ORAL HISTORY: Charles Denton

About Charles Denton

Charles Denton was born in Grafton, West Virginia in 1928. He majored in engineering with a primary focus in mechanical engineering at West Virginia University, receiving his degree in 1950. After graduating, Denton worked as a design engineer at a Navy shipyard in California before being called to active duty in 1952; first to Fort Belvoir, Virginia and then the Far East Command, serving in Japan and Korea during his two years of service. After leaving the Army, Denton began working at Westinghouse Baltimore. His first assignment was with an engineering group working on defensive systems for Navy aircraft. Over his long career at Westinghouse, Denton worked on many important projects – such as the UK2 satellite, ECM programs, physical countermeasures pod, ALQ-131 and A-10 CFF – and held managerial positions such as engineer supervisor (from 1954 to 1973), program engineering manager, program manager and investment manager for commercial systems. Since retiring from Westinghouse, Denton has become involved in digital photography and auto racing, and remains technologically current through a colloquium at the Applied Physics Lab at Johns Hopkins.

In this interview, Denton discusses his career in the Army, but mostly his years at Westinghouse. He talks about his service as a platoon leader in a combat engineering operation during the Korean War, and his experiences in Japan and Korea. The many projects he was involved with are also covered, including his time as an investment manager for commercial systems, leading to a discussion about Westinghouse's attempts to move from mainly DOD-oriented work to more commercial opportunities. Denton also talks about the importance of 'picking-up' electronics during his career because of the different concepts involved in mechanical engineering. The organization of Westinghouse is also covered, with a switch to a functional group organization which Denton viewed as more efficient, allowing for more flexibility and the best use of the good people Denton worked with throughout his career. Denton also discusses his role as a manager, and the emphasis he placed upon the goal of reliability.

About the Interview

CHARLES DENTON: An Interview Conducted by Frederik Nebeker, IEEE History Center, 12 April 2010

Interview #535 for the National Electronics Museum and IEEE History Center, The Institute of Electrical and Electronic Engineers Inc.

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Interview

Interview: Charles Denton

Interviewer: Frederik Nebeker

Date: 12 April 2010

Location: National Electronics Museum, Baltimore, Maryland

Background and Education

Nebeker: This is Frederik Nebeker of the IEEE History Center. It's Monday, the 12th of April 2010. I'm here at the National Electronics Museum near Baltimore to interview Charles Denton. I wonder if we could start by hearing a little about your background, where and when you were born and a little about your family.

Denton:

Well, I was born in 1928 in Grafton, West Virginia, one of a family of four. We were two boys and two girls in the family. I grew up there, and I was educated in the public schools there in Grafton.

Nebeker:

What did your father do?

Denton:

My dad was primarily in the automobile business. He basically ran a dealership, a Chevrolet/Oldsmobile dealership for a number of years. I spent a lot of time there [as] kind of an apprentice mechanic. I liked working there. It gave me a chance to get my hands dirty, and it really did, much to my mother's chagrin.

Nebeker:

So you were interested in technology from an early age?

Denton:

Very, very early age. It was always kind of interesting and gave me exposure to really see how things worked, how they were built, what it took to fix and maintain them. So it was an interesting opportunity I enjoyed very much.

Nebeker:

What was Grafton like?

Denton:

Grafton basically was an old railroad town. It was a main stop on the B&O Railroad from Baltimore to the west. It was also in a mining area, so there was a lot of industry there,

but it was largely based on railroading. There were other subsidiaries, you know, small businesses and activities and manufacturing facilities that heavily depended on the railroad. When the railroad technology went from steam engine to diesel engine that affected a lot of things. There was a big repair center in Grafton where they did a lot of maintenance work on the steam engines. But with the demise of those and adoption of the diesel engine, why, that need, you know, began to dwindle.

Nebeker:

So you can probably remember something of that transition, which was in the '40s, is that right?

Denton:

Very much so. Basically after World War II. That's when the change over went.

Nebeker:

You grew up in Grafton and stayed there through high school?

Denton:

Yes, through high school. Finished and graduated high school in 1946. Then I enrolled at West Virginia University, which was really only about 30-35 miles away from Grafton, in Morgantown. I started there and graduated in the summer of 1950.

Nebeker:

Were you interested in science as a youngster?

Denton:

Yes. I remember we started basically a science club. I was very interested in chemistry, enjoyed it very much, also general physics.

Nebeker:

Did you have a Gilbert chemistry set?

Denton:

Later on, I did, that was interesting. Physics, for some reason, was more of an attraction for me. Much to my wife's chagrin, I think, because when she was in school and college, I encouraged her to take a course in physics, which she really resented, long after that.

Nebeker:

Thanks a lot.

Denton:

Yes, thanks a lot is about the size of it. Anyhow, my contention was, well, if you understand physics, you have a pretty good understanding of the world around you.

Nebeker:

So when you went to University of West Virginia, what did you major in?

Denton:

Majored in engineering with a primary emphasis in mechanical engineering, which I think may have been kind of a follow-on from the auto interest and work that I had done. I enjoyed it very much.

Nebeker:

What was your intention, as to a career, when you started?

Denton:

Well, I really didn't have a fixed intention, but I thought I would just go through and see what it was like and then, you know, decide as I went along. So I just took a general mechanical engineering course. There was an emphasis on engineering mechanics; it was one branch of that. Another one was the power and the energy side of it. I tried to mix them and blend them together so that I had the opportunity to do both. But I think I ended up having more of an interest in the physics and the structural part of the mechanical design. That seemed to be a bit more interesting, and academically, I think I took more of an interest in that as well.

Nebeker:

Were you happy with the education you got at the university?

Denton:

Yes, I felt that it was good. In retrospect, it was an interesting experience. It was the first time that I was away from home, in college and off on your own. So you tended to take advantage of that liberty a little bit. But the interesting thing was, from my point of view, that this was basically the end of World War II and veterans coming back had the advantage of the GI Bill.

Nebeker:

You must have seen a lot of the GI Bill people there.

Denton:

They were really great. And when I was going in, there was a flood of those. Of course, they were much more mature, many of them. Most of them were married, so they had a different aspect on education. It took me about a year to realize that if I was going to compete with them, I needed to change my ways and focus on the academics.

Nebeker:

That's interesting.

Denton:

I think a good experience that really helped me along the line. So I began to change my attitude.

Nebeker:

I can imagine these veterans were more goal directed.

Denton:

Absolutely. It took me a little while to realize that basically learning was what it's all about.

Nebeker:

Did you go straight through to your degree?

Denton:

Yes.

Naval Shipyard
The university, being a land grant university, had a requirement for two years of military ROTC work. Then [you] had the option of continuing it for another two years, in which case at the time of graduation not only would you get your academic degree, but you'd get a commission in the Army for a commitment to active duty, if called. My dad strongly encouraged me to do that, which I did do. So when I graduated in 1950, I got my academic degree, as well as a commission.

Nebeker:

In the Army?

Denton:

Yes. About the time of graduation was when the North Koreans crossed the 38th Parallel.

Nebeker:

In 1950, wasn't it?

Denton:

Yes. That was in 1950 and so I could see the handwriting on the wall, but anyhow, I waited to see what happened. So I was then able, mainly through my brother, who was a career Navy officer, to come to California and work out there in the Navy shipyard. And that's how I happened to get involved there.

Nebeker:

So at the time, you knew that you could be called to active duty anytime, but in the meantime, you had to get a job?

Denton:

Yes, to get a job, and I really wanted to put some of that education time to work and just kind of go with it.

Nebeker:

Where was that shipyard in California?

Denton:

It was in Vallejo, California, right outside of San Francisco in the bay there. So I went to work there as a design engineer, working basically on submarine control, depth control systems. Interestingly enough, they had a special project that I was asked to get involved with where they were working on the capability to launch a Regulus guided missile from the submarine.

Nebeker:

From a submerged state?

Denton:

No, you had to do it from the surface. And that grew, of course, into the Polaris and the underwater Lodge system.

Nebeker:

That sounds like quite a nice first job.

Denton:

It really was. It was an excellent opportunity, a good experience, and it got me away from home.

Nebeker:

San Francisco was a nice area to be in, and you liked the work you were doing there?

Denton:

Oh, yes, I liked it very much. These were the World War II diesel engine submarines that we were upgrading. With the Russian build-up of their undersea capability, there was a strong emphasis then on development of sonar for tracking.

Nebeker:

This was an internal Navy development, that is, designed and implemented by the Navy?

Denton:

Right. About that time, well, actually while I was there, I came back to West Virginia to get married. My wife and I then returned to California. She enrolled at Cal Berkeley and was attending school there while I was working.

Active Duty in Japan and Korea

But in early '52, I got my call to active duty. I then reported to active duty for two years.

Nebeker:

Please tell me about that period of work.

Denton:

That, again, was an interesting experience. My first assignment in the military, I like to tell people, was to the post office in Baltimore. As a matter of fact, it was interesting, but basically it was a holding pattern, a holding assignment to the Maryland military district. That was a paper shuffling exercise where they basically were handling the logistics of active-duty military, moving people and families, that sort of thing. At that point I got orders to report to Fort Belvoir, Virginia, which is where the engineering center was. My commission was the Corps of Engineers in the Army. That was a three-month assignment, a basic training program for new lieutenants. And it was a preparatory program for going overseas. Ultimately then, I was assigned to what they call the Far East Command.

Nebeker:

In an engineering group?

Denton:

Well, I was an individual then and would be assigned once I got into the Far East. I ended up in Japan, and was assigned as a platoon leader in a combat engineering operation as part of the 24th Infantry Division.

Nebeker:

Where in Japan?

Denton:

First at Camp Matsushima and later at Camp Fuji, pretty much at the base of Mount Fuji. It was really scenic. That was a different experience too, you know, for a young immature lieutenant.

Nebeker:

Was your wife able to go with you?

Denton:

No. I knew at that point in time that I would be going ultimately into Korea. The assignment into the 24th Infantry Division - this was the early division that went from Japan into Korea at the time of the invasion. They were decimated, really. So they were brought back to be restructured in Japan. They were building up the troop level and building up the equipment.

Nebeker:

What were you responsible for?

Denton:

I started out managing a carpool or a transportation center. It was a matter of keeping the vehicles moving, that sort of thing. Ultimately from there then, I moved as a platoon leader.

Nebeker:

Was this a transportation platoon?

Denton:

Well, actually, it was an engineering group, which has the responsibility for engineering work associated with an infantry division, including road building, grading equipment, heavy equipment, transportation, trucks, that sort of thing. So it's a matter of providing the infrastructure for the transportation. Even the areas of mine detection and water supply. So it was just a general utility type of operation.

Nebeker:

I see.

Denton:

It had very broad capability. My responsibility as a platoon leader was basically building up and training the staff and getting them built into an operating unit.

Nebeker:

How long were you in Japan?

Denton:

I guess it was about 9 or 10 months. At that point in time the activity along the 38th parallel was kind of at a standoff. They had truce talks that were going on, but they kept breaking down. My wife and I were watching a history of the Korean War recently, just as a matter of interest. That was the time when [Dwight D.] Eisenhower, who was president then, said, "well, if we can't get these talks through, we're going to go ahead and make a grand push, to get the issue resolved and unify Korea." They began to build up troops in Korea, and we ended traveling north on standby status behind the front lines. But fortunately, at that point in time, a truce was signed.

Nebeker:

That was the final armistice?

Denton:

I wouldn't call it final. It was a cease fire. That's pretty much what it amounted to. So they moved us back into the southern part of Korea, down around Pusan. I spent the rest of my two years of active duty there in Korea.

Nebeker:

I see.

Denton:

Well, it was the first time that I'd been in a different culture. This was post-World War II time. In Japan, there was still a lot of damage, but there was a lot of positive activity going on. I had a chance to go out and interact with the native Japanese, visiting and that sort of thing. It was a very positive experience and a great learning experience for me, learning that there are other cultures or other habits. And beginning to respect and honor those, because that was very important to those people. On the other hand, my military exposure was to a very broad mix of American people. And I can still remember the thing that impressed me was that there were people who couldn't read and write. You know, I'd had very limited exposure, and I'd come to believe everybody was like me. But here, I was thrust into a different mix of people, and it began to make me realize that even with our own culture, there are lots of people, different capabilities, that are good people, want to do the right thing, and you need to encourage them and help them. I can still remember one individual to this day, very strong resemblance to my dad, coming to me with this letter and says, "can you read this to me?"

That made me sensitive then to other people. I think that's been a help to me through the rest of my life in terms of realizing and understanding that there are people with differences, different ideas. Doesn't mean they're wrong. And they should be respected and honored for that.

Nebeker:

Did you see any combat in Korea?

Denton:

Very little. There was some activity going on once we got to the front line, but after about three or four months, you're always on the alert.

Nebeker:

So you completed your two years when you were there in Korea?

Denton:

Yes, I did.

Nebeker:

What was your feeling overall about that time with combat engineering operations?

Denton:

In terms of practical experience, I didn't feel that it added a lot to my engineering background and knowledge, other than basically a little bit of hands-on time.

Nebeker:

I would also imagine you gained some managerial skills.

Denton:

Yes. But in a matter of working with people and understanding people and being able to motivate - that was a great learning experience for me.

Nebeker:

So the deal when you received your commission was that there would be two years of active duty. Would you then stay in reserves?

Denton:

You stayed in reserve for a total of five years. That was the commitment. At the end of five years, you had the option of continuing on in the reserves or being discharged.

Nebeker:

What did you elect to do?

Denton:

I chose to be discharged.

Nebeker:

And you were not called up in the five years of reserve duty?

Denton:

Only the two years and when I fulfilled my commitment I settled into a more conventional lifestyle.

Coming to Westinghouse Baltimore

Nebeker:

When you came out of the Army what work were you able to find?

Denton:

I had contacted the folks at the Mare Island shipyard, and they very much wanted me to come back for an assignment there, and I was leaning heavily towards that. But while I was overseas, my wife continued her education.

Nebeker:

At Berkeley?

Denton:

No, she went back with her parents in western Pennsylvania and went to school there. So we talked about going back to California, and her parents and my parents began to make subtle comments that they wondered whether that was maybe the right thing to, the best thing to do. So as an alternative, I went back to West Virginia University to their placement bureau. Just so happens at that point it was about midterm. They were in the process of industries coming in, interviewing graduates, and so I signed up to interview just through the university, even though I'd already graduated. So [I] interviewed with

several different companies. I actually ended up with, I think, five job offers and chose to accept the one from Westinghouse here in Baltimore.

Nebeker:

Why did you choose that?

Denton:

Well, that's really hard exactly to say. I think probably the main thing that drove that was the individual that did the interview was a former graduate of West Virginia, a distinguished gentleman. In my opinion, a great engineer.

Nebeker:

Do you remember his name?

Denton:

Yes, it was Reuben Lee who was a longtime engineer here at Baltimore. He strongly encouraged me to consider that, and actually took the extra step of arranging for me to come to Baltimore to be personally interviewed and get exposure to what the opportunities were. So I think it may have been that extra step that kind of made me make the final decision.

Nebeker:

What was your initial job at Westinghouse?

Denton:

My initial job was that I was assigned to an engineering group, working on defensive systems for Navy aircraft. Basically, radar controlled gun turrets.

Nebeker:

Fighter aircraft?

Denton:

A Navy patrol type aircraft. So I entered into a new area of airborne electronics.

Nebeker:

You were hired as a mechanical engineer?

Denton:

Yes, as a mechanical engineer.

Nebeker:

Did you get drawn into the electronics work?

Denton:

Had to, basically. When you stop and think about it, there's a strong interplay between the electronics and mechanical aspect, because electronics end up as essentially mechanical equipment in terms of performing their functions and activities. So I had to begin to make kind of a transition to a different concept of what mechanical engineering was. And to pick up on the electronics side as much as possible and as quickly as possible.

Nebeker:

How large was this group working on that system?

Denton:

The group itself was probably about 25 people. There was a small group of the mechanically inclined, part of a mechanical design group.

Nebeker:

That was controlling the turret for the radar?

Denton:

Yes. That would perform the tracking and the control function, pointing the turret.

Nebeker:

That was a Navy contract that that group was assigned to?

Denton:

Yes, it was a Navy contract. Then that program evolved into other tail turret programs. The other one that I was heavily involved with was the beginning of a gun turret system for the Martin P6M sea boat. That was a jet flying boat. It was very interesting and had some unique mechanical problems associated with it.

Nebeker:

You worked on the radar for that?

Denton:

Yes, the radar and the turret itself. Sitting out there in the ocean, that was a different environment. But that was an area where some of my submarine experience at least helped me appreciate what the environment was.

Nebeker:

I see. How long were you then doing this work on the turret systems?

Denton:

About two years, two to three years.

UK2 Satellite

Then the organization within Westinghouse here in Baltimore began to grow and evolve, and that's when the concept of the functional organization began to come into place. There would be basic engineering groups that would be assigned to specific programs, as opposed to a project having a committed and dedicated workforce.

Nebeker:

I see.

Denton:

Gave a lot more flexibility to the organization, able then to apply the resources in the most effective manner where they were needed. I ended up as part of that design group.

Nebeker:

What was the work of that design group?

Denton:

It was, at that point, a mechanical design group, as well as an electrical design group, an antenna design group, support equipment, that sort of thing. So there were groups that developed expertise within airborne electronics equipment. I was assigned as an engineer within that design group.

Nebeker:

The mechanical design group?

Denton:

Yes. And that's where I spent a good bit of my time early on from an engineer to a supervisor, and ultimately as a section manager for supporting these various programs. There were two kind of major activities. I had an opportunity to get involved as a lead mechanical engineer on the UK2 scientific satellite that Westinghouse built, integrated, and tested for NASA. As a matter of fact, the prototype is here on display [at the Historical Electronics Museum]. That was an interesting experience because we had an opportunity to interface with the experimenters, who were all British experimenters, who provided the instrumentation.

Nebeker:

Tell me about that satellite.

Denton:

It was a satellite that had sensors for evaluating galactic noise, noise from the space environment. It had a meteorology experiment, and it had a radio astronomy

experiment. There was a long antenna wire for the radio astronomy. These were projects that the scientific community in the UK had proposed to be incorporated into the satellite. This was a joint venture between the UK ministry and NASA in which NASA would provide the satellite structure, the launch capability, all of that, and then the UK would provide the instruments.

Nebeker:

What was your part in that?

Denton:

My part of that was the responsibility for the mechanical design and integration.

Nebeker:

Of the entire thing?

Denton:

Yes, entire structure.

Nebeker:

How did that go?

Denton:

I thought it went very well.

Nebeker:

Did it work the way it was supposed to?

Denton:

Yes, as a matter of fact, it did. As part of that, to make sure we understood the needs of the experimenters, the program manager and I made a trip to the UK and visited with the ministry. That was in grand British style. They'd have a break in the afternoon for tea

and crumpets, all of that sort of thing. We went from there to visit the suppliers of the experiments themselves.

Nebeker:

The British makers?

Denton:

Yes, such as the British General Electric. I know the Marconi company was another one. I don't remember who the third one was.

Nebeker:

They were still using the English system of measurements then?

Denton:

Oh, absolutely right.

Nebeker:

So no snafu because of different units.

Denton:

Right. So we came back, and it was then a matter of putting that all together. Another interesting aspect of that work was that if something goes wrong, you can't go out there and repair it. It's going to work or it's not going to work. That made clear to me the real impact of quality and reliability, that you need to do it right the first time because you only got one shot at it. That lesson stuck with me through the rest of my career very significantly.

Nebeker:

So you did things differently on that project because of that fact?

Denton:

Yes, a little more thorough. Most things, you can go out into the field, you can take it to test if it doesn't work, and you can repair it or modify it. With the satellite, there's no modification once it's gone

Nebeker:

Were there any NASA engineers working with you on this?

Denton:

Yes. They provided a lot of support and guidance and monitored us very closely to make sure that lessons learned from their experience were incorporated. We had a very close working relationship, or I did, with our counterparts. In that particular case it was NASA Goddard, as you know, close by.

Nebeker:

How long did that project occupy you?

Denton:

It was about two years. From the beginning to launch.

Nebeker:

Did you observe the launch?

Denton:

Yes, I was there at the block house. You begin to get a little uptight as the countdown starts, but it all worked out well. That was another learning experience that I felt I carried with me later on.

Nebeker:

So at that point, you were in this mechanical design group, which was being put on different projects at different times.

Denton:

Yes.

ECM Programs

Nebeker:

What came next for you?

Denton:

Well, as a result of those assignments, most of my activity was associated with ECM programs, electronic countermeasures programs.

Nebeker:

Just as a result of the assignments that were made?

Denton:

That was the assignment and personal associations. You know, people that you know and respect and like to work for.

Nebeker:

I see.

Denton:

You'd kind of like to get in an environment like that. So I tended towards that, and those personal relationships that begin to build up become a strong factor. As you get to know people and work with them, that makes for a much better working relationship. So I began to know most of the ECM group, a small development group at that time.

Nebeker:

They were a separate one of these functional groups?

Denton:

Yes. They had a small ECM group and then they had the radar groups.

Nebeker:

I see.

Denton:

They had an electro optical group that was basically project or program oriented, and there would be a small staff of key people there. They would bring in resources they needed to support programs from an engineering standpoint.

Electronics Systems Management and Structure

Nebeker:

How did the overall management of Westinghouse Electronics Systems go?

Denton:

I think it went exceptionally well. Considering the fact that it was kind of a loose relationship and management - well, loose isn't the right word. It was not a strongly structured environment. And I believe it was intentionally done that way in order to emphasize entrepreneurship, doing your own thing within reason, bounds, and guidelines.

Nebeker:

It gave the flexibility that you mentioned, so that they could shift resources quickly.

Denton:

Right. The effectiveness of it was heavily dependent upon these personal relationships, your working together. You began to build up teams that were compatible. It was, in my opinion, a very effective way of handling a growing business.

Nebeker:

I see.

Denton:

You didn't feel that you were stifled by a very strict structure.

Nebeker:

This was a project-oriented approach where the team was assembled for a single project.

Denton:

Right. You had the flexibility of shifting, and that is one of the strengths that allowed the Electronics Group here to grow as much and as quickly as it did. It also developed a very strong rapport among the professionals here. You all worked together, you grew together, you prospered together.

Nebeker:

You knew where to go for certain skills and capabilities?

Denton:

Yes. And you didn't necessarily feel that you were limited by a discipline. You could pretty much grow into it, and you felt capable of going and doing.

Nebeker:

I see.

Denton:

That was a very significant part of the growth and development of the operation here in Baltimore. One of the things that kept me at Westinghouse as long as I was is because I felt that it was an excellent group of people. Good people to be with, you liked working with them, you didn't mind socializing with them off the job. So it began to develop a fairly close-knit organization that still exists today.

Physical Countermeasures Pod

Nebeker:

You list the physical countermeasures pod in your work. Can you tell me something about that?

Denton:

That was interesting. That was, I guess, a Navy program as kind of a follow-on, if you would, of the defensive systems, the radar-guided gun turret, where they wanted to go more towards electronic defenses. They wanted to develop an external mounted store that had countermeasures in it.

Nebeker:

To jam enemy radar or navigation systems?

Denton:

Yes, basically to jam the radars themselves. So there was a chaff dispenser, as chaff was one of the effective jamming techniques at that time. There were forward-firing rockets. The chaff dispensers would give you chaff aft of you. They had forward-firing chaff rockets. There were IR [infrared] flares that could be dispensed.

Nebeker:

Was there electronic jamming?

Denton:

No. The chaff that created the noise was the primary countermeasure. Then there was also a corner reflector decoy that could be deployed. It had eight corner reflectors, which would enhance the return signal. The decoy would be deployed and then drift away from the ship itself. Enemy radar would lock onto it, that being the stronger signal.

Nebeker:

I see.

Denton:

That was what the Navy wanted. In order to make it an external store, it was decided that we would make the pod in the configuration of an external fuel tank. That way, we knew we would have compatibility with the air frame and with the aerodynamics.

Nebeker:

As that had already been worked out.

Denton:

We began looking at fuel tanks to be able to utilize those as a structure, but those had all sorts of baffling and things like that internally to prevent fuel sloshing. We settled on the configuration, but built a structure in that configuration that was essentially a shell, and the internal structure would accept all the countermeasures.

Nebeker:

I see.

Denton:

There was a radar sensor that would be used to detect an oncoming target. That pod was a program then that I had an opportunity to be the lead engineer on, designing the structure, integrating it, and then testing it. We went through a testing program, but never did get the flight test because at that point in time the major thrust was on the electronic countermeasure as opposed to the physical countermeasures.

Nebeker:

I see.

Denton:

That did give us a base for sticking our foot in the door, saying we have this kind of countermeasures experience. It was a very early countermeasures program. That experience, because of personal interest and experience, more or less drove me into this countermeasures program that I was heavily involved in. It kind of just flowed naturally that way.

Multipurpose Pod

Nebeker:

The next thing you have listed here is the development of the multipurpose pod for airborne electronic countermeasure systems.

Denton:

That was the time the military began to realize that electronic countermeasures have a place in lieu of the physical activity. There were a lot of techniques, testing programs, and that sort of thing in development to demonstrate effective countermeasures. Techniques that were proven against different types of radar generated interest in getting them into operational systems.

Nebeker:

Yes.

Denton:

Countermeasures is a cat-and-mouse game, countermeasure, the counter-countermeasures, this kind of thing. It was going to end up being a product that needed to be highly flexible and easily adapted and easily changed. Real estate in an airplane is at a premium and so the black box concept, which is basically what the electronics was at that point in time, was going to limit itself in terms of being able to adapt, to be flexible enough. In order to modify, you'd have to take a whole airplane out of service.

Nebeker:

So the idea was to not have to do that by having things in a pod that could be altered as the technology changed.

Denton:

Right. That's where the physical countermeasures pod, as an external store, began to play a role. If we could develop a smaller pod, highly flexible, that could be installed on the external part of the airplane, it would give you the capability. You could download this thing, take it offline, load another one back on and do any modifications, updates, and that sort of thing.

Nebeker:

Presumably it could go on different aircraft?

Denton:

Absolutely. As long as you make a standard interface like the stores, bombs, that sort of thing. There's a standardized interface there.

Nebeker:

Yes.

Denton:

So if we could adapt that standard interface into a structure that was modular, compatible, flexible, those sort of things, it seemed like that would be a right direction. So the small countermeasures group that I'd said I was working with really picked that up as a sales tool. Using the experience of the physical countermeasures pod and saying, "look, we've been there, we've done that, it works, the interface and that sort of thing. Why don't we institute a program to develop a standard modular pod structure?" The countermeasures people within the Air Force were all for this. They thought it was a great idea. And so they funded this program to develop this, what we called the multipurpose pod.

Nebeker:

Was the earlier pod also for the Air Force?

Denton:

It was for the Navy.

Nebeker:

But you convinced the Air Force that this was a good idea.

Denton:

Right. From the business standpoint, the management here within Westinghouse says, "okay, if we're going to invest in this product line, let's go with the biggest customer, the Air Force."

Nebeker:

Yes.

Denton:

That was how that evolved. They did fund the development of a standard 10-inch diameter pod with a hard back, inside of which the electronics could be mounted. It incorporated a cooling system and had the flexibility of being able to add to or change a set of specs for a standard interface. It then went through a qualification program from the air framer standpoint to demonstrate compatibility and jettison-ability, that sort of thing. So as long as you were within these standard interface limits, you didn't have to go back and requalify and recertify the physical aspect.

Nebeker:

I see.

Denton:

So it turned out to be a good program and a very effective program and a real key building block.

Nebeker:

So these pods were actually used?

Denton:

Yes, they were, with that standard pod. The activity in Southeast Asia was starting to pick up at that point in time. There was heavy involvement there.

Nebeker:

This is the mid '60s?

Denton:

Yes, the mid ‘60s, early ‘70s, that time period.

Nebeker:

Okay.

Denton:

They were able to demonstrate techniques that were effective against the SAM, the radar-guided SAM missiles. And when they were flying in Southeast Asia, the Air Force was losing a lot of airplanes, [a] lot of pilots, so it was a key emphasis that we needed to get something out there quick. So they turned on the program of incorporating these ECM techniques using the standard pod structure, because that way they could be built, tested, and incorporated on the airplane.

Nebeker:

Yes.

Denton:

That turned out to be a very effective tool for the pilots, once they accepted it. We said, we’re going to start putting this ECM pod on your airplane and you’re going to give up one of your store mounts. Once they finally consented to some trial period, they began to realize the effectiveness of it, and it got to the point that they really wouldn’t fly without an ECM on it.

Nebeker:

I see. What aircraft were these on?

Denton:

Mainly the F-4s and the F-105s. Those were the two key airplanes flying in Southeast Asia.

Nebeker:

Did this kind of standardized pod, modular pod structure, spread to other types of aircraft?

Denton:

Those were the main ones. With later versions of the pod, the 131 was certified for use on the F-4s and F-105s. Let's see, A-10s, later on, F-16s C-130s. So it got wide application where it could be used as deemed appropriate.

Nebeker:

That sounds like a fundamental idea to me, rather than incorporating equipment in the fuselage, putting [it] in a pod.

Denton:

Right. I think that was the thing that allowed Westinghouse to get a major hold on the ECM business from the Air Force. Of course, it was growing at that time. New techniques and the ground radar would change, you would have to then change the programming techniques for the pod. In the early days of the program, in order to reprogram it, this was done mechanically by setting switches and that sort of thing. You needed to download the pod, take it back into the shop.

Nebeker:

As when the enemy starts using different radar?

Denton:

Yes, you'd have to reset it. But still, that was much better than tying up an airplane. You could then turn this thing around in probably 24 to 48 hours.

Nebeker:

I see.

Denton:

So that early program then led on to later versions with newer and updated techniques.

Nebeker:

Was this your main work in those years?

Denton:

I was almost solely dedicated to that. It was an interesting time. To a large extent, it was a management activity, providing the guidance and direction for the engineers that were part of that support team, utilizing the background experience.

Nebeker:

So you were more a manager than a design engineer?

Denton:

Right. But I was still working closely with the program people in terms of the direction and the inputs and that sort of thing.

Countermeasures Collaborations, Suppliers

Nebeker:

There must have been quite a few companies involved in countermeasures. Were there exchanges of results or collaborations?

Denton:

Yes. The Air Force was more of an overseer. There were symposiums, that sort of thing.

Nebeker:

So your group might show what it had been able to do?

Denton:

Yes. It would be more of the program people than the direct design people. We would support them, but they were driving the show and interfacing more directly with the customer. You know, there was an informal organization of the Old Crows, the ECM fraternity. There would be a lot of informal exchange at the personal level.

Nebeker:

You weren't discouraged from doing that?

Denton:

No, not with reasonable bounds. Some of the conferences were classified conferences. Still, there was a lot of exchange.

Nebeker:

You could talk to an engineer working on similar problems elsewhere?

Denton:

Yes. Sanders was a big player in this. Raytheon was a major competitor.

Nebeker:

And the engineers formed this community that had real opportunities to share results?

Denton:

Yes.

Nebeker:

One might imagine that because the work was classified that it would get done in isolated groups.

Denton:

Right. It was kind of compartmentalized.

Nebeker:

But that wasn’t a problem in your experience?

Denton:

No. I didn't feel constrained, but using prudent judgment. You're not going to give away the store.

Nebeker:

Did Westinghouse collaborate with these other companies on projects? Or were the systems pretty much isolated, this would be a Westinghouse system and this would be a Sanders system?

Denton:

Pretty much. There would probably be more collaboration through supplier databases because you were very dependent upon component suppliers that performed specific functions.

Nebeker:

I see.

Denton:

With leading-edge technology we were very heavily dependent upon key component suppliers. And these key component suppliers would be working with other systems. So there was a lot of interchange because there was a very limited capability within the industry.

Nebeker:

What about the relationship with the suppliers? How often would Westinghouse say to, I don't know, some magnetron manufacturer, we need this kind of a tube.

Denton:

All the time.

Nebeker:

So you're constantly getting them to develop new components?

Denton:

All the time, because new techniques generally required new components of some nature. Because you're either stretching the limits of the frequency, bandwidth or the power levels. Almost every change was an upgrade.

Nebeker:

I see.

Denton:

More often than not it would evolve around key suppliers. So the development of a relationship with those suppliers was key. The nature of the business, from my perspective later on as I got more involved in [the] program, [it] became obvious to me that the people you have are the discriminating factor. Anybody else could go out and buy the same thing that you could from these key suppliers. You're heavily dependent upon that core group of people with the technical expertise there.

Nebeker:

How did it work with these suppliers? If they manufactured something to your specs, could they immediately sell it to other companies?

Denton:

Yes. They could market it elsewhere. Restraint of trade is what the government would refer to it as. But you tried to develop that relationship closely enough that they say, here's a key customer we want to keep. But, you know, they were in business too.

Nebeker:

Were there ever cases where a supplier would say, well, can't you use this that we've developed for NASA or some company?

Denton:

Yes, that was their first opening, generally. But then you begin to say, we've got this configuration of structure, we've got these mechanical constraints, we've got these power constraints. More often than not, it ends up being a tailored design.

Nebeker:

I see.

Denton:

Maybe you can take the basic function, but then you begin to need to tailor it to the application. And so that's kind of the way a lot of the development evolved.

Program Manager, Reliability

Nebeker:

I wanted to ask about these titles that you held. You were from 1954 to '73 engineer supervisor, engineering manager. And then in '73, you became program engineering manager. What change was that?

Denton:

A little bit of background. In the '60s, '70s time period when Southeast Asia was driving this countermeasure activity, Westinghouse kept getting basically sole source procurements for new techniques, new programs. There was a lot of flack, if you'll pardon the expression, from the industry about the sole source. So later on the Air Force acknowledged it, saying the next generation of ECM pods were going to be put out as a competitive bid so the industry will have an opportunity. We will give everybody a chance to compete on even footing.

Nebeker:

I see.

Denton:

Here will be your opportunity to break into the business. That was basically the ALQ-131 program. That was a competitive one, and fortunately, Westinghouse won that program.

Nebeker:

Were you manager of that program?

Denton:

Not at that point in time. I was still part of the design group, the manager of the design group, supporting that proposal and the development of it.

Nebeker:

I see.

Denton:

It was based on, again, the modularity, the flexibility. So we were successful in winning that program. We got a development and a limited production order. Early on in the program there were a lot of problems that began developing, and there was a thrust that said we're going to terminate the program. But then there were other elements in the Air Force that said, no, we'll go ahead. So it was restructured, there was a change of management that the customer insisted on. At that point, I was approached and asked if I would accept the job as the program engineering manager and then be responsible for the overall program engineering.

Nebeker:

Yes.

Denton:

It was a matter then of completing the design. There was a very strong ECM design team there doing that. That worked out well. This was where, in order to get the flexibility that they needed, it was to be a digital system. A centralized computer with a basic operating system that would make it operate like a pod.

Nebeker:

Program control of the system?

Denton:

Exactly. Then there would be a separate program so that you would be able to tailor it for mission to mission to mission. That was a whole new thrust for ECM. All of the

software associated with it, which was a new experience for me and an interesting learning experience. We were successful in getting the design completed.

Nebeker:

It was in 1976 that you went from being engineering manager to program manager?

Denton:

Right. We finished up the design, we did the flight testing, quality testing, basically the DT&E, or design, test, and evaluation phase. Then the Air Force had to make a decision whether they wanted to proceed with a full-scale production, or what they wanted to do because they did have production options in the program at that point. During that time phase, there were a limited number of the 131 pods that were in the operating environment within the Air Force. I spent a reasonable amount of time visiting the user, the ones that were flying. That was a part of the business that I had not been directly associated with within the engineering community. I felt it would be worthwhile getting out and see how the user perceives this equipment, what their thoughts and ideas are.

Nebeker:

What sorts of aircraft was this intended for?

Denton:

At the time the F-16 was being brought into the inventory and replacing the F-4. The early flight tests were done on the F-4, but the operational usage was going to be with the F-16.

Nebeker:

Okay.

Denton:

So we went out and visited the users, not only the field shop support people, but the flyers as well. I brought back a message on one trip. I remember this tall, nice-looking bird colonel, you know, a typical fighter pilot. He was telling [me], "I flew in Southeast Asia, I saw these SAM missiles coming up, like telephone poles, and I could see them veering off." And he says, "I'm a believer in ECM." But the F-16 is coming on, the, as he

put it, hottest airplane in the world. We've got a bunch of young, white-scarf pilots, they think they can out-fly anything in the world. They're just that cocky. And he said, "you're really going to have problems getting them to accept this dummy [the pod] flying on the airplane."

Nebeker:

Yes.

Denton:

Limiting their performance and that sort of thing. "The thing you got to realize," he said, "when you're actually on a combat mission" - and these are his exact words – "you're putting your ass on the line and you got to decide whether you're going to go for it or whether you're going to abort." And he said, "that pilot's going to be sitting there with that dummy, as he looks at it, it doesn't make any noise, it doesn't go bang, it doesn't go flashing," he said, "he doesn't know whether it's working or not. And he's putting his life on the line for that piece of gear."

Nebeker:

I see.

Denton:

That stuck with me, that we really need to address the reliability issue. Because at the same time, when I had gone out into the field shop, there were shipping containers with 131s in there, still sitting in their container. I said, "why are they there?" He said, "we don't want to waste our time testing them because we take them out of the shipping create, run them through a test, and they fail." I said, "man, bad news."

Nebeker:

Yes.

Denton:

I came back, talked with Jim Holman, who was my boss at that point, a staunch man at reliability. That was his theme song. I told him, "Jim, we've got to do something about the reliability." "All for it," he said, "but just don't screw it up." Anyhow, we went through

an update program, and at that point, with Jim's consent, I agreed to a requirement in the contract where we would double the MTBF from 25 hours, which, in retrospect, was nothing, to 50 hours. We would guarantee that on production equipment that was going out. That's where I began to think back on my concept of the UK 2, when it's out there, you know, you can't go out and fix it. It's got to be right the first time.

Nebeker:

Yes.

Denton:

And so that's when, you know, it really hit home to me, it said, "hey, this electronics equipment, we've really got to drive the reliability." All right? You know, if it's going to go and it's going to be successful, it's got to work right, it's got to work the first time. And so that was my main thrust then within, you know, the engineering activity. And then ultimately, I took over as the program manager. And that's when I began to drive this thrust home, that, if you're going to do it, it takes a total commitment.

Nebeker:

So with this goal of reliability, you put a lot more time into the testing of systems?

Denton:

No. As a matter of fact, I said, we need to do the opposite. We need to do the right testing, but we need to do less of it. We need to build it right the first time, so that when it goes to test, you test it once, it's there, and it goes. That was basically my thrust, we've got to go back to the basic design, the basic components. We've got to get the reliability built in there. Now, do more testing, perhaps, at that level. Drive that test back down rather than leave it at the end where it's very time consuming, it's very expensive. Drive it back down.

Nebeker:

I see.

Denton:

I don't want to sound overdramatic, but it almost involved changing the culture of an industry. Because up until that point in time, the main thrust on ECM was, we need it, we need it now, because we've got this crisis in the field.

Nebeker:

I could imagine you're also looking at the end capability of it.

Denton:

Absolutely. They went to this quick react capability. The important thing is build it, do safety of flight testing, get it out into the field. We'll worry about it later on. That very quickly gained a bad reputation.

Nebeker:

Yes.

Denton:

This next competitive generation, where they went to digital to give them a lot more flexibility, it became obvious that we needed to drive the reliability. To do that, we needed to change, from my perspective, the quality culture. There was such a close relationship between suppliers, so it was not only an in-house problem, but it was a vendor problem.

Nebeker:

I see.

Denton:

That's the reason I say you need to change the industry. And that was where I spent, I'll bet, 75 or 80% of my time, driving that message home.

Nebeker:

So there was more rigorous testing of all the components. Were there also more reliability measures at the system level?

Denton:

Absolutely. Because part of this agreement to improve the reliability was the incorporation of what I call a TAF program, test, analyze, and fix. You'd test until you got a failure, you'd fix that, and you'd test some more. It was difficult to get the customer to accept this concept that a test didn't have a pass/fail criteria. The purpose of the test was to find out where the weak links are, fix them, and go back and find where the next weak link is. We drove that point home, and we had a reliability growth curve that we monitored to see where we were. As we went through that, it was a matter of going back to our vendor base also. It became obvious to me, in order to make this happen, we had to get a top management commitment. The best way I could find to do that was related to cost. Get the top management level to say, look, take a look at your test yields. Every time a test fails, it goes back and into what I call the hidden factory. You're doing more rework. That's costing you money. Find out what it is, fix it so that your test yield goes up. Then we provided incentives to vendors. TWTs were one very fragile structure.

Nebeker:

What is that?

Denton:

Traveling wave tubes, an RF amplifier.

Nebeker:

Yes.

Denton:

If you envision the old electron tubes with the grids and everything, well, the TWTs were a version of that in which they had these very fragile grids. They were subjected to high stresses as a result of extreme temperature changes. At one time, we even funded TWT suppliers to do a finite element analysis of where the stress fractures were, in order to go in and fix those on the front end. So it took a cooperative effort to get them to do it. A TWT vendor used to send me his first cycle test unit curves where he was very pleased when, for a month, he'd have zero failures. So they began to realize that it became a more profitable business for them. Using that cost technique and making sure that the management wanted to be a part of the program, the successful, profitable program.

Then you could get their dedication. In-house, we did the same thing. We instituted this first cycle test yield at the production level. Drive the test back down. PC boards? They all go through the first time and pass and no failures. So we were very successful with doing that. But in order to follow that, there was a matter then of rigorous failure analysis and corrective action that says, I got a problem, fix it. It became obvious to me that finding a problem is easy, getting the fix for a problem is easy. Implementing that fix and getting a change made, difficult. Because that's where you had to go in and change the culture. It says, you need to do something different. But, we've done it like this in the past, and everybody else is doing it this way was often the response.

Nebeker:

Did you see going into this program manager position that that would be your main work, the reliability issue?

Denton:

Hadn't the faintest idea. It wasn't until I went out and began to realize the user's perspective in this equipment . You know, once that pilot's out there getting lined up, he has to believe that when he flicks that system on it's going to work and it's going to work right and it's going to work every time. That really made an impact on me.

Nebeker:

Was your emphasis on reliability something that was noticed elsewhere in Westinghouse?

Denton:

Yes, it was beginning to permeate. Radar was basically doing the same thing. So it wasn't unique to us. But I personally felt that the particular industry that we dealt with was not akin to this. Our customer talked a good game, but I think didn't appreciate what it took to get it implemented. Like the concept that says, if you're testing and it fails rather than say it's a failure, that's an improvement. We're going to go on from there. They finally came around to it as well.

ALQ-131

Nebeker:

Looking back on that ALQ-131 project, how would you say it worked out?

Denton:

Very well. The equipment got deployed and had excellent results. As a matter of fact, I'm almost certain that it's still in the active inventory. It was heavily used in the Middle East, in the Shock and Awe program.

Nebeker:

And this was one of the early digital systems?

Denton:

Yes.

Nebeker:

That's quite an achievement.

Denton:

It was the first program that could be programmed on the flight line. Before, we had to take it off, take it back to the shop, flip the switches to set up different techniques. Not required on this. You didn't have to download it from the airplane. You had what we called a loader box where you could generate the threat tape, as we called it. In the shop you could generate the new tape and reprogram the pod on the flight line. Then it was ready to go with the latest updates. That worked out well, and I'm very pleased.

Nebeker:

How widely was that system used?

Denton:

It was a prime mission piece of equipment for the F-16. The A-10, which is the tank buster, so to speak, it was standard on that. And then was used on transports.

Nebeker:

Also there?

Denton:

But the main mission was the fighter, the F-16 and the A-10. Those were the mainstream equipment that it was dedicated to.

Nebeker:

I see that you were on that 131 project for many years.

Denton:

More than I expected. A lifetime, it seemed like. From the early 1970s to about 1990. But never a dull moment. I remember a fellow telling me, I feel sorry for you as a program manager. I said, "why is that?" He said, "program managers are like baseball managers. There are those that have been fired and there are those that are going to get fired." That's a pretty good assessment. The program manager is where the rubber meets the road.

Nebeker:

Right.

Denton:

I always figured if at least 50% of my decisions could be right, I'd be okay. But the 131 turned out to be a very good piece of equipment, a very profitable one from a business standpoint. You couldn't ask for more. You got all kinds of support from general management, as long as you're delivering on time and delivering a profit. There aren't too many people that are going to rock the boat.

Nebeker:

You managed not to have a nervous breakdown in these years in charge of the program?

Denton:

Well, yes. It takes a different mindset. I used to get really upset about things, then I finally decided to tell myself, I'm going to put in a good hard day's work. When I leave, I'm gone until tomorrow. And every time you'd have a major success, you'd want to say, that's over with, now I can lean back and relax. I learned you don't lean back and relax more than a few hours because the next one is right out there coming down the pike.

Nebeker:

One of the best historians of engineering, Henry Petroski, has written about how top engineers are worriers. They are people who are always thinking about what can go wrong.

Denton:

That's true.

Nebeker:

It's such an intense job in that way.

Denton:

Yes. You've got to do that, but at some point, I said, I've got to be able to turn that off because I got another life as well. Somehow, I was able to do that. How successfully, I'm not sure. I'm still married.

Nebeker:

Before we go on, is there more about the 131 project that you'd like to mention?

Denton:

Well, this earlier thing I talked about, about how to work with people. I was always a strong believer that if I was going to be involved in something, I'd like to have strong people there working with me or working for me. I'd rather not have somebody that comes and asks, "what do you want me to do?" Take it and go with it. We developed that very strong team, a team that really pulled this thing together, and especially during this reliability growth. There were a core group of myself, the engineering manager, the production manager, the quality manager, procurement, you know, the key people. We were a corrective action review board. We were configuration

management review. We did things all together as a team and worked very well together. We didn't always see eye to eye, but we managed okay. I remember that within Westinghouse, they had these self-audit groups to make sure that, with these programs that were kind of autonomous, they were fulfilling the policies and the standards and the commitments that are set up. So they had this group that would come in, and they would audit each group individually. I can remember that we always came out very well on those. Jack, the fellow that headed up the group, said, "where in the world did you get that bunch of renegades that you got there?" Because everybody was strong willed. I said, "Jack, they were all handpicked." That was a team building exercise that I thought was meaningful to me because we had good personal relationships, as well as a good project and a good product, and it was successful. It was a win-win situation for everybody, which is what I took a lot of pride in and was comfortable with.

A-10 CFF

Nebeker:

So in 1990 you became a program manager of the A-10 CFF project.

Denton:

That was a Navy program that was going to be the next generation of stealth attack aircraft. It was run by General Dynamics. Westinghouse had the radar sensor part of that program. We were also the supplier of a passive sensing system, the CFF (Combined Function FLIR – Forward Looking IR).

Nebeker:

I see.

Denton:

The development program was pretty well along, and they were looking to transition into production. So Emmett Wheeler, who was the manager at that time, approached me and wanted to know if I would be willing to move over and assume the responsibility of transitioning that program into a production phase, based on my experience in the 131. I told him, "you know, Emmett, I'm getting pretty close to retirement age." But he said, "what we really need to do is to get this program on track, get it moving in the right direction." There were, as typical in a program, some

significant problems that needed to get ironed out. So I agreed to do that and was very involved with that. But unfortunately, Dick Cheney was Secretary of Defense at that point in time, and there was a lot of problems associated with the air frame itself at General Dynamics. He ended up saying, "this program isn't going to be successful, it's overweight, it's not going to meet the mission of flying off the aircraft carrier, so we're going to cancel the program."

Nebeker:

I see.

Denton:

So we never did make the final transition into the production program. But it was a new technology for me. It would've been an extremely interesting program, and I was looking forward to being able to do the front end of that transition and get it going.

Investment Manager for Commercial Systems

Nebeker:

Then you became investment manager for the commercial systems?

Denton:

Yes. At that point I was debating whether to retire or not. Westinghouse Baltimore was a mainly electronics DOD-oriented business. The decision was made that we should take this technology and apply it to some areas of the commercial market in order to provide another growth opportunity.

Nebeker:

I see.

Denton:

So Ed Silcott, who was head of the commercial part of it -I had worked closely with Ed on some of the production programs before - wanted to know if I would come onboard to work with him as an investment manager because there was a big emphasis on managing and controlling the investment.

Nebeker:

Could you explain that?

Denton:

Well, within the military, the contracting part of it, you could be reimbursed for your cost on a progress payment basis. Within the commercial business, you didn't get the benefit of that. When you deliver the product, you get your money.

Nebeker:

Yes.

Denton:

The mindset basically was, okay, we'll do a lot of front end work, we'll basically recover the cost in time so we won't be carrying a big investment on the books. So from a profit and loss standpoint, you're able to run a business in an acceptable manner. When you go into the commercial side of it, there's a different mindset. So he said he'd really like to have somebody to work with him to say how we manage this investment side of it. So I got involved with that for a couple years. Then I went to Ed and said, "I'm not sure how well this commercial operation is really going to pan out because it is a real struggle."

Nebeker:

When did the commercial systems start at Westinghouse electronics?

Denton:

It was in the late '80s, early '90s.

Nebeker:

Okay.

Denton:

To be honest, at that point, Westinghouse, as a corporation, was struggling financially. They'd had problems with the nuclear industry.

Nebeker:

Yes.

Denton:

It nearly took the company under, and that was followed with some bad real estate. The mainstream industries that they had were really not growing. The two most profitable operations within Westinghouse were broadcasting, basically through CBS and cable, and the Electronics Systems Group here in Baltimore. Those were the two. They brought in some new management, and they were trying to decide which way should the corporation go. So they were trying to get a commercial side of the electronic system as a growth opportunity.

Nebeker:

Such as equipment for civilian air traffic control?

Denton:

Right. Or, the transportation market, such as some of these sensors for highways. Also, security systems.

Nebeker:

I see.

Denton:

That was coming along. They were hoping that that was going to be a growth opportunity for the corporation. But in the meantime, the new management that came in said, if you look at it objectively, there are two growth opportunities: the entertainment and the electronics, which is heavily defense-oriented. Personally, I think they made the right decision. If you look at the military electronics industry that's dominated by the big air-frame people, here at Westinghouse Baltimore, the bulk of the business was subcontracts from the air-frame people.

Nebeker:

Yes.

Denton:

So you're going to have a tough time competing in that business, unless you can expand. The decision was made, go entertainment. That's when they ended up selling the Electronics Systems Group here to Northrop Grumman and using the proceeds of that to buy CBS.

Nebeker:

I see.

Retirement

That was going on at about the time that you retired?

Denton:

You could kind of see which way things were going. So I said, hey, I think it's time. Actually, I'd worked beyond the normal retirement age by a couple years anyhow. So I said, I think it's time to relax.

Nebeker:

I see. I'm interested in any hobbies you have and in how your retirement years have gone.

Denton:

An interest that my son and I have is that we got involved with auto racing.

Nebeker:

A throwback to your father's automobile business?

Denton:

Yes. My son and I made it a point to follow the Formula 1, which is a world-class, really the high-tech part of auto racing, the open wheel racing. It really is the ultimate capability in a machine itself and the best of the drivers. We became enthusiasts, and we traveled to the races. I always thought I'd like to go to Monte Carlo to see the race there through the streets, so we did that.

Nebeker:

I see.

Denton:

Then I decided I'd like to try driving on the racetrack. So I ended up with a Lotus Elan, a little British sports car, and had that rebuilt. I got a BMW 2002 and had that updated. We'd drive it on the track. The Elan, I did a lot of auto crossing with that, which is where a course is laid out on a big parking lot. It's a function of how well the driver can do, racing against the clock. We did well on that.

Nebeker:

I see.

Denton:

And then I got involved with digital photography. I became very interested in the Photoshop aspect of handling and processing digital images. So I signed up for a couple of courses at the community college. Bought the program, a fantastic, powerful program. It was a way of keeping the brain exercised.

Nebeker:

Enhancing images?

Denton:

Yes, enhancing images. A lot of personal pictures, being able to improve and develop those. But I don't profess to be a expert.

Nebeker:

You haven't turned that into a business?

Denton:

No. I don't think we need that. So that's an activity. We moved into a retirement community. It's about 2,000 residents on a 100-acre campus. They have lots of activities going on, so I've gotten involved in that. I'm limping along with a sprained ankle now because of playing softball. So I am able to keep occupied.

Nebeker:

That's great.

AIAA, Staying 'Current'

I wanted to ask about your involvement with professional societies. I know you were with the American Institute of Aeronautics and Astronautics. That was your principle professional society over the years?

Denton:

Yes.

Nebeker:

Did you join that early on?

Denton:

Yes, shortly after I graduated from college. Just seemed to have an interest in that.

Nebeker:

And that was before you got into the aeronautics business.

Denton:

Right. But later on, the AIAA began to broaden their scope. They began to have specialties in sensors and electronics and that sort of thing. So I began to focus in on that.

Nebeker:

I see. So they have technical groups in those areas?

Denton:

Yes, technical groups and meetings and journals.

Nebeker:

Did you go to AIAA meetings?

Denton:

Yes, I'd go to several of them. As part of the local group, you can meet your peers. I was able to end up as an Associate Fellow within the AIAA based on experience.

Nebeker:

Did you value their publications over the years?

Denton:

I did early on, but then as I got more and more into the management side of the thing, their general publications were a way of keeping current.

Nebeker:

Were there other professional societies you were involved with?

Denton:

Not actively. Since retirement, there's another thing that I've done. I have an associate at Charlestown who is a retiree from the Applied Physics Lab of Johns Hopkins. And at the lab there they have a weekly colloquium as they call them. I look at it as kind of a staff development where they have top-notch speakers that come in and present hour or two-hour sessions on various topics. He's invited me to go to that, and I've been a fairly regular attendee. That's a way to keep current with what's going on in technology, as well as through general publications. One speaker was the retired chairman of the

medical group at University of Maryland who gave an hour presentation on his perspective of healthcare in the future. He was a very distinguished individual, very interesting. So it is a broad area of topics that kind of keeps you challenged and keeps you thinking.

Nebeker:

That's wonderful. Since I'm at the IEEE History Center, I wonder if you've had any involvement with IEEE Aeronautics and Electronic Systems Society.

Denton:

I've attended some of the meetings, as a matter of fact, but I have not been actively involved.

Nebeker:

Are there any things I haven't thought to ask about that you'd care to comment on?

Denton:

I think you've done an excellent job of bringing out all aspects and covering the main highlights. I guess the final thing that I would say is that I've enjoyed my career, it has been a good experience being associated with some outstanding individuals, and so I'm comfortable with it.

Nebeker:

Thank you very much.

Denton:

You're quite welcome. And thank you for your time.