

ORAL HISTORY: William Skillman

About William Skillman

William Skillman worked for nearly forty years as a radar system engineer at Westinghouse Aerospace and Systems Division in Baltimore, Maryland, where he participated in numerous groundbreaking advances in pulse Doppler radar systems. At Westinghouse, Mr. Skillman took part in several projects that advanced the development of radar systems and contributed to the success of pulse Doppler radar. His team provided the radar systems engineering for the seminal BOMARC pulse Doppler seeker, the AWG-10 radar in the F4-D, E and F aircraft, and the Airborne Warning and Control System (AWACS) that is currently used by the U.S. Air Force, NATO, the United Kingdom, Saudi Arabia, France, and Japan.

Mr. Skillman also taught the "Introduction to Radar" course at the Westinghouse Evening School for nineteen years. He has published and presented several papers on radar technology, including the influential "Development of the Airborne Warning and Control System Radar," as well as a chapter on pulse Doppler radar in Merrill Skolnik's Radar Handbook. In the early days of personal computing, Skillman also published a widely used set of programs for performing radar calculations and performance predictions that could run on computers and scientific calculators.

An IEEE Life Fellow, Mr. Skillman has been a member of the IEEE Radar Systems Panel for nearly twenty years. He also is a member of Phi Beta Kappa and Sigma Xi. He holds three patents and has received the IEEE Aerospace and Electronic Systems Society Pioneer Award for his contributions to AWACS. In 2003, Mr. Skillman was awarded the IEEE Dennis J. Picard Medal for radar technologies and applications.

Mr. Skillman graduated with High Honors from Lehigh University (Class of 1948) where he obtained a BS in Engineering Physics (Phi Beta Kappa) and went on to attend the University of Rochester where he graduated with an MS in Physics in 1954.

About the Interview

WILLIAM SKILLMAN: An Interview Conducted by Sheldon Hochheiser, IEEE History Center, 13 October, 2010

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Interview

INTERVIEWEE: William Skillman

INTERVIEWER: Sheldon Hochheiser

DATE: 13 October 2010

PLACE: National Electronics Museum, Baltimore, Maryland

Early Life, the Navy, and Education

Hochheiser:

We could start with a little background. When and where were you born?

Skillman:

I was born January 22nd, 1928 in Lakehurst, New Jersey.

Hochheiser:

Were you raised in Lakehurst as well?

Skillman:

I was raised 'til the age of about five then I went to Tom's River for a better school.

Hochheiser:

Right, but not far away?

Skillman:

About six miles away.

Hochheiser:

Right, right. I'm from New Jersey; I certainly know the area. What did your parents do?

Skillman:

My father worked for the Naval Air Station; my mother worked there until she got pregnant with me.

Hochheiser:

Were you interested in technology and science and things like that as a youth?

Skillman:

Yes I was. My father had studied to be an electrical engineer and had a nervous breakdown in his senior year. So I kind of felt I wanted to carry on for him. And he had a lot of stuff lying around the house that he had worked on such as crystal sets and other receivers.

Hochheiser:

So did you work on the crystal sets yourself?

Skillman:

Yes.

Hochheiser:

Were you a ham?

Skillman:

No.

Hochheiser:

So when you graduated from high school you went into the Navy?

Skillman:

Yes.

Hochheiser:

You enlisted, or were you drafted?

Skillman:

I enlisted for two years and since I had taken and passed the Eddy test, I was qualified to get electronic technician's training.

Hochheiser:

Could you describe the Eddy test a bit?

Skillman:

No, I don't remember it at all, but it tested our ability to be educated as an electronic technician.

Hochheiser:

Okay, so you went in the Navy and they sent you to train to be an electronics technician?

Skillman:

That's correct. Actually it was an aviation electronics technician school in Corpus Christi, Texas. Later they moved the school to Memphis, Tennessee. When I graduated I only had six months left of my hitch and had good grades, so I became an instructor there.

Hochheiser:

Not bad. So you finished your two-year obligation?

Skillman:

Yes. Then I got married and went to Lehigh University in Bethlehem, PA.

Hochheiser:

What led you to Lehigh?

Skillman:

My brother talked me into it; he had gone there.

Hochheiser:

And he had a good experience?

Skillman:

Yes.

Hochheiser:

Did you go there planning on electrical engineering?

Skillman:

No, I was planning on physics but was talked into engineering physics which was a broader curriculum.

Hochheiser:

I'm sorry, and I have that written down here. What led you to engineering physics as opposed to electrical engineering or something else?

Skillman:

Well I was really interested in more than electrical; I was interested in all of physics, which I had enjoyed in high school.

Hochheiser:

When did you graduate from Lehigh?

Skillman:

'52.

Hochheiser:

Okay and what led you to continue on to graduate school after that?

Skillman:

Well, I thought I would go on in the field of physics and really found it too much and I was given the side door, the Master's degree, after taking a test for it in '54.

Hochheiser:

And where was this?

Skillman:

University of Rochester.

Westinghouse: BOMARC and AWG-10

Hochheiser:

What led you from your Master's work to Westinghouse, rather than some other company?

[Note: There is a gap in the recording at this point. A portion of the interview of unknown length, but probably a few minutes, was not recorded.]

Skillman:

I had interviewed several electronics firms when I got my B.S. in '52 and thought Westinghouse was the most attractive. In the back of my mind I was also lured by the fact that I had garnered Honorable Mention in the 5th annual Westinghouse (now Intel) Science Talent Search.

Skillman:

At Westinghouse the first project I worked on was the BOMARC missile seeker.

Hochheiser:

I mean it's a big project; there are lots of people involved.

Skillman:

Right.

Hochheiser:

So what was your piece?

Skillman:

Well, I was up there in the "penthouse", working on getting it to work, the final steps of putting it all together and operating it and making sure it'd detect the targets. I didn't do any of the detail design; I was a systems engineer.

Hochheiser:

About how long did you work on the BOMARC project?

Skillman:

Probably two years, roughly.

Hochheiser:

So where does that take us up to, about '50 — ?

Skillman:

'58.

Hochheiser:

'58 or so? Then what did you move on to in '58?

Skillman:

Well at some point I went to the AWG-10 project.

Hochheiser:

Okay, which was?

Skillman:

That was a fire control radar for the F-4 fighter. We made different versions, eventually, for the British version of the F4 as well as for the American versions.

Hochheiser:

So this was the radar system for the F-4?

Skillman:

That's correct.

Hochheiser:

Now did you work again as a systems engineer on this?

Skillman:

Yes. I ran a systems group and we came up with the technical specification for it.

Hochheiser:

Okay, so if you ran a group by this point are you—?

Skillman:

I was a group leader, I guess you'd say.

Hochheiser:

Okay, so you had people then reporting to you?

Skillman:

Yes.

Hochheiser:

How was that different from being the first line to having a group of people reporting to you?

Skillman:

Well it wasn't my cup of tea, being a technical guy, but we managed to get the report out the door.

Hochheiser:

Do you recall any particular problems that you needed to solve in order to get it out the door?

Skillman:

We had to get everybody working together on this. We really didn't have any experience in writing a tech spec like that so we were learning as we were going. Can't mention any specific problems with it.

Hochheiser:

There's nothing that sticks in your mind after all these years?

Skillman:

Right.

Hochheiser:

Understandable. About how long did that — ?

Skillman:

I have no idea, several years again. We were finishing up when Kennedy was shot!

Birth of AWACS

Hochheiser:

Once you and your group finally got that tech spec written for the radar for the F4, what did you move onto next?

Skillman:

Well we did, as I recall, various smaller projects. And then eventually somewhere starting around 1963 the AWACS program got kicked off. And we worked with the West Building on that; they had done some initial work. The various groups in our building had done parts of it. Eventually it got started and went through many, many years of development.

Hochheiser:

So once you got involved with AWACS you were then involved with that for a considerable period of time?

Skillman:

Yes, for something like 20 years or so.

Hochheiser:

That's a considerable period of time. When what would this be, about '63 or so?

Skillman:

Yes, '63 the Air Force really started looking for a replacement for their airborne long-range surveillance radars. We thought the pulse Doppler technology that we had developed for the AWG-10 and the BOMARC were applicable. Oh, in between we developed the APQ-81 radar. I skipped over that.

Hochheiser:

And what was that?

Skillman:

That was originally started as a surveillance radar for the Eagle Aerie or Eagle Missileer system. It didn't go anywhere but it gave us the technology to perform track-while-scan, which was what the AWACS required. This means that the AWACS performs a continuous 360 degree scan and tracks all targets it detects.

Skillman:

The BOMARC and the AWG-10 were both single-target radars, basically fighter radars. The BOMARC was a missile, an unmanned fighter, you might say. So the APQ-81 was a predecessor for the AWACS and we built a demonstration model of it and had it working, and then went on to build the AWACS itself.

Hochheiser:

Okay. So you got involved with the AWACS then very much at the beginning of the project?

Skillman:

Yes.

Hochheiser:

How did the project start? How has the project gotten off the ground and running?

Skillman:

That was a great difficulty; you have to find an airplane that the Air Force is going to use for it, then figure out how we're going to install it on it. And various ideas popped up and using several pods for it, or eventually settle down to putting the antenna in a radome or rotodome up on the top of the fuselage. But we went through various exercises of trying to size and figure out the power needed for various installations.

Hochheiser:

Did you have a group of people working under you on this, or are you back doing the technical stuff?

Skillman:

No, I was a fellow engineer at the time. They had taken me out of the management area and made me a fellow engineer. I worked with people; I didn't have a real group myself. I worked with the so-called "APE" group, which was the Aerospace Programming Engineering group.

Hochheiser:

Who did you report to at this time, the early AWACS days?

Skillman:

Al Nims. At that time we worked on several small studies not related directly to AWACS.

AWACS: Competition with Rival Manufacturers

Hochheiser:

Now in the early days were you working with a specific plane or aircraft manufacturer?

Skillman:

In the early days of AWACS they didn't know who was going to build the airframe for it. In 1963 the Air Force produced a joint Specific Operational Requirement (SOR 206) "Airborne Warning and Control System (AWACS)" In response, Boeing (707) and Douglas (DC-8) and Lockheed(C-141) began to develop airframe and system concepts. The Grumman Navy E-2A was also in the competition. Seven radar contractors expressed interest in building the radar.

Hochheiser:

So there are two levels of competition: one, what airframe? And two, who's going to build the radar?

Skillman:

Correct. And a study by IITRI narrowed the field down to Raytheon, Hughes and Westinghouse. In 1966 all three went into the Overland Radar Technology (ORT) program to demonstrate our piece of the technology. We flew in three separate airplanes, Super Constellations, EC-121. At the conclusion of the flights Raytheon was eliminated, so we're down to Hughes and Westinghouse. And then, after another bunch of delays, we started the Brassboard program after the Air Force awarded the AWACS prime contract to Boeing in July 1970. Westinghouse and Hughes each built a Brassboard radar and installed them in separate 707s and had a fly off that started in early 1972 and ended in September, 1972.

Hochheiser:

So this is now almost a decade from when you had started?

Skillman:

Yes, nine years, right?

Hochheiser:

Right.

Skillman:

That's pretty fast, it seems like. You don't get operational for another four years, five years after that.

Hochheiser:

Sure. So all this period between '63 and '72 is basically to get to the point Air Force needs to make a decision between the two possible radar systems?

Skillman:

That's correct.

Skillman:

And we flew off out in Seattle. We flew mostly over Canada, where there's less automotive traffic, which is one of the great things we can see with the radar, which makes it difficult to find airplanes with all the traffic around.

Hochheiser:

How closely did you work with Boeing during this phase, up to '72?

Skillman:

That was very close because our antenna had to go into their radome.

Skillman:

Before Prime Contractor selection we worked with both Douglas and Boeing. We made one-seventh scale model antennas and put them in scale model radomes and evaluated the patterns. Our pulse Doppler radar concept required a very low side-lobe radiation pattern. You can't afford to have the radome spoil the pattern. So even though we made this fantastic low side-lobe antenna, we installed it in one of the model radomes and found the pattern was terrible. So we had to work with them to correct this problem.

Hochheiser:

It didn't work well with the radome?

Skillman:

Correct. So they modified the radome on the basis of this and finally came up with something that was better, not perfect, but better. And even after we had won we still went back and they did more changes to the radome to try to improve it as it's very difficult to work with a radome in front, particularly the odd shape because it's very long shape in front of the antenna, as opposed to being in a fighter, which isn't quite as long.

Hochheiser:

Now did you need to spend time out in Seattle during this phase?

Skillman:

About 50 of us moved out to Seattle at the beginning of Brassboard.

Hochheiser:

You were one of the group that moved out to Seattle?

Skillman:

Right, in '72, yes. I even brought my family for the summer of '72.

Hochheiser:

How long were you out there?

Skillman:

'Til September. We delivered the first radar in late December '71, so I went out in January and stayed through September and the family came out for the summer.

Hochheiser:

Who was the leader of this band of 50?

Skillman:

Bob Cowdery was the program manager and spent much of his time in Seattle during the flight test.

Hochheiser:

That must have been quite an effort moving and finding housing for 50 people.

Skillman:

Yes. We had an office out there, Westinghouse West and we operated out there.

Hochheiser:

This is all leading up to the final decision?

Skillman:

Yes.

Hochheiser:

Did Hughes similarly have a team out there, do you know?

Skillman:

Yes.

Hochheiser:

So Westinghouse had a group of about 50 people there, and Hughes had a group probably around the same size out there?

Skillman:

Right. And Boeing had separate teams supporting both radar contractors, and the Air Force had a monitoring team.

Hochheiser:

Did you have much contact with the Hughes people?

Skillman:

No. I'd known one or two of them from the early days, but we were not allowed to fraternize at all.

Hochheiser:

I figured as much. It just strikes me as kind of a strange situation; both groups are out there, both working with Boeing get to the point to win the fly-off.

Skillman:

That's right. Well, both planes were identical, and except for the tail numbers you couldn't tell them apart.

Hochheiser:

Right. So you were both working with the exact same radome?

Skillman:

Yes. It had come down to that. And everything was— the configuration was the same except the electronics inside the cabin. And one of the fellows climbed up the stairs into one of the airplanes and he walked halfway down the aisle and finally decided that was the wrong radar. He escaped without being arrested or anything. It was a fun time.

Hochheiser:

What can you tell me about the fly-off itself, the actual competition?

Skillman:

Well, we flew, mostly, as I said, over Canada and at night, and we frequently had target airplanes that the Air Force supplied. We would track the AF targets. Again, that's another place where we worked with Boeing because Boeing really does the target tracking; we reported the targets every time the antenna circles around. And they put it all together and found the tracks. So we had to work with them in order to get that to work copasetically.

Hochheiser:

Do you have an idea what factors led to Westinghouse winning the fly-off over Hughes?

Skillman:

That's a good question. We'd like to think we had a better performance in many ways. We were criticized sometimes because we had certain holes in the performance and they said, "Oh, Hughes doesn't have that hole." They would just drop hints about it, but they couldn't tell us a lot.

Hochheiser:

Right.

Skillman:

And I don't know, they really didn't let us look into the judgment factors; we didn't know what it was going to take. In addition to the flight test results, the final radar supplier decision considered the production proposals by both contractors. Partway through the fly-off we sat down and made some serious decisions on changes, based on the flights up to that time, that we thought would improve the radar. So we had about five of those changes that we made about the last month before the final fly-off. Then they declared it over; they had enough information, go home. So we went.

Westinghouse Wins

Hochheiser:

So then you go home and you have to wait for the decision?

Skillman:

Yes. October 6th the decision came down. And the plant kind of rose about six inches.

Hochheiser:

I was going to say, what was your and everyone else's reaction to what must have been a big win after lots and lots of work.

Skillman:

Greatest, greatest. And Hughes had just won the F-15 before the AWACS, so it was us beating the bad guys, the black hats.

Hochheiser:

[Laughs]. Yes, I know I spoke to at least a couple people who were involved with the unsuccessful F-15 program.

Skillman:

Yes, that was a shock.

Hochheiser:

Did you celebrate the win?

Skillman:

Yes, we went down to the Odenton fire hall and had a party and Bob Cowdery got a ceramic bull as an award.

Hochheiser:

So now you win the fly-off, you have a contract.

Skillman:

Right, eventually.

Hochheiser:

All right, how long did it take to go from winning the fly-off to having the contract to go into production?

Skillman:

Well I don't know when we got the contract. But the next thing we did was bring AWACS down to the Washington area and we flew a whole bunch of VIPs to show off the radar and had all kinds of generals and senators and representatives there. I flew on most of those flights as a systems engineer to explain things to them. That was kind of a

thrill. I don't know how many flights there were now, probably a half a dozen, with a dozen VIPs on board. So that was the fall of '72. And then we started to design the production version, and we had another big change to go through to convert the Brassboard radar to a production configuration.

Hochheiser:

That's what I was going to ask you, you've got this one-of-a-kind model built for the fly-off and I imagine there's a good bit of work before you got something ready to go into production.

Skillman:

Right, a lot of configuration changes. It was '76—we had it flying again in a production version. I went out to Seattle and flew with it to solve all the new problems that had been introduced by the reconfiguration.

Hochheiser:

You talked about working closely with Boeing on this; did you also work closely with the customer, with the Air Force?

Skillman:

Not much at that time, no. Way back when we got started AWACS, we had worked very closely with the Air Force.

Hochheiser:

But by this point it's pretty much working with Boeing?

Skillman:

Pretty much, yes, since they became the system prime.

Hochheiser:

Now was the actual production done here in Baltimore as well?

Skillman:

Yes.

Hochheiser:

So did you get involved with the plant, with the people actually making the things?

Skillman:

To the extent that we, or I, approved all the things that were changed as it went through the initial design phase.

Hochheiser:

Did your involvement continue past '76 with AWACS?

Skillman:

Yes, I was on it for another I don't know how many years after that. Jim Allen had taken over as program manager at that time, and I was his right-hand man for systems problems.

Hochheiser:

What system problems do you recall? It's in production. What is your role now over the years, starting from '76, when it's in production on the project?

Skillman:

Good question. Other things that happened; we talked about adding more modes to it. They wanted to add a maritime mode to detect ships on the ocean. So that was another big effort to go through to decide how to do that, what modifications would need to be done, and eventually were put in. That was another part of the growth afterwards. Specific problems I can't identify any right now. But one comes to mind that happened during refueling over Saudi Arabia, I believe. After refueling an error in the navigation system caused the antenna beam to be directed to an impossible angle and this resulted in burning up parts of the antenna. Lots of detective work to fix that!

Colleagues at Westinghouse

Hochheiser:

When did you get involved in teaching radar engineering internally here at Westinghouse?

Skillman:

I don't remember just when I started with it. Maybe it's in my resume.

Hochheiser:

I didn't see a specific date

Skillman:

I taught it for something like 20 years, but I can't remember the dates. Initially we taught it as a group; we had about six guys that were teaching the subjects that they were most expert in. But the way, Harry Smith taught me in the first course, way back about '58, I guess.

Hochheiser:

What can you tell me about Harry Smith? He's clearly one of the most important figures in the history of this operation - and of course we just missed the opportunity to interview him.

Skillman:

Yes. I was in the hospital with an operation of my own so I missed his funeral, but my wife went in my place.

Skillman:

Harry and I were pretty close. During the early days every day he would come in with a new solution to whatever we were working on, Dave Mooney and I particularly at that time. Harry had enough knowledge of engineering to be dangerous because he'd have a solution that wouldn't work; but we had to convince him that it wouldn't work. He was a very innovative guy, though, interesting to work with. He's the one got everything started.

Hochheiser:

What can you tell me about Dave Mooney?

Skillman:

Dave was a genius. He never got excited, always went down and solved the problem one step at a time. He was the brains that started the pulse Doppler at Westinghouse. He was a very good friend. I'm living in Charlestown Retirement Community now and Dave was in Charlestown the last few years of his life. He died there. Great loss.

Hochheiser:

Yes, I know. Like Harry, Dave is a person who's come up in a number of these interviews. One of the things I saw on your website was discussion of a trip you took in 1980 to Iceland. Can you tell me a bit about that?

Traveling Around the World for AWACS

Skillman:

Well, it was an opportunity to see the AWACS being used by the Air Force. Very few radar people get to see that. It was interesting because they knew how to run it, they knew quite a bit about it. And it worked well; so I was impressed by it. And I'm proud to have been part of the operation that came up with that.

Hochheiser:

I know in the 1980s that AWACS systems were sold to the governments of a number of our allies.

Skillman:

That's true.

Hochheiser:

Did you play any role in that? Did things have to be adapted to the needs of other countries?

Skillman:

I was part of the sales group, you might say. I toured the Pentagon numerous times. When they were going to sell to the Saudis; a lot of people didn't like that, including my wife. But we eventually sold it to them. I went over and talked to the French about it. They were going to buy an E-2. And the Brits had their own version installed in a Nimrod aircraft . It was different from the AWACS; they were going to have one antenna in the nose and one in the tail and they eventually decided that wasn't going to work, which I had told them earlier.

Hochheiser:

So what led them to conclude that their system was not going to work as well?

Skillman:

Well, I think they found the problem, particularly with altitude line clutter that I told them they were going to have.

Hochheiser:

Now did you need to travel to these various places, to Britain—

Skillman:

[interposing] Yes.

Hochheiser:

To France, Saudi Arabia?

Skillman:

Yes. No, I never got to Saudi Arabia. I was on the verge; I was within a few days of going, but they canceled it.

Hochheiser:

Oh, why did they cancel?

Skillman:

I don't know. Politics.

Hochheiser:

You continued working on AWACS through the Eighties?

Skillman:

Pretty much. I did get off on an Army program, though, later on called Quiet Radar. And it had another name, MRSR—Multi Role Survivable Radar.

Hochheiser:

What was that?

Skillman:

That was for a vehicle-mounted radar with a mast-mounted antenna that looked around the battlefield. We worked with Redstone arsenal on that. That was bringing our pulse Doppler down to the ground and a lot of different things. It was interesting to work on that. And we started building it and then the program got canceled.

Hochheiser:

Any idea why the program got canceled?

Skillman:

I'm not sure.

Hochheiser:

Did you think the program was technically successful?

Skillman:

It didn't get that far.

Hochheiser:

How far did it get?

Skillman:

Well we'd just started building it and never got it all together so we never got to test it.

Hochheiser:

And was this a side light, a time away? And then did you go back to AWACS?

Skillman:

Well, I guess I was mostly on that program at that time. Once in a while AWACS had a little emergency and they'd consult me.

Hochheiser:

They'd call you back. Hey, we need a bit of your time"?

Skillman:

[interposing] Right.

Hochheiser:

And then what did you do once the Quiet Radar program ended?

Skillman:

Mostly miscellaneous programs. Nothing too exciting.

A Lifetime in IEEE

Hochheiser:

To switch gears a bit, you know I'm from IEEE, so I know you're a Life Fellow of IEEE, so I'm going to ask you a little bit about that. You started out in engineering physics?

Skillman:

Yes, that was my B.S. degree, then Physics was my M.S.

Hochheiser:

So when did you first join IEEE? What led you to do so?

Skillman:

Oh dear. I don't know; you can probably find out when I joined.

Hochheiser:

I can find out what IEEE records say. I have found in asking people that sometimes there are errors in our records. Our records say 1961.

Skillman:

I don't remember. That's probably correct; I have no memory of it myself.

Hochheiser:

In what ways, if any, were you involved in IEEE? Societies? Conferences? Publications? Sections?

Skillman:

Well I was active on the AESS Radar Systems Panel; I'm an emeritus member now.

Hochheiser:

Which was?

Skillman:

That panel runs various conferences on radar.

Hochheiser:

I know.

Skillman:

But I hardly ever get to the meetings.

Hochheiser:

And then in 1985 you were elevated to become an IEEE fellow?

Skillman:

Yes.

Hochheiser:

What were you recognized for?

Skillman:

"Contributions to the field of pulse Doppler radar."

Hochheiser:

Yes, I know, but that's one sentence; do you recall any more detail beyond the one sentence and the actual citation?

Skillman:

No, I don't think so.

Hochheiser:

Do you recall if there's any kind of ceremony?

Skillman:

Yeah, I think I went to one; I think I said a few words about it. We're going way back here. Can't believe I've been retired almost 19 years.

Hochheiser:

It's kind of interesting to see what one remembers after lots of years and what sticks in one's mind and what doesn't stick in one's mind. You said you were on the IEEE radar board that planned conferences. Did you also participate? Did you give papers, chair sessions?

Skillman:

No. I guess my most valuable contribution was in regard to a glossary of terms which was one of the products of that group. I worked on that for quite a while. I went to the meetings but I didn't want to attend too many conferences. Did I chair one? I think I chaired one session.

Reflections on Career at Westinghouse and IEEE

Hochheiser:

Going back to Westinghouse. So after the mobile radar for the Army project was canceled, you're now working on a bunch of miscellaneous projects. Where are you organizationally at this time? Who are you reporting to?

Skillman:

The last boss was Kelly Overman, who later started working on battery-powered cars. I had known Kelly quite awhile.

Hochheiser:

How did you get your projects? Where's the work coming from? You're getting all these little miscellaneous projects to work on.

Skillman:

Well, it comes from marketing and from the boss. I guess there was one program I worked on with—it was Drome [spelling?]. Can't remember much about it, though.

Hochheiser:

Now did your title continue to be fellow engineer at this time?

Skillman:

Well at some time it became advisory engineer.

Hochheiser:

Okay, what does that mean?

Skillman:

More money.

Hochheiser:

Okay, so it's a promotion to a title with a higher salary rather than a change in the nature of your activities?

Skillman:

That's correct.

Hochheiser:

Because sometimes a promotion—a new title means you're suddenly doing something different

Skillman:

Got more people or something, no, not in this case. And I guess then Senior Advisory Engineer and then Consulting Engineer. Yeah, again, all more money.

Hochheiser:

I found in at least one or two other cases someone received a title of consulting engineer as a transitional title before retirement. I don't know if that was the case for you?

Skillman:

I don't think so.

Hochheiser:

Is there anything at all notable from the latter part of your career? Were you just working on a series of miscellaneous projects until retirement?

Skillman:

Yeah, nothing real big that sticks in my mind.

Hochheiser:

After AWACS there was nothing to quite as notable.

Skillman:

That's true.

Hochheiser:

What was Westinghouse Baltimore like as a place to work? Atmosphere, collegiality?

Skillman:

I thought it was a great place to work. Never having worked anywhere else I didn't have anything to compare it with. But I certainly loved working with the people there. Most of them were very good, we got along very well.

Hochheiser:

Then you retired in 1993? What led you to retire at that time?

Skillman:

As a consulting engineer you have to retire as all higher management has to retire at 65.

Hochheiser:

It was simply that you reached the mandatory retirement age?

Skillman:

Absolutely.

Hochheiser:

In what ways have you kept yourself active since your retirement?

Skillman:

I'm still doing programming; I'm still working on, the books—or the programs for the books that I had published. I did a little bit of that, and I did some consulting work after I retired. But I switched over mostly to genealogy.

Hochheiser:

Can you tell me a little bit about your publications, about your writing?

Skillman:

Yes. Dave Mooney and I co-authored the pulse Doppler radar chapter in the 1st Edition (1970) of the Radar Handbook edited by Merrill Skolnik. We also revised that chapter for the 2nd edition (1990). Now there's a third edition out with people I don't even know who wrote that chapter.

In the early '80s pocket calculators became available, followed by programmable versions. The TI-59 programmable calculator had considerable capability so I wrote many radar-oriented programs for that calculator. I used them quite a bit instead of using—we didn't have personal computers at the time—so I used that quite a bit in designing radars. I wrote a lot of different programs to do different things. Then I wrote the hard-cover book Radar Calculations using the TI-59 Programmable Calculator. Then I converted these programs to BASIC and published several other volumes of a few programs soft cover. Unfortunately the TI-59 is no more; there's no support for it, no nothing. Too slow, compared to PCs.

Hochheiser:

That's how technology goes.

Skillman:

Yes, that's incredible.

Hochheiser:

One other IEEE thing—I know in 1995 you were awarded the AESS Pioneer Award.

Skillman:

Correct.

Hochheiser:

Can you tell me a little bit about that?

Skillman:

That was awarded to Bob and me for having developed the AWACS. The citation reads: "For contributions in the leadership and development of the Airborne Warning and Control System (AWACS)."

Hochheiser:

Do you recall whether there was an awards ceremony of some sort?

Skillman:

Yes, there was an awards ceremony at NAECON at Dayton, Ohio.

Hochheiser:

Was that at an AESS meeting?

Skillman:

The award is from the AESS but NAECON is an IEEE meeting.

Hochheiser:

In what ways, if any, did the operation here in Baltimore evolve or change over the course of your career?

Skillman:

Besides getting bigger?

Hochheiser:

Well that's one thing.

Skillman:

It expanded a lot. I don't know how to answer that question. It didn't change over to Northrup Grumman until after I retired.

Hochheiser:

No, not until after several years later. In what ways did the overall technology evolve and how did that affect your work. I just think just even over the many years you worked on AWACS, the underlying technology and the miniaturization and —

Skillman:

Well, yes, things got smaller. The transmitter, though, was the old-fashioned—you might say old-fashioned klystron for AWACS. I had a go-round on that because of one of these detailed problems that arose because the manufacturer of the klystron had changed the design unknowingly bringing up a new problem for us that he'd never dreamed of. And I finally analyzed it and figured out what had happened. Afterwards they modified the design of the klystron slightly to ameliorate this problem. Another change was the introduction of digital processing. Originally our pulse Doppler radars used mechanical crystal filters to separate target signals, but the digital processing came along and the Fast Fourier Transform was re-invented by Cooley and Tukey to perform the same functions as our analog filter bank.

Hochheiser:

Looking back, how would you characterize your career as a whole?

Skillman:

[Whew], very satisfying. Good to be able to work on various programs that were good for the defense of the country.

Hochheiser:

Then in 2003 you received another award from IEEE, the Dennis J. Picard medal for radar technologies and applications. Can you tell me anything about that award and ceremonies involved with it?

Skillman:

Yes, that was another big ceremony, black tie, kind of interesting.

Hochheiser:

In what ways?

Skillman:

Yes, this is not just radar; this is all IEEE.

Hochheiser:

Right, this is a bigger award than the one from the '90s?

Skillman:

Absolutely, yes. Very nice. I don't know, do we deserve these awards? There were so many people. As Bob Cowdery used to say, "AWACS had a thousand heroes," why single us out for the Pioneer Award particularly?

Hochheiser:

Well I guess you can't really give an award to 1,000 people.

Skillman:

No, but we had a big meeting to share it. Air Force came in and had quite a meeting out in the hangar to celebrate the Pioneer Award.

Hochheiser:

Well, I seem to have turned all my cards over.

Skillman:

Good.

Hochheiser:

At this point is there anything that you would like to add or talk about that I've not thought to ask you?

Skillman:

No, I don't think so.

Hochheiser:

Well, in that case we're done. I thank you very much; I've enjoyed sitting and listening to you.