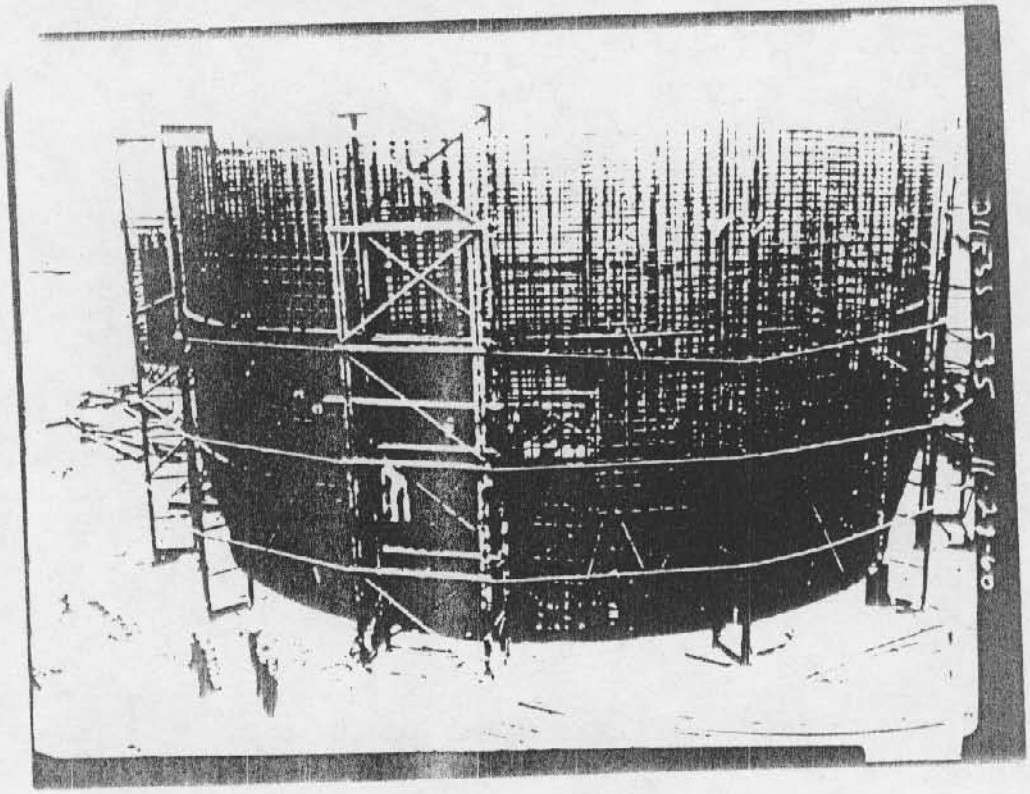


SITE 12 WINTERS

VIEW OF CONCRETE BUCKET BEING UNLOADED INTO HOPPER OF PNEUMATIC BUGGY FOR TRANSPORTING ALONG THE SLIP FORMS.

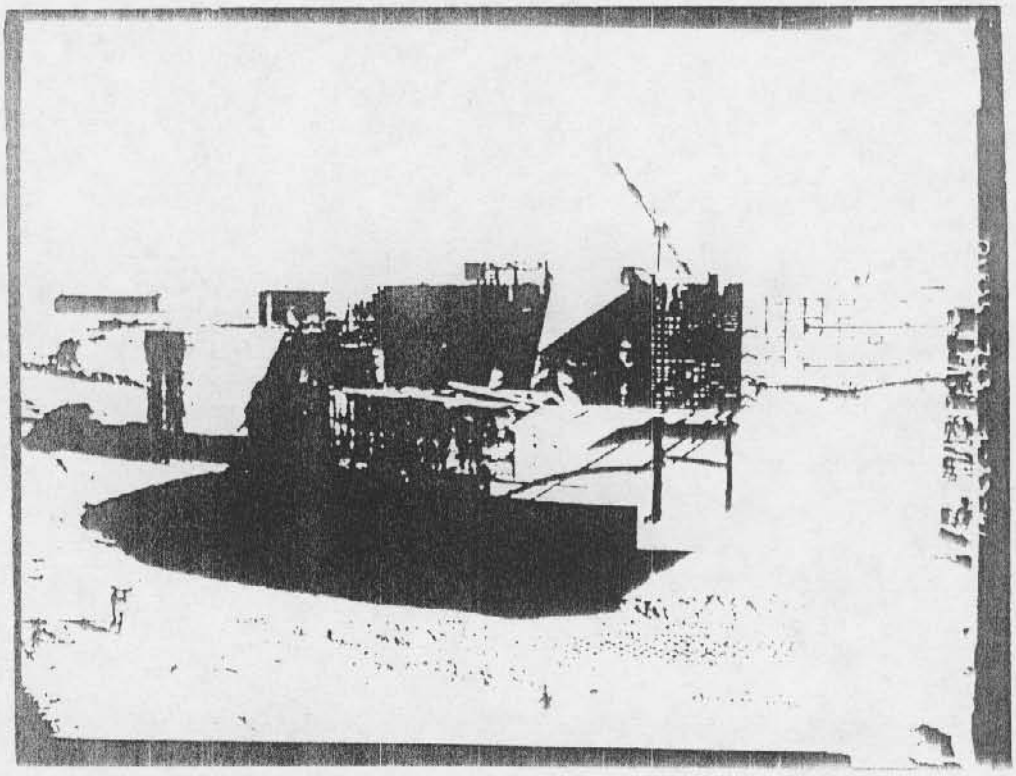
NOTE CONCRETE FINISHER WORKING FROM SWINGING SCAFFOLD BELOW.

SLIP FORM WAS RAISED ABOUT 13 IN. PER HOUR ON THE AVERAGE, 24 HOURS PER DAY.



SITE 7 NOLAN

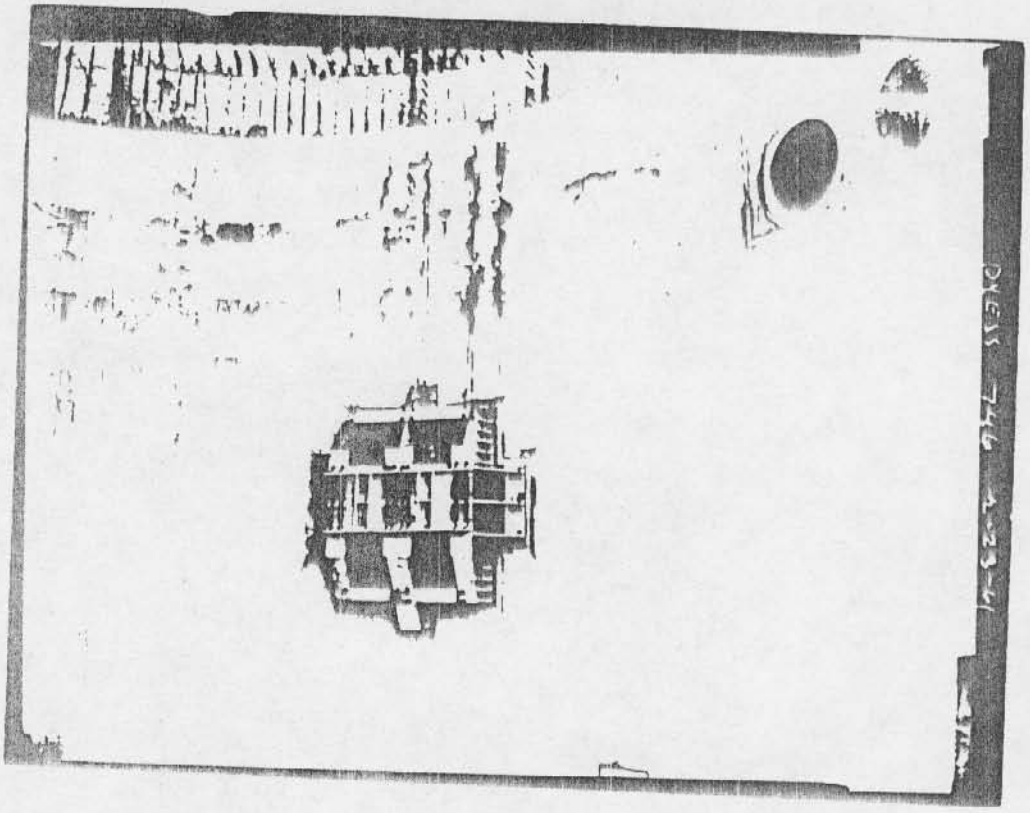
VIEW OF REINFORCING STEEL INSTALLATION IN UPPER PORTION OF SILO. STRUCTURAL STEEL FALSEWORK IS UTILIZED TO SUPPORT CIRCULAR TEMPLATE FOR REINFORCING STEEL INSTALLATION.



SITE 10 ALBANY

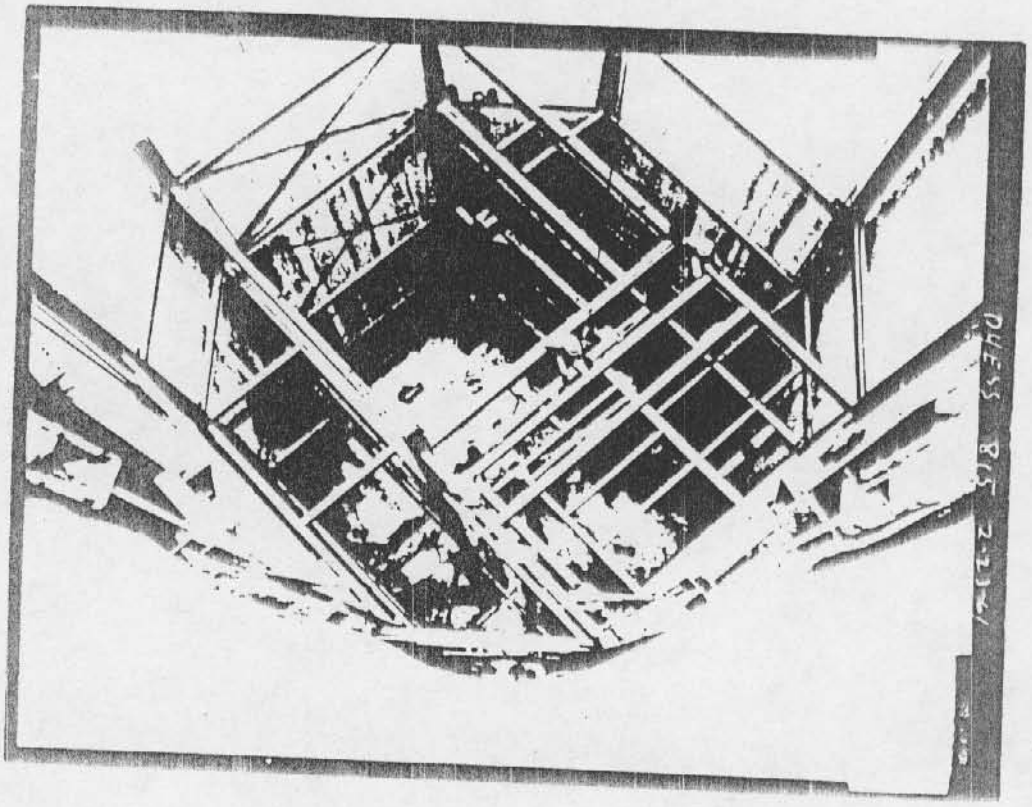
VIEW OF THE UPPER PORTION OF A MISSILE SILO AFTER PARAPET WALL WAS COMPLETED AND PRIOR TO COMPLETION OF BACKFILL.

NOTE THE AIR INTAKE TUNNEL WHICH WAS CONSTRUCTED ON SHORING PRIOR TO BACKFILLING.



SITE 10 ALBANY

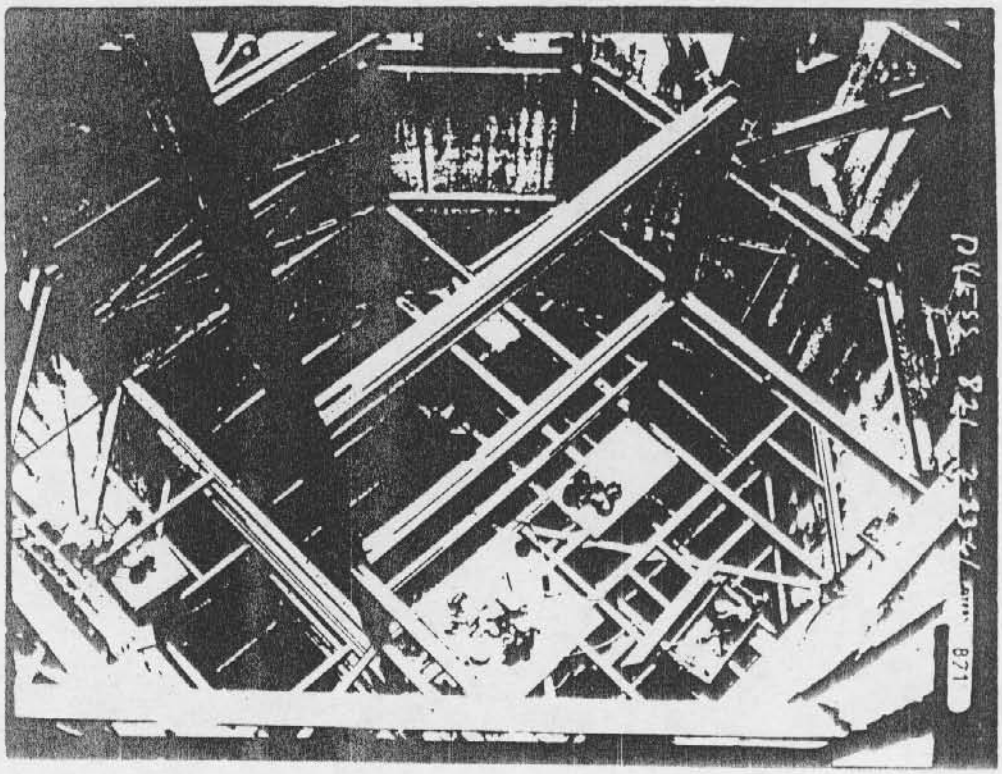
VIEW OF SILO SHOWING SHOCK HANGER BRACKET IN PLACE. OPENINGS FROM THE AIR INTAKE TUNNEL MAY BE SEEN IN THE UPPER RIGHT.



SITE 6 SHEP

INTERIOR VIEW OF SILO SHOWING ERECTION OF STRUCTURAL STEEL WORK. NOTE THE SHOCK HANGER SPRINGS ON FAR LEFT AND FAR RIGHT OF PHOTO.

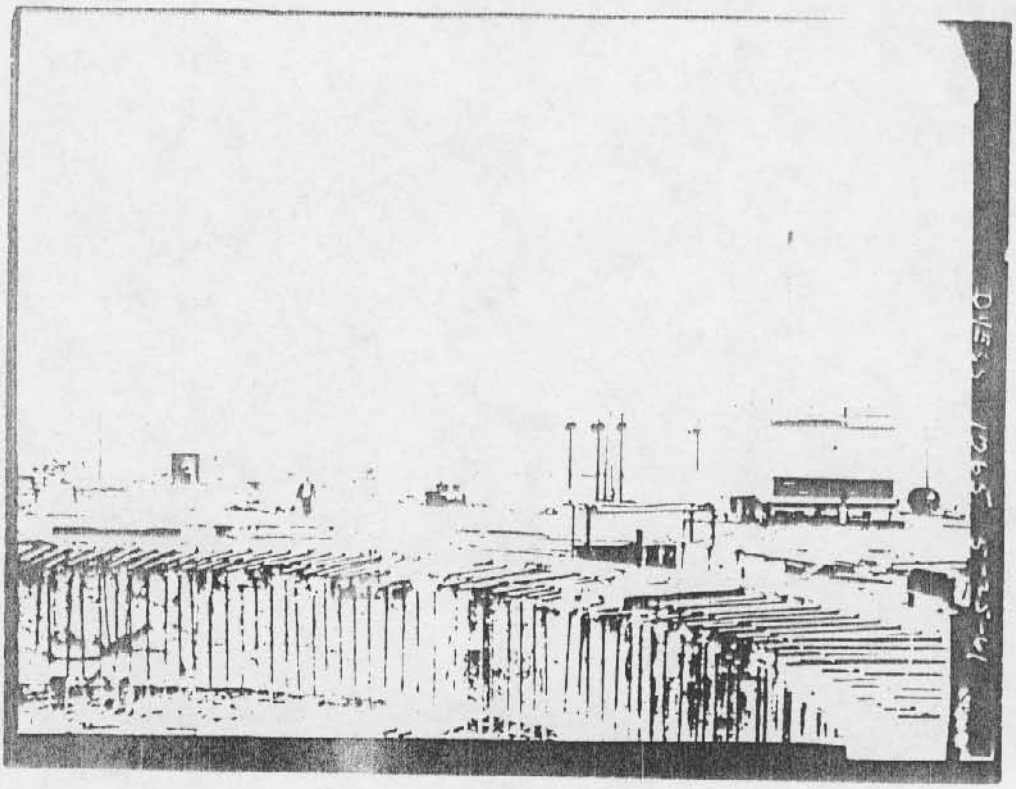
Photo No. 18



SITE 7 NOLAN

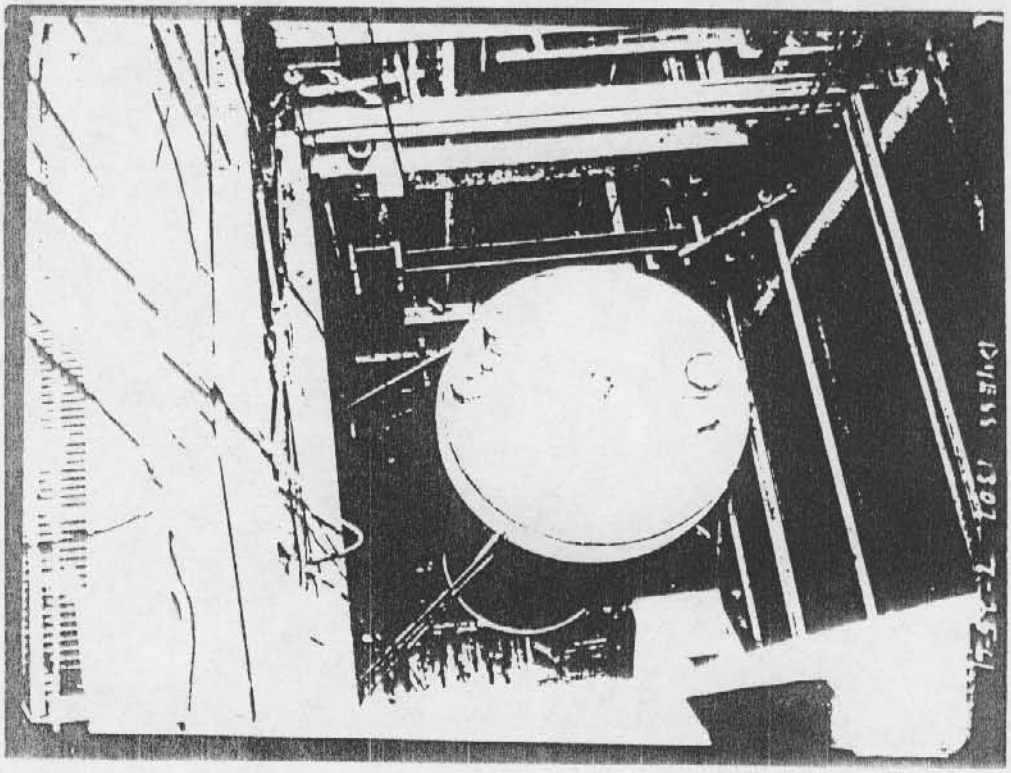
A LATER STEP IN ERECTION OF STRUCTURAL STEEL CRIB. NOTE THE CONNECTION OF SHOCK HANGER SPRINGS TO STRUCTURAL STEEL ON FAR SIDE (ARROW).

AFTER MAJOR STRUCTURAL MEMBERS WERE INSTALLED, STUB COLUMNS WERE REMOVED AND THE ENTIRE STRUCTURE WAS SWUNG FROM THE FOUR SETS OF SPRINGS. ADJUSTMENTS WERE THEN MADE FOR CORRECT HORIZONTAL POSITIONING OF THE CRIB.



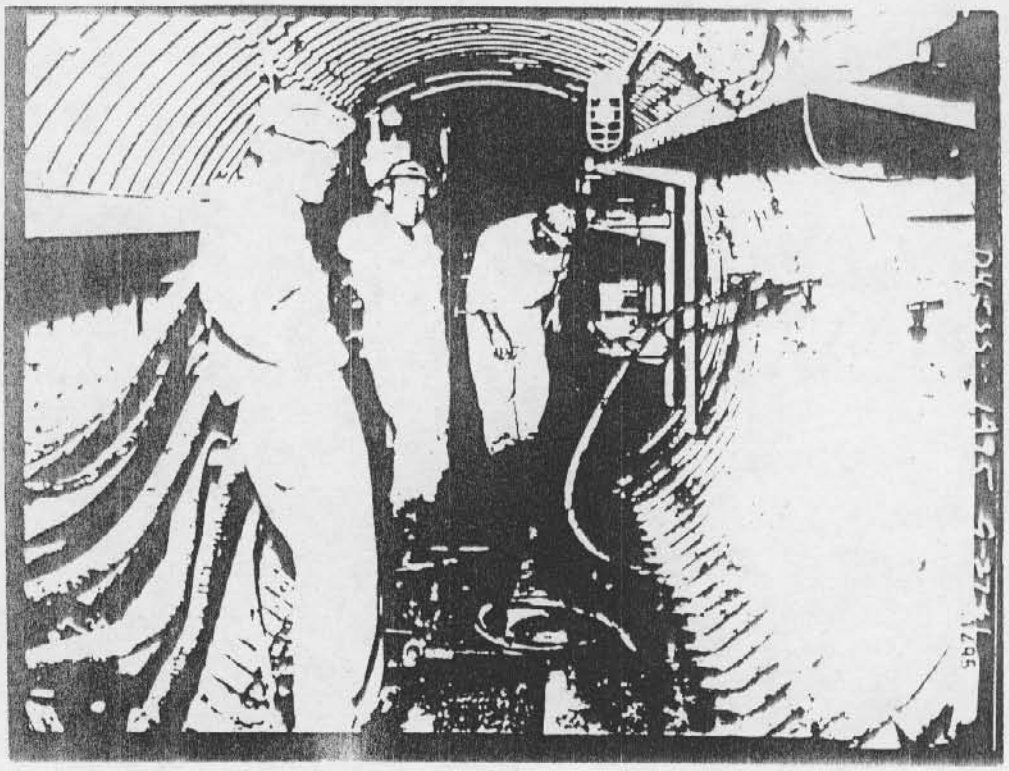
SITE 9 CORINTH WEST

VIEW OF A PARAPET WALL WHICH WAS CONSTRUCTED TO PERMIT ENTIRE BACKFILL TO BE COMPLETED PRIOR TO SETTING CRYOGENIC VESSELS IN THE SILO. THE PILASTERS WHICH ARE SHOWN IN THE CENTER WERE USED LATER FOR SUPPORT OF STEEL FALSE WORK USED IN PLACING CONCRETE FOR SILO CAP.



SITE I PHANTOM LAKE

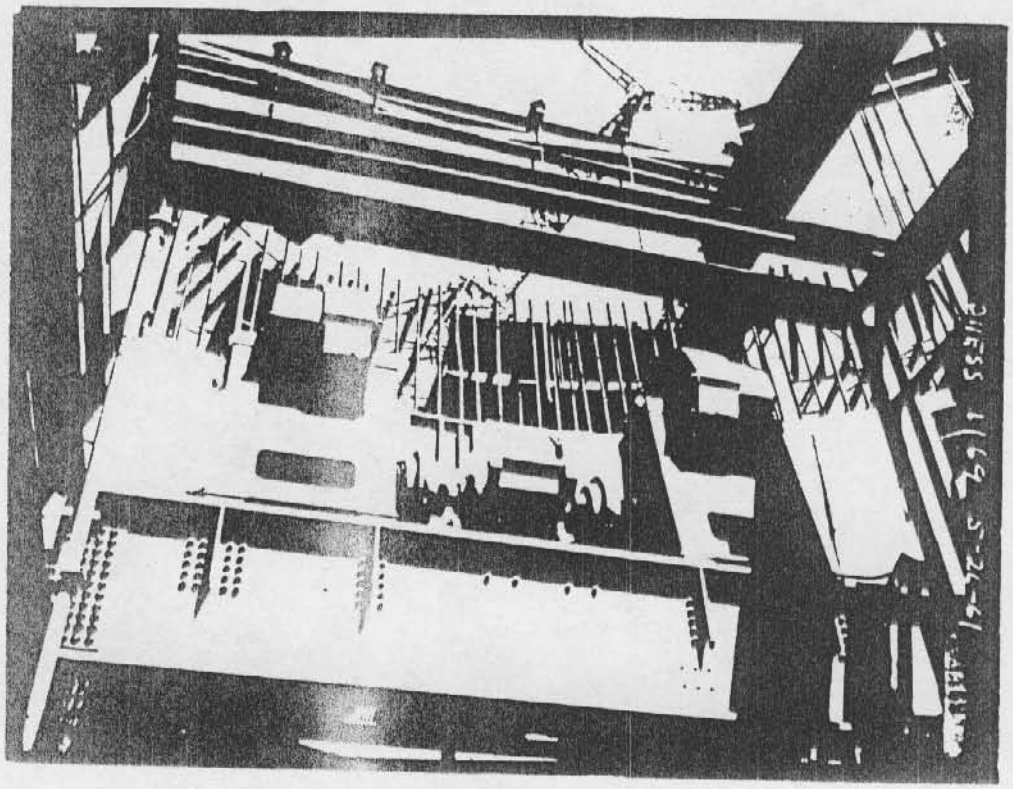
THE CRYOGENIC VESSEL PICTURED HERE IS 45 FEET LONG, 12 FEET IN DIAMETER AND WEIGHS 106,000 POUNDS. IT WAS LOWERED INTO THE SILO BY USE OF TWO 85 TON CRANES AND SET ON STEEL SUPPORTS TO BE ROLLED INTO POSITION ON STEEL ROLLERS VISIBLE BENEATH THE VESSEL.



SITE B ANSON

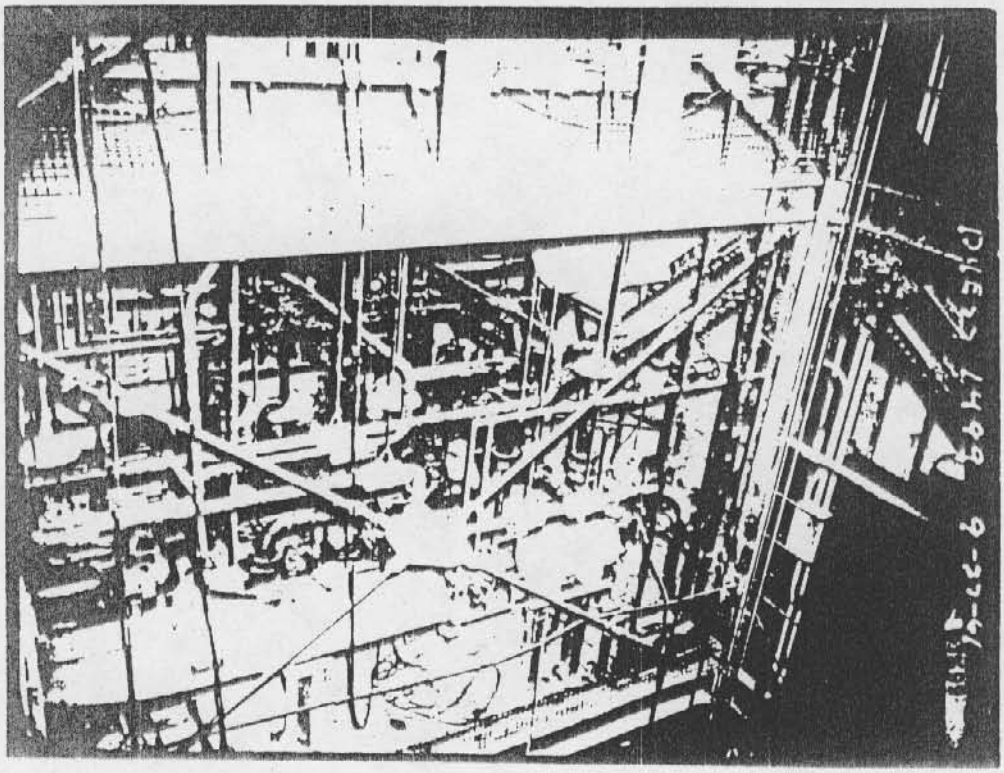
GROUTING OPERATIONS AROUND UTILITY TUNNEL AT THE WET SITE. STRING LINE IN LOWER RIGHT WAS USED TO DETECT ANY MOVEMENT OF THE TUNNEL. SEVEN ROWS OF FIVE GROUT HOLES EACH WERE DRILLED AND TAPPED SO 3/4" PIPE NIPPLES COULD BE THREADED IN AND GROUT PUMPED UNDER 20psi. GROUT MATERIAL USED WAS A SOLUTION OF HYDRO-LOX GEL "PWG" AND AMMONIUM SULPHATE CRYSTALS, AS MARKETED BY HALLIBURTON PR. GROUTING CO. NOTE FLEXIBLE WATER LINES ON LEFT.

Photo No. 22



SITE 7 NOLAN

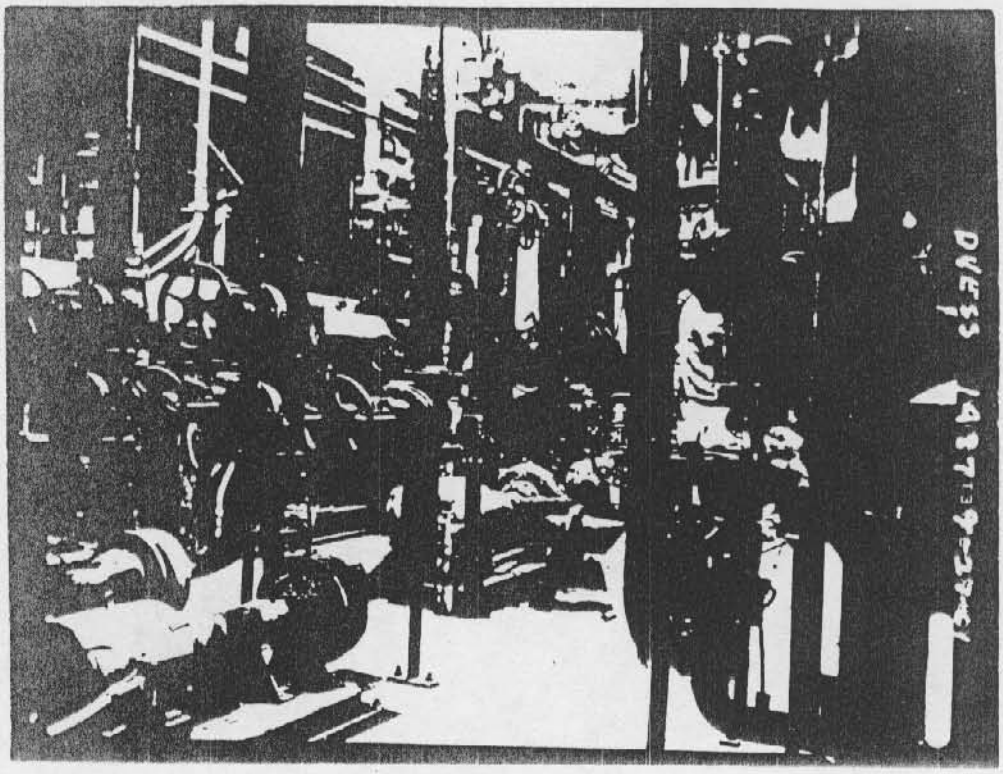
DRIVE BASE ASSEMBLY FOR MISSILE PLATFORM IN PLACE. STEEL BEAMS ABOVE WERE BEING SET TO SUPPORT FORMS FOR SILO CAP POUR.



SITE 8 ANSON

VIEW OF THE MECHANICAL PIPING BEING INSTALLED ON LEVEL 4 OF SILO.

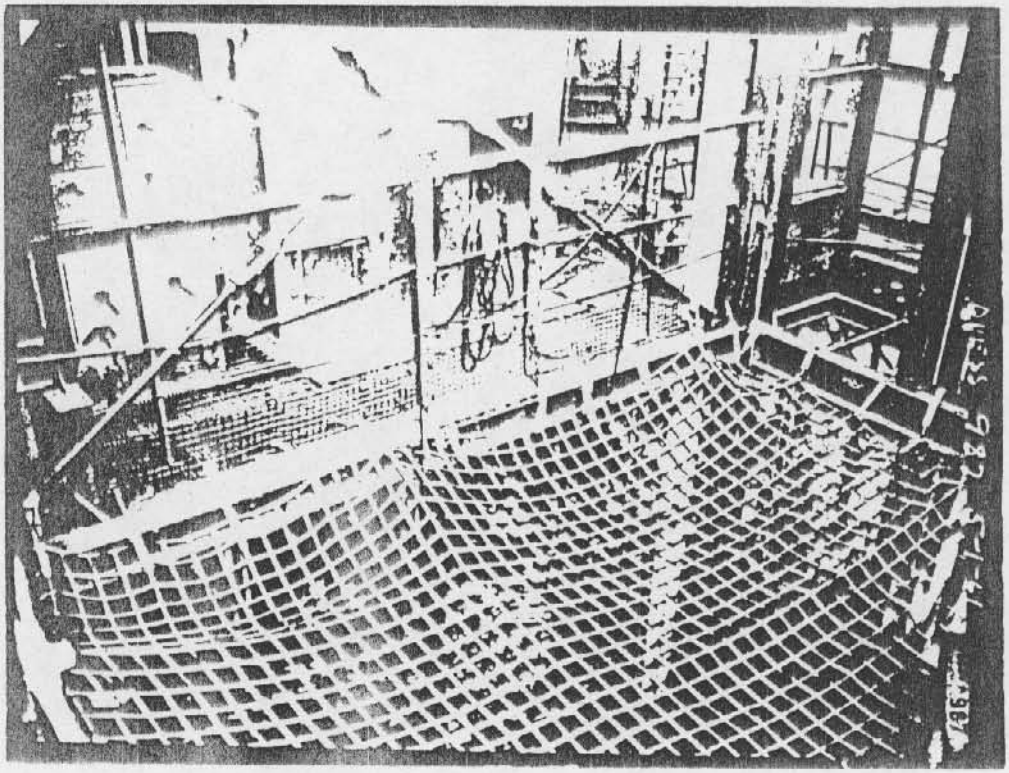
NOTE WATER CHILLER UNITS IN FORE-GROUND AND BACKGROUND.



SITE 9 CORINTH WEST

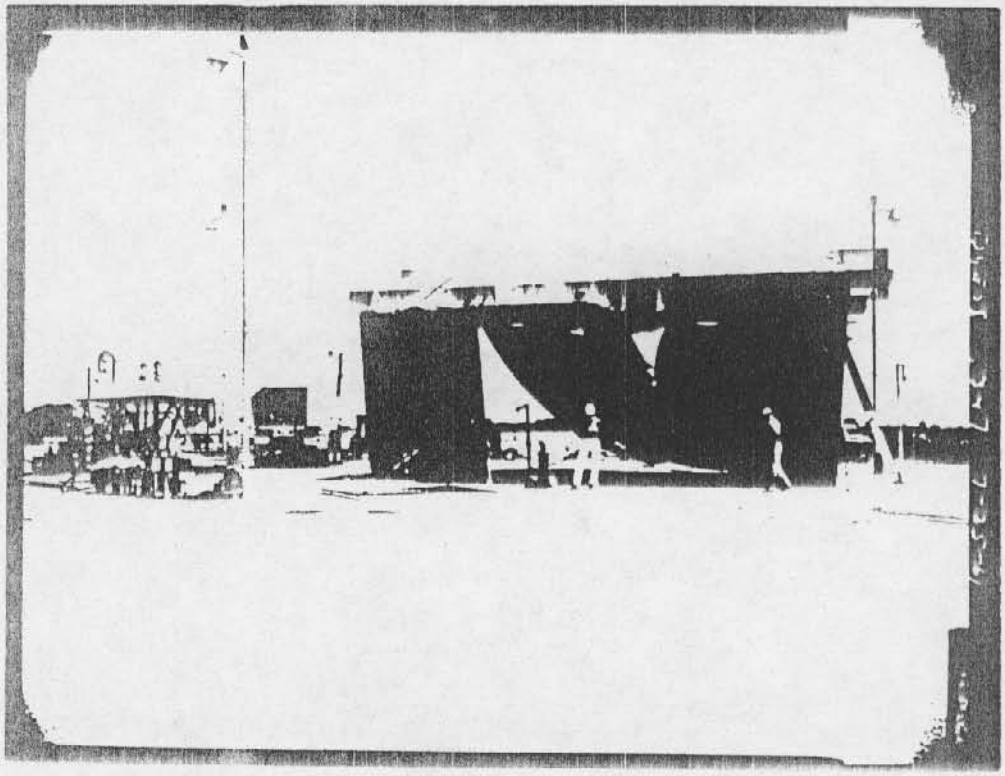
VIEW OF MECHANICAL PIPING, PUMPS AND MOTORS INSTALLED ON LEVEL 4 OF THE MISSILE SILO.

NOTE SHOCK HANGER SPRINGS IN FAR LEFT OF PICTURE FOR SIZE COMPARISON.



SITE II OPLIN

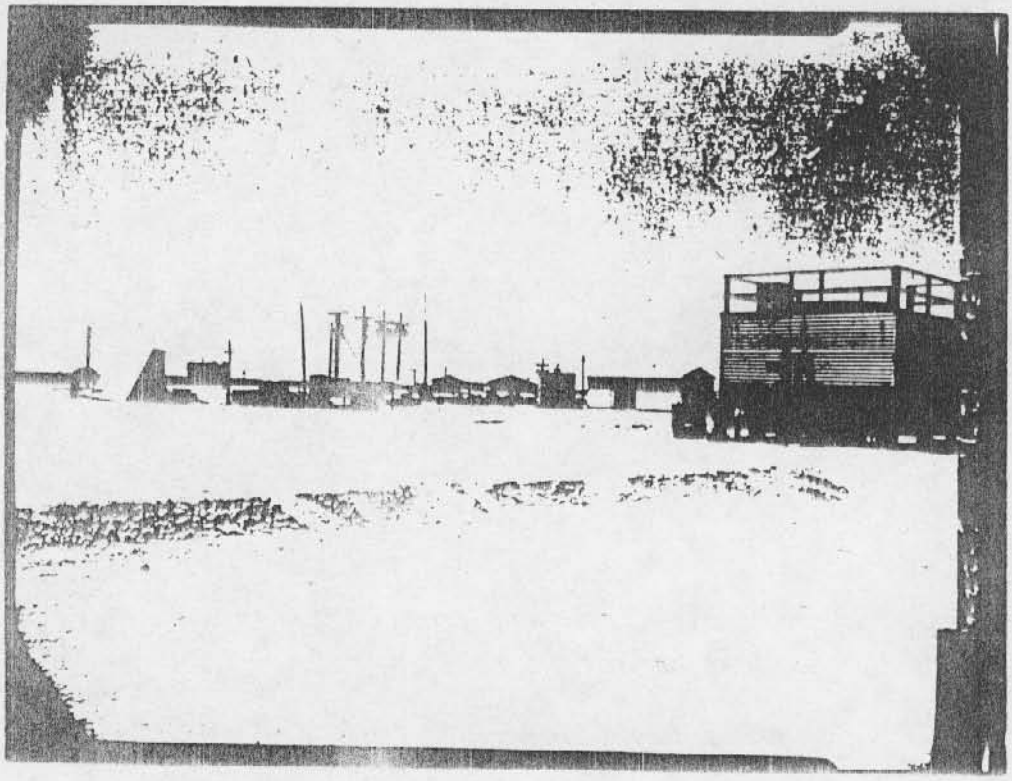
TYPICAL SAFETY NET INSTALLED DURING COURSE OF CONSTRUCTION AT EACH MISSILE SILO.



SITE 2 BAIRD

EXTERIOR VIEW OF SITE AFTER DOORS WERE COMPLETED. THE TARPAULIN SHOWN HERE WAS USED TO PREVENT RAIN WATER FROM ENTERING THE SILO. THIS SYSTEM WAS FOUND TO BE INEFFECTIVE, IN THE LEFT PORTION OF THE PHOTO MAY BE SEEN THE PLS TEST SET UP.

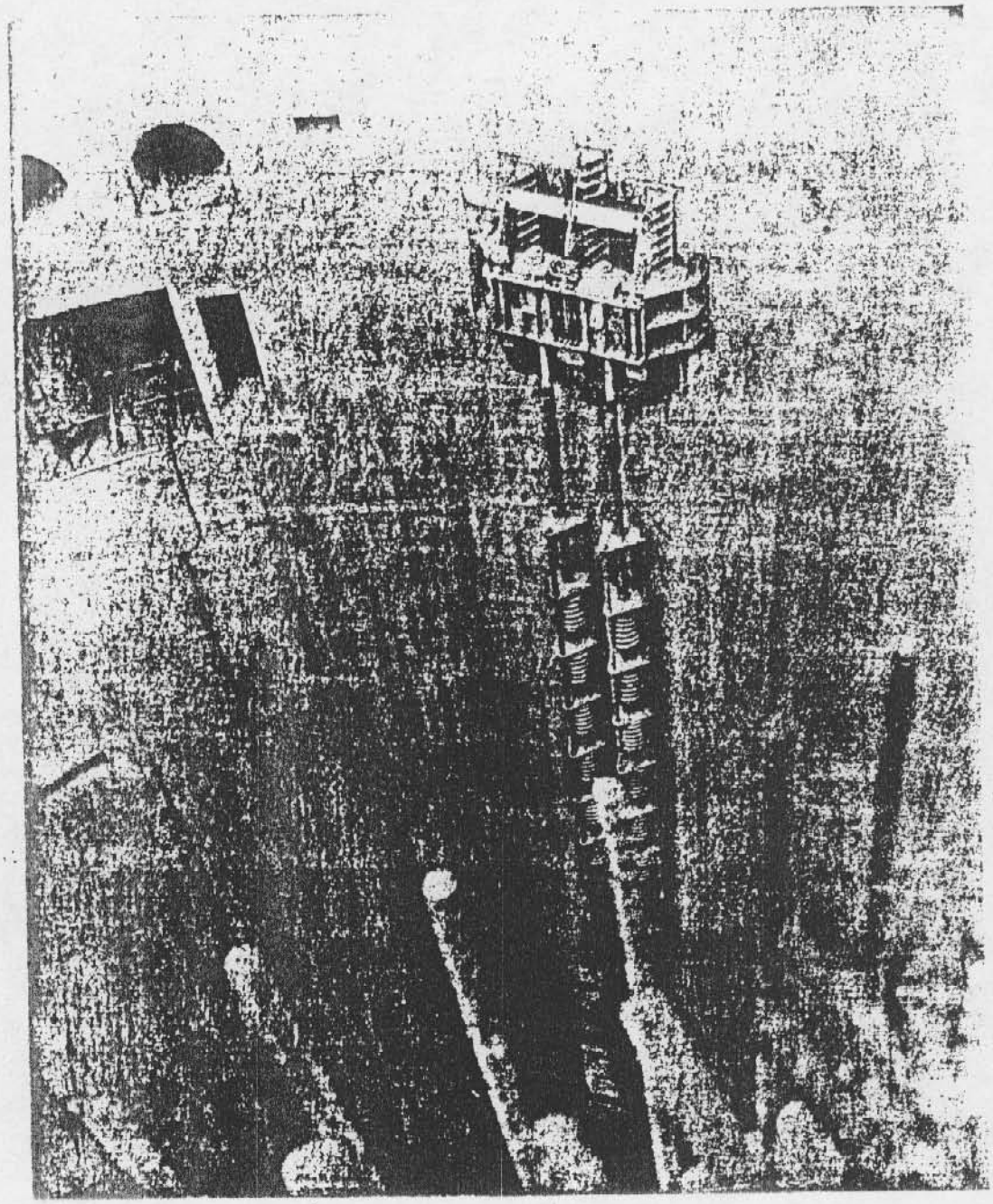
Photo No. 27



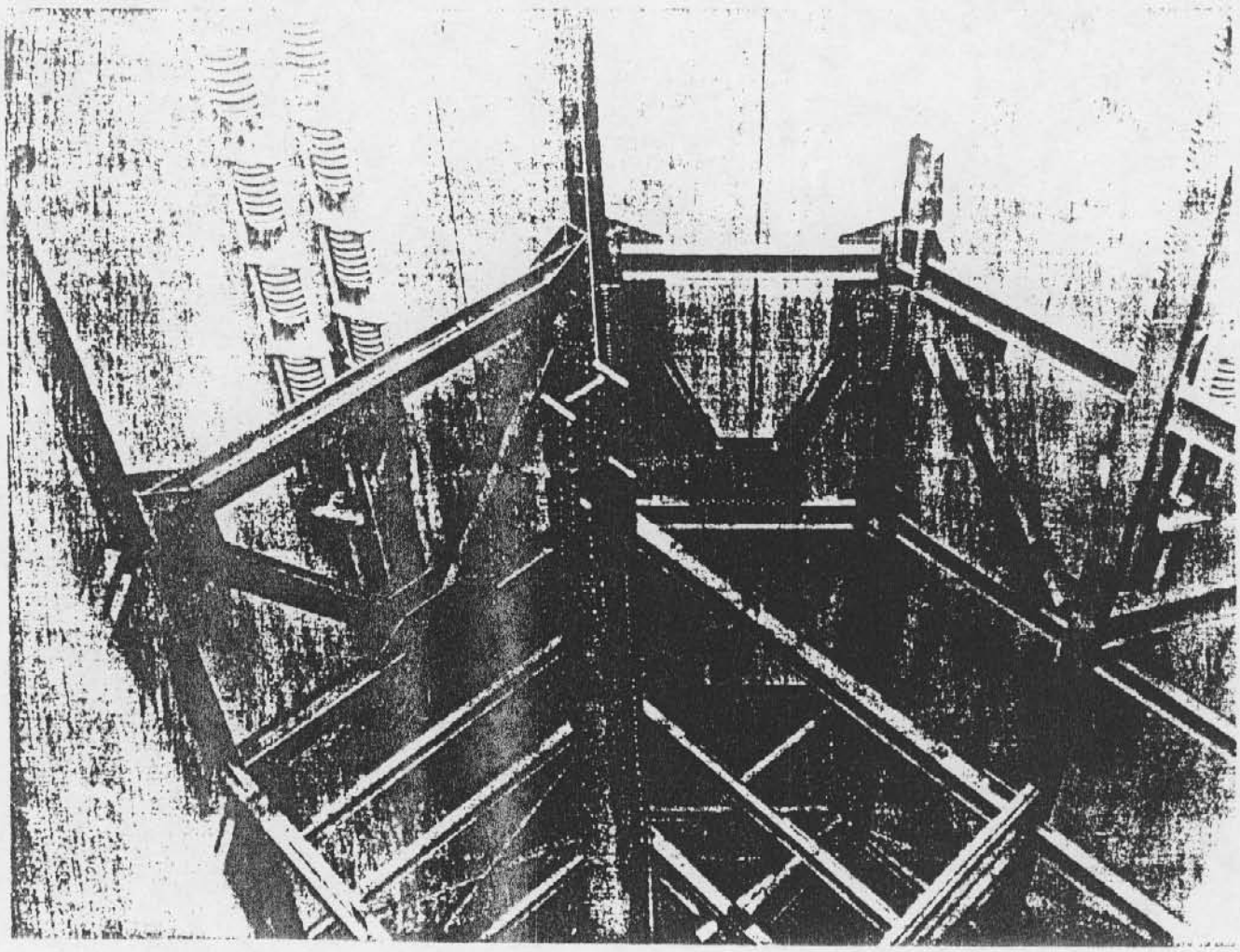
SITE 12 WINTERS

VIEW OF EXTERIOR SHOWING (FROM LEFT TO RIGHT) THE TUNNEL ENTRANCE TO LAUNCH CONTROL CENTER, AND VENT PIPES, CONTRACTOR AND CE PROJECT OFFICES, WATER TREATMENT BUILDING AND WATER COOLING TOWER.

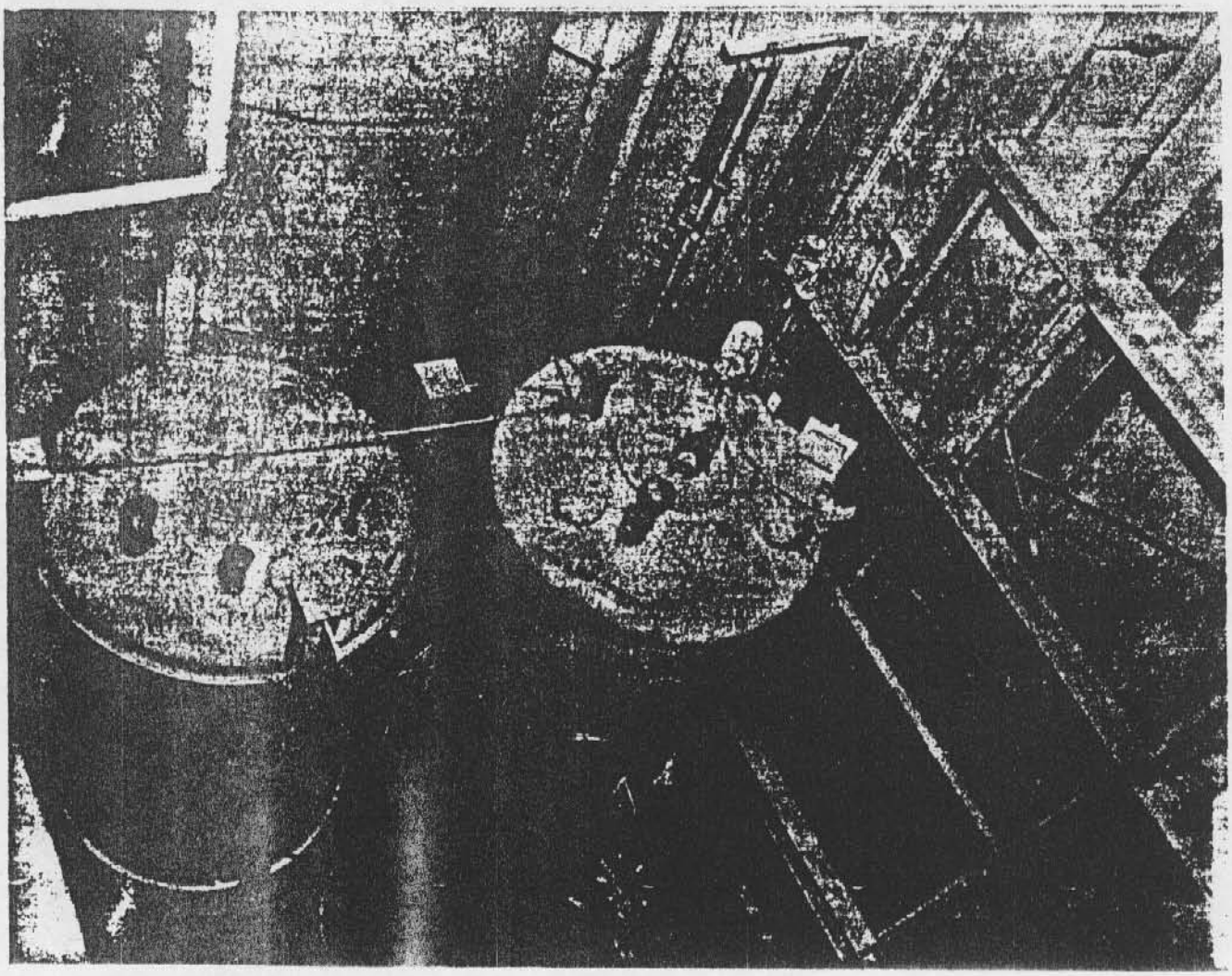
Photo No. 28



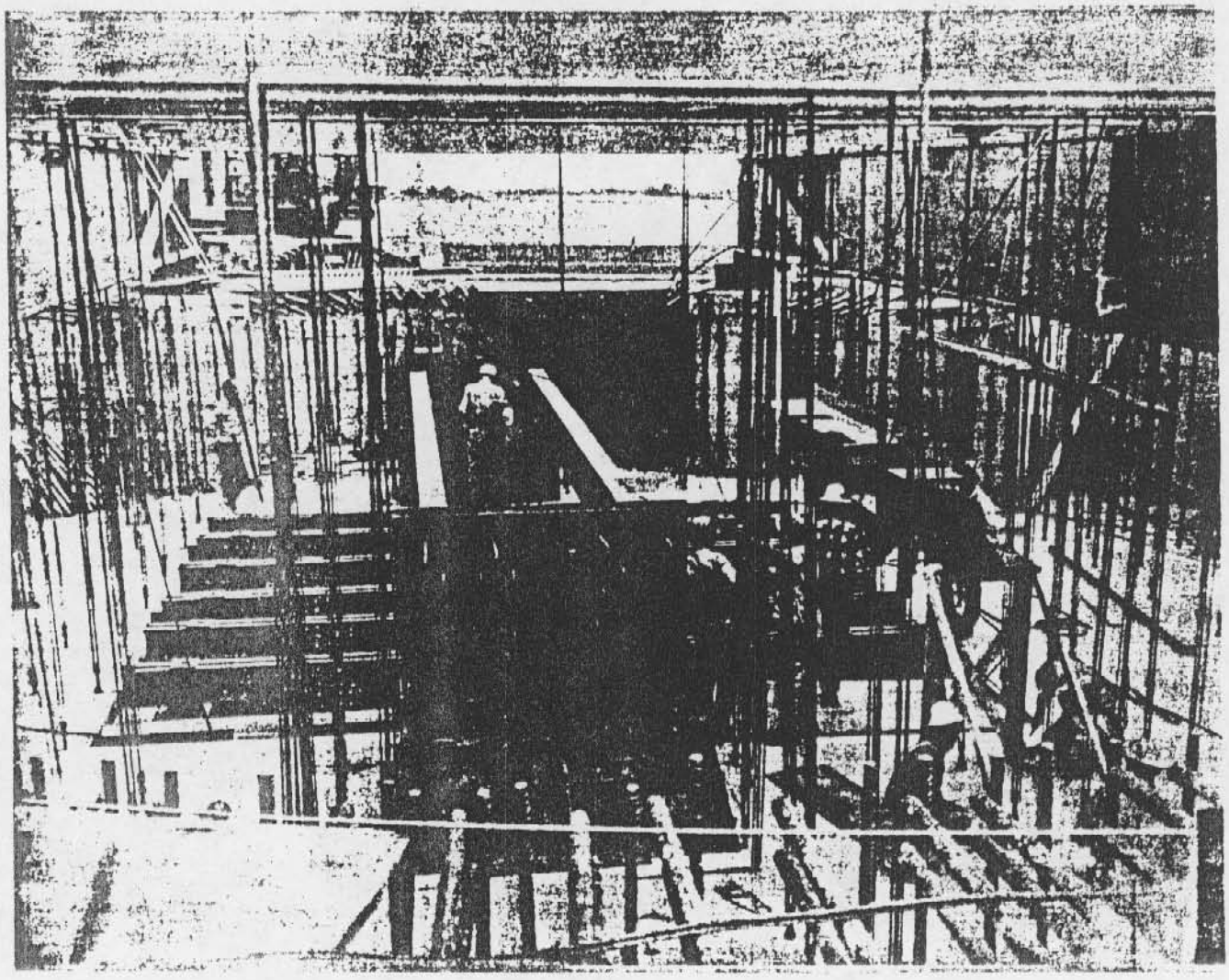
THIS IS ONE OF THE FOUR SUPPORTS USED IN THE SILO TO SUSPEND THE CRIB. THIS SPRING ASSEMBLY HAS AN OVERALL LENGTH OF APPROXIMATELY 45 FEET.



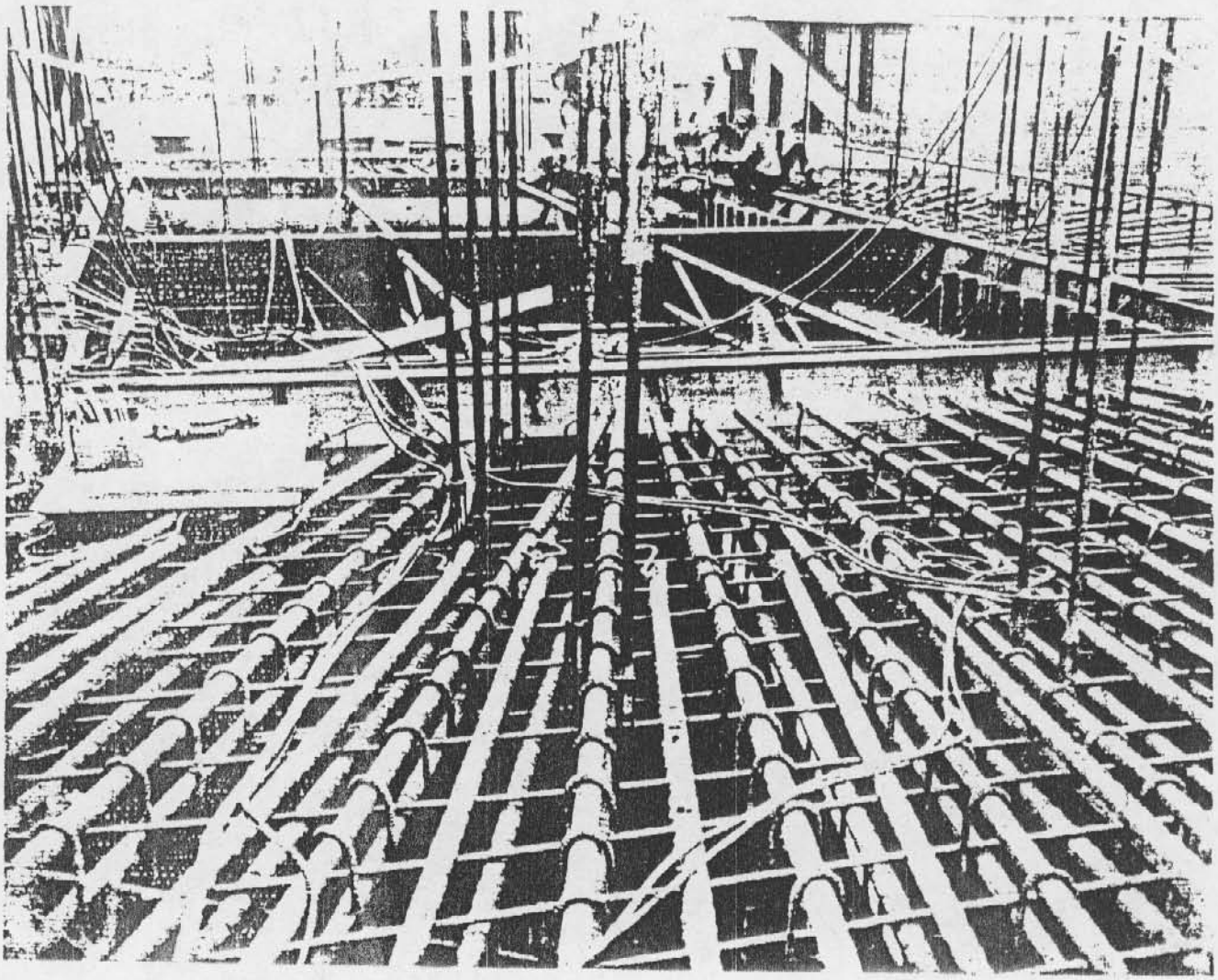
THE STEEL CRIB IS ATTACHED TO THE SUSPENSION SYSTEM AS SHOWN AT LEVEL 5.



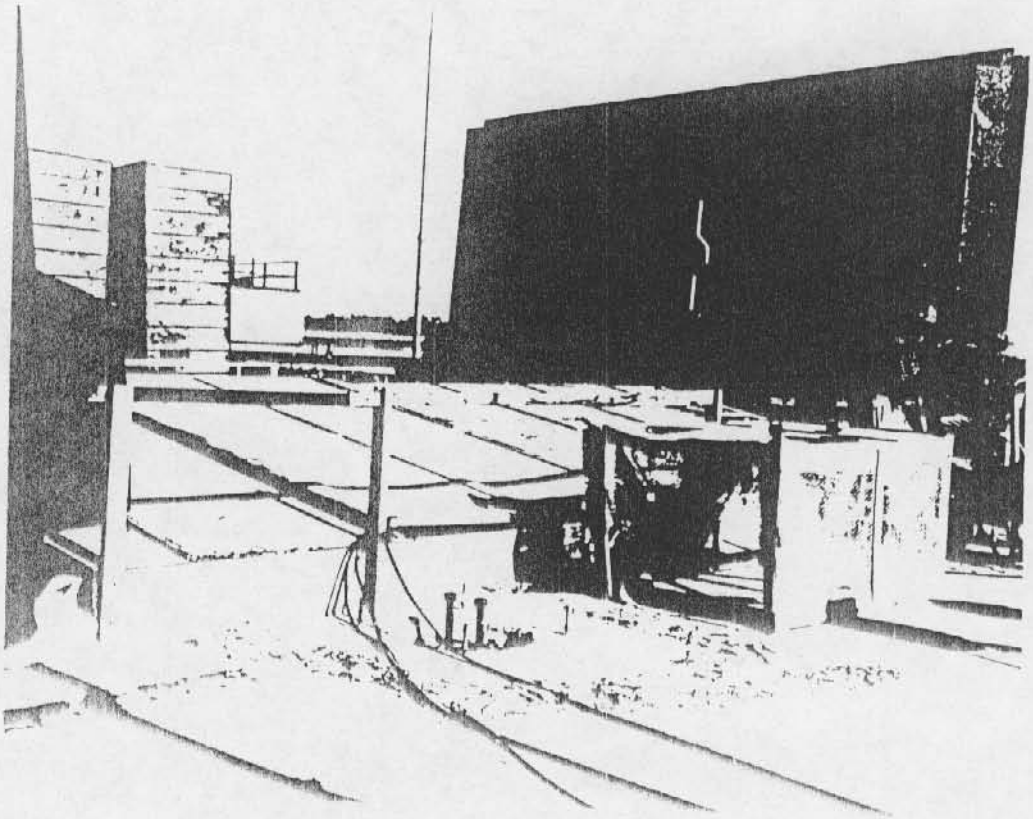
THE VESSELS SHOWN ARE INSTALLED ON CRIB LEVEL 8, AT THE BOTTOM OF THE SILO. THESE TANKS WILL CONTAIN LIQUID OXYGEN, LIQUID NITROGEN AND GASEOUS NITROGEN TO SUPPORT THE MISSILE SYSTEMS. THE TANK IN THE LEFT REAR IS IN REALITY A LARGE VACUUM BOTTLE AND WILL STORE 23,000 GALLONS OF LIQUID OXYGEN AT -297° F.



WORKMEN PREPARING THE FORMS FOR THE CONCRETE SILO CAP. LONG "I" BEAMS IN THE UPPER LEFT & RIGHT SIDES WILL SUPPORT THE WEIGHT OF THE CONCRETE WHEN POUR BEGINS.

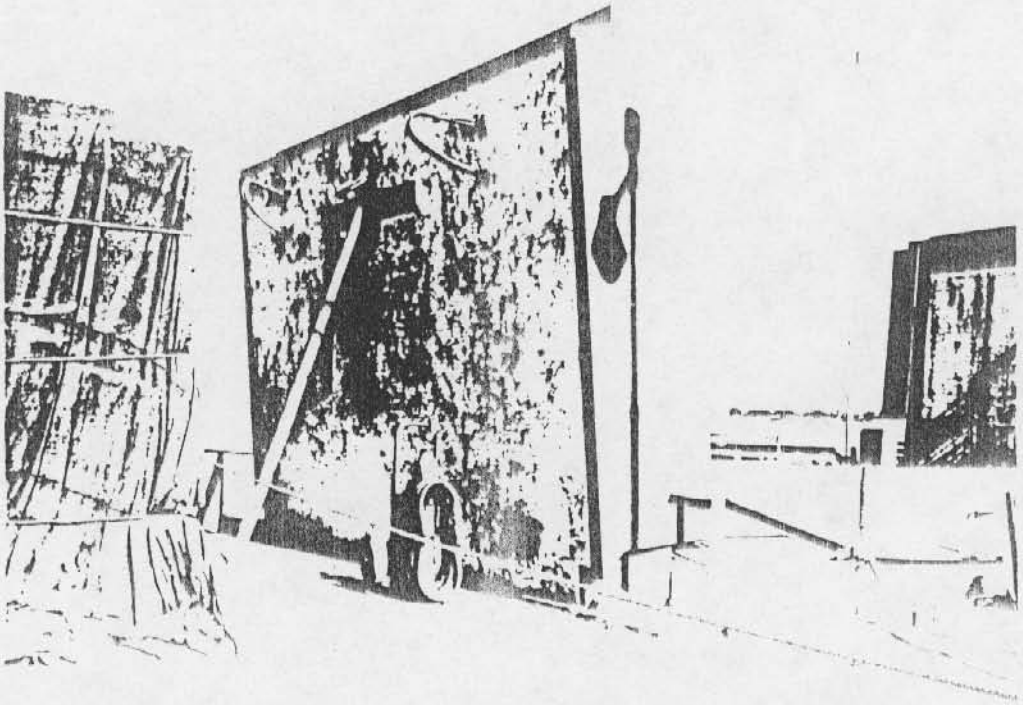


HEAVY REINFORCING STEEL REQUIRED FOR THE SILO CAP. CAP IS 9' THICK AND REQUIRES APPROXIMATELY 50 TONS OF STEEL AND 1100 CUBIC YARDS OF CONCRETE. RECTANGULAR SECTION IN THE CENTER OF THE PICTURE IS FOR THE SILO DOORS WHICH WILL BE INSTALLED AT A LATER DATE.



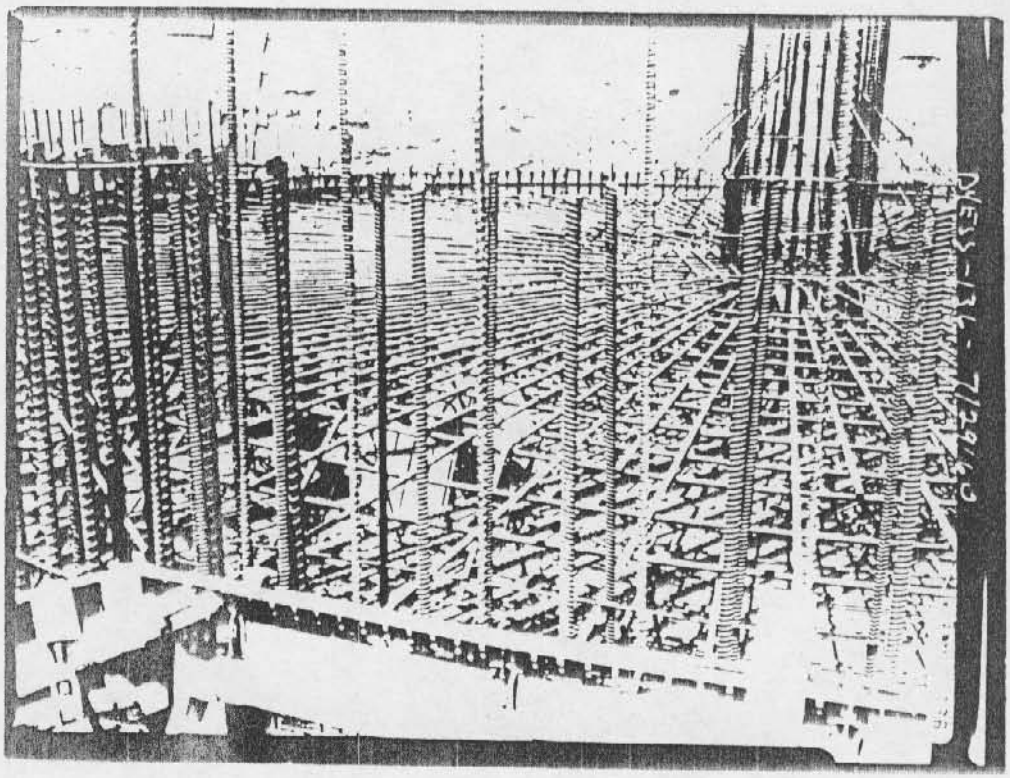
SITE 2 BAIRD

A VIEW OF A TEMPORARY EFFECTIVE COVERING FOR THE SILO OPENING WAS INSTALLED TO PREVENT WATER DAMAGE TO EQUIPMENT PLACED INSIDE. THESE COVERS WERE LEFT IN PLACE FOR USE OF I AND C CONTRACTOR.



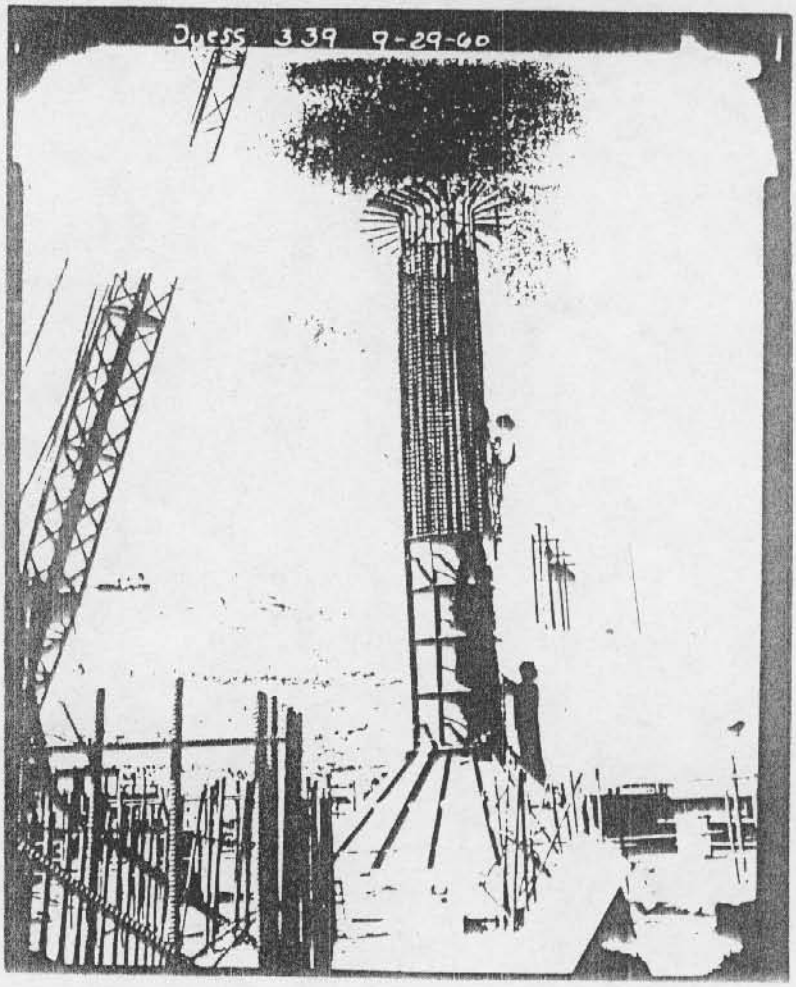
SITE II OPLIN

CABLES WERE CAST IN PLACE WITH THE CONCRETE OF THE DOOR TO FACILITATE OPENING. CABLES WERE LEFT IN PLACE AFTER COMPLETION OF CONSTRUCTION CONTRACT FOR THE USE OF THE I AND C CONTRACTOR.



SITE 3 DENTON

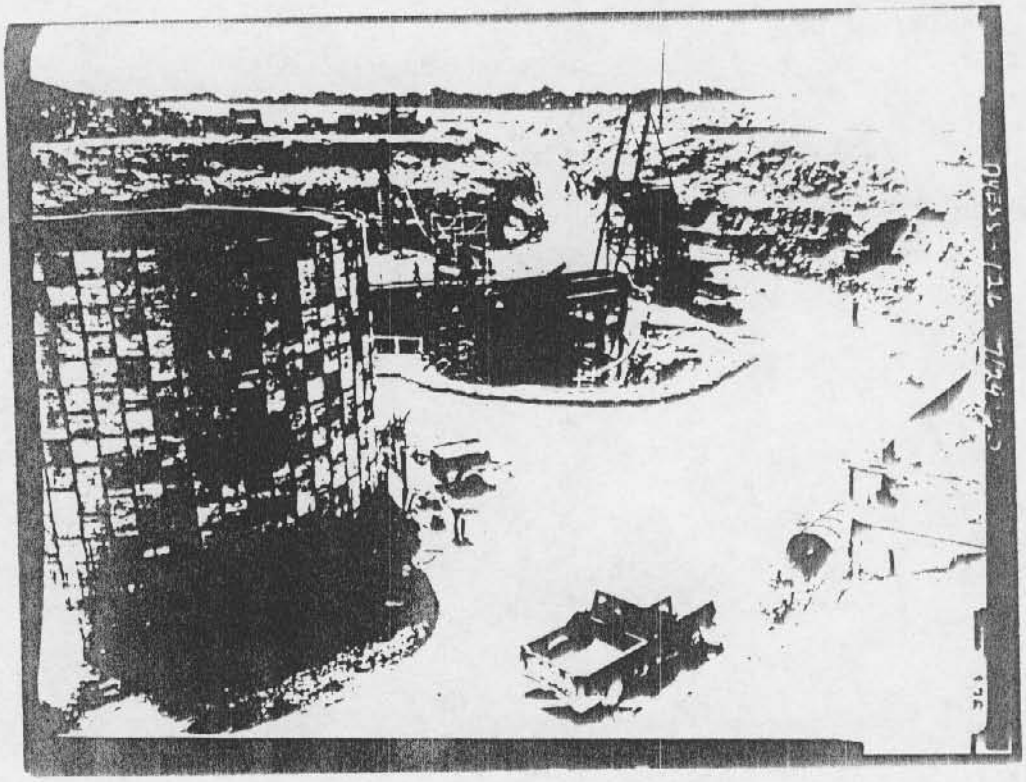
A MAZE OF REINFORCING STEEL IN THE BASE OF THE LAUNCH CONTROL CENTER. STEEL WAS PRE-FABRICATED OFF-SITE AND DELIVERED READY FOR INSTALLATION.



SITE 12 WINTERS

TYPICAL VIEW OF THE REINFORCING STEEL IN THE CENTER COLUMN OF THE LAUNCH CONTROL CENTER.

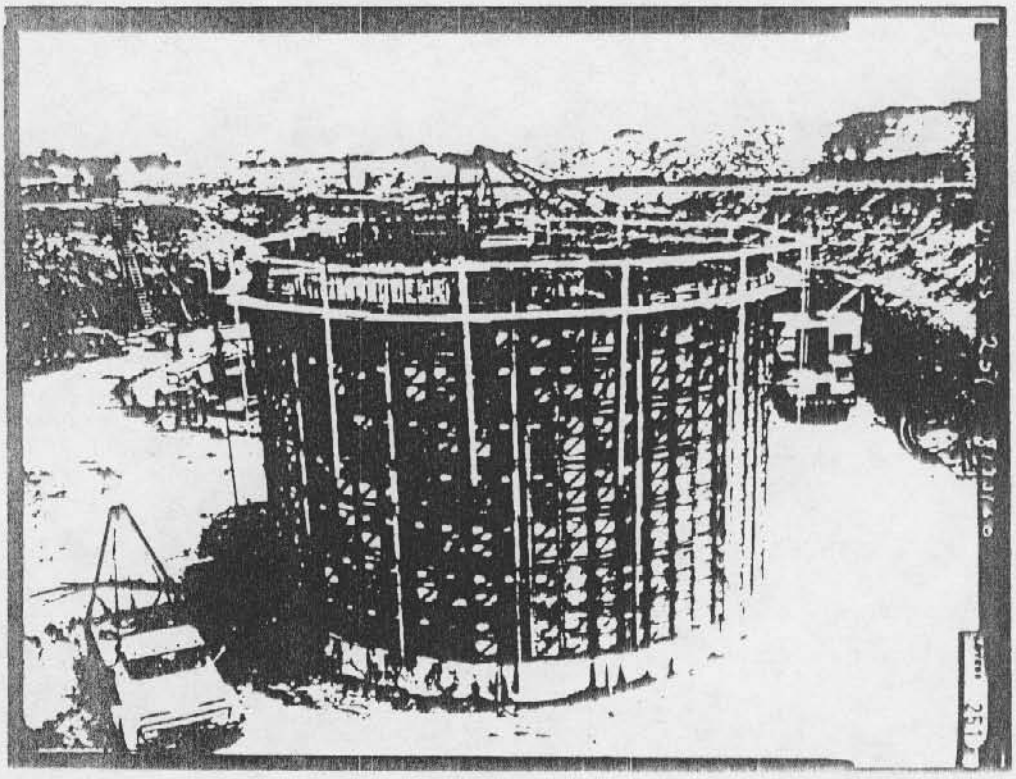
NOTE THE PREFABRICATED STEEL FORM BEING USED. A SIMILAR CONE FRUSTRUM WAS USED AT THE TOP OF THE COLUMN.



SITE 2 BAIRD

INTERIOR FORMS SET FOR LAUNCH CONTROL CENTER WALLS.

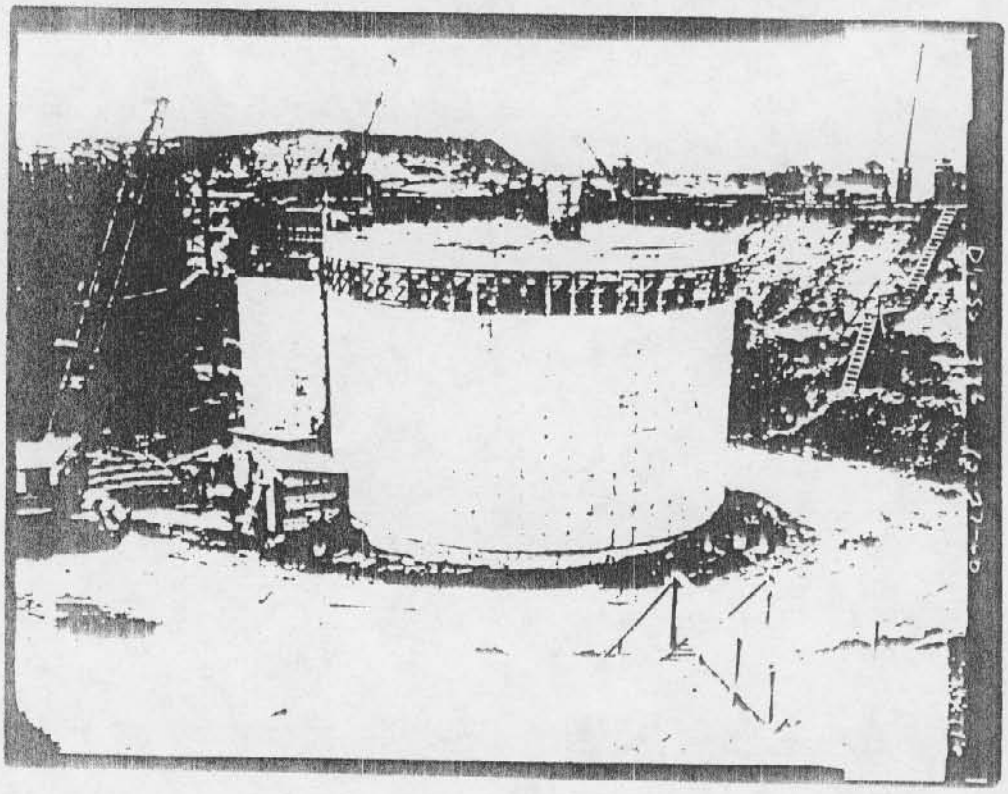
IN BACKGROUND SKIP HOIST METHOD USED FOR SILO SHAFT EXCAVATION.



SITE 2 BAIRD

VIEW OF EXTERIOR LOW COST FORMS IN PLACE FOR LAUNCH CONTROL CENTER WALLS. WALL REINFORCING STEEL HAS BEEN PLACED, TIED AND CLEANED.

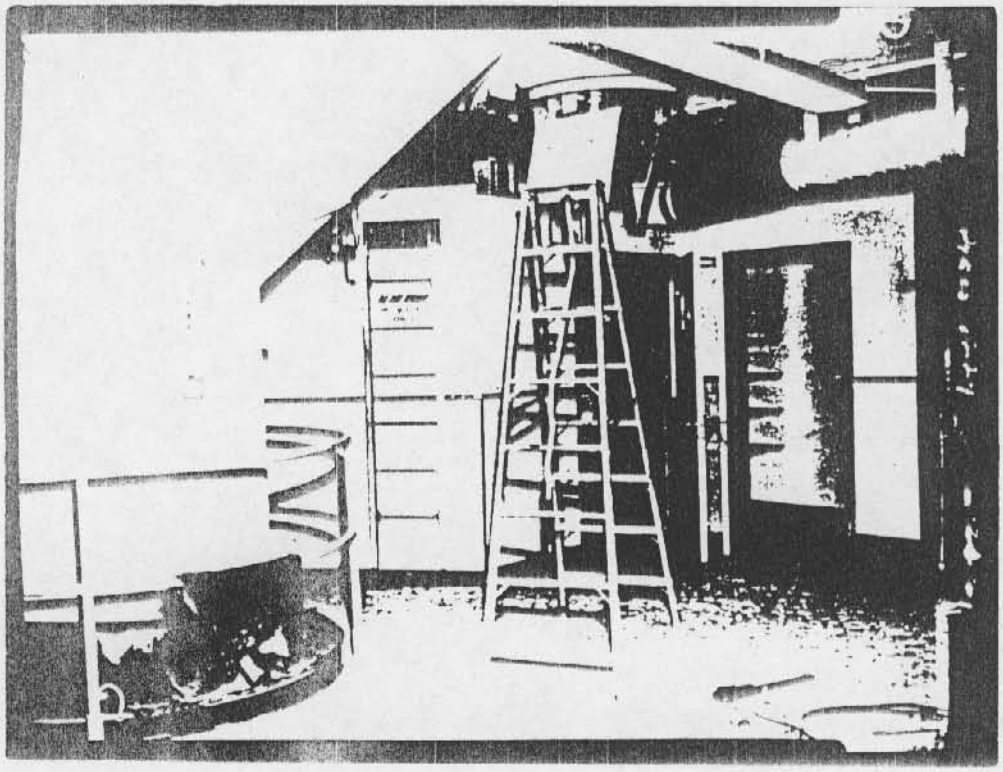
CONCRETE PLACEMENT IS THE NEXT STEP.



SITE 2 BAIRD

LAUNCH CONTROL CENTER IMMEDIATELY AFTER LOW COST FORMS WERE STRIPPED. FORMS WERE LEFT IN PLACE DURING CURING PERIOD.

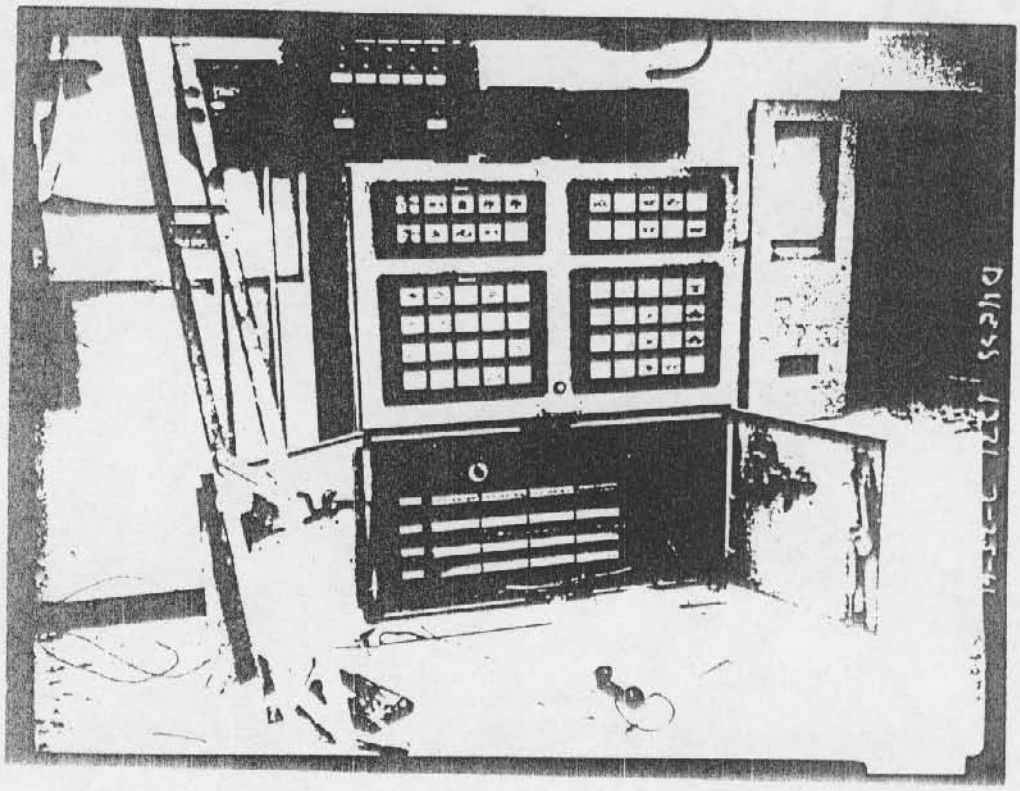
IN BACKGROUND FORMING FOR UPPER PORTION OF SILO CONCRETE.



SITE 10 ALBANY

VIEW OF COMPLETED CONCRETE OF THE LAUNCH CONTROL CENTER SUPPORT COLUMN.

NOTE THE EMERGENCY EXIT HATCH.

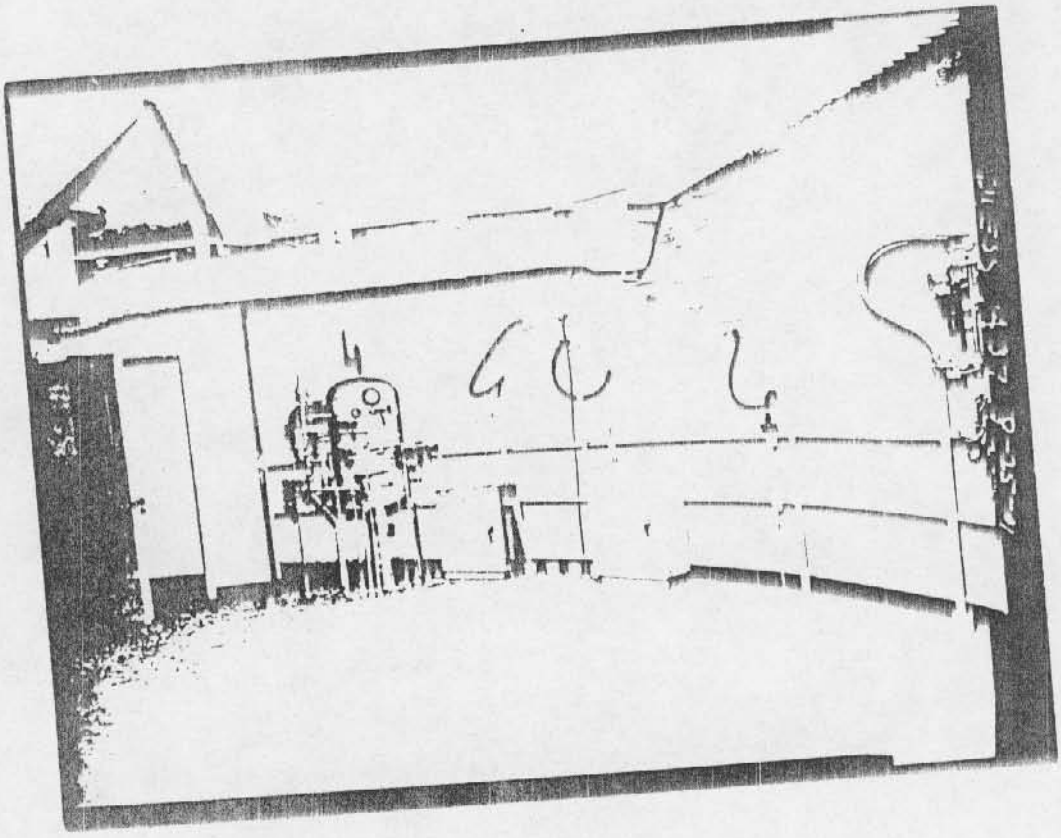


SITE 5 BRADSHAW

THE SCAM UNIT INSTALLED ON LEVEL 2 OF LAUNCH CONTROL CENTER. THIS UNIT REVEALS THE POSITION OF VARIOUS DOORS, VALVES, ETC.

NOTE THE FIRE WARNING LOCATION SYSTEM MOUNTED ABOVE SCAM UNIT.

Photo No. 42

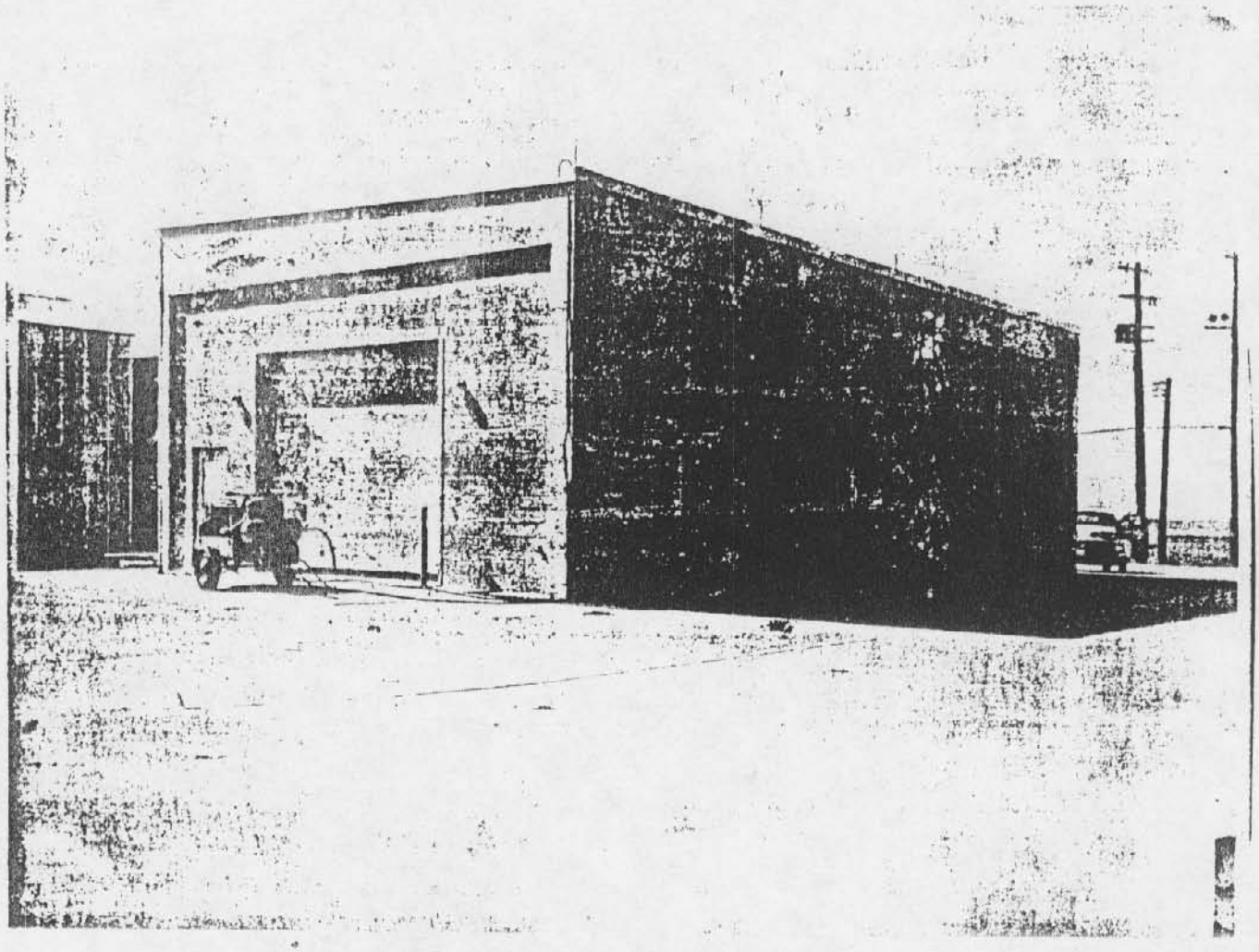


SITE 8 ANSON

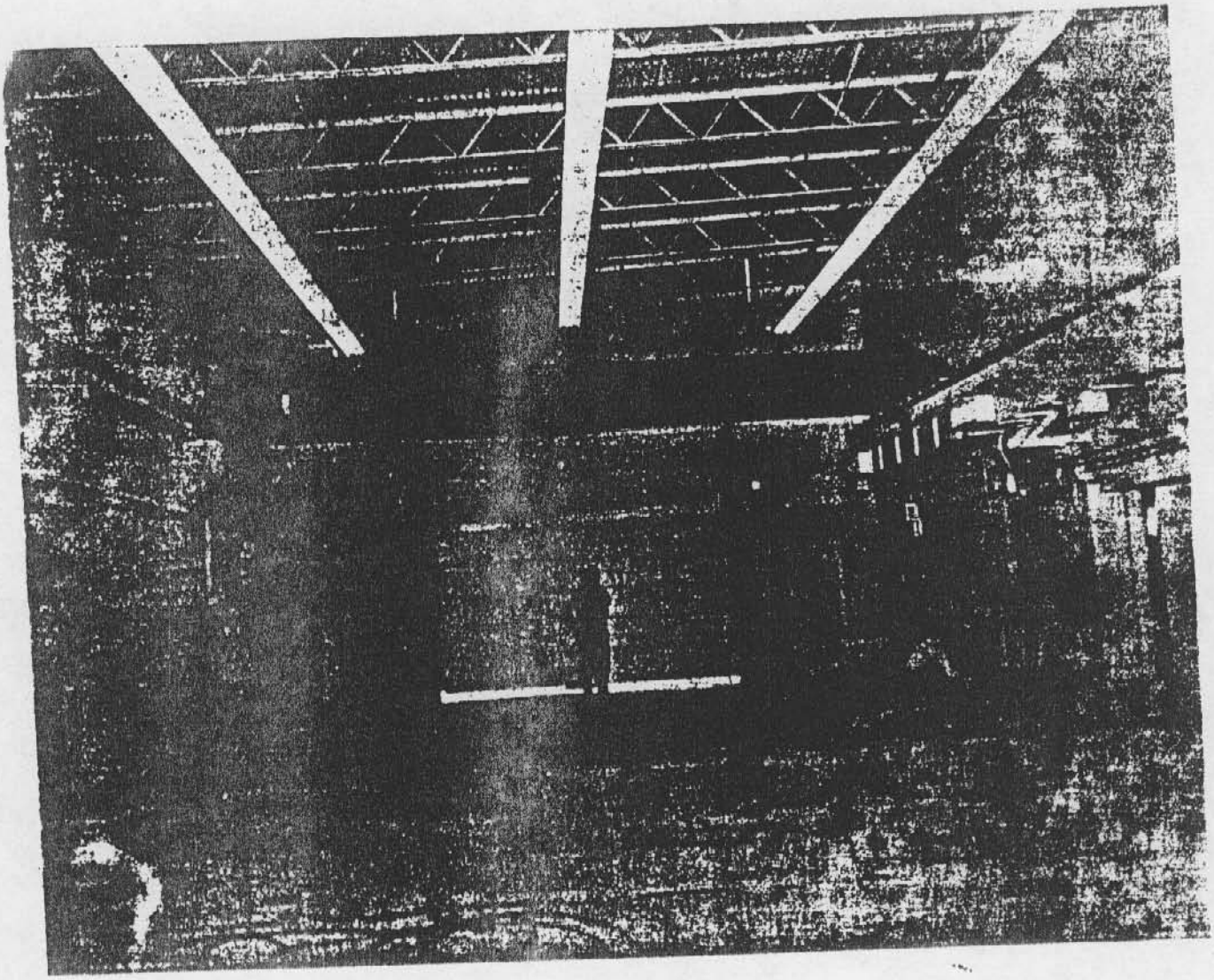
VIEW OF INTERIOR, FIRST LEVEL, LAUNCH CONTROL CENTER SHOWING THE COMPLETED CONCRETE SURFACE.

NOTE FLEXIBLE CONNECTIONS BETWEEN OUTSIDE CONCRETE "SHELL" AND INTERIOR STRUCTURE.

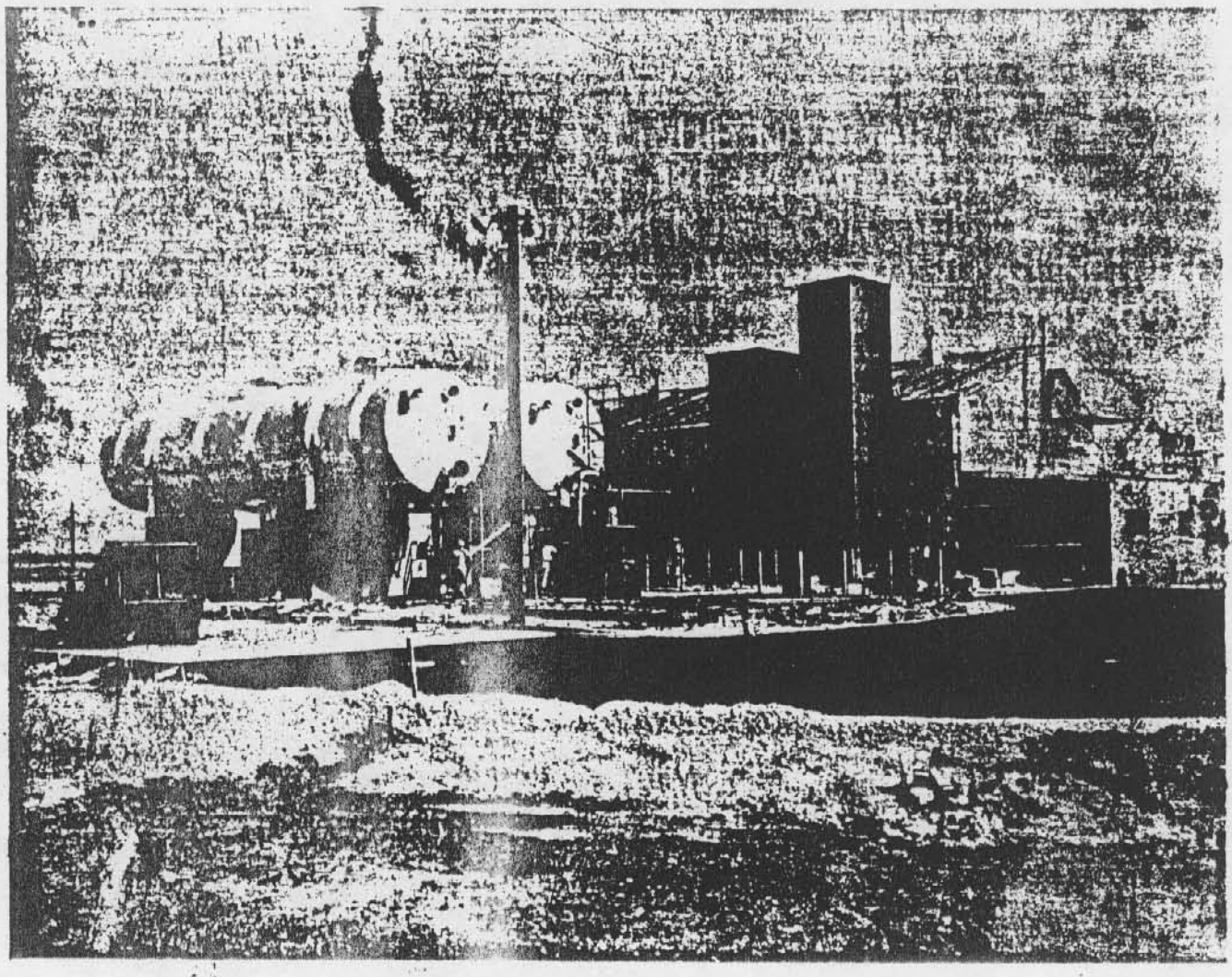
Photo No. 43



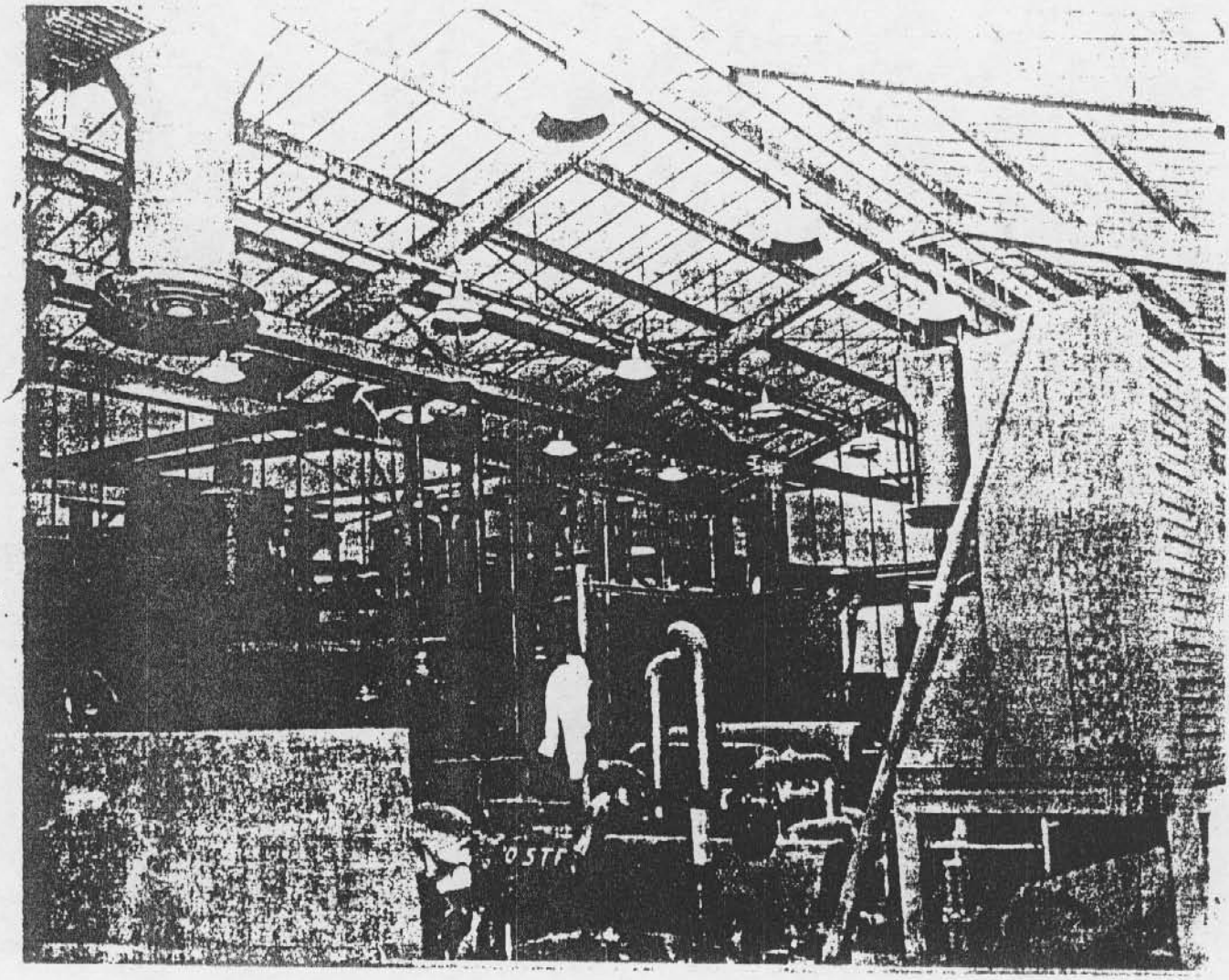
THE RE-ENTRY VEHICLE (MISSILE WARHEAD) BUILDING IS A MODIFICATION TO AN EXISTING MUNITIONS MAINTENANCE AND INSPECTION BUILDING. HERE MAINTENANCE AND CHECK OUT OF THE VARIOUS COMPONENTS IS ACCOMPLISHED.



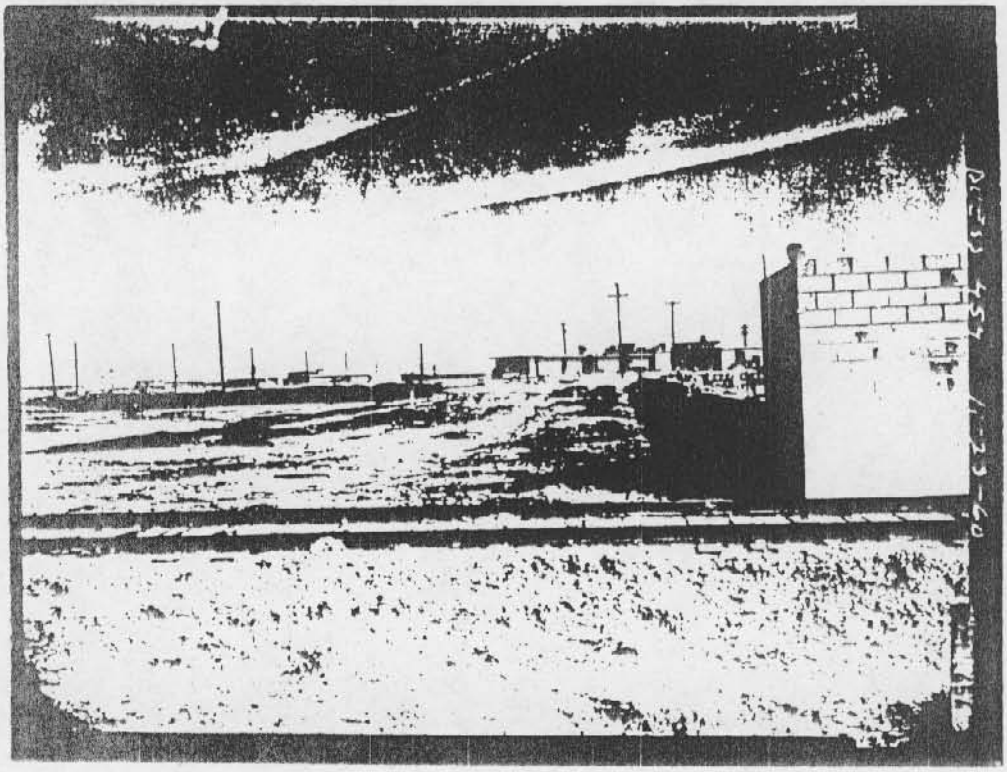
INSIDE THE RE-ENTRY VEHICLE BUILDING A 5 TON BRIDGE CRANE IS USED TO HANDLE COMPONENTS OF THE WAR HEAD.



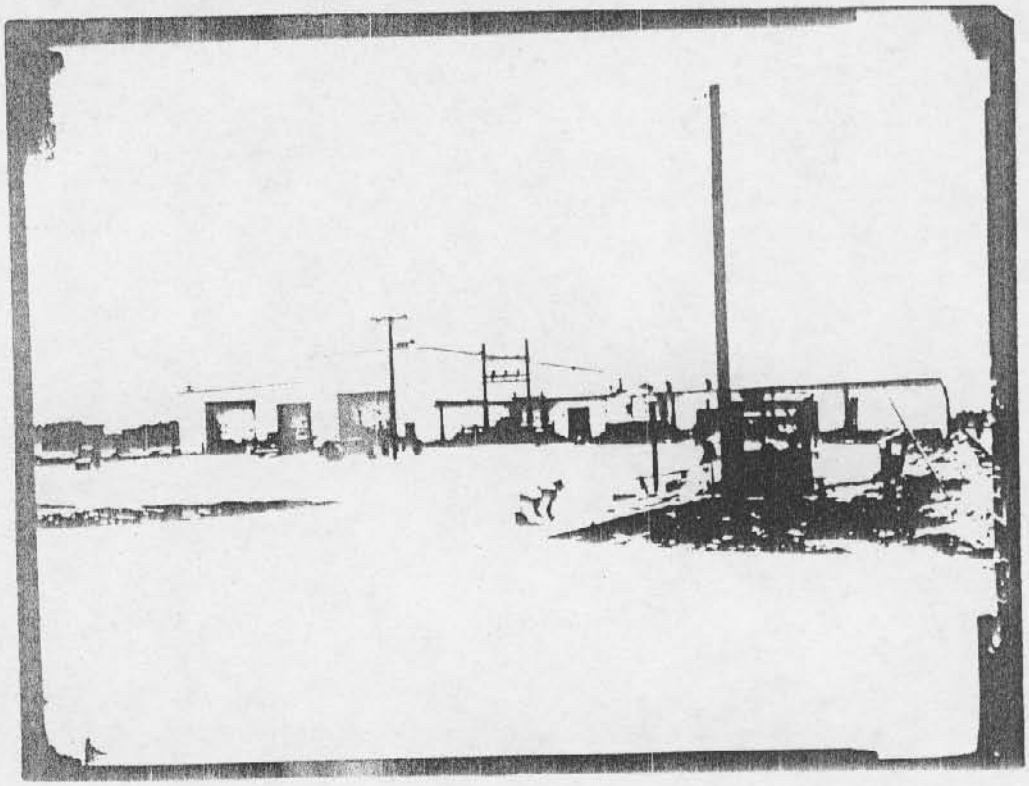
THE LIQUID OXYGEN, LIQUID NITROGEN GENERATING PLANT, LOCATED ON DYESS, WILL FULFILL THE LIQUID GAS REQUIREMENTS FOR ALL THE COMPLEXES. THE PLANT IS DESIGNED TO GENERATE 25 TONS OF LIQUID OXYGEN (LOX) OR 21 TONS OF LIQUID NITROGEN PER DAY. THE TWO TANKS SHOWN EACH HAVE A STORAGE CAPACITY OF 28,000 GALLONS.



INSIDE THE LOX PLANT, TWO CHICAGO PNEUMATIC COMPRESSORS ARE USED TO CONVERT AIR TO LIQUID OXYGEN OR LIQUID NITROGEN

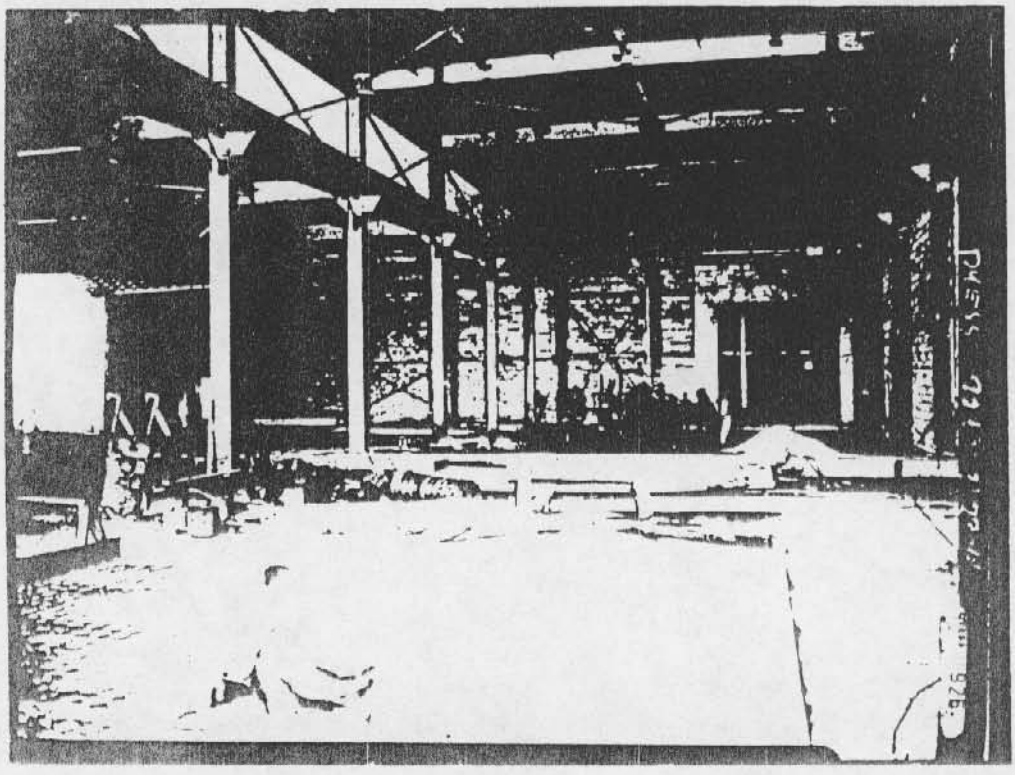


GRADE BEAM OF NORTH WALL OF MISSILE ASSEMBLY BUILDING, CONTRACT NO. 5967, CONCRETE BLOCK EXTENDS TO A CONTROL JOINT.

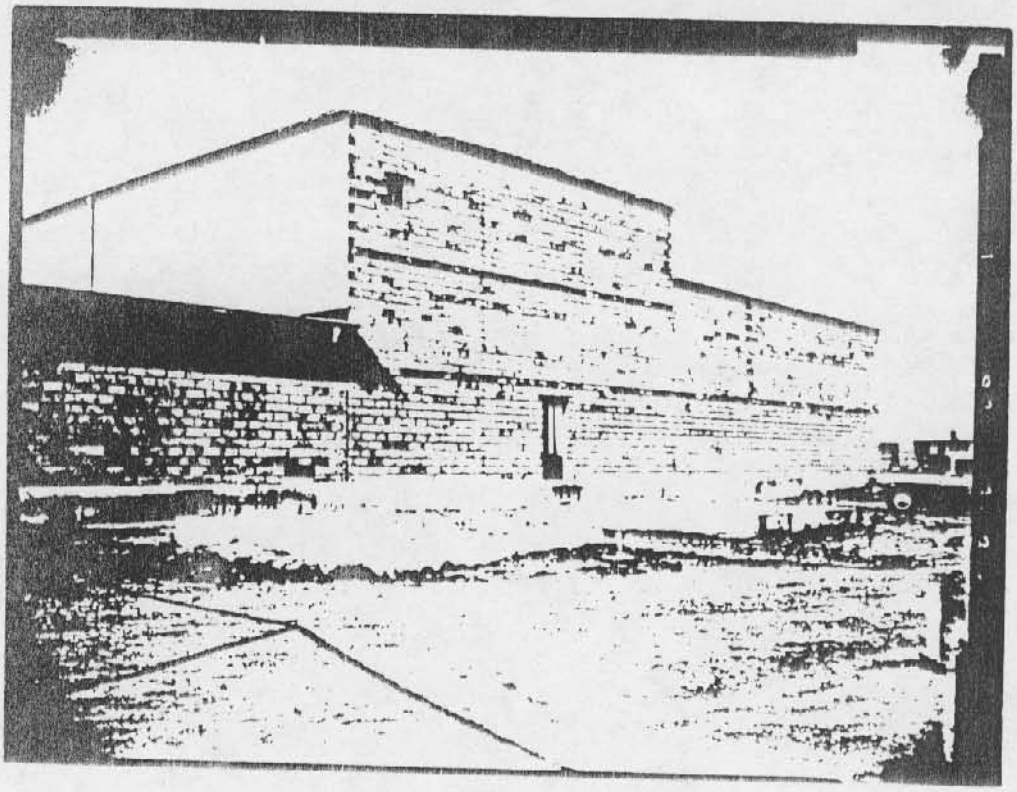


EXTERIOR VIEW OF THE MISSILE ASSEMBLY BUILDING NEARING COMPLETION. CURB AND GUTTER HAVE BEEN PLACED AND PREPARATIONS ARE UNDERWAY FOR PAVING PARKING AREA.

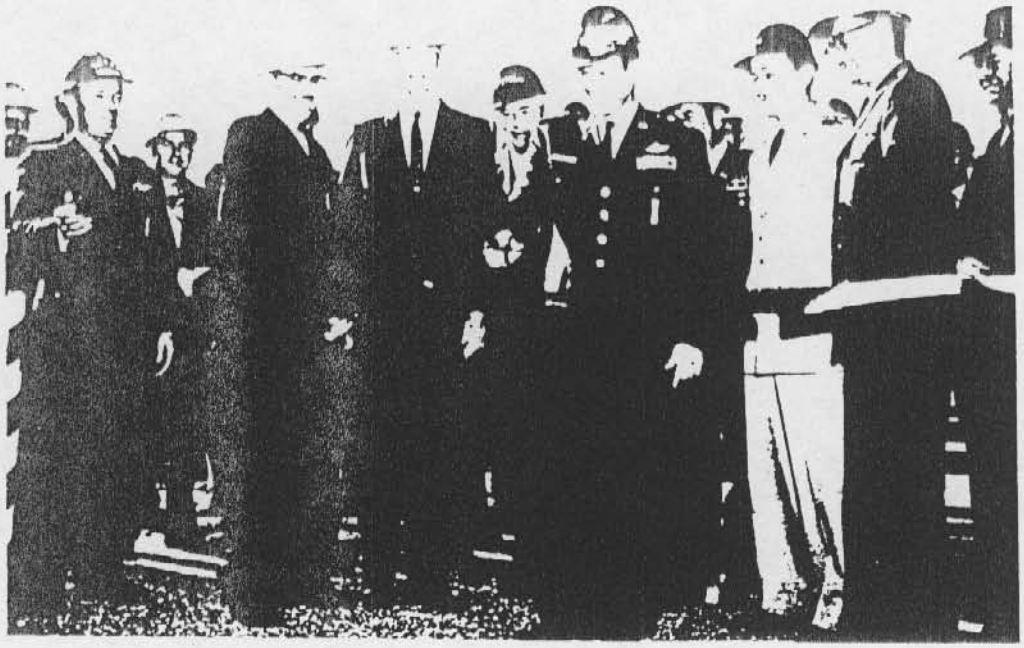
Photo No. 49



INTERIOR OF MISSILE ASSEMBLY BUILDING. PREPARATIONS ARE BEING MADE TO PLACE CONCRETE FLOOR.



SOUTH WALL OF MISSILE ASSEMBLY BUILDING AFTER COMPLETION OF CONCRETE BLOCK AND ROOF. IN THE FOREGROUND ARE CONCRETE PADS FOR HELIUM VESSELS. BUILDING CONTAINS APPROX. 36,775 SQUARE FEET OF FLOOR AREA WHICH WILL PERMIT ASSEMBLY OF TWO MISSILES.



MAJOR GENERAL THOMAS P. GERRITY, USAF, COMMANDER OF AIR MATERIAL COMMAND BALLISTIC MISSILES CENTER CUTS A RIBBON ACROSS THE GATE AT THE TWELFTH AND LAST SITE TO BE COMPLETED IN THE DYESS AREA ON 3 NOVEMBER 1961. LOOKING ON FROM LEFT TO RIGHT ARE COLONEL HUGH B. MANSON, USAF, COMMANDER SATAF, DYESS AIR FORCE BASE, MR. HARVEY JONES, MAYOR OF WINTERS, TEXAS, MR. H.B. ZACHRY, PRESIDENT, H.B. ZACHRY CO., MR. W.P. WRIGHT, LOCAL BUISINESSMAN, LT. COL. ALBERT M. ANTONELLI, CEBMCO, AREA ENGINEER, MAJOR GENERAL ALVIN C. WELLING, USA, DEPUTY FOR SITE ACTIVATION, COLONEL THOMAS B. HAYES, USA, COMMANDER CEBMCO, AND MR. D.V. MOORE, PROJECT MANAGER FOR H.B. ZACHRY AND BROWN AND ROOT INC.

Photo No. 52

LT. COL. ANTONELLI GIVES THE KEY TO THE TWELFTH AND LAST SITE TO BE COMPLETED TO COL. MANSON, SIGNIFYING COMPLETION OF THE PROJECT.

LT. COL. ANTONELLI IS AWARDED THE AIR FORCE COMMENDATION MEDAL BY GENERAL GERRITY FOR SUCCESSFUL COMPLETION OF THE CONSTRUCTION OF TWELVE ICBM LAUNCH AND CONTROL FACILITIES NEAR DYESS AIR FORCE BASE, TEXAS. WORK WAS COMPLETED AHEAD OF SCHEDULE AT A MINIMUM COST.

MR. H.B. ZACHRY, PRESIDENT OF H.B. ZACHRY CO., SPONSER OF THE JOINT VENTURE OF H.B. ZACHRY CO. AND BROWN AND ROOT INC. IS AWARDED THE COMMANDER'S AWARD BY GENERAL GERRITY, FOR TIMELY COMPLETION OF THE TWELVE ICBM LAUNCH AND CONTROL FACILITIES NEAR DYESS AIR FORCE BASE.

SUPPORT DOCUMENTS