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Interview with Rex Ridenoure

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Name: Rex W. Ridenoure

Date of Birth: May 23, 1956

Place of Birth: Phoenix, Arizona

Question: What's your relationship with the Get Away Special team? Were you a student?

I worked up here at the Center for Atmospheric and Space Sciences at Utah State from about December 1985 through August of '86. I was, on paper, listed as a "research engineer" which was kind of a made up title. About two-thirds of what I did here was interacting with the Get Away Special activities that were going on at that time. There's more of a story to that that I'll tell. The context was that I was a undergraduate at Iowa State University, Ames Iowa. When I was a junior I was what they called a speaker manager for the local chapter of AIAA and so my job was basically to follow up on some leads that professors in aerospace engineering gave me for bringing in speakers from industry or government. Typically on a every month or so basis. Somehow or another Gil Moore was one of those people sort of suggested as a speaker. So I managed to arrange for him to come to our campus and this was, as it turned out, four years before the Shuttle launched. So at that time Gil was an executive at Morton Thiokol here in northern Utah and probably one of the best advocates for the Shuttle program on the whole planet. He gave a terrific overview talk about what the Shuttle program was trying to accomplish. As you know Gil Moore was very charismatic and still is. So I was so impressed with the guy that we basically have kept in touch since. As I got started in my career and moved out to California and so on and so on, met him at conferences occasionally, he and I just kept communicating occasionally. So I worked about five years in the space business after I graduated and I worked at Lockheed on the Hubble Space Telescope program and also down at Hughes Space and Communications on communications satellites that were specifically designed for the Shuttle. I sort of got tired of working on these big projects and so I was thinking of working on smaller spacecraft, but I didn't know what was going on really. Then in an Aviation Week and Space Technology article there was this write up about the NuSat Program here at Iowa State, or at Utah State. It quoted Gil Moore in the article and it had pictures of Hal Merritt who was one of the technicians working on the satellite, assembling the small basketball sized satellite. I said boy that sounds just like what I wanted to work on. So I called Gil and I said hey Gil tell me what's going on up there, this sounds pretty interesting. Turns out the campus had just started deciding to spin off a small company from the campus effort working on these small satellites. It was going to be in the research park here, which back then was, this was late '85, was just an empty field. The first building was just getting, they were scrapping the dirt for the first building in late '85 and there was a company that was going to go in there called GlobeSat. I interviewed up here probably within two weeks after I found out about all this. Gil Moore set it up to have me tour the facilities and talk about what their plans were. They decided they wanted to hire me as a spacecraft systems engineer for GlobeSat. So I think within probably no more than a month from the time I first placed that call I was up here moving into the valley in the middle of December in the middle of a raging blizzard. I barely got into the valley, just barely,

over the highway which back then was a two-lane highway going across the pass you know. So my intent was fully to become a spacecraft systems engineer in a start up small spacecraft company here in the Cache valley and it sounded really exciting. A month after I got here the Shuttle, Challenger, blew up and I never actually even got processed in as an employee of GlobeSat. The paperwork was still in the works. So once Shuttle blew up their entire business plan at GlobeSat was based on Shuttle launched small satellites out of Get Away Special canisters, so all that got put on hold. I was ready to work and I was willing to work and campus had some money so I got hired in as a research engineer at the Center for Atmospheric and Space Sciences. So then the question was what do I do and what they did was assign me to manage a couple of contracts that had been funded by other sources. I think one was Thiokol and one was the Air Force and they were Get Away Special experiments but not the GAS program experiments. They were a little more mature and basically the focus of a PhD thesis for a couple of guys and so that's how I kind of got started and there's more after that, but keep asking questions.

Question: Do you remember any of the specific projects that you worked on?

Yeah, the first one which I was probably a little more involved in was the one funded by Thiokol. It was, of course, funding that Gil Moore arranged through their Internal Research and Development pool of funds in northern Utah. At that time Gil Moore was very interested in learning how to blow bubbles in space and then cure them somehow so they would become a solid sphere, very light weight spheres and he had this vision of having Get Away Special canisters have equipment inside that would blow these bubbles, basically cure them so they would be hard, then cut them off at the base and let them release out of the Shuttle's Get Away Specials and then they would use different size spheres as calibration devices for upper atmospheric densities and things. The ballistic coefficients would be such that they would come in very quickly. They were like beach balls, that's the basic idea, beach ball sized bubbles. So the research was in the lab here at the campus using all sorts of fancy surfactants which is a fancy word for soap. Very slimly fluids that as you slowly blew air into a membrane of this fluid stretched across a wire or something it would start blowing a huge bubble like kids do with soap bubble blowing toys. We were trying to figure out how to do this repeatedly in a Get Away Special in the vacuum of space and then cure them. The surfactants were such that, they were going to be of a kind that first would blow a bubble and then as the ultraviolet radiation hit them in space they would basically crystallize and turn into hard bubbles. It was pretty complicated chemistry and vacuum physics and you know transition phase chemistry from fluids to, from membranes to solids and none of that I had any background in. So I mostly stayed on top of the schedule and the progress of the program and then some of the technical people here did the actual technical work. But it wasn't going that well at the time. The problem was as soon as you put them in a vacuum typically the bubbles popped. They basically started evaporating, you know, so that was going on. The key person involved was a very senior technician probably in his sixties by then, or maybe even seventies, named Hal Merritt. He's the guy featured in the Aviation Week article I mentioned, is in the room, in the other room here, where he's working on the small satellite and that's that guy. So he pretty much stayed in the lab and worked on the experimental set up and the different runs they were doing. There was a chemist from Thiokol, that I don't remember the name of, who was actually the guy trying to pick the right chemistry. He was like a PhD in chemistry with a very fancy background in that area. Gil was mostly

making sure the funding was still in place and we were making the right judgments of where to go next every week or so. So that's the first one.

The other one was an Air Force funded experiment to basically test out some lasers. Back then solid state lasers were just coming on line as devices you could use and very few experiments had ever used them in space under the space radiation situation and also space vacuum. There were quite a few applications proposed for these things to use for metrology and all sorts of other applications for spacecrafts. So there was a PhD student here, originally from Thailand, named Swat Tantiphanwadi and he was getting a PhD in EE, Electrical Engineering, and he was the experiment's principle investigator. Basically his job was to build up this experiment and get it to work inside a single Get Away Special tray which would then be ganged up with other trays, like Utah State is famous for, and launched in space. I was basically managing his money and his schedule, but he was doing all the technical work. Those were the two most familiar to me that I was working on.

Coincidentally, it had nothing to do with my job really, but my apartment mate at the time was Scott Thomas, who by that time was already one of the most experienced Get Away Special guys. He was a physics student finishing up his undergraduate degree. He was a senior at the time, and he, of course, had already had several experiments launched in the Get Away Special canisters. So he and I just became good friends and we still are, but I wasn't involved with his work at all. He was mostly trying to finish up his degree.

Question: So you weren't a student yourself, but you interacted with quite a few GAS students?

Right. Yeah, in fact as soon as the Shuttle exploded that was in late January 1986 it took about a month or a month-and-a-half before it all became clear that the Shuttle Program wasn't going to be launching anytime soon. You just didn't know how long, but you could tell it was going to be many months before they ever figured out what happened. So then the concern on the part of Gil Moore and Rex Megill especially, and even the administration here at the campus, was what are we going to do if the Shuttle is down for a year or two with this program? How are we going to keep the students interested? How are we going to keep the funding coming in from different sponsors like Thiokol and other companies and as these experiments get completed, there were quite a few in the works, how are we going to get them launched them off and get them done if there is no Shuttle. So then the concern was how do we keep the community talking with each other and excited and engaged so this all doesn't fizzle out. The momentum at that time was huge, there was a lot of interest in this stuff. So a couple of things were basically invented here at Utah State to make sure the momentum wasn't lost.

The first one was Frank Redd, who at the time was the department chair of Mechanical Engineering, was very good friends and colleagues of Gil Moore and Rex Megill. Rex was in CASS, Gil Moore was, I think he was an adjunct professor here, but normally at Thiokol working as an executive. So they had always wanted to have a space systems design course here at the campus. There never had been one so they used this gap in everything, all the activity to create the first course. So those three guys basically sketched a syllabus for the course which was intended to be the Spring quarter back then. They basically sketched out what they wanted it to cover and Gil, of course, is always full of ideas of Get Away Special ideas he wanted to pursue. At the time there was a fairly serious concept for enlarging the canister from the normal diameter, whatever it is, about what is it 25 inches or something, what ever the diameter is. There was an idea back then to build a much wider canister but squatter. Not as long but much wider, about twice the diameter and they called it the "fat can." Since a fat can made out of solid

stainless steel would be too heavy for the Shuttle, the idea was to get Thiokol to build the fat can cylinder out of composites. So it would be very lightweight and then maybe put steel end plates on it. But that thought was to open up much more volume for experimenters and use the same basic architecture. Put some trays in it and do some cool flatter, squatter satellites inside. So Gil Moore had an idea to from a fat can eject a small satellite that would have deployable wings on it and do it in a very low orbit and have some propulsion on the satellite and dip it into the atmosphere by changing its orbit make the perigee come down and make it pass through the upper atmosphere and use the wings to actually change the plane of the orbit and then pop it out of the atmosphere. It would be an elliptical orbit so every perigee would pass through at a few tenths of a degree of plane change to the orbit and then come out again. Then the next time around do it again and evidentially you get several degrees of plane change. So we focus the first course not only on going through the space systems engineering process and mission engineering process, but focus it on this fat can deployed small satellite that would dip into the atmosphere. So we called that the Little Dipper. So that was our whole project to design this Little Dipper spacecraft and mission concept. So some flyers, we didn't have much time to put it together because by the time this all came together was maybe March. I think the last quarter started in early April or something. So some flyers were put around and some newsletters were kind of sprinkled around campus to try to get some students signing up. I think we got about six or seven of them, maybe eight. There were a couple of graduate students and the rest were undergrads. So after Gil and Rex Megill and Frank Redd agreed on what the syllabus was going to be, they turned it over to me and said ok you get to teach the course because I had almost nothing to do at the time. I said I've never taught a course before and they said that's ok, now is a good time to start. I had been a spacecraft engineer and a mission engineer so at least I knew some of the basic concepts. I ended up basically having to teach the course and have other professors come in if I didn't know the subject matter. I would get other professors come in and teach that little module. But generally I had to coordinate all these students and get them on the schedule so they could generate this preliminary design by the end of the session. The goal was to get a preliminary design review out of it, which we did, and do a bunch of calculations and simulations. So that was one thing we did. The other thing that was invented which is still, there's a legacy for that already here, and is the space system design course still here?

Yeah.

Okay so that's still here.

The other thing was the small satellite conference was conceived that spring as a way to get the community to continue to meet and talk. The first one was coordinated by the same three guys. I sort of helped, as best I could, but wasn't terribly involved with the organizing because that was mostly working with the campus people. I believe that first Small Sat Conference, if I'm not mistaken, something like 30 people showed up. It was held in the little theatre, you know, I don't know where it was, in the Eccles or somewhere but there is a little theatre where they do little plays and things that's where we used it. It was just a real small lecture hall sort of. Of course last year, it was the 24th year last year, I think it was 1200 people taking over the entire student union building you know on the second floor so it's really turned out to be a great thing.

The other thing I did in that time frame related to the Get Away Specials was after being here about a month, month and a half, talking with Scott Thomas and some of the other students and some of the professors that were involved with these Get Away Specials, anecdotally I could appreciate that there were quite a few that had failed. The experiments just didn't work or they had serious problems. I thought it was kind of a useful thing to maybe just put together a list of

all the Get Away Specials that had been launched on the Shuttle and then try to understand which experiments were inside of each one of them and then get the results for those experiments and write it all up as sort of a summary so that the students here especially could benefit from all those lessons learned. I naively thought that that would be about a two week effort. So I jumped into, back then with the Shuttle down and everything in ciaos, I could literally come in the morning at 8 o'clock and work as late as I wanted. Until 6 o'clock in the evening or whatever, 8 o'clock in the evening with no interruption whatsoever, just totally focused time. There were no distractions. So I started jumping into that and the first thing I realized was NASA Goddard, who ran the Get Away Special Program, had a list of Get Away Specials that had been launched. But it wasn't accurate. I could tell just from looking at that list versus the list the Air Force kept, which was a separate list, and then the Johnson Space Center with the Shuttle Program had their own list. All three lists didn't compare very well. Generally I could tell there were seventy or so canisters that had been launched. But the range between those lists was, like one was in the eighties and one was in the sixties, they were way off. So I said ok first thing I need to do is to verify how many canisters have been launched. That took me about two months. I literally got to the point where I had these lists in front of me and I kind of merged them together as I correlated them. Then I started comparing that list with images taken of the Shuttle cargo bay at the launch site where the doors are open. I could see canisters in the cargo bay, but they weren't all listed on the list, that kind of stuff. So I had to call people and say ok what was that other canister in there, why isn't it on the list? Well it turns out that was first aid covers from the US Postal Office and no one wanted to put that on the list, but I put it on the list anyway. So the bottom line is, after about three months, I finally got a list I believed in that had both the canisters and the experiments in it and most of the results.

The bottom line was pretty surprising to both Gil and everybody here that was involved. The bottom line was there was something like seventy-seven canisters launched, about half of them had active experiments in them. Half of those active experiments completely failed, just spectacular failure, nothing happened. Then of the other half of the experiments that were active, which were about a quarter of all of them, half of those had serious anomalies or otherwise had compromised objectives because something didn't work but they bumbled through whatever they were trying to do. Just a small fraction of these things actually worked the way they were designed. So Gil suggested that I write all that up and present it at the annual Get Away Special User Conference that was always held at Goddard Space Flight Center in Maryland at the end of the fall season, like in October or so. So I did that and finally presented all those results, sort of unannounced, to Goddard. They didn't know those were the results because they weren't keeping track of results. That's one thing I realized. No one was keeping track of results at all. So when I presented these it was pretty much of a "wet blanket" on this whole workshop because the results were pretty disappointing. So at first, the Goddard managers in charge of the Get Away Special Program actually were getting angry with me. Right after my talk, during the question and answer session, they were getting angry with me and acting very defensive and very a sense of denial like well it couldn't be that bad. But fortunately Gil stood up and so did some senior guy from NASA that appreciated all the results and they sort of stood up for me and said hey listen, time out guys these are real results. Rex has all the back up information, he's called all these experimenters and you just have got to swallow the bad medicine and face up to the fact that this program isn't working as well as you thought. They really called them down on it. So they calmed down and I actually had the chance a couple of years later to update that report with some additional information and that's sort of in the archives now. That's part of the lessons

learned up until Challenger blew up. It was a fun exercise mostly because I had so much time to work it, I could actually do a good job and not get distracted. So that will be, if there's not a copy here already, I'll make sure you get a copy for your archives. It's useful information.

That's one thing we are concerned about because everyone that is here now has no clue about what ??? None of us.

Is that right. I'm pretty sure from the time that the Shuttle started launching two year later, that would have been in '88, late '88, my understanding is that the total canister count went from something like 77 or so to 150 or something. It almost doubled until they finally shut the program off. But I don't know anybody that's kept track of all that second half, and there's a lot of good stuff in there. They did all sorts of satellite deployments and fancy stuff. But I don't know anybody that's kept track of it. What happened was it became clear in the summer of '86 that the Shuttle was going to be down for a long time. I came here to work for a small satellite company not a campus environment, so I started getting itchy about staying here, not really doing what I wanted to do. I had come up from Southern California and a friend of mine that worked at the Jet Propulsion Laboratory appreciated that I was stuck here without a rudder, not really doing what I wanted to do. He learned about an opportunity down there for me to work on Voyager going to Neptune. That intrigued me so I actually left here in August of '86 and started working at JPL. It turns out that the same week that the Challenger blew up, just a couple of days before that, Voyager went by Uranus. But because of the Challenger news that whole story got buried. It almost didn't get notice unfortunately. That same week both of those things happened. So I continued my involvement with the Get Away Special folks here even after I went to JPL for several more years because I fully appreciated what was possible here. As you might expect at places like JPL to do anything small and simple is very hard to do and it takes a lot of money and time.

So I actually, several years later, was involved in proto-typing some micro-spacecraft concepts which were generally about Get Away Special size. These were for going to the Moon and asteroids. I had become a fan of isogrid structures through a separate meeting with a guy who knew all about those. I told Gil Moore that I would like to have a student up here actually help me design and build a micro-satellite structure built out of isogrid. Gil thought it was a great idea, so he arranged to have a masters student use that as his masters thesis. A mechanical engineering student, his name was Joe Greathouse. So I got the funding and the funds were put up here on campus and Joe started this thing. We sketched out what we wanted to do and he, one of the main things that I wanted him to try to do was keep track of every single cent spent both in his time and materials and machining time everything else to tell me how much it cost to build this thing, design and build it. So he finished the whole thing in about four or five months and just to make the point I asked him to FedEx it to me at my office at JPL when he was all done with it. Which he did. It was sitting on my chair one day at the office in a FedEx box. It turned out the whole thing cost from start to finish $2,000.00. This isogrid you know when it is first machined it looks like it's gold plated. It looks very fancy. I would take this isogrid structure around to different places at JPL and I would put it on someone's desk who I was pretty sure was sort of a cynic of this sort of structure and I would say "ok tell me how much this cost." They would look at it and say that has to be at least $100,000.00, maybe $200,000.00. I had a little price tag on it that attached to it. I would keep it flipped over one way so that you couldn't see the price, then I would flip the price around and it was $2,000.00. It blew everybody away there. It was nice that it worked so well with this project that Gil started asking other students to build their trays for Get Away Specials out of this stuff and evidentially balloon payloads and full

blown satellites buses and stuff. So now it's all over the place. It's very satisfying to see that it's not only here but at other campuses. I think it vindicates what I had in mind back then.

Question: One thing that I don't understand is how they release the satellites from the Get Away Special payloads on the Shuttle. Do you know how that works?

The early one had a, the canisters are what about three feet high maybe? A meter or something? The early ones probably used about 20% of that volume for a pedestal in there which was a really beefy three-legged aluminum structure that came up like a tripod with a really thick base on it. On top of the base was a clamp-band assembly just like any other launch vehicle would have and a fairly stiff spring. The clamp-band was attached to the circuitry that went back into the cabin for the Shuttle. Of course to deploy a satellite you had to open a door on the Get Away Special canister so that also had some switches and drive motor and stuff. The crew in the Shuttle cockpit looking out through the back windows had a switch panel that operated all these functions. So they would open the door at the right time, they would get the orbiter situated at the right angle and orientation and then at the right time they would flip these switches which would blow the clamp-band and the spring would eject the satellite out. I'm pretty sure most of them used that technique. It's just that over time they shrunk the form factor of the clamp-band so it didn't take up so much volume. That's how it worked.

Question: Were you ever part of a Get Away Special road trip?

No, I heard about them, but I never was. I did have some fabulous conversations with some these students who had built experiments when I was tracking down these results. From all over the country, not just here at Utah State.

I remember talking to one student who said he was from Houston and their team was about four students strong and they had an assignment with a launch date and everything at the Cape. He said they were literally assembling the experiment for the final time in the backseat of the car driving from Houston to the Cape. That's how late they were with their test program. Crazy stuff like that.

One of the payloads that failed was a really cool payload from Cal Tech that was going to do multiple turntables inside, spinning at the rates that would simulate Mars, Lunar and Earth gravity with seeds on them at different positions radially out on the turntable. They were going to try to see what the threshold for gravity field was when the seeds start realizing they need to turn their growth direction. It was a great experiment and they had tested this thing. It was designed with a lot of help from JPLers. It was very robust and reliable, I thought it would work great. I learned that the whole thing didn't work at all up in orbit. So I called one of the students, I said did you ever figure out why it didn't work? He said yea, it's very embarrassing. All though our test program we tested the daylight out of the thing it was all ready to go and at the Cape when they were doing the final closeout one of the students remembered they used the same fuse during the whole test program. So he passed the idea around to his student team, why don't we change out the old fuse with a brand new one to make sure its just fresh and they said great idea. Improve the chance of mission success. So they changed the fuse out but they put the wrong size in. It was too small. The one they put in was too small. So what happened was as soon as the crew flipped the switch to turn it on the fuse blew and the whole thing just stopped. They got like a milla-second of data.

There was another one, a similar thing, one of the failures it was a multi-million dollar experiment that McDonald Douglas in St. Louis put together. It was a fluid physics experiment.

Really fancy, probably the fanciest one I ever saw. Likewise they launched the thing, they got it back, they read the data out, and they said everything operated but there's really is no data here. It not doing what we thought it would do. We expected some more interesting results in micro-gravity. But all they saw was that all the switches worked and all the little motors worked and all the fluid transfer functions worked, but it wasn't working the way they thought. So they looked into it, looked into it and they finally realized that everything worked, but the time it started didn't correlate with the launch time. It was actually earlier than the launch time. So they looked back at the records at the Cape and it turned out that they had an acoustic switch installed in the Get Away Special, which was one way they used to start them, which detected the noise from the solid rocket boosters on the Shuttle. You know once the solids go, the Shuttle is launching. That's your key that you are really going. This acoustic switch was suppose to turn on when the solids ignited. What they found out was that two week before launch when the Get Away Special was in the hanger where they integrate with the Shuttle it was just waiting for it's slot for integration and that day a Delta II rocket took off from the Cape. The noise from that is what triggered the acoustic switch. So that was very embarrassing. Stuff like that.

One thing I found out from all those experiment failures was generally, the general cause was a poorly executed integrated test program, environmental test program for the whole experiment. That's generally where things fell apart. They would have a great design. They would assemble it and all that, but a lot of these teams got time crunched at the end because their development took too long so their test program was truncated somehow and they just didn't test as much as they should have. So controllers didn't work, batteries didn't work, memories didn't work, heaters didn't work and that all compromises things when that doesn't happen right. That was interesting. So that's where we are with that.

I could say a couple of things that are interesting for context. One is this fat can idea I mentioned. There was going to be a contract from Utah State University to Morton Thiokol, up here in Brigham City, or wherever it is. It turns out the morning of the Challenger accident I was at the Thiokol executive conference room with Gil Moore. He had called a meeting which was with all of the key decision makers at Thiokol, and me and Rex Megill here from the campus, and one grad student that was going to work on the fat can from mechanical engineering. We were there that morning to negotiate the contract for Thiokol, you know the scope and the price and everything. We were going to negotiate and get a contract signed. Surprisingly this was only about the 25th Shuttle mission. There must have been a dozen people in the room and everybody to a person that morning forgot there was a Shuttle mission that morning because it was so routine by then. So what happen was we are right in the middle of these thick discussions about contract language and stuff and Gill Moore's executive assistant comes in and puts her hand on his shoulder and doesn't say a word, she just looks at him. They had been working together for years and years and so she knew him really well and vice versa. She just gives him this funny look and then nodded her head like come with me. So he said excuse me gentlemen, apparently something important has come up. So he goes out in the hall and he disappears for about 30 seconds. Then you hear this gasp out of Gil Moore and I frankly thought that he had just been told that his wife had gotten seriously injured or killed in an accident or something. That's what it sounded like. So another minute goes by and then he comes back in. He's clearly very unsettled and he kind of composes himself and says gentlemen I have to call this meeting closed. There's been a terrible accident at the launch site for the Shuttle this morning and he says all personnel on board were killed. He says we're going to have to do other things today than this meeting. So he just called the meeting off right then. So we all filtered out of the room

and tried to find a TV because back then it wasn't very common that you could find a TV in building like that. This was before the internet, before flat screen TVs, even before Direct TV and all those things. So it turns out one secretary down the hall somewhere had like a news radio station from Salt Lake City on and that was giving real time news reports on things. So we realized how bad it was fairly quickly. Gil Moore, in the meantime, one of his jobs out there was to do public relations liaisons with the media whenever there was something important to talk about. He was the person for Thiokol. He had to sort of change his spots like Clark Kent and become the PR guy. The news trucks were on their way up from Salt Lake City up to the site, racing out there to get the first hand word from Thiokol and what happened. So not knowing anything about what actually happened, Gil had to stand in front of all these reporters with their microphones and cameras and try to explain what happened, not knowing what happened. It was very awkward, but Gil handled it pretty well, very poised and sounded very professional and kind of kept everybody at ease. He though he didn't know anything about what had happened, so that was very cool. It was a very surreal day because everything just completely, you know everybody's plans changed in one day. Really weird.

Question: Is there anything else you would like to add to this?

Well there's one little antidote which to me captures Gil Moore perfectly. The context is once the Shuttle stood down and looked like it was clearly going to be down for at least a year or maybe two years, and safety, of course, became the number one priority all across NASA was we got to get this thing safe again. There were rumbling to cancel anything that was really not mission critical to the Shuttle program. There was an upswell of support for a while to cancel the Get Away Special Program completely and just get rid of these things because they don't really add to the core mission of the Shuttle. So Gil, of course, took that as a personal challenge to make sure it didn't get canceled. At the time the NASA administrator was Dan Goldman, who was a fairly brusque former spy satellite guy from the, what used to be called TRW, that is Northrup Grumman in Rondo Beach. He mostly worked in the classified world all of his career. He was a PhD level guy, really smart and everything, had a huge ego and turns out that it was very difficult to just get a meeting with Dan Goodman because he had all these people around him that would buffer him from normal people. Very difficult to get a meeting or a phone call, a difficult guy to approach and get some time with. Gil figured if he could just get a meeting with Dan Goldman he could convince him, pretty much on the spot, that this program was worth saving and shouldn't be canceled, but he needed a meeting with Dan Goldman. First he tried calling Dan Goldman's number at NASA headquarters. Of course he gets two or three levels of assistants and assistants to assistants to keep Gil from talking to Dan Goldman. So he tried for a month to do that and never could even get a call scheduled with Dan Goldman. Then he tried letters. So he started sending letters directly to Dan Goldman. They wouldn't even get opened typically. He started sending them to friends of his who would walk them down the hall and put them on Dan Goldman's desk or his assistant's desk and nothing ever happened there. So months went by and nothing was converging. So in classic Gil style he finally decided, he said listen, he said I'm not going to get in to Dan Goldman through the official channels. So he said I know this guy is invited every month to go give a lecture or a speech somewhere. I'm going to track him down at one of these lectures and figure out how to get to him there. So he started getting information on where Dan Goldman was going to be appearing at different space conferences and what not. I think there was finally one in Anaheim or somewhere in California, or possibly Las Vegas, I forget exactly where it was but Gil figured he would use that one as one

of his opportunities. He went to this conference and he started basically stalking Dan Goldman. He's going to get a word with Dan Goldman some way or another. It turns out that even on travel Dan Goldman has this entourage with him that would keep people away from him unless they were scheduled to meet with him. So it's the same old problem. In typical Gil style he figures ok I'm not going to get to him this way either, but he says I know one thing about Dan Goldman, sooner or later he's got to go the restroom just like every other human being. So what he did was camp out near the restroom, the men's restroom at this conference and he waited until Dan Goldman went to the restroom and then he went in. He got right next to him. It sounds like he was right next to him at the urinals and that's when he gave him the pitch. The quick you've got to save this program. Dan you can't let it die and he wouldn't let him leave the restroom until he committed to save the program. It worked. Goldman assigned an action item to one of his staff and they finally worked it and got the official paperwork in place to keep the program alive. That just gives you an idea of how Gil can always, you know, when he wants his way he'll get it some way or another. Just a great little story about him.

Question: Is there anything else?

Just that I'm delighted to see that the program is still pretty vibrant here even though there is not going to be any more Shuttles. I'm anxious to see how it gets converted over to something that routinely launches on other vehicles. So that's important. I'm glad to hear that the space system design class is still going. That's great. As you know small satellites are going to keep going probably forever. So good stuff. So that's it.

Thank you for sitting down with us.

Yeah.