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ORAL HISTORY INTERVIEW

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Oral history interview with Jesse C. Jones
[full name of interviewee]

about Thermochemical Test Area (TTA)
[main focus of interview]

Title: 1962 - ~~STD~~ Systems Evaluation & Dev. Div / Test Facilities Branch
[interviewee's current and/or former title and affiliation]

1968 Chief, Laboratory Operations, E+D

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

Historian **at** ~~MSC~~ White Sands Test Facility WSTF
[location of interview]

Transcript and tape(s). [for inventory only: # pages 21; # tapes 2]

Master 1

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

Education -

Career Path - Douglas Aircraft (L.A.); Bechtel Corp. (Linzborg, KS); 1962 MSC Houston

Topics - Initial confusion w/ MSC job; Thermochemical Test Area (TTA); initial plans for feasibility study; other test facilities: power systems, auxiliary propulsion, fluid systems, pyrotechnics; Space Chamber; propellant waste disposal; problem with Contractor's dri-lube supply; problem using support contractor; construction delays; squabble with IESD (Instrumentation & Electronics Systems Div); RCS engine combustion problems; staff and operations; need for laminar flow clean room; increase in TTA workload; TTA & TSD clean room services; Standards Calibration problem

OPTIONAL FORM NO. 10
MAY 1962 EDITION
GSA FPMR (41 CFR) 101-11.6

UNITED STATES GOVERNMENT

Memorandum

TO : EA2/Jesse C. Jones DATE: May 22, 1968

FROM : AC/Special Assistant to the Director

SUBJECT: Preparation of a History of Manned Spacecraft Center

At the request of Dr. Eugene M. Emme, the NASA Historian, we have agreed to assume responsibility for the preparation of an MSC history. This effort is expected to complement programmatic histories (Projects Mercury, Gemini, and Apollo) which are either in preparation or complete. The MSC history will place primary emphasis on the Center as an institution--its general management philosophy, the evolution of its major organizational elements, growth and modifications of its staff, management of its financial resources and contracts, acquisition of its facilities, and its impact on the economy, culture and society of the community in which it exists.

Dr. Robert B. Merrifield, a professionally trained historian, has been asked to prepare this record of our progress from Langley origins to the present. Since he has been with the Center for over five years, Dr. Merrifield is familiar with many key decisions, events, and trends in the Center's past. However, he will need help from all of us who have been major participants in the life of the Center, particularly in interpreting why and how various forces have influenced the development of the Center as an institution. Your aid and cooperation in this undertaking are vitally important to its successful completion and will be appreciated.

Paul E. Purser

Paul E. Purser

OPTIONAL FORM NO. 10
MAY 1962 EDITION
GSA GEN. REG. NO. 27

5010-107

UNITED STATES GOVERNMENT

Memorandum

TO : EA2/Jesse C. Jones

DATE: May 22, 1968

FROM : BN5/Dr. Robert B. Merrifield

SUBJECT: Preparation of a History of the Manned Spacecraft Center

As is pointed out in the cover memorandum, I have been commissioned to prepare a history of the Center. There is a large volume of information (memoranda, blue prints, sketches, etc.) available in the official files and, of course, I plan on exploiting it. However, such information is only the bare bones of history; I will also need intimate detail and personal insight from major participants and informed observers. It is especially vital that I have the benefit of the personal recollection of our key personnel who shaped the management philosophy of the Center during its early formative years. It is for this reason that I would like to have the privilege of spending a few hours with you, to help you put together a statement reflecting your knowledge of the Center's history.

If you have no objection, I will plan on using a tape recorder while I am with you, as it is a convenient way of obtaining a lot of information quickly and economically. I fully appreciate the fact that you have been involved in a seemingly infinite number of major activities, all of which are complex and of such significance that they cannot be disregarded in a Center history. At the same time, I recognize that your time is valuable and limited, and will leave to your discretion what you should put into your statement. I am interested in any information you consider to have been important in the establishment, growth, or maturation of the Center, and invite you to feel free to go into whatever depth of detail you feel advisable and within the limits of your available time. There will be no need to be concerned about grammar, structure, or repetition at this point. I will plan on submitting a transcript of this recording to you as soon as I can get it typed; if you wish, you may then amend or add to it.

I am keenly interested in those minor details that will add vividness and vitality to a historical narrative. For example, a key management decision may have been reached in one of those drab, crowded, stuffy conference rooms of the "Dolly Madison House" (rather than "at OMSF"); or the wisecrack or joke that relieved the tension or boredom or weariness of an important meeting; or the unprepossessing appearance of the Carla-battered Clear Lake Site. Although such details may seem trivial, their judicious use will make the difference between dull and interesting reading.

Because of your position and long association with the Center, it is quite likely that you are familiar with events where personality clashes, conflicts in judgment or other human failings have played a considerable role. The natural tendency in dealing with such sensitive issues is to avoid them or to gloss over them with generalities. Obviously, any history based on this type of treatment will be bland, innocuous, and superficial. On the other hand, if potentially explosive information were to be incorporated into a history, it would certainly lead to embarrassment or more serious consequences to the Center. As an alternative to these two extremes may I suggest the following: I would like to have your statement to be completely candid; I will consider it to be personal and confidential, and will safeguard it accordingly. After typing your narrative, I will return it to you for verification. At this time, I will ask you to indicate those portions of your statement which you regard as "privileged information." They would never be alluded to in any way in the Center history, and would have the sole purpose of giving me the necessary background information I need to write a factual and objective history.

May I call you in a few days to make arrangements that will be mutually convenient for me to see you?

Robert B. Merrifield

authorize Poland to take over TTA for when needed as well as TSD. Problem — much Testing of routine work — ~~—~~ Dave McShaw, Al Watkins + I worked out agreement which enabled to reduce workload backlogs. Painful process of many meetings in trying to solve

3'. In standards + calibration - similar problem had to get E+S out of this area — now trying to get ~~Serv~~ work into hands of people. ~~Moved on~~ Hal wrapped around axel as bid by qual assurance + question as to where function should be - where go + assign. Learned assign function + get back for them.

Not in TSD

See Al Watkins for up dating from Aug 66 on + tour of ~~site~~ TTA

Weldon Heath - died at 31 years of heart attack around Oct - Nov 67.

INTERVIEW WITH JESSE C. JONES
June 18, 1968

I am an ex-Texan and had worked out in Los Angeles area for three years with the Douglas Aircraft Company. I was not too happy with the LA area, and at the time we finished a project we were primarily involved in I started looking around for a job that would move me out of the LA area. I took an offer to go to work for Bechtel Corporation in Kansas on the Atlas silo program. It was at a little place called Linzborg, 20 miles south of Salina, a community in which 95% of the people there speak Swedish on the main street. We were there about two years, getting near the time when that job was to be finished. Bechtel wanted me to come back to Los Angeles but I had no desire to do so and began looking around for a job. At that time NASA was building up so I contacted several Centers. I was not too interested in coming to Houston at the time, primarily because I had not heard too much about that aspect of the space program. This was in January or February 1962. I got my Form 57 back from Langley and Ames with the comment that they were not hiring, and I had just about given up on the idea of going to work for NASA when I got a call from Wes Messing here at MSC. He offered me a job, and he wanted me to come right away. By this time it was April or early May 1962. I did not want to leave till the latter part of the summer because the job was not completed. But this offer looked like something I would be interested in and the Colonel in charge of the project agreed to release me.

We left Kansas in mid-May of 1962 and came to Houston. We left our kids with our folks in Childress, Texas, got here on a Saturday night, and

came out on Sunday looking for NASA. I had been to Houston once about 10 years before but didn't know where NASA was. I had the address of the Rich Building so I went there. In the lobby there was a guard and secretary. I asked them where I would be working and they said it would be in the Houston Petroleum Center, so I spent most of Sunday looking for a place to live around the Houston Petroleum Center. On Monday when I came to work it turned out that I was supposed to be working at the Rich Building.

I started there in the Rich Building for Wes with two other young fellows, Weldon Heath and Al Watkins, both of whom were inexperienced. Wes had a good many years with NASA out at Edwards Air Force Base and I had some experience working but none with NASA. It was a pretty confusing time. The C&F budget authorization for construction of the Thermochemical Test Area was $6,000,000. We were just then getting started on a feasibility study to see exactly what we should build or what we could afford to build. I followed Wes around for a couple weeks. He was the kind of supervisor that ~~was~~ did not ~~too well~~ things too well coordinated, ~~and~~ a lot of confusion seemed to characterize our operation. Across the street from the Palm Center, MSC had a Facilities group working on the second floor of a former real estate office building, and we used to go there quite often. After I had been with MSC about three or four weeks, Wes told me he was going to be leaving and he was leaving me as acting manager. He had recommended that I be given this responsibility. ~~Here I was~~ This left me with only four weeks' experience with NASA, and ~~not getting anything done, with~~ two young guys, who altho top notch, also knew nothing about ~~NASA~~ MSC. I talked to Aleck Bond, then Division Chief, and Kurt Strass, Test Facility Branch Chief

who was responsible for the Thermochemical Test Facility, as one of several of the large test facilities then in the early stages of design. I told them that I thought I should be given a chance to see if I could handle the job. So after a few days they told me they would appoint me as acting section head, and would see how it would work out. So that is the way it started in July 1962. We had a section of three people with a total experience working for MSC of about three or four months. We added people as we went along and fortunately were able to pick some top notch fellows and ~~they~~ who were real interested in getting the job done and things went along real well.

At that time we were trying to get involved in the Facility feasibility study. We needed to decide what we could afford to build, what it should look like, and how big it should be. The ~~general~~ primary purpose was ~~primarily~~ to support the S/C propulsion and power systems development program. We needed to have the ~~in-house~~ capability to properly manage and run an effort the size and scope of the Apollo Program. To do this we needed the capability to perform in-house testing and evaluation of propulsion and power systems and components. We negotiated our feasibility study contract with Brown and Root, and the fellow they assigned to be project manager was Harry Hutchins. He was an extremely capable manager and has been one of the moving forces in the ~~things that we developed down here~~ development of MSC. We also had GE and Marquardt Corporationas consultants for propulsion work and a few other specialized consultants in the area of acoustics and pollution problems.

In our first review--I think it was a 30% review--the recommendations brought in by contractor were pretty wild--construction of something like a 100 foot high tower for the thrust stand, and a cost estimate of about 25 million dollars, or about four times what we had to work with. We regrouped and told the consultant on propulsion he was shooting a little

high for what we felt we needed here. We were far from certain ourselves as to how large an engine we should be getting geared up to test. Of course we knew what size the Apollo S/C propulsion system was to be, but we just didn't know for sure if we could afford to build an altitude facility to test it, as it took a good-sized structure to do it. So we redirected our contractor and told him to take another look at the thrust stand approach. He did and came back a week or two later and managed to cut the cost down to $12 million. He was still 100% over what we had to spend. We really took a serious look then at what we could do about the thrust stand problem. It seemed to be one of the large expense items. At that time we were planning for five basic facilities. This included a controls systems facility where we could mount reaction control engines in conjunction with a stabilization control system that would be mounted in turn on an air bearing table, and we could hot fire these engines. This was a sophisticated facility and no one else had done anything like we were talking about doing. There were a lot of problems and there was a lot of doubt in our minds as to just what we were going to be able to achieve in that facility.

We kept a jaundiced eye on that one as it went along. We held many meetings with the guidance and control people at that time concerning the control systems facility. The other facilities included a power systems test facility primarily associated with the development of the fuel cells and power supply system, an auxiliary propulsion test facility which was associated with the development of the RCS engine, a fluid systems test facility which was primarily associated with the development of the large propellant transfer and fluid systems of the spacecraft, and a pyrotechnics

test facility. We realized that to have these facilities ~~and that~~ PLUS THE large thrust stand would never be possible and still stay within the six million we were talking about, ~~and develop the altitude capability,~~ so we redirected our contractor again and suggested just stubbing in utilities, etc. for the thrust stand but not really going ahead with its construction. We also recommended cutting down the number of test cells. The contractor had suggested a control room separate from the cells. His experience on the West Coast had led him to believe that a control room was normally separated, like a block house, from the thrust stand itself. We put a lot of pressure on him to bring him around to our point of view. Actually we were treading on thin ice ourselves. We had done enough checking to convince ourselves that the right approach was to have an integrated facility with the test cells AND CONTROL ROOM grouped in the same complex. We finally got him to thinking along those lines which cut down the cost estimate to about six or seven million, which was still too much. We still had to PAY FOR ~~perfect~~ the design--the feasibility study--and we had to pay the fee of the Corps of Engineers, inspection, etc. out of the six million. Really what we had to work with was something around five million for actual construction. About that time in our dealings with the Guidance and Control people, we finally concluded that we should not proceed with a control systems facility. It didn't look like it would warrant spending that kind of money. It would not be utilized to the extent necessary to bring to bear any effectiveness criteria in support of spacecraft development. We cancelled the controls system facility. This brought our costs well within our construction estimate. I was inclined to try to get as much as we could for our dollar, so we undertook a small in-house study

to look at what we might be able to do toward building a sea level large engine thrust stand ~~as opposed to~~ OR a thermo-vacuum chamber for hardware development work--to see which one of those facilities seemed to be the most needed in terms of our overall support of the Center's need. It turned out that the right approach for us was to shoot for a thermal vacuum facility.

What we ended up getting was five facilities in what we call the Thermochemical Test Area: 1) The Space Chamber which includes the thermal vacuum facility, 2) the Power Systems Test Facility, 3) the Auxiliary Propulsion Test Facility, 4) the Pyrotechnics Test Facility, and 5) the Fluid Systems Test Facility. We kept the design and construction contract for the thermal vacuum chamber separate from the overall Brown and Root contract because we felt we had to handle that ourselves, and felt if we kept it in-house and contracted for it separately we would have better control over what went into the facility. So in the construction package we had the building to house our thermal vacuum chamber, we had the other four facilities and the office building and systems test laboratory. I started working with Jim McLane at that time ON A SPECIFICATION FOR A THERMAL VACUUM CHAMBER. Jim had been hired several months earlier from AEDC and had a lot of experience in space chamber development. He and I developed the spec on the chamber we thought we needed. We went out on a separate contract for that and negotiated an agreement with SIP, Inc. here in town. SIP had never built a vacuum chamber before but of the bids we got, we felt that theirs was soundest both in cost and approach. We have since had no cause for regret. We consider it the best small hardware development thermal vacuum facility in the business.

One of the problems that came up during the design phase of the TTA was what to do about waste propellants. We had to dispose of these waste propellants in such a way that we did not contaminate Clear Lake. It was a serious problem and we had no experience to draw on. Nor could anyone in the area help us. Our contractor suggested a pretty sizeable batch-decontamination plant. It was an automated plant that looked like a cement batch plant with a lot of hoppers, for chemicals. These hoppers would be automatically controlled depending upon the preponderance of fuel or oxidizer in the effluent that was collected. It was a pretty expensive system, and we desired a less expensive approach and one that would be easy to maintain and operate. We worked far into the night many sessions in reviewing our detailed design. We also did a lot of head scratching trying to decide what would be the most suitable system. About that time I went with some Facilities personnel to Austin to talk with the state health people to try to get some guidance as to minimum standards in treating our effluent before disposing of it. Unfortunately, we didn't get much guidance. What we finally came up with was an idea that developed into what probably is the first system of its kind. It's the only one that I know of although there may be some chemical plants employing somewhat the same concept. All of our test cells and storage areas were sloped to drain into a process sewer. So if we had a spill, we could immediately flood the area with water, from what we called the floor deluge system. It would wash all this propellant down into a trench where it was channeled thru an underground process sewerage system to a sewer plant in the northeast corner of the Thermochemical Test Area. We had two ponds there and a series of pumps so we could move the effluent out of one pond to another. We

finally concluded that exposure to atmosphere would probably be sufficient treatment in itself for 99% of the cases. If any other treatment was required it would be a special type handling problem based on analysis of the effluent and of course we had to keep doing this through our pumping system transfering it from one pond to the other. From this it went into a water drain system for the site and then dumped into the Houston Power Light draining ditch and so it got a lot further dilution by the time it got to Clear Lake. Also it was just impossible to contemplate a spill of such magnitude that it would ever be any problem. As a consequence, we were able to do away with the batch plant entirely. It was one of those things that one is never 100% sure of but as it turned out it was the right decision.

During the construction phase, we had a problem that came about because of the turn-key concept, which in effect requires a contractor to have everything in good operating condition when he hands the "key" to the purchaser. Our contractor was Paul Hardeman, who had some experience in building propellant type systems and in fact had a propellant systems contract on the Atlas silo program. But as it turned out most of the people he used were local people out of the union hall downtown who had no previous experience in building a propellant system and we just could not get what we considered to be a quality job. One of the primary problems with propellant transfer equipment is that a high level of cleanliness in the system has to be maintained since hazardous propellants can be violently decomposed by exposure to contamination of certain types. We knew we were not getting the kind of work we wanted but we didn't seem to be able to do anything about it. We couldn't force the kind of inspection that was re-

quired, so we had to get in there and clean the systems ourselves. Unfortunately we had a devil of a time getting Hardeman to finish the job and get out so we could get in to disassemble, and clean things. He managed to extend his construction contract six months past the original estimated completion date. But we finally got him out and then went back in and cleaned those systems. One of the hardest things was getting the contractor to respond. One particular instance was typical: we couldn't get him to use the right kind of lubricants and sealants. One of them happened to be a material that is called dry-lube, and which is used to put together large tubing systems. He ran out of dry-lube relatively early in the contract and he started borrowing dry-lube from us a few tubes at a time without my knowledge. Then he would come back later and say if we didn't loan him this dry-lube he was probably going to be held up a little bit longer. We would keep loaning it to him and since he had an order in supposedly he would pay us back. This went on for a couple of months. I happened to mention it one time to a couple fellows who came through--one of them might have been Wes Hjornevik--but whoever it was, it was the wrong person as I got involved in a big investigation on the dry-lube thing and I spent many hours trying to put that problem to bed. I probably spent $300 or $400 worth of time on the phone just trying to get that problem resolved. We did finally. The contractor traded us a lot of spare parts for the dry-lube. It was a devil of a problem, but characteristic of the way he worked. It was difficult to get him to do anything right.

Incidently, all the time we were building these facilities we were in temporary quarters at EAFB. We let a contract early in the winter of 62-63 for the construction for two temporary facilities at EAFB. One was

a small reaction control facility and the other was a small power SYSTEMS test facility. We felt we had to get our people experienced in supporting the development of these systems on the spacecraft and at the same time develop some kind of capability in-house so that when we got out here we would have a fully experienced staff. Those facilities were invaluable. At that time we planned that we would have our own staff of technicians led by engineers. We operated under this arrangement for about a year. About the time of the construction phase of the contract was completed, we got word that the decision had been made to rely on a support contractOR to operate the facilities for us. That decision seemed to make quite a bit of sense for ~~the~~ A facility like SESL where a lot of people were required to run it and the work load could be ~~predicted.~~ VARIABLE. When sharp changes in staffing were involved, obviously it was much easier accomplished with a support contractor than with civil service employees. But such aspects didn't characterize the operation of the Thermochemical Test Area, where we had a lot of small facilities, no large staff at any one of these facilities, and the work load was pretty static. If we ran out of direct program type work there was just so much hardware development work that needed to be done that it would be no problem at all keeping a real small staff in an individual facility busy continuously. So we felt like it was a bad decision as far as our particular area was concerned. There were also many problems associated with getting a contractor to do the work. I wrote a long memo to ALEC Bond to warn him of the consequences I felt ~~like~~ would result from this approach but of course it was beyond even him control.

The IS requirement posed a significant problem for us because at that

time we had built up a staff of about 12 top-notch technicians. We had scoured the country for them, and now we had a real problem as to what to do with them. The support contractor ordinarily provides both technicians and their supervision. The only thing we had left to do was the engineering work, and of course it is pretty difficult to use technicians as engineers. In a few cases we converted these technicians to engineers. But by-and-large it ~~posed~~ RESULTED IN a long standing morale problem. I was quite concerned about it from the standpoint of these fellows' careers. We brought them in here to perform certain functions and all of a sudden we were retrendhing and they would either have to go elsewhere or work for Brown and Root-Northrop. I discussed the problem with some lead engineers in the section. They felt we could find a real useful function for the technicians in providing the interface between our engineering staff and the contractor staff and between the support contractor and the support he required from the other parts of MSC such as Engineering, Tech Services and Procurement. So after considerable discussion and WITH some lingering doubt we tried this system. One of the things that influenced us at this point was the fact that several of our technicians very much wanted to stay with NASA. So we felt like all factors considered, the right approach was to assign these fellows as engineering assistants or operational assistants and actually have them provide interface with the support contractor in the facility. Because the Center was forced to turn more and more work over to the support contractor, the contractor began to hire greater numbers of engineers. This posed an increasingly difficult problem for our technicians in that they were now obliged to interface with the support contractor engineers. It is difficult for a technician to provide an interface

between two engineering staffs. As a result, the scheme just hasn't been feasible, and it has posed additional problems for us.

When we first started this arrangement the support contractor used senior technicians to manage the facility and it worked out pretty well. But gradually we have had to turn more and more work over to the contractor and we have had to get him more and more in the engineering business. Now he runs those facilities with the engineers and we have had to pull our technicians out of that function. It caused quite a bit of consternation among our technicians. Some became so disturbed that they wrote letters through the government union to people at headquarters and congress about the support contractor problem, and several times groups from headquarters have come to talk to us about the problems. Some of the technicians were dissatisfied over the fact that they had been replaced by support contractor personnel and demanded an investigation. We finally transferred some of these fellows to other areas of the Center where they are performing a valid function and they feel like their capabilities are better utilized. We finally solved the problem, but it took too long to do and it has not been easy for those concerned.

The primary reason for the contractor being late, was that the Center had a lot of construction work going on at the time that the facilities at TTA were being constructed. There was also a great deal of construction going on in Houston. Some of the projects here at the Center were working overtime and our contractor just couldn't seem to hang on to his people. Hardeman refused to work them overtime, and of course we didn't want to pay him to work them overtime. On something as critical as the installation of propellant transfer systems he should have had people that were

experienced and knew what they were doing in order to maintain the standards of cleanliness required by the system. Such was not the case. He would bring in a new crew on Monday and by Tuesday evening they would have gone over to another job where they could get overtime. We also had a lot of bad weather and coupled with the fact that he just couldn't seem to hang on to a crew he just could not get the job done. Of course he used a lot of excuses. We made a change to some valves during the design phase. In his negotiations with this valve supplier he got crossed up, and didn't get the valves delivered on time. He blamed the fact that the valves were not delivered, but I think the real problem was getting capable people and keeping them on the job.

The Facility Division felt that we guided the contractor a great deal more than they would have liked. They prefered to provide the total interface, but in the interest of getting what the Center needed in the design of unique facilities, etc had it been any other way I don't think we could have cut the mustard. There were many cases where we would sit down with Hutchins and a few of his lead engineers and hammer out decisions on design of systems. Had we not had that flexibility I doubt that the Center would have the facilities that it now has. However, in some cases it put the Facilities Division in somewhat of a compromise position. We tried to be sure they were involved in the changes so the right kind of influence was exerted in the discussion. The Facility Division certainly deserves credit for allowing us to move forward on the approaches that we did.

In a lot of cases we felt that we didn't get the kind of inspection support out of the Corps that we should have. They had a large piece of pie they were trying to manage. I suspect they stretched themselves too

thin. Those guys are tough though when it comes to negotiation. I've seen them make statements to the contractor across the negotiation table, and there would be a stoney silence for about 30 minutes. We did not always get the type of response we wanted from either the Corps or Facilities Division when it came to leaning on the contractor phase. This was disappointing but understandable. I know how difficult it is.

About six months after I had begun working for MSC, I got my 57 back from MSC with a letter mailed to my Houston address saying they had no openings for anyone. I guess this attests to how confused the personnel office was in those early days. They had their hands full hiring a lot of people and trying to get people moved to Houston.

It's strange how problems develop from unlikely situations. When we activated our facilities at EAFB we needed help with instrumentation. At that time there was a branch in SEDD, that later became the Instrumentation and Electronics Systems Division, and I asked Ralph Sawyer, the branch chief, for support. He couldn't give me any support, so I hired two instrumentation engineers and one top-notch instrumentation technician. After we had them for about a year and they had set up the data acquisition system at EAFB and done a lot of work toward laying out the instrumentation systems out here, at the site, we got involved in a rubarb with the IESD people, over the matter of whether they ought to be developing our data acquisition system for us. In developing our data acquisition equipment we found we had problems that were more or less unique, and we needed people with experience in firing engines and running fuel cells, etc. to know what kind of instrumentation and data acquisition capability we really needed. We were hung up for a long time over whether to have

analog or digital ~~computers~~ capability, what we needed in the way of number of panels, what kind of things were going to be measuring, what kind of flexibility we needed, what kind of response, etc. In the last couple of years with the problem of the day-to-day workload becoming heavier with less-and-less people to do the job, we tended to draw support wherever we could. Once the basic systems had been developed, of course, we began making improvements in some elements. IESD and ISD have built up a lot of experience and capability in this type of testing--ISD primarily for the data acquisition and IESD for the instrumentation itself--by the Center. In the last couple of years we have tended to lean on those people more and more. I also learned something else out of that squabble with IESD. Our management was taking a laissez faire approach to solving problems of that nature--management allowed the people that were actually involved to hammer out a solution. Perhaps this was a better way in this instance than if someone made the decision for us. So often that is what happens with that kind of problem.

When the Directorate was reorganized, the Thermochemical Test Area was put into the Propulsion and Power Division. Of course that was really a good move. It put us in to the very organization that is responsible for developing these systems and the Center looks to to provide this type of support. At that time Guy Thibodaux came in as Division Chief.

One of the problems we were having at that time was the combustion phenoena on the RCS engine. At ignition we got a violent reaction and sometimes a subsequent engine failure. We had difficulty phasing out our testing effort at EAFB because we were still heavily involved in trying to solve that problem. This problem was first noted in late 1963. We had a couple

of engine failures at Marquardt, the RCS engines developer and we started developing some unique instrumentation so that we could actually monitor what was going on in the combustion chamber. We could spread the 10 ~~multi~~ milli-second firings out over a considerable period on recording equipment and could actually take a look at what was going on in fractions of a milli-second. At first it appeared that the problem was associated with characteristics of the ignition of these two combustibles in a vacuum environment. If ignition failed to occur immediately, and a little more propellant flowed there was more mass to cause a violent reaction when it did go. It set up a shock wave which was propagated in the combustion chamber. We came up with a solution based on the concept of preignition--like a pilot light and a lot smaller than the combustion chamber. The ignition would occur there first. Once it lit, then it caused a more stable combustion without filling the whole chamber. Marquardt redesigned the engine around that solution. As we went further in the program we began to see that the problem was also associated with a buildup of a residue in the chamber. In itself it was a highly explosive ~~characteristic~~ MATERIAL, especially under the environment to which it was being exposed. About 1-1/2 years ago we found this socalled "gunk" (as it is referred to by everyone), was finally identified as one of the nitrates. At any rate it was concluded that under a hard vacuum, this material really wouldn't form if the proper temperature was maintained.

We started off operating about the way we always thought we would--small staff operating on basically a single shift operation of facilities except in fuel cell testing. It wasn't very long however, before we started expanding in the Auxiliary Propulsion Test Facility. We would have to

come in early to start the steam ejector system up and leave late so we could shut it down. Soon we got so much testing scheduled there that we just couldn't afford the loss of those four hours a day, so we started working two shifts for awhile and later moved into working around the clock. This problem of overload in the test facilities was one that was characteristic of Center operations as a whole. The work load just kept going up hill. As we moved into multi-shift operations we had to have more people to do the same job operating for more hours--so the support contractor staff built up from about 50 originally to 95 people currently. In the mean time the NASA staff dropped off some as we turned more and more work over to the contractor.

Another problem was the lack of recognition on part of the Center of the need for clean rooms. No one had really recognized the need for providing full blown support of this type for the Center. Part of the operation in TTA consisted of a laminar flow cleaner--and incidently laminar flow cleaner was a new concept at that time. The Sandia Corporation developed this concept. We had some discussions with Sandia people and as we did not want to alarm our contractor by putting in a requirement for something that would scare him into adding another $500,000 to his construction estimate, we just specified some blowers and equipment and told him what kind. We told him we wanted a room constructed of a particular type but we didn't call it a clean room. So we built a laminar flow clean room. Tied in with it was a preclean area outside with a pass-through and all the capability to disassemble and preclean parts, pass them into the clean room, inspect them, reassemble them, check them out, bag them, etc. It wasn't too long after we had our facility in operation that I got

a call from someone in SESL who wanted support in a little cleaning of small parts till Tech Services got their clean room activated. TSD had a clean room being installed. It was prefabricated to be erected inside a building and going to be a real sophisticated vertical laminar flow system. We had been operating about a year or so at that time, and ~~had~~ a good bit of development HAD take place in the laminar flow field in the previous two years. I agreed to support SESL as long as it did not wipe out ~~onto~~ OUR ability to take care of our own work load. We started supporting North American--small parts, gaskets, washers, etc. This went on for some time and the work load kept increasing.

We kept hearing that Tech Services Division had a lot of trouble getting its clean room operational. We emphasized, as the opportunity arose, that we needed to get relieved of this work load that was pyramiding rapidly. About this time the question was raised to Center management as to what should be done about providing the Center with sufficient clean room capability, and Center management asked Management Analysis to study the problem. Management Analysis did a study, and did a pretty fair job of defining the existing situation, but could not come up with an adequate definition of the future cleaning load and were unable to justify a need for a good Center support clean room so really nothing was done on it and of course the work load continued to mount. TSD was still having trouble getting their clean room in operation. It was about this time that we sat down in ernest with some of the people around the Center that were involved in the problem, AND looked at what TSD was planning. Unfortunately TSD did not contemplate a full blown clean room capability, even after recognizing the need for providing a precleaning capability they lacked

the disassemble, reassemble, inspection, and checkout functions required. Their clean room was to support the fabrication work basic to TSD functions.

When we learned this we were alarmed to again we pushed very hard on management to get something going to provide a Center-wide support clean room. We had several meetings with management of E&D, recommended strongly that they go to the administrative side of the house and get service people to provide this kind of support. This problem lingered on an uncommonly long period of time; about the summer of 1966 E&D asked the administrative side of the house to do something, and they again turned on a management analysis study. This was to update the earlier one that had been made, and I guess they came back with somewhat the same answer. They really couldn't define the work load, and looked like it would cost quite a bit of money to build a clean room capable of doing the job. So it appears, because of funding, it dropped by the wayside again.

In the summer of 1967 the problem still was with us, and TTA's workload had increased many times in the intervening two or three years. TTA was so buried in outside work that it no longer had the capability of doing both its own work and the outside work, too. We were on a three shift basis and did everything we could to squeeze out every ounce of capability. I continued to lean on TSD as hard as I could to get them to assume this responsibility. We would get committments from them and then they wouldn't be able to come through. This condition continued for another six months or so until we finally were working sever days a week around the clock and we still had a back log building up at a phenomenal rate. We were forced to ship boxes of parts out to White Sands to get

them cleaned over a weekend. Finally in desperation, Max Faget and I went to Wes Hjornevik. He agreed that something had to be done, and that is when TSD began in earnest to get themselves a full-blown clean room. They had been providing a good bit of finished clean room-type support but were still limited as to what they could do. For example, they could not disassemble, preclean, check out, test, and reassemble parts in their clean room. By early 1968, we began to see evidence that we were soon to get relief in this area. The final responsibility was assigned to Joe Piland. He ~~was given~~ ASKED FOR authority to take over E&D's clean room in the mean time. One of the problems we had in that is that TTA work is primarily the nature that it is not directly related to a program. TTA offers basic support to the Propulsion and Power Division, and a lot of its testing doesn't get identified as flight constraints, etc. in the program plan even though indeed it is just as important. There is more than enough LTA-8 and 2TV-1 work to eat up all the cleaning capabilities. It would be necessary to keep all balls in mid-air, do a little for everybody and keep everybody happy. That had a lot of pitfalls, so we got together with Dave McCraw of TSD, Al Watkins and myself and hammered out a working agreement between TTA and TSD in which work work was scheduled in the TTA clean room and TSD clean room. It looks like it is working pretty well. So far we have been able to reduce our backlog quite a bit. It's, I think a good example of what sometimes happens. People up the line are not familiar with clean room operation. They get involved in their own problems and didn't know enough about it or didn't know how to implement it. I would hate to count the meetings we have had on the clean room. I guess we've spent more time with managers and supervisors trying to solve it than we have actually done

in cleaning parts.

Another similar problem has been in the standards calibration area. E&D got into the business of doing the standards and calibration for our divisions and over a period of three to four years it grew to such proportions that we have had to get E&D out of the service business entirely. We are now trying to implement just such a plan to keep E&D aligned toward E&D-type work and give the service-type work to the people that are really capable of performing a real good service function for the Center. In this regard we drafted a plan to move the standard and calibration function over to the service side of the house. But because of operational reasons we got wrapped around the axel on a bid by the Reliability and Quality Assurance Office to pick up this function. We are now in limbo trying to make a decision as to where this goes--to the house where we think it more logically fits but which is a little reluctant to accept it, or to one of the other sides of the house which feels like they ought to have it. We are having a bit of difficulty in getting this problem resolved in the Center now.