NASA GLENN HISTORY OFFICE
ORAL HISTORY TRANSCRIPT

BILL GOETTE
Interview by Virginia Dawson
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My name is Bill Goette. I went to school at Purdue and graduated in 1956. Prior to that time, though, I was looking for a summer job in ’55 and John Sloop interviewed me at Purdue and invited me to come to work at Lewis. So I worked in the summer of ’55 as an engineer’s aide and the lab made me an offer, so I came back once I graduated in ’56. So I really started in ’55 at the old rocket lab.

In ’56 I did a variety of tasks, kind of a mix if you will at that time of operations and research work. One of my jobs was having hardware built that would be tested in cell 22. Another part of it was analyzing data from rocket thrust chamber testing. At that time as you’ve heard earlier we were doing test work, different propellant combinations and different injector designs trying to optimize the performance with a particular propellant combination.

I don't recall too much about the early days of Cell 22. Most of the work that I did was involved [with] JP-4[1], gasoline type fuels. It had a bigger thrust, it would take a bigger thrust level, a 5,000 pounds thrust chamber. It had a scrubber, originally some fluorine work was done in there. And a lot of the work, the results from that led to the design of South 40.

Part of the some of the testing done at Cell 22 [in ERB] was a precursor to the work for South 40, the idea of using the scrubber to take fluorine or fluorine compounds out of the exhaust gas, that was done first at cell 22, to show the feasibility and make sure that it would work. One of the things we also learned about the scrubber in Cell 22 was that inadvertently a lot of additional fuel got into the scrubber, and there was a detonation in the scrubber that broke a number of windows in the building across the street. So we learned after that that we had to inert the scrubber before a test firing. And so what happened was before the engine was run, we’d flood the scrubber with CO2 so that in the event fuel was inside, there was no oxygen to cause a detonation. That technique was followed in South 40 then as well.

I started working in the old rocket lab, as I said, between ’55 and ’56, probably in South 40 around ’57, and that lasted up until about 1960, or ’61. In ’61, I was transferred over to PSL. Propulsion System Lab, we were going to test some unusual nozzles. And we were also doing some testing on the earlier version of the RL-10 engine. In

[1] JP-4: Jet Petroleum 4. A type of jet fuel.

1962, I got transferred to the Centaur project when it first came here, because of my previous knowledge of the RL-10 engine.

I was within the first group of people that were given the job of managing the Centaur project, that, of course, was built by Convair [correction: General Dynamics], I believe, in San Diego at the time. The engines were built by Pratt & Whitney in Florida. And I was a member of their first, for the project office that managed the development of the Centaur. I was there from ’62 to ’76.

I was not working with RETF at that time. The project management job was more than a full-time job for a long time.

I did not go to RETF after that. I might have walked in there out of some, for nostalgia purposes or something, or to talk to some old friends. But I had no dealings with it after that point in time.

It is a strange set of coincidences. I had some experience with liquid hydrogen, gaseous and liquid hydrogen in South 40. In 1961, the Centaur engine had some development problems, and NASA Headquarters, I guess, had asked, NASA Marshall was running the RL-10 program, but they asked for some help. They wanted some people that had some experience, to go down to Florida and participate and help the NASA office down there monitor the activities that Pratt & Whitney was doing. So I spent about 3-1/2 months down there in summer of ’61. And I learned a lot about the RL-10 engine at that time by being in Florida. In ’62 when the Centaur project came here, my experience was, I guess the reason why they called me to be on the Centaur project.

I’ll make a couple remarks about liquid hydrogen because I think liquid hydrogen is a very interesting fuel. As you heard before, it’s probably the best rocket propellant, rocket fuel to be used. However, it is extremely cold, and when we first started using hydrogen, especially liquid hydrogen, we did not know all of the properties of the materials we would use. I remember one, we had some experience at the lab. We built some regeneratively cooled nozzles. I believe it was a material with Seventeen-Four-PH stainless steel. It was an extremely strong material. But we didn’t realize at the time it was extremely brittle. And when you start liquid hydrogen flowing through a piece of metal, it will cool very rapidly; when that happened because this material had no, it was so brittle, it just fractured. And many of the problems that people had with hydrogen in the earlier days was just because of that. They didn’t understand the properties, the materials at those very cold temperatures.

We did a lot of work in materials, but, I don't know how to say it, we didn’t check all the materials that were used, and people didn't really realize at the time how important certain properties were. We found in the Centaur program that nylon is a bad material. We lost a hydraulic pump coupling, lost a flight vehicle in the early test stage just because it had no impact strength either. Any kind of a shock would cause it to shatter. Earlier, we’ve been talking about fluorine in South 40, and we learned how to use it, but we also found that it is a very difficult propellant to use, and that’s why it, that's one of the reasons it went away. As an example, we used to start hydrogen oxygen is not hyperbolic. What that means is you bring the two propellants together, and they do not ignite. Hydrogen fluorine is. So there's no problem starting that. But with a hydrogen oxygen engine, you have to start it with an external source. So we were using propane torches underneath the nozzle in the engine. However, they didn’t always start when we wanted them to. So we, I’m not sure who was responsible, but we developed a system where you inject a little bit of gaseous fluorine into the combustion chamber. That immediately caused a reaction, the propellants lit, and there was a very smooth light and no problems. However, we had this, built this tank to store gaseous fluorine near South 40. It had been in operation for six months. And the bottom fell off one day. What happens is fluorine will attack most anything, and we had good techniques. We had to x-ray welds. We had to use the right materials, x-ray the welds, make sure they were spotlessly clean before the system went into operation. Then we put in a little bit of fluorine gas to what we call pickling the material. It would form an oxide coating to protect it, but it wasn’t always perfect, and as we found out, this system had been in operation for six months, and then it failed. So, that was another reason why fluorine never went far there as a rocket propellant. It was just too difficult to handle reliably.

There were some additional problems with hydrogen that we didn’t realize. One of them, and maybe I’m picking on somebody the wrong way, but the original South 40 test cell was built, the walls were built with a material called transite, and they’re not quite sure exactly why it was selected. But it looked to be good at the time. The only trouble was with hydrogen as you’re heard from Gene Krawczonek, is a very light material. It disperses very quickly. We had a leak one day, and hydrogen leaked into the test cell, and something set it off. And it blew the transite walls off the test cell. We had a couple of experiences like that, and finally put roll doors on the test cell. So when we would run a test, we’d open the roll doors, and that way that then the test facility was open to the outside air, and if hydrogen leaked, we would not have another problem.

We had some other, maybe, it was amusing to us, a couple times, but when we had this big liquid hydrogen tank sitting down in there, we would pressurize it with gaseous hydrogen, and once you’re through running, you have to take the pressure gas off the surface of the liquid hydrogen, so we could vent it out. We found that in venting the hydrogen, we could often create large 20 foot in diameter fireballs. Again, static electricity, I guess, is the best excuse. This hydrogen is expanding up this vent stack right into the air, the static electricity would set it off, and you would hear a big boom, and see this big flash of fire. But those were things we modified the vent system to bleed more slowly and the problem went away. But there were a lot of things we learned in those early days in dealing with that propellant.

If there was literature, we weren’t aware of it. It’s common knowledge that static electricity would set off this gaseous hydrogen, but again, what caused the static electricity. We certainly were not aware of it.

I was unaware of literature [to go back to try to find out about liquid hydrogen]. Some other people might have been. I know, I could say too in the Centaur program, we had, at least two or three times in the early 60s when we went through a detailed review of all the materials used in every part of the Centaur that was exposed to cold temperatures, and found materials that really weren't suitable for it. So, it was quite a long process, and I'd say by the end of the 60s I think people knew how to handle it and knew what materials they could use. But up until then, it was, people would have a problem, and then study it and find out what the problem was. It was just incompatibility to the propellant.

I believe that my early experience in the use of hydrogen at the South 40 combined with my spending time learning about the RL-10 at Pratt & Whitney in '61 was certainly very well, was the reason why I was appointed to the Centaur project, and why I was able to work well in that field due to the previous experience at both places.