ORAL HISTORY: Guilfred “Guil” Vogt

About Guilfred "Guil" Vogt

Guilfred "Guil" Vogt was born and raised in Baltimore, Maryland. Expressing an early interest in planes, radios, and radars, he attended Baltimore Polytechnic Institute. Following his graduation in 1950, he began to study electrical engineering at the Johns Hopkins University. While he was a student, Vogt had summer jobs at the Bendix Radio Division and Westinghouse. After earning his bachelor's degree, he started working full-time at the Bendix Radio Division in 1955. Although the division experienced a series of mergers, sales, and changes in the next decades, Vogt remained there for the duration of his career. He worked on several projects over the years, focusing mainly on military radar systems. As part of his duties he traveled frequently, counting Greenland, Italy, France, Germany, and England among his favorite work destinations. Since his retirement in 1993, Vogt has become an active member of the Bendix Radio Foundation, which works to document the history of the Bendix Radio Division.

In this interview, Vogt discusses his 38 year-long career. He proceeds chronologically, commenting on each of the projects on which he worked, including the T47 battlefield radar, the nuclear cloud radar, and the Patriot fuse transmitter. Vogt elaborates further on those he felt were the most interesting, namely the FPS-30, the aim of which was to extend the Distant Early Warning Line across Greenland, and the Mark 15 system, the aim of which was to develop an enhanced NATO interoperable communications system. He also reminisces about the Bendix Radio Division, which was acquired first by the Allied Corporation during his employment and then by Raytheon after his retirement. Finally, Vogt describes his engineering-related experiences prior to his career and after his retirement.

About the Interview

GUILFRED "GUIL" VOGT: An Interview Conducted by Frederik Nebeker, IEEE History Center, 14 October 2010

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Interview

INTERVIEW: Guilfred "Guil" Vogt
INTERVIEWER: Frederik Nebeker
DATE: 14 October 2010
PLACE: National Electronics Museum, Baltimore, Maryland

Growing up in Baltimore

Nebeker:

It's the 14th of October, 2010. I'm at the National Electronics Museum talking with Guil Vogt. This is Frederik Nebeker. Could we start with where and when you were born?

Vogt:

Yes. I was born in Baltimore in 1932, in fact, and raised here in the state. Let me correct, my last name is pronounced vote, as in the election.

Nebeker:

Vote.

Vogt:

I don't mean to do that on this but let's get that straight at the beginning.

Nebeker:

[laughter] So you're born and raised in Baltimore?

Vogt:

Exactly. Yes.

Nebeker:

What was your father's employment?

Vogt:

Employment? My father was actually probably a farmer, and perhaps a treasurer in a building and loan association. The farmers used to have a little co-op of some sort where they would loan out their money. So I don't know. He was retired. I came along very late in his life. He was a mechanic, a farmer, and had a little bit of financial background.

Nebeker:

Working on the loan business in Baltimore?

Vogt:

In the building and loan, the farmers would loan out their money to prospective home owners who would like to borrow money to build a house.

Nebeker:

And that was in Baltimore?

Vogt:

Yes, it was.

Nebeker:

How did you like growing up in Baltimore?

Vogt:

Oh, I didn't know any different.

Nebeker:

[laughter]

Vogt:

But it was great. No, my uncle and my grandfather each had a farm. I had a good time. My family had a group of homes together because my grandfather had the farm originally. All my aunts and uncles lived nearby. I had a dozen cousins; each one did some pretty decent things in this world.

Nebeker:

A farm in Baltimore? In the city limits?

Vogt:

Actually Baltimore city limits used to stop at North Avenue, which is like 20th Street, and the farm was further out from there. They had eight acres, I think it was. Then when Baltimore city expanded in the early 1900s, it encompassed this farm. It existed until about 1950, not as a farm but as a piece of property. It was sold off.

Introduction to Planes, Radios, and Radars

Nebeker:

Were you interested in science and technology as a kid?

Vogt:

All kinds of things. I had two cousins that had an airplane or two throughout my youth and then they would land it on the field nearby and take it off from there. A Piper J3 and an Aeronca something or other.

Nebeker:

Do those run on alcohol?

Vogt:

No. These were two passenger airplanes.

Nebeker:

Oh, a real airplane!

Vogt:

Yes a real airplane.

Nebeker:

You're not talking about one of these models.

Vogt:

Yeah, we also did model airplanes with engines.

Nebeker:

[interposing] Oh my goodness. You're playing with real airplanes.

Vogt:

They were, I wasn't. But they would bring them home sometimes on a tractor trailer and fix them up. And the farmer next door would make sure the grass was cut and they had enough runway to get off the ground. Just the wee little ones. It was fun in the 1940s, 50s.

Nebeker:

So you had a lot of hands-on experience with these things.

Vogt:

They were kind of instrumental in wherever I landed because I got radio kits from them and model airplane kits. Anyway. [laughter]

Nebeker:

So you got into radio as a youngster?

Vogt:

A bit. You start with a crystal radio. I guess it was one vacuum tube radio for a while that you could build into a bunch of things. So that's where I got started.

Nebeker:

You can probably remember World War II.

Vogt:

Actually, I just escaped it in a sense. I was the youngest of all these cousins and they were all, every one of them, all the men were in World War II. One of them came home and said, you ought to look into radar. He was a radar operator in the Air Force serving on a ship.

Nebeker:

In the Air Force on a ship?

Vogt:

Serving on I think a merchant ship as a radar operator and it got him across the Atlantic and back several times.

Vogt:

So anyway, that's how I got my start into radar.

Education

Nebeker:

I see. Is Baltimore Polytechnic a special high school?

Vogt:

It's a pretty good school.

Nebeker:

So it's difficult to get in?

Vogt:

It's one of the two leading schools in Baltimore. It's not difficult; you do have to have decent grades. But it had higher standards than other high schools, to my knowledge. I think it had a higher passing grade. I wasn't in the most advanced course but if you were you could skip a year of college. It's still pretty good. I don't know whether you have any familiarity with it, if you're not local.

Nebeker:

Was it oriented toward, as its name suggests, technology, technical fields?

Vogt:

Absolutely. Quite a few people ended up at Bendix, where I worked. The technicians probably stopped after high school. They could get a job because it had machine shops, wood shops, electrical shops, foundries, forges, drawing.

Nebeker:

I see.

Vogt:

It was a pretty good school.

Nebeker:

Sounds like a good place to go. And then, you graduated in 1950?

Vogt:

Yes.

Nebeker:

I see. And then went to Hopkins? That's very nice.

Vogt:

Johns Hopkins, yes. Would you believe Johns Hopkins tuition in 1950 was all of 600 dollars. Last time I checked it was 30 some thousand.

Nebeker:

[laughter] You got in at the right time.

Vogt:

There's more to be said about that. I was born at the height of the depression, so there were always plenty of job opportunities because there weren't too many people born at that time. Think about that. Everything opened up. It was marvelous.

Nebeker:

The postwar economic boom of the 50s anyways.

Vogt:

Yes.

Nebeker:

So um, did you major in EE?

Vogt:

I did, under a couple of interesting people there. Dean Kouwenhoven always comes to mind. Dean Kouwenhoven was instrumental in the development of the defibrillator. In fact, we could get him off the subject and talk about defibrillators when we were supposed to be learning about I don't know what. Because we got him off the subject. He was very good.

Nebeker:

So you knew when you started at Hopkins that you wanted to do EE?

Vogt:

I did. And furthermore I was lucky enough I had summer jobs waiting at Bendix radio.

Nebeker:

Yes, I saw that you had started in at Bendix even before graduation.

Vogt:

Every summer. When I graduated from Hopkins, I was offered a scholarship courtesy of a good company called Westinghouse and a summer job to go with it. So the summer of 1954 I did my summer work down here at the Air Arm division.

Nebeker:

You had graduated?

Vogt:

I had graduated.

Nebeker:

At the beginning of that summer.

Vogt:

And spent a year doing some graduate work. But by that time, it was time to get to work. I did not continue to get a master's degree. I was ready to go to work when I graduated with a bachelor's. I got married that summer; it was time to get on with life.

Nebeker:

I see. Did you think about continuing with Westinghouse?

Vogt:

Not really. I really knew quite a few people at Bendix from my summer work there through 1953.

Nebeker:

You had worked there part-time or summers.

Vogt:

Yes. Our group of people, radar people, at Bendix installed the ASR-3 airport surveillance radar right across the street at BWI. We were all over that tower and in that building. I liked that. It was the summer of 1953.

Nebeker:

Okay. So you knew you wanted to do radar work.

Vogt:

I went to work with that same group I'd worked with that summer. It was very interesting. This was the same group of people that designed the first X-band aircraft weather radar, the RDR-1, which provides commercial aircraft with storm visibility and improved safety. All commercial aircraft today fly with such a radar.

Nebeker:

And that was-

Vogt:

[interposing] Yes we're up to about 1955.

The T47 Battlefield Radar

Nebeker:

In 1955, you started full-time working. You list here the T47 battlefield radar.

Vogt:

Yes, we can talk a little about that. It was a development model for Frankfurt Arsenal, three jeep transportable units for the Army to do some field testing. . At any rate, it wasn't all that useful to the Army. I don't know whether you're familiar with K-band.?

Nebeker:

Yeah.

Vogt:

It was a K-band 24 gigahertz radar and it was hoped you could see battlefield artillery and it did.

Nebeker:

Track shells?

Vogt:

It did not. It had a small antenna that was co-located and tracked with a pair of binoculars, I forgot the terminology. But you could use the binoculars to see what the radar beam was illuminating. You were looking through some high powered binoculars to determine what it was. It was pretty good but it was very awkward to haul this thing around on the battlefield.

It needed to be made smaller; it was the first generation employing vacuum tubes. Now to my knowledge it was never used beyond evaluation testing.

Nebeker:

What was your role, initially?

Vogt:

In that? When I came on board, the design was well in progress. I got a little bit of transmitter design experience there. The transmitter pulse was unusually short and I needed to redesign the pulse forming network for it since the first design produced incorrect pulse duration. Then I got to carry it through acceptance test and sell it off to the customer, which was a nice experience. I could get along with a lot of people; I think they picked me to do that.

Nebeker:

You liked that part of the business?

Vogt:

It was good,.. It was fun...

Working on Gap-filler Radars

Nebeker:

And then I see a couple of gap-filler radars you worked on.

Vogt:

Yeah. These were Air Force radars located I don't where all around this country, within this country, they were located between the long range radars to handle the coverage dropout for low altitude aircraft in between. The FPS-14 was a magnetron system and the FPS-18 was a klystron system. About my only activities on these radars was designing some built-in test devices to monitor wave forms for maintenance purposes. The design of the equipment was complete. So my first equipment design experience would have been on the FPN-34 in some receiver areas.

Nebeker:

Okay. So these are all Bendix projects?

Vogt:

Every one of these was a Bendix project. When you see an FPS or FPN nomenclature radar it was usually for the Air Force. The TPN-12 that you see on the equipment list, I do not know who procured it and there's no one left to help me remember. Mostly by that time I was doing receiver design work.

Nebeker:

Oh, is that what you moved toward?

Vogt:

Receivers, transmitters, RF design, basically.

Nebeker:

Okay. Were these good years for Bendix radio?

Vogt:

I think so. If I recall wasn't '57 a depression year of sorts? There were some struggles to get through that year without laying off people. But yes, they were good.

Nebeker:

The 50s generally were strong, economically? And also for I think defense spending it was-

Vogt:

[interposing] Yes, I think the government was spending at a pretty good rate throughout the years after WWII. Its my understanding that when the Air Force was separated from the Army after WWII, it had little or no radars and had to procure enough for their needs. There was concern about the Cold War perhaps by that time, I think. We had been through Korea I guess.

Working on Navigation Radars

Nebeker:

Yes. So tell me about these navigation radars that you then worked on.

Vogt:

Okay. The FPN-34 was also just a few units. I think two or three were designed and built. I think probably for the Air Force, judging by the nomenclature. And then later on, the FAA became interested in it.

Nebeker:

So these are ground based?

Vogt:

These are ground based search radars. The 14 and 18 were shorter range, much like an airport surveillance radar.

Nebeker:

I see.

Vogt:

The FPN-34 was meant to be a 200 mile range radar I believe. I have trouble remembering exactly what the plans for it were but I do remember that one of the models went to the FAA at its facility near Atlantic City... And we went down there to get it working. It had been shipped for a good while. And then to put in some modifications that were discussed with the FAA. But it's too long ago. [laughter]

Nebeker:

How did you like the work on these systems?

Vogt:

Oh I enjoyed it, I really did.

Nebeker:

So you were doing receiver design, transmitter design?

Vogt:

Up to this point it was receiver design, yes primarily. I got to use some of things I learned at Hopkins. Designing, it was kind of neat. It was. Life was good.

Nebeker:

How large were the groups you were working with, typically?

Vogt:

Usually 20 people assigned to a group. In other words, it was a project oriented organization in a radar department which may have more than one ongoing effort.

Nebeker:

Yes. Sure.

The FPS-30 in Greenland

Vogt:

Yes. I'm ready or anxious to talk about the FPS-30. The FPS-30 was very interesting.

Nebeker:

It was a very special one?

Vogt:

Yes, it was. It was the extension of the DEW line across Greenland. The Distant Early Warning Line had already been brought across Canada, right about at the Arctic Circle.

Nebeker:

But it stopped there?

Vogt:

The FPS-30 was four radars. Right. They hadn't gone to Greenland to extend it. So they bought a new radar for the eastern end, it was four radars across Greenland. And I got to Greenland a couple times. Once in August and once in February for a month.

Nebeker:

Are these going on the north of Greenland?

Vogt:

I'm sorry?

Nebeker:

Up on the north coast of Greenland?

Vogt:

It's approximately following the Arctic Circle, across Greenland. One radar was near each coast and two were on the ice cap. It wasn't as far north as Thule. You really had some interesting people up there in Greenland. If they signed on for a year and a half they could do their payroll and banking overseas and avoid income taxes.

Nebeker:

So the people were there for a good while. Maybe some of them shouldn't have been there that long. [laughter] I can't even repeat some of the language that I ever heard from about, they didn't like this place.

Nebeker:

So those radars were different, I take from the other two radars?

Vogt:

Indeed. The FPS-30 was a 200 mile radar. It was the first radar we ever worked on that had a phase coded pulse compression system. It had an incredibly long transmitted pulse of 50 some microseconds.

Nebeker:

Is it easy to explain to the layman why that's valuable?

Vogt:

Yeah, that's difficult.

Nebeker:

Okay.

Vogt:

Let me just put it this way. They put out a very long pulse for very high power and then because a very long pulse confuses all overlap targets, you put in pulse compression so you can separate the targets. It was the first time I'd ever worked with a pulse compression radar. It was kind of neat. I did the moving target indicating system, which is a comparator that says was I here the last time the interrogation radar pulse went out. Did it move any in phase? If the transmission reflection came back and the phase was different, it was assumed to be a moving target.

Nebeker:

And how would that show up?

Vogt:

Fixed ones could be canceled and only moving targets would be reported.

Nebeker:

I see.

Vogt:

So it was a good job. It had a problem, which we didn't know about. The receiver design, in order to pass this real long pulse had a very narrow bandwidth receiver and the bandwidth-determining device was a crystal filter and the crystal filter echoed. Now when we tested it in the U.S. you couldn't tell there were any echoes because it picked up a lot of targets. But in Greenland there was one target per day. It was the Scandinavian Airlines plane that came by.

Nebeker:

[laughter]

Vogt:

Here right behind it was another one. Oh, that's that dumb filter ringing, so we had to change that. That's what we went up to discover and then managed to redesign the receiver and fix it and took it up in February.

Nebeker:

So this was a longer project?

Vogt:

These were one month trips. It went on for quite a few years. It was already shipped and about to be accepted when some of the problems were observed. It was a hasty program to make it function correctly.

Nebeker:

Yes.

Vogt:

So that was one of the high points because the site commander, when we put the fix in, gave us a nice compliment about having done a good job. That's another reason I remember Greenland. It's nice when the customer tells you you've done a good job. It had a unique circuit in it if we want to talk a little bit about it.

Nebeker:

Please.

Vogt:

The radar often observed the sun on the horizon because in Greenland over months at a time the sun hardly comes above the horizon. The radar had an automatic alarm system in it because operators could fall asleep because of lack of activity. So the alarm was to go off if a target would come. Well the alarm wanted to go off every time it swept by the sun's noise. So we had some circuits in there that would take the threshold and ride the sun's noise up and down so that it didn't false alarm on the sun's noise. Now how do you test that? [laughter] You get to test it in the morning and in the evening down here at this latitude and longitude. So anyway.

Nebeker:

I see. That's very clever.

Vogt:

It did work, so that was nice.

Nebeker:

Did that radar itself or some of its techniques get adopted elsewhere?

Vogt:

To the extent that it was like the beginning of pulse compression. Later on, I'm sure, radars when they wanted to do a similar thing might have used any kind of random code and some kind of system to put it all back together or shorten it or whatever. But yes, that was the first one that did that. And I guess I could say it had a couple of interesting situations. It was pretty powerful and it would get second and third time around echoes. What does that mean? Well it means that if it had two hundred mile range and a plane flew by at three hundred miles the radar might think it was actually at a hundred miles because it had the power to see that far.

Nebeker:

I see. It could pick that up.

Vogt:

And while you would think the radar beam would escape the earth's atmosphere, it turns out that those low frequencies that it operated at, it would duct.

Nebeker:

I see.

Vogt:

So then these-

Nebeker:

[interposing] So you could see it over the horizon?

Vogt:

Yes. I had learned to live with these added inputs that occurred from targets way beyond its planned maximum range. It was the first time I'd run into a radar that was that capable. I think they managed to live with it. It was obvious what was going on.

Nebeker:

That suggests-

Vogt:

[interposing] Turning the power down too.

Nebeker:

Well, that or regarding this as a longer range radar-

Vogt:

[interposing] Yes.

Nebeker:

And taking advantage of that channeling. That sounds like an exciting project.

Vogt:

It's the first time I encountered a couple things. It had a high power klystron. It operated I think at 60 thousand volts. The klystron was maybe ten foot in length. And the power supply for it was done with solid-state diodes all under oil. And when you turned the power on and you happened to be looking at the top of the oil, there was a hill in the oil and I've often told people about this. It turns out that diode array that was rectifying the voltage was perhaps an electrostatic pump that caused the oil to circulate and therefore there was a little hill on the surface of the oil.

Nebeker:

Oh. My goodness, you get that flow.

Vogt:

You could only see it if you looked at the reflection but that's what was going on. A lot of things happened with that radar.

Nebeker:

So you built an electrostatic pump.

Vogt:

Who knew? [laughter] Who knew? To say nothing of getting to go to Greenland. That was a nice part of the job. My wife might not agree, we had three children and one was born between the two visits. The phone system across the DEW line was excellent but when you tried to phone south, we would shout into the phone to try to talk to one another. I wish I could say she was as happy about it as I was.

Nebeker:

How long were you out there at a time?

Vogt:

A month each trip. It was first lengthy amount of traveling I really did for Bendix. We got a lot of traveling in for Bendix.

Working on Long-Range Radars

Nebeker:

What about these long-range radars, the FPS-65 and 66?

Vogt:

Most people would know them. Bendix designed the FPS-3 in the late 1940s. The 3 became the FPS-20 with the modifications to upgrade it with a klystron transmitter and then a lot of FPS-20s were produced. They did not go in the DEW Line, they went in a line called the Pine Tree Line I think and they were located throughout the country. And then the FPS-20 had a modification, the FPS-20A. I just looked this up today, with a GPA-102 or 3 added to the FPS-20 and FPS-20A it ends up four radars, FPS-64, 65, 66, and 67. And these were 200 mile radars. They were Air Force radars used by the Air Force and the FAA at some joint use sites…

Vogt:

They input the SAGE system. I don't what the acronym stands for anymore.

Nebeker:

Semi-automatic ground environment.

Vogt:

That's what I was thinking about coming down here but I didn't want to just say that. Good, you're excellent. The 64 and 65 and whatever had to deal with an input computer that had a limited capability in terms of the number of targets. So where as a radar might see many targets, this radar could see birds. You could see a lot of things. You could overload the computer. And so the modification kit that went on the FPS-20, which could see so many things had to have in it a thresholding device called a CFAR device, a constant false alarm rate to limit the inputs to the SAGE system to realistic targets. And it went around the world, this set. Some went to Australia. I got to go to Australia for a month.

Nebeker:

Oh, that's a nice assignment.

Vogt:

Fortunately all my children were born by then. [laughter] That was also very interesting. That was a neat job too.

Nebeker:

Was Bendix selling a lot outside the U.S.?

Vogt:

Yes, as far as around the world. I didn't work on them, but some went to Argentina, a later version of this. I know some went to India and Thailand, I think it was one of these radars. I think some went to England. I don't know where else. We were working on this at the time of the Cuban Missile Crisis. And I had to go to a base in Hutchinson, Kansas and I knock on the door to the base and I'm met by an armed guard with a rifle, in Kansas. They really played it safe. Things you remember.

Nebeker:

What was the connection between that and the Cuban Missile Crisis?

Vogt:

This was done at the time of the Cuban Missile Crisis.

Nebeker:

You were just checking or working on some radar there?

Vogt:

This FPS-20 radar, when we were putting in these upgrades to the FPS- 60 series.

Nebeker:

I see.

Vogt:

I had to travel there to verify its operation and do whatever.

Nebeker:

So just security was much tighter.

Vogt:

Security was ridiculous at that time because of the Cuban Missile Crisis. Maybe not ridiculous, I just thought in Kansas it was a little overblown.

Nebeker:

[laughter] Right. Then you've got listed this wide band phased array.

Working on Wide Band Phased Array Radars

Vogt:

Wide band phased array. Bendix also built a couple of radars called ESAR and SPADAT. The SPADAT radar was put in Eglin, Florida. It's operating today, it's been operating continuously for 40 some years.

Nebeker:

Wow.

Vogt:

It inputs the tracking, satellite tracking system in Colorado somewhere. I don’t know anymore where it is. In any case, that is a football field sized phased array radar known as the FPS-85. Ten thousand receivers and several thousand transmitters and whatever.

Nebeker:

Hmm.

Vogt:

And it's been operating as I said, all that time. But it typically doesn't have, as I know, bandwidth problems. In other words, if you have a phased array, to handle a very short pulse, you need a very wide bandwidth. The face of the array typically is not oriented to where you've electronically aimed a beam. So a very short pulse comes back, for example, it comes across the receivers on the right hand side sooner than it comes across the receivers on the left hand side. And so how do you handle this because this has the effect of limiting the rise time of the signals you can get through it. And therefore limits your bandwidth as you steer off boresight. So you could do it with, for example, different time delays in each receiver location to put all the phasing back together. Or maybe some other ways. The wide band phased array program was actually an experimental program that looked into ways to accomplish that. I did not work on the FPS-85 in Florida. But with this program in Baltimore we would generate beams at Bendix on a line array on the roof and aim the beams straight up. And we would fly a B25 with a test transmitter over the plant and look at it in our beam.

Vogt:

And this was sometimes done at night because you put a light on the plane to aid in tracking. This sometimes lit up the people in Baltimore who were concerned about this relatively low flying airplane.

Nebeker:

Or a flying saucer.

Vogt:

Flying from Pimlico to Towson. Right. [laughter] Several aspects of phased array antennas were investigated with this line array literally by flying airplanes through the beams and recording beam patterns. This went on for quite a few phases, if you will. One was the first test array, and then we, "wide banded" it. So there were two sets of these testing episodes.

Nebeker:

So this is fairly early, I would guess in the phased array radar?

Vogt:

Yes. Let's see. I thought we were working that in the early 60s, 1962-65. SPADAT was put in 1965 and 6 in Florida. SPADAT is one name. FPS-85 is a better name, perhaps, for it.

The Nuclear Cloud Radar

Nebeker:

This next one has a very interesting name.

Vogt:

Yes. The next one really is interesting.

Nebeker:

The Nuclear Cloud Radar.

Vogt:

Yes. The LAPQ-1. It was done for Lawrence Radiation Labs, that's where the L came from in there.

Nebeker:

I see.

Vogt:

We built three LAPQ-1s and put them on the noses of B57 Martin Canberras. We used portions of the RDR-1 series of airborne commercial aircraft weather radars, which have log receivers in them to handle the wide range of returns that you get back. We built this radar at the frequencies as requested by Lawrence Radiation Labs. It's not a classified number. It was 35 gigahertz and calibrated the radar log receiver, Lawrence Radiation Labs actually calibrated it to look at the nuclear clouds that existed when China lit off their bombs. And this was near the coast of China, to look at their explosions. This was to gather information on those blasts and about Chinese nuclear activity. That was fun. We didn't get to travel to China.

Nebeker:

[laughter] I imagine that was classified work?

Vogt:

It wasn't so classified as you might think because we weren't privy to how you calibrate it against a nuclear cloud. For us it was pretty much a standard radar. There may have been some classified aspects. So we can start with the commercial system and then I had receivers in it to upgrade to work over a wider temperature range. But the RDR1 was pretty good and it didn't take much at all to make that receiver work over the specified temperature range.

Nebeker:

I see.

Vogt:

Yes, that was nice.

Bendix and the Applications of Radars

Nebeker:

It’s interesting for me to hear about all these different applications of radars.

Vogt:

Isn't it amazing? Bendix was into a lot of it. Our research department, if you ever get to some of those people, had a radar on the front of an automobile to warn you of traffic stopping. This was done out in Southfield, Michigan, I think in the research lab.

Nebeker: And it's finally getting into use.

Vogt:

It's finally getting into use, it wasn't affordable back then.

Nebeker:

Bendix was a half century ahead.

Vogt:

But the idea was really there. Bendix worked in a lot of those areas. There's an interesting story about the LAPQ-1. It took a big cradle in the front of the aircraft to house this radar, which was a mechanically scanning radar with azimuth change gears in the bottom and all this. So here's this rather large radome compared to commercial antenna radomes, on the front. And one time they landed the B57 and the nose wheel didn't come down. So the thing went down the runway on its nose and it ground into the radome, it ground through the azimuth change gears.

Nebeker:

That was an expensive landing.

Vogt:

It did not touch the airplane. The airplane did not get damaged, alright? They fixed the landing gear and they sent the radar to us and said fix it.

Nebeker:

[laughter]

Vogt:

A good friend of mine named George Walter fired up the radar and other than the fact that the azimuth change gears didn't work, the radar worked!

Nebeker:

Oh!

Vogt:

So we went around patting ourselves on the back and fixed it. Yes, that was funny.

Working on IFF Systems

Nebeker:

And then you got into IFF.

Vogt:

Yes, then came an interesting episode in my life. By that time we got to the IFF activity. NRL is the Naval Research Labs; I suppose you're familiar with that. But anyway, the Naval Research Labs had developed a very small transponder. In fact, they wrote some papers about it. It was called the NRL small transponder. It was approximately 6 in. wide and 12 in. tall and maybe 15 in. deep. It was at least half the size of previous Air Force transponders. Of course, there was always a competition between the Navy and the Air Force. Then NRL came to Bendix and wanted us to build their design. I think they wanted a dozen and a half of them. It has a log receiver in it as well. Each of the ones that were built required someone to go in and tweak resister values to make them actually log. I got called in on the job. A good friend of mine actually worked on a redesign of this receiver. He and I worked on a different version of it. It was a video log. It was an RF amplifier with a detector and then a video log. The Navy had specific reasons why they wanted RF amplifiers because they didn't want enemy jammers to be able to jam you on an image frequency. The RF amplifier filters set the receiver bandwidth and reduced vulnerability to jamming. So they wanted a TRF receiver, which made for a difficult log receiver. Anyway, when I say NRL transponder activity, that was making 18 of them work and then came the redesign.

Nebeker:

So then the Bendix redesign of that transponder?

Vogt:

Yes. We produced 12,500 APX-72s with some other people. We were required to set up a leader follower contract.

Nebeker:

What does that mean?

Vogt:

It means we released the drawings to another company and led them through initial production of the same identical unit. The Navy wanted two suppliers to bid against one another, logically, for the next procurement. And that was good. But anyway, that was the APX-72.

Nebeker:

And you worked on that system?

Vogt:

Yes, Charlie Rasch and myself worked on the receiver, which became a log video amp with some integrated circuits and some one percent resistors. And you never had to adjust it.

Nebeker:

Pretty early for integrated circuits.

Vogt:

It was just a little amplifier circuit. Actually it's probably a differential amplifier that you could work with. Yes, it was very early. They were in little round cans, they weren't flat. It was nice.

Nebeker:

I remember seeing some of those. Well that must have been gratifying to have such a successful project.

Vogt:

Well it really was. We'd go down to the production line and we didn't have any trouble with the receiver in testing. Of course, every once in a while, somebody came around and say "why don't you take those one percent resistors out of there." We'd say, no, no, no. You don't want to adjust this thing in production. You don't want to adjust 12 thousand of them. [laughter] So that part worked. But we were busy then. If you look at the next item, it was a diversity APX -72. NRL was off working on this. Let's explain it this way. The IFF antenna usually resided on the bottom of the airplane. So when the airplane flew any landing pattern and banked to make a turn, it shielded the antenna and you lost replies. So you self shielded your own return, even though you were very interested in where you were at that time. This was also true of military maneuvering, that you would shield this antenna. So the Navy and Army and Air Force had a lobing switch that would alternate between top and bottom mounted antennas. Therefore each antenna was only on 50 percent of the time. And never was it right. You cannot feed them in parallel because you will create an RF interference pattern right where you want the best pattern. At least I believe that's the case.

Nebeker:

Oh. Switch back and forth.

Vogt:

So the trick would be to make a diversity transponder. What we are talking about is building a transponder with a receiver for the top antenna and a receiver for the bottom antenna and the circuitry to figure out where the signal came from and to direct the transmitter to reply out that particular antenna. So that's what diversity means in this sense. It's space diversity, if you will. And the military wanted this very badly. I don't think commercial aircraft necessarily have it yet.

They probably have more than one transponder, but anyway, that's what a diversity APX-72 is. And we developed one in the same size box by, again redesigning a smaller receiver into a different system. So we thought we were going to sell a lot these as modifications to it because we only had to change out the RF tray to get a diversity APX-72. These were tri-service devices. Meaning that Army, Navy, and Air Force all used the same unit. At this time we were working with Naval Air Systems and NRL on diversity transponder systems. We would get development contracts to make the whole transponder and crypto unit for it smaller. We also made the crypto unit for the APX-72, a separate box. And eventually we got to the APX-100 which put all of this in one box. Not the crypto yet, that came later. But the APX-100 was a diversity system, pretty much all integrated circuits now. Solid state transmitters, finally. No more vacuum tube transmitters and whatever. I think we made 15 or 20 thousand APX-100s.

Nebeker:

My goodness.

Vogt:

In fact, in a sense it's still being made. The APX-100 started around, what did I figure out?

Nebeker:

You've got 1969-70.

Vogt:

This was proposal activity, IR&D effort, where we would produce a piece of it small enough to fit in this reduced size. We actually made a panel mounted version of it; it fit in no more area than the control panel for the APX-72. So at any rate, this was where the procurement went then to APX-100s. I believe this was around the mid-1970s. Now, I didn't mention this, Bendix existed in Baltimore as Bendix and then Allied Signal. And then our division was sold to Raytheon in Towson on Joppa Road.

Nebeker:

Oh. When did that happen?

Vogt:

Allied bought Bendix around 1983. I retired in 1993 and in 1998 our division was sold to Raytheon. Raytheon continued to build the APX-100. I know quite a few people yet that are still there and they're now up to the APX-114 I believe. I don't know where they've gone. But we need to talk about some of these other activities.

Nebeker:

It's quite an important device if it's had that kind of a lifespan.

Vogt:

Yes. In that time, from 1970 to 2000, we added mode-S, which was a civil mode that produced a data link from the aircraft to the ground. I don't know what it's called right now, is it still called mode-S? I think it is. It had several names. In any case, that was incorporated into the APX-100. Bendix Avionics was building it in their commercial transponders and we put it in this military transponder. To jump ahead a little bit.

That was a Mark12 IFF system. A lot of activity went into improving the Mark IFF system. To finish up the story on the 100, eventually it got military mode-5. It had a military mode-4, which was crypto. Military mode-5 is an enhanced, improved crypto. And so that's why it has existed all this time, because it got these improvements. I said that first the crypto unit was a separate box; well the British wanted the APX-100 and crypto. Today you can put the crypto unit instead of in a box like this, you can put it all in a chip, practically, with a little bit of peripheral. And so now, as a result of the British procurement the crypto circuits have been built into the APX-100. So you have to have the key fill on the 100. It grew all of these things before it became an APX something else. It had a long life span.

Nebeker:

And it didn't require more space as it got more sophisticated?

Vogt:

It never ever required more space. We always thought we were helping out the military if we could get rid of something. We kind of had our comeuppance of a sort with Grumman Aircraft because we went up to New York with the APX-72 and said we can reduce the size of this and get rid of that and reduce all your cabling and save you weight, you know. And we were told, we only have this unit on the airplane because we're required to fly in civil space and they weren't at all interested in changing their F-14 airplane.

Nebeker:

[laughter]

Vogt:

Then we knew where we were in this world. But nevertheless, the 100 did achieve all of that size and weight reduction and was compatible with all future aircraft. I'm sure later planes flew with it. The F16 and 18 fly with 100s. The Mark 12’s IFF system had some problems and if you see here, it's a Mark 12 system test facility. I jumped past a couple of directional antenna system IR&D efforts to get to the system test facilities. I'd like to make a correction to what I said on the list. I don't know whether the BTF3000 ever really existed. The Navy may have indeed bought another BTF2000 like the one designed for Air Force testing… These test facilities looked at all the interfaces between the transponder and its crypto unit and the signal coming back out of the crypto unit that said okay, this is a valid interrogation. And also on the ground, in between the interrogator and its associated components, to see whether you were getting all the hits per beam width you could expect out of this. You could overload the system with say, jamming or whatever. You could find out where in this whole two ended ground and Air Force airborne system, where it was breaking down. And so there was a lot of studying done to see what could or should be done in this area.

Out of this evolved the Mark 15 system, which had phase coded secure transmissions. This does start to get kind of classified, transmissions that changed rapidly with the crypto information; let’s just leave it at that. So the Mark 15 system was to be a NATO interoperable system because by now, if you do this right, you can give even your enemies this system, but you just don't give them the code. And then everybody with the code can communicate that wants to. And anyone without the code can`t. The NATO identification system which became the Mark 15 identification system grew out of the study efforts from the Air Force utilizing the test facilities. This was utilized not to test just the APX-72s and 100s, it was the APX-64s and I think it's an APX-101 on an F15. Lots of these systems were tested to see if there were overload problems.

Nebeker:

What did the test facility consist of?

Vogt:

It actually looked for the desired signal at every interface. For example, was it actually being transmitted to the transponder? Did it come out of the transponder and go into the crypto device? Did the crypto device properly respond to it? We had signal monitors and counters at all of these interfaces so you'd do a signal count at each interface to determine its operation. So at any rate, the Mark 15 system came along, which was another delight to work on because it lasted for years and we got to travel back and forth across the pond to Europe.

Nebeker:

So this is the one that was to be used by NATO?

Vogt:

The Mark 15 was going to be used across the international spectrum of countries that were friends. And we had, I don't know, 250 million or a 500 million dollar contract to do this. We competed in the early 80s against eight companies. They narrowed it down to four companies and we won again. They narrowed it down to two companies and we won again. Every so often it was rebid and the last two companies were Texas

Instruments and Bendix. And we bid on it and I guess it was in the '88 or '89 and won the big enchilada if you will and go into production. We were in partnership with Raytheon. They were officially a subcontractor. But they did some of the integrated circuit work and design for the... I'm sorry, I've lost the name for it. It was a correlator I think. But in any case, the signal processing circuitry.

Nebeker:

Yes.

Vogt:

We were competing with Texas Instruments; we felt the need to develop an integrated circuit facility. We built our own integrated circuits out near Columbia, Maryland. Where Bendix Field Engineering was there was another facility which grew the silicon and did the integrated circuit work. In order to prove our point that we actually could do this and compete with TI, who was heavily in the integrated circuit, Raytheon sent the design down to Bendix via the internet, the artwork, as I understand it, and we produced the chip here and took a, I don't know, board loaded with integrated circuits and put it on a wee little chip so we could prove that it would fit in there. But it any case, it came to a rather sad end around 1990 or '91 because there was a cutback then. Peace had been declared, right? The Cold War was over.

Nebeker:

Berlin Wall was down in '89.

Vogt:

Right. And the Air Force said we're not going to spend money on boxes, we're going to spend it only on airplanes. And the Air Force canceled the contract midway through. We had working models of just about everything. I was responsible for the ground interrogator for the Army; actually that meant I oversaw the Raytheon people who were doing it. This was quite a project then. Hundreds of people were laid off as a result of this. So it came to a bad end.

Nebeker:

That must have been a blow.

Vogt:

It was quite a blow. I think I was down in Florida and somebody phoned me and said, look out, because layoffs are coming. And to this day it's known as the Valentine's Day Massacre because they laid people off on Valentine's Day.

Nebeker:

Oh.

Vogt:

Yeah, really. It was bad. Here and in Boston, Raytheon people. Nobody wanted to carry the work forward. Don't you want to taper down? No, no. Now. Stop. Don't spend, we won't fund you.

Nebeker:

And I imagine you were very proud of the development work?

Vogt:

Yeah, it worked pretty good, we thought. It was going to be expensive, that's one of the reasons why it probably got canceled. Actually I think it would have been canceled independently because it was a box on an airplane, it wasn't the airframe. Any money the Air Force got they wanted to buy airplanes. Navy was upset, the Navy was fighting for it. The NATO people were upset. Out of that came Mark 12 mode-5.

Nebeker:

Before we leave the Mark 15, your role you said was the ground?

Vogt:

Interrogator. This would have been an Army interrogator. It would have worked on battlefield equipment. It was no longer just necessarily an L band system. It had other frequency bands, if you wanted to do identification of tanks and whatever. It required other frequencies for resolution.

Nebeker:

I see. So what happened after the cancellation of 15?

Vogt:

Well, to finish the IFF story, the IFF mode-4 military crypto mode design occurred in the 1950s and 60s and we're dealing with a crypto unit of that era. And then we have computers of the 1990 era. You could crack the codes in use. So mode-5 took a lot of the techniques that we were planning on using in Mark 15 and shrunk it, if you will, into an affordable add-on, and the last APX-100 has mode-5 in it. That handles that situation. It is classified, the techniques and whatever on there, so I won't say anything about that…

Nebeker:

Okay.

Vogt:

It might not be by now, but it was when I retired.

Nebeker:

Okay.

Vogt:

We left out a couple things.

Nebeker:

Yes, please.

Vogt:

I would like to back all the way up to 1970, 1, 2, somewhere in there. If you're on a civilian airplane, or a military plane, and the interrogator asks you who you are, the transponder provides the replies... It says who he is, an ID # and by the way, my altitude is, it'll do all of that. That reply goes out on an omnidirection link because you don't know where the interrogator is. If you could figure out where the interrogator is, you could put a directional beam back to the interrogator and then other people wouldn't hear you, the military liked that. So the object was to get the side lobes down and make a directional reply beam. To do that you had to have the ability to figure out where the signal came from.

Nebeker:

Right.

Vogt:

We had an excellent antenna designer. His name was Wilfried Jaeckle. He designed the antenna that's sitting up on the moon that sent the information back from the first moon walk. He knew how to design a four element receiver array antenna that would give you two outputs from only four elements, an omnidirectional beam, and an omnidirectional antenna beam with spiraling phase. If you compared the two outputs, the spiral phase output and the other output would be in phase at say, angle zero. One degree at a time, as you walk around the antenna, the relative phasing between the two outputs would change by one degree.

Nebeker:

So you have a way of knowing where you are.

Vogt:

So you know exactly where it came from. That part works excellent. The fundamental problem with this, and both the Air Force and the Navy looked into it, is making a reply beam that has very low side lobe levels. The side lobe levels were not low enough to make this thing ever attractive. But nevertheless, it was looked at as a possibility. The Navy I believe wanted quadrants, they were happy to have quadrant reply beams. The Air Force wanted a dozen or so positions with narrow beams. The side lobe levels were never very good. I'm talking maybe 15, 20 db. That's not all that good if you don't want the reply to be overheard...So at any rate, that was the study effort for directional antennas applied to a transponder. The reply remains omnidirectional, which is now more important because of systems such as TCAS which also utilize the IFF system...

Nebeker:

Oh, that's interesting.

Videographer:

I'm sorry, before you move on, can I stop to change the tape?

[End Vogt - Tape 1. Start Vogt - Tape 2.]

Vogt:

Sure. So we're good to go?

Nebeker:

Hold on just a few seconds.

The ATCBI-5 Beacon Interrogator

Vogt:

OK. Timewise we passed a device known as the ATCBI-5 beacon interrogator. ATC is air traffic control, BI is beacon interrogator, and this is the fifth one in the FAA series. We built several hundred of these on a production contract. We built them for the FAA, for airport surveillance radars, one sat over here at BWI, along with an ASR-8 airport surveillance radar. They existed with these mid-country sites, long range sites, FAA en route sites, to do interrogations. This was a large production contract for us. I don't know how many are still being used. I know some still are. It replaced the ATCBI-3s and 4s, it has some interesting aspects.

Nebeker:

Is this the main such device for the FAA?

Vogt:

It was. In the mid-70s we started shipping them and installing them. We had our own installation team. The BI-4 had, they don't talk about a mean time between failures, they talk a mean time between outages, meaning it's a dual channel system with rapid transfer so that you don't lose coverage at an airport or en route, for example. The BI-4 mean time between outages, if I remember the FAA's number, was in the four thousand hour region. The BI-5 was over 22 thousand hours the last time I checked with the FAA.

It means that both channels went down or the antenna went down. Or some common equipment went down. The BI-5 had only four vacuum tubes in it. Those would have been the transmitter. It produced a wide range of power output depending on the site requirements.

Nebeker:

What was your role on that?

Vogt:

I was responsible for the transmitter design. Back to transmitters. We subcontracted, to be quite honest. I learned a few things on it; it had some interesting problems, which I can talk about without feeling like we didn't do our job. These were really unexpected situations. From the FAA's viewpoint, it had to have compatibility with a military mode-4, which required a rather lengthy transmission, and also all the standard civil interrogating modes, A, B, and C. Military 1, 2, 3, and 4. At any rate, it did all of these things and as I said, was more reliable. It was also pretty well integrated. Receivers were probably transistorized with some integrated circuits and all of the processing and whatever was digital. The antenna and transmitter and receiver were located out across the way from the runways and it has line drivers to put the video over to the controls towers. So it has all these elements.

Nebeker:

Yes.

Vogt:

Some memorable stories on that program.: To test that line driver, for example, we had a 12 thousand foot coil of coax and we were sending the video through the coax. Well, video is unipolar. If you disconnect the cable, remember all 12 thousand feet is on a spool, a coil if you think about it. You interrupt the DC current through the coil resulting from the unipolar video. It's all one polarity and a gigantic spark will come across the ground when you disconnect that cable. And who would have thought that with a few volts of video. [laughter] Good that we didn't hurt ourselves. Yes, it was pretty good. I guess the first time we type tested it, it had to go through humidity. I don't even remember the testing chamber, but we didn't have the facilities. We went somewhere down in Virginia I believe for testing facilities and the company had a difficult time making 95 percent humidity. It actually kind of rained and the unit was really totally soaked and it played underwater. We were really happy about that.

Nebeker:

[laughter]

Vogt:

I was really sweating it when we went through the test. Let's see, what else, there was another unique problem that it had. I talked about the transmitter. The system could be operated at any PRF and it was usually slave to the radar but in the testing process it ran off of devices that you could change the interpulse period in one microsecond increments. You could make it whatever PRF repetition you wanted. Well we hit one where all of a sudden, the rock solid output level developed a sine wave on the top. And within a very narrow range of PRF frequency you would see this sine wave. This is a story like the oil pumping. [laughter] Okay? So what's going on here? We had subcontracted from a gentleman down in Florida, a company down there. And he came up and he looked at it, and he was good. He says, I know what's going on. The grid in these transmitters is mechanically vibrating. You've excited it with the PRF on the electron flow through it.

Nebeker:

Oh. So it's hitting the natural frequency.

Vogt:

It's hitting the natural resonant frequency of the grid. And I'm thinking yeah, yeah, yeah. But it turns out he was actually right. [laughter] He says, oh! We can fix that. And I can name the company because they fixed it. It was IMAC out in Salt Lake City, were making the tubes. So he and I went out to IMAC and the engineer out there said he had grids with bars across them that stop that. I was trying to be a wise guy so I said, all you're going to do is double the frequency of oscillation. I don't even know if that's true. He says, oh no. We put it off center. [laughter] He was waiting for it. He was waiting for the comment. We put it off center. Okay. He sold the tube that way thereafter and we never had the problem anymore. Things you find out.

Nebeker:

It's fun to hear about those kinds of things.

Vogt:

It is. You see in the past, you had a little knob where you could adjust the PRF. Well you couldn't have even sat on that number but we were crystal controlled, you could sit on that number because that grid resonance was very sharp. Anyway, that was the BI-5 interrogator.

The Gas Monitor in Ann Arbor

Vogt:

Then there came a time in the early 80s if you want to talk about the gas monitor.

Nebeker:

Sure.

Vogt:

It bears no relationship to radar or IFF or anything. I guess Bendix Aerospace Systems Division in Ann Arbor, Michigan had a contract with I'm not sure who to build a gas monitor. The gas monitor was to be installed at a nuclear power plant that was proposed and being thought about, being built in Michigan somewhere. And in close proximity to the site was a chemical plant. Across the river from this nuclear power plant if I can remember the story was a chemical plant and they were concerned that the chemical plant would have a natural disaster of some sort, wipe out all the nearby people, including those controlling the nuclear plant would then cause an even greater problem. And so the deal was to build a gas monitor. And so here's this monitor with all kind of analysis. What do you call the device?

Nebeker:

Spectrographic?

Vogt:

Yes. Mass.

Nebeker:

Mass spectrometer?

Vogt:

That's not right. At any rate, it could detect all the various expected possible gases.

Nebeker:

I see.

Vogt:

It had to ride the natural detected level, but if it ever spiked up, it was to alarm. Needless to say, the nuclear plant never got built so this device never got built.

Nebeker:

But it was an interesting project?

Vogt:

Along the way, Aerospace System Division was closed by was it, Bendix or Allied Signal at that time? Can't remember when. In any case, that was the last job to be done in Ann Arbor so for six months about a half dozen of us from Towson flew out to Ann Arbor every day. Monday morning I should say and all of us flew back Friday and we worked on the gas monitor out there. I wasn't ever sure whether I believed it would function but one day I got a print out of the print room and opened it up and the ammonia line went up on the display. So then I realized, hey this thing might work. [laughter] It did work.

Nebeker:

But never got produced.

Vogt:

It never got used. But nevertheless, it was kind of an interesting assignment.

Nebeker:

That is interesting

Vogt:

I got to work on a lot of things. I've got one more, one or two more on there.

Nebeker:

Sure.

The Patriot Fuse Transmitter

Vogt:

When the NATO, when the Mark 15 system went down, I temporarily worked on the Patriot fuse transmitter. The Patriot fuse means it's a little radar in the Patriot missile.

Nebeker:

A more sophisticated proximity fuse kind of thing?

Vogt:

Exactly. And when you get near enough to the device you don't have to hit it. But when you're looking at an airplane or a missile it will alarm and the Patriot will go off. We got a report back from Desert Storm about every one that was used, which serial numbers were used. It was an incredible logistics tracking so that you always knew if a trouble developed, how many of them were whatever. Anyway. This was also built and put in the Patriot, which was a Raytheon device. So I mentioned that Raytheon was a partner on the Mark 15 and Raytheon was building the Patriot Missile and used our fuse. I think that's one of the relationships between the two companies, which was pretty good, which is why they bought our particular division. So I get my health insurance from Raytheon and my retirement from Honeywell. Allied Signal acquired Honeywell after I retired…

That's why Patriot's in there. I worked on that for a little while. And then for a little while near the very end was the combat identification system proposal effort. After Desert Storm the Army was interested in an identification system. The Mark 15 system didn't go. So to prevent fratricide they were looking for an identification system. We had to put it on helicopters and send the signals up and down the rotating shaft to a stable platform on top.

Nebeker:

On vehicles?

Vogt:

It was also on ground vehicles, it was on nearly every vehicle. So we got to go all around the country and look for vehicles that were intended to have this and where were we going to put them.

Nebeker:

I see.

Vogt:

So the proposal effort was expected to lead to a huge contract so we worked a lot on the proposal effort. But we didn't win. In fact, actually nobody won. The company that won, they only bought a few experimental units and I don't know what they do now. Actually I think they just keep track of everything in a computer now. Anyway.

Nebeker:

So are we reaching your retirement?

Retirement

Vogt:

Yes. I retired in 1993.

Nebeker:

Do you care to talk about how things have gone since, what you've gotten involved in?

Vogt:

I don't know how I had time to work. I've kept myself busy.

Nebeker:

Too many other things to do!

Vogt:

You've got to keep busy. Words of advice. Keep going. Don't ever stop. Yeah, it was a good 38 years. Mark 15 program was particularly good. I got to take my wife to Europe whenever we went.

Nebeker:

Did you make many trips to Europe for that program?

Vogt:

Yes, we did. Italy and France and Germany and England. Each a different trip, pretty much.

Vogt:

Yes, it was good. Retirement came because it was time. I haven't regretting retiring early. I retired when I was 60, I think. 61. But we still have quite a few people from Bendix that get together as we may have talked about a little earlier off camera.

Nebeker:

Yeah, that's great.

Vogt:

We all reminisce.

Nebeker:

And you've been helping out with the effort at the museum there?

Vogt:

Yes.

Nebeker:

To document Bendix's history.

Vogt:

Yes, indeed. This has gone on for almost ten years. We just put up a new display. In fact, this is the third display we’ve had. We also had one here at the Electronics Museum for a while. That was pretty neat. We used panels from our original display and put it up. We tried to tell the story. 60 years in Baltimore. Bendix came to Baltimore in 1938, sold to Raytheon in '98. We had a pretty good relationship with Raytheon. For example, we were invited into the vault at Towson where we used to work after it was Raytheon's to look at anything left and anything we wanted for the Bendix Radio Foundation was ours as long as it was before a certain date. So we took drawings and whatever.

Nebeker:

That's great you've been working to preserve some of that history.

Vogt:

It is kind of neat to think about it. We have so many stories. It’s not my story but Bendix had a low light level TV camera system. The Navy wanted it for the tops of the nuclear subs so that when they went under the ice cap they could look up and get some indication of what was up there. .And the gentlemen who was head of the installation team and testing and whatever you want to call it, first operator of the unit with the Navy on the shakedown cruise to test it had no idea where he was going. And he went under the ice cap.

Nebeker:

Oh! That's an unusual field assignment!

Vogt:

He's the fellow I mentioned earlier, who we've got four hours of recording of his stories. But he was in the submarine and of course, their destination was unknown to anybody other than when he would be back. And he was back in time. I would not have liked that one. I don't think I like submarines. [laughter]

Nebeker:

Not as much fun as Italy or England.

Vogt:

The ice caps sites were pretty interesting. The FPS-30, that was my speed for adventure.

Nebeker:

Is there anything we haven't covered already that you'd care to?

Vogt:

No I think we pretty well got through here. I hadn't thought about carrying it on any further.

Nebeker:

Well thank you.

Vogt:

Retirement's been fine and I'd like to mention the Bendix Radio Foundation for recording some of this. We have an online website that you can look up a lot of the information that we've put online, drawing information and history information.

Vogt:

I have a little paper in there besides the papers that I wrote while working that addresses remembering the Bendix Air Force.

Nebeker:

Yeah I did read that actually. Very nice story.

Vogt:

Yes, one of the summer jobs, I flew in the airplane and looked up at the ships masts in Baltimore harbor. [laughter]

Nebeker:

That's great. Well thank you very much.

Vogt:

Thank you.