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Oral history interview with Charles W. Abbitt
[full name of interviewee]

about ~~Philco role in~~ Development & Mission Control Center at Manned Spacecraft Center, Houston
[main focus of interview]

Title: Manager (Philco), Ground Operational Support System; Senior Philco Tech Rep.
[interviewee's current and/or former title and affiliation]

Interview conducted by Robert B. Merrifield, Staff Historian
[interviewer's name/position]

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CONTENTS:

Biographical - [date/place of birth; family background] _____

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Education - _____

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Career Path - USAF; DOD rep. at Cape Canaveral; Electronics Systems Division, Western Development Division, Philco; 1963 Philco Mgr, GOSS (Ground Operational Support System) unification (MCC Contract); * 1967 Program Mgr & Analysis

[* 1965 - Senior Philco Tech Rep, Mission Control Center Operations]

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Topics - Ground Operational Support System (GOSS); Gemini Launch Data System (GLDS); Philco - NASA interface; Integrated Mission Control Center (IMCC); GT-4 (June 1965) flight control; command systems problems; power fluctuation problems; Operational Readiness and Confidence Tests (ORACT); NASA lack of firm schedules for software; pre-launch configuration freeze date; reconfiguration & readiness cycle model; Gemini program problems; Master Digital Command System (MDCS); Communications Command & Telemetry System (CCATS); NASA - Philco Contract Changes; Philco Safety review board - Sept 1967; recruiting qualified technicians; NASA duplication of effort; ~~NASA management - Philco interface~~.

1810

Interview with Charles W. Abbitt
8/6/68

I retired from the Air Force and I was hired ~~into~~ from the A.F. Electronics Systems Division by the Western Development Division of Philco. I previously worked for three years at Cape Canaveral as the DOD representative for obtaining DOD support for Project Mercury, ~~and~~ such support involved principally the national ranges, biomedicine and recovery. Having been in that position, I had worked with Barry Graves and Walter Williams, who was the Operations Director in those days and Chris Kraft, who was the Flight Director even back in 1959.

I came to Houston in late July 1963 and became manager of GOSS Unification under the IMCC contract. There were 3 parts to the contract, the biggest and most important part was the IMCC implementation. Then there was a GOSS Unification and Analysis of which I was the manager. The third part was a requirement study, which essentially was a carry-on from the old original study which laid down the design criteria for the Control Center. The GOSS, Ground Operational Support System, Unification involved studies on the compatibility of the network with the Control Center--we were assuring that the interface between the Control Center and the outside world was efficient. Involved in that was the design and implementation of GLDS - Gemini Launch Data System, which collected the various data at the Cape and transmitted it through telephone lines to Houston. We also implemented the terminal landing system which was a complex of trailers that were planned and prototyped in the event of a land landing. We designed and implemented a launch data system for Project Apollo which essentially was a similar system but over on MILA.

For the most part our work was involved with the command system as a network, the telemetry system as a network, and a total network included the control center and the communications. I had about 35 professional people starting in July-Aug 1963, and worked primarily under the direction of Howard Kyle and Vavra as part of Barry Graves' contract.

Philco was then in the main building downtown Houston but my group was at the Houston Petroleum Center. We were co-located with Chris Kraft's Flight Operations Division, and Vavra and Howard Kyle's Ground Operations Support Office. At that point, Philco people in Houston who interfaced with NASA did the requirements definition and shipped these criteria back to Palo Alto where the hardware was built. We essentially completed the installation and checkout of equipment in December 1964. In January 1965, I was transferred to Mission Control Center Operations, and became the senior Philco Tech Rep in Houston. My duties included responsibility for the maintenance and operations department and the flight control personnel and installation and installation design - primarily site oriented and totally devoted to the operations. In January 1965, we monitored the GT-2 flight which was controlled from the Cape. In March we monitored GT-3 and again essentially on a non-interference basis. The implementation of the control center was to be complete so we would have the control center ready for GT-4. The GT-4 was the first flight controlled from Houston. It was somewhat controversial as there was some doubt as to whether Houston was ready to control GT-4. Philco actually recommended that the control be exercised from the Cape, while IBM and Univac both recommended that it be controlled from Houston. The paradox of the whole situation was that it was our belief within Philco,

306 as the integrating contractor, that the software produced by the IBM and Univac, was not ready for GT-4. But in the presentation to Mr. Kraft both of the associate contractors, IBM and Univac, insisted that they were ready for GT-4 so Kraft made the decision to proceed with GT-4 totally controlled from Houston.

This decision put a lot of pressure on me as the manage of the MCC operations since up to that point my main job was to assist the engineering people checkout the equipment and systems for the Control Center. We were supposed to have from Jan '65 until June '65 to demonstrate to NASA that the systems and interfaces actually met the contract specifications. We had little time for our M&O people to get onboard, and to train in the pure operations mode. Rather we had to concentrate on playing a secondary role in helping the engineers prove out their equipment. We started a new ball game in GT-4 on March 15 when we were given the flight control requirements for GT-4. We made an analysis of these requirements and decided what changes had to be made from the acceptance configuration, as defined in the contract, to a configuration which would support GT-4. It turned out to be a sizeable change, in spite of the fact that we had not proved out the contracted configuration. The communication system, for example, changed its

306 configuration by 50% -- approximately 1/2 the circuits had to be rewired, reconfigured to satisfy the flight controller requirements for GT-4. The

display system required a fairly large reconfiguration and we devoted on a readiness schedule approximately 2 weeks for this and approximately another month to do the intercom reconfiguration.

We laid out a schedule based on the preparation as we saw it and fairly well followed it. On Apr 28 we started into a series of confidence tests as designed by our field engineers. We devoted 3 weeks to equipment interface tests, systems tests on the command, telemetry, trajectory, and air-to-ground aspects and in particular the interface with the Gemini launch data system. This took from Apr 28 to May 18, and we were supposed to turn the building over to the Flight Control Division of NASA - ready for NASA to start into their flight control test and pad tests. In that period we demonstrated that the equipment was ready but we could not firmly demonstrate the overall readiness of the control center because of software problems. We turned it over to Flight Control on May 17 with the reservation that the software was not totally debugged but with the recommendation that it could probably be brought up to a readiness state by continuing development during flight control tests. We started into the tests on the 17th and gradually beat the bugs out of the CP and the RTCC, and GT-4 lifted off on June 3 and flew until Jun 7 as planned. It demonstrated convincingly that the Control Center could operate a single vehicle.

We had numerous problems as might be expected. One of the command systems went red and stayed red for most of the flight because we couldn't take it off line to check it out after we thought we had fixed it. The part ~~which was part~~ of the master DCS which was mandatory

was operating. The part that wouldn't work was transmission to Corpus Christi and Bermuda. That was red and the flight director felt that his mandatory requirement was for Canaveral, and it was working, we shouldn't take it off line. We went through 75% of that flight with one red command system but the second system operated properly. We also had a lot of trouble with the pneumatic tube system. It hung up and several of the carriers and switches broke but there was nothing serious that interferred with data gathering or communications. We had numerous problems with the hard copy machines ~~and~~ which has been ~~a~~ marginally performing systems ever since. We had some problems with TV monitors, circuits, logic cards, intercom, and some of the slide files broke, but the only serious discrepancy in Philco's hardware was power fluctuation just before retrofire. It shut down about 4 pieces of equipment for 12 minutes. It took down the ~~ido-for~~ EIDOPHOR, the video scanner, and the input multiplexes, and the hard copy but fortunately it did not affect the retro signals or seriously affect the recovery. But it did make it impossible for people to change displays through the RTCC. The big problem we had involved the fact that we were manned only for 2 shifts. We had to run for approximately 6 days with a double shift of the M&O people, and the engineers who assisted us were on a 12-hour on and 12-hour off basis from May 28 to June 7. We had a particularly bad situation in the message center where most of our people were new to this type of operation. Fortunately in the other areas we were able to use people from other Philco contracts who were fairly well qualified in this type of environment, and most of them had been involved in the checkout with engineering. Actually, we came out fairly well for GT-4.

306

The one lesson we learned in Philco was that as we proceeded through the readiness cycle, we got a continual chain of changes from the flight controllers either in display or in communications. We never could freeze the configuration and really check it out and let it operate. As a result of that we gave up on what we call Operational Readiness and Confidence Tests. We could not keep the tests up to date with the configuration so we dropped the tests on telemetry and command. This proved to be a mistake for if we had kept our command tests up to date, we would have detected the problem we had in one of the master DCS's. From that point on we decided that in accepting changes, the ORACT Tests would be one of the criteria we would use to decide whether systems were ready. From that date on, we took advantage of this hard lesson and relied most heavily on a computer ORACT test to determine in a very short time whether or not the control center was operating.

347-V

Another thing we were critical of(and this was a sensitive area with MSC), was that NASA did not set firm schedules for the software in the RTCC and the CP and insist that the associate contractors meet these schedules. As a result of this lack, the whole readiness cycle, the training cycle, and the development of simulations were seriously jeopardized by a series of computer outages. For example, the CP still had not completed all of its software development on F-1 day. Here was a real difference in philosophy between NASA and DOD. The DOD would have insisted on more disciplined guidelines ~~and would have insisted on more disciplined guidelines~~ and would have insisted that these be met.

I think there really hasn't been any significant improvement in that area up to today.

However, the ORAC lesson was learned. We also recommended to NASA that the changes which we were continually getting right on down to the liftoff--the last change we got was 4 hours before liftoff--that should not be permitted, for they jeopardized the whole system and the integrity of the Control Center. We convinced NASA and they have been very firm as to a freeze date on the configuration some few days before launch and it permitted us in every case to have a M&O downtime day where we go through the equipment with a fine tooth comb to check it after all the engineering changes and reconfiguration changes have been completed.

It took a lot of time on GT-4, but the reconfiguration and readiness cycle which we used for GT-4 that first time essentially set the pace for all of our missions. We are using the same basic step, same basic philosophy in getting ready for 503. We've made progress in doing some of these steps quicker and we've made progress in assessing the scope of each one of the steps sooner. We have shortened the cycle. But the various steps where we take first requirements from Flight Control, we turn into a reconfiguration packet or an engineering order packet, then we actually make the configuration changes, or put in the engineering changes, check the equipment, and then check the equipment with the software in an overall system test, and finally turn it over to flight control. That concept still survives.

After GT-4 we proceeded a flight per quarter through GT-12 and all of those flights were so similar, as far as we were concerned, to GT-4 that all of the major risks were taken in GT-4.

Once we made it through GT-4 we knew we were home free, and in fact the control center was declared operational in May 1, 1965, based primarily on the progress we were making toward readiness for GT-4. This announcement wasn't made until after GT-4, but there had to be an operational date when we had demonstrated our readiness. It was originally envisioned that we would go through a series of tests which check out the total system, both hardware and software, with simulated missions. It was obvious after GT-4 that that wasn't necessary so the contract was amended and preparations for GT-4 served as an acceptance test for the Control Center. The only thing remaining for us to do to meet our contract was the rendezvous which we accomplished in December 1965 on the GT-7/6 flight. With it we proved we had met the contractual provisions.

All through the Gemini program we had certain equipment with which there were continuous minor problems. As far as our hardware was concerned, the only serious problem we had was with the master digital command system. All through the Gemini program there were occasions where we had commands being transmitted from the Control Center for totally unexplained reasons. On one case during a wet mock demonstration where Gemini, Titan, and the Agena were all on the pad and active, we loaded over 80 commands into those vehicles for no reason. This always concerned us as it did NASA. We never found out exactly what caused the commands. We always believed it was a power fluctuation or short, but along toward the mid-term of the Gemini program, we start taking a point of view that the ~~massive~~ master DCS configuration must be frozen at the end of the re-configuration period, and that no engineering changes should be made to that system after we started into the readiness cycle. Each time we made a

modification, we checked it thoroughly with all types of meters and test equipment we had, and we ran a series of confidence tests, ~~strain~~ string tests with the outside world, and stayed in that configuration right on through the mission itself. After we started exercising more discipline and dedicating people to that system, we got much better performance out of the Master DCS. On the last 3 missions we had no discrepancies. But it was always considered a marginal system in the Mission Control Center.

All of this time we were on a cost plus fixed fee arrangement into what is called Schedule I of our contract. Then in July 1966, we went under the new schedule, called Sched II, as we transitioned into Apollo Program. For approximately 6 months between July 66 and Jan 67 we were defining the incentive arrangement under which we would operate under Sched II. During that 6 months we stayed on a cost plus fixed fee until the contract could be signed and agreed to by both parties.

It was during this period when we completed the GT-12 flight in November '66. We also installed the Communication, Command, and Telemetry system to replace the Master DCS and some of the functions of the telemetry ground station . The idea was to put the command functions into the Univac 494 general purpose computer and also do the decommutations of telemetry which had previously been done in the ground station ~~in the 494~~. The thinking was that in an integrated system where we did the communications, command, and telemetry in one system was a better arrangement than having separate special purpose boxes for each. We transitioned into that system to meet the original 204 flight which was to have been the Grissom flight. The fire happened in Jan '67 but nevertheless we continued with the system into the Apollo to make it ready

for the Apollo Program. We had a lot of trouble transitioning into that concept and have had to make a number of changes and modifications most of which are just being completed now prior to the 205 flight. There have been major changes which relate to arriving at a greater reliability for command and to insure that the command which is called out by the flight controller at his console is in fact the command which the ~~CCTS~~ CCATS sends out to the remote site and finally up to the spacecraft. We had to put in a lot of safeguards by changing the wiring concept, by adding some hardware into the multiplexes inputs to the machine, and a lot of software safeguards within the ~~CCTS~~ CCATS itself. We have just completed the last modification which we feel brings the command portion of ~~CCTS~~ CCATS up to an acceptable level.

Finally in January 1967 we went into the cost plus incentive fee arrangement with NASA and 55% of our incentive grade is based on operation and the remainder on systems engineering and operational support. I was transferred in January 67 from the MCC Operations into the program managers position which I am still in now. This position is to coordinate all of our efforts in support of NASA. We have been oriented even more toward the operation facets based on the arrangements in the incentive plan. Our contract changed at this point, in respect to the engineering portion of the contract under which we furnish engineering and studies to NASA as directed by NASA. We negotiate a certain level of manning but we do not actually perform those jobs until we are directed to by the contracting officer. This arrangement started in July 1966 and approximately 15 months later, we determined that was not a useful way to do business. People at Philco doing engineering

orders, task orders, and studies would only accomplish a study or engineering job when they were told to by NASA. As a result, we had people with no particular security in a given field and they were forced to jump from one job to another. As a result we didn't have any person who was a command specialist nor any group of people who were telemetry specialists, nor any who were display specialists. Although we forewaw this when we negotiated, we couldn't convince the negotiator that this was going to be not in NASA's best interests. As a result we got together later with NASA and agreed this wasn't a proper way to work. In October 1967, under the same basis of the contract we agreed we had to have a staff dedicated to the various disciplines such as telemetry, command, display, communications, etc. We came up with agreement of approximately what level of effort was required and since that time, we feel the engineering performance on our contract has improved by about 25%.

The effect of the accident was to cause our activity, particularly in the control center, to be cut back drastically. The next flight was AS 501, an unmanned Apollo in November 1967, and then the 204L, an unmanned test on the LM in January 1968, and finally the 502 unmanned flight in April 1968. Since then things have started to pick up. At the completion of 204 in January, we started almost immediately on reconfiguration for 205 on the 2nd floor. There has been an entirely new configuration installed for the Apollo manned flight. This has been completed and approximately 50 EO's have been installed and that operational control room has been turned back over to flight control. They are running a simulation today. We feel that floor is ready to go. The third floor

has just recently been completed for 503, the manned 500-series flight. We have installed approximately a little under 50 EO's and have about 12 more to go. Essentially, we have caught up with configurations on both the 2nd floor and the 3rd floor, and we are just getting the package ready so that the 2nd floor will be configured after 205 for 504. At that point we feel both floors will be essentially identical and it will be a matter of assignment according to NASA schedules. In August 1967, we had Tiger Teams put onsite to try to instill in the engineering people the necessary motivation to keep them abreast of what the M&O people were doing and what the NASA people were doing. We had a Tiger Team in telemetry and command and display. These eventually turned out to be the dedicated people I was talking about that we convinced NASA were needed in November 1967.

In September 1967 at the direction of Dr. LaBirge, we formed a Philco safety review board which the general manager of the division is chairman. It is to insure that our efforts toward all manned flights are maximized. We go through each critical line manager who has a sensitive role to play in the flight and have him defend his preparations for the mission, subject to any particular clarifications that we might want or any particular job we might want to lay on him to insure that he is doubly prepared for the flight. It usually centers around the preventative maintenance instructions, whether or not they have been carried out by M&O, whether any key people have been moved and why in the sensitive areas, any changes in reliability factor or the equivalent, particularly regarding the command system or any system which may have been added or changed since the last flight. Also, we receive an estimate from quality assurance as to whether it considers equipment and people ready.

In GOSS Unification all of our people came from Palo Alto. This wasn't a very good area for recruiting professional people during the period from July '63 to January '65. My experience after January 1965 on into a year ago had to do with field engineers and technicians, and in the early part of that period, it was almost impossible to get technicians and qualified field engineers from the southwest or Houston area except in the most menial of disciplines. We got most of our teletype operators, but we did most of the training ourselves. We got some of the more menial and low level technicians tasks filled locally, but the highly qualified technician we had to go outside the local area. At least 50% of them came from the Satellite Test Facility, which is the other large contract we have on the West Coast and through the Pacific for the Air Force. Of late, the availability of technicians and field engineers in this area has been more favorable and we have been able to get people from Biloxi, Mississippi in particular, where there are people leaving the Air Force who are uniquely qualified for this type of work. Being the size company we are, we rely to a large extent on transfers within the company. On the professional end I have had only limited experience in recruiting. Of late, our professional IR people have been hiring engineers with a minimum amount of experience usually from the local colleges and universities believing that they will be happy here, will stay with us longer, and hence it is in the best interest of Philco and the Government to hire them. We have been getting most of our new people in the professional

fields from Louisiana, Texas, Oklahoma, and other states of the southwest.

In many cases, particularly in equipment and system engineering, NASA tends to redo what we've done. In other words if we design a box, they will tend to go to almost the same depth as we do in the guise of monitoring what we do. We've also noted that each group within NASA tends to have his own sandbox and area of interest and he doesn't worry about whether the whole job is done or whether he is duplicating somebody elses' work--his interest is limited to a certain part of the whole. From time to time they do what they want to do, rather than what they are chartered to do.

347-4
346-2

Our interface with NASA management has been excellent. Once a month our contract manager gives us a briefing on how well we've performed under the contract, and once a quarter the contracting officer summarizes our performance in about a 25 page document. Also approximately once a month, we have a Philco NASA management meeting where our manager meets with Chris Kraft. At that time we are free to bring up any controversial item that we want to direct to Mr. Kraft or question any judgments made by his subordinates. Likewise he is clearly able to criticize us or ask us for improved performance. There are no feuds going on between Philco managers and NASA managers.