

I B54B

MC CULLOCH TAPE -Ibs4b

"I have some specific questions I'd like to ask you, if you don't mind on the flight histories on the S4B. AS20I as a start, what occurred, what happened, what you found was different than from what you expected and what you ~~plan to do in~~ ^{did in} preparation for the next mission?"

"I think that most laymen are a little bit vague about the "Building Block Concept" and the velocity and altitude mass, and why they seem to go to all these extra flights. Beginning with the ~~201~~ 2010 you wonder if any unusual thing occurred and what you did for for the next one."

"I probably should read a history of that and be sure of the results on it, but I don't recall any specific things from that flight that we had to correct before we could fly again. There are always a number of things that you find that maybe didn't work like it should, a small leak or something else. But I don't recall now any fixes we had to do, now in order to make the next flight run."

This is the first _____ escort B."

"Are there any special problems in working either phases with the people from Douglas for example? What about management of the launches, with people from the Cape, Marshall and Douglas being involved in all of this?"

"We had in order to keep that date, in order to hold us close to the launch date as possible we had people from the management here spend all of that summer at Sacramento ~~where~~ where the static firing was. And then down at KFC ~~is~~ I spent two to three weeks

at a time out there. Lee James the Saturn _____ was some of that summer and we alternared to be sure we had someone there to decisions, reach agreements or knew who to contact back here, if we needed to get any other people out to be sure we didn't get in any schedule problems."

"Did you get to the point where you sometimes began to bypass ordinary management chanel's?"

"No I don't recall that we had any of those problems, our condition was that this was the first stage and that there were many more following it by two or three monthseach. It was a question of the allocation of parts and once you had assimbled a stage and you needed a part, we had sometimes had to take one off of a completed to put on one that was closer to shipment. And these sort of things did require ggovernment approvaland we wanted to be sure we had considered those things and made the right decision. I don't believe we really had to many crises."

"OK, what about looking at AS203, this was the first orbital."

"203 was launched next after 20I. And that was the oneit was decided to conduct a hydrogen experiment, to see if we could control that, in other words to keep some forward motion on it all time,

"We got an agreement sometime before thatwe did not need to be sure th that the propellants were ~~added~~/ saddled and at the bottom of the tanks so tha when engines startde there would be liquidthere, So we put a propulseve vent on the hydrogen tank. As the hydrogen boiled off it creates pressure, so

we pointed that to the rear. This gives it s enough thrust to keep it under a small Gload at all times which does keep the propellant settled ."

"Was there an unusual installation you had for monitoring this?"

"We did have TV cameras mounted at the top, the front of the stage where we could look down in it sitting on the ground and we could see this on the TV camera. And we did find that we had to put a baffle (we call it) about the middle of the stage. It's a circular disc with a hole in the middle. We have to install ~~that~~ ^{Saturn} on all Saturn V stages as a result of that test. We found that, that was needed to keep the propellant from getting too far forward when the engine was cut off."

"Is that the first time you ever mounted TV cameras inside a tank for observation like that?"

"I think this was probably the first time and one of those (cameras) failed at the launch pad before launch, .. So it was a real decision whether to go ahead and launch. The purpose of the experiment was to find out the behavior of hydrogen under low G conditions. And these two TV cameras were ~~only~~ really the only means of observing that, so it was a question of , if you launched and the other went out then it would ~~be~~ be gone. But the other one worked real well."

"Wasn't there another experiment on that one, wasn't it the differential test on common BOCAD ?"
sp?

"When the flight was finished we did close the vents on the hydrogen tank, but we left them open on the last tank to see what pressure this would burst out. And it did burst ~~out~~ about

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where it was predicted to. I guess we hadn't fully informed everyone that we were doing, so there were some people concerned, who were afraid it a had blown up.

On 203 also the f configuratoin was a lot differint you have whart they call a biconoc nose cone.

Yes, I guess there was no payload above this. They just put a nose cone on to give it a bare ~~a~~ pointed shape."

"That didn't have anything to do with the rupture test necessarily did it?"

"No, this was just to get a bearing, see on top of this will be the instrument unit and then on top of that should have been the _____ and t e service module ~~were/only/there/~~ and the spacecraft. But none of those were on there so it meant putting a parachute there to close up it's a large dis opening 20 feet in diameter. It meant closing that and comeng then coming to some reasonabel point."

"When you were testing the settling of hydrogen in the tank had you constructed some mathematical models before hadn of ~~it/it/~~ what you thoutft would happen in there?"

"Yes, that had been a lot of calculations and a lot f of predictions as to what would happen and also there was predictions as to ~~that where~~ what G-loading this event would give. And there was also estimates or calculations as to where the hydrogen would be in the tank, how much of it would be forward and how far up t the walls it would go. I think that what that experiment did not turn up anything that was completely suupuisng. It did show some changes and improvements we needed to make, the bapple we had to on all Saturn V stages. If I recall we put this bapple in that stage

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of the SaturnV., not really knowing if we needed it or not, but we found that it did work then we put in all the other SaturnV stages.

I believe prior to that time there had been a failure of the ^{sp?} sintag stage, it had failed to orbit start in orbit. And I believe it was related to this hydrogen not being at the pump."

"I wanted to ask you about that . / . . . "

"What they think happened there were booster pumps on there and they were pumps for getting the lines of cold before they start. And I believe the discharge from these pumps were _____ and caused the hydrogen to be going around in the stage but not where the outlets were. There was no hydrogen where the engine would get that when it ~~would~~ it tried to start. I believe that's what we were told."

"Do you know if they did some re-designing on the sintag?"

"They had pretty well determined what had happened and they corrected that."

"OK, the next question I have down here is AST02, and apparently that was a fairly normal flight, was a sub-orbital job."

"I don't remember any problem. There was one of those flights I don't ^{know} ~~remember~~ whether it was 202 or not. That the launch crew first called off the launch and about ten minutes later they did launch.

~~On 204 there was~~

On the 204 there was a 3 hour, 45 minute delay, something on the spacecraft, I've got a note here on the GSE malfunctions.

The one that I was thinking about I believe, was the 202. There was a ~~SIX~~ 51B stage on it which had nitrogen tanks on there. When the ~~me~~ nitrogen is put in, it is allowed to get in a certain

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The nitrogen is used to blow in and cool something. They thought, from looking at some of the gauges, that the pressure was ~~g~~ dropping to fast. They thought that there was a leak in the stage. The launch was then delayed. They proceeded to launch after testing how long it would take for the pressure to go down. I believe that is the flight that did not have much camera coverage.

You mentioned that you have a launch center here at Marshall. Could you make groundage about how they work together during the...

For that you could talk to Dr. Speer. It is set up in the building over there by the sonfutation lab. The crew is from here. On the early flights there ~~x~~ were about 2 or 3 hundred people in the crew. In later flights they cut this down to 50 or 100 people. They go over there at different times. Some of them go about 10 hours before a luanch, others maybe 2 hours before the launch. They stay over there to be on call and available if anything comes up in regard to the launch vehicle. ~~In other words, most of the people are not able and cannot..~~ Ther is not room down on the launch pad at Cape Kennedy for all the people to be there, so a large collection comes here to be ~~x~~ on call. There are instamation ~~xxxxxxx~~ consols here so that you can read out the _____, alot of the same things that are read out down there. In other words, we can tell what the temperatures are in the engines, chilling down, tell what the ~~tempera-~~ tures-are tank pressures are, we can tell what the pure loading _____ and this sort ~~x~~ of thing on the gauges that are here. There is a base wires that goes down with ~~a group of people~~ the group, as a means of having conference calls with the group there. The control is at KFC, but they know this group ~~is~~ here so that is anything arises, such as a problem in the launch vehicle, they don't have the people down there to solve, they can call here to get some work done on that.

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Do you remember any instances^e where there was a problem that Marshall was able to come up with a solution at the time from here?

Well I guess... Let's see if there were any... I think a good many of the things that they talk about are in the case of the orbital conditions. In other words, once a stage goes into orbit, there is a continual monitoring^(sp) of the gauges gases, the helium, that is aboard, and the propellants aboard, and the additives that control the propellants, how much of it is left. Is there any leaks, and if there is a small leak, is there enough pressure to do the job. Those sort of calculations were normally done here. In other words, they had 2 or 3 people that came here to do that same because there wasn't room at KSC to do that same thing. They then call here before they proceed on to the moon to make sure everything looks alright. Now they are doing a series of their own checking, Houston is doing theirs, and the group here is doing the same. I guess there is a series of checks and double checks to make sure everything looks alright to everyone before they proceed to the moon. I don't recall any specific problems right now that the group here was called to solve. Usually when they have a problem, they start working on it and at the same time they call up here to get someone here to work on it also. Now whose solution they end up using, I don't know. That is always a question.

O.K. let's see. We got up to basically 202, which was in August of '66. Then we had the Apollo fire. Did the Apollo fire have anything to do direct or indirect consequences on your operation here from your office?

No, we didn't do anything at the time, anything different. Now we had just one week before that had an accident at the stage. We were in the middle of our own investigation.

Was that the stage explosion at Sacramento?

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Yes, that was the stage explosion. It happened just one week before. It was on one Friday night and the next Friday night this fire happened. We were still looking into what happened there on the stage. We did conclude, as far as the fire goes, that there was nothing in the stage that had any cause or added contribution to that. ~~We-also,-enee~~ We did proceed to go ahead and use that stage later. There was nothing wrong with that stage. We launched it later.

Were you pretty much involved in the explosion out there?

I was involved in the standpoint of having to decide from here what we should do. I was called here from the manager out there and told that there had been an accident and a fire. They thought that the stage was totally destroyed, they weren't sure yet. They did not know of the extent of the damage, the test stand. The present indication was that no people were injured in the accident. That call was within 10 or 15 minutes after the explosion. They told me that the thing was still burning at the time. The manager said he would call me back later and let me know further what they had found out. I called the other people here in the center that needed to know about it and they got in touch with the newspapers. I guess by then they had gotten a call from the press out there who wanted to take pictures, wanted to know what happened. I guess we had to decide what we should release at that point.

Did it turn out that there was a faulty weld in one of the helium bottles?

It was the wrong material that had been used in welding one of the helium bottles. These helium bottles are about 4 or 9 cubic feet, I'm not sure which. They are about that big around and they hold a pressure of about 3,000 pounds when they are pressurized. They are made out of top ~~-----~~ alloy. They should have been welded with a top hanging

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a top [?] hanging alloy weild rod. I believe the company that made these got some of their weild wire mixed up or either some rod that they orderd. I'm not sure where the mix-up came in. Pure titanium was used weilding it up. Apparently this causes a condition that can develope ~~ante~~ ^{in it} in its join to the fusion lines between the pure titanium and the alloy where this hydrogen ^{ex} embritilment , as they call it, where hydrogen can get in and cause the thing to become grandular and to have no strength. The ~~s~~pperantly found this by looking at where the peices of the stage were . They found peices of the stage where there they found peices of this triangler wield metal which looked like you had just peeled it off. It was obivious that is was not a sound wield, otherwise you couldn't have just pulled this little weild plug out like it was. Having found a few of these, they concluded that this must be what it was. In peicing the rest of the ~~stage~~ story together, it appears as if that is pretty conclusive.

You don't remember the name of the company that made those helium bottles do you?

I think I know the company. I'm not sure whether we sould get involded in that. I ~~ht~~ think it is a matter of public record. I think it was ^{the} Airstect. There were 2 or 3 companies that built those and I believe it is a subcity area of Douglas Steel is the ~~apparent~~ [?] apperant company. I believe Airstect is the name. I believe that there were 8 or 9 that had been made the same way. These have gone through the required proof ? [?] . The proved well enough to around 4,800 pounds of pressure for a brief period of time. They stood that alright, but it was apparently a lower pressure [?] for a long period of time was the cause of the problem. ~~They were all checked~~

Did this company continue to be the supplier of the helium bottles in the differnt manufacturing problems?

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They continue to use those bottles, in fact, we continued to buy those bottles from them for some period of time now. As a later date (in fact I think it was in the process at the time, but I don't think it had become effective), Douglas had already made ~~prev~~ provisions to manufacture those bottles themselves. ^{They} ~~That~~ thought that they could come out cheaper by building them on their own. They were in the process of training people and running tests in them at the time that happened. We did go ahead and use those bottles that that company made. They made them, I ~~believe~~ believe for other stages too, and they continued to use those. Once that it was determined what was wrong with it, then it was possible to use a test, an anti-current test, which uses ^{these} magnetic waves to check each of the ^{seams} ~~of~~ and to find out if it is welded with the right material. All of the bottles, after that accident, were checked on all the stages. They have got some of those on the J2 engine and there is some on each Saturn stage. ⁿ They were all checked. They went to the company and got the records clear on how many of ^u they had bought and they ^u went out and checked all of these. They found that all of these had been accounted for and it was through this that we found we had actually launched 2 of them. The other part of it is, is that there is a question of time. Now if that had not happened at Sacramento, it is conceivable that it could have happened later in the launch pad at Cape Kennedy. It is possible that this situation could have happened there, but it is fortunate that it didn't. It could have been more serious at Cape Kennedy. It is based on the time it has ~~been~~ pressurized. That is what caused the problem.

Do you always have very good relations with ^{the} counterparts at Douglas?

Well I guess when you say "good relationships", I think we had a business type relationship. I think we were concerned with keeping

our cost down and doing the right job that should be done. I think we have a straight-forward relationship with them.

Did you get a lot of complaints from them that you were bothering them too much?

In general most companies would like to have a freer hand in their affairs than what we normally let them have. We have resident offices in Sacramento and in Douglas. We have some of the government people who live there and work there.

I've got some comments here on the AF204, which was the earth orbit varified the IU involved . Was that the first chance that you tried the --- [?] [?] [?] perpultion systems in the APS module?

No, all the stages had an APS module. All of the stages had to have a rover vehicle and a ^{Yankee} [?] control. The same model was used on the all of the 1B stages that had the different modeling. The 201, 202, 203, 204, 205, all of those had the same model APS system on it.

Does that give you any probelms? I don't know, but somewhere I came up with the idea that there were some minor difficulties, anyway, with the APS module.

We had some problems with building. They weren't really an major problems, but we did have some minor ones. I don't believe we had any problems with the 1B stages, they had a model of stainless steel tank inside them. I don't believe we had a guage, maybe a bar rod or something, where you could tell ~~th~~ when they were filled up. When we lifted the Saturn V, that took a larger module. That one had a titanium tank with a teflon liner in it. We had problems with that liner, getting it filled without having it tear ot break. It is a real thin thing, ~~like~~ like a baloon. It is about like a heavy gauge plastic. We

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had some problems with the first 2 or 3 of those size _____ we used. They over-pressurized that thing or they over-filled it. We had to change _____ down at the launch pad. We also are concerned with, once we fired the handshift in a test at Sacramento, how long could we wait before we could actually have the _____, because there was ~~to~~ some corrosion built up in those things. We had to measure the time between that.

I was also curious about propellant dumping. Is it based still on the sequence when the propellant dumping operation takes place? I wonder if you can comment on the necessity of a propellant dumping and why it was considered to be a parameter for the remission. There is usually; some propellant that are left in there, some of them are hydrogen. Some of the stages cut off on time, some cut off on propellant. It has some depletion senses there, but it has a cut off velocity. In other words the guidance system will shut down the S4B when it has achieved the correct speed. Which means you may have a good bit of propellants left in there in some cases, based on what the stages below it are done. As a result this you are able

"OK, we are talking about the problem of dumping and it's difficult to do it to the I engine."

"Well I wouldn't say it's difficult, I would say you do that extra in order to gain velocity, or to slow it down. I believe in some cases the stages ~~are~~ turned around and its dumped in the backward direction to slow it down any way it is a means of using the propellants that are there to get some extra energy from it. Now the tanks are pressurized and in order to dump this you have ~~to~~ been venting

order
the tanks then you'll need to shut the vents in order ~~to~~ to s build
up pressure in there and then that will force it out to the engine.
So you just use the pressure the pressure in the tanks to force out
to the engine.

"But does this dumping take place before you have this trans-
verse p operation and docking or after?#

"Always after. You have gotten into the orbit you want to be in
with the proper orbit, and ~~and~~ another thing you're doing
when you're just coasting after that you're maintaining your
position with the galactic control engines whether you want to
roll a or jump and down you na maintain a given position, level
or stable attitude. But then you proceed to finish the docking
and after that, and after the spacecraft gets away then you will
cut the propellants ^s you see, you will dump the propellants, see that
gives it a push in some direction, so you don't want them to be out
of control. I think the dumping, you see you have the same thing
in the attitude control engine, some of the engines are pointed
directly to the back two of them one on each side so and these
flights where they have impacted the ^{moon} ~~the~~ they have had to de-
cide o how much of the propellants ^{that} to use and how much they can use
on the propellants that they dump. Because you have these two sources
of energy and you've got to decide then how much of these you need to
use to get to the right velocity. ^{to get to the moon} And you are able to use either one,
you can either dump the propellants and that will give you ~~you~~ you a
certain ^{amount} amount of energy and a certain amount of w velocity or you can
turn ~~on~~ the attitude control and you can di keep track of how
much you use this so ~~how~~ you can tell how much you have left. ~~so~~
So I guess the attitude f control is more precisely able to turn
it on and off if you want to."

"OK, I have another note jotted down here on 204, something about panel flutter on the S4B4 , remember any thing about that?"

"We had a lot of discussion about that but I h guess I'm not sure that we really had i any problem with that. The forward steering made up of rings andthen there longitudinal stiffeners and there's a flat sheet across that. And there was concern ~~that~~ these, this flat sheet material would flutter would vibrate and would break up, And when you reach a certain plate conditions . So we had made a set of parts to cut down on the size of these panels,we had some little bars which could be fitted in between, you're panels are 6inches apart and you can actually put another in half way v between, but since there is a bunch of rings there that got difficult to do. So the next ~~correction~~ would have to be put some little circular bars it was easier to get ing and put those around than cut out of those panels. ~~the sides~~ So ~~we~~ we made up some of these kits to put on the Saturn IB I believe we made up some for Saturn V. And I h guess with ia each flight we decided to put one of these on or not and I think we put in on some of the flights , I don't remember now which ones we decided to put on now, But some we puton on/ the launch pad and I don't ~~work~~ pay up there I pay up in the air. After we put it on we found that there was still problems there was a little a small opening at each ind andthey thought this was going to get aliittle to hot due the air matic heating we to go up and put little clips over all these things. And I believe we o put ~~that~~ that on two or three stages, I believe we did, I don't recalln now which of those stages which it was. 204 may have been the first of these we put that on. ""

"OK, I guess kind of the climax was the last one too, it was the 205 and the first manned Apollo, and I was wondering it was a first manned fo flight if you had any special attentions unusual things ocured in special precautions you took because ~~of~~ it was the first manned S Apollo flight? Because it was after the fire too. "

"I guess we had a lot of reviews and meetings to decide if everything was well, I don' t know of any special work t hat we did on the stage, I think we went through all of the repairs and all of business tickets and write-ups and we checked those a number of times to be sure we had thoroughly coverd everything . I don't recall now any special thig we did. There was one of those stages I don't recall if it was 204 or 205 , I believe it was in filling the propellant tanks inthe stage up above, this would be the space-craft, the service module. Theyspilled some of that propellant down in there andwe had to take that forward inner stage off, I believe and cleaning it out and putting it v back on. We had never done that before, taking the whole fornt in off and put it back on. Because this propellant is highly corrosive,the propellantthey use as far as aluminumo or electrical wire is concerned , is something highly corrosive."

"The EDMH stuff?#

tetre

"I think the nitrogen hydroxide is the oxidizer is the mos t corro-
sive, I think it's ^{worse} ~~worse/corrosive~~ than the propellant, I'm not sure that the propellant is not as bad as the oxidizer. And I believe they spilled some of that on there and it just takes oa alot of water I guess to wash it off. I believe that cleans it up, and I'm surethere we e many of the tests run over as a result ofhavingto take that apart. I don't know of any problems that we knwo of

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with the stage. "

"The astronauts were pretty busy obviously during the spacecraft mission thing. Did you find that they did take occasion to, were interested in the launch vehicles that were going to send them up, were there any astronauts that were especially interested in it, kidding around, asking questions about it."

"Well there were earlier among the design part, there were some of those assigned, they used to take turns coming to our review meetings that we had, I guess the _____ of S4B say that used to come to some of our meetings. Frank Gorman used to come to some of those and they were interested in what it was, I guess they were interested in working on but not to the point of . . .

I guess they were mainly concerned with having some assurance that it would work all right. Now there is a booklet that's prepared, like one of those for a car, gives pictures of all the systems and how the thing works and all because they're prepared for use. Now I'm not sure that they have time to use that thing I think it's really used by the people in the control center at Houston, who have some people there assigned to follow the booster part of it. And they need to be sure what the systems are and the vehicle and how it works, what parts are there. I don't think the astronaut^s really have time to study this thing and actually there is not too much they can do about it you see, all they can do is here what has happened down there or will here something about it, but I don't believe there's any direct approach that they can have over it."

"Were there any people on this list that struck your memory your recollection as outstanding personalities any meetings that you remember particularly that things happened?"

"I don't recall any, we had a lot of meetings.

"What about your relationship with Von Braun is he very much involved ~~very much~~ ^{management} with the program here at this stage?"

"Yes he is very much involved in the status and reviews of the program, I guess every two or three months we would have a meeting like that to review what we still want to know, what problems existed and what directions to take. And before each flight there was always what we call a "readiness review", to review all the problems and all the corrections that ^{been} had ~~been made~~ made and the history of the stage, and what had happened in the past and to review any areas that we thought might be a problem, outline these. Meetings of that type he always attended, yes."

"Now I've heard some comment that occasionally there were differences, say, between the old NACA people who moved into NASA and the Von Braun team, occasionally there was let us say a difference between the old Air Force philosophy, difference with the missile theories the Von Braun team had developed in Germany under different conditions, did you ever run into any occasions?"

"Well I don't know of any claims like that, I've seen, I think there has been more ground testing of these rockets, and there is normally been tapes, that is what we have continually run into with the work with the contractor, they in general are not accustomed to doing the standard ground testing, and normally what I have run into, they would be satisfied to do a little bit less than what we require."

"Looking back on, do you think you did more ground testing than ~~you did~~ was necessary?"

"No, I don't think we did more of than was necessary, I think that in some cases that we were in a rush to get finished

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and we would build an interim configuration, that is, we would end building a valve one week, to have it to acquire something and put a test together and then later we would have the time, to have the time to have the other one finished. I think that I would say, the type of testing was probably what should have been done, if we had to do that over, I think we would try to do a better job of testing of only one configuration and complete the testing then. Because in some cases we can look back and say well that's a particular valve and we really have two of them now if we test it now, one of them in which we had to take some shortcuts in, but as far as the testing and the qualification it's all right, but it didn't have all the features in it we needed you see. In other words it won't do certain things we want it to do, so we had to go ahead and build it and qualify it and then later we were able to get all the pieces in there we needed. If I think that would be the only place in order to look at is not cutting out the kind of testing but to be sure we were doing it all at one time, there were several things to look into.

"What about Lee James? Do you have a lot to do with Lee James?"

Yes, I worked with him ~~an-a-couple-of~~ for quite a long time. I had a high regard for his, for what he did. The way he went about the problems.

"Can you say that there are certain ways that he went about his job that were different than usual or different than you might have expected?" I guess what I'm saying is, were there certain things about his style that were unique?

No I guess, I'm not sure that you would call it unique. I think there were some differences between the way he went about it and the way Dr. Rudolph went about it. I think he was more able to, he was

more inclined to listen to what he had heard and to form his opinion as to what he wanted to do and Dr. Rudolph case, he was more deliberate and much deeper, much more detail on most everything he did. Most of the presentations would take much longer to get results just like he, Dr. Rudolph wanted them rather than to have a meeting with Lee James. I'm ^{not} sure that, I don't think that there is any difference in the end results of what comes out. I think it was a different way of operating and background on that.

"I was wondering to about these logistics, there are talking about getting this for B stage for California and testing stand to Cape Kennedy. Do you have any comments on these forms, the Guffey and those kinds of operations?"

We, with what was available we took all of the stages, it was much quicker and I think it was much easier on the stage unless and much easier to do than the first few stages, the first 3 I believe. We shipped our water. We used a commercial ship and it would be mounted on the deck, on top of the deck, with cover and canvas whatever to have it protected. It would take about 2 or 3 weeks or a month to 15 or 20 days to go through the Panama Canal. I think that airplane would take, it would take only 1 day, to We could load it 1 day and have it over the next day.

"I hear you comment that the Guffey got the ^{choirs} [?], a very ^{really} crucial, healthy and eager scale."

It did in addition to giving your [?] an extra 4 weeks it did mean, and we could also load it. See the state had to be loaded, I believe it had to go from Sacramento, they had to carry it down to a little dock there on the Sacramento River, I believe it was Cordland. Then it had to be put on a barge and carried down the river and then in the bay

there in San Francisco, it had to be put on an ocean ship. That meant ^{picking it up} getting off and handling it there. The airplane that was used, they carried it over to this ^{Bog} Latan Airforce Base which was about the same distance as Cisco to _____? and while it was there, it was rolled on the airplane and then it was in place until you roll it down at the Cape Kennedy. So you are handling it, picking it up and moving it and things of this type.

"I had some kind of specific questions I wanted to ask. Maybe I've been asking the wrong questions! "

~~It~~ I think we have covered , I think we have covered most of the things. The other things we have to get in time . So as long as you have finished with that one you think of the next one.

"When you , well when you transferred out of the ^{F1B-S1B} ~~F1B-S1B~~ ? ^{#shovel} F1B-S1B, did you go to Ecland to work at that place?"

I was asked to come over to the shovel group here and try to get something settled over here so ...

"Are the problems a heck of alot different?"

They are quite alot like that was back with the first. In other words, we are now in the process of what is the proper plan for a project and what sort of money should it take, what requirements should we set, this is the same sort of thing we were going through really on the S4B, really We are trying to decide what requirements we should use really, how much we should budget we should pull, should we claim what is needed each year, what schedule should we be on. This is quite similar to what we were going through back at that time.

"What were you doing before you got on the S4B in '66?"

I had got on , well I got on the S4B in '61. I came to NASA in '61.

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"So you went through all development and test and everything?"

I started from the S4 at that time. I was with it.

"Well from your standpoint were you primarily involved with mission schedules or were you involved with details and manufacturing as well?"

I was in ~~eah~~ charge ~~w~~ of the S4B project, from when it was started in, I guess, '61. We started out requesting a study on the qualification of the S4 stage. Then when this was finished we had some meetings with our people and the government and laid out the requirements for the S4B stage. We proceeded then to contract for that stage. Then I was, I guess, I was at that time I was myself. We had curfews with the ... Later Charlie Myers ~~gee~~ joined that group. Then we proceeded on with that, with the S4B and first with the LB and later with the ?/ ? and later with the LB. Then in about 1963, I believe it was in late 1963, there was a reorganization in which the Saturn V group was formed and the Saturn LB was read off as a separate project. I continued with the LB project under Lee James. Godfrey was assigned as the Saturn V and I then continued from about late 1963 until about 1967. At that time ~~then~~ Godfrey was assigned over to S2 and then I had to try to find as well as the LB from then on, I came over here to shovel. If I had been with the S4B and the LB from when it started out in '61.

"So you've covered some of the early Saturn launches too, then."

That was in the LB, but not the , we're thinking of the S4B, is what we're talking about.

"Were there any special problems in the early Saturn V launches involving the S4B?"

I guess it was the most things in the LB and then you said we had the same stage, we just had a different attitudes and different

control systems. That's why as I pointed out, this lateral. I guess the 501, 502, that's the one I believe we did not start on. The 502 that, the one that had the fire, I guess the J2 engine line first. I guess it lost 2 engines and our stage lost that line, I guess it happened toward the end of that burn, the first burn, then we just didn't get started the second time.

"Was there much carry over that you know of from the Santar program, the S4 and the S4B?"

I don't really know. There may have been that from the S4. That was, I was not here when the S4 got started. It was fairly well underway I guess. I don't really know of too many things that are similar, the engines were the same. To my knowledge the engines were the same engine. S4 uses the sec 7. I believe that's S4 had a rigid structure, sitting there by itself, whether it is pressurized or filled, I don't know whatever else you have. I believe _____ is more like atoms the _____ which are flexible and had to be pressurized to be rigid loading qualm. and maintain its _____. There were some differences there. I guess we didn't ever use these, what they call boost pumps, like the Santar had. As I understand, that is a prop up in the tank which gives you some pressure before it ever gets to the engine. We never did use that sort of thing on the Saturn stages. I'm not sure if I would advise it at this time. I believe that is the difference, the basic difference.

"O.K. Well I asked for it now and got a good out. Thank you very much for your time."