NASA SANTA SUSANA FIELD LABORATORY ORAL HISTORY PROJECT
EDITED ORAL HISTORY TRANSCRIPT

JOHN COSTELLO
INTERVIEWED BY JOY D. FERRY
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FERRY: I have with me here John Costello, my name is Joy Ferry, and it is July 29th 2015 at 2:35 pm. And Mr. Costello do I have your consent to record this interview.

COSTELLO: Yes.

FERRY: Yes, perfect. So I know you provided us with this really nice write-up, but could we start with you just giving us some information? Tell us the story of how you got involved with the Santa Susana Field Laboratory.

COSTELLO: I'd be glad to. Actually it all started out, I was planning on a career in the Air Force, and went through pilot training and everything, and it turns out they didn't need active duty pilots anymore in 1954. And so I was transferred to the Air National Guard at Van Nuys, as a weekend warrior. And simply put, I had to get a job, a real civilian job. So I had thought about different places like North American, (McDonnell) Douglas, things like that.

And just purely by coincidence, my stepfather had been in the restaurant business, and we had guests for dinner one night that just happened to be Dutch Kindelberger and his wife Helen. And Dutch, at that time, was chairman of the board of North American Aviation, and so during dinner I just broached the idea of coming to work for North American, but I didn't relish the idea of driving all the way down to El Segundo, to the main plant. And he said, "Well maybe you don't have to." He said, "We have a facility up in the mountains west of the valley here, that you might want to check into. And I thought "Oh, that was convenient."

So he gave me a number to call at the employment bureau up here, and it was a small trailer, just about the same location, just in the parking lot where we just parked. And so I gave them a call, they said "Oh yes, come right up, we'll have an interview this afternoon!" So I drove up, thought I was going to the other end of the world in the mountains, but finally got here, and a fellow came out to the employment office, his name was Norm Reuel. And he was chief of engine systems development at that time. So I told him frankly I'd only had a year of college at Los Angeles City College, but I planned to keep going on a part-time basis to get my degree eventually. So I told him the courses I'd had, and he said "We think we can find a spot for you in the organization here."

So he had another fellow, the supervisor came out, his name was Dick Agulia, and he decided - well we filled out a requisition, everything, I was gonna work for him in the Engine Analysis Unit. Which essentially my job would be on second shift, which I didn't think was too great, but a job is a job, so anyway he said, "You'll be finishing up plotting the charts and graphs that they didn't finish during the day." And that meant I'd be by myself on second shift, the only one in the unit, so that's gonna be interesting too. So I had to go down to the facility on Lakewood Boulevard, the Downey facility, to go through the formal employment paperwork, take a physical, get an I.D., and fill out the security questionnaire.

And that went through pretty quick, and then a week later I came up on Monday morning, September 20th 1954, to report in for second shift. And once again, at the guard gate, like today, they gave me a badge that was waiting for me. We didn't have our name on the badges in those days, at least that was on the hourly system, so I just had a number. And we used to call them number badges or name badges. Anyway, again Dick Agulia came out, and took me into the engineering building, which was actually on this same location right here. It was a wooden building, one level, and had a bunch of desks in there lined up in rows. And he introduced me to the other people in his unit, very nice people. And then he introduced me to a fellow named Al [Kawaler], which he'd been there working for Dick about one year. He was an engineer from New York City, from Brooklyn, and he had his degree from NYU, an engineering degree. And he was a very sharp individual, he – a lot of the people thought he was a little too gruff. But I found out over the years, that he was just kind of a taskmaster. He wanted to make sure that whoever was doing something got it right. And as it turned out, we became longtime friends, for many years. And he would give me the – I'd report in to work at 4:30 (pm); I was on the shift 4:30 (pm) to 1:00 (am). So I'd get here at 4:30 (pm) and he'd hang around a few minutes afterwards, and give me my assignment for that night. Which turned out to be much less complicated than I expected, because I could use – most nights I was getting the job done in about 3 hours.

But I was getting to know - since I was by myself - it was a friendly bunch of people. I was getting to know the different engineers that were still working on second shift there. And I got acquainted with the two engineers that were working on VTS-2, V-T-S 2, Vertical Test Stand number 2, down in the Bowl Area. And they were testing a development version of what would be the G-26 booster engines for the Navajo, which was a cruise missile that was mounted to a big rocket propelled booster. It was this kind of an early version of what was considered an intercontinental missile. So anyway, we got acquainted and after a week or so they invited me down to the test stand with them to hang out the rest of the evening. And I'd go down there when they were working, into the control center and so on. And after a couple of weeks they finally got ready, they were running a test, so I got to see my first rocket engine test from the control center in the Bowl. And I was impressed, because I can't imagine what it sounded like outdoors. Because inside it was a pretty good loud rumble. In a concrete bunker, essentially what it was.

And I was duly impressed, and it would be brought home even more-so about two weeks later, when I went down to watch a test on the same test stand, and they had a problem. And it turned out to be probably the most devastating problem we'd ever had at Santa Susana, because VTS-2 blew up burned to the ground. The steel railings around the walkways and stuff were curling up from the flames. What had happened is these huge tanks with thousands upon thousands of gallons of kerosene and liquid oxygen - the valves at the bottom had broken, and they were just draining into the fire, both of the main tanks. And it just kept collecting propellants, and blowing up, and blowing up. It was interesting because we were just sitting there trying to hope the walls would hold up. And anyway, security closed the road at the bottom of the hill, because they didn't know how much of a fire it might start if it really blew up. So at the end of the evening, about two hours later, we finally were allowed to go out. And that was my introduction really, to the testing.

I got well acquainted with the two engineers, and we would work together. In fact, they sort of would give me odd jobs. They transferred over to another test stand, VTS-1, and so I was working essentially for them, but nobody knew it. My boss didn't know it. But after a couple of months of doing that, I'd plot some graphs for them, and things like that, they thought it was a pretty good arrangement. So what they did after my three-month probation was up, they went to Norm Reuel, the chief of engineering, and said "We'd like to reorganize so that we have an analyst, junior analyst, that would work with us as part of the team." And I thought, "Oh, that was really going to be interesting." So he put through the change, and I left Dick Agulia's unit, and went to work with Ron Goe and Dick Summers as part of the three-man team on VTS-1. And I was on that for a long time. In fact, on the 4th of July, of the coming year I got a reclassification from junior analyst to research analyst.

And as part of the team, we just kept working on trying to solve the problems that blew up the test stand previously, and also to develop a new thrust chamber, that was going to be – well it was tubular construction. Like if you lined up a bunch of thin tubes next to each other into the form of a thrust chamber, it would have much better cooling, much more efficient cooling, than the old heavyweight things that were a derivative from the V-2 that the Germans were testing. So we tested one after another version of that. Of course along the way we would burn out a side of the chamber and have to get a new one, or have it repaired. It was always a case of learn by mistakes, learn by failures, because nobody had ever run rocket engines in this country before.

And we were learning as we went along, and enjoying every minute, I might add, because it was an adventure. So, we did that quite a while, until we finally were able to get the 75,000 pound thrust engine that we started with up to 120,000 that the Navajo required. And they put two of those together into 240,000 pounds of thrust. Which is quite a bit, considering that in those days jet aircraft - the fighters that the Air Force had - only had about 6,000 pounds of thrust.

I'll say just going back, my other weekend job in the Air Guard proved interesting, because besides being my pilot duties I had a secondary job as squadron intelligence officer. And that was surprising, because I was getting a monthly intelligence report form Air Force headquarters, and it told of the Soviet rocket engine development program. And they were already in production on a 240,000-pound rocket engine. And that's how we pretty much figured there was gonna be a race for the rocket, not in those days for the space race, because nobody was going into orbit yet. The whole idea was trying to develop a weapons system, before the Soviets could. Because - Time Magazine put a big article out, about that time that – in fact it featured Santa Susana. And with interviews of the people up here, and the whole purpose was we went into a crash program to develop the ICBM, the first Intercontinental Ballistic Missile. Because they had cut down the weight of the warhead, the nuclear warhead, enough to make that feasible. So to sideline the program in about 1957, another year on, we're still drying to develop a larger, more powerful, single chamber engine. And by that time we got it up to about 125-130,000 pounds of thrust. And we could do it several times without destroying it.

So about that time, it was like the crash program. Our program, the Atlas ICBM Program, had one step higher priority than the Manhattan Project of World War II. And there was a blank check from Congress, and the Air Force. And we started working seven days a week, 24 hours a day, and in bursts. Sometimes you could get a Sunday off, or something. But it was a 12-hour shift, generally. Two 12-hour shifts, and a long week. Sometimes they would cut back from the seven-day week to what they call a 52-45, where it was every other week. Fifty-two hours one week where you worked Saturday, and then a five-day week, nine hours a day the next week, and you can alternate that way. But it varied because of the program needs. Whatever the program needed, is what you had to do. And we were hiring a lot of people, expanding quite a bit.

And that's when they started building Area Two, which is the largest part of the area up here at Santa Susana. And we used to drive over during the construction phase; there was a dirt road. And it was interesting because along the way you might see a bobcat, or a mountain lion, or plenty of deer, and things like that. So it was an interesting wildlife experience too. But anyway the first area they built in Area Two was the Alpha Area. They built Alpha Three, was the first test stand, and I was assigned to that, to work with an engineer named Marsh Brown. And the two of us, we were the two development engineers on the stand. We were responsible for giving all program instruction to tests. What we wanted to do for the next test, how to set it up, how long to run, what levels to run, and all of that, which we were responsible for. So we took that 120,000-pound engine that they'd down on VTS-1 back in the Bowl Area, and we got a new version of it, with a bell chamber, bell shaped. The first ones used to be conical, because that's the only way they knew how to make them. Well they determined that it was more efficient to shape them in a bell shape, at the exhaust part. You have the combustion chamber, goes through the throat, and then the expansion part was bell shaped.

Anyway, first thing, they were still building the test stand when we got job. So, it became customary so you were really familiar with what you were doing, as they built the test stand we drew a hand-drawn schematic of every part of the test stand that the engine was going to go on. So we knew every valve, every wire, every tube. And in fact, when they got it finished, Marsh and I, our first big job was to calibrate the flow meters for the main tanks. That took about a week, because they would fill them with water, and we drained it into a 55-gallon drum, one drum at a time, and had to weigh it very accurately to the nearest tenth of a pound, until it was drained. We had about - I think there were 30-35,000 gallons – until that was all drained.

And then meanwhile we were plotting the depth gage, a float in the main tanks, which would slowly go down as the tank was drained. And we'd calibrate the electrical measurements with that. And so that then in the end, they could compare that with a simple flow meter, and get a real accurate flow rate.

Well, one-by-one we'd get all of the parts installed that the facility built, and then they gave us the engine, which we had to install it. And it was called the S-1 engine, Sustainer 1.

Because the idea – the single engine of the Atlas was going to be a sustainer engine, and then eventually the other part would be two larger engines called the booster engines. They would fire first, for maybe 150 seconds, and then they would shutdown, and drop off to save weight, and the sustainer would go on for maybe 350 seconds. Well anyway, we got this first engine, and we gradually worked it up to 135,000 pounds of thrust. And then they thought "Well that one's doing pretty good." And then we – they were supposed to send us an S-2 engine, but we did so well with the S-1, and everything went so smoothly, they decided to skip the S-2 and go straight to the S-3.

So we had a little more time on our hands, a couple of weeks before the first S-3 engine was set up. And what that was going to do, was eventually we were going to increase the thrust on that, get it up to 150,000 for the one chamber. And once again, it went pretty good. We had a few problems, a few fires, which will happen when you're running liquid oxygen, and RP, which is just a little more volatile version than JP-4 jet fuel. But when it got to 150,000 (pounds), then we tried to build up the reliability of it. We ran many tests; just one after the other, and usually there'd be a few long ones in there. We'd run the 350-second version, but mostly it was maybe 150-second tests. And make sure that they were repeatable, that the thrust was exactly right. And one of the interesting things on that, they even were concerned about the cutoff. Accuracy of the thrust was so important, that from the time you hit the stop button - shutdown cutoff - as the thrust decays, we even had to accumulate how many fractions of a second – how much impulse, which was the thrust times the time, during the thrust decay. So that had to be repeatable, within 100 pound-seconds, for every test, one test to the other. And it worked out pretty good. It was a very reliable engine.

And when we finished the test program, the company had a bright idea, and they talked to the Air Force. And they decided instead of waiting for the ICBM, the Air Force would start with an intermediate range missile, called the Thor. And the Army wanted one called the Jupiter. Both of them would use the single engine that we just developed, only a spinoff of it, and a few modifications, not much different. And that was the forerunner of today's Thor – Delta space research vehicle, that of course is a lot more powerful than ours. But that was the first Thor, an intermediate range weapons system, which was good up to about 1500 miles.

And so once that spinoff was done, the S-3 had done its' job. And the next step was going to be the S-4, which was to be the actual sustainer engine for the Atlas combination, for the center engine. Now it went down, it was reduced. The actual Atlas center sustainer engine was only 60,000 pounds, but it had a very large, over-expanded nozzle for operating at high altitudes. Because that's where it was doing most of its work. And we had a couple of problems right off; it's just a matter of the combustion phase, and the expansion of the gases. Where at sea level, where you have normal sea level air pressure, the combustion front and the exhaust as it's accelerating to these supersonic speeds, would pull away from the inside wall of the expansion area, and it wouldn't always do it evenly. It might be more on one side, and it produced hellacious side-loads. And we found that out with the first test we ran – it was a main stage test – I was watching it, in fact Marsh and I were both watching it with binoculars. And as it transitioned from ignition into full thrust, we thought we saw the engine move. And it wasn't supposed to, it was locked in position. This was before we were doing anything like gimballing, and couldn't believe it. But it finally we ran about 60 seconds, and it was fine. So afterwards we went up, and we took a look at it, and the two struts that lock the engine into position, one of them was sheared through. The thrust chamber had moved out to the side, smashed in the side of the thrust chamber against the work platform, and then went back straight, and somehow stayed there without flailing around. And that's when we said they had to design quickly, a bracket that bolted onto the bottom, and then mounted to the test stand, to lock the engine in position, and resist this tendency to move. So that was a problem solved.

We also had problems with the LOX (liquid oxygen) pumps. Early on the spinning impeller would sometimes rub against the housing. That metal against metal rubbing created lots of heat and a very hot fire. That problem was solved by adding a Kel-F (non-metal) liner to the housing.

Then we had problem, where I thought - again we were watching a test - we thought we saw a flash. And indeed we had seen a flash, but we went up and we couldn't see anything wrong with the engine, it looked fine. Until somebody was looking over in one corner of the engine deck, we call it, where you walk around the engine. And over by one of the test stand posts, sitting there on the deck, was the inducer. It's a circular part that essentially - it pulls in the fluid to the opening of the pump, the inlet, before it's spun up to speed. And I couldn't figure out, how did it get out of the pump, and over on the deck? So finally we looked at the pump very closely, with magnifying glasses, and we found a hairline crack all around the inlet of the oxidizer pump. And when you looked at the high-speed movies, and slowed them down to slow motion. It turns out that there was a rubbing inside the pump, which caused a detonation. The explosion inside the pump just forced it apart – blew it apart, so smoothly that it had opened up the inducer, unscrewed itself, jumped out, and then the pump went back together again, and you couldn't tell it opened [laughter]. And people had to look at the movie before they would believe what happened. After looking at the hardware they didn't. So again, there had to be some design changes made to the impeller so it didn't rub on the metal again, and there was no more explosions inside.

So anyway, that went on, and then it was pretty straightforward after that. We got the S-4 engine going, and the old S-3 engine that they'd broke off to the side program, they also used that to make the booster engines from. Put two of those separate, the sustainer mounts in the middle between the two, and there's a single set of turbo pumps, and one gas generator, that drives the pumps on both of the booster pumps. Well anyways, again that S-3 engine became the booster engines while we were working on the S-4, and the next test stand next to us, they developed the booster engines. And that gas generator was over temping; it was having trouble keeping the temperature down, where it would burn a hole out, to burn right through the ducting. And Arnie [Barrett] was the test engineer in charge, and Ed Carter was the development engineer. And they were just getting frustrated by these burnouts. So the instrumentation people came with an automatic cutoff that's supposed to detect the temperature rise quickly, and shut it down before it could do any damage. Well, if it was working at all, it was shutting down false indications. It wasn't – you'd try to run a test, and everything would be fine, but it would be cutoff and it was a wasted test. And after about a dozen of those, I remember Ed Carter came up to the test stand, opened up the big junction box, a big box where all the wiring were, and he said, "Where's the overtemp device?" And they pointed it out to him, he reached in, he grabbed all of the wires, and ripped them out with his hand, and threw them in the flame bucket [laughter]. Okay, there'll be no more automatic cutoffs. Anyway, by then we had – his people had figured a pretty reliable way of getting a temp start without getting too hot. And so we never had any more problems with that after Ed pulled out the wires.

(End of interview)