reprocessing.

When installation of a pipe spool was made to that portion of the system already installed, argon gas was used as the purge media. After completion of the joint make-up and during stand-by, the system was maintained with a positive pressure of argon gas to prevent contamination from being introduced into the system. The unconnected ends were kept sealed until the next section was ready for installation.

After the start of field installation, in an attempt to reduce installation costs, nitrogen gas was approved for use as the welding backup gas and system blanket media. The cost of the argon gas was approximately ten times the price of the nitrogen gas.

This use of nitrogen gas presented field problems not associated with the use of argon gas. The nitrogen gas, not being a chemically inert gas, caused the formation of nitrides during the welding operations. As the nitrides created a hazardous condition in the presence of liquid oxygen, they were not acceptable. Also the techniques using nitrogen gas as a backup during welding are more critical than with argon. With nitrogen, the gas inclosure surrounding the weld zone could not be maintained completely void of oxygen. Therefore, there was a development of undesirable oxides during the welding operation. After discovery that there was oxide and nitride contamination due to the nitrogen gas welding, the approval to use nitrogen gas was revoked. Those welds installed using nitrogen as a backup gas were removed from the system and replaced with argon backed welds.

Problems of mis-fabrication and interferences in the field necessitated the refabrication of many pipe spools. As alignment was a critical requirement, to prevent forcing of pipe into place during installation, pipe was field reworked or returned to the shop for refabrication to correct mis-alignment. Design interference and interferences created by layout drawings not complying with the contract plans also necessitated the rework and/or complete refabrication of pipe spools. Spools reworked in the field were routed to the cleaning facility for cleaning prior to installation in the system.

The contractor fabricated some pipe spools to connect to Government furnished equipment for which he was supplied the manufacturer's drawings prior to actual receipt of the equipment. The equipment received did not always conform to the manufacturers' drawings and necessitated some refabrication of pipe spools. As the Government furnished the system vessels, the cost for this refabrication was done at the expense of the Government.

Because of the expansion and contraction of the cryogenic lines and shock loading requirements of the complete PLS, extensive use was made of expansion joints and flexible metal hose in the piping system. As the design movements of the joints and hose were based on predetermined installed dimensions, the proper installation was critical. The joints and hoses were not used to make up construction misalignment or any deficiencies in the prefabricated pipe spools.

A problem was encountered in the cleanliness acceptance of the hoses and joints at the construction sites. Although the units were cleaned at the point of manufacture, and sealed, upon inspection at the sites the units were found to be contaminated. Recleaning of some of the expansion joints and all the flex hoses was accomplished. The convolution type construction of both the flex hoses and expansion joints made the cleaning and inspection extremely difficult. Cleaning was accomplished by blowing hot, clean, dry, filtered nitrogen gas through the units while simultaneously rapping or vibrating the item. Inspection was performed by flushing isopropyl alcohol through the hose and taking a millipore extraction of the effluent of the flushing media. If the millipore filter was found acceptable, the item was dried, sealed and delivered to the sites for installation.

PLS SYSTEM COMPONENTS

All the valves, filters, pumps and associated PLS equipment were furnished by the Government to the construction contractor for installation. All the equipment was received from a common supplier who acted as a broker to handle all the varied items to be supplied. All the items were certified at the point of manufacture as being clean, and arrived at Beale sealed in accordance with the specifications.

Upon receipt at the construction site, the contractor refused to install the items without first performing his own inspection to assure that they met the required standards of cleanliness. A facility was set up to handle and process the items for inspection and any necessary recleaning. Visual, wipe, black lite and millipore examinations were made on each item.

All the items required a flushing with isopropyl alcohol as they did not pass the initial millipore examination. Numerous fibrous particles in excess of 150 microns were evidenced during the millipore extraction. After a thorough investigation of the flushing facility and the procedures used, it was determined that the fibrous contamination was introduced by the alcohol. The fibrous particles were an inherent characteristic of the alcohol. The use of other flushing reagents was researched but the advantages of the alcohol outweighed the problem with the fibrous contamination. Two millipore filters in series were installed in the alcohol system. With a constant recirculation and frequent changing of the alcohol, it was possible to obtain a clean media for the inspection and cleaning procedures.

Additional time and effort was expended in removal of fluorescent stains that were present in the PLS valves. The alcohol would not remove this hydrocarbon contamination. Trial attempts were made with other cleaning agents such as trichloroethylene acetone, hydrochloric acid and caustic solutions without success. The installation of an ultrasonic cleaner, utilizing chlorothane as the wetting agent, successfully removed the fluorescent contamination.

A field installation problem was encountered with the socket weld control valves manufactured by Powell Company. Excessive heat concentration in the seat area, during the field welding of the PLS piping into the socket weld body, caused distortion of the seating surface. This resulted in an excessive leakage past the seat. Shop welding, with controlled heat conditions, of a nipple pipe spool into the valve body prior to field installation eliminated the field distortion problem. Those valves installed without the nipple piece that had distorted seats were lapped in place to provide the proper seating surface necessary to prevent excessive leakage.

The Kieley-Mueller, Inc. automatic control valves failed at the valve seat and plug. This failure occurred after all the valves had been field installed. The material of the seat and plugs of the furnished valves were not of the stellite-surfaced material required by the specifications. During valve operation, the pressure on the control diaphragm closing the valve exerted a force that caused the "soft" plug and seats to scour and break on contacting each other. All the valves were disassembled and inspected in their installed position for damage. Damaged seats and plugs were replaced in approximately 25% of the furnished valves.

Considerable difficulty was encountered with the components that were connected to the piping with threaded joints. (Such as Pressure Regulating Valves, Control Valves and Check Valves) Design criteria specified that no lubricants or sealants were to be used on threaded joints. During acceptance testing, the dry joints presented a serious leakage problem. As these units were not provided with break outs for easy removal, endeavors were made to seal the leaks in the installed position. An attempt to back-solder or braze the joints proved unsuccessful. The excessive heat build-up during the brazing operation caused distortion to the body and/or internal parts. The system was then cut and the components removed. When they were reinstalled, teflon ribbon was used as a thread sealant. Extreme care was used during the application of the ribbon to assure that no particles would propagate into the system. The ribbon provided an adequate installation to prevent leakage at the threaded joints.

The laborious task and expensive cost of removing those components that were threaded to the PLS piping resulted in the decision to install break-out connections for certain components. As the PLS installation was complete, only items that required removal for the correction of deficiencies or where it was determined that future maintenance functions would necessitate removal, were removed and provided with break-out flanges. This clearly indicates the requirement at any future installation for the use of break-out connections on components that are welded or threaded to connecting system piping.

Strainers in the high pressure gaseous helium subsystem presented a serious leakage problem. The specified teflon gasket between the strainer body and element would not provide the necessary seal to prevent leakage at the 3000 to 6000 psi pressure ranges. The installation of a stainless steel backup ring was used in an attempt to resolve the leakage problem. This did not stop the leakage and a material substitution was made for the teflon gasket material. A viton gasket with the stainless steel backup ring prevented leakage under the high pressure condition. Neoprene was not used as a gasket material as it was difficult to obtain the neoprene free of undesirable hydrocarbons.

FILTERED COMPRESSED AIR SUPPLY

The copper tubing used for the PLS instrument control air was installed at the sites using an accepted method for field soldering. The use of the flux left an undesirable contamination in the tubing. It became necessary to remove that tubing which had been installed. The tubing was recleaned and installed using a fluxless soldering method. This technique, used with a nitrogen gas backup purge in the pipe during the soldering operation, produced a clean interior surface at the soldered joint. This method of joining the tubing was used for subsequent installations.

The contractor was also required to refabricate some of the tubing because of a misfabrication. The contractor used a constant diameter tube in connecting the automatic control valves to the supply header. Generally, this diameter was of insufficient size to assure the proper volume of air to provide the critically timed valve actuation. Therefore he was required to refabricate the tubing to get the proper cross-sectional area to assure sufficient air supply to the valves.

GUIDES AND ANCHORS

The location of the guides and anchors for PLS pipe presented more difficulties than is normally encountered in construction. Because of the critical alignment requirements, it was important not to deviate from designed location and configuration of the necessary pipe supports and guides. As a design stress analysis of the PLS was not complete at the time of installation, makeshift pipe supports were used during the initial pipe installation. The after-the-fact determination of the location and type of supports instigated numerous field modifications to the final prescribed supports and guides.

To expedite installation the Government and Architect-Engineer provided a field team to resolve field problems. Solutions to interferences and additions required for adequate support and guide of the piping were determined at the sites. The exacting location and outline requirements of the supports resulted in some elevation changes to PLS piping already installed. This necessitated the removal, refabrication and reinstallation of some spool pieces to make the final installed elevations meet those specified by the contract plans.

PLS TESTING

Final acceptance testing of the PLS was performed upon the completed installations to insure that they would hold a proof pressure, that they did not leak at working pressure, and that they were clean. All associated equipment used for testing was cleaned to the same standards of cleanliness as the system prior to making any connection to the PLS. All test gauges were calibrated within the acceptance standards of the industry. All system filter elements were removed and the safety valve connections capped prior to testing.

Prior to pressure testing and cleanliness checks of the system, all the system gauges, pressure controllers, liquid sensors and automatic control valves were verified that they were still within the calibration requirements of the specifications in their installed positions. Electrical continuity checks were made to assure that all the electrical equipment functioned properly.

The proof pressure was a pressure specified for each subsystem and was normally 1¼ times the working pressure. If the subsystem held a proof pressure for five minutes, the pressure was reduced to working pressure. At working pressure the entire subsystem was checked for deformation due to proof pressure testing. Leak checks of all connections at working pressure were then performed. In checking for leaks, a tape was placed encircling the complete flanged joint. A pinhole was punched in the tape and leak-tek applied over the hole. A formation of bubbles would indicate that nitrogen gas was escaping at the joint. If a joint indicated any leakage, the pressure was bled from the system, the leak repaired and a re-leak check performed.

A blow horn was installed, usually at the interface in each complete line of each subsystem to check the cleanliness of the lines. The blow horn was designed to hold a multi-layer gauze pad upon which the contamination could be trapped. The line was blown with nitrogen gas that passed through the blow horn for a certain amount of time or through a certain pressure drop at the pressure source. The pad was removed for a laboratory analysis of the contamination present. If no particle larger than 150

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microns and no hydrocarbon were detected, the pad was accepted. The dew point of the gas remaining in the lines was then determined and a gas sample extracted. The gas sample was analyzed with an infrared spectrometer for evidence of hydrocarbon and acetylene. If the particle size, hydrocarbon, acetylene and dew point met the requirements of the specifications the line was accepted.

Upon acceptance of the individual lines, the subsystem was placed in stand-by condition. All system safety valves and strainer elements were installed and a revalidation leak check made of the broken connections. Revalidation checks were made at pressures just below the safety valve set pressures. The system was then maintained with a positive pressure blanket of clean, dry, filtered nitrogen gas.

A cold test was conducted on the liquid oxygen and liquid nitrogen subsystems. These tests were performed to validate the operational function of these subsystems when subjected to cryogenic temperatures as well as the air cleanliness. Particular attention was made to conditions of the expansion joints, pipe supports and guides during and after the cryogenic liquid flow through the system. Liquid samples were taken of the liquid nitrogen test media at the missile silo inter-face of the piping. It was analyzed for contamination and if the sample met the requirements for system cleanliness the subsystem was accepted. The subsystem safety valves and strainers were installed and the subsystem validated and placed in stand-by.

The liquid nitrogen for the cold tests and conversion to gas for the proof, leak and blow down tests was supplied by the Air Force. Liquid nitrogen was used in lieu of liquid oxygen because of the obvious safety hazards connected with the handling of LOX. The liquid nitrogen was produced at the Nimbus, California facility of the Air Force and delivered by truck to the construction contractor at the sites.

As the procurement specifications for the liquid nitrogen were not as rigid as the PLS cleanliness specifications, the liquid required filtration prior to being introduced into any subsystem. Difficulty was encountered in filtering the liquid to meet the necessary standards for cleanliness. All filters installed between the tankers and subsystems were Government furnished. This was originally intended to meet the Government's obligation to supply the construction contractor with clean media by providing adequate filtration at the site.

A pot type, 40 micron absolute filter, with a stainless steel dutch weave type element was placed between the delivery tanker and the charge connection to the subsystem. A liquid sample taken downstream of this filter showed evidence of contamination in excess of the construction contract requirements. A millipore filter, especially designed for the filtration of micronic sized metallic and fibrous particles, was installed in series, downstream of the pot type filter. This filter consisted of a dual pre-filter and millipore filter pad element (4 micron diameter pores) approximately 8 inches in diameter. With close surveillance made of the sampling techniques and laboratory analyses, liquid samples taken downstream of the millipore filter were found acceptable.

In testing the RP-1 fuel loading system, the cleanliness was determined after the system had been circulated with RP-1 for a period of two hours through at least one system filter. At the end of this period an examination was made of the system filter element and also a liquid sample taken at the effluent of the system. Although clean liquid samples were obtained from the system, the millipore extraction of the filter elements contained particles in excess of 150 microns. This required the system to be recirculated. After repeated and prolonged periods of flushing, the millipore examination of the filter elements showed no decrease in the particle contamination. To expedite the progress of the testing program and in accordance with operational requirements a visual inspection of the element in lieu of the millipore examination was instituted.

The visual inspection of the filter element and clean liquid sample were acceptable methods upon which the cleanliness requirements of the using agency could be determined. Their criteria were not as strict as the construction specifications.

As with the liquid nitrogen, the RP-1 was delivered by the Government to the construction contractor at the sites. The RP-1 was circulated at the site to obtain a test media that met the cleanliness requirements imposed by the construction specifications. The difference between the Air Force procurement speci-

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fications and the construction specifications caused considerable delay to the testing schedule while efforts were made to clean the fuel. Clean fuel samples were obtained only after four to eight hours of circulation through an Air Force filtering and dewatering unit.

Evaporation loss tests were performed on the liquid oxygen storage tanks. This was a seventy two hour recording of the evaporation loss or boil-off of the liquid contained within the tank. The tank was filled to capacity with liquid nitrogen. Upon stabilization of the liquid temperature, the readings for the seventy two hour test were started. The data obtained during this test was converted to a percentage of boil-off of liquid oxygen under conditions of standard temperature and pressure. All the vessels checked were within the specified evaporation loss rate of 0.25% by weight per day of liquid oxygen.

The tests, as outlined above, and performed on the PLS were the following:

1. Control system testing
    a. Continuity checks and field verification of component calibration.
2. Gaseous nitrogen subsystem
    a. Pressure storage vessels
    b. Propellant transfer pressurization piping
3. Gaseous nitrogen subsystem
    a. Pressure storage vessels
    b. System blanket and purge piping

4. Liquid oxygen subsystem

   a. Liquid storage vessels

   b. Transfer piping

5. Liquid nitrogen subsystem

   a. Liquid subcoolers

   b. Fill piping

6. Helium subsystem

   a. Pressure storage vessels

   b. Transfer piping

7. Fuel loading subsystem

   a. Gaseous nitrogen for fuel system blanket and purge.

   b. Circulation of fuel system with RP-1

8. Cold test of liquid nitrogen subsystem

9. Cold flow test of liquid oxygen subsystem

10. Revalidations

11. System standby configuration

12. Evaporation loss

The final acceptance testing at each site was conducted from a central control location. From this test control center, testing was directed in all three launcher areas simultaneously. A closed circuit telephone system tied the individual launcher stations to the test conductor at the test control center. This enabled the test conductor to coordinate activities without undue time loss. In conjunction with the test control center, a laboratory trailer was located at each site to perform the analysis of the blow down pads and other required analyses under carefully controlled environmental conditions and procedures.

A total of 52 blow down sequences were required at each launcher area. An average of six blow downs were made during each sequence before an acceptable pad was obtained. No extreme difficulties were encountered in meeting the specified standards for cleanliness. Problems were encountered with the non-performance of components which are detailed in the section entitled "System Components".

During testing, the using agency questioned the cleanliness of the liquid oxygen storage tanks. Although the vessels were cleaned at the point of manufacture and had been previously inspected at the sites by the contractor, the using agency prevailed and the tanks were entered for inspection. Six tanks at two sites were physically entered. A black-lite, visual, and wipe examination was made of the interior surfaces, interior piping connections and the pressurization header. Only one vessel showed evidence of contamination. A cup-full of sand was found in the tank sump. This was leftover from the sand blasting used as a cleaning method for a few of the first tanks fabricated. The sand was easily removed by vacuuming and wiping the area with trichloroethylene and a blow down of the discharge nozzle for final acceptance.

The Government furnished to the contractor the following equipment for use during PLS testing: Tube Bank Trailers (13); Nitrogen Rechargers (6); Helium Compressors (3); Liquid Nitrogen

Trailers (7); RP-1 Trailers (4); Liquid Nitrogen Filters (9); Gaseous Filters (7). The contractor operated and maintained the equipment. Down time for maintenance of the equipment was within the acceptable time for the operation of construction equipment and did not delay the testing schedule.

The equipment furnished provided the necessary quantities required for the testing program. All equipment performed satisfactorily except for the liquid filters. The problems encountered with the filters were discussed previously in connection with the Government furnished liquids.

Representative photographs of the Propellant Loading System follow.

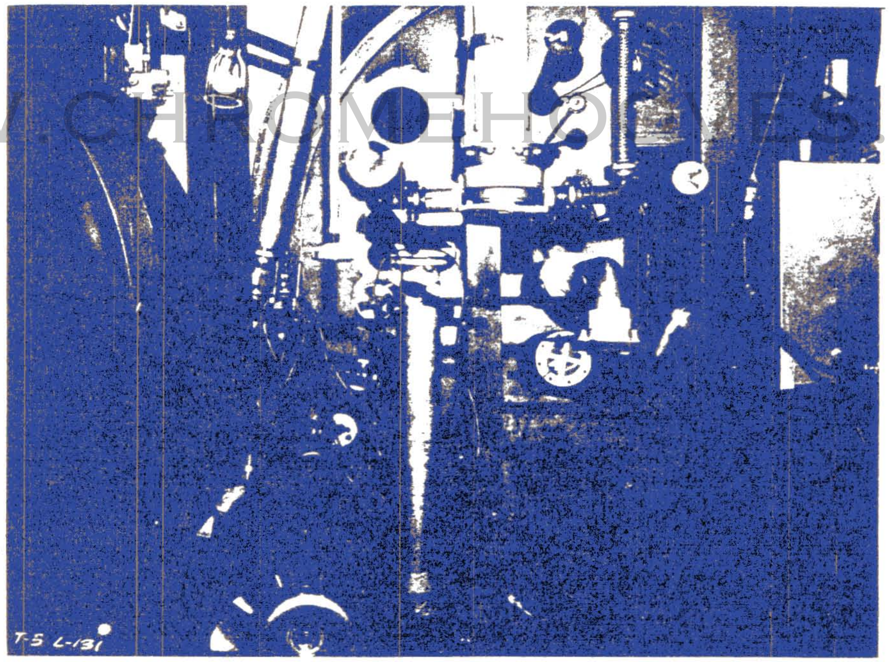

Fig. 82
Propellant Terminal Looking into Interconnecting Tunnel
(Sealed pipe ends and purge set-up)

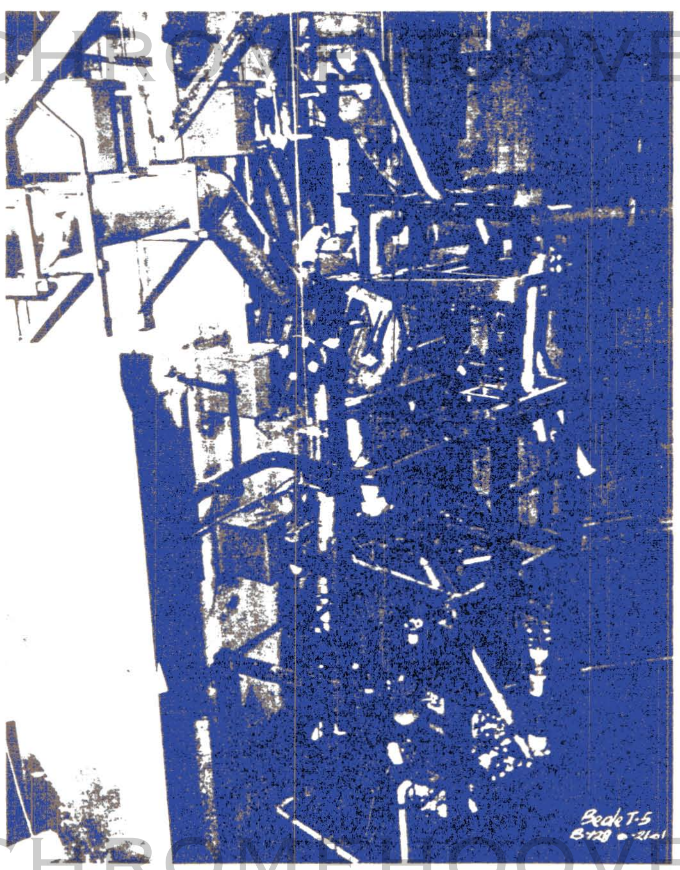

Fig. 83
LOX Crib, Missile Silo, Interconnecting Tunnel Level
(Interim piping installation)

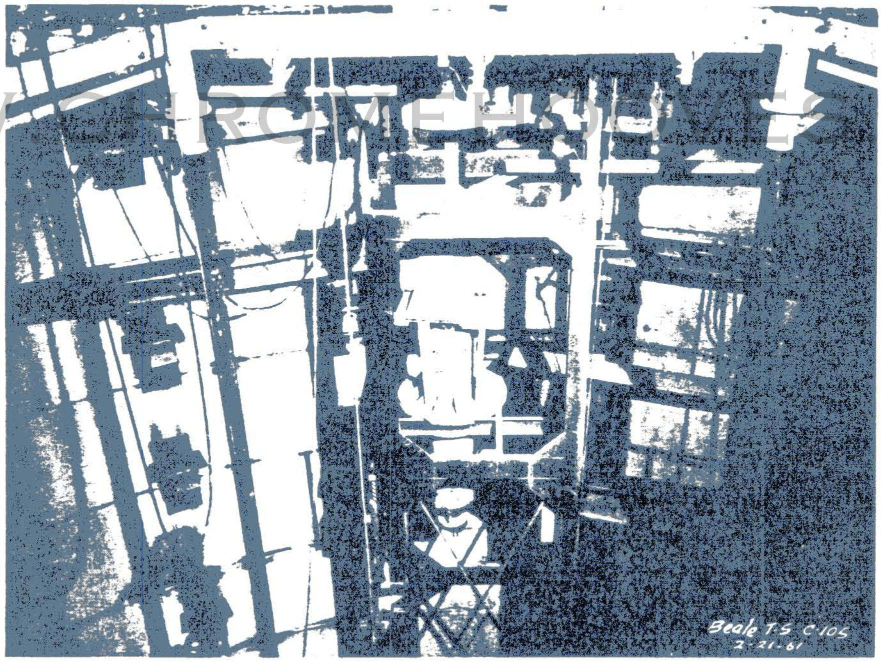

Fig. 84

Lox Crib, Missile Silo (Catch Pot Installation)

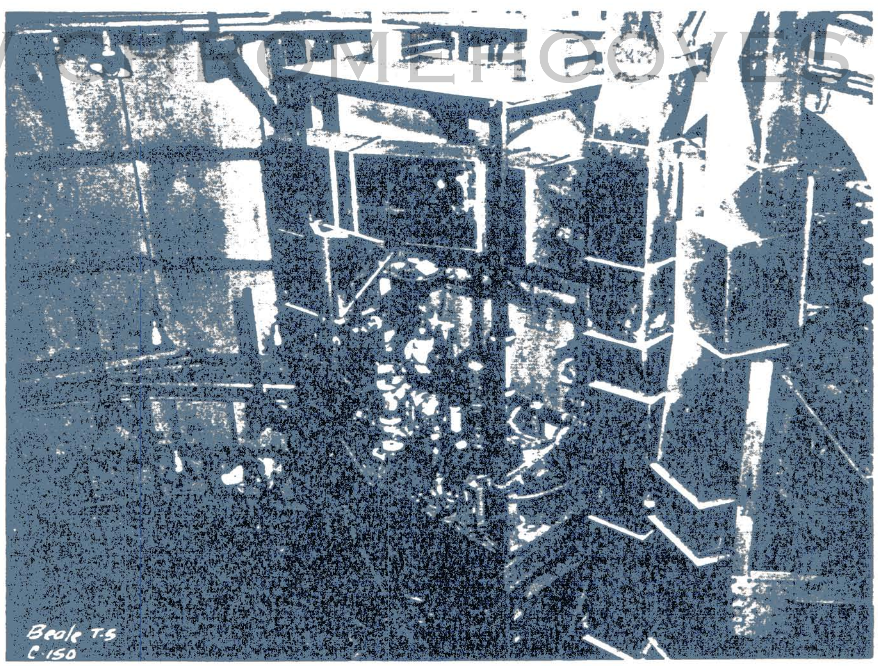

Fig. 85

Fuel Crib, Missile Silo (RP-1 flow controller and air release tank installation)

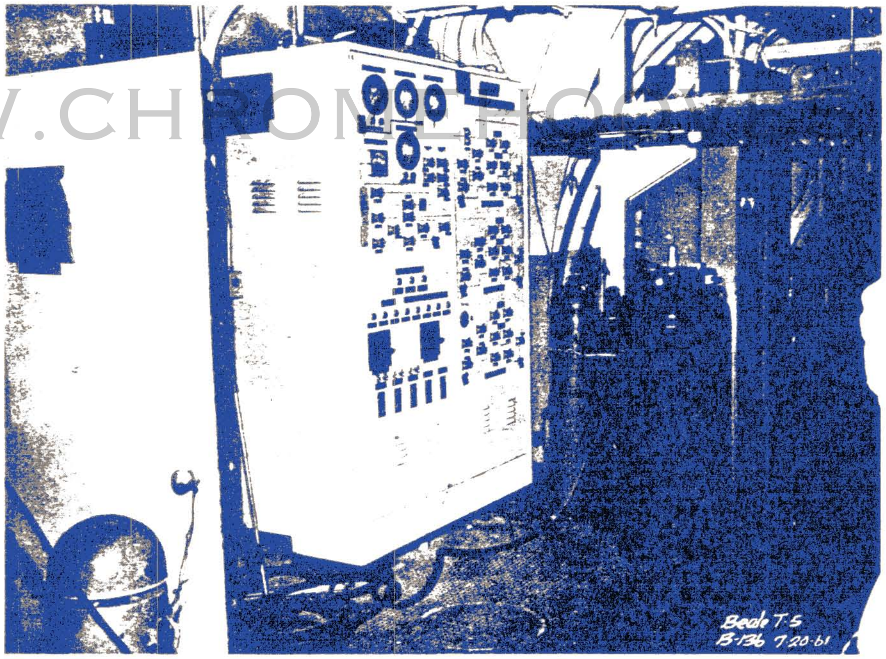

Fig. 86

Tunnel Junction 12, Fuel Transfer Panel

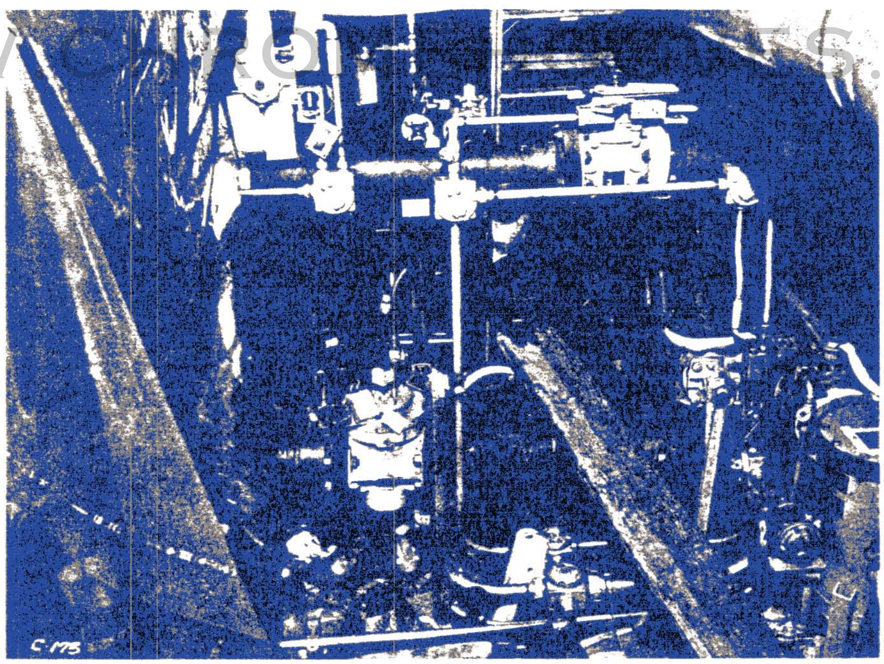

Fig. 87

Tunnel Junction 12, Fuel Control Valves and Piping Installation

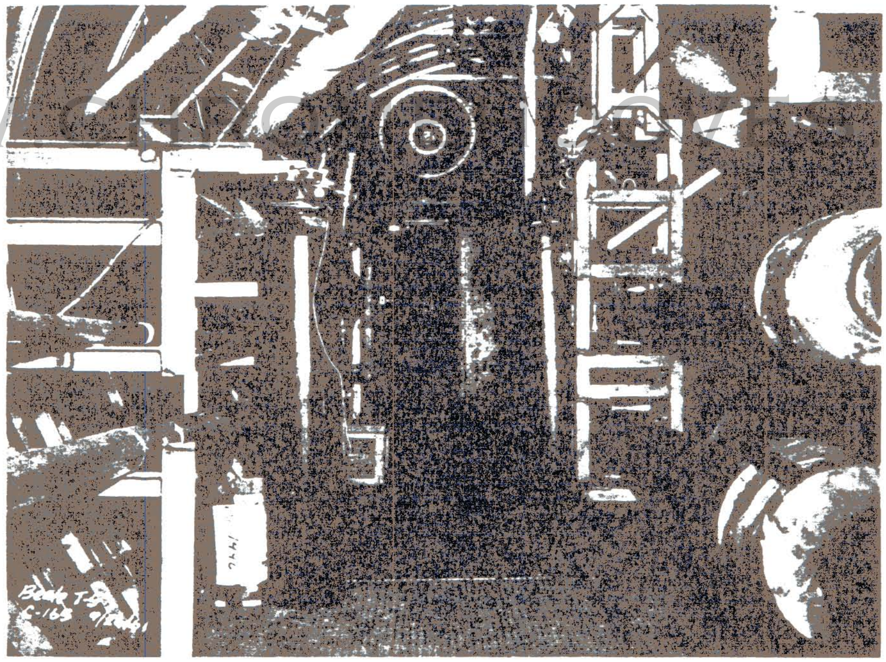

Fig. 88

Interconnecting Tunnel (Field installation set-up)

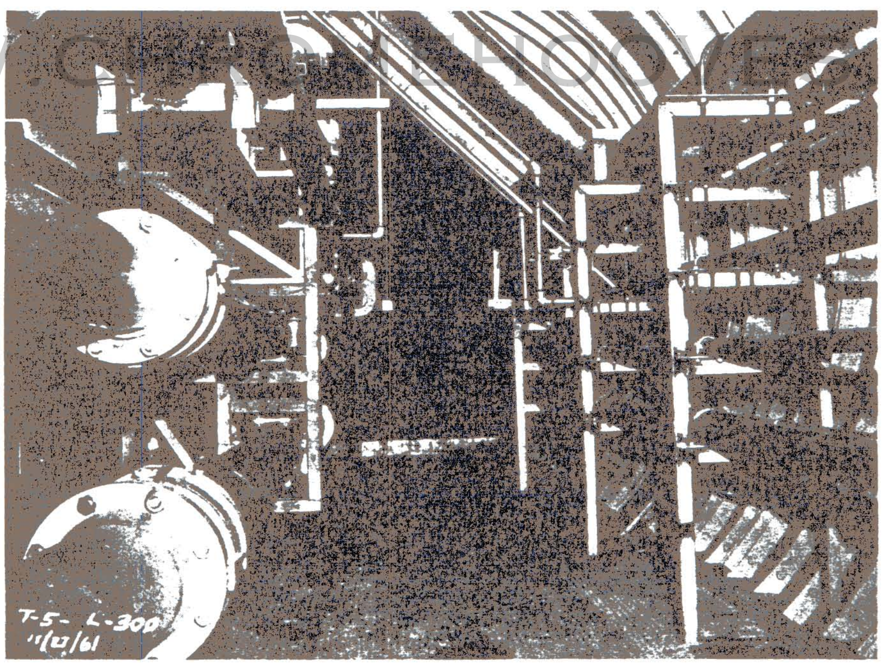

Fig. 89

Interconnecting Tunnel (Completed installation)

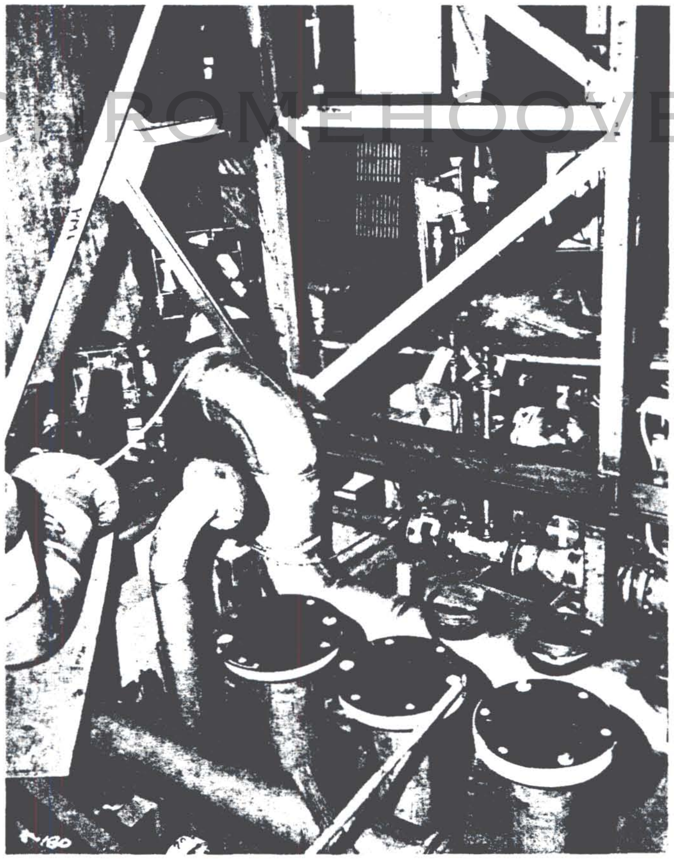

Fig. 90
Propellant Terminal, Main Deck-(Piping installation for LOX tank safety valve manifold)

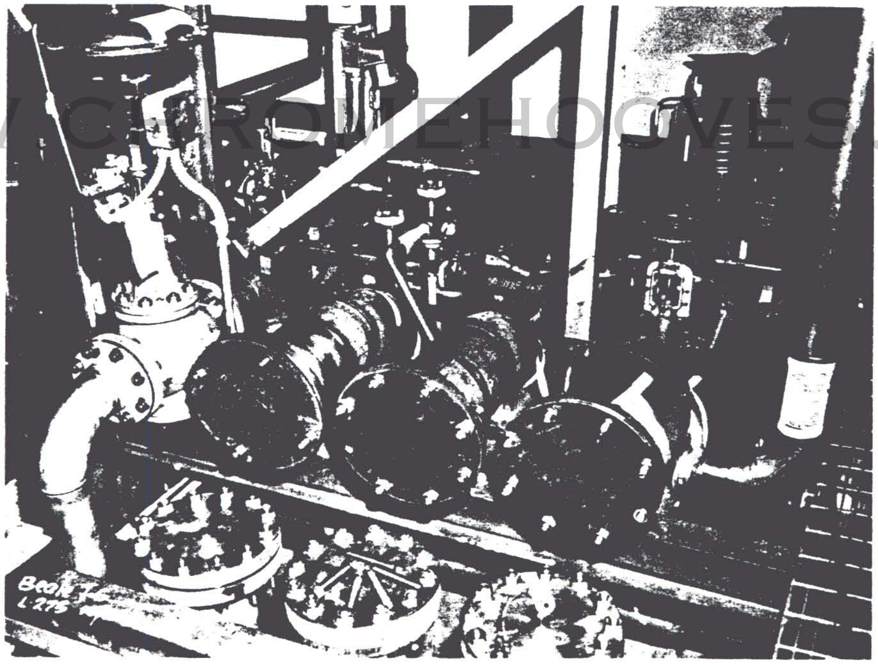

Fig. 91

Propellant Terminal, Main Deck (Valves and connections taped for leak check during testing)

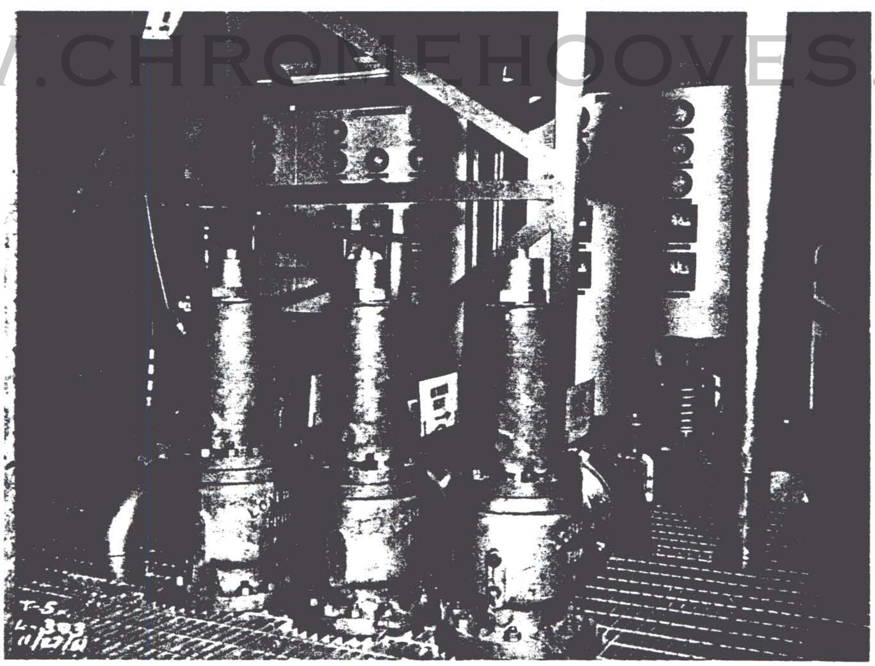

Fig. 92

Propellant Terminal, Main Deck (Completed installation of LOX tank safety valve manifold)(Transfer panels in background)

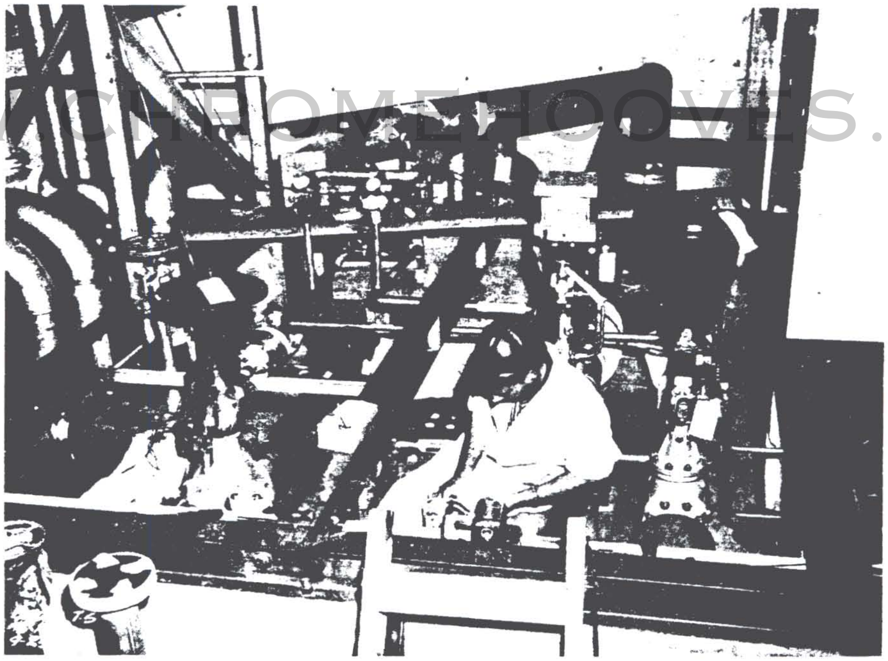

Fig. 93

Propellant Terminal, Main Deck (Interim LOX control valve installation

Fig. 94

Propellant Terminal, Main Deck(Completed valve installation and transfer panels)

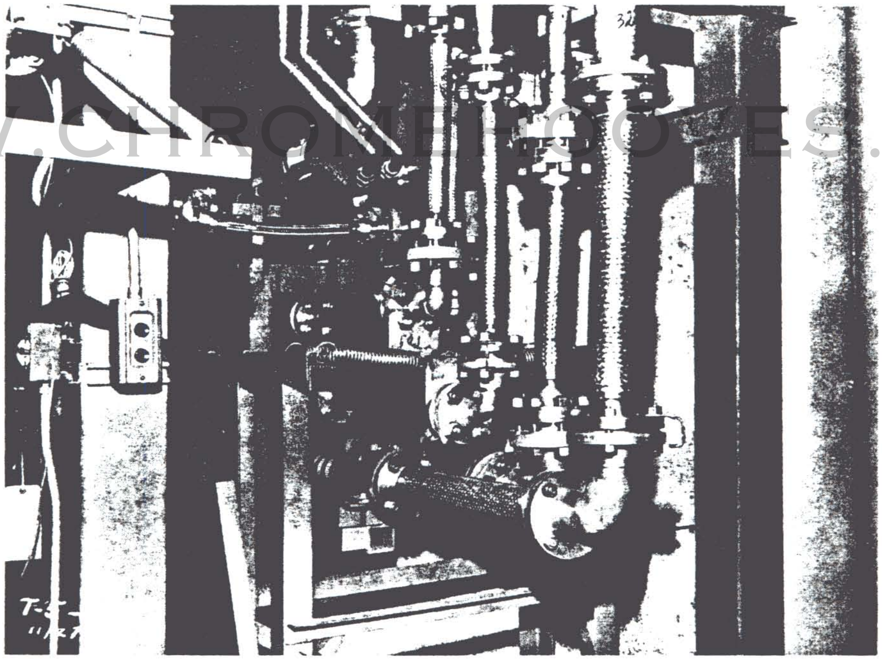

Fig. 95

Propellant Terminal, Lower Level (Flex hose and pipe support installation)

Fig. 96

Propellant Terminal, High Pressure Gaseous Bottle Cluster and Control Manifold

Fig. 97
Radiation Shield between Vent Shaft and Interconnecting Tunnel

Fig. 98
PLS Testing Equipment (High Pressure Recharger and Liquid Nitrogen Storage Tank)

10. MECHANICAL FACILITIES

GENERAL

The mechanical work for each complex consisted of the installation of various systems as listed below. The Propellant Loading System is described elsewhere in this report. The mechanical systems were:

1. Plumbing
2. RP-1 Fuel
3. Ventilating
4. Air Conditioning and Evaporative Cooling
5. Heating System: Forced-hot-water, Glycol, and Steam Converter and Boiler
6. Filming Amine
7. Water

   a. Domestic
   b. Fire
   c. Hot water supply and return
   d. Chilled water supply and return
   e. Deep well pumps
   f. Water storage underground
8. Diesel lube oil, supply and return
9. Diesel exhaust
10. Signal and Alarm
11. Compressed air
12. Blast closure
13. Sanitary sewer

Some of the piping was prefabricated at Beale Air Force Base and then shipped to each of the three sites; other piping was fabricated at the work site. The coordination of the work by Kiemech, Inc., the mechanical subcontractor, was an important part of the work.

PROBLEM AREAS

Pipe Supports

In many cases pipe supports were either not detailed or not located on the contract drawings. In some cases the supports that were detailed were considered inadequate from the shock viewpoint. The Architect Engineer, in preparing the contract drawings, should have either shown the location of all supports, or none. If the location was not shown on the contract plans, it could have been taken care of by tables and other descriptions in the specifications. The resolving of pipe support problems became a major duty of one structural engineer and one mechanical engineer who, as a team, were assigned to the various sites on a full time basis from April 1961 until December 1961.

Flexible Hoses

The location of certain flexible hoses was shown on the contract drawings but the location of many others was omitted. The Architect Engineer took the position that those hoses not shown were still required by the contract specifications. This was considered a weak argument and it was necessary to issue a modification in order to obtain these hoses.

Shock Testing

Due to the complex and different nature of this project, many items were required to pass shock testing prior to installation. Although many switches, solenoid valves and meters were available on the open market, they either did not have the capability of functioning under shock or it was not known by the manufacturer whether their product could operate under these conditions. As a result, valuable time was lost in having items shock tested, and sometimes having to re-test a product when the first test failed. The Architect Engineer provided valuable assistance in providing the names of approved manufacturers of some of the products that the contractor was unable to obtain.

Validation Testing

Validation testing was performed with representatives of the mechanical subcontractor, The Martin Company, Corps of Engineers, USAF-SATAF, and sometimes the manufacturer's representative. Generally speaking the validation testing, although time consuming, ran rather smoothly and as could be expected, certain adjustments and repairs were required as the tests proceeded.

11. ELECTRICAL FACILITIES

GENERAL

The electrical work for each complex consisted of the installation of a 2400 V power plant, including switchgear and a distribution system, lighting systems both emergency and normal, motor control centers, grounding systems, alarm, control and surveillance systems.

PROBLEM AREAS

Some of the more frequent problems involved interference of electrical items with those of other crafts, and the incompatability of Government furnished equipment with contractor furnished items. Another major problem arose with the installation of cable tray shock mounts. The shock mounts which were installed were different than those which had been originally designed for the contract.

The numerous changes and modifications also caused some delay and added to the number of problems. A difficulty which was never overcome was that the contractor frequently installed conduit and equipment without benefit of approved layout drawings. The electrical layout drawings were submitted to the Area office for approval and then directly back to the contractor. Many times the work would be accomplished before the approved layout drawings were returned to the job site. There were many other problems, too numerous to mention here, which normally occur on any project.

SHOCK TESTING

The electrical switch gear was manufactured and shock tested by Westinghouse Electric Corporation. The Architect Engineer would not approve the Westinghouse procedure as originally written, due to the fact that their system would show when a switch would open and close, but it would not record the interval of time. Several months elapsed between the Architect Engineer's disapproval and the revision of the procedure which provided a method of measuring the interval of time that the breakers were open.

<u>VALIDATION TESTING</u>

Validation testing of all electrical systems was to be performed upon completion of each system. However, some systems were tested concurrently, due to the dependence of one on the other. Validation testing was one of the most troublesome items accomplished during the project and accounted for a large expenditure of time. Many times the system would not operate as designed, which necessitated adjustments or repairs before the test could proceed. Adjustments or repairs could take hours or days. Another source of delay in testing was due to the fact that a system was not always ready for testing when scheduled.

12. PHOTOGRAPHIC COVERAGE

Photographs of the three sites were taken on a monthly basis and as needed for special requirements. The photographs presented detail and general views of work and events of major significance in engineering and construction fields. The photographer relied upon the judgment of the Resident Engineer in selecting the items of work to be photographed. Views were taken of building tradesmen and laborers actually performing specified or unusual functions within their field; clarifying the position of various components to the whole, sequence of operations and delay factors, as well as indicating overall progress.

Construction photographs depicted the following major features: size and depth of major structures, interior views of structures showing installed equipment, unusual as well as common (sanitary, mechanical and electrical), flexible mountings (spring shock mounts, suspended floors, expansion joints, etc.), interior views of personnel tunnels, above ground shots after backfilling was completed and any other shots which would aid in presenting the construction story to technical persons as well as the general public.

The photographs were used for briefing and claim purposes, to inform technical organizations and higher authority of unusual problems and various phases of the program and to provide a history of the work.

13. SUPPORT FACILITIES

CONTRACT NO. 2174 - RE-ENTRY VEHICLE FACILITY

Addition of one cubicle on existing Multi-Cubicle Storage Building, addition to existing Surveillance and Inspection Building and appurtenant paving and utilities. Cubicle building had reinforced concrete walls with precast lightweight roof panels. The addition to S & I Building included concrete block wall, lightweight steel joist roof, wood frame and gypsum board interior partitions, bridge crane, air conditioning, ventilating, heating and plumbing. There were no unusual construction features. Although some difficulty was encountered in obtaining satisfactory workmanship and timely completion, the facility was completed well ahead of the Using Agency's required occupancy date.

CONTRACT NO. 2175 - RE-ENTRY VEHICLE FACILITY

Consisted of storage building with structural steel frame and sheet metal siding with a small office area. Mechanical and electrical features were very simple.

CONTRACT NO. 2176 - HELIUM UNLOADING FACILITY

Included construction of small parking area and driveway adjacent to existing railroad siding, overhead lighting on existing power poles and provision of transformer and power outlet for operation of Government transfer pump. No unusual construction features were involved.

CONTRACT NO. 2177 - GUIDED MISSILE ASSEMBLY, TECHNICAL SUPPLY FACILITIES AND EDISON STREET EXTENSION

The Guided Missile Assembly included the following features:

1. Structural steel framework with precast, tilt-up concrete walls.

2. Steel roof deck.

3. Wood frame and gypsum board interior partitions.

4. Extensive electrical and mechanical facilities, including specialty piping for test purposes, heating, air conditioning and ventilation systems.

5. Appurtenant outside utilities and paving.

Considering the number of crafts involved, complexity of the work and the extremely short construction period, the contractor did an outstanding job of supervision and coordination. Even though there were several changes, the contractor finished the work on time. He was given a citation for outstanding performance for both timely completion and excellent quality of workmanship.

Administration of the contract was somewhat unwieldly, due to indirect communications with the Architect Engineer in resolution of design problems encountered.

<u>CONTRACT NO. 2230 - ALARM SYSTEM FOR RE-ENTRY VEHICLE FACILITY</u>

This work was done under a classified contract for installation of an intrusion alarm system for the facilities constructed under Contract No. DA-04-167-eng-2174.

14. LABOR

The Prime Contractor attempted to hold down overtime by working on a shift basis; however, some subcontractors were forced into overtime because their activity was the pacing factor in over-all job progress. Labor outlay to completion of project is as follows:

Regular Time		Overtime	
Hours	Cost	Hours	Cost
3,160,000	$14,300,000	498,000	$4,130,000

(See Figure 99 for detailed breakdown.)

AVAILABILITY

With two exceptions the labor supply was adequate. There were of course some delays in manning at the start of various phases of work such as structural steel work. However, the labor business agents did catch up with job needs within a few days. In order to do this it was often necessary that the Union agents go outside their local area to recruit adequate forces. The two exceptions where the labor supply presented a major problem were:

1. Plumbers and Pipefitters

There was a shortage of qualified specialists, mainly welders, which delayed build-up of a full crew at the start of work. The Aerojet General Corp. was in competition with the contractor in securing this type of labor. In order to improve the supply the contractor contributed to a training program sponsored by the Union. During the later stages of construction there was a noticeable movement to other Missile Sites and A.E.C.

2. Electricians

In the latter part of 1961 the demand for electricians for associate contractor activities caused considerable job hopping in pursuit of overtime pay. Throughout the job, personnel turnover was quite high.

RELATIONSHIP BETWEEN CONTRACTOR AND LABOR

This relationship was very good. To a large extent this was due to the Prime Contractor's labor policy and the activities of their labor relations representative. The Prime Contractor operated on the principle that he and his subcontractors should make every effort to abide by union management agreements and, just as important, insist that labor make the same effort. On the whole the unions did cooperate. There were some disagreements and some "walkoffs" and the contractor appealed to the international representative in some instances. (See Figure 100, Work Stoppages) It is believed that the Prime Contractor's reputation and his contacts with the National Union representatives were very beneficial in holding labor problems to a minimum. There were no special agreements providing more liberal benefits or wage rates than those defined in the existing union management contracts. However, there were two separate agreements as follows:

1. An Agreement was drawn up by the electrical subcontractor and Local 340 of the IBEW establishing the exact limits of "High Time" of "Hazard Time" areas. This agreement did not materially change the pay for such work from that provided by the NECA agreement with Local 340.

BEALE AREA OFFICE
CONTRACTOR'S PAYROLL DISTRIBUTION
Contract No. DA-04-167-ENG-2140

MONTH	REGULAR TIME		OVERTIME	
1960	Hours	Cost	Hours	Cost
Apr	55,552	240,060	6,580	35,023
May	58,506	222,916	6,834	40,898
Jun	80,696	297,242	11,386	56,221
Jul	101,810	383,014	12,854	65,852
Aug	120,332	416,424	18,898	119,122
Sep	115,447	446,312	16,444	100,762
Oct	200,185	762,738	37,955	241,718
Nov	178,157	765,118	36,611	253,551
Dec	205,963	855,367	24,734	169,304
1961 Jan	180,732	823,740	12,442	88,773
Feb	216,913	966,934	15,047	113,882
Mar	251,826	1,132,795	8,761	82,986
Apr	155,829	727,200	10,942	96,916
May	170,065	900,238	20,801	197,705
Jun	161,659	846,950	31,873	301,738
Jul	167,097	775,137	29,019	290,695
Aug	147,282	728,966	25,083	241,114
Sep	134,593	635,764	22,198	215,074
Oct	120,934	603,574	26,559	263,450
Nov	162,563	821,137	61,088	596,414
Dec	87,418	494,329	36,119	291,111

Fig. 99

MONTH	REGULAR TIME		OVERTIME	
1962	Hours	Cost	Hours	Cost
Jan	$ 48,287	$ 255,599	$ 20,041	$ 193,677
Feb	21,825	107,005	4,734	45,062
Mar	13,517	61,480	249	1,942
Total to Date	3,157,188	14,270,039	497,252	4,102,990
Estimated Final	3,160,000	$14,300,000	498,000	$4,130,000

Fig. 99

WORK STOPPAGES
BEALE AREA OFFICE

Following is a tabulation of data pertinent to work stoppages on Contract No. DA-04-167-eng-2140:

1. Date: 18 August 1960
   Site: 1-B
   Craft: Electricians
   Number Men: 6
   Man Days Lost: 9
   Reason: Lack of ventilation and method of egress during shafting operations
   Impact: No appreciable affect

2. Date: 3 October 1960
   Site: 1-A and Beale Fabrication Yard
   Craft: Plumbers and Fitters
   Number Men: 24
   Man Days Lost: 89
   Reason: Argument regarding use of laborers to handle pipe in cleaning plant. Sacramento local pulled out at Beale and later at Site 1-A. Marysville and Chico local people at Beale continued working. Sacramento local directed by International to return to work
   Impact: No delay to overall project

3. Date: 16 January 1961
   Site: 1-A
   Craft: Electricians
   Number Men: 22
   Man Days Lost: 24
   Reason: Electricians walked off in protest of other crafts setting generators in violation of previous agreement established by contractor and crafts involved, ie: Operating Engineers, Millwrights and Electricians. Apparently Electrician Steward was not aware of agreement.
   Impact: Completion not appreciably affected

Fig.100

4.	Date:	27 January 1961
	Site:	1-B
	Craft:	Electricians (72) Plumbers (150) Ironworkers (40)
	Number Men:	262
	Man Days Lost:	95
	Reason:	Electricians walked off at noon on a Friday in protest of bad air in working areas. Plumbers and Ironworkers walked off at 2:30 P.M. All returned for work on Monday morning. Contractor installed additional ventilation fans.
	Impact:	Completion not appreciably affected
5.	Date:	30 March 1961
	Site:	1-A
	Craft:	Plumbers and Fitters
	Number of Men:	180
	Man Days Lost:	653
	Reason:	Walk off allegedly due to lag in paychecks after close of pay period and also time required for final pay for voluntary separations. Contractor's position was that payments were not delayed. As a result International withdrew all Beale Titan Sites from Sacramento local jurisdiction.
	Impact:	Site 1-A delayed approximately one week
6.	Date:	3 April 1961
	Site:	Beale Air Force Base-Fabrication Yard
	Craft:	Plumbers and Fitters
	Number Men:	17 (total crew 22)
	Man Days Lost:	27
	Reason:	Exact reason unknown. There was opposition to reduction to 8 hour day. However, only Sacramento local men walked off probably in sympathy with walk out at Lincoln. As a result this area transferred from Sacramento to Marysville Local.
	Impact:	Negligible. Fabrication ahead of field installation

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2. Pipe fabrications and cleanings for all three sites were performed at a central plant at Beale Air Force Base. The unions involved at each site requested that they have equal representation at the central plant. An agreement was drawn up to this effect.

PRODUCTIVITY

The contractor experienced considerable difficulty in obtaining adequate production from electrical workers. The subcontractors accused the union of slow-down tactics to obtain overtime concessions. The union counter-charged that the contractors' difficulty was due to poor management. There was considerable merit to the charges made by both parties; production was quite low, especially at Site 1B. This situation was improved to a big extent beginning the first of April 1961 when the contractor started a hire and fire program to weed out nonproductive workmen. This procedure was made possible through the efforts of the IBEW representative and the labor relations representative of the Prime Contractor.

To a lesser degree slow-down tactics were noticeable at Site 1A among plumbers and pipefitters. This trouble probably would have been greater had not the mechanical subcontractor been required to work considerable overtime to stay on schedule. Addition of more men was not possible due to limited working space. Therefore, more hours per man were required.

AVERAGE WAGE SCALE

The average wage scale at the beginning of the job, compiled from the Secretary of Labor reports for wage scales for the counties in which the work was situated, reflected an overall average wage scale per hour of $3.75. It must be noted that this hourly wage scale was averaged from 35 classifications applicable to the work, but it does not include taxes and insurances and does not include foreman's wages for any of the classifications. A similar study was made of Secretary of Labor reports for the hourly wage scale for 30 classifications for the three counties in which the work was situated for the ending period for the job and this overall average was $4.17. Again it must be noted that this is the journeyman's rate only and does not include the foreman's rate or taxes or insurances as applicable. Therefore, in comparing the overall average for the beginning of the job of $3.75 an hour for journeyman, with the overall average rate for the ending of the job of $4.17 an hour for journeyman, showed an increase of 42¢ per hour or an increase of 10% for labor.

WORK STOPPAGES

There were six work stoppages during the course of the work. They were more of a wildcat or walk-off nature, rather than a strike. The only one which caused appreciable delay involved plumbers and fitters at Site 1A. The contractor appealed to the International for assistance in getting the men to return to work. Apparently the International felt that the local union action in this case had been wrong because Site 1A was transferred from the Sacramento Local to the Marysville Local. Details of each work stoppage are shown on Figure 100.

MISSILE SITE LABOR RELATIONS COMMITTEE

The local committee was organized by the SATAF representative, and the Commissioner of the Federal Mediation and Conciliation Service, who was the chairman. The committee consisted of five representatives each from Management and Labor. The Management Members represented the Air Force contractors, and Labor was represented by one man from each of the following:

Building Trades Council

Carpenters

Laborers

Operating Engineers

IBEW

Later a representative of the construction contractor was included in the group. The main features of the committee policy were:

1. Disputant parties would make every effort to resolve differences before referral to the committee.

2. All parties would comply with the ruling of the committee. Either party could appeal through proper channels but no stoppage would occur.

3. The committee would take action promptly on any matter referred to it and in no case later than 24 hours.

4. Any member representing a disputant would withdraw during the vote on the committee decision. Such a member would be temporarily replaced by an alternate from another company or union.

The Corps of Engineer's Area Engineer was designated as an observer with full liberty to submit suggestions or problems.

The committee undoubtedly can be credited with preventing labor disputes from developing into work stoppages. Although the committee made very few official decisions, its existence served as a deterrent to "wildcat" action. The Corps' contractor was never directly concerned. However, there were some trouble spots in associate contractor activities which could have spread to the Corps activity had not prompt action been taken.

15. RECOMMENDATIONS

RESIDENT OFFICE

The 10 foot by 50 foot office trailer did not provide adequate space. It is recommended that either an office building of 750 square feet minimum floor space, or two 10 foot by 50 foot trailers be provided.

RESIDENT OFFICE STAFF

It is recommended that:

1. The electrical inspection force should consist of one Electrical Engineer and one Electrical Inspector, with provisions for increasing this to two Electrical Inspectors when electrical installation work is in full progress.

2. The mechanical inspection force should consist of:

a. One Mechanical Engineer and two Mechanical Inspectors for all mechanical work excluding the Propellant Loading System and the RP-1 System.

b. One Mechanical Engineer and from one to twelve Mechanical Inspectors for the Propellant Loading System and RP-1 System work.

c. The Mechanical Inspectors to be Corps of Engineers personnel.

d. The Martin Company to be excluded from furnishing Inspectors to the Corps for the Propellant Loading System or RP-1 System work.

3. A Construction Management Engineer, Grade GS-11, be assigned as a full time Office Engineer, and that an Engineering

Aid, Grade GS-7, be assigned to assist the Office Engineer.

4. The Clerk-Typist grade be upgraded to GS-6. This is felt necessary in order to attract qualified people for field office duty.

PART III

CONTRACT ADMINISTRATION

Contract administration at the Area level compared in importance with construction in the number of people involved and magnitude of work accomplished. Contract administration was directly or indirectly involved in most of the numerous problems arising during the course of the project. To aid in the review of activities this summary was divided into the following topics:

1. A brief history of each construction contract.
2. Estimating and negotiation.
3. Reasons for increased costs.
4. List of principal subcontractors, scope of work, effectiveness of subcontractors' operations.
5. The race against time, showing construction period and statement of liquidated damages.
6. Standardized equipment contracts.
7. List of all contracts administered by CEBMCO, Beale Area.
8. List of all modifications for each contract.
9. Administrative problems.
10. Conclusions and recommendations.

16. HISTORY OF EACH CONSTRUCTION CONTRACT

Following is a brief history of each construction contract with original and final contract cost exclusive of unsettled claims, and the total number of modifications and claims exceeding $100,000, together with their description and comments concerning their settlement. The information provided concerning the modifications and claims is current as of 31 March 1962.

WS-107 A-2 TECHNICAL FACILITIES

COMPLEXES 1A, 1B and 1C, BASE T-5

BEALE AIR FORCE BASE

Contract Number:	DA-04-167-eng-2140
Date of Contract:	15 January 1960
Contractor:	Peter Kiewit Sons' Co. 345 Kieways Avenue Arcadia, California
Construction:	WS-107 A-2 Technical Facilities Complexes 1A, 1B and 1C, Base T-5 near Beale Air Force Base Marysville, California
Notice to Proceed:	20 January 1960
Original Contract Amount:	$30,157,150.50 for three sites

MODIFICATIONS

Of the 317 modifications, exclusive of claims, the following modifications resulted in increases of over $100,000:

Mod. No.	Description	Amount
72	Furnish L & M for GFP cleanliness inspection	$ 299,000
102	Design changes to PLS System	186,526
104	Modification to shock test equipment	195,436
109	Miscellaneous changes to certain drawings	793,847
122	Revised Propellant Loading System tunnel supports	211,292
127	Required revisions to fuel system and fire water supports in Missile Silo	110,742
135	Revised PLS Piping Supports in Missile Silo and P.T. Lox Cribbing	1,100,000
137	PLS Test Specification Changes	1,824,007
147	Segmentation of MCC and additional installation of package controls	131,453
151	Hardstands for Assoc. Contractor, revised grading and relocate portion of Security Fencing at Site 1B	175,000
161	Blowdown of C. F. Cryogenic Vessels and Tanks	198,976
166	Provide additional pipe supports for PLS piping in P.T. and inter-connecting tunnels, 3 Complexes (Flex. Hose)	194,662
262	Revise Pipe Supports T.J.12, RP-1 Fuel Systems	162,852
267	Provide for Contractor purchasing RPIE Spare Parts for Use during PLS Testing	101,387
286	Clean RP-1 Fuel by circulating thru Filters	128,869
	TOTAL	$ 5,814,049

Contract:	DA-04-167-eng-2140
Modification No. 72	84 No. 91
Date of Modification:	22 November 1960
Description of Work:	Furnish labor and materials to provide for additional cleanliness inspection of Government furnished property installed in the Propellant Loading System at Complexes 1A, 1B and 1C.
Amount of Modification:	$299,000.00

- -

Contract:	DA-04-167-eng-2140
Modification No. 102	84 No. 172
Date of Modification:	31 January 1961
Description of Work:	Revision to the PLS piping System
Amount of Modification:	$186,526.00

- -

84 No. 395 - Accelerate Completion of Electrical Work held in Abeyance due to Changes in Blast Valves.

This modification was initiated to accelerate the adjustment of the limit switches on the blast valves on premium rate. Proposed Amount $2,200.

84 No. 397 - Revise Blast Lock Covers of 36" Blast Valves

The 36" Blast valve shafts after previous modifications were found to be short; therefore this modification will correct the above deficiency. Proposed Amount $1,800.

TOTAL - - - - - - - - $809,000.

CLAIMS

As of 31 March 1962, 214 claims were submitted by the contractor and have been processed as follows:

Modifications over 100,000	5
Modifications under 100,000	25
Claims negotiated but not processed into Modifications	30
Claims withdrawn, cancelled or denied	123
Claims unsettled	31

An explanation of each of the above categories follows:

Modifications Derived from Claims over $100,000

Mod. No.	Claim No.	Amount
149	C-17	$210,253
209	C-2	246,087
264	C-45	264,904
313	C-87	435,000
319	C-7	195,000
	TOTAL	$1,351,244

Modifications Derived from Claims Under $100,000

Mod. No.	Claim No.	Amount
51	None Assigned	4,620
115	C-160	2,700
247	C-15	3,320
263	C-134	2,400
265	C-145	4,391
273	C-113	1,487
279	C-124	850
280	C- 49	2,757
282	C-138	4,921
287	C- 71	428
289	C- 83	12,788
290	C-152	635
293	C-153	404
294	C- 11	7,015
311	C-144	3,500
312	C-206	20,088
315	C-149	11,500
317	C-141	2,100
329	C- 84	1,406
326	C-117	3,000
321	C-200	35,000

Mod. No.	Claim No.	Amount
322	C-208	815
325	C-215	4,072
328	C-218	600
320	C-222	1,500
	TOTAL	$ 132,297

Modifications Derived from Claims

Claim No.	Mod. No.	Description	SETTLEMENT
None Assgnd.	51	Claim (Dampproofing E.T.)	4,620
C- 2	209	Changed Conditions at Site 1A	246,087
C- 7	319	Excessive Engineering Costs	195,000
C- 11	294	Size of Ice Banks	7,015
C- 15	247	Protective Coating T-110 Tanks	3,320
C- 17	149	Two Hole Straps	210,253
C- 45	264	Scope of Required Painting	264,904
C- 49	280	Accessories for Engine Instrument Board	2,757
C- 71	287	Safety Valves for GFE	428
C- 83	289	Shock Flexible Connections. E.T.	12,788
C- 84	329	Fire Water Valves in T.J. No. 10 & B.L.	1,406
C- 87	313	Delay GFE, Errors in Drwgs. Interference	435,000
C-113	273	Relocation of Door 11/13 Control Centers	1,487
C-117	326	PRV-562 Valve Failures	3,000
C-124	279	Interference-Drain Pipe and LOX Crib	850
C-134	263	Vermicalite Concrete in Tunnel Inverts	2,400

Claim No.	Mod. No.	Description	Settlement
C-138	282	Control for PHLC-5V	4,921
C-141	317	Support Flex Hose at Line 1-½" CF-1023	2,100
C-144	311	Color Coding for Pipe Line Identification	3,500
C-145	265	LOX and Fuel Crib Changes	4,391
C-149	315	Interference between CV-702 & Pipe 540-1	11,500
C-152	290	Support for 2" AA-703	635
C-153	293	Completion for Furnishing Recharger Oil	404
C-160	115	Electrical Hand Hole Receptacles	2,700
C-200	321	Misc. Changes to C-2 Compressors	35,000
C-206	312	Piping for SOV 565	20,088
C-208	322	C-1 Compressors	815
C-215	325	Insulate Cyclonic Separators	4,072
C-218	328	Additional Security Guards 1-B	600
C-222	320	Enclosures for Helium Compressors	1,500
		TOTAL	$ 1,483,541

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Claims Negotiated

Claim No.	Description	Settlement
C- 12	LOX Bay Covers	23,007
C- 48	Bolting Down Low Voltage Switchgear	3,386
C- 76	Backup Gas for Installation of PLS Piping	55,994
C- 79	Unusable Neoprene Ring Gasket, 1A	58,328
C- 80	Galvanizing Ladders	18,800
C- 89	Asphalt Coating of LOX Structures, etc.	45,692

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Claim No.	Description	Settlement
C- 97	Rework of LOX Supports - PT	7,514
C-100	Telephone Manhole Cable Racks	875
C-101	Cleanliness Inspection of GFE-Reinspection	161,803
C-115	Installation of Flexible Hoses	300,000
C-139	Duct Work in Interconnecting Tunnel	1,626
C-140	Reverse Valve Flow	20,000
C-148	Safety Valve Design Deficiencies	2,562
C-155	Mounting of C-1 Compressor	6,493
C-158	Bonding and Grounding of RP-1 Fuel Piping	45,000
C-173	Sheared Conduit at Entry Portal Surface Hatch	1,309
C-174	Misc. Addtional Work performed by Booth	9,856
C-175	Grounding of Cable Trays	5,833
C-191	Powerhouse Light Fixtures Relocation	600
C-193	Installation Breakout Flanges PRV's	20,531
C-194	Reverse Gimball Joints in CSO-320	3,000
C-197	Powers Misc. Extra Work	10,885
C-211	Supports, Anchors & Bolts for GFE	18,431
C-214	By-passes at PCV's and TCV's	20,000
C-220	Repair & Replace GFE	175
C-224	Slot for Support Steel MCC 9	2,139
C-228	Repair & Replace FCV	10,500
C-229	Repair & Replace CHV's	4,080
C-231	Repair FC-122 & 123	40,000
C-232	Kiemech Portion - Late Delivery GFE	111,000
	TOTAL	$ 1,009,469

Claims Unsettled

As of 31 March 1962, 31 claims remained to be settled. A brief description, with the anticipated cost of each unsettled claim follows:

Claim No.	Description	Cont. Prop.	Gov. Est.
3	Delays, Government Furnished Equipment	$555,297	$ 500,000
36	Neoprene Water Stops	351,011	200,000
93	Refabrication of PLS Spools	582,983	300,000
109	Powerhouse Pipe Supports	120,189	10,000
112	Tunnel Subsidence	627,127	400,000
129	Additional Cost for Procurement of Sump Pumps	30,815	20,000
150	Vibration Isolators Supports	3,453	2,000
151	Discrepancies in Nozzles,GF Vessels	143,002	120,000
154	Misalignment of Piping due to P.T. Design Deficiencies(Spring Mounts)	390,378	250,000
155	Mounting of C-1 Compressors	6,633	5,000
158	Bonding of RO-1 Fuel Piping	66,917	75,000
171	Additional Bolts MS Light Fixtures	65,739	10,000
176	Remove and Replace Blowdown-Powell CV	136,000	100,000
182	6" Firewater Line Interference with Assoc. Ductwork	45,836	40,000
184	Overall Time Claim	-	2,550,000
190	Superior's Cost Factors for Mods.	500,000	50,000
192	Additional PLS Pipe Supports	91,263	80,000
196	RP-1 Punch List Items	55,599	40,000
198	PLS Changes by Area Engineer Letter	32,537	15,000

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Claim Nos.	Description	Cont. Prop.	Gov. Est.
199	Repair of Sump Pumps- Part Denial	$ 11,673	$ 5,000
209	GFE Water Chillers	15,985	10,000
211	Supports, Anchors and Bolts GFE	52,621	20,000
220	Repair and Replace GFE	472	400
234	Delay to Validation Testing Due to Damage by Assoc. Contractors	17,726	15,000
236	Electric Revisions due to 2140-212	105,679	60,000
241	Boltdown of GF Federal Pacific Switchgear - KV 2.4	8,808	4,000
69	Validation Testing	-	500,000
247	Cable Tray Shock Mounts	-	-
	Clarification of Conflicts		300,000
	Superior Acceleration	-	1,000,000
	Armco Acceleration		500,000
	TOTAL		$7,181,400

CONTRACT 2140 - TOTAL ANTICIPATED COST

ORIGINAL CONTRACT AMOUNT FOR 3 SITES		$30,157,150
OVERRUNS - UNDERRUNS		161,383
MODIFICATIONS EXCLUDING MODS. DERIVED FROM CLAIMS		
Over $100,000	$ 5,814,049	
Under $100,000	2,284,633	
TOTAL		8,098,682
MODIFICATIONS OPEN (POSSIBLE SETTLEMENT)		809,000
MODIFICATIONS DERIVED FROM CLAIMS		
Over $100,000	$ 1,351,244	
Under $100,000	$ 132,297	
TOTAL		1,483,541
CLAIMS NEGOTIATED		1,009,469
UNSETTLED CLAIMS		7,181,400
CONTRACT 2140 - TOTAL ANTICIPATED COST		$48,900,625

SUPPORT FACILITY FOR
WS-107 A-2 BASE T-5
BEALE AIR FORCE BASE

Contract Number:	DA-04-167-eng-2174
Date of Contract:	26 September 1960
Contractor:	Fullerton Constr. Co. & Samuel N. Zarpas Inc. 2583 Valley Road Sacramento, California
Construction:	Re-Entry Vehicle Facilities at Beale Air Force Base
Notice to Proceed:	28 September 1960
Original Contract Amount:	$146,000.00
Modifications:	A total of five Modifications was proposed:
	1. $ 279.67
	2. 7,366.00
	3. 920.45
	4. - 475.00
	5. N.C.
Net Overrun on Unit Bid Items:	$1,699.20
Claims:	None
Final Contract Amount:	$155,790.32