ORAL HISTORY: Jack Spangler

About Jack Spangler

Jack Spangler was born and raised in Floyd County in southwest Virginia. He studied physics at Virginia Tech, receiving his degree in 1953. After graduating, Spangler began working at Westinghouse in Missile Ground Control Engineering, but he was drafted into the Army after only a few months. In the Army, Spangler worked in intelligence, utilizing his background in physics and electronics. Upon leaving the military, Spangler returned to Westinghouse, where he quickly joined the supervisory and managerial ranks, serving as senior engineer, supervisory engineer and program manager. During his long career at Westinghouse, Spangler worked on many important projects such as BOMARC, Typhon, SPADE, Deep Submergence Program, and a meteorological satellite. Spangler retired in 1994, but remained active consulting for the Air Force and Aerojet, as well as writing books on the DMSP, genealogy, and the war with Japan during World War II.

In this interview, Spangler discusses his education and military service, but focuses mostly upon his career at Westinghouse. He talks about the various projects he was a part of at Westinghouse, but is particularly detailed about his work on the meteorological satellite, a project which he worked on from 1966 until his retirement in 1994. Spangler discusses working in an aerospace program, as well as with the Air Force and other companies such as RCA and Harris. The various issues, challenges and evolutions involved in the satellite are also covered, along with the new technologies utilized on the satellite over the years. The uses of the satellite are discussed – both military and civilian – as well as the longevity of the program, which is nearly 50 years old. Spangler also talks about his managerial role, how he took on a strictly supervisory role, working with customers, and building a successful workforce.

About the Interview

JACK SPANGLER: An Interview Conducted by Sheldon Hochheiser, IEEE History Center, 13 October 2010

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Interview

Interview: Jack Spangler

Interviewer: Sheldon Hochheiser

Date: 13 October 2010

Location: The National Electronics Museum, Baltimore, Maryland

Background and Education

Hochheiser:

It is October 13th, 2010. I'm Sheldon Hochheiser of the IEEE History Center. I'm here at the National Electronics Museum with Jack Spangler, retiree from Westinghouse here in Baltimore. Good morning Jack.

Spangler:

Good morning, sir.

Hochheiser:

If you'd start off with a little background, where were you born and raised?

Spangler:

I was born in a small community in Southwest Virginia, a place called Floyd County. I lived on a farm for my first16 years or so. I graduated from high school about the age of 16 and then I went off to college at Virginia Polytechnic Institute in Blacksburg.

Hochheiser:

What did your parents do?

Spangler:

My parents were farmers. I lived on a farm all my life until I went off to college. My father was a WWI veteran and brought back with him a painful injury sustained in the line of duty in France. However, using progressive farming techniques, he was able to keep up with the farm work and eek out during the depression years a living for our family of five on his 160-acre farm. Life on the farm can be tough at times especially during the depression years, but my parents would have it no other way.

Hochheiser:

I always assume that some people who lived in farm country were the guys in town who ran the feed store or something.

Spangler:

No. That was not the way. This was the Depression era and everyone in the county was either a farmer or bootlegger.

Hochheiser:

Were you interested in technology and science as a youth?

Spangler:

Oh yes. When I was ten or so years-old my dad bought me an old antique Atwater Kent radio that I wish I had now. It'd be worth thousands of dollars. I tore the radio apart and made all sorts of radios and other electronic gadgets out [of] the parts. I was really interested in radio.

Hochheiser:

Were you a ham?

Spangler:

No, I could never learn that code. I could get to five words a minute but that was about it.

Hochheiser:

What led you from Floyd County to Virginia Tech?

Spangler:

No one in the family had ever gone to college. My mother and dad definitely wanted me to go even though they really couldn't afford it. So, I went off to college where I basically worked my way through. Tuition was only like $50 a quarter at that time. My most expensive book as I recall was $1.35 which was an engineering drawing book. I graduated with a BS degree in physics in four years.

Hochheiser:

What led you to physics rather than some other course of study?

Spangler:

At that point in time the college advisors were all saying don't become an engineer because the engineering profession is full and jobs will be hard to find. So, I chose Industrial Physics that was [a] close second to engineering.

Hochheiser:

Were you in ROTC at Virginia Tech?

Spangler:

No, I was not in ROTC. I couldn't afford it. ROTC required you to stay on campus. I worked at a hotel as a night clerk for my room and I worked in the hotel restaurant waiting on tables to get something to eat. Consequently, my spare time was very limited as to getting into outside activities. My social life as well was very limited.

Hochheiser:

You were too busy.

Spangler:

That is correct. I was too busy. My spare time was spent either studying or working at other odd jobs including evenings and weekends.

Hochheiser:

So you graduated when?

Spangler:

In 1953.

Going to Westinghouse, Army

Hochheiser:

And what led you from Virginia Tech to Westinghouse?

Spangler:

I had an interview on campus. The job situation was not as bleak as the experts had predicted four years earlier. Engineers, at least VPI graduates, were in demand. Lloyd Clark and I think Don Cole from the BOMARC Missile Ground Control Department came down from Baltimore. It was a group interview if you will. Everybody in the class that was interested in Westinghouse attended – there were only about four or five there. The interview went something like this - "We've looked at your academic records. We know Virginia Tech is a good school. We're going to make an offer to each of you." Westinghouse was only one of several job offers I received. Glen L. Martin, also in Baltimore, offered more money but I didn't like their reputation for hiring and firing for the job. And of course I knew Westinghouse had a reputation that once you become a Westinghouse employee, you're there for life.

Hochheiser:

Well, I guess that worked out for you.

Spangler:

That worked out - 41 years later I retired.

Hochheiser:

And then you came directly to Baltimore?

Spangler:

I came to Baltimore and was here for only a few months before I had to go into the Army for a tour of duty.

Hochheiser:

You got drafted?

Spangler:

I got drafted over the objections of Westinghouse. I came back to Westinghouse after I was released from active duty.

Hochheiser:

Can you tell me a little bit about your experiences in the Army?

Spangler:

Sure, but some of the areas we can't go into in any detail because of the area where I served and the long term security commitment I made when I was released. Some of the programs I was associated with had a 50-year information release restriction and as far as I know still have not been declassified.

I was inducted into the army at Fort Meade. During the orientation process, I had a Job Classification Interview. They came up with a MOS for everybody in my group of inductees.

Hochheiser:

MOS?

Spangler:

Yes. The MOS or Military Occupational Specialty is a job description of what the army wants you to do and thinks you are qualified for. At the Classification Interview I had a nice letter from Westinghouse that talked about the technical things that we at Westinghouse were doing at the Missile Ground Control Engineering Department which I was a part of. It specifically addressed missile ground control equipment design work and so forth. In addition to having been employed by Westinghouse, I had worked for the government civil service during the summer months doing test and evaluation work on a new weapon called Atomic Annie.

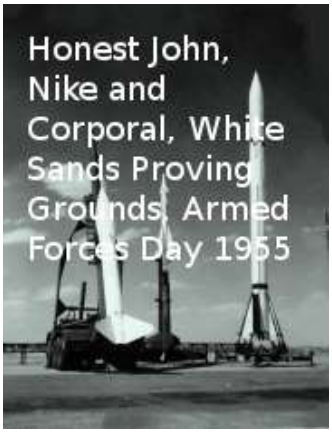
During the interview, I mentioned that my testing, data analysis and evaluation experience might be useful to the Army. Also, I used the words electronics, physics, atomic, missiles and rockets as well as highlighting, to some degree, design experience at Westinghouse in my sales pitch. The interviewing officer listened and then went through his list of job descriptions that the army needed to fill. He came up with something called Aviation Intelligence Electronics Engineer or something like that. I cannot recall at the moment exactly what it was called.

Hochheiser:

That's okay.

Spangler:

Yes, my MOS had something to do with intelligence. With a college degree in physics, some work experience and an extremely high score on the army placement tests, I qualified as a scientific and professional electronics engineer. But, I had no idea what the aviation part meant since I thought I was in the army.



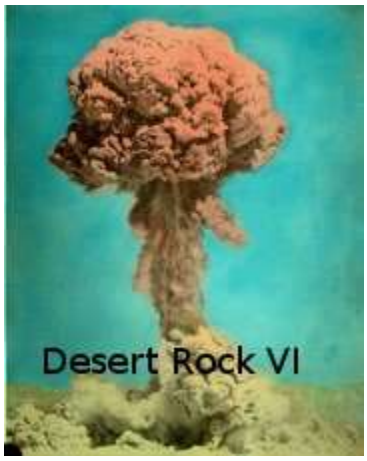
And so they sent me from Fort Meade to Fort Knox for eight weeks of basic training and then to White Sands Proving Ground. I was there for a few months doing "gofer" type stuff while my clearances came through. Well, not Beetle Bailey type stuff but technical work with missiles and rockets. I assisted in testing of the Corporal, Aerobee, Viking, Honest John, Lacrosse, Terrier, and other missiles.
After my clearance came through, I got reassigned to other activities and went TDY. I don't think we want to go into those activities in much detail.

Hochheiser:

I quite understand that there are such things. Anything else you can or wish to tell me about your tour in the service before we move back to Westinghouse?

Spangler:

Well. It was good. I enjoyed it. I got to see and do a lot of things that I would not do otherwise or otherwise have seen. To give a little insight into the types of work my Army assignments may have included, and without going into any specifics, I'll mention some generic examples of some of the things that were happening at that time.



The Korean War was winding down and the Cold War heating up. Strategic and tactical missiles were being tested at White Sands. Atomic weapons were being tested at the nearby Nevada test sites. The old OSS was being disbanded and the new CIA was being formed. In Asia, the US was flying "training and weather gathering missions" almost daily using unmarked black B-29s and other aircraft. These

planes were loaded with the latest electronic intelligence and communications equipment. They flew over Korea, off the coast of China and to other places. I don't know for sure but I suspect they were probing the Chinese defenses and communications in case an invasion of the mainland became necessary. You can draw your own conclusions as to the purpose of these flights.
Also my first few months at White Sands were quite interesting and exciting times. I got to see a lot of things happen that I would never have seen otherwise. For example, Corporal missile No. 100 launch was supposed to be a big show for Congressional VIPs. They had bleachers set up about a mile and a half back from the launch site. Some VIPs were even up front, up near the launch pad or in the blockhouse. They lit the thing off. It goes up. It goes south toward El Paso instead of north to the impact area. Guys were jumping around, scrambling, trying to find a place of safety. I was on the roof of C-Station looking up at that thing going overhead at a few hundred feet, spouting a stream of fire. After it got just beyond where I was located, the range safety officer killed it. Burning parts fell on the airfield where the Congressmen had parked their airplanes.

Hochheiser:

Where was this?

Spangler:

This was at White Sands.

Hochheiser:

At White Sands.

Spangler:

Yes. And there were a few other similar memorable incidents I witnessed. The Nike Test Program had another show for Congressional leaders. The plan was to shoot down a F6F target airplane with a direct hit. They had three F6Fs ready and flying in the target area and three Nike missiles poised on their launch pads. Everything went great during countdown. They fired Nike No.1. It was not a direct hit but exploded nearby and actually killed the target plane but the program really wanted a direct hit for show purposes. So, they fired Nike No. 2. It went straight up. It was fired five degrees from the vertical and was supposed to turn over at 30,000 feet and go after the target but it just kept going until it ran out of gas. Next they fired No. 3. It took off and went west towards Los Cruses, New Mexico and impacted in the Organ Mountains.

I also know of a few more of those embarrassing incidents. For example, Viking 12 was being test fired on its launch pad as a static firing to measure the motor thrust. During the test, the missile broke away from the launch pad and went skipping around on the desert floor. I believe they picked up the pieces, repaired it and later launched it. If you're ever in the Smithsonian Aerospace Museum, you'll see Viking 12 there. I happen to have a picture of Viking 12 taking off. That's not Viking 12 in the Smithsonian. The tail number is incorrect.

Hochheiser:

You told the folks at the Smithsonian?

Spangler:

Yes. I told the Smithsonian the real story. It turns out that Martin had lost or destroyed the records of how many Vikings were made. They thought serial No.12 had never been launched. The one in the Smithsonian was built up using surplus parts and so they stuck the No. 12 on it. I have given the Smithsonian a picture of No. 12 taking off. You can see my photo on the internet.

Hochheiser:

Now when you went into the service did Westinghouse promise you there'd be a position when you got out?

Spangler:

Yes. That was law at the time.

Missile Ground Control, BOMARC, Management

So I came back, and went back to my old group in Missile Ground Control Engineering at Parker Road.

Hochheiser:

So your years in the service are done. You come back and you go back to your old group, presumably they've been moved ahead some in the two years you were gone.

Spangler:

Oh yes, almost. I was in the standby reserve for another 6 years. Somewhere along the line the Army transferred me from inactive status to a ready reserve unit and issued a call up alert. However, the unit was not activated.

Now back to Westinghouse. We had just received the BOMARC contract when I left and all we were doing at that time was reading up on the requirements and block diagramming potential implementation. When I returned two years later they had made great progress. Hardware had been built. My first job after returning was writing GX letters if you know what they were.

Hochheiser:

What are [they]?

Spangler:

That was change notices to fix problems. That was a good learning experience for the Westinghouse drawing system and getting familiar with the hardware.

Hochheiser:

And this was part of the BOMARC project?

Spangler:

Yes, it was part of the BOMARC project. It was the Missile Ground Control Engineering Department who had the responsibility for the BOMARC ground test equipment.

Hochheiser:

And who did you report to when you came back?

Spangler:

Oh, Len Ulman was the section manager. My immediate supervisor was Howard Kuehn and my mentor was Bob Wesen.

Hochheiser:

How long did you write change notices before you moved on to something else?

Spangler:

Oh, that was a matter of a couple months. Then I went into the design work, doing some new design as well as design fixes. That obviously got more interesting.

Hochheiser:

What was your role in doing this? I assume this was a bigger job than one person.

Spangler:

The project group I was in was responsible for designing and building some equipment called an A to D converter. An A to D converter - analog to digital converter - these days is a component chip maybe a half inch square or less.

Hochheiser:

Right.

Spangler:

In those days, we had four A to D converters in a 90-inch high equipment cabinet with standard 24 inch panels, 30 inches deep. That's how much things have changed. There were only 4 A/D converters in each cabinet. And, they operated very, very slow compared to today.

The BOMARC ground control system had analog trackers and a digital central computer. Matter of fact, our program bought the UNIVAC 1100 series computers. As I recall, the program paid for the design of the 1100 series computers and we got the 1100 or 1101. Now you can buy a hand calculator the size of a cell phone that will do many times as much as that computer would do. That computer had 1K of magnetic core memory. A core was about a half inch in diameter, wound with a few wires on it; a flip-flop was two vacuum tubes. That's how things have changed. The bulk storage was a drum. That

thing was probably about 2.5 to 3 feet in diameter. It had 60 tracks as I recall and was a pain to keep working.

Hochheiser:

And what were you using the UNIVAC for?

Spangler:

The UNIVAC was the central computer for the system. This BOMARC ground test equipment system was designed to "test it like it flies," that is track targets and launch and control a missile as if it were in real flight. And incidentally our test equipment could be used in an emergency situation where they only wanted to defend a small area.

Hochheiser:

And this went through several iterations? XW-1?

Spangler:

XW-1, XW-2 and XW3

Hochheiser:

And what was this evolution from 1 through the 3?

Spangler:

The XW-1 was the very first generation. It went to Patrick Air Force Base for testing of the missiles. And then XW-2 I think went to Tampa, also for test purposes. XW-3 went to McDill, also for testing purposes.

Hochheiser:

Where's McDill?

Spangler:

Florida.

Hochheiser:

Also Florida.

Spangler:

Yes. The evolution of the computers showed greatly between those three. The XW-1 computer consisted of a row of cabinets, probably 25 feet long with a large air conditioner on each end. The computer console was the size of a big desk. The XW-3 computer was a cube maybe 4 feet in dimension.

Hochheiser:

So does that mean between the XW-1, the XW-3 you moved from vacuum tubes to transistors?

Spangler:

XW-3 was partially transistorized -

Hochheiser:

[Interposing] Transistorized. Which helps explain why it got a lot smaller.

Spangler:

Yes.

Hochheiser:

But it's only partially - you're still using a mixture of vacuum tubes and transistors.

Spangler:

Yes, vacuum tubes have been around a long time. Transistors were just showing up. Just to diverge a little bit, we still have a vacuum tube flying in space on the sensors we'll talk about a little bit later, the DMSP sensor.

Hochheiser:

We will certainly get to that. Over the six years you were in missile ground control engineering, how did your position evolve? Did you get promoted or moved to different assignments?

Spangler:

Oh yes. Uh, things were different back in those days. I typically got a raise every six months. And the numbers were good too, like 10%. But that's not the way it is today. I was promoted from a code 3 junior engineer to senior engineer in less than five years and made a supervising engineer in six and a half years. By having a degree in physics, I started as a code 3 as opposed to those with engineering degrees who started as code 5 assistant engineers.

Hochheiser:

How did you find that transition from being a guy on the bench to managing people?

Spangler:

No different. We all worked together as a team. That's one thing about Westinghouse. It was a team effort. You couldn't tell who the bosses were. They all worked together. And as you know, after BOMARC I moved over to the Typhon program as a senior engineer. From Typhon I moved as a supervisor to a sonar equipment contract for the Navy.

Hochheiser:

Okay well we'll get there. Anything else on your work while you were working on BOMARC? How closely did you work with other contractors?

Spangler:

The area where I was working in, our contractors were only piece part suppliers. I did not get involved with Boeing. Bob Wesen our Project Engineer handled those contacts.

Hochheiser:

I've spoken to other people who worked on other parts of the BOMARC project who ended up working closely with counterparts at Boeing. I don't know this until I ask you.

Spangler:

Yes. The equipment that we were working on, we didn't get involved that much directly with Boeing or the ultimate customer.

Hochheiser:

Um-hum. So you didn't get involved with the military, with the government either?

Spangler:

No, not at that point in time.

Hochheiser:

Anything else on your BOMARC work before we move on?

Spangler:

One thing I can tell you is it was a very interesting assignment. I got lots of very good experience working with hardware. We got to do some of the first digital work that was done in Westinghouse Baltimore. And we were among the first to use printed circuit boards. We used printed circuit boards with vacuum tubes and that didn't work out too well because the boards were flexing and breaking the tracks.

Hochheiser:

Yes. I hadn't heard too much about printed circuit boards with vacuum tubes and maybe that's why.

Spangler:

Yes, we were using PC boards and vacuum tubes and tube sockets and so forth. And they had a tendency to cause a lot of problems.

Hochheiser:

Would it have been a problem with the heat given off from the vacuum tubes and the boards?

Spangler:

We never had any problem with heat. We just had mechanical problems with people pulling tubes out and putting them back in and then the circuit ceased to work. You troubleshoot the problem and find a broken connection.

Hochheiser:

So did you have to retreat back from out of circuit boards then?

Spangler:

Well at that point the schedule did not permit wholesale redesign. We left the boards in but we beefed them up mechanically so that the boards would not flex when the tubes were inserted and removed. On the later XW-3 designs we used subminiature tubes for some of the analog circuits that did not have the socket problem. As I recall all of the digital circuitry was transistorized as well as some of the analog circuits.

Typhon, SPADE

Hochheiser:

What led you from BOMARC into Typhon in 1960?

Spangler:

Yeah. Well, Typhon was the big program at that time and they needed people and BOMARC was tapering off.

Hochheiser:

Right.

Spangler:

So I went to the Typhon program. And there, I worked with the microwave switching equipment, and the digital circuitry for controlling the horns. Typhon had an electronically steerable array. I didn't stay on Typhon very long because we had other programs coming up in the undersea area that needed people.

Hochheiser:

Well, how did this work? How did you end up going from BOMARC? Did somebody call you in and say, we need you there or did you say, hum, I'm looking for something else, is there? BOMARC is coming down, you know - how does this movement get orchestrated?

Spangler:

It was more or less by groups of people.

Hochheiser:

So you and your whole group, you moved together with the people you were supervising.

Spangler:

[Interposing] Yes, from BOMARC into Typhon but not as a supervisor.

Hochheiser:

About how many people was this?

Spangler:

Golly I don't recall. It was probably as many as 10, maybe 12.

Hochheiser:

So you were only working on Typhon then for a short period of time?

Spangler:

Yeah, I can't recall how long it was.

Hochheiser:

Right.

Spangler:

It was not very long. There was another Navy program gearing up and they needed people. I went on to that program and to a new group of people as a supervising engineer.

Hochheiser:

Now was this the same group or is it a different group?

Spangler:

It was different people.

Hochheiser:

Okay. So you moved and the people you had been supervising didn't move with you.

Spangler:

That is correct.

Hochheiser:

Right, so you now have a new group again.

Spangler:

Basically a new group.

Hochheiser:

Is [it] somewhere again the same size?

Spangler:

Probably about the same size. They tried to limit the number of people that each supervisor had to 10 or 12. We were doing design work associated with an electronic steerable sonar transducer array for submarine use.

Hochheiser:

That makes sense. I guess that's somewhat a switch going from in the air to under the water.

Spangler:

Yes, it was.

Hochheiser:

So after this time in Typhon now you moved over to sonar.

Spangler:

It's called SPADE. And I can't recall what that meant*. [Sonar Processing and Display Equipments]*

Hochheiser:

That sort of thing can be looked up.

Spangler:

Yes.

Hochheiser:

What was your role in the sonar project? What part of it were you doing?

Spangler:

My group was responsible for the data handling and the display equipment.

Hochheiser:

So were you developing the equipment that would then be installed on the submarine?

Spangler:

That's correct. But the electronics - that is the receivers, the transmitters, computers, data handling and display equipment - finally outgrew the available space on the submarine and the program was cancelled.

Hochheiser:

Okay, so the requirements for the equipment got to the point where it was too big to fit in the submarine? Is that what you're telling me?

Spangler:

It grew to the point that it was too big to fit in the space available. I don't believe the transducers were a problem but the controlling and data handling equipment just got too big.

Hochheiser:

So did that mean that they did without sonar at that point?

Spangler:

Oh no, no. SPADE was a new concept. They obviously had others. And by that time, you know, transistors were coming into play and vacuum tubes were out.

Hochheiser:

[Interposing] So did the SPADE program then still use some vacuum tubes?

Spangler:

Yes, some, but it was primarily transistors.

Hochheiser:

Okay, and then it gave way to another approach that was straight transistors.

Spangler:

I don't know what followed on that because I then got involved with new business.

Hochheiser:

Ah. Were there other groups within Westinghouse who were involved with the SPADE project that you worked with?

Spangler:

Oh yes. It was a large program. And mostly in the Underseas Division on Washington Boulevard.

Hochheiser:

Now did you move to Washington Boulevard then when you did this or -?

Spangler:

No. My group stayed at the Parker Road plant. The areas where we [we]re working in were pretty well defined and could be carved out and worked offsite.

Hochheiser:

Right. So it was not necessary for you and the people who are working for you to move over where the rest of the people working on the underseas project were working.

Spangler:

[Interposing] It was not physically necessary to be in the same location, although we had lots of meetings.

Hochheiser:

I guess it wasn't that far anyway. It was just down the road.

Spangler:

Correct.

Hochheiser:

Right. It's not like you're working with a group in Pittsburgh or something.

Spangler:

Yes. On this program, I got involved with the customer a lot. We had monthly meetings with the customer, going over the requirements and progress. And I think a lot of the increase in size came from the fact that interpretation of the requirements kept growing and changing. And to meet these additional requirements the physical size got significantly larger and the costs and schedule suffered.

Hochheiser:

By the customer, do you mean a group within the Navy?

Spangler:

Yes, NEL, the Naval Electronics Lab in San Diego.

Hochheiser:

So did this require you to go out to San Diego for these meetings?

Spangler:

Once a month we would go to San Diego for a meeting. And NEL would bring in not only civilians but also operational, Navy people.

Hochheiser:

Now was there ever any discussion about how these changes in the requirements were endangering the project because of the physical constraints?

Spangler:

Obviously it was brought up. The scientists would say we want this and we want that and maybe we can fit it in. Eventually the hardware got to the point where it was too big and costly.

Hochheiser:

Would it be fair to say that at least some of the problem with this was disagreement between the Navy scientists and the Navy operations people?

Spangler:

Hum. I don't know how to word an answer to that question. So yes, there were differences between what the scientists wanted and what the physical space limitations would permit. So, it depends upon how you interpret their answer.

Hochheiser:

So you stayed with the SPADE project until it was cancelled?

Spangler:

Yes.

Deep Submergence Program, Air Traffic Control

Hochheiser:

Now when it was cancelled how much scrambling around did you and your staff have to do to find other spots?

Spangler:

Oh, there was no problem. A lot of them went directly back to the Underseas Divisions on the other programs.

Hochheiser:

Right.

Spangler:

There was another called WDSP going on about the time. You may have heard of it - Westinghouse Deep Submergence Program.

Hochheiser:

Maybe you can tell me a bit about it.

Spangler:

I don’t know whether I can or not.

Hochheiser:

Well, tell me what you think you can tell about it. I realize there are things that even after many decades are still things you can't talk about.

Spangler:

On the WDSP program Westinghouse was doing several things one of which was the underwater recovery vehicle called the DSRV designed to recover people from a damaged submarine in 30,000 feet of water. When you think of that it makes you wonder, is that really going to happen or was there some other reason for that? I can only conclude there was probably some other use for the DSRV. You might get some other people that can tell you more.

Hochheiser:

Well that's fine. You know what you can talk about and what you feel you can't talk about.

Spangler:

I don’t want another black SUV showing up in my driveway, my phone ringing and somebody saying, this is so and so from such and such agency. I am parked in your driveway. Can I come in and talk to you? Obviously no was not the right answer. My answer was “I’ll come out and talk with you.”

Hochheiser:

Understood. Can you tell me now in your work with WDSP, are you supervising a group of people?

Spangler:

Yes, I had one or two people working on it.

Hochheiser:

Okay.

Spangler:

I really didn't get that much involved personally.

Hochheiser:

Okay. By this point was your work more supervisory than engineering in nature?

Spangler:

[Interposing] Strictly supervisory.

Hochheiser:

Okay, is this a change then from Typhon or SPADE, where you were still doing some actual engineering as well as supervising people doing it?

Spangler:

Yes. But my job was now primarily new business at that point in time. Going out and talking to the Navy, talking to the FAA, talking to the Air Force etcetera, etcetera.

USNS Mizar, Aircraft Salvops Med Westinghouse "Fish" Team Off Palomares, Spain, March 1966

Hochheiser:

So the WDSP was only part of what you were doing at this point?

Spangler:

Yes. A very small part.

Hochheiser:

Okay, then perhaps since we can't talk about WDSP, [but] perhaps you can talk about some of the other new business you were trying to develop.

Spangler:

Yes. About this time, Westinghouse Surface Division, the West Building, hired a marketing guy named Ed Gumphrey. Ed was a former Air Force pilot and air traffic controller. He had been in Germany and some other places controlling tactical air operations for what he [called] "brushfire mission" training. Based on his experience, he saw a need for a new air traffic control system to better control these planes to get them to the designated targets, to know what was going on in the surrounding air environment and get them back home. To get more background data a small group of us made lots of trips to the tactical Air Force, to the FAA and to various other agencies to see how they did the air traffic control and what were their problems.


Department of the Navy

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Westinghouse Electric Corporation

Undersea Division

for services set forth in the following

Citation

The tactical air command needed a global response team, so taking all this background knowledge into consideration, we designed on paper something called a manual mode facility for air traffic control. The system concept consisted of display equipment, plotting boards, radar sets and what have you. Ed Gumphrey kept telling us exactly what they really needed based on his first hand experience. We put together a system concept and went on the road trying to sell it. All equipment was fit into an air transportable shelter. We went all over the country presenting this concept to various Air Force people trying to drum up interest from someone with money. They liked the concept but did not have money to fund further studies or developmental tasks. During the wrap up of one of these meetings, I think this was out in [the] Fort Leavenworth area, a colonel asked why don't you guys go back and put this thing in an airplane and then come back and tell us how you can do it? We said, okay. So we came back and got with the Air Arm Division and selected Westinghouse radar and an airplane. Next, we modified our concept to fit in the airplane. We incorporated a digital tracker using the DIGTRAC concept that was an outgrowth of the BOMARC ground control system for tracking targets. We liked that idea since it was now all digital and went on the road again.

I just recalled one hilarious incident I will mention here. We had a meeting with George Shapiro of Air Arm and Morrie Wexler of Surface Division. The subject was selecting the radar for the aircraft and the location of the antenna. In the process there were some very heated discussions between Morrie and George. After George left the meeting, Morrie said, "when you get two Jews together, you'll get three opinions."

We continued marketing the digital airborne concept. However, Westinghouse was not getting any funding. Surface Division management got tired of funding the in-house effort and Westinghouse dropped out. We had the whole system, aircraft and everything. I guess Boeing picked up on it at some point. Sometime later, I think this concept may have later evolved into the AWACS system.

Hochheiser:

At which point Westinghouse was very much deeply involved again.

Spangler:

That's correct. I was not associated with it but believe Westinghouse interest was only with the radar. Not all the equipment that was inside the airplane as we had had before nor with modifying the airframe as we had been before. So, it was another case where Westinghouse got tired of spending money. Somebody else picked it up. But Westinghouse still got part of the pie. A piece of the pie is better than none

Hochheiser:

Exactly. Exactly. I guess it's a half full/half empty thing. One can say, hey if we'd kept up we might have had the whole pie but hey, because we started with it we ended up with a pretty nice chunk of the pie anyway.

Spangler:

I believe that is correct. And so the rest of that is history.

Space Programs, Meteorological Satellite

Hochheiser:

Any other new business you were pursuing during this period?

Spangler:

Yes. At the end of that time period we did some business explorations with the FAA. We didn't have much success, but then along about early 1966 Westinghouse got interested in the space business.

Hochheiser:

Right.

Spangler:

George Towner assigned a couple of his people, Bill Parnell and Jacob Beser, the job to get some new space business. Nick Petrou was interested in this too. He wanted to get into some of the big black programs. Jake and Bill made lots of trips out to the Air Force at SAMSO - Space and Missile Systems Organization - in Los Angeles, talking capabilities mostly as we did not have much hardware to offer. However, Westinghouse had a little experience with the lunar camera, lunar drill, AIMP and AERIAL scientific satellites and Apollo radar to talk about. First, I believe they talked with TRW. TRW said in order to get into this business on a big system it's going to cost you big bucks. You're going to have to get in there and spend money to demonstrate your capability. You're going to have to lose money on your first program. They were talking from experience.

Hochheiser:

Right.

Spangler:

Westinghouse bid with TRW on a radar set for something. TRW did not get the job but Beser and Parnell got contacts within the Air Force to whom they made more technical capability presentations.

At that time SAMSO had a program called P 35 or maybe P 417, I think it's 417 at that time. The Air Force said we've got something called Mission 2A - would you like to bid on it? Send us a proposal. Westinghouse sent them a proposal. They said we like your proposal, so here's a contract for X number of bucks. Here's some requirements. Go out and tell us how you would solve these requirements. Back at the plant we get hot on these requirements, collected some of the best brains in Westinghouse and started designing a system to meet the requirements using innovative concepts. Early in the study, we had a design review that seemed to go quite well. We continue the study effort for a few weeks then we get word the program was cancelled and submit your final report.

Hum. Wonder why? Yes. Send us a final report. We sent them a final report. It wasn't long, they came back and said "Westinghouse, we've got a couple hundred thousand

bucks. We have a requirement for a block change on an old system. We're perfectly happy with the contractors we have. They're doing a good job for us. The price is right. They're meeting the requirements. They're meeting their schedules. If you would like to bid on this and win you have to be better, your price has to be right, and your schedules have to be right and you must meet them. Are you interested?" We replied that we were interested. I think [the] previous contract may have been a test to see what our capabilities really were.

Hochheiser:

Yes.

Spangler:

So we get this copy of an RFP. It's handwritten. This was the first time I'd ever seen a handwritten request for a proposal or RFP, or for that matter a handwritten copy of a performance specification. Everything was classified Secret, Special Access. Our next step was to get a few people briefed so they could work on the study. Parnell and Beser got this request in on a Friday. I was in the Surface Division at the time and my boss gets the call from Aerospace - you guys better work over the weekend on this. So, we started our weekend work. I looked over the RFP. Initially I didn't have the slightest idea of what they were talking about. They were using terms as if the RFP had been written by a guy with long hair, a beard and [the] title professor. They used scientific terms. They even used the word kinescope. We haven't used that term in years. But as I went through the requirements, I concluded that they were looking for a sensor that would collect weather information from a satellite. They were also looking for a display system to display the data in a user friendly manner with emphasis on user friendly. They were looking for a data handling system to collect the data from remote sites and transmit it to a central site for further processing by a computer. They were looking for a receiving system that they could put out in the field that would stand autonomously. Using these as requirement and working with people from the Aerospace Division, we generated a proposal for the two segments: one for the display and user segment, and one for the sensor segment.

Shortly thereafter, we received two contracts – one for the sensor and one for the ground data handling and display system. This was on November 6, 1966. In a couple weeks, we had our first design review. It was almost like taking an oral for a PhD. On the other side of the table they had Air Force people, many holding PhD degrees, and one civilian from the Aerospace Corporation. They also had one other member who sat back in the corner and the only thing he would do was to nod or laugh or shake his head. I

still don't know who he was or who he represented. Well, it turned out that some of the people were from the NRO. We can use that acronym now. Back then we had to refer to NRO by the office letters, 4C-1000 in the Pentagon.

Hochheiser:

NRO, does that stand for something?

Spangler:

National Reconnaissance Office.

Hochheiser:

Oh sure. I have actually been there so I should have recognized the acronym.

Spangler:

Good for you, it's a hard place to get into.

Hochheiser:

Yes.

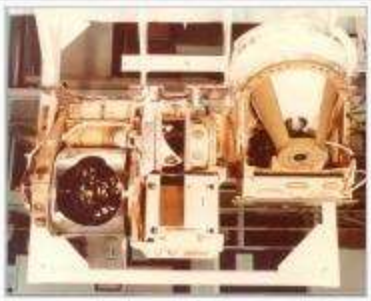
Spangler:

Anyway, the NRO and the Air Force were depending upon NOAA and NASA to provide them with weather information and for a satellite system that replaced the U2's that were over-flying China and the Soviet Union. They needed weather information since the satellite carried a film camera and they didn't want to make pictures of clouds. They wanted a weather system that would give them good high resolution and timely weather information so they could program these satellites to make pictures on cloud-free days. I later found out that NOAA and NASA was not meeting schedules, so the Air Force went off on their own and developed this system. Initially I think it was called P-35.

This was a secret program and here as usual they hid it in plain view behind a program called Discover or Discovery. They launch a Discover satellite. It makes all these good scientific pictures and information, collects scientific data, etc. They have press conferences and tell everybody about it. They launch more. It becomes old information.

Then they launch one that ain't a Discover satellite. These launches continued through Block 4. The study program I mentioned earlier was for Block 5 generation and the program designation had become P-417. We were competing against two and maybe three other companies for the Block 5.

So after we got through the study program midterm exam, we got a lot of questions and some very good comments from the customer and ideas to incorporate in our final design. It was revealed years later that The Aerospace Corporation had hastily built and flight tested (on an airplane) a proof of concept breadboard model of our sensor. The customer's ideas were incorporated in our final design and included in our proposals. In early '67 we were notified that we had won the contract. I guess it was around April, May or something like that of '67. So, during the Israeli/Arab War in June of '67, we negotiated the first Block 5 contract. Years later after I retired, I was told by a member of the Air Force original proposal evaluation board that it was the Westinghouse ground data handling and display system that won the contract – not the sensor. According to him, "any one of the study contractors could have built the scanner but we really liked your proposed display system. But we wanted to buy the system as a package."


Sensor System, Block 5C
Sensor and Display

I must say that the Air Force people that we dealt with were certainly the cream of the crop with the Air Force. That particular program has turned out more general officers than you can count on one hand. Jack Kupla, Don Cromer, Nick Chubb, Steve McElroy, John Weber and several others. Some attained 3-star rank. They were good people. Also, several of the lieutenants then are now CEOs of major corporations. So, it's been a very good program. I was on the Block 5 from the very beginning writing the proposals, developing the concepts, negotiating the contracts, building the hardware, operating the hardware and providing people that operate the hardware on orbit. I was on Block 5 from November of '66 until I retired in May of '94.

Hochheiser:

That's a long time on one program.

Spangler:

Yes. Guess I was in a rut, but I enjoyed it.

Hochheiser:

If we maybe go through this program a little bit in detail over many years.

Spangler:

Okay.

Satellite: Management, Customer and Contractors

Hochheiser:

So you get involved in '66 and you get the first contract in '67?

Spangler:

We had a contract in ‘66 to do the study so my tenure on the program was from November of ‘66 through May of ‘94 when I retired.

Hochheiser:

I assume now you're a bit higher level -

Spangler:

Oh yes. I managed the program and managed the department finally.

Hochheiser:

Okay, so you start out managing a program. I'm trying to figure out a little bit of the hierarchy of the way the company worked.

Spangler:

Yes. Initially I was the Program Manager of the ground data handling and display segment and it turned about to be quite a success.

Hochheiser:

And the ground segment, you had about how many people?

Spangler:

Oh at that point in time we probably peaked at maybe 30 or 40 people.

Hochheiser:

Okay, so then I assume there's a hierarchy. You've got supervisors below you, then, rather than having 30 people directly report to you.

Spangler:

I can't recall too much about it. I had a field engineering group drawn from FE&S as well as the design group and then people in manufacturing and quality drawn from the matrix organization.

Hochheiser:

So you would have reported to someone who was in charge of the overall program at the beginning?

Spangler:

Yes, the overall program manager initially was Bill Parnell and later Bob Howell and still later Tom Hollis. I succeeded Tom.

The Air Force SPO had a young major as the SPO System Engineering Manager. He later became a 3-star general. He was a workaholic, a slave driver. He would come into his office in Los Angeles at 5 o'clock in the morning and stay until 8 or 9 o'clock at night. And he expected some one responsible to be here at Westinghouse at the same time so he could call back any time and discuss what was going on. He also had a mind of his own, how things should be done, which were very good for the most part. I can remember one meeting that I guess was the first meeting that I had with him. I went into this smoke-filled room and there was the Major and several others. I got the feeling that the Major had a chip on his shoulder and was daring anyone to knock it off. Somehow, I got through that meeting without knocking that chip off his shoulder. And from there on in, he and I were good friends.

Hochheiser:

So the customer was based in Los Angeles?

Spangler:

[The] customer was based in Los Angeles. They went through name change transitions from SAMSO to whatever they call themselves these days, Space Division maybe. I'm not sure what they call themselves now.

Hochheiser:

Sure. I assume therefore you needed to make frequent trips out to visit?

Spangler:

Yeah, we have these management reviews.

Hochheiser:

Right.

Spangler:


Block 5 Test Team at RCA

We would have a monthly management review and make frequent trips out there. They would alternate places here or there. Then on a yearly basis we had what they called a Maxi-review where the Air Force got all their contractors together to bring out the soiled linen from all the contractors where we discussed our technical problems, discussed interfaces and so forth. I recall our first meeting with the Air Force and with the other contractors, RCA and Harris Corporation. This was at RCA. The colonel, he got up and says, you'll note we have all our three prime contractors here. The bidding process is over. The areas of responsibility have been assigned. We want each of you to stay in your area, don't try to hog in on someone else's area of responsibility. We want you to work together as a team. We are a team member too along with the Aerospace Corporation. And that's the way it's going to be. And that's the way it was for the whatever number of years it was that I worked on the program. We had people at RCA and RCA existed at that time.

Hochheiser:

Right, it's 87 when GE buys them.

Spangler:

Yes. At Hightstown, New Jersey. We had people there integrating our equipment with the spacecraft. At one time we wanted to reassign one of our men who was at their facility to another contract. The RCA I&T manager came back and says you can't do that. He's one of my men.

Hochheiser:

Even though he was on your payroll.

Spangler:

Yes, he was on the Westinghouse payroll. That's the way we worked together.

Hochheiser:

How were the responsibilities for the program divided between Westinghouse and the other two prime contractors?

Spangler:

Okay. We had the responsibility for the sensor that went on the spacecraft. We had the responsibility for integrating it to the spacecraft. RCA physically mounted it. We had the responsibility for testing it on the spacecraft at RCA. We had the responsibility for testing the spacecraft at Vandenberg before launch. We had the responsibility for on-orbit testing after the system was launched. We had the responsibility for the ground equipment that went onsite at bases at Fairchild and Loring AFB, Maine, Fairchild AFB, Washington and at Offutt AFB in Nebraska. Harris had responsibility for equipment at these sites also. They had the communications equipment, and they had the equipment for…well, let's say they had some equipment at Omaha. Omaha was an interesting place. One of the outputs of our system was a film record and I've got a sample here I can show you.

Hochheiser:

We can film it before we're done.

Spangler:

Yes. We had film that was one of the products that came out. It was a compartmentalized program but the film was distributed to another office at Offutt AFB who used it for programming their satellites in orbit.

[End of tape 1, beginning of tape 2]

Hochheiser:

Okay. Now we're ready to start tape two, the second half of the interview.

Satellite: Security, Evolution and Improvements

Spangler:

Okay, we were talking about the meteorological satellite, the DMSP and providing the weather information for those people to use. Only a very few of us on the program knew at that point in time who the ultimate user was -

Hochheiser:

[Interposing] Right.

Spangler:

And even my boss didn't know.

Hochheiser:

But you knew.

Spangler:

I knew.

Hochheiser:

Right. But because of the security procedures you couldn't tell your boss.

Spangler:

That's correct.

Hochheiser:

Now who was your boss?

Spangler:

Tom Hollis was the Program Manager.

Hochheiser:

Okay.

Spangler:

And even at the very beginning when we did the study, we could not tell our boss what we were working on. As a matter of fact, initially Nick Petrou, who headed up the Baltimore Operations, initially didn't have a clearance on the program. Our Program Manager would just ask for money and he'd say what are you going to use it for and we tell him we can't tell you and he said okay. We did have one guy along the line, and I won't mention any names here, but he was very concerned because they wouldn't tell him anything at all about it. He had people that were working on it and he said, well if you guys get in trouble don't look for any help from me.

Hochheiser:

Right. Well it must cause some problems as far as supervision. I mean, how is your boss going to evaluate you if he's not allowed to know what you're working on?

Spangler:

That almost made me leave the company. Yeah, my administrative boss says it ain't radar, I ain't interested. And I was on the program for two years and never got a raise in between, and so I was about ready to tell them okay, goodbye. And that's when I administratively transferred from Surface Division to Aerospace Division. And years later

that particular boss had gone to Pittsburgh for the new business effort in Pittsburgh. Who should I get a call from? I got a call from him wanting me to come to Pittsburgh to work for him. Thank you, no.


First Block 5A Image

Hochheiser:

So how did this program evolve? A lot must have happened as you spent almost three decades on it.

Spangler:

Yes. A lot did happen on the first systems that we launched. When we got the first film back out of our equipment, the SPO Engineering Manager, who was Maj. Chubb, and the SPO Director Col. Botzong took one look at it. Maj. Chubb yelled for a sergeant to get him an airplane. So he, Col. Botzong and a couple of others, along with that piece of film, they jumped on an airplane and went to DC to tell the people all about it. And his comment was, "if we never get another piece of data out of this system, this launch has been well worth it." He had a strip about 10 or 12 feet long of this 9.5 inch film, and off he goes to Washington to tell everybody about his program that he could.

The first satellite only lasted six or eight months. It had a problem with lubrication of bearings. Lubrication of bearings in space is a problem, a serious problem. We used the NASA recommended lubricant which was a silicon fluid. It turns out the stuff turned to sand in a vacuum. That was not very good on bearings.

Our scanner was a mechanical device. It was a rotating mirror that scanned the Earth. It had three channels. It had a high resolution visible light channel. It had a lower resolution channel in the visible and near-IR for wide area coverage. Bandwidth limitations did not allow all the high resolution data to be transmitted to the ground or even stored on the on-board tape recorders. We also had a lower resolution infrared, long wave infrared, in the 8 to 13 micron spectral channel for looking at high thin cirrus clouds where contrails could form. So the first system was very successful but its life was not as long as we had hoped for. They launched a second one. It was a good launch also. Then somewhere along the line we added a high resolution IR channel.

Hochheiser:

So you're improving Westinghouse's part of the system.

Spangler:

That's correct. And, as a matter of fact, we have out here on exhibit in the museum the breadboard model of the sensor that shows the high resolution IR channel on it.

Hochheiser:

About when?

Spangler:

About when? Oh we're talking probably late-'60s, early-70's. I can't recall all these dates.

Hochheiser:

Well you answered my question, which was about when. I wouldn't expect you to remember specific dates but late-60's, early-70's tells me it's a few years into this long effort.

Spangler:

We actually flew some experiments. The new high resolution IR detector had to be cryogenically cooled. On one of the earlier launches we had flown a cooler to cryogenically cool a test device to look for ice buildup and look for contaminants, things like that. It proved successful. Then we launched one with the real detector on it that got high resolution infrared in the long wave IR band, the 8 to 13 micron band. And there the user had a choice. We didn't have enough storage for both visual and IR at the higher resolution so the user could select one or the other.

Satellite: Ground Stations, Usage

Hochheiser:

So where was the storage? Up in the satellite?

Spangler:

Storage in the satellite was on tape recorders.

Hochheiser:

Then how did the information get from the satellite to where the customer could use it?

Spangler:

We had two ways of getting it down. We had one way where we didn't store it on board. We could send it in real time to a user site such as the one in Vietnam, for example. Or wherever. We had the onboard storage when the satellite was not visible to a ground station. We stored the data on digital tape recorders. Each satellite had three tape recorders. They weighed about 25 pounds each and they stored less data than you can get on a microchip these days. Each recorder could store 1.67 times 10 to the 9th bits, not bytes or words.

Hochheiser:

Bits, yes.

Spangler:

And that was all in 25 pounds and lots of watts of power. We had three of these things along with all the associated problems of tape recorders in orbit such as mechanical problems, tape problems and so forth. So, the name of the game was to store the data when the spacecraft was out of sight of one of the two readout sites - there was a readout site in Loring AFB, Maine and another one at Fairchild AFB, Washington State. When the satellite became visible to either of these sites, the tape recorders would be sped up and the data transmitted to the ground. They would dump the data very fast and the data would come down backwards. Then we'd store it on the ground and transmit it from Loring or Fairchild over telephone lines to Offutt Air Force Base in Nebraska where it was displayed, recorded and sent to the users. It also went into their digital numerical weather forecasting system at Offutt.

Hochheiser:

Right.

Spangler:

For other users, like tactical users - like Vietnam for example, there, they could read it out directly to a ground station. And we actually did have a ground station in Vietnam. It

got overrun once. The equipment cabinets had thermite to destroy them but it was not used since the ground station was in an area surrounded by a chain link fence. And the enemy didn't go inside the fence and the equipment survived.

Hochheiser:

And then I assume we, the American military, recaptured it because of the site? And then you were back in business.

Spangler:

Yes, we were back in business. They had sites like this at various places in Asia. One was in Korea and there was one in Thailand. The equipment played a major role in the Mayaguez rescue by providing the weather information on where to refuel the helicopters. Actually, they changed plans based upon the information that our equipment provided.

Hochheiser:

Which gives some indication of the [importance] that the system had -

Spangler:

[Interposing] Yes. And there were other situations similarly where information was used in real time because it was needed. A lot of them associated with rescue efforts.

Hochheiser:

Sure, where knowing the weather -

Spangler:

In real time is very important. For example, saving money by moving ships out of the way of weather situations in the Pacific. I was told that the government saved enough on one particular occasion to pay for this system by moving the ships out to a safe place when a typhoon would have wreaked havoc with them. As a matter of fact, one ship lost its bow before it got out of the danger area.

Hochheiser:

But being able to see when the weather was coming and getting the information to the ships in real time -

Spangler:

Yeah. Was very important. And it takes a while to get ships ready to move out of port. You can't just say okay, leave, you know. Get up a head of steam and whatever. And get the airplanes moved to safety.

Satellite: Block Changes and Launches

So, there were various block changes to Block 5 sensors -

Hochheiser:

[Interposing] Block changes?

Spangler:

Block changes. We had Block 5A Block 5B, Block 5C, 5D, D1, D2 and D3.

Hochheiser:

And what were these?

Spangler:

They were changes in configuration. Upgrades in most cases.

Hochheiser:

Are these upgrades on the ground or upgrades in new additional satellites?

Spangler:

On the satellites. Sensors.

Hochheiser:

So in that case there were periodically new satellites launched?

Spangler:

Oh yeah they launched. I guess they are up to F-18 - 17 or 18 - now of the Block 5 series. And that doesn't count the Block 1's, 2's, 3's, and 4's.

Hochheiser:

Right, but which is before you got involved.

Spangler:

Yeah.

Hochheiser:

So how did the system evolve? By the time Vietnam is really hot, this is now an important part of the military infrastructure.

Spangler:

That's correct. We had a colonel on board whose name was Colonel Will Botzong. He was the SPO Director. He met periodically with the secretary and the undersecretaries of defense. One of the things he had displayed proudly on the wall in his office was a note from Dr. [John L.] McLucas who was a Secretary or an Under Secretary of the Air Force. And it says to Will Botzong, your program is the best and most cost effective program in the Air Force today.

Now talking about the Block changes. The latest Block change where we went from Block 5C to Block 5D - that was a major block change.

Hochheiser:

This is about when? Is it the 90's now?

Spangler:

That was in the mid to late-1970s. One of the problems with the original sensor was the mirror rotated at a constant angular velocity which gave much higher resolution at the center of the picture than it did the edges because of the geometry. It was a problem

that was inherent. Everybody knew about it. It was going to happen. You knew that. The problem the Air Force was having was the resolution at the edges of the scan needed to be the same as at the satellite nadir. So Tom Hollis and a couple of guys went out to talk with Colonel Botzong about the problems and what problems could we solve that would be most beneficial to the program. And this was one of the problems, the constant resolution. So using IR&D funding, Tom got several of the best engineers available to come up with an idea of a sinusoidal scanner that would swing back and forth like a pendulum. The dwell times would be longer on the edge. You could have smaller fields of view. You could get the constant resolution all the way across. And we had Frank Rushing, who was a brilliant mechanical engineer, probably the best that Westinghouse has ever owned and who came up with the washing machine balance mechanism for the front load washing machines. He and Gordon Lye, another distinguished scientist at Westinghouse, came up with this idea of a mechanically resonant scanning system that would scan in a sinusoidal motion and simultaneously varying the optical field of view, we could get the constant resolution. We built a breadboard model, brought Botzong and his crew in to look at it. After looking at the demonstration Botzong said, "I want this." So, he told his people to go back home and get some money to start funding this sinusoidal scanner. We called it a fixed resolution scanner. We submitted a proposal and they liked it. They bought it. The first proposal was just for the scanner itself, but the scanner would not work with the current onboard data processing equipment design. So, we gave them another proposal for the onboard data processing hardware. And of course this got big and it was beginning to look like all the new hardware plus the new sensors that the Air Force wanted to fly wouldn't fit on the existing spacecraft. So, they told RCA to come up with a new spacecraft that they called Block 5D. The Block 5D ended up being a complete changeover of sensors and spacecraft as well as a lot of ground equipment and the launch booster.

The first Block 5D1 launch in the fall of '76 turned out somewhat disastrous. It went up and the spacecraft started tumbling and lost power. The Air Force kept sending commands to it. Where are you? Where are you? Finally in early '77 the spacecraft answered back - here I am. RCA and The Aerospace Cooperation engineers got enough information to find out what the spacecraft was doing and put together a team of engineers to figure out how to stabilize the spacecraft using a software fix. After a month or so, maybe more than that, they came up with the software, sent it up to the spacecraft that says, "okay guys, straighten up and fly right." And it worked. We immediately started getting good data. The only thing that had failed as far as our equipment is concerned over all that deep freeze operation where the temperatures went extremely low was one tape recorder. Everything else worked fine.

Hochheiser:

And you had what, still three tape recorders?

Spangler:

We had three tape recorders -

Hochheiser:

[Interposing] Recorders so -

Spangler:

- we had two good ones. We got data out of that one, and RCA incorporated the changes to keep the spacecraft from going into tumble mode again.

Hochheiser:

Right.

Spangler:

Into the software. And then the Air Force launched more of those. Unfortunately about every fifth one would have a booster failure for some reason on each F5 - F5 on Block 4 and so forth, back -

Hochheiser:

So about every fifth one didn't succeed in getting operational.

Spangler:

Yes. But after an F5, all of them since F5 have been okay.

Hochheiser:

Now you talked about RCA's role and your role in the 5D, did Harris play a role in the redesign as well?

Spangler:

They didn't have much of a role with the spacecraft interface.

Hochheiser:

Okay.

Spangler:

Harris had lots of ground equipment. They have the antennas and receivers and the communications gear on the ground. That did not need to change. Although, they did come up with a small tactical terminal that was much more transportable than the old 18-wheeler that they had earlier. They got it into a small one. Now they've got it into a suitcase size using laptop computers.

Satellite: Managing Program, Evolution to 5D

Hochheiser:

And so now we're well up into the 70's.

Spangler:

Yeah.

Hochheiser:

Now are you managing the entire Westinghouse program by this point?

Spangler:

Yes, I pick up the whole program sometime after 1976.

Hochheiser:

Okay. So I assume now you've got quite a sizeable team.

Spangler:

Well, it depends upon what point in time. As you know we had a matrix organization.

Hochheiser:

Of course.

Spangler:

With engineering, quality, manufacturing and so forth all reporting to me program-wise but administratively to the other organizations. At times, we had 150 or more people working full time [on] the program. I did have one budget center consisting of a dozen or so people to manage administratively.

Hochheiser:

How do you manage a group that size for success? Even with the matrix aspects.

Spangler:

We had the opportunity to pick and choose people, and the people that we chose were all loyal to the program as opposed to loyalty to their matrix organization. Our mechanical engineer, for example, he was on the program from the very early days in 1966 until he retired. His loyalty was to the program. I would have trouble getting him promoted and things like that. At one time I had to go over his administrative boss's head and get him promoted to advisory engineer. We had one or two problems like that but in most cases we did not have any problems at all. We had good people loyal to the program and they stayed with us. They knew it was a long-term program and they liked the comfort of job security.

Hochheiser:

Sure. Now, as far as the evolution of the program up to the 5D in the late 70's.

Spangler:

Yes. It went D1, D2, D3 -

Hochheiser:

And what are the differences of the D's?

Spangler:

End configurations of the sensor differed slightly and I guess the latest changes occurred after I retired - they got rid of the tape recorders. They went to chips for memory.

Hochheiser:

Sure.

Spangler:

In addition to our sensor the spacecraft carried lots of other mission data sensors. Some of them were highly classified and known only to the users. But all of their data went through our box and I obviously had contacts with the people on the other end. So, we had those responsibilities as well. I had a group of seven or eight engineers at Omaha that worked shift work providing support for the users in Omaha.

Hochheiser:

So these are Westinghouse people assigned as field engineers to the customer in Omaha?

Spangler:

Yes. Those I got from Westinghouse field engineering. I had people at RCA or Martin or Lockheed or whoever they became doing the same thing. And I guess they still have that arrangement.

Hochheiser:

Yes. In turn did you have people from RCA or from the customer or any of the other contractors here in Baltimore?

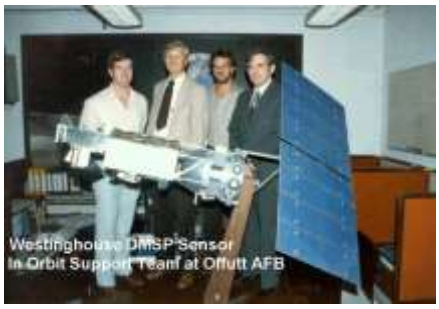
Spangler:

No, we never did. No need for it. We would have frequent visitors from the customer or frequent visitors from RCA or not as frequent from Harris as the need arose.

Hochheiser:

Yeah. And then of course you and people in your team then were similarly on the road visiting.

Spangler:



Oh yeah. But by having people at RCA and people at Omaha we really didn't have to send many people from the plant. We had very capable people in the field. During launch preparations and launch we would have some additional people from Baltimore at VAFB, CA to handle specialized operations.

Hochheiser:

Now did you have the production people reporting to you as well?

Spangler:

Yeah. Project-wise, yes they did. I had a production manager. I also had a quality and reliability manager, a systems engineering manager, a test manager, a field services manager, etc. who were on my staff. I had morning standup staff meetings.

Hochheiser:

Standup meetings - ?

Spangler:

[Interposing] Standup -

Hochheiser:

- literally meaning standing up so the meeting wouldn't last long?

Spangler:

That’s correct, at first, but chairs soon came in later - but the idea was to keep the meetings short.

Hochheiser:

That's a good technique. People are not going to want a long meeting if they have to stand up. I hadn't thought of that one.

Spangler:

To go over progress, problems and anything that needed immediate attention.

Satellite: Notable Problems

Hochheiser:

Any particular notable problems you recall having to solve?

Spangler:

Bearings. Bearing lubricant was a serious problem that was not solved for a few years.

We had a problem with some government furnished encryption equipment that turned out to be whisker growth in vacuum. They used a bad material that would grow conductive whiskers shorting out the equipment. That was a pesky problem since it was intermittent. It turned out we found the problem and to the embarrassment of the government, they had to retrofit all their pieces of equipment they had in the field.

We had our usual run of typical engineering hard to solve problems like mirror coatings for example. Our scanner mirror looked within five degrees at the sun and at the same time trying to see a dark scene. This problem was solved by shielding the mirror and a very low scatter super polished mirror surface.

I had one of the best software engineers in Westinghouse permanently assigned to my program. His name was Ken Martin and he was able to solve a lot of hardware problems using his “bag of magic tricks” in software.

We had a pesky infrared problem in a mask that we used in one of the relay optic systems. In the visual and near IR it was opaque, as it was supposed to be, but then it became a mirror in longer wave IR.

Hochheiser:

But you eventually solved it

Spangler:

We eventually solved it. And it turns out that our optical design ended up to be a graduate student study problem in optics at the University of Arizona. I don't know whether they still use it or not to analyze that optics.

Hochheiser:

And is it these kind of challenges that kept you and your folks busy through the 80's?

Spangler:

Oh yeah and production, building and testing things. The space program component test requirements were very critical to keep good parts in and weed out the bad ones. Our sensor life history in orbit reflects the benefits of being sure you have good piece parts.

Hochheiser:

A lot of quality control work.

Spangler:

Yes. And I mentioned earlier, vacuum tubes. We have one tube in the sensor which is an image dissector photomultiplier tube with an opaque photocathode. It was a challenge to build and very expensive.

Hochheiser:

Yes, there aren't too many things vacuum tubes are used for these days.

Spangler:

Yes.

Hochheiser:

Did [you] try to find a solid-state replacement or did you just think it was hopeless?

Spangler:

It was not available back then. It could be done easily right now. It could not be done then. And we looked. We even looked at some of the ultra black programs, if you know what I mean.

Hochheiser:

Yes.

Satellite: Production, Block 6, Civilian Applications

And then so you kept up with this. How did things change as you moved towards the latter part of the 80's and into the early 90's with this program? Was it steady or?

Spangler:

It was production, mostly production -

Hochheiser:

[Interposing] By this point your job has evolved to more dealing with production because the system is more - ?

Spangler:

[Interposing] Mature.

Hochheiser:

Thank you, I was looking for the right word.

Spangler:

Yeah. And of course since I left they've replaced tape recorders because memory chips became available. I would have hoped they would have also replaced that

photomultiplier which they could have done easily. But the Air Force did not want to do that. Matter of fact, we had a proposal several years before I retired to replace it. But the answer was we don't want to replace it. That if it works, don't break it or however that goes.

Hochheiser:

Yes.

Spangler:

If it ain't broke don't fix it.

Hochheiser:

Yes.

Spangler:

And another thing we did, we added the capability for additional IR channels for snow-cloud discrimination. I think we designed the optical capability, I'm not sure whether they've ever implemented it in hardware or not. And as it turns out the follow-on which was going to be Block 6, the White House decided that to save money they would let NASA/ NOAA do the Air Force job. Okay, well after years of failures and billions of overrun dollars, Congress cancelled the program.

Hochheiser:

Was this decision before or after you retired?

Spangler:

That was before I retired. That was in '93. We were going to bid on Block 6 sensors and I guess Northrop bid on the NASA/NOAA sensors -

Hochheiser:

[Interposing] Of course now the actual decision was made in '93 so you start preparing to bid, but then you retired before the bidding process was over?

Spangler:

Right. Well the bidding process really hadn't started. They were still doing studies. The new sensor turned out to be a royal pain for NASA/NOAA. The sensor problems and associated costs, I guess, is one of the reasons that caused the program to be cancelled and the Air Force and NASA/NOAA told to go their separate ways. It turns out right now that the sensors that we designed in the '70s are providing both NOAA and the Air Force with the information until NOAA/NASA gets their act together and get something up there. I think there [are] a couple more of our sensors waiting to be launched.

Hochheiser:

So eventually this program did have civilian applications.

Spangler:

Oh yes, it's been used by civilian applications for years. John McLucas made it available to the civilian people sometime in the 70's.

Hochheiser:

So the military was sharing -

Spangler:

[Interposing] Correct.

Hochheiser:

Sharing the appropriate sections of the data with NOAA, with the government civilian people.

Spangler:

Of course, you always have the "not invented here factor" in the NASA/ NOAA arena.

Hochheiser:

Yes.

Spangler:

And right now I don't know what the Block 5 Program is doing at Northrop Grumman. I haven't kept up with it for a while. I believe that Northrop Grumman currently has support contracts with options that go to 2014. If it goes to 2016, that will be 50 years of continuous contracts with the same customer, sole source.

Hochheiser:

Yep. There are very few programs I can think with that type of -

Spangler:

That have a 50-year history.

Hochheiser:

Exactly. Exactly.

Spangler:

It depends upon how long this next satellite lasts. And you know they were designed to last three years and they've been going at least twice that, maybe as much as nine or ten years.

Hochheiser:

Yes.

Spangler:

And it's a mechanical scanner. Lifetime improved dramatically after we got the bearing lubricant problem solved.

I think you have an engineering breadboard model out here in the museum of a Block 5C scanner. They have an engineering test model of the Block 5D that the museum should get their hands on when and if the Air Force ever releases it. Ralph Strong tried to get one of the tape recorders when they decommissioned all the tape recorders, but the local DEPRO put them up for bid. They wouldn't give one to the museum.

Westinghouse Atmosphere and Changes

Hochheiser:

Let's shift gears a little bit. How did you find Westinghouse in Baltimore as a place to work?

Spangler:

I never had any problems whatsoever. It was a great place to work. People were always very good. I still remember my last financial review with the upper management, the VPs etc. It was Christmas time. They had sent out an edict to us Program Managers, a list of everything to discuss like program issues, technical problems, financial problems, customer problems and etcetera, etcetera. I made up a chart that said "no technical problems, no customer problems, all financial objectives met, have a nice Holiday." I don't remember who all was there.

Hochheiser:

That's okay.

Spangler:

The boss says that's the best financial review I've ever had. Let's all go out and get a drink. And I got a very nice Christmas present from him.

Hochheiser:

In what ways if any did Westinghouse Baltimore evolve or change over your many, many years?

Spangler:

[Interposing] Over the years. Well when I started work at Wilkins Avenue - it was a union shop for engineers. Then we went to the airport. We were in Airport Terminal Pier B. Got rid of the engineer's union. And I've never had any problems whatsoever as far as management goes. For the most part throughout my career was technically oriented. Obviously, when I got into the higher management positions I had to also worry about financial reviews and making a profit, so that had to come into play. But in the last years, the pressure was down from Pittsburgh to show a good profit. And sometimes they

wanted double-digit numbers, and that was kind of hard to do on the type of contracts that we had, especially with the rate situation that we were having. Rates kept going up and up. You'd have a meeting with the boss and he says, here's what's happened to the rates. We still want you to bring your program in at your target cost. We had to live with it. But other than that I had no complaints whatsoever with Westinghouse.

Hochheiser:

Were these directives the extent of your interactions with Pittsburgh over the years?

Spangler:

Profit was a local issue but probably reflected pressure from Pittsburgh. [I] did interact with Pittsburgh on some IR&D, Research and Development.

Hochheiser:

And can you talk a bit about the ways you interacted with IR&D?

Spangler:

We would usually just fill out a form, get what we call six dash money and the local guy would approve it. And if we needed help we would go to the people in the research labs that we needed. And if you had a number, it's all they looked for.

Hochheiser:

Were you a member or otherwise involved with any professional societies, organizations?

Spangler:

Not really. I presented papers to the American Meteorological Society, wrote some articles for them and other magazines, conducted a short seminar at Cornell University, things like that. Those were usually by request.

Retirement, Career, Books

Hochheiser:

What led you to retire in 1994?

Spangler:

Age.

Hochheiser:

[Interposing] It's just the right age?

Spangler:

Age, yes. Westinghouse had an early out offer in ‘94. I was within months of hitting the mandatory retirement age of 65 for my job code. With all the incentives they offered I couldn’t afford not to retire. The boss tried to keep me on and when I told him what the situation was he says, I can’t blame you. I can’t match it.

Hochheiser:

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

Spangler:

Other than a couple of years with a radar oriented boss, I would say it was great. And the radar boss didn’t really get involved too much. He had one meeting with our customer and I could see arrows going between them. I think my transfer out of his organization was of great benefit for both he and I.

Hochheiser:

In what ways have you kept yourself active since '94?

Spangler:

I did some consulting work for the Air Force and for Aerojet. I also helped resolve a contract dispute between Aerojet and the Air Force. Since then, I’ve been doing a little bit of writing. I did a book on the program, the history of the DMSP program as we saw it. And genealogy. I got a book out on my genealogy and I’ve got a couple of other books. I’ll put in a plug for my book, The Rising Sun Sets, The Complete Story of the Bombing of Nagasaki. Jake Beser, whose name I mentioned earlier, was the only guy

who flew on both the Enola Gay and the Boxcar as a crew member. He had a story to tell. He wrote one book, Hiroshima Nagasaki Revisited. He started another one to tell the untold story of [the] Nagasaki mission when cancer intervened. He was unable to finish it. His son picked it up but also developed a medical problem. I had known old Jake for 25 years. I'd heard his stories many, many times.

Hochheiser:

Right.

Spangler:

I volunteered to finish it up for them. We finished that book in 2007. On a book signing in Washington I was talking with a public school teacher. The subject got around to World War II. She thought the invasion of France was because France was our enemy and Germany was our friend. That was her knowledge of history.

Hochheiser:

Oh dear.

Spangler:

And her knowledge of history went downhill from there. On the war with Japan, she'd never heard of a lot of things that happened. Never heard of the Bataan Death March. She had heard of Pearl Harbor but she never heard of a lot of the other happenings before and during the war. That inspired the book, second book, which was The Long Journey from Pearl Harbor to Nagasaki. I haven't got a publisher yet. I've got some preliminary copies out and one public school is using it in a history course.

Objects

Hochheiser:

I know you brought one or two things to show us.

Spangler:

Yes.

Hochheiser:

Can you manipulate the camera so we can do that?

Cameraman:

Yes.

Spangler:

Yes I have some photos I would like to show. The nighttime photos our equipment makes are impressive. One was used by corporate on the cover of the Westinghouse annual report to stockholders.

Can we take another break?

Hochheiser:

Well of course.

[End of Interview]

Northeast US Blackout
August 14, 2003