NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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Interview with

GENE MATRANGA

- - -

July 28, 1971

(TRANSCRIPT OF A TAPE RECORDING)

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PROCEEDINGS

MR. ERTEL: This is an interview with Gene Matranga at Flight Research Center on July 28th, I guess, on what he remembers about the LLRV and all the sweat, blood, fire --

MR. MATRANGA: My memory is mostly written down on pieces of paper, I may have to call on that now and then,

MR. ERTEL: According to Ken (Lavent) some people out here at Bell were talking about something like the LLRV in Late '61, and they found out when they had something on paper, ~~lists missing~~ was missing gat in touch with [Ken] Lavent and asked him to come out and bring what he had, get to thinking and see how your thoughts matched.

Were you in the program that early?

MR. MATRANGA: Yes, in fact, we got started thinking about the problem in the summer of 1961. An ad hoc committee was formed to see what we could do that rebated to lunar landing.

We felt ourselves some kind of experts in the terms of landing, based on the ~~lower lever de-landing~~ Lunar Orbit Rendezvous work we had done particularly as related to X-15.

And we felt we should extend this expertise into the area of lunar landing, so the ad hoc committee was formed at the inkling or questioning, I might say, of [Robert] Jake Drake, who pretty well was coordinating and thinking about our long rang research efforts out here.

So we formed a committee at Jake's insistence and we came up with a number of recommendations for looking at manned lunar landing.

At the time, there was, the official NASA policy was that the whole command module would go on down to the moon, and Drake, I guess, could see the handwriting on the wall and decided, "Well, we ought to be thinking more about a LEM type vehicle breaking off from the main system and going on down."

Anyway, the findings of the committee said, essentially, that we should look at this satellite type vehicle for going on down, It should be manned. We should be able to simulate five-sixths of the earth's gravity through some other form of propulsion device and have rockets to duplicate the sort of thing you'd expect the spacecraft to do,

The findings of that committee were typed up and given back to the Director, I guess it was. Probably September, August or September of 1961.

The formal group was set up -- the very nucleous of the group, I guess you'd say -- under Wes (Messing) in November of 1961.

We talked to Johnny Disher who was heading up the office and headquarters at the time. And I think he's the one that put us onto Bell.

MR. ERTEL: Yes.

MR. MATRANGA: Apparently Ken Levin and company had talked to Bell -- had talked to him at Headquarters a week or two earlier, and it sounded like their approach was just exactly what we had been talking about.

And Bell came out here just before Christmas, as I recall -- it was late December. And we initiated a study contract with them to run for three months. It ran from the beginning of January through the end of March.

And this looked at the feasibility of the whole concept.

MR. ERTEL: I have a copy of that,

MR. MATRANGA: Okay.

MR. ERTEL: A portion of it,

MR. MATRANGA: We then went through the battle of trying to find money to finance the project. Don Bellman, by that time, had been appointed program Manager since Wes Messing had left to go down to White Sands.

In Pact, Wes left late December, early January -- I don't recall. really, but just as we were getting off the ground. So Don Bellman was brought in as Project Manager and I guess I had the title of Project Engineer, or something like Ghat.

We played the money game, We went dawn and talked to the people at Houston -- had very strong support from Walt Williams, who was the Assistant Director down there and

from Dick Day, who worked under Warren North in the flight crew division.

We got mixed reaction among the astronauts. Most of them seemed to be pretty open-minded about the whole thing, Max Faget, who was quite skeptical, and -- I'm trying to think who the Apollo Program Manager was at the time; he was a fellow who had come from Convair.

MR. ERTEL: Charlie Prick.

MR. MATRANGA: Charlie Prick. That's right. He was very much opposed to it. He didn't see any particular advantage to it at all.

In any ease, we gat to the point where right at the middle of the summer, July or August, that time period, we had our money about two inches from our fingers.

And all of a sudden, it got pulled back. We sweated again for a while. Finally gat the money released.

Wayne Ottinger : That was the mail box drop. (Inaudible) apparently the -- he had the contract signed by the Government, ready to go at the ring of the bell, was ready to drop it in the mailbox as he was walking out the door, --

MR. MATRANGA: On a Friday afternoon, if I recall, correctly.

Ottinger : And had he dropped that, we would have had a contract and Seen off and running in September.

Ottinger : A little action and ready to go in

Buffalo.

MR. ERTEL: Who was this?

Ottinger: ~~(Bowling).~~ Boeing. It was in Washington and they got all this paperwork -- but then somebody caught it. Somebody caught him in the hall or something as he was ready to mail this thing, and he said, "We just got a new directive. If the thing hasn't been mailed, don't mail it," and we had to wait until when? February?

MR. MATRANGA: It was January --

Ottinger: January, February, '62. So we wound up with about five months delay because the thing hadn't been dropped in the mail.

MR. ERTEL: Oh, boy.

MR. MATRANGA: Our angel in the whole thing really turned out to be Bob Seamans. He was pushing for this agains some of the opposition at Houston.

I recall the Houston -- the money apparently was allocated in the budget, but [Wesley] Bjornerud ~~(Yarnovich)~~ and some of the money managers down at Houston really weren't convinced that they wanted to utilize the money where it had been budgeted.

And finally, I guess Seamans just said, "Get off the dime and let's get this thing moving."

Ottinger: Wasn't OART trying to get money out of them?

MR. MATRANGA: We tried to get money out of them, and their attitude on the whole thing was they had funded the LLRF at Langley, and they could not see funding two similar projects, because they felt that was the real research tool that OART would use and then LLRV would be more a pilot train: 4 device than a research vehicle, as suck.

MR. ERTEL: I heard the story somewhere else, and they said the money should come out of manned space flight funding.

MR. MATRANGA: Right. Right. And that -- and it was budgeted accordingly. And ultimately ~~Also~~, it was released. Anyway, as you indicated, Wayne, money did became available in early 1962, and we did get the contract written with Bell and the original dollar value, as I recall, was almost -- was it 4, point, 3?

I think that's what it went up to, but I don't think the original contract --

MR. ERTEL: A Little less than 4, I think,

MR. MATRANGA: A little less, okay. Something like that. Wayne went back to Bell as in-plant representative of NASA so that he could live with the machine and Its detailed design and fabrication, and also so he could apply his expertise in rocket systems, which he learned on the X-15, I guess it was

And make sure that the machine met our standards of safety. We had had a number of technical disagreements with

Bell, over how things should be clone. Bell was not as -- I guess I'd say careful -- maybe that's not *the* right choice of words, but they had a different philosophy ~~of~~ on how some things shauld be done.

And we thought those things were not in line with things that we felt should be safety-wise.

We had a design review at the -- what was supposed to be the 90 percent drawing release time, and that was in June of that year. Remember we had quite an entourage that went back to Bell for the design review.

Recall Warren North being there? As I recall, ~~Dean~~ Deke Slayton (~~Trolton~~) was there. I know Dick Day was there In Houston. Neal Armstrong was there representing the Flight Research Center *as* their project pilot, which is kind of interesting.

Be was designated as the Project Pilot when the group was set up. Of course, before it was delivered, he --

MR. ERTEL: Along came September, and he --

MR. MATRANGA: Moved on down to Houston in a differ~t capacity.

Let's see. Vehicles were pretty well put together and went into some ground testing back at Bell in the spring of "63, I guess it was.

Ottinger: It was about (inaudible) 1964.

MR. MATRANGA: Was it '64? Okay. April, '64. The first vehicle was delivered, as you say, in April. It was

delivered in pieces, We had the main frame; we had the legs, We just packed it up in a moving van and brought it back,

The second vehicle followed about a month later, in smaller parts. And the reason for the parts then was Bell got into money trouble; they were obviously over-running the contract, and we decided -- we put a ceiling on the contract, and what they didn't finish, we would finish out here.

So vehicles were delivered out *here*. We had a contingent of eight *or* ten Bell people that came out with the machine, helped us in the final assembly and the check out.

Again, we had another pre-flight DFI, and I recall (Inaudible), Warren North being out here for that, They made a number of recommendations, which *were* incorporated in the vehicle.

We made ground runs. We made runs on two different fixtures that we computated to exercise all the systems on the ground. And Chris White was -- covered everything.

It was the day before Halloween, I know.

: (Inaudible,)

MR. MATRANGA: That's right, We only got about six or eight feet in the air on the first flight. We had testors on the thing; I remember that.

MR. ERTEL: (Inaudible,) flight plan, eight or ten feet above the ground. (Inaudible) station. I was down there --

MR. MATRANGA: No, I was (inaudible).

MR. ERTEL: Someone else was in on that too,

MR. MATRANGA: I don't recall it. We *got* somebody up there though. I'm sure we did. (Inaudible), we ran that relay (inaudible).

We could see the (inaudible) of the *rockets* and it was very obvious that it was not performing as it should because it was a perilous situation.

(Inaudible),

I'd never get up enough guts to do a thing like that.

: (Inaudible,)

MR. MATRANGA: (Inaudible) in the beginning, and I remember he lifted it up when he was having a test of it, and there was 3 or 4 hundred mile and hour wind blowing, and he decided to scale (inaudible).

The first flight as you *say*, went eight, ten feet in the air. He went progressively higher on the next two *or* three flights. (Inaudible.)

(Inaudible Discussion.)

MR. MATRANGA: Five or six of these rockets -- (inaudible).

(Inaudible discussion.)

MR. ERTEL: Now we're back on.

MR. MATRANGA: Okay, let's *see* where we are.

Okay, the next thing we looked at was the displays,

as they related to ~~(Landruff)~~ LEM. And along about that time, we checked out a third pilot in the machine, Colonel ~~(Kluver)~~ Clooven (Kluver), Jack Kluver of the Army, who was assigned to the Center.

It would be interesting to get his comments on the machine. He had spent a great deal of time in helicopters with the Army. We had flown the variable ~~(Stagordy)~~ stabilizer X-14, a plane that Bell had built for the Ames Research Center,

He had flown chase on a great number of our flights in the helicopter, and was extemely skeptical of the kind of pilot comments, pilot ratings, that were being given to the control system.

He just didn't know of any VTOL machines that he had ever flown that had the kind of good pilot ratings that both Joe Walker and Bob Malek were giving to the control system on the machine.

So he was extremely anxious to get in the cockpit and fly it and see if they really knew what they were talking about.

~~(Alin : (Inaudible).~~

MR. MATRANGA: Yes, he had to knock off a few pounds because he was up in excess of 200 pounds, and that required a great deal of ballast on the bark end of the machin to counter-balance.

Of course, on a hot day, we had trouble getting off the ground. Fortunately, he checked out in December of '64.

Ottinger : (Inaudible.) to get really into the hot summer day take-offs, To get the gasses away so we would 't ingest.

MR. MATRANGA: We were limited to about -- with the original engine, to something on the order of less than 90 degrees of having the temperature.

Ertel : Yes.

MR. MATRANGA: And we ultimately got that up to close to 100 degrees, by the time the program was over.

Ottinger : (Inaudible.)

MR. MATRANGA: That's right. In the summertime.

Okay, after we got Jack on board, after we had looked at the different displays, we also *put* in cur (side arm) controller, which we had fabricated --

Ottinger : Gemini.

MR. MATRANGA: -- modified. It *was* off the Gemini-8, yes. That was the one that Neil Armstrong had had trouble with on Gemini-8.

And Bob (Ballard) down in our machine shop re-configured the whole thing, putting in sink grooves instead of(potentiotomers). Or was it the other way around? Probabl; the other way around.

And putting in redundancy, so *that* we bad dual sensors everywhere.

MR. MATRANGA: We (flew) that through that, *so* we moved the pedestal, the instrument panel, from between his legs in front of him *over* to the right hand side, as it would be in line.

And then put in the side arm controller, *so* that he had the same relative position from his eyesight to the instrument panel as the ~~(inaudible).~~ astronauts would have in the LEM

And he had the same altitude control stick, with three access sticks.

Ollinger: (Inaudible.) RV-2?

MR. MATRANGA: Two was the first one that we put the entire enclosure over,

Ollinger. You're right. We took the emergency rockets off of it,

MR. MATRANGA: No, we never -- did we or didn't we?

Ollinger: You never got those emergency rockets

MR. MATRANGA: Okay. You may well be right,

Ollinger: -- took it off of one before we sent it to --

MR. MATRANGA: Back to this part. Okay. We'll come to that little story.

The next thing we looked at, as I recall, was trajectories. And we specifically went through and flew some of the proposed LEM trajectories. We demonstrated that the - seat trajectories had been proposed ~~for~~ used easily flyable, showe

that you could get relatively higher rates of descent in close proximity with the ground without any particular difficulty,

And then came the enclosure. We started to restrict his vlsion, built that cockpit up around him. Originally, he had plexiglass on the sides, primarily to shield him from the spray of the peroxide attitude rockets,

But we built up a styrofoam enclosure around him, giving him Just the same field of view as the astronauts would have out of the LEM.

And ran ~~final~~ ground ejection tests of that configuration.

Ottinger : (~~Inaudible) of~~ Combined with the new rockets?

MR. MATRANGA: Combined with the larger thrust rockets, right. To give him a little better push away from the vehicle, give htm a little more height, and demonstrate that the ejection seat would punch through the styrofoam canopy without, any difficulty.

That brought. us up to the point where we started checking out Joe ~~(Alivanti)~~ Algranti first and then Bud ~~(Rheem).~~ Roam

Ottinger : Before you progress, let's cover this seat upgrading.

MR. MATRANGA: Let's talk about the seat itself.

Ottinger : Okay.

MR. MATRANGA: The seat originally was developed for the lifting bodies. (Quit) Johnson bought the original type

seat for the lifting -- the plywood lifting body,

Attinger : T-37? ~~(Inaudible)~~ shell.

MR. MATRANGA: That's correct. Essentially for (low Q). I remember we cut it from 40 G's to 20 G's in terms of acceleration capability and from the six or seven hundred Q down to about 400 Q or so. Very small --

MR. ~~ERTEL~~ Attinger: Very light weight. (Inaudible).

MR. MATRANGA: Right; we asked -- the spec that went out said it had to be less than 100 pounds.

MR. ~~ERTEL~~ Attinger: And it came in about 96.

MR. MATRANGA: And it came in about 96. We had two responders to the -- well, we had *three* responders to the proposal. One was --

MR. ERTEL: Douglas?

MR. MATRANGA: Yes, Douglas had one that they thought could come in under 100 pounds, and it had a spring-loaded canopy. And we felt that was somewhat marginal on really being able to do the job at low altitude.

The Weber seat that was rocket deployed canopy -- and then Stanley came in, and he wheeled and dealed saying that he could do *it,* although he had never done it. He was saying that he felt that they had the technical expertise to go ahead *and* do it.

And we just felt that he hadn't demonstrated it and we couldn't take a chance with seeing a couple of machines --

VTL machines, go in here on the base with the loss of crew because the ejection *seat* did not work properly.

And we felt that was a real must. We put a lot of effort into that. We had Weber make three ~~(setting pines)~~ static springs fo us, one with the vehicle -- the seat --

MR. ~~ERTEL~~ Ollenger: Fixture,

MR. MATRANGA: Fixture; right. At zero attitude, one tipped forward 30 degrees, and one tipped to the ~~(road)~~ right it rolled 30 degrees, and we demonstrated *that* the seat would work under those conditions.

As you say, then we increased the thrust of the rocket to give us *a* little better capability, We thought it was margin (prayer). Comment if you will on your memory of the battles

MR. ~~ERTEL~~ Ollenger: ~~(Inaudible)~~ we had in moving ahead with that upgraded seat the main thrust in terms of trying to get that thing implemented, funded, and ~~of the -- we~~ agreed to, I'd say, ~~(inaudible)~~ by MSC as I recall, (inaudible) and he was flying the thing, had a personal interest in it as well, but he --

MR. MATRANGA: Well, we were in the program for fairly small funds. It was running us about a million dollar a year in terms of total expense for running the program, And this included some design work for the ~~No~~ V; it included things like operating the seat: it included the fabrication of these controllers and displays,

And *we* had various and sundry product improvement as we went along. If you'll recall, we had a great deal of

difficulty with the ~~other two Generals. There was~~ Cal Jarvis shuttling between here and Portland, Oregon with *gyros* on several occasions because we down to our last spare, and tryin to figure out how *to* beef these things up and **make** them last little bit longer.

Well, that's that again. Everything on the vehicle was light-weight. We developed an instrumentation system, that PCM telemetry system, because it weighed 35 pounds as contrasted with an (Assoangrad) that would weigh 75 pounds,

And all ~~that (wire) in~~ the ejection seat had to be 100 pounds **or** less. We really ***sweated*** *for* ulcers on the machine.

~~Now,~~ primarily because there were thrust limitations it just wouldn't get up in the air.

MR. ERTEL: ~~(Inaudible) —~~ on the LEM, their ~~maxima~~ weight was 22 pounds. ~~(Inaudible)~~ and they went to 33-5.

MR. MATRANGA: And our total got up at one stage as high as 36, and they felt it just would never get off the pad at that kind of weight.

Ollinger: I think we grew LO or 15 percent, but ou engine actually -- went ahead of us. I think we wound up with more actual thrust margin in the TV 'than we had dreamed of. Even though we grew in weight in total -- (inaudible).

I think (G's initial conservative).

MR. MATRANGA: That's true. And it's an ironic

:hing if you wish, You were told that the background of the engines. The engines originally were developed by the Air Force. The PAN-J-85 was what it was.

And the original --

Ollinger: -- they went into the commercial -- I know the ~~(fault)~~ qual tests were -- the first ~~fault~~ qual test was an Air Force' ~~fault~~ qual test.

MR. MATRANGA: It was basically --

Ollinger: But they never went into production,

MR. MATRANGA: But it was a horizontal engine. Not a vertical engine.

Ollinger: Yes, but his production was really commercial.

MR. MATRANGA: Right.

Ollinger: Not military.

MR. MATRANGA: That's true.

Ollinger: ~~(Inaudible)~~ it was qualified under the Air Force contrac

MR. MATRANGA: Very true. And the thing that we did was take one of the original Air Force engines, modified it --

Ollinger: I think we took our own --

MR. MATRANGA: That may be --

Ollinger: Put in a new --

MR. MATRANGA: Modified it for vertical operation and the original qual test in the vertical would run with the Air Force engine. It was not a new engine at all. It was a

used engine. And that engine always produced more thrust thar any of the others. (Laughter.)

And that engine always produced more thrust than any of the others, That was the best --

Ottinger : I think we wound up -- I think our firs "light engine was a used engine in a sense.

MR. MATRANGA: That looks -- that was the --

Ottinger : -- the same one. (Inaudible,)

MR. MATRANGA: Right. But G.E. did a fine job and that engine was a fine engine. That was reliable --

Ottinger : There were a few ~~(glipses)~~ glitches in the engi program, but they were so small and very --

MR. MATRANGA: I remember we put some ducts, some covers over the bleed ports.

Ottinger : Yes.

MR.MATRANGA: To deflect the air as they came out o the bleed ports, and we obviously choked those bleed ports. They had some compressor stalls, on the engine run.

Ottinger : But we wound up --

MR. MATRANGA: We wound up changing those.

Ottinger : Expanding them, putting in bigger ones for some reason. And we had some solder (inaudible).

MR. MATRANGA: Yes, I remember that.

Ottinger : It was ~~(blitches)~~ glitches on the things like servicing the lube oil tank. It was just nit picking stuff

that you could solve, by keeping your nose to the grindstone, (Inaudible) -- nothing in practice (inaudible), or safety, except perhaps that bleed port, That could have gotten to us, but we picked it up ~~and --~~ on the ground

MR. MATRANGA: Fortunately, we picked up most of our problems ~~a~~ on the ground in fact, we picked up all of our problems on the ~~ran.~~ ground. We didn't have any significant airborne problems, with the exception of the one flight where Cooper made very very much at the end of the program, where the feedback connections on the attitude control system were *not* plugged in and he flew not only back-up, but *he* flew open loops with the acceleration control.

Ollinger: Right.

MR. MATRANGA: But that really was the only --

Ollinger: Wasn't (inaudible) that occurred --

MR. MATRANGA: Yes. We had a peroxide leak on Bud Rheem. We had a valve --

Ollinger: -- peroxide leak or something -- or Bud ~~Rheem~~ Roam flew or something and -- we had a peroxide leak though, behind the cockpit.

MR. MATRANGA: Was it a seal or was it the actual buckling of the valve?

Ollinger: I don't remember. (Inaudible.)

MR. MATRANGA: But anyway, it sprayed straight peroxide on (inaudible).

Ottinger : So out of what -- 200 flights; roughly or more than 200 counting Ship-2.

MR. MATRANGA: More than 200, counting Ship-2. We made 198 flights on Ship-1, and 6 flights on Ship-2 before we delivered those --

Ottinger : So say a couple hundred flights, and you've got really two flight incidents regarding hardware.

MR. MATRANGA: I think a great deal went back --

Ottinger: We had a number of ground incidents and learned our Lessons well, I hope --

MR. MATRANGA: Well, we had a number of ground incidents and we had some hard and fast ground rules.

Ottinger: Yes.

MR. MATRANGA: Which we never violated in flight. We never flew in winds over 12 feet per second, if I recall correctly, or was it 15?

Ottinger : We gradually expanded to this; --

MR. MATRANGA: Oh, we got up to maybe 15. We would not go if we had any questionable system operation. We would not go unless we had telemetry, to be able to monitor the systems,

Ottinger : You picked up some comments in Buffalo about some of our flights getting down pretty close to the board point because of jet engines running fast --

MR. ERTEL: I think that was --

Ottinger: Things of this nature and -- I can remember now when --

EMERTEL: I don't know if it was Reiken or who, but he says he had a bunch of people out from Washington -- a bunch of Generals, a bunch of MASA people, and they were standing there watching and it was just ready to go and they sat these and sat there and sat there, and they could see that fuel burning up, and he was saying to himself, "Oh, hell, he's not going to get it off the ground."

Ottinger: Well, I think a little is related in somewhat in what we are talking about. If a ~~(blitch)~~ glitch came up after you start the engine, go through this fairly extensive checklist, and then you go back, and we had power problems and we wanted to make sure all the firing backup systems were working, and all the stuff was very thoroughly checked out, and of course, you come up, and you go back and start it over and re-check it and then you had ~~to~~ go, no-go,

Many times it would be no-go, but I think for all of our ~~(stemos)~~ domes, I can't think of a one where we really shut down and reserviced it again, but we did just get it off.

Maybe we didn't give a full trajectory or a full --

MR. MATRANGA: The one that John's thinking about, and I remember it, was during the (Expedine) Conference of 1965 or somewhere in that ball park.

We flew it off here off the the bank ramps. That wa

the first time we ever flew off the back ramp.

MR. ERTEL: Yes, that's AIAA. Yes, the X-15 Conference, but that was not --

MR. MATRANGA: But that was not a marginal service situation.

Ottinger: No, that; was the one we (made fission) at 20 feet off of the ground.

MR. MATRANGA: But the thrust light computer didn't work properly.

Ottinger: Well, it was successful.

MR. MATRANGA: Okay, Well, that's what I'm saying, It was pilot technique.

Ottinger: Yes. Right.

MR. MATRANGA: That made the difference, but because of the pilot technique, the jet engine was not putting out enough thrust, and he got down in close proximity of the ground and didn't have enough thrust.

Ottinger: What was the switch that we moved that I was arguing with him? You had -- I was talking about the XB58 going in a week or two before that, and I had a big battl going with Walker about wanting to do this.

I wanted to get it off the console and put it up on the jet throttle head.

MR. MATRANGA: It was the (lunar) sim switch that he could punch off of lunar simulation and lock everything back u

Ollinger : And that particular flight convinced him that we are moving up and he did it,

MR. MATRANGA: Right.

Ollinger : But there was another switch which got moved off of the throttle and was it the same switch Later on for different reasons?

MR. ERTEL: Was that the one that Alex was telling me about that after the change in your seat, you were sitting in a different position and he accidentally --

Ollinger : Was it the emergency throttle?

MR. MATRANGA: I don't recall.

Ollinger: We had a backup jet throttle system that was electrical instead of hydraulic.

MR. MATRANGA: Right.

Ollinger : And, as I recall, we had a switch on top of the throttle hand with that and it could have been tha one was actuated.

I think we always had to keep that right up there.

MR. ERTEL: Well, he said that after this happened

Ollinger : I remember what you're talking about. There was a switch -- down here in South base in your (flight steer) you actuated a -- it got inadvertently actuated and the decision was made to get rid of it.

And I don't know if we got rid of it entirely or what, and I think that --

Don Mallick

MR. MATRANGA: I don't recall. That slips my memory Okay, so where are we? We've got ~~Mach~~ Rearn Algranti and ~~Reem~~ and (Alvrany) checked out.

We got a contract run-through with Bell to redesign the vehicle to make it more operational -- LLTV, if you wish, rather than LLRV.

Ollinger: Do you have GE contract --

MR. MATRANGA: Put the second vehicle -- okay, get everything documentation-wise --

Ollinger: -- and injection with that so it could take off from there.

MR. MATRANGA: Right, and the second vehicle put together --

Ollinger: All right.

MR. MATRANGA: -- which included, as you say, the deletion of the emergency rocket system which, in retrospect, we felt was certainly marginal for use by astronauts.

Ollinger: Trainees.

MR. MATRANGA: Trainees, yes, right. For experienced pilot, that's one thing, but for a trainee, that's better to just punch out as --

Ollinger: Yes, because once you come in under that land emergency system, you're putting yourself in worse ejection position.

MR. MATRANGA: That's true.

Allmon : And you're just running a bigger risk in loss of life, whereas a research situation with more expertise, then you'll always save the vehicle than when you take a --

MR. MATRANGA: Right, right. And then we delivered the first vehicle to Houston in January of 1967 and shortly thereafter, the second vehicle was brought down to Houston.

We tried to check out the vehicle. We went down in February to demonstrate that the vehicle was still flight-worthy down there and ran into difficulties with facilities at Houston and just couldn't get proper peroxide servicing.

We couldn't get --

Allmon: Power.

MR. MATRANGA: Yes, power -- a whole bunch of facilities things. We made a ground run --

Allmon: And wouldn't give stable enough power, permanent --

MR. MATRANGA: We made a ground run right there on the ramp and wound up chipping concrete like crazy, so we figured we had to have a blast shield under the machine to protect us from blowing up concrete.

I decided that we were going to pack everybody up and come home until they got all of the facilities problems solved.

And we went back in March and then got off two full

simulation flights, with Jack (Hoover) flying the machine and --

: Coming in out of this (inaudible) point of the flight.

MR. MATRANGA: Yes, and so it was operational. And so that was Bind of the end of our committment, except that we did consult with the Houston people in the fabrication and design of LLTV and of course a couple of us got involved with accident investigations down there.

: ~~(Inaudible).~~

MR. MATRANGA: (Malik) was in B-70 school or -- I don't recall this -- B-70 school or B-58 school, but in preparation for B-70, that is Correct.

Don got wrapped up in the things involved with B-70 in the fall of 1966 and Jack Hoover flew most of the latter flights in the machine.

In fact, the people who flew the different flights down here at kind of interesting and, in fact, the flight distributions are kind of interesting,

Walker flew 35 flights for something in the order of two hours and 23 minutes of actual time. Malic flew 79 flights and wound up with the most flights here and he had a little over six hours, eight minutes and 37 seconds, to be exact.

Jack (Kluger) wound up with only 65 flights, but he had six hours, eight minutes and 59 seconds, so he had

22 seconds more time than Don (Marick).

Ollinger: Yes, I'll bet he's the happier of them all -- squeeze more out of it.

MR. MATRANGA: But Al (Granny) made 13 flights here for a little *over* an hour's time, but (Reem) made 12 flights for 59 minutes before the machines went down to Houston.

So, they *were* pretty proficient in the machine by the time it got down there -- each one came down -- so about six weeks here.

Ollinger: (Flowery) and (Don) went down there -- to check it out, quit South base for a couple months,

MR. MATRANGA: For a year.

Ollinger: For a year, but the ironic thing about it is that hardly any of the guys that trained here stayed with *us.*

MR. ERTEL: Stayed with us (inaudible).

MR. MATRANGA: When they all went back to Houston they decided that was the end of the rope. Most of them quit and stayed cut in Southern California.

Ollinger: Did they?

MR. MATRANGA: Yes, most of them quit and stayed in Southern California.

Ollinger: (Zero) had a real problem on manning, getting good technicians --

MR. MATRANGA: Qualified people.

Ollinger : And they didn't even have an engineering budget or staff.

MR. MATRANGA: Okay, a breakdown on the flights as we made them and, as I say, we made 204 flights with the two machines.

58 landings were made in the lunar simulation mode. We made 37 operational check flights; we made 15 flights in this check-out of the jet stabilization system; we made 8 flights for the auto throttle check-out; we made 43 flights for pilot familiarization -- that's really the biggest chunk of flights we made.

We made 12 flights evaluating the side arm controller; we made 6 flights evaluating the LEM panel; we made 10 flights evaluating the drag of the machine, the aerodynamic characteristics of the machine.

Ollinger : And some interesting flights, as I recall.

MR. MATRANGA: We made 16 flights evaluating attitude control, which the LEM did not have, but that was an academic interest and the indeed the number of (V20) machines have gone to that.

Ollinger : You're talking about attitude command?

MR. MATRANGA: Attitude command, right.

: Yes.

MR. MATRANGA: A number of (V20) machines have gone

to *that* probably as a result of our problem on --

We made 31 flights evaluating the rate command system and then 26 flights specifically looking at lunar trajectories.

Ollinger : Now, this attitude command -- now, the LEM had attitude ~~(forwards).~~ holds

MR. MATRANGA: The LEM had attitude command with attitude ~~(haul)~~ hold -- the combination of the two.

: Which was the better thing. Now, the pure attitude command, the ~~LEM (states)~~ LEM take over, the vehicle comes over and it stays there. The (stick) comes back to the (Inaudible).

MR. MATRANGA: No, no. He'd have to hold the stick to whatever attitude he wanted *to* hold.

Ollinger : And it would stay there.

MR. MATRANGA: And it would stay there. If he let go of the stick, then the machine would come in back to --

Ollinger: So the vehicle follows the stick, pure and simple.

MR. MATRANGA: Pure and simple.

Ollinger : Command with attitude holds --

MR. MATRANGA: ~~Break~~ Rate command with attitude holds.

O Hara : Okay, yes, you said it the other way, but it would be ~~break~~ rate command with attitude hold would be what I ~~sound out~~ summed up first, wouldn't it -- move the stick over and let

it come back to the tip of the vehicle and --

MR. MATRANGA: It will stay at that attitude, that' correct, which is what LEM has and which is what LLTV had.

: Yes, right.

MR. MATRANGA: When vie originally designed the machine, we designed it to what ne expected LEM to have and, of course, it changed as --

: As tine went along.

MR. MATRANGA: -- as time went along. And we updated the LLTV to be more like (Thor).

We had to make some hard decisions on LLRV Long before systems were frozen in the LEM.

: I think one of the interesting design experiences I do recall and it is certainly from a systems analysis standpoint, it was early in the TV program, MSC had a separate (authority) for failure analysis modes.

And it was a darned good exercise, at least for me. I don't recall specific design changes that were made out of that.

MR. MATRANGA: Well, a specific design change that was made was -- for instance --

: The electrical system on the last ship right.

MR. MATRANGA: The electrical system of the last LLTV, that's right.

Ollinger: Well, I think some of those changes though were made before, and the analysis itself was just reflecting what would haapen on the -- is this third crash -- I've heard it explained -- apparently, it was a generator failure?

MR. MATRANGA: That is correct.

Ollinger: And then from that the residual field that apparently no knew was there kept the relaying to put you on the battery from dropping it out or dropping in.

So here you are with ~~another~~ neither bus to generate power.

MR. MATRANGA: That's right. We had neither generator power nos battery power.

Ollinger: And then I heard also that once the engine flamed out due to the ejection seat gasses, ingesting into the engine as you pointed out, the engine wound down in RPM's.

Your generator wound down the field disappearance, the relay came on, the battery came on, and this attitude control system started firing, and that's how they found out what the problem was.

And there is a good example for the failure analysis didn't pick up the thing, and actually even the test program to, let's sag, more realistically check out the system.

MR. MATRANGA: Okay, what else do we have?

MR. ERTEL: Well, I think I want to ask you a couple -- do you recall who was on that early ad hoc committee? Name as many as you can, and I can say the ad hoc committee is --

MR. MATRANGA: I can go back and look. I remember Jim Atkins specifically was on it I remember (Farmer) John Smith was on it. I remember a fellow named Joe (Washfield) was on it. Joe was a performance engineer. He left shortly thereafter. I have no idea where he went.

I was the Chairman of the committee.

Ottinger : Was Drake part of it?

MR. MATRANGA: No, Drake --

Ottinger : Or just an assistant, as before?

MR. MATRANGA: He insisted that it be formed and shepherded us along, but he was not an active --

Ottinger : In terms of -- in Drake's part in it was more or less addressing the general problem of lunar landing and what can this center contribute to it, but it didn't really constitute building a simulator.

MR. MATRANGA: No. And the question was, what kind of simulator should we use. We went down to the south track, for instance, and talked with those people to see if there was some wag we could orient the man on the sleds down at South Track to simulate it, to see whether we could do it with a helicopter.

: Well, you had to get the general parametric things together so that you would need, let's say, a combination of a jet engine, but as it turned out, the combination of a jet engine rocket made more sense. Because of the impulses involved.

MR. MATRANGA: We went up and talked with some people at (Chon) China Lake. They had a tower, a 100 foot tower, that they were running some Ranger rocket engines, rocket engines that could have been utilized on Ranger -- using radar altimeters. That type device.

All of these things were too constrained. We figured we had to get something that could go to as high as 1000 feet, and that was the kind of number we talked about.

As high as 1000 feet to simulate this Last 1000 feet of the lunar landing, and that was one thing that made us so skeptical of the LLRF at Langley.

We felt that they Just couldn't get enough simulatio time in there to do the pilot enough good.

: What was its height?

MR. MATRANGA: 200 feet, maximum. But, of course, by the time --

: -- into the trajectory, yes.

MR. MATRANGA: Right, by the time you got into the simulation modes, they were down something on the order of 75 or 100 feet. Our ~~My~~ feeling was that just wasn't enough.

And I think, again, that was fairly well confirmed that --

Ertel : Yes, they stopped using them pretty early.

MR. MATRANGA: I'm aware of that. They did run som landing gear type studies with it, which were extremely useful. Each one wound up having its place, as it turned out.

But from the flight training standpoint, I think all the astronauts had flown the machine, and our pilots certainly felt that the strange attitude you got into with this machine was like nothing else they ever experienced before or since, other than on the moon,

Because you just had the tip, attitude-wise, so far -- unnaturally far to get the proper thrust and the prape thrust background.

And, of course, the other thing was the very steep attitudes that were involved in the whole thing. They were much steeper than normally utilized, let's say, with a helicopter, for instance.

MR. ERTEL: Would you address yourself a little bit to your fixed ~~base~~ base simulator?

MR. MATRANGA: Well, again, the fixed base simulato -- each one had its place, and I think you could not have done as good a job if you didn't have any one of them,

The fixed base simulator certainly allows you to

go through all the parametric things, particularly relevant to trajectories, but it does not give the pilot the feel of the large attitudes; he cannot get a feel for it on the fixed base simulator, or even a moving base simulator.

Because you don't have the acceleration associated with the large attitude. You can tip a cockpit up on a ground base simulator, but you don't have the accelerations that go on with it. It's not all there.

MR. ERTEL: It's really -- for some reason, I'm sure it was a good idea, Somebody told me that the fixed base simulator -- it was really a simulator simulator simulator, because it would simulate RV's which would simulate the TV, which would simulate the LEM's.

MR. MATRANGA: We had a small --

: It didn't really simulate the TV.

MR. ERTEL: It did in a sense, didn't it?

. In light ground work; as far as a true simulation, the TV's just sort of a follow-on of the RVN. We did build in some variability, as I recall, in the control system for the RV to do basic free-style research work.

And some was done, which really wasn't, as you call, necessarily related to the moon,

MR. MATRANGA: That's right. We were interested in basic research and research that pertained to DOTL as well as to general spacecraft application.

Ottm3a : So you had a dual role with the RV where the TV simulator, as far as operational training, it was timed -- it was late enough so that we could get more up-to-date with developments in configurations, all the way around,

But then we went ahead and put some (virgos) back into the TV's to keep up with LEM. So in the long run, probably wound up ~~this~~ more complex (~~inaudible~~) if not more so than the RV because of the additional operational controls.

And this is where, I think there's addressed -- we hit an the real weak spot, as far as the failure ~~of those~~ models studies is concerned. ~~Where they are~~ But in terms of trying to handle this transition from RV to TV, that kind of an effort really had to take place. And it was strictly a fall-out of an ~~airsnip~~ interesting exercise in the rocket systems, jet systems.

I think there were a few changes that did fall ~~work~~ out, now that I recall, in the jet system. There was a discovery (inaudible).

MR. MATRANGA: And we always recognized the one area we had no redundancy was in the jet engine attitude control systems. And there was no way to provide that.

We just never could figure out a way to -- if you ever added hydraulics to that jet engine attitude control system, your accumulators would lock up the gimbal system, but as soon as you ~~burnt out~~ bled off the hydraulics, you were dead.

That was the one area we had no redundancy -- that

and the jet engine, of course. We lost the jet engine and couldn't (inaudible).

But those really were the only two areas that we didn't have some form of redundancy.

MR. ERTEL: You had your (burn) seat accumulator -- was redundant to the normal hydraulic pump on the jet engine.

MR. MATRANGA: Right, but if you had a hydrolic line failure, where you lost hydraulic pressure, the accumulate would not --

I'm going to have to but out for about a half an hour.

: (Tell) wanted to catch us earlier today, so why don't we move down in here with him and then later on wrap up.

MR. MATRANGA: We'll plunge through some of these things. I've been trying to get to that ever since you called saying you were going to cane, and that got delayed until tomorrow -- until tomorrow -- until tomorrow.

I have a collection of photographs, if you would like to look at them.

MR. ERTEL: I surely would. That's one thing I need badly.

: (Inaudible) and he wants to get a copy of it; do you still have any (inaudible)?

(Inaudible discussion.)

MR. MATRANGA: Oh, I don't know.

MR. ERTEL: I think that was really --

: See, that was (inaudible) at Edwards (inaudible) picture.

MR. MATRANGA: Okay, I'm sure I have --

: --and should probably have a negative of your (Inaudible).

MR. MATRANGA: Wade through photographs of --

: I would like --

(END OF TAPE ONE, SIDE ONE)

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