APPENDIX II

PHOTOGRAPHIE
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HISTORY
OF
THE DISS AREA OFFICE
18 April 1960 - 28 April 1962

Prepared by:
LaRoy V. Eklund
and
John L. Lem

Transcribed by:
Inez R. Horvall

Edited by:
Hunter S. McCloud

Approved by:
Albert M. Antmelli, LA/Cal
Area Engineer
6 APR 1962

CORPS OF ENGINEERS BALLISTIC MISSILE CONSTRUCTION OFFICE
<table>
<thead>
<tr>
<th>NAME &amp; ADDRESS</th>
<th>SCOPE OF WORK</th>
<th>AMOUNT</th>
<th>EFFECTIVENESS*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industrial Television, Inc.  Denver 7, Colorado</td>
<td>Furnished &amp; Installed Closed Circuit TV, Tested System &amp; Instructed Owner</td>
<td>$66,130</td>
<td>Above Average</td>
</tr>
<tr>
<td>Cyclone Fence Dept., American Steel &amp; Wire Div., US Steel Corp. San Antonio, Texas</td>
<td>Furnished &amp; Installed Security Fence</td>
<td>120,350</td>
<td>Above Average</td>
</tr>
<tr>
<td>Refractory Const. Co.  Tulsa 12, Oklahoma</td>
<td>Furnished &amp; applied Gunite Lining to Required Areas.</td>
<td>233,820</td>
<td>Above average</td>
</tr>
<tr>
<td>Iowa Sheet Metal Contractors, Inc.  Des Moines, Iowa</td>
<td>Furnished &amp; Fabricated Sheet Metal Work In Ventillating &amp; Air Conditioning Systems</td>
<td>353,349</td>
<td>Above Average</td>
</tr>
<tr>
<td>Ceco Steel Prod. Co.  Houston 10, Texas Subcontracted With G &amp; N Corporation Houston 20, Texas</td>
<td>Supplied &amp; Installed Reinforcing Steel</td>
<td>1,797,770</td>
<td>Average</td>
</tr>
<tr>
<td>Johnson Elevator Constr.  Salina, Kansas</td>
<td>Placed, Finished &amp; Cured all Slip Formed Concrete in Silos</td>
<td>297,980</td>
<td>Average</td>
</tr>
<tr>
<td>Barber-Colman  Rockford, Illinois</td>
<td>Furnished &amp; Installed Automatic Control Devices</td>
<td>258,280</td>
<td>Average</td>
</tr>
<tr>
<td>NAME &amp; ADDRESS</td>
<td>SCOPE OF WORK</td>
<td>AMOUNT</td>
<td>EFFECTIVENESS *</td>
</tr>
<tr>
<td>-----------------------------------</td>
<td>-----------------------------------</td>
<td>----------</td>
<td>------------------</td>
</tr>
<tr>
<td>Premier Roofing Co.</td>
<td>Applied Waterproofing Membrane</td>
<td>$57,830</td>
<td>Average</td>
</tr>
<tr>
<td>Montebello, Cal.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Randall H. Sharpe, Cont.</td>
<td>Painted</td>
<td>169,690</td>
<td>Average</td>
</tr>
<tr>
<td>Oklahoma City 11, Okla.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parker-Fallis Insul. Co.</td>
<td>Furnished &amp; Installed all Insulation</td>
<td>243,490</td>
<td>Below Average</td>
</tr>
<tr>
<td>Dallas, Texas</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Rated effectiveness determined by opinion survey of the Project Engineers and Area Engineer
<table>
<thead>
<tr>
<th>CONTRACT NUMBER</th>
<th>MAJOR FEATURE OF WORK</th>
<th>CONTRACTOR OR MANUFACTURER, NAME &amp; ADDRESS</th>
<th>AWARD DATE</th>
<th>ORIGINAL CONTRACT VALUE</th>
<th>FINAL CONTRACT VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>DA-22-029-eng-4241</td>
<td>Facility Elevators, Furnish &amp; Install</td>
<td>Otis Elevator Co, New York 1, N.Y.</td>
<td>17 Feb 60</td>
<td>255,393</td>
<td>342,107.10</td>
</tr>
<tr>
<td>DA-22-029-eng-4249</td>
<td>Switchgear &amp; Panels</td>
<td>General Electric Co, Denver 1, Colo.</td>
<td>17 Feb 60</td>
<td>107,100</td>
<td>147,214.28</td>
</tr>
<tr>
<td>DA-22-029-eng-4266</td>
<td>Diesel Generators</td>
<td>White Diesel Eng Div, White Motor Co, Springfield, Ohio</td>
<td>26 Feb 60</td>
<td>748,692</td>
<td>999,795.98</td>
</tr>
<tr>
<td>DA-22-029-eng-4328</td>
<td>Blast Closures</td>
<td>Henry Pratt Co, Chicago 7, Ill.</td>
<td>25 Mar 60</td>
<td>104,499</td>
<td>139,316.01</td>
</tr>
<tr>
<td>DA-22-029-eng-4336</td>
<td>Air Cylinder Spring Supports</td>
<td>Boeing Airplane Co, Wichita, Kansas</td>
<td>25 Mar 60</td>
<td>55,205</td>
<td>85,320.00</td>
</tr>
<tr>
<td>DA-22-029-eng-4343</td>
<td>Overhead Door Hinge Assemblies</td>
<td>Boeing Airplane Co, Wichita, Kansas</td>
<td>28 Mar 60</td>
<td>177,039</td>
<td>233,932.00</td>
</tr>
<tr>
<td>DA-22-029-eng-4439</td>
<td>CBR Filters</td>
<td>Mine Safety Appl. Co, Pittsburgh 8, Pa.</td>
<td>6 Jun 60</td>
<td>6,705</td>
<td></td>
</tr>
<tr>
<td>DA-41-443-eng-5713</td>
<td>Package Water Chillers</td>
<td>W. M. Lockett &amp; Co, Ltd, Dallas 1, Texas</td>
<td>23 Feb 60</td>
<td>79,938</td>
<td>106,732.32</td>
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<tr>
<td>DA-41-443-eng-5720</td>
<td>Cooling Tower</td>
<td>Water Cooling Equip. Co, St Louis, Mo.</td>
<td>23 Feb 60</td>
<td>31,950</td>
<td>43,309.00</td>
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<tr>
<td>CONTRACT NUMBER</td>
<td>CONTRACTOR OR MANUFACTURER, NAME &amp; ADDRESS</td>
<td>ORIGINAL VALUE</td>
<td>FINAL CONTRACT VALUE</td>
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<td></td>
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<tr>
<td>----------------</td>
<td>--------------------------------------------</td>
<td>----------------</td>
<td>---------------------</td>
<td></td>
<td></td>
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<tr>
<td>DL-51-143-eng-5793</td>
<td>Dean Hill Corp., Indianapolis, Ind.</td>
<td>38,682</td>
<td>52,793.32</td>
<td></td>
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<tr>
<td>DL-51-143-eng-5777</td>
<td>Bennett Pumps, Salt Lake City, Utah</td>
<td>6,257.00</td>
<td>9,276.00</td>
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<tr>
<td>DL-51-143-eng-5751</td>
<td>Sewage Pumps, Minneapolis, Minn.</td>
<td>6,677.00</td>
<td>20,476.00</td>
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<tr>
<td>DL-51-143-eng-5741</td>
<td>Submersible Pumps, Milwaukee, Wis.</td>
<td>15,290.00</td>
<td>131,274.00</td>
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<tr>
<td>DL-51-143-eng-5754</td>
<td>Air Washer Dust Collector Units, Dallas, Texas</td>
<td>99,258.00</td>
<td>393,156.00</td>
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<tr>
<td>DL-51-143-eng-5755</td>
<td>AC Fan Coils, La Crosse, Wis.</td>
<td>29,737.00</td>
<td>27,965.00</td>
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<tr>
<td>DL-51-143-eng-5763</td>
<td>PLG Pressure Fans &amp; Blowers, Detroit, Mich.</td>
<td>16,967.00</td>
<td>27,240.00</td>
<td></td>
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<tr>
<td>DL-51-143-eng-5766</td>
<td>Centrifugal Fans, Hammond Inc., N.Y.</td>
<td>1,450.00</td>
<td>1,920.00</td>
<td></td>
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</tr>
<tr>
<td>DL-51-143-eng-5786</td>
<td>Axial Flow Fans, The Harvey P. Bertram Co., Cincinnati, Ohio</td>
<td>1,900.00</td>
<td>177,039.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DL-51-143-eng-5900</td>
<td>Propeller Type Fans, C &amp; L Manufacturing Co., Chicago, Ill.</td>
<td>2,640.00</td>
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</table>
### Precipitation

<table>
<thead>
<tr>
<th>Month</th>
<th>Normal (Inches)</th>
<th>Maximum of Record (Inches)</th>
<th>Minimum of Record (Inches)</th>
<th>24-hour Maximum (Inches)</th>
<th>Average No. of Days 0.01 Inch or More</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>0.88</td>
<td>3.10</td>
<td>T</td>
<td>1.97</td>
<td>5</td>
</tr>
<tr>
<td>February</td>
<td>0.91</td>
<td>4.07</td>
<td>T</td>
<td>2.17</td>
<td>5</td>
</tr>
<tr>
<td>March</td>
<td>1.12</td>
<td>4.36</td>
<td>0.00</td>
<td>2.78</td>
<td>5</td>
</tr>
<tr>
<td>April</td>
<td>2.47</td>
<td>9.80</td>
<td>0.09</td>
<td>4.63</td>
<td>7</td>
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<tr>
<td>May</td>
<td>3.68</td>
<td>13.19</td>
<td>0.05</td>
<td>6.78</td>
<td>8</td>
</tr>
<tr>
<td>June</td>
<td>2.69</td>
<td>8.40</td>
<td>T</td>
<td>4.35</td>
<td>7</td>
</tr>
<tr>
<td>July</td>
<td>2.50</td>
<td>7.95</td>
<td>T</td>
<td>3.81</td>
<td>5</td>
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<tr>
<td>August</td>
<td>2.09</td>
<td>15.70</td>
<td>T</td>
<td>4.34</td>
<td>5</td>
</tr>
<tr>
<td>September</td>
<td>2.60</td>
<td>10.53</td>
<td>T</td>
<td>5.13</td>
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<tr>
<td>October</td>
<td>2.57</td>
<td>10.88</td>
<td>0.00</td>
<td>5.10</td>
<td>5</td>
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<tr>
<td>November</td>
<td>1.02</td>
<td>5.82</td>
<td>0.00</td>
<td>2.16</td>
<td>5</td>
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<tr>
<td>December</td>
<td>1.37</td>
<td>6.69</td>
<td>0.00</td>
<td>4.57</td>
<td>4</td>
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</table>

Annual or Extreme: 22.55

### Temperature

<table>
<thead>
<tr>
<th>Month</th>
<th>Normal (Degrees F)</th>
<th>Maximum of Record (Degrees F)</th>
<th>Minimum of Record (Degrees F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>43.3</td>
<td>90</td>
<td>(b)</td>
</tr>
<tr>
<td>February</td>
<td>48.1</td>
<td>94</td>
<td>-9</td>
</tr>
<tr>
<td>March</td>
<td>55.1</td>
<td>98</td>
<td>-6</td>
</tr>
<tr>
<td>April</td>
<td>64.5</td>
<td>102</td>
<td>-7</td>
</tr>
<tr>
<td>May</td>
<td>71.7</td>
<td>106</td>
<td>25</td>
</tr>
<tr>
<td>June</td>
<td>79.8</td>
<td>110</td>
<td>33</td>
</tr>
<tr>
<td>July</td>
<td>83.1</td>
<td>110</td>
<td>44</td>
</tr>
<tr>
<td>August</td>
<td>82.8</td>
<td>111</td>
<td>54</td>
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<tr>
<td>September</td>
<td>75.5</td>
<td>106</td>
<td>48</td>
</tr>
<tr>
<td>October</td>
<td>66.2</td>
<td>100</td>
<td>35</td>
</tr>
<tr>
<td>November</td>
<td>53.7</td>
<td>91</td>
<td>23</td>
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<tr>
<td>December</td>
<td>45.8</td>
<td>89</td>
<td>13</td>
</tr>
</tbody>
</table>

Annual or Extreme: 64.1

### Notes
- (a) U.S. Weather Bureau normals for period 1921 - 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.
<table>
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<th>Contract</th>
<th>Milestone</th>
<th>Dates</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Silo Concrete</td>
<td>31 Nov 60, 2 Dec 60, 7 Dec 60, 11 Dec 60, 16 Dec 60, 21 Dec 60, 26 Dec 60, 30 Dec 60, 7 Jan 61, 12 Jan 61, 17 Jan 61, 22 Jan 61, 27 Jan 61</td>
</tr>
<tr>
<td>2</td>
<td>PLS' Vessels</td>
<td>31 May 61, 7 Jun 61, 17 Jun 61, 27 Jun 61, 7 Jul 61, 17 Jul 61, 27 Jul 61, 7 Aug 61, 17 Aug 61, 27 Aug 61, 7 Sep 61, 17 Sep 61, 27 Sep 61</td>
</tr>
<tr>
<td>3</td>
<td>Diesel Generators</td>
<td>31 May 61, 7 Jun 61, 17 Jun 61, 27 Jun 61, 7 Jul 61, 17 Jul 61, 27 Jul 61, 7 Aug 61, 17 Aug 61, 27 Aug 61, 7 Sep 61, 17 Sep 61, 27 Sep 61</td>
</tr>
<tr>
<td>4</td>
<td>Cable Trays &amp; Switchgear</td>
<td>31 May 61, 7 Jun 61, 17 Jun 61, 27 Jun 61, 7 Jul 61, 17 Jul 61, 27 Jul 61, 7 Aug 61, 17 Aug 61, 27 Aug 61, 7 Sep 61, 17 Sep 61, 27 Sep 61</td>
</tr>
<tr>
<td>5</td>
<td>H V and AC</td>
<td>31 May 61, 7 Jun 61, 17 Jun 61, 27 Jun 61, 7 Jul 61, 17 Jul 61, 27 Jul 61, 7 Aug 61, 17 Aug 61, 27 Aug 61, 7 Sep 61, 17 Sep 61, 27 Sep 61</td>
</tr>
<tr>
<td>6</td>
<td>L CC</td>
<td>31 May 61, 7 Jun 61, 17 Jun 61, 27 Jun 61, 7 Jul 61, 17 Jul 61, 27 Jul 61, 7 Aug 61, 17 Aug 61, 27 Aug 61, 7 Sep 61, 17 Sep 61, 27 Sep 61</td>
</tr>
<tr>
<td>7</td>
<td>Silo Electrical</td>
<td>31 May 61, 7 Jun 61, 17 Jun 61, 27 Jun 61, 7 Jul 61, 17 Jul 61, 27 Jul 61, 7 Aug 61, 17 Aug 61, 27 Aug 61, 7 Sep 61, 17 Sep 61, 27 Sep 61</td>
</tr>
<tr>
<td>8</td>
<td>Silo Cap &amp; Doors</td>
<td>31 May 61, 7 Jun 61, 17 Jun 61, 27 Jun 61, 7 Jul 61, 17 Jul 61, 27 Jul 61, 7 Aug 61, 17 Aug 61, 27 Aug 61, 7 Sep 61, 17 Sep 61, 27 Sep 61</td>
</tr>
<tr>
<td>9</td>
<td>Grading, Paving</td>
<td>31 May 61, 7 Jun 61, 17 Jun 61, 27 Jun 61, 7 Jul 61, 17 Jul 61, 27 Jul 61, 7 Aug 61, 17 Aug 61, 27 Aug 61, 7 Sep 61, 17 Sep 61, 27 Sep 61</td>
</tr>
<tr>
<td>10</td>
<td>Fencing</td>
<td>31 May 61, 7 Jun 61, 17 Jun 61, 27 Jun 61, 7 Jul 61, 17 Jul 61, 27 Jul 61, 7 Aug 61, 17 Aug 61, 27 Aug 61, 7 Sep 61, 17 Sep 61, 27 Sep 61</td>
</tr>
<tr>
<td></td>
<td>Completion of 10 Contract</td>
<td>31 May 61, 7 Jun 61, 17 Jun 61, 27 Jun 61, 7 Jul 61, 17 Jul 61, 27 Jul 61, 7 Aug 61, 17 Aug 61, 27 Aug 61, 7 Sep 61, 17 Sep 61, 27 Sep 61</td>
</tr>
<tr>
<td>ITEM</td>
<td>DATE STARTED</td>
<td>DATE COMPLETED</td>
</tr>
<tr>
<td>------</td>
<td>--------------</td>
<td>----------------</td>
</tr>
<tr>
<td>1. Open Cut</td>
<td>7-1-60</td>
<td>10-29-60</td>
</tr>
<tr>
<td>2. Shaft Work</td>
<td>8-25-60</td>
<td>1-16-61</td>
</tr>
<tr>
<td>3. LCC Concrete</td>
<td>9-30-60</td>
<td>12-17-60</td>
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<td>4. LCC</td>
<td>10-6-60</td>
<td>6-2-61</td>
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<tr>
<td>5. Silo Re-Steel</td>
<td>11-3-60</td>
<td>1-12-61</td>
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<tr>
<td>6. First Phase, Wall</td>
<td>11-4-60</td>
<td>12-22-60</td>
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<tr>
<td>7. First Lift</td>
<td>11-8-60</td>
<td>11-25-60</td>
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<td>8. Second Phase, Wall</td>
<td>11-29-60</td>
<td>12-18-60</td>
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<td>10. Silo Electrical</td>
<td>1-3-61</td>
<td>8-23-61</td>
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<td>11. Utility Tunnel</td>
<td>1-17-61</td>
<td>1-28-61</td>
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<tr>
<td>12. Backfill</td>
<td>1-27-61</td>
<td>8-1-61</td>
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<tr>
<td>13. Structural Steel</td>
<td>2-12-61</td>
<td>3-8-61</td>
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<tr>
<td>14. Parapet Wall</td>
<td>2-26-61</td>
<td>3-14-61</td>
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<td>16. Diesel Generators</td>
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<tr>
<td>17. Switchgear</td>
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<tr>
<td>18. Cable Trays</td>
<td>3-6-61</td>
<td>3-26-61</td>
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<tr>
<td>19. Sight Tube</td>
<td>4-1-61</td>
<td>3-26-61</td>
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<tr>
<td>20. Heat, Vent &amp; Air Conditioning</td>
<td>4-12-61</td>
<td>8-30-61</td>
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<tr>
<td>21. Water Cooling Tower</td>
<td>4-11-61</td>
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<tr>
<td>22. Entry Tunnel</td>
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<td>23. Water Treatment Building</td>
<td>4-13-61</td>
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<td>24. Grading, Fencing &amp; Fencing</td>
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<td>9-20-61</td>
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<td>25. Completion of Contract Work</td>
<td>7-1-60</td>
<td>9-22-61</td>
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<tr>
<td>MAJOR EQUIP. AND CRAFTS</td>
<td>QUANTITY</td>
<td>SHIFTS</td>
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<td>F. E. Loaders</td>
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<td>Office</td>
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<tr>
<th>TOTAL EMPLOYEE</th>
<th>SHIFT LENGTH (hours)</th>
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NOTE:

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

S-1, S-2, L-1 and L-4 = Conc. Mon. = Standard C.O.E. Bronze Disc in Conc. Post
L-2, L-3, L-2 and L-3 = Standard C.O.E. Bronze Disc Star Drilled into Concrete
C.E.M. "A" & C.E.M. "B" = Standard C.O.E. Bronze Disc Star Drilled into Concrete

\[ \Delta = 1/2 \]

\[ EL = 1793.991 \]
NOTE: Ground Plate 1-A is nearest to bottom of wall, and 9-B, 17-C, 25-D, and 33-E should be in numerical order up the wall, and directly above 1-A. (This is typical of each group of ground plates.)
## GROUND PLATE ANGLES AND ELEVATIONS

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<th>Actual</th>
<th>Call Elev.</th>
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<td>G.P. 33E</td>
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## SITE

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<td>G.P. 39E</td>
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</table>
COLLIMATOR BENCH MARK & ALIGNMENT
STATION HOUSING INSERT PLATES
SITE ALBANY

DEVELOPED ELEVATION INSIDE LCC STAIRWELL WALL
### KEY

**HORZ. DISTANCE FROM SILO W.P. TO POINTS**

1. 2. 3. 4.

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

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### SHOCK HANGER

<table>
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<th>SHOCK HANGER</th>
<th>1</th>
<th>2</th>
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<td>18&quot; LT</td>
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**CONTRACT CALL RADIUS = 26' 1"**
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, some of 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 have not been slowed by wrangles and disputes.

We cannot speak too highly of the nation, nor 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 sites. 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, however, 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 Horace Partlow

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

J. H. B. Zachry of San Antonio, one of the prime contractors on the 12 Atlas missile launching site at nearby Abilene and Dyess AFB, had reason to be proud of the formally turned over Oplin site.

No site over to Lt. Col. A. M. Anzalone of the Corps 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 site could have been changed because of changes and modifications ordered after the work got underway, but it was, originally, scheduled for Army Lt. Gen. E. P. Tock and delivery was planned.

Lt. Anzalone said a complete office was about to install the leadership of military officers and the entrance to this major central member near the south corner of the expressway site. Then through the days over to Col. W. R. B. Freeth, chief engineer's assistant, at Dyess AFB, who supervised the design for a number of military and civilian visitors.
Bustle at Missile Site

By Robert M. Brown

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 skimped along on the way to Opin Number One.

Sure enough, the wheat was fresh green, just beyond the muddy 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 Harford speeded motionless, blinking under a scrub oak.

Yet with it all there was an idyllic side.

spring is on us here with the occasional red hot people in the sun. At this place and time Opin Number One seems incredible, and what it stands for. Simply put, Opin Number One is a hole in the ground. Militarily, Opin Number One is a missile site—11th Air Force, Strategic Air Command, 819th Air Division, Brig. Gen. William E. Yanus, commanding. When finished Opin will be an Atlas ballistic missile ready to fly.

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 take concrete, reinforced steel, backfill, cranes, not to mention to sandblowers, 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 site and accessories. 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 are three feet thick had swung open. It could rise into outer space and fire a nuclear cone that could kill half the earth and the North Pole and serve a ball with killing missiles.

The Texas country proudly carries such names as Mud, Mustang, Terror, and Sweetwater Creek; the Eunice, Bustle Cap, Cloce. Now there are four trees while with blossoms, And the sight before in Abilene at the Brands Bowl, across at Highway 66, Ma and the kids were dancing old as the bell went down the alley and flashed them up.

Teens were bowling—Abilene Mexican Foods versus Akin's Pizza, Foremost Dairy versus Morris and Bum, and Jones Cleaners versus Abilene Abstract. Their shirts were salmon pink and turquoise. The delightful Texan spread out the conversation, lots of laughter. And when not watching the children played tag, in the background, an oldster barked a bit as is the Texan right: "The thing about west Texas is that you can sure see over yonder."
Missile in Repose

Now "ever yonder" has a new and strange meaning for Abilene, young and old. "Yonder" 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 debate 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, digging a 25-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 blio showing only its lip. They seem to be doing 60 different things—crawling through the steel structure inside or holding spattering 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 mass of girders, pipes, beams, grids, pulleys, wires. At each of the eight levels there is a spot where persons are.

There's a spot of these men of Texas, because the contractors, both H. B. Zachry and Down and Root, are from Texas. These lean men are hard, brown, a bit mean, with hard hats and a white grin. Larry Moore, like, "it's all right if you're doing something just do it well." This is hardly the expression since they're working hard.

But what a long generation of good and kind people. Behind it all is "safety." This means that the missiles—Atlas, Titan, and the Minuteman—are being developed at the same time that in all the sites—these holes—are dug and equipped. This is not only meant for everything that is possible to done at once on the hole, but there are changes. Larry Moore talks of modifications and then modifications in the modifications. That's what it is complicated with the turning out of what was put in before and what this time to what is going into equipment and structures. One that is in order of security, no "an entire series of false cues or cues."

The Abilene Center

The men in to say 25 miles away. The men are 60 and in stores. Then a 600-mile drive away, there's rough countr in the Abilene area. The town 2 miles; in the state, 3 miles.

Spread over this land is a system of communications, railroad, water, electric, and interments. There are about 1,800 men with the torches and the many wrenches, the pliers, and the hammers.

Multiply Oplin's organized effort with the men's efforts. Multiply the construction on the ground with the building in the electronic computer in San Antonio that tells him what to do next in the pipeline.

And standing aside as the modifications are made, the 12-site testing range in Air Force Col. H. L. Marson. He's self-asserting in his way, he's a man that uses most of his time—best his easy to get and he has several whole things that are coming down, including one that he's been involved in since 1957. He keeps the hurry-up job going.

At Ingleside in the Able site, the Able site is 40 miles to the south. The Able site is 40 miles to the south. The Able site is 40 miles to the south. The Able site is 40 miles to the south.
WINTERS EXCAVATION BEGINS

Digging 180-Foot Silos Begins Today at 1st Site

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

The site, located about two miles north of Opelus in southwestern Caddo Parish, is the first of 12 sites to be ready for the huge silos.

The shaft will be about 60 feet in diameter, placed near the center of a sloping excavation dug to a depth of about 40 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 southwest of Opelus Valley will be finished Friday and shaft work will begin possibly Monday.

Surface excavation work at the Lawn and Broadway sites will be completed Tuesday. Drilling plans begin during the first week of next month, Moore said.

At the site near Winters, Moore said, to begin about 40 feet of shaftwork on Monday. At Winters, the site was hit by a violent storm Thursday. At least two feet of water were in shafts, access tunnels are being planned to help complete the excavation.

Construction of the silos, to be built by Brown & Hares, will begin Thursday. Work at the remaining sites by Moore said the company's plans to start work at the next available time.
Three Atlas Sites Beating Schedule

By H. V. O'BRIEN

A major milestone in construction of the 18 Atlas missile launching systems is in the making now.

With completion of the site at the Olton site starting next, the contractors will be ahead of the contract schedule on the flood three sites, Lt. Col. A. M. Antonelli, area Corps of Engineers chief, said.

Shakeouts of two yards of cement each began going down into the firing pits here at the Olton site last Tuesday night and the tiles of the site began coming up.

The first explosive confirmation shot was being finished at a

The top is to support the physical

building the site, worked on by the 1,000 men and women by the first week of October. When the work is completed around the base, the other three sites will be ready for work.

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building the site, worked on by the 1,000 men and women by the first week of October. When the work is completed around the base, the other three sites will be ready for work.
By BOB BROOK

A happy crowd of more than 10 men pressed close to the one remaining barrier in a scene two miles south of Angeles Friday afternoon, their senses of pride intensified by muggy heat.

The barrier, 60 feet long and 10 feet high, was a ribbed steel plate which divided one of the 12 sites of the Atlas missile installation. The steel plate was removed, the remaining barrier was knocked down and the crowd moved in.

The crowd, led by Air Force Maj. Gen. James F. Flaherty and the commander of the 37th Strategic Missile Division, Col. H. D. Stufflebeam, went to the launching site of the Atlas missile that, according to the Air Force, had just been installed.

There was no sign of the missile as the crowd passed the 12th Street site and then the 13th Street site. The crowd then passed the 14th Street site and then the 15th Street site.

The crowd then turned to the corner of 15th Street and 16th Street, where the Atlas missile was being installed.

The crowd then turned to the corner of 16th Street and 17th Street, where the Atlas missile was being installed.

The crowd then turned to the corner of 17th Street and 18th Street, where the Atlas missile was being installed.

The crowd then turned to the corner of 18th Street and 19th Street, where the Atlas missile was being installed.

The crowd then turned to the corner of 19th Street and 20th Street, where the Atlas missile was being installed.

The crowd then turned to the corner of 20th Street and 21st Street, where the Atlas missile was being installed.

The crowd then turned to the corner of 21st Street and 22nd Street, where the Atlas missile was being installed.

The crowd then turned to the corner of 22nd Street and 23rd Street, where the Atlas missile was being installed.

The crowd then turned to the corner of 23rd Street and 24th Street, where the Atlas missile was being installed.

The crowd then turned to the corner of 24th Street and 25th Street, where the Atlas missile was being installed.

The crowd then turned to the corner of 25th Street and 26th Street, where the Atlas missile was being installed.

The crowd then turned to the corner of 26th Street and 27th Street, where the Atlas missile was being installed.

The crowd then turned to the corner of 27th Street and 28th Street, where the Atlas missile was being installed.

The crowd then turned to the corner of 28th Street and 29th Street, where the Atlas missile was being installed.

The crowd then turned to the corner of 29th Street and 30th Street, where the Atlas missile was being installed.

The crowd then turned to the corner of 30th Street and 31st Street, where the Atlas missile was being installed.

The crowd then turned to the corner of 31st Street and 32nd Street, where the Atlas missile was being installed.

The crowd then turned to the corner of 32nd Street and 33rd Street, where the Atlas missile was being installed.

The crowd then turned to the corner of 33rd Street and 34th Street, where the Atlas missile was being installed.

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The crowd then turned to the corner of 36th Street and 37th Street, where the Atlas missile was being installed.

The crowd then turned to the corner of 37th Street and 38th Street, where the Atlas missile was being installed.

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The crowd then turned to the corner of 42nd Street and 43rd Street, where the Atlas missile was being installed.

The crowd then turned to the corner of 43rd Street and 44th Street, where the Atlas missile was being installed.

The crowd then turned to the corner of 44th Street and 45th Street, where the Atlas missile was being installed.

The crowd then turned to the corner of 45th Street and 46th Street, where the Atlas missile was being installed.

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The crowd then turned to the corner of 49th Street and 50th Street, where the Atlas missile was being installed.

The crowd then turned to the corner of 50th Street and 51st Street, where the Atlas missile was being installed.

The crowd then turned to the corner of 51st Street and 52nd Street, where the Atlas missile was being installed.

The crowd then turned to the corner of 52nd Street and 53rd Street, where the Atlas missile was being installed.

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The crowd then turned to the corner of 54th Street and 55th Street, where the Atlas missile was being installed.

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The crowd then turned to the corner of 56th Street and 57th Street, where the Atlas missile was being installed.

The crowd then turned to the corner of 57th Street and 58th Street, where the Atlas missile was being installed.

The crowd then turned to the corner of 58th Street and 59th Street, where the Atlas missile was being installed.

The crowd then turned to the corner of 59th Street and 60th Street, where the Atlas missile was being installed.

The crowd then turned to the corner of 60th Street and 61st Street, where the Atlas missile was being installed.

The crowd then turned to the corner of 61st Street and 62nd Street, where the Atlas missile was being installed.

The crowd then turned to the corner of 62nd Street and 63rd Street, where the Atlas missile was being installed.

The crowd then turned to the corner of 63rd Street and 64th Street, where the Atlas missile was being installed.

The crowd then turned to the corner of 64th Street and 65th Street, where the Atlas missile was being installed.

The crowd then turned to the corner of 65th Street and 66th Street, where the Atlas missile was being installed.

The crowd then turned to the corner of 66th Street and 67th Street, where the Atlas missile was being installed.

The crowd then turned to the corner of 67th Street and 68th Street, where the Atlas missile was being installed.

The crowd then turned to the corner of 68th Street and 69th Street, where the Atlas missile was being installed.

The crowd then turned to the corner of 69th Street and 70th Street, where the Atlas missile was being installed.

The crowd then turned to the corner of 70th Street and 71st Street, where the Atlas missile was being installed.

The crowd then turned to the corner of 71st Street and 72nd Street, where the Atlas missile was being installed.

The crowd then turned to the corner of 72nd Street and 73rd Street, where the Atlas missile was being installed.

The crowd then turned to the corner of 73rd Street and 74th Street, where the Atlas missile was being installed.
GLOBAVER

CEWCO

ABAY

GEC

HA Form 230

FE

ABIT

Modified Proctor Curve

AFBC

AL

EBC

EC

LCE

ENA

I & C

EYEO

Corps of Engineers Ballistic Missile Construction Office

Site Activation Team, Air Force

Change Order Conference

Document used for transfer of completed facility from construction agency to using agency

Evaporant Heating System

Real Property Installed Equipment

Curve formed on a graph where results of laboratory densities are plotted against moisture content of material sampled

Air Force Ballistics Missile Division

Department of the Army

Engineering

Special Conditions of the Contract Specifications

Launch Control Center

Kilovolt Amperes

Installation and Check-out

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


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. 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, from city mains at one site, and was pumped from ponds, lakes, or streams at the remaining sites.

1. Site Location Map DOC 1.
2. Site No. 2 (Baird), Site No. 3 (Denton) and Site No. 7 (Hulen).
3. Site No. 10 (Alhama)
The geology of the area varied greatly from site to site.\textsuperscript{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.\textsuperscript{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

\textsuperscript{4} Rechtel Corporation Geologic Map DOC 2.

\textsuperscript{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.
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 CEEMCO, SAWF, 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 contractual and non-contractual claims for the Area. Processed settlement of contractual documents as delegated by the Office of Counsel, CEMCO. 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
genral 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 impress 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 railroad.

**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, of SAAV 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 addenda 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 EN 415-4-131. 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 EMO Form 230 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 comments as to desirable additions 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 FIS 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 FIS Division of CEMCO; provided technical advice on FIS matters during the construction, installation and field operational testing stage for final acceptance; coordinated activities of FIS inspectors on operational sites and support facilities; conducted FIS inspector training; coordinated with all branches of the
Area Office in phases of their work involving FLS equipment or materials; supervised operation of FLS fluid testing laboratory; supervised operation and maintenance of Government furnished FLS test equipment used by the contractor; furnished direct surveillance of FLS 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
LABORATORY BRANCH

The laboratory work was accomplished by Corps of Engineer personnel in a separate laboratory branch set up under the Area Engineer. The function 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 MLS 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 E. J. McCarvey, who was designated as Deputy for Acceptance. 6

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 AFB&O 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 SAMAF 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, 17½ feet deep with a diameter of 52' 2". This silo was to house 329 tons of structural steel to be suspended from the silo walls at four points through shock hangers by spring loaded rods. 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. In addition

7. See photos 5 thru 15.
8. See photos 16, 17, 18, 20 and 29.
9. See DOC 5.
to those 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.\textsuperscript{10} This was to be a reinforced concrete structure of two floors, completely underground.\textsuperscript{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.\textsuperscript{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.\textsuperscript{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 $21,998,000 and the low bid was $20,075,000. The Government Estimate was $22,584,544.

The low bidder was a joint venture composed of H. A. Zachary Company and Brown and Root, Inc. The contract was

\begin{itemize}
\item \textsuperscript{10} See photos 25 thru 32.
\item \textsuperscript{11} See DOC 6.
\item \textsuperscript{12} See photo No. 26
\item \textsuperscript{13} See DOC 7.
\end{itemize}
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. 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 80-42 of the Contract Specifications. 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 D-20s, one Michigan dozer and one D-8 "Pusher".

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15. See DOC 9.
Interceptor "Y" 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 D-11s 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 utilized.

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 site 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 seam 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 Y-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. Lime rock bad 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 1/4 foot 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 904, 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:

<table>
<thead>
<tr>
<th>DRILLING</th>
<th>HOLE DEPTH</th>
<th>MASTING</th>
</tr>
</thead>
<tbody>
<tr>
<td>26 July 1960</td>
<td>15 ft.</td>
<td>27 July 1960</td>
</tr>
<tr>
<td>3 August 1960</td>
<td>21 ft.</td>
<td>4 August 1960</td>
</tr>
<tr>
<td>11 August 1960</td>
<td>21 ft.</td>
<td>13 August 1960</td>
</tr>
<tr>
<td>18 August 1960</td>
<td>20 ft.</td>
<td>19 August 1960</td>
</tr>
<tr>
<td>26 August 1960</td>
<td>12 - 15 ft.</td>
<td>27 August 1960</td>
</tr>
</tbody>
</table>
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. Then 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.

**BENTON 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 D4-D6 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 D4-D6s. 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 10 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 levees and "Y" 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 and of the excavated area.

Fire bedrock was encountered 13 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 1/4 feet deep. The holes were loaded with 8 pounds of gelsmite, using decked method. The yield per shot was 1.6 cy per pound of gelsmite or 0.62 pound gelsmite 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 gelsmite 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 24 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 near 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-60 scrapers, D-3 "Cat", D-8 "Pusher" and motor patrol grader.

Interception drainage was provided by Contractor in the form of a barn 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 Beallid 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 loose 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 933 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 ceased 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-3 "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 962 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 loose material.

Open cut excavation to reference elevation approximately 960.5 was completed on 7 July 1960. Excavated materials were stockpiled in designated waste areas to the east, west and southwest 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 932 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 shoveling 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 and loader. This test blast was sufficient in that it revealed the break up of the materials would be satisfactory, so lime 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 gelignite. Firing sequence was from center 1, 2, 3,
pitching all material to center of silo. Approximately \( \frac{1}{2} \) pound galmite 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 "galmite" 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 E-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 D-20 scrapers was hauled and stockpiled in designated waste areas on site.

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.

WINTER SITE

Contractor started common open cut excavation 28 June 1960 using D-20s, three dosers and a grade. Excavation was accomplished by ripping ahead and pushing D-20 scrapers.
Interception drainage was provided by ditching on west side of cut, around north and east. 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 dipping 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 "transcavator" (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 "transcavator", 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 1-inch holes were required for each shot. Approximately 1/4 pound of Hercules galatin dynamite was used per cubic yard of excavated...
material. (Bottom of third shot at elevation 626). 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 piles. 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.

FIELD SITE

Contractor started site grading and stripping operation 20 June 1960 utilizing DW-20s, B-6s 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 bench 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 severely 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 loose 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 clamshell was used to remove loose 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 beam. 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.
MOLAH 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-3 "pusher" 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 1.5 - 2ft. 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 150 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 3600 pounds were used. The center holes were fired by instantaneous electric caps with connecting primacord and the concentric circles of holes were progressively fired by delayed electric caps and primacord. 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 circles 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 grout. 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.

ANCHOR HITE

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 23 July 1960 the excavation
equipment for the open cut was moved onto the site with four
20 yard scraper 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 vege-
tation 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 southeast.

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 20 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 Cippolatti 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 wall point system established on an open cut bench ledge, 15 feet below ground surface with wall 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 30 to 30 feet) was sucked 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 Koerner Dumpster 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 rotoer 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 1/3 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 654, 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 643 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, 8-8 dozers and motor patrol grader.

Interception 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.

Milo 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 crews with chamballs 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 920' 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 and 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 320 to 332. At reference elevation 332 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 347, 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 loosening 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 wall, 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 1.23' through the brittle and fractured shale and soft seams. From reference elevations 954 to 920 firm layers of red mottled greenish-gray shale would occur 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.
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 contractor's operation until common open cut excavation was completed on 26 July 1960 when rock was encountered at reference elevation 971 and contractor attempts to break the medium hard limestone ledge with a heavy duty router 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 elevation 823 was limestone separated by small layers of shale, all approximately horizontal. Shale layers had a tendency to erode and weather rapidly following exposure. The weather had no apparent affect on the limestone.

Open cut rock excavation was in progress from 13 August 1960 after drilling and blasting operation at reference elevation 971 to 16 August 1960 when work area reach 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 Bucyrus 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'. Those were then loaded with powder and then blasted.

ALBANY SITE

The Contractor started common open cut excavation 14 July 1960 using EW-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).

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.\textsuperscript{10} 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 hour. 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 1,000 began as soon as the initial set of the silo walls was achieved.\textsuperscript{19} As the installation of the reinforcing steel neared completion the exterior form was started. This

\textsuperscript{10} See photos No. 11, 12 and 13.
\textsuperscript{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, SAFB and CD/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 AFFECTING 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 9C-7b of the contract specifications out forth the weather conditions which could be expected, the 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 - 1950.20

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 51.68 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.

20. 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 Shop 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 complex, the sequence of completion of the various sites was changed due to delays experienced at some of the sites in some of the early phases of the work and

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 E6 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 $132,800 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. 196.

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. Manson
USAF, Site Activation Task Force Commander by Lt. Colonel
Albert M. Antonelli, Area Engineer, CERMAC.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. Garrity, USAF, Commander of AMC Ballistic
Missiles Center awarded the Air Force Commendation Medal to
Lt. Colonel Antonelli.24

Mr. H. E. Zachry was presented the Commander’s Award by
General Garrity. As president of H. E. 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. E. Zachry
Company and Brown and Root, Inc. by Colonel Thomas B. Hayes,
U. S. Army, Commander, CERMAC.25

23. See photo 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 overall water supply and supply line picture developed as follows:

<table>
<thead>
<tr>
<th>SITE</th>
<th>SUPPLY SOURCE</th>
<th>SUPPLY LINE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weatherford Lake</td>
<td>City</td>
<td>Contract</td>
</tr>
<tr>
<td>Baird</td>
<td>Wells</td>
<td>Contract</td>
</tr>
<tr>
<td>Denton</td>
<td>Wells</td>
<td>Contract</td>
</tr>
<tr>
<td>Lawton</td>
<td>Wells</td>
<td>Contract</td>
</tr>
<tr>
<td>R_RW_11024052</td>
<td>Wells</td>
<td>Contract</td>
</tr>
<tr>
<td>Shelp</td>
<td>Wells on Site</td>
<td>Not required</td>
</tr>
<tr>
<td>Nolen</td>
<td>Wells</td>
<td>Contract</td>
</tr>
<tr>
<td>Arteson</td>
<td>City</td>
<td>City</td>
</tr>
<tr>
<td>Corinth West</td>
<td>City</td>
<td>Contract</td>
</tr>
<tr>
<td>Albany</td>
<td>City</td>
<td>City</td>
</tr>
<tr>
<td>Oplus</td>
<td>Well</td>
<td>Contract</td>
</tr>
<tr>
<td>Winters</td>
<td>City</td>
<td>City</td>
</tr>
</tbody>
</table>

Contract No. DL-01-443-eng-7963 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-Ehix 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 $177,330.

A Missile Assembly Building was constructed under Contract No. DA-41-443-ENG-5967 which was awarded to MacDill 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 23 October 1960. The original contract amount was $349,748 which was modified to $259,467 by ten (10) change orders.28

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

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 $195,000.

All of these support facility contracts have been completed.
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 these 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 interfered with a complete

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.\\footnote{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.\\footnote{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

\\footnote{31} See photo No. 15.
\\footnote{32} See photo No. 19.
largest single item which permitted the timely completion of the project.\textsuperscript{33}

\textbf{PROBLEM:} To protect the installed equipment in the silo from weather.

\textbf{SOLUTION:} The first attempt to solve this problem resulted in failure as the Contractor set up tarps over the silo opening in a tent arrangement, suspended from a beam which laid from one open door to the other.\textsuperscript{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 polyethylene.\textsuperscript{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.

\textbf{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).

\textbf{SOLUTION:} Three doubled one inch cables were craned in place with the concrete of the door with a loop protruding above the surface of the concrete.\textsuperscript{36} These cables were to have been cut off after the doors were opened and anchored, but were

\textsuperscript{33} See DOC 13.
\textsuperscript{34} See photo No. 26.
\textsuperscript{35} See photo No. 33.
\textsuperscript{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 semi-permanently 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 Telexon 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
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 Byass 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

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.33

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 so 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 LOC 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

33. See LOC 25.
footing and column arrangement to assist in supporting the weight of the vestibule or (2) 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 slope 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 seawall, vessel or breakwater 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 tolerances was demanded of the construction contractor only to learn that the item to be installed later did not have a critical location or that skins 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
CONTRACTORS' RELATIONS WITH LABOR

Much of the credit due the prime contractor for completing the construction of the Iyengar 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, or 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. A. Eckert & Brown and Root, which was non-union. It should also be noted that no work stoppage 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 Right Hour Law by H. A. Eckert & Brown and Root and their sub-contractor, C & N Construction Company, was begun by OFSDC Labor Relations Branch 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. A. Eckert Company & Brown and Root, Inc., file No. L-3-65-61-3. In brief, the final findings and determination were that the Contractor had underpaid 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

39. See DOC 16.
The original amount of Contract No. DA-41-003-eng-5078 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.\textsuperscript{40} These assigned contracts were added to the prime contract by two modifications, numbers 25 and 30. The total amount of the assignment was $3,098,969.03 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 FIS vessels. The net total contract amount at the time of this report is $30,558,184.02 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 Raylor Forge Company for approximately $1,264,063 and time extensions for performance of certain

\textsuperscript{40} See Doc 9.
"sweat" 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 judgment against him by the NELA 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

DYES

CLAIMS SETTLED (OVER $100,000)

1. Contract No. DA-41-043-ENB-5878


3. Modification No.: 96


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: $203,410

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.
MODIFICATIONS (NEGOTIATED)


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 94.5.0 feet. No acceleration as such was authorised. The original authorisation was issued on the basis of preliminary instructions, revised by a preliminary drawing and finalized on the basis of drawing No. AFMD-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

CHANGES ISSUED (OVER $100,000)

Contract No. DA-41-003-ENG-5378
Modifications, Change Order No. 17 (RI-17)
M. R. Zachry Co. & Brown & Root, Inc.


2. Date: 10 Sep 60

3. Received by Contracting Officer: 14 Sep 60

4. Presented to Contractor: 15 Sep 60


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 - $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: $723,473.58, 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, E.V. & A.C. cost 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 $1,808,305, but agreed to settle for $1,036,560.
ATLAS F

DYESS

CHANGES ISSUED (OVER $100,000)

Contract No. DA-41-043-EM-5878
Modification No. 37 (U-1 and U-2) (RI-37)
H. B. Zachry Co. & Brown & Boot, Inc.

   EMMA-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 CBR/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 milo. No escalation 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 $109,568.00. The contractor has submitted
   a revised proposal on 1 Aug 61 for an amount of $159,243, but agreed
   to settle for $108,108.
CHANGES ISSUED (OVER $100,000)

Contract No. DA-41-044-6598
Modification No. 65 (RI-74)
H. B. Zachry Co. & Brown & Root, Inc.


2. Date: 19 Jan 61

3. Received by Contracting Office: 8 Mar 61

4. Presented to Contractor: 9 Mar 61


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 23 Apr 61

8. Remarks: The work included in this change consists of modification of LCC'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.
1. Contract No.: DA-41-003-MEC-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 room allowed was inadequate.

The modification was not included in the previous CCE.
ATLAS F

CHANGES ISSUED (OVER $100,000)

Contract No. DA-11-443-EMI-5878
Modification, Change Order No. 17 (RI-17)
K. E. Kennedy Co. & Brown & Root, Inc.


2. Date: 10 Sep 60

3. Received by Contracting Officer: 14 Sep 60

4. Presented to Contractor: 15 Sep 60


6. Notice to Proceed: 15 Sep 60

7. Cost Estimates:

   A. Available to CCF/COC - N/A

   B. Government Estimate at beginning of negotiations:

      Amount - $553,096, 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 $1,038,653. The contractor has verbally on 16 Sep 61 raised his proposal to $1,203,305, but agreed to settle for $1,036,560.
ATLAS F

MODIFICATIONS (NEGOTIATED)

1. Source of Modification: COC 419, LR 2307, 9 Sep 60:
   Message ENMA-70-1839, 16 Sep 60; Letter ENMA-70-5, 5 Oct 60,
   Subject: "Army Silo (Atlas F) Electromagnetic Pulse Screen"
   Letter ENMA-70-4B, 29 Oct 60, Subject: "Atlas Silo Squadron,
   Dyess AF" Contract DA-41-003-eng-5973, Mod. No. 20 (RL-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 (Rechtel 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 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 estab-
   lished 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
The original authorization was issued on the basis of preliminary instructions, revised by a preliminary drawing and finalized on the basis of Drawing No. AFMD-1-5-45. The final Government Estimate of cost of $106,754 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.
ATLAE F

CHANGES ISSUED (OVER $100,000)

Contract No. DA-41-043-EMI-5878
Modification No. 37 (U-1 and U-2) (Rl-37)
H. R. Mackey Co. & Brown & Root, Inc.

   Letters, EMMA-AD-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.


7. Cost Estimates:
   A. Available to CBO/COC: $24,000 (No estimate for COC
      505).
   B. Government Estimate at beginning of negotiations:
      Source: Prepared by Area Office.
   C. Latest estimate of settlement: $109,108.00.

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

9. Remarks: The work included in the change consists of
   modifications to facility piping, 6th level floor sink, pipe and
   duct hangers in the site. 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 $109,360.00. The
contractor has submitted a revised proposal on 1 Aug 61 for an amount of $159,243, but agreed to settle for $108,106.
ATLAS F

MODIFICATIONS (NEGOTIATED)

Contract No. DA-41-043-ENG-5878
Modification No. 49 (U-4)

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

1. Source of Modification: COC 505, LR 2458, 23 Nov 60;
   COC 527, Letter 2662, 15 Dec 60; Letter HNDA-AB-1, 26 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 - $34,680
      
      Source - Prepared by Area Office
      
   C. Contractor's Initial Proposal and Date: $134,558.52,
      15 Mar 61

8. Negotiated Amount: $109,384

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, addi-
   tion of damper VF-21 and revisions of UV-3" and UV-1\frac{1}{2}" to DC-80
   and DC-21 to agree with vendor furnished equipment connections.
   The changed work was authorized on the basis that a time exten-
   sion, if applicable, would be negotiated and applied to all 12 sites.
   No acceleration as such was authorized. The final Government
Estimate of Cost of $109,554 was higher than the original estimate because of increased labor costs based on more experience, allowance for equipment not previously included, addition of deeper VD-21, and miscellaneous additional costs for scaffolding, welding operations, etc.
CHANGES ISSUED (OVER $100,000)

Contract No. DA-41-043-ENO-5878
Modification No. 65 (WI-74)
N. B. Shackly Co. & Brown & Root, Inc.


2. Date: 19 Jan 61.

3. Received by Contracting Officer: 8 Mar 61.


7. Cost Estimates:
   A. Available to COO/COC - $52,000.
   B. Government Estimate at beginning of negotiations:
      Amount: $64,502
      Source: Prepared by Area Office.

   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 LOC's to provide 2na soil 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 $333,695, but agreed to settle for $135,837.
ATLAS 1

MODIFICATIONS (NEGOTIATED)

Contract No. DA-41-003-EM-5070
Modification No. 71
N. R. Zachry Co. & Brown & Root, Inc.

1. Source of Modification: COC 583, 16 Feb 61: Letter
   KEMMR-AB-1, 16 Mar 61. Subject: "Modification to Guide Rail
   Supports, New Loads on L/P to Crib Locks, and Crib Diagonal
   Bracing, Dyess AFB, Contract 5070".

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 583 - 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: $208,386.28, 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/P 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

DRESS

MODIFICATIONS (NEGOTIATED)

Contract No. DA-41-0-443-EN-5873
Modification No. 88
H. R. Zachry Co. & Brown & Root, Inc.

1. Source of Modification: COC 612, 5 Apr 61; Letter ENWA-AB-1, 16 May 61, Subject: "Modification to Air Washer Dust Collector and Dust Entrance to Blast Closure No. 3, DRESS AFB, Contract 5873".

2. Date: COC 612 Dated 5 Apr 61

3. Date Received by Contracting Officer:

4. Date Presented to Contractor: 28 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 - $60,340
      Source - Prepared by Area Office
   C. Contractor's Initial Proposal and Date: $438,640.20, 1 Aug 61

8. Negotiated Amount: $441,360

9. Remarks: The work included in the change consists of the addition of a volumetric 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 V

PRESS

CLAIMS SETTLED (OVER $100,000)

1. Contract Number: DA-41-003-MD-5978


3. Modification Number: 96


5. Date of Modification: 13 Jan 61.

6. Date Received by CCR: 7 Jan 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 erie 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

DYES

CLAIMS SETTLED (OVER $100,000)

1. Contract Number: DA-41-043-EN3-5978

2. Contractor: J. 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 Jan 61, on Area Letter, 14 Apr 61, Subject: "C-30, Extending Work Areas Around Silos and LCCs, Contract No. 5978".

5. Date of Modification: 26 Jul 61

6. Date Received by COR: 16 Jun 61

7. Date Negotiation Completed: 26 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 room allowed was inadequate. The modification was not included in the previous CCE.
ATLAS Y

DYESI

MODIFICATIONS (NEGOTIATED)

Contract No. DA-41-043-ENG-5978
Modification No. 11¼
R. A. Zachry Co. & Brown & Root, Inc.


2. Date: Claim Nos. G-63, 14 Jul 61; G-106, 23 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 CCC - 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: $135,238.50

9. Remarks: The work includes settlement of 1¼ contractor's claims for revisions of hangers and supports, bonding and grounding of various items, revision of filter housing, provision of riser 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

MEWS

MODIFICATIONS (NEGOITIATED)

Contract No. DA-41-043-ERU-5878
Modification No. 115

M. E. Zachary 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; RD Form 96, 17 Nov 61, Subject: "Outstanding Claims - Contract DA-5878 - Mews".

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: $267,699.31
      Source: Prepared by Area Office
   C. Contractor's Initial Proposal and Date: $370,344
(Various dates)

8. Negotiated Amount: $267,533

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.
MODIFICATIONS (NEGOTIATED)

Contract No. DA-41-003-MD-5878
Modification No. 117
M. H. Zachry Co. & Brown & Root, Inc.


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: N/A

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 Emanuel L. Ariape, a labor-halper employed by Pecky-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 Ariape 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. House (a local doctor) pronounced Ariape 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 mats in open areas.
3. Proper safety instructions to workers.
4. All sites 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. R. W. Bagdade, Electrical Foreman, employed by Zachary-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. Bagdade was pronounced dead on arrival at the Hendricks Memorial Hospital, Abilene, Texas by Dr. Guerra. 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 Bardnessen, Inc. The accident occurred while the deceased was working on PL3 system piping on Level No. 7. The deceased was working off of a scaffold over-hanging the missile opening and fall 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
then fall 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 - DYES

Personal Injury Accidents

Total Manhours worked 2,342,545
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 6.11

Army Motor Vehicle Accident Summary

Dyes 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 62 feet to 63 feet at the silo end and from 55 feet to 53 feet at the LCC end. This increased the amount of the excavation at each site by approximately 20,000 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

VISTI TO 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 ceremoniability 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 CERCO in the ceremonies conducted in the acceptance of the first site (Opina No. 11). 41

General Garrity, Commander AFHMD, General Welling, Commander CERCO, Colonel Hays of CERCO, 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 Commandant Medal 43 and Mr. E. E. Zachry, Representing E. E. Zachry Company and Brown and Foot, 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.C. 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

45. See photo F2.
46. See appendix I.
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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. 59 gpm 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\(\frac{1}{2}\):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.
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.
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 TUN-
NEL. 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 SU-
PHATE CRYSTALS, AS MARKETED BY HALLI-
BURTON PR. GROUTING CO. NOTE FLEXIBLE
WATER LINES ON LEFT.
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 TARP- IN 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 P.L.S TEST SET UP.
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.
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.
SITE 8 ANSON

VIEW OF INTERIOR, FIRST LEVEL,
LAUNCH CONTROL CENTER SHOWING THE
COMPLETED CONCRETE SURFACE.
NOTE FLEXIBLE CONNECTIONS BE-
TWEEN OUTSIDE CONCRETE "SHELL" AND
INTERIOR STRUCTURE.
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.
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.
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.
SUPPORT DOCUMENTS