

## Editor's Foreword

When my father, George A. Spangenberg, was killed in an automobile accident on November 13<sup>th</sup>, 2000, our country lost one who had devoted his entire professional career to Naval Aviation. He received many awards for his service, including "Honorary Naval Aviator", "Golden Eagle", and induction into the Naval Aviation Hall of Honor in Pensacola.

It was that latter group who initially asked Dad to do an oral history, although you will see from his memorandum at the beginning of the history that a good number of other people also became involved. At the time of his death, he was editing the hard copy of the oral history as it then existed. I have taken his edited version and produced a cleaner copy so that it may be more easily read by all. The original will be held at the Naval Archives located in Washington, D.C.

I would like to thank Vadm. Jerry Miller for retrieving the diskettes of the transcription that was being edited. Without that, this task would have been monumental, to say the least. Also, many thanks go to the tireless efforts of Dad's friend and colleague, Hal Andrews. He has proofed all my edits and re-types, and has offered valuable information when the words did not make sense at all.

The approach of Mr. Andrews and myself has been to insert the editorial changes that had been made and correct transcription errors, but to resist the temptation to try to further organize, shorten, or otherwise change what was there. I am sure that Dad would have edited further, but not knowing how that would have been done, we took the approach that the oral history should stay true to how he had left it.

As you will see when you read the oral history, Dad decided it would be more efficient in many cases to simply reference published memos and articles that he had written. These he included in the Exhibits. Many of the Exhibits were quite difficult to read due to poor copy quality, and I decided to retype all of them both so that the entire oral history could be in electronic form and so that it would be more readable visually. There are a few instances where we still could not determine the words, and those are denoted by ??? in the text. The Exhibits are an integral part of the oral history in my opinion, and actually are far longer than the oral history itself.

I hope this effort has been worthwhile, as Dad's concern was that the history of Naval Aviation not be lost. He believed that we should learn from that history as we approached the future.

Judith (Spangenberg) Currier

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<sup>1</sup>The numbers in parentheses are from the start of the document, as would be used in the Adobe PDF reader.

## Memorandum

From: George A. Spangenberg  
Subject: "Oral History", Transcription and Attached Documents  
Date: 31 August 1997

1. My "Oral History" is about to be circulated to a few professionals by VAdm. Miller for information and perhaps recommendations on what should be done next. In its current form, the project is confusing to say the least, and I believe some explanation of how it got that way may be helpful.
2. In September 1989, I was informed that I had been selected for the Naval Aviation Hall of Honor at Pensacola with "enshrinement" to follow in May 1990. As I said then, and reiterate now, I firmly believe that my selection was really a recognition of the contributions of our entire "Technical Community", and they must share in the honors. I was lucky enough to become a spokesman for the community on occasion, but virtually all of the data on which decisions were based was generated by others. We had the best design and acquisitions group in government.
3. In November `89, I was asked by the museum to participate in an oral history program being initiated. It was proposed that "Capt. Zip Rausa, editor of Wings of Gold conduct the interview ---- ". With no personal experience with an "oral history", it sounded easy enough; Zip Rausa's office was close by, and since I had been fully retired for years, no scheduling problems were anticipated. I'm sure now that Zip was not nearly as naive since he had co-authored the book Ed Heinemann. Combat Aircraft Designer, with interviewing apparently started in 1977 and published in 1980. Also, Zip now had a full time job, and undoubtedly other commitments.
4. The first interview was done in February 1990. Zip outlined the intended procedure of his taping a one or two hour interview, forwarding it to Pensacola, where the museum would transcribe it and provide copies to each of us. After the first session, I was very unhappy with the way I remembered my performance — pauses, hesitations, etc. I did a new tape on my own trying to cover the same ground. The current version of the transcript uses the latter tape. A second session was held the next day, with no advance planning on the subject matter to be covered in either case. Sometime, probably in the second session, it became apparent that we needed some kind of a road map on what models of aircraft we were, or would be, discussing. (I had participated in the acquisition and development phases of at least 125 aircraft.) We then started to use a chart labeled "Navy Aircraft Starts" which I had prepared initially about 1960, and had updated through 1970. The transcript refers to the chart, a copy of which is included as "Chart 2" in "Exhibit A-5". [*Ed: This chart is referred to often*

*throughout the oral history and so was moved to the beginning of the Exhibits and is called "Chart 1" or "Naval Aircraft Starts".]*

5. A couple of months after my "enshrinement" (*Ed: in the Naval Hall of Honor in Pensacola*), four interview sessions were completed during the month of July, 1990. During that same period, I was being treated for bladder cancer, and became concerned as whether my "oral history" would ever get finished. I then did five more tapes on my own, and delivered them to Zip Rausa together with a copy of each of what are labeled as "Exhibits". The latter were copies of official memoranda, letters, presentations, published articles, etc. which I believed to be an effective way to keep talking, taping, transcribing, etc., time to a minimum, and yet accomplish what I perceived to be our purpose.

I should probably comment on the subject of my records. On my retirement in 1973, I had no copies of any of my official correspondence, classified or not. Navy files were believed then to be always available for any official purpose, and I saw no reason to duplicate them. I had only my own personnel action sheets, travel orders, efficiency ratings, and the like. If I had it to do over, I would undoubtedly keep more records as I've seen too many papers lost for posterity by "clean out the file" orders. After my retirement, I was asked on occasion to give presentations of one form or another to various organizations, and have gradually built up a disorganized file of items such as those in the "Exhibits".

6. Back to the oral history. By the end of August, 1990, I considered my part of the first phase of the effort to be complete, and I am confident that Zip Rausa completed his part of the exercise. Apparently the museum never made a transcription. A year or two ago, I inquired informally of RAdm. Furlong as to what had happened to the project. He promised to look into the matter. Then VAdm. G.E. Miller was appointed to the Ramsey chair at the Air and Space Museum, and in connection with his research project asked me for information on the start of the XAJ-1 program. From memory, I was able to answer his specific question, but advised him that the records of all Navy design competitions of that era should be available in Navy files. I knew, personally, that the competitions were well documented. The oral history project was mentioned as a matter of possible related interest. Jerry then took over, obtained the tapes and "Exhibits" from the museum, allowed me to duplicate the tapes, found funds for the transcription effort, etc. I did a first pass type of editing, but much remains to be done, eliminating duplication in coverage between the February and July tapes, overall format, possibly tying in the "Exhibits" to the basic dialogue, etc. I recognize at least some of the shortcomings.
7. For the record, I will attach to this memo an "Epilogue" drafted early this month bringing my view of naval aviation developments in the seven years since the oral history was recorded up to date. It is hard for me to be positive about any of

those developments. *[Ed: That Epilogue, and another found in his papers are included at the end of this Oral History].*

8. From my standpoint, what comes next with this "Oral history" will depend on why such programs exist, who will pay any attention to the "lessons learned", or even who will even read them. Everyone nods wisely when one recites Santayana's advice that: "Those who fail to heed history are doomed to repeat it", but in practice my observation is that most individuals will attempt to avoid repeating their own mistakes, but ignore the mistakes made by others, sometimes in ignorance, sometimes with arrogance.
9. Enough for now.

## **TAPED TRANSCRIPT: ORAL HISTORY OF GEORGE SPANGENBERG**

TAPE 2 of 16, SIDE A [TAPE 1 NOT USED]

February 21, 1990

### **FOREWORD**

This morning Captain Rausa recorded a couple of hours of oral history as he had been asked to do by the Naval Aviation Museum Foundation. This evening I'm vaguely uncomfortable with the results of that interview, although I've really not heard a playback. I believe my effort was somewhat disorganized and I'm unhappy with it. In this tape I'm going to attempt a solo recording of the period covered this morning and hopefully with a little more organization.

I'll start with the family history. I was born in Duluth, Minnesota in 1912 of a Yankee father and a Confederate mother. Father worked for Armour and Company and was transferred frequently during my early years, but not as much as the Navy might move people around. We ended up in Yonkers, New York until I was about five, then to Jacksonville for a year, then to New Bedford, Massachusetts. We actually lived in Fairhaven, Massachusetts, across the river, and stayed there for most of my elementary school and high school. I'm probably the only person you know that had to repeat the first grade (due to minimum age requirement differences between Yonkers and Jacksonville). After New Bedford, the family moved to Detroit, Cleveland and finally to Hartford. I have a brother that was born when we were in Yonkers and a sister that was born when we were in New Bedford.

I went through high school in Fairhaven, graduated from there in 1930, just a couple of months after my father had been transferred to Detroit. Early on in the high school years I had thought I was going to become a chemist due to having a very good chemistry teacher and then later I was interested in physics, primarily because the principal of the high school was also the physics teacher and assured me he could get me a scholarship at Harvard if I would take either chemistry or physics. However, in the meantime I got interested in model airplanes and aeronautical engineering became the career of choice. I thought about MIT but it cost too much and with my father in Detroit it became logical that I would look around in that area to go to school. I ended up selecting Michigan which had the oldest aeronautical engineering curriculum in the country. You'll recognize that the Depression was on. I got my bachelor's degree in 1934 and then when there were no jobs available – I think no one in my class got an aeronautical job that year – with the help of a small scholarship and a student assistantship I went back and got my master's degree in 1935. Aeronautical jobs in 1935 were still awfully scarce. The only one we had really heard about toward the end of that school year was that Pan American Airways were hiring people, presumably to wash seaplanes, in Brownsville, Texas; that didn't sound very interesting to anyone.

Then, lo and behold out of the blue sky, came a recruiter from the Naval Aircraft Factory. None of us had ever heard of the Naval Aircraft Factory. However the recruiter was quite impressive. He was Capt. Zeigler, the manager of the factory. As we found out later, the story went that he needed a new automobile and he could save \$100 or so by going to Detroit and taking delivery of a new car there. In order to save the cost of the trip, he set up an official recruiting trip where the government paid him \$6 a day and

probably three cents a mile to get to Detroit. He also had stopped, we found out later, in Pittsburgh and Carnegie Tech on the way to Ann Arbor. In his interviews with perhaps fifteen or twenty of the graduates of the class of '35 and those of us from '34 that were left over, he told us why NAF was hiring. Congress had passed the Vinson-Trammell Act in 1934 which required the government to build ten percent of their own aircraft and engines. This was because Congress in those days didn't trust the military anymore than they do today. The question of what airplanes should cost was apparently just as great then as it is now. The idea of the government building ten percent of their own airplanes of course probably sounded good to the congressmen but it was really a tough task. The government had no production facilities in the country except at the Naval Aircraft Factory which had been started back in World War I. They built some airplanes then, but by 1930 it had become primarily an overhaul and repair facility.

In any event, they had jobs and no one else did, so perhaps a half dozen of us, or maybe more, received emergency appointments that started us off at the munificent salary of \$1440 a year in my case. I was hired as a junior engineering aide. Some of the people who had had some experience during the summer working for an aircraft company got a little higher salaries but most of us started as what were called SP-3s in those days, sub-professional category. We were not in the regular civil service so they didn't deduct the civil service retirement part of the salary from us. We got the full \$60 twice a month.

I actually started at NAF then on 12 August 1935 . At that time the major project in the engineering department was the N3N which was in the design stage but approaching flight test. It was being designed both as a land plane and as a seaplane.



Across the aisle in the non-airplane part of the engineering department the main project was the H-2 catapult. At the end of the room, design modifications of fleet airplanes were in work. On the engine side of the floor the design of a new, I believe an air-cooled engine, that was to be presumably competitive with the Fairchild V-770.

Now the factory had set up a training program for all of us new recruits whereby we'd spend a little time in the various parts of the engineering department in order I suppose for them to see what we could do and for them to try to educate us a little bit into the real world of airplane design. In my case I started in the Standards group. I think my first project was to make some change in the drawing for the rip pin on a parachute pack. I worked for Mary French, the head of the section, who in turn worked for Henry Hoot, one of the senior civilian men in the engineering department who ran the whole Standards operation.

From the Standards group I went to the weight group for a while and then to the physical test lab or it could have been vice versa. At that point in time, the Navy tested all of its own airplanes for structural strength. They did drop testing and test of component parts as well as static tests of the entire airplane. Contractor testing was probably just starting. My big project in the test lab was running the static test of an O3U-6 wing beam, an aluminum alloy extrusion. It was set up in a jig with whiffle trees, and the loads were applied by hydraulic jacks. I screwed up on that one and didn't provide enough lateral supports on the beam. Somewhere close to ultimate strength the beam failed in lateral bending instead of normal bending as it should have. The big task then was to write a report justifying that it was strong enough despite the fact that we broke it – a real challenge.

But that was not as bad as one other individual that in his career had designed a walkway for an airplane when he was working "on the board," and then later, in the stress department he analyzed it. One day just before he left the factory for another job he saw the thing sitting in the test lab and decided he would test it to finish the design cycle. He climbed up on a bench and jumped on the walkway and broke it all to pieces. He left the factory within a matter of hours thereafter.

Well, about that time in the history of things, the other parts of the factory started getting in trouble with their program to try to meet that ten percent airplane and engine production requirement. So some of us youngsters were transferred from the engineering department to the inspection department. In my case, I ended up going to the new engine facility which was set up to build not only the V-770 engine, or whatever it was that the factory was designing, but also to build a production run of R-760 Wright Whirlwind engines. The facility was brand new. The inspectors, which we now call quality control people, had all come up from the machine tool ranks, were basically ex-machinists, foremen, lead men and so on. My boss was a real nice individual, probably forty-fifty years old, named Sterret. He was very knowledgeable in the machine tool part of the game but he was not knowledgeable of all with the new inspection tools that had been bought by the Principal Engine Inspector.

The Principal Engine Inspector was Harry Lynn, who in turn worked for the Chief Inspector, a naval officer, Cdr. Del Fahrney. Fahrney later was to have an important role in my career. Lynn was a man who had been around in the inspection business, a BuAer rep at various aircraft plants, and he knew airplanes and the whole system very, very well. He was a man who insisted on getting everything in writing and as it turned out the

inspectors then in the engine shop were hard pressed to meet Mr. Lynn's standards on inspection memos for his signature. So that fell upon my shoulders and fortunately I could meet his requirements for writing nasty memos from inspection to engineering. It was a good learning experience. Among other learning experiences for me was that when I checked the dimensions of a lead gear blank I needed to use a "shrink" rule. I had never heard of a "shrink" rule at the time. I was ready to reject several blanks when my older and wiser boss saved me that embarrassment.

The most controversial episode I remember was when we did reject a batch of camshafts for NAF's in-line engine. They had been made by a major manufacturer who specialized in camshafts and that manufacturer was sure that their machines were right and our jury rig checking had to be wrong. We knew that we were right however since not only were the cam profiles wrong but even the total lift was wrong, which could be checked easily with a micrometer. The manufacturer eventually apologized and built new shafts. That seems like enough for my experiences as an engine inspector.

Now I'll go back a bit. I mentioned earlier that when I started at the aircraft factory that I had an emergency type of appointment, not under normal civil service career-type appointment rules. The commission had not held competitive exams for the junior engineering, or any other category, for a number of years, all during the Depression, since they already had more people on the rolls than they could employ. But some time in '36 they decided to have a nationwide competitive exam for Junior Engineers and of course all of us at the NAF took the test as well as others all across the country. The test was a long and hard one consisting of three hours of general engineering testing in the morning and another three hours of your specialty in the afternoon. Most of the

people that took the test flunked it. Somehow or another I managed to pass it, although I was never sure why. I tended to think they must have made a mistake somewhere because I got a higher score on the general part than I had on the aeronautical part. I could not believe that to be correct. In any event, they finally established a Junior Engineer, or P-1 as it was called, register and Civil Service started hiring people off that register, and converting temporary appointments such as we had into permanent appointments.

The system that was set up was supposed to work so that those of us working for the Navy would be referred by the Civil Service Commission to the Navy. Those working for the Army, for example, would be referred back to the Army and those holding temporary positions with NACA would get referred to NACA. But I suppose, not unexpectedly, the system broke down and some of us started getting offers of permanent employment with other government agencies. In my case I had letters from NACA at Langley Field. They seemed to be eager to hire me. The NACA answered letters within a day with a telegraphic reply while the Naval Aircraft Factory took several weeks to answer each question that arose. Needless to say, we were in the middle. We wanted to continue working for the Navy but we didn't want to lose the chance for a permanent job. Eventually, of course, it all got squared away and those of us, or most of us, who had started at NAF stayed there.

My next assignment after that engine inspection job turned out to be a real surprise. I had expected to go back to the Engineering Department but I was told instead to report to "Special Project D." That project, about which I was completely unaware, turned out to be probably the most interesting and challenging of any around. Lt. Cdr.

Fahrney who had been the Chief Inspector when I started on the engine inspection assignment had been given the task of developing radio controlled, pilotless aircraft, or drones, for use as antiaircraft gunnery targets for the fleet. Fahrney divided his time between the Bureau of Aeronautics where he was a Class Desk officer and at NAF. The project started in 1936 and I joined it early in 1937. Almost simultaneously the civil service paperwork was squared away and I became a P-1 Junior Engineer at \$2000 a year.

There are a number of interesting aspects to that Special Project D. No one at that time had developed any remotely controlled, full scale airplanes, though Sperry had flown some gyro stabilized models back in 1924. There was a major controversy in the fleet going on as to the effectiveness of the ships' antiaircraft against attacking aircraft. The ordnance side claimed invincibility against any bombers while the aviation community claimed just the opposite. Special Project D, or Project Dog as it became known, was to provide the means for resolving that controversy. For security reasons the project was operated outside the normal NAF organizations. It was located on the first floor of the building just down the hall from the manager's office. The chief engineer, understandably I suppose, resented the fact that he had been taken out of the loop and had no control over the project. At the time I joined the project, the personnel already assigned were some eight enlisted men headed by a Warrant Officer who was also a pilot. Two NAPs, Wallace and Bohlen, a Chief radio man Hendrickson, a Chief Machinist Mate, Herzog, and first, second and third class Machinist Mates McKean, Foster and Schultz. The only civilian on the job at the time was Bill Wait, an experienced designer, who had been project engineer with some outside companies before he came to the

aircraft factory. He was a P-4, I believe, at the time and I became the tenth man in addition to Fahrney in the group.

All of the enlisted people were really top class. It was my understanding that Fahrney had a free hand in selecting them and he had sure done a wonderful job. You got the impression quite soon that the Navy was really run by the chiefs and the enlisted men. These guys were really good. Bill Bohlen had been to the South Pole with Adm. Byrd. Eddie Herzog had been a wing walker in the same group as Lindbergh during the latter's barnstorming days. All of them could tell all kinds of sea stories and contributed greatly to my education.

Bill Wait, on the other hand, although an excellent designer, unfortunately had a personality that didn't get along very well with people. I ended up half the time being the conciliator between the enlisted group and Wait or between Wait and the people in the shop who were doing work on the project.

When I joined the group, work had been going on perhaps for a year. The basic electronic development of a transmitter and a receiver which would transmit signals between the control plane or the ground station and the aircraft was all being done at the Naval Research Lab. All that equipment had already been designed, built and tested and was being installed in an aircraft when I joined the program. The Navy had ordered two JH-1 Stearman Hammond planes that had recently won some safety competition run by the CAA. The main reason that they were bought was that the airplane had tricycle gear and it was known that we didn't have a chance of getting a successful operational drone unless we did have tricycle gear, or at least that's what we thought. Unfortunately the development of the JH-1 didn't proceed according to schedule.

Deliveries were delayed so long that the Navy had decided to seek other solutions. The first program was to take an NT-1, a New Standard training plane, and install the radio control system in it. It was never intended to be flown as a nolo (*ed: "no live operator"*) airplane, but always with a safety pilot. It was used primarily to develop and make sure that the electronics and control system worked. The planes that did the controlling, or had the control operator in the air, were all TG-2 Great Lakes, three place, three cockpit, single engine biplanes. The forward cockpit in its service use had been a bomber station so that it had good visibility for the man who was controlling the drone from the air. In addition to the plane, there was a field control cart developed so that takeoffs and landings were done from the ground.

After the NT-1 flights demonstrated the basic feasibility of the program and with Stearman Hammond JH-1s delivery still far behind schedule, it was decided to modify a Curtiss Fledgling trainer, an N2C-2, and attempt full nolo operation with it. The entire project was being conducted on a financial shoestring. Of course I was not involved in the financial management of the program, but I was sure indoctrinated that money controlled nearly all decisions. In a 1982 magazine article Fahrney, then Rear Adm. (ret.) stated that "A budget of \$77,500 was estimated to be sufficient to purchase two Stearman Hammond JH-1 planes on tricycle gear, modify two Curtiss N2C-2 training planes to accept tricycle gear, purchase and install control gear for the target planes, two control planes and two field control carts and pay an engineer and a draftsman. The budget was eventually increased fifteen percent to take care of modifications and delays". This would indicate that the total cost of what we now call the R&D effort was

under \$90,000. Almost unbelievable. Apparently I cost the project about four percent of the total cost during my two years on the program. Bill Wait cost about twice that.

Actually, though, the small cost was probably possible only because of the different accounting rules which were used in those days which reminds me then of one of Mr. Lynn's educational sea stories. He was fond of telling me that he had been one of eight students who took a graduate accounting course one time. For the final exam each of the students was given the same problem, and after they turned in their test the group obviously compared notes with one another. They found that each one had given a different answer to the problem, so they then assumed that there would probably be an eighty-seven percent failure rate. When they got the grades, they found to their surprise that each one had gotten an A in the course and all the answers, eight different ones, were judged to be correct. So the moral of the story is be sure when you compare costs you know the details of the accounting system being used.

And, in the case of Special Project D, all of the uniformed personnel apparently came with no charge as did all the material that we drew directly from the stock. I'm not sure about direct shop labor, it may have been charged to the program, but there were certainly no overhead charges involved.

Project Dog was classified but none of the drawings or any of the paperwork was marked with any of the usual Restricted, Confidential, or Secret stamps. We had open orders in all the shops and we operated almost entirely by making sketches which we then hand-carried to the appropriate shop. We did all of our own weights and stress analysis and so on. When the first installation had been made in the NT-1, it included a purchased Sperry autopilot and the cost of that unit alone used up most of the budget of



that particular area. As I remember, they quoted a figure of something like \$10,000 for the Sperry unit alone. When we got to the N2C-2 and the JH-1 we made our own much simplified hydraulic actuators, control valves, solenoids and so on. The actuators were made from two open ended cylinders made from aluminum tubing, fitted with aluminum pistons on the ends of a steel drill rod connecting the two opposing cylinders. The pistons were made of aluminum stock and used Lockheed automotive brake cups (at seven cents each). The airframe part of the N2C-2 conversion involved really stripping the airplane because we had to move the landing gear to go from a conventional gear to a tricycle gear. The tricycle gear arrangement used the lower hinged, V portion of the original gear moved aft. The upper portion of the oleo was cut off and the remainder installed vertically between the wheel and the lower wing. A fixed strut was added to transfer the load to the upper longeron of the fuselage. The nose gear was, of course, all new. It consisted of a V arrangement from the wheel to the fuselage at the bottom of the firewall. The oleo was procured from Pitcairn Autogyro where it was used on a production autogyro main gear. The cost was on the order of \$100, I believe. Since that oleo was not quite long enough, an auxiliary structure was built to transfer the load to the upper and lower longerons at the firewall.

Changing the landing gear then changed the stresses in all of the forward part of the fuselage which was made of welded steel tubes. Rather than cutting the old members out, we added reinforcements to those parts of the fuselage that weren't going to be quite strong enough. These were made from steel tubing and bolted over the original fuselage members.

The lateral control of the airplane and directional control was combined so we made coordinated turns. Some theory, and perhaps some flight tests, showed that we would be better off if we had some vertical tail area down below the fuselage in addition to the normal fin and rudder mounted on the top of the fuselage of the original airplane. The solution to that problem was to draw a spare fin and a spare rudder from stock, thereby adding the same fin area on the bottom as we had on the top; we welded the two rudders together giving us a larger vertical tail, about half above and half below the fuselage.

A lot of the details of the control system I no longer remember, but in any event the whole thing went very well overall. My nose landing gear turned out to be extremely flexible. When we turned a corner, the vertical spindle of the nose gear must have turned perhaps ten degrees, very scary to look at it. It actually had plenty of strength but it just wasn't stiff enough and it's very difficult to make that type of a long V gear so that it is stiff enough. Eventually we had to change it after we busted it up on the first landing we tried of the modified airplane. That episode was one I remember well. They had been doing a fair bit of flying without any particular trouble. I suspect Fred Wallace was the best of the control pilots. He did the takeoffs and landings operating from the field cart. When it got time to do a formal demonstration as a drone Lt. Cdr. Fahrney decided that he should be the pilot in the more difficult part of the job which was doing the landing. He did this primarily not because he wanted the glory or anything of that nature, but rather that he didn't want the NAP to take the blame in case things didn't go well. I can remember now the NAP's complaining that Fahrney should never have been allowed to do it for he was the worst of the control pilots. Anyway, the flight went well on the takeoff

and controlled well in the air, but when they landed Fahrney put the drone in about a ten degree glide slope and never pulled the thing out. It landed nose wheel first and the gear went in all directions. So the first flight ended really in a failure. Following that we redesigned the nose gear and probably had the strongest nose gear that had ever been built. I still recall looking through the few records that existed at the time on design requirements for nose wheels and eventually we elected to take a design condition of basically 6G or six times the weight of the airplane on the nose wheel of the airplane balanced by rotational inertia. We had a very strong nose gear at the end of the program.

Although all of this happened over fifty years ago now I remember parts of that program still quite vividly and other parts of course I don't remember at all. Maybe some of the other things that I do remember could be of interest. I talked about the fact that money was so important. We probably couldn't have accomplished that whole task if it had not been for the salvage yard at the factory. Fortunately, Curtiss BF2C airplanes, biplane dive bombers, had been stricken after experiencing vibration or flutter problems. A few were sent to the salvage yard and you could take whatever you wanted from any of those planes and they became the source of all of our bell cranks, ball bearings and whatnot, things that we couldn't afford to buy otherwise.

Another highlight I remember is for some reason or another we needed some short stroke actuators and we ended up by getting some Walter Kidde emergency flotation gear items, probably from that same salvage pile. The actuator had been a carbon dioxide system, but in this case we didn't have any means to do it other than by using electrical power.

## **TAPE 2 of 16, SIDE B**

Well, that ingenious bunch of enlisted personnel came up with the idea of using a squib to provide the power to move the actuator. The squib was a little device about a quarter of an inch in diameter and an inch or two long, couple of wires coming out of it and filled with powder. When you put six volts across it, it essentially blew up. We hooked that thing up to the little Kidde actuator in such a way that the gas from the explosion would go into the actuator and move the actuator down to the next port where it would exhaust. I happened to be out in the working spaces of the group on the second floor of a hangar on the flight line when this test came off. They clamped the actuator down to one end of a bench and attached by cable something like a twenty pound weight over a pulley. Everybody crouched down behind some tables, they ran wires maybe fifteen, twenty feet away and touched them to a battery and whoop! the thing worked. We had lots of power. The biggest problem was really trying to harness it all. We actually used those in several applications later on.

Another interesting thing to me was we obviously needed some means of emergency power in case the engine stopped running and we wanted to get the airplane back. So, we decided to take a normal generator and mount a propeller on the end of it which would act as a windmill and drive the generator and produce electric power. I remember them coming to me and telling me to design the propeller to drive the generator and I had no idea how to do that. I ended up by making a drawing of a propeller similar to the ones I had made on model airplanes except this one was sent out to the shop and they carved it out of aluminum. They put it on the shaft of the generator, went up and flight tested it, and the thing worked fine. I don't know to this day why it

didn't blow up or go too fast or go too slow but it didn't. I think we were lucky all through that program.

Another interesting thing that happened to me, was in addition to doing the drafting and the shop liaison and the miscellaneous chores, I was also the gofer. When there would be a situation where the enlisted guys needed a new hunk of electronic gear I would often be selected to go to a storeroom and draw out an RU-4 receiver, a GT something, or another transmitter. I'd just sign chits for them, took them out, and they got put in the airplanes. Some years later, probably a couple of years after I was in Washington, two naval investigative service people walked in. They had all my chits and they wanted to know where the RU-4s were and the transmitters and all these other things that I had signed for years before. Most of the electronic stuff was at the bottom of Guantanamo Bay by then. There was a fire extinguisher and a safety belt that had gone into the NT-1, that thing was still hanging up in Building 75 at the factory, so eventually I got out of the mess without going to jail. I often wondered how many other people had the same experience. I never found out.

When I stop and think about all this, I end up by really wondering who did what. Who started the thing? Obviously the concept must have come from Fahrney, perhaps with input initially from the Naval Research Lab (NRL). The development work on the radio control part of it was really done by NRL, and virtually all of the electronics in the airplane were done by all those enlisted guys. I know that there are no drawings of an electrical system, for example. Hendrickson, Herbst, and then later Jack Pearl and a few others did all that work on their own. The early drawings or whatever existed were done by Bill Wait before I got there, and after I got there, I suppose I did ninety-nine percent of

the drawings that applied to the program. Sometimes drawing things that the enlisted group of guys wanted done, wanted made, sometimes things that obviously had to be done that I knew something about. Obviously also Fahrney would tell me to do things and Bill Wait would ask me to do things.

Fahrney at that time was thinking guided missiles and I remember one program where they had borrowed an early CBS rotating disc television set, did something to make the power supplies work, and put it in the nose of, I think, an SNB and flew up and down the Delaware River with it. When they came back from that flight they reported that they did a pretty reasonable job of watching the television screen and aiming at buildings that they knew existed up and down the river. Nothing ever was done while I was still on the project in that line. However, the concept of using television as a sensor seemed to have been established and later on television was used in the Gorgon program, as well as others. Fahrney had me make a drawing of a small attack drone for his use in promoting the concept.

One other interesting idea that came about during that period was when they were considering what happens when the engine quits and we put in the emergency power and so on, but then as a last ditch thing a parachute recovery device was desired. That was done like all the other parts of the program with using things you could get your hands on and wound up by taking three standard twenty-eight foot chutes, running the shroud lines through the vent holes in the top of the first chute to get the second chute attached and the third one in line, so we had three twenty-eight foot chutes in tandem. It was actually tested at Lakehurst and the system worked pretty well, frankly much to my surprise. Well, enough for the things we actually did on the program.

One of the things I ran into in those days that later was of interest to me when I became more involved in Washington and the acquisition problems of naval aircraft was that when I would pull a drawing on the Great Lakes TG-2 airplane to find out what the airplane structure looked like, or something of that nature, about half the time the drawings were marked T4M. That was very puzzling at the time, but eventually I found out that the T4M had been the original torpedo plane design. Normally the Navy bought production airplanes from the manufacturer who had developed the experimental model. But pressures developed apparently for a competitive buy and so for a short period of time the Navy tried doing a formal advertising when they had a follow-on production buy. Perhaps in this case Great Lakes won a production contract by underbidding Martin, the original developer. We stopped doing that in the acquisition business really because industry finally refused to bid on such things. There was no way that the second manufacturer should ever be able to produce the airplane for the same cost as the original producer. One of the lessons one learns when you go back and look at history.

Along that same line, before I forget it, was a tale that happened at NAF in that same time period. You remember that I had said that we had the Vinson-Trammel Act and the Navy was supposed to build ten percent of their own airplanes. To do that I mentioned we had built R-760s, using Wright Company drawings and whatnot for a production run. In the airplane field I believe the first buy of NAF building other people's airplanes was the SON program. This was a Navy built version of the SOC that had been in the fleet for some time and produced by the Curtiss Company in Buffalo.

To appreciate this you have to know a few other facts, unfortunately, so this will wind on for a while. When an airplane was priced in those days, one of the items on the

final corrected data list that the Navy required was a cost breakdown of the entire airplane. The rules were such that the breakdown of all the parts of an airplane which you used for buying spares and pricing spares had to add up to the unit price of the airplane that was being produced. This, you immediately recognize, could be a very difficult thing to do basically, to price each part and make the total come out to the unit price of the airplane. You did have a break in that the manufacturer at least had the assembly labor available as a cushion. In any event, the common practice of industry was that you would price things like wing tips pretty high and you would price things like fuselages pretty low. When the factory got the job they were faced with a problem of how to produce the SON within the price of the SOC, to prove perhaps that Curtiss had or had not been cheating us all these years. In any event, either the production superintendent at that time, probably Cdr. Ostrander or his civilian assistant, a man named Stevenson, got the brilliant idea that rather than trying to build a SON welded steel tube fuselage they'd just buy them at the price of a steel tube fuselage from the spares list of the SOC. The price was remarkably cheap. The aircraft factory just sent off a purchase order to Curtiss, "Please send me 44 steel tube fuselages." Curtiss squealed like a stuck pig but eventually they had to produce them, otherwise they were proving that they had mispriced spares for a great number of years. Then the factory was able to produce the SON within the unit price of an SOC. A great sea story.

I ended up staying on Special Project D for roughly two years. Before I left the program the N2C-2 had been flown successfully. We finally got the Stearman Hammonds and had modified them to the extent of putting in the radio control gear. The N2C-2 had been dispatched to Guantanamo and run over part of the Atlantic Fleet on a



prescribed course, prescribed altitude, at a prescribed speed. I think they flew at 10,000 feet and somewhere around 85 or 90 knots up and down the deployed fleet which shot at the poor old N2C-2. There were no hits on the first run. Two or three runs later the airplane did pick up a few shrapnel hits but the airplane was recovered and was actually used again in later target tests against the fleet. The higher-ups in the Navy department were really shocked I guess at how poor the performance of the antiaircraft guns of the fleet really were and immediately ordered that we have a production run of N2C-2s. I think the Navy then had perhaps a dozen Curtiss Fledglings still laying around somewhere and that program was carried out.

I had been on the program two years and it was time for me to get a raise. When the program went into a production run it basically had to go back into the normal routine of the aircraft factory so I could stay on the program, but if I wanted to get a raise the Chief Engineer said I was entirely too specialized to get one and I had to prove that I had a great deal more versatility. Well, you can believe that everybody fought the idea including me. I thought that the assignment on Project Dog was just about as versatile as anything I'd ever heard of. You did everything. But to get the raise I got transferred off of Project D back to the Engineering Department in early 1939.

By that time the situation in the country was that aeronautical job opportunities were available virtually everywhere and the companies were looking for people with a bit of experience so we all started getting job offers. Lockheed was trying to hire people and their offers were that they'd match our salaries and depend upon the low living costs and the wonderful weather of California to lure us to the west coast. They didn't get anybody to bid on that one. And then McDonnell was starting his first company in St. Louis and

James McDonnell came to Philadelphia and interviewed people. I remember being interviewed by him in a downtown Philadelphia hotel. I concluded that James S. McDonnell was nuts. He had asked me whether I knew anything about hydraulics, landing gears, surface controls or whatnot and he would interrupt his question by pointing to a picture of a Maryland 167 (for which he had been the designer when he was at Martin) and said, "Yes sir, that's my baby." Another remark was with a pat of his hand on an aerial view of West St. Louis saying, "Isn't that God's country?" There were just a few five room bungalows scattered around hither and thither. At the time I think he was operating out of the old Robertson hangar in St. Louis. Anyway I ended up by not going to McDonnell, probably much to my financial detriment. Later, just about the time I left NAF for the BuAer, Glenn L. Martin was making offers and I went down there for a couple of interviews.

Well, I got a little bit ahead of the story at that point. When I went back into the engineering department I first had to train three or four guys to take out all those sketches that I'd been making over the two year period and they had to be converted into normal production drawings. They had three or four draftsmen working on that program. I kind of oversaw them as an added responsibility to the job that I'd been assigned in the stress department. I had to do it because nobody else knew what the drawings were. The Chief Engineer was very unhappy when I'd spend any time on the Special Projects work.

I spent probably six months in the stress department doing stress analysis of the programs that were coming up. I guess the N3N was well along by that time and in production. We were still doing some work on changes that had to be analyzed. The

X0SN had been started. That program eventually got stopped I believe just after an early flight test when the then Chief of the Bureau RAdm. A.B. Cook walked through the plant one day and his words were something to the effect that, "Hell, I thought I stopped this program on my last tour in BuAer." So everybody rolled up the drawings and started on a new program the next day.

Well, after about a week or two of working in the stress department I had demonstrated my versatility and so I got a raise from a P-1 to a P-2. That meant \$2000 to \$2600. I stayed in the stress department for about six months and got transferred back into the design group, back on the board. I was assigned to the SBN where I was supposed to do a few miscellaneous jobs first and then they gave me the task of trying to design a flexible gun mount for the rear seat. The SBN had been built – the original airplane had been built by Brewster as the XSBA-1, and as part of that Vinson-Trammell Act they were ordering a batch of them to be produced as SBNs. The drawings were in awful shape. Since the Navy had really not intended to buy the airplane in production, the contractor never reached the stage of cleaning up the experimental drawings. The drawings had been made from pencil vellums and the blueprints were difficult to read. In any event my learning process continued. I then got involved in a few other programs where I had some dealings with Bureau of Ordnance drawings and it was obvious by looking at anything done by Ordnance that it was overclassified and overdesigned, altogether too heavy, too big. That was a lesson I suppose that carried on for years thereafter. I never was very much entranced with anything BuOrd did, at least in the aeronautical line.

It just occurred to me that when I was talking much earlier about the enlisted personnel on Special Project D or Project Dog that I had said that we had eight enlisted people when we started plus Lt. Cdr. Fahrney, Bill Wait and myself. During the two years that I was on the program the number of enlisted personnel increased and over that two year period some ten more people were brought into the program. Toward the end of the game they also picked up another officer or two. I remember Lt. Bobby Jones came aboard and he later headed up the project when they started setting up the operational squadrons to go down and run the exercises for the fleet. He continued on the program through the TDN, TDR and attack drone modifications of fleet aircraft started during World War II. I should also say that the ten additional people that came in were perhaps a shade below that original group but not a lot. They were a very sharp bunch of guys. I just hope that the current day Navy is as good as those guys were.

Back to the present of sixty years ago. I was working on the board sometime in the fall of 1939 when the Chief Engineer advised me that I was to be interviewed by someone coming up from BuAer, a Mr. Frisbie. They needed personnel down there. Actually the Naval Aircraft Factory served a very useful purpose as a manpower pool for the Bureau, and did a worthwhile job of training people like myself, that had no experience whatsoever, in getting ready to come down to Washington to help in the management of the naval aviation program. Anyway, when Karl White had talked about a Mr. Frisbie he obviously held him in high regard and let me know that Frisbie was considered one of the prime movers of naval aviation in Washington. So I looked forward to the interview. I guess within a couple of days I was interviewed by Mr. Frisbie. He told me what he and his section did, and it was obvious that it was one of the places

in the Bureau that took a look at the whole airplane rather than pieces as you might get if you went to work in a powerplant section or other specialty groups in those days. I was interested in the job. By that time I had a very high regard for the Navy, its people, primarily its people. I didn't know enough about the equipment but the people were sure first rate. To make a long story short, Frisbie then eventually offered me a job and he also offered a job to a Mr. Gil Weiss who had come into the factory in 1938. Gil was a NYU graduate and had worked at Burnelli briefly before NAF.

Gil and I came down to Washington at the same time on 1 December 1939 and we stayed together until he retired a few years before I did. I stuck on a while longer than that – getting ahead of the story again. My orders to Washington were that I should report on 1 December 1939 and since the move was "in the best interests of the government", the Navy Department would gladly pay my transportation. What that amounted to finally was that they would pay me three cents a mile for the 141 miles involved. So, after I got to Washington, I got a check for my moving expenses and transportation of \$4.23. That was my introduction to traveling for the Navy, and the first travel orders I had ever had. Anyway, the next step was Washington.

**TAPE 3 of 16, SIDE A**

**RAUSA:** We had covered your four and a half years at NAF, and your transfer to Washington. When did that occur?

**SPANGENBERG:** 1 December 1939. You'll find out that's the only date I remember.

[laughter] I don't even remember the date I retired. I know the year though. But Washington was obviously the best place to go.

**RAUSA:** By the way, by now you are married. Did you have any children?

**SPANGENBERG:** I was married six months after I started at NAF. We had our first child in June of 1939.

**RAUSA:** So you had a baby there before moving to Washington.

**SPANGENBERG:** We had a six month old girl.

**RAUSA:** In Washington did you work on the Main Navy Building on Constitution Avenue?

**SPANGENBERG:** We were in the eighth wing on the second floor, Room 2841.

**RAUSA:** That's not the building out in the back, this was the main building?

**SPANGENBERG:** This was the main building. The N and W buildings in back hadn't been built yet. It was the Main Navy Building. All of the Bureau of Aeronautics was located in the 8th and 9th wings of that three story building. My boss had been given the title of "Design Coordination" when he became a P-7, which was then a newly created "supergrade" and he was also head of the "Contract Airplane Design" section of the "Engineering" branch.

**RAUSA:** What was your first job with Frisbie?

**SPANGENBERG:** The first thing he gave me to read was the BuAer Manual which could be read in an hour, I suppose. I read that all and said, "now what?"

**RAUSA:** Were you meeting with the contractors a lot at this point?

**SPANGENBERG:** Not when I started, but pretty soon I did. Obviously they would rather talk to P-7 Frisbie than they would to P-3 Spangenberg or P-2 Weiss. But eventually it became a melded office. Frisbie was a long-time Navy employee, had started at BuAer in 1923. He had received a Mechanical Engineering degree from Cornell and had worked at Curtiss. He became a Project Engineer before coming to BuAer.

**RAUSA:** Was he a pretty good guy?

**SPANGENBERG:** A very fine individual, widely respected, and widely liked. Industry knew him and respected him and he was a wonderful guy to work for. He was a father figure to Gil and me. Later years it was really pitiful because he started what I now know to be Alzheimer's. In his last few years in BuAer, he was really slowing down.

**RAUSA:** So you eventually became like his right hand man.

**SPANGENBERG:** Very quickly I became his right hand man and Gil Weiss his left hand. Mr. McCalmont, the second man in the office who was one grade lower than Frisbie, developed cancer of the intestines and in those days they didn't really know what to do about it. I found out about it when he telephoned one morning and told us that he wouldn't be in for the next six months. He went out to the University of Michigan hospital and had one of the first operations where they removed the colon. Well, this necessitated a very quick learning experience for Weiss and myself.

**RAUSA:** Frisbie would almost be like the technical director, like the number one civilian in BuAer.

**SPANGENBERG:** Well, he was the number one civilian then. There were two others that had the same grade level as he, one that ran the Drawing Room, Mr. Clark.

Mr. J.E. Sullivan headed the Equipment and Materials. Sullivan was a reserve naval officer, an Annapolis graduate, I believe, but ran his section as a civilian. The functions of the Design Coordination/Contract Airplane Design office at that time were very broad. As you mentioned, Mr. Frisbie could be described as a technical director, or perhaps better as the senior technical advisor to the command structure of the Bureau of Aeronautics. The office duties included coordinating design requirements for all aircraft, running design competitions for new aircraft, preparing test directives for all aircraft, administering the design and operational weight and balance control systems, as well as the requirements and approval of the mechanical design systems of all naval aircraft, including surface controls, landing gear, wing folding, towing, mooring and anchor gear, flotation gear, cockpit arrangements, and so on. We also wrote all the letters for having trials done and this again was a coordination kind of a job. We wrote to a flight test organization then at Anacostia for testing of experimental airplanes, then called Service Acceptance Trials. For production airplanes, we wrote to the Bureau of Inspection and Surveys for Production Inspection Trials. We coordinated getting the letter out, and what was to be tested. It was done in a lot more detail than today where we can just about tell Patuxent "test the airplane" and they now know what the job is. In those days I imagine that there was just not enough of an organization at Anacostia that the bureau trusted to know the entirety of what had to be done. Mr. Eddie Rounds over there was probably the only civilian continuity kind of a guy available. Pilots rotate in and out and you just don't get the breadth of experience, but put them all together and you do of course. The scope of responsibility seems almost impossible to imagine in today's world. The Design



Coordination title that Mr. Frisbie had was the best name that section, later division, ever had.

**RAUSA:** Well, once McCalmont went out there for the operation then you became the man, is that right?

**SPANGENBERG:** Yes, I became number two guy. McCalmont had been number two to Frisbie and had run almost all of the test directive type of activity – accepting the reports, doing the weight and balance, writing the directives for flight test and to the Board of Inspection and Survey.

**RAUSA:** This looks like a good spot to stop because it's a new milestone if that's all right with you.

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**RAUSA:** We stopped last time after you left the Naval Aircraft Factory and came to Washington for the first time to work for Bill Frisbie, McCalmont got sick, and had to have an operation and had to leave the area for a while, so in effect and in a very short period of time upon arrival you became Frisbie's number one guy. Have I got that correct?

**SPANGENBERG:** Partially, that was one part of the job when we got to Washington. I say we because Gil Weiss came down at the same time, you will remember. The two of us went to work on the same day in the same office so Frisbie's office expanded from Frisbie and McCalmont and a stenographer, Gladys Fricker. The Bureau of Aeronautics in those days was very small. We were located on the back end of the eighth wing,

second floor, Main Navy Building on Constitution between 17th and 19th. The whole bureau was concentrated pretty much in the eighth and ninth wings. There were some people I guess on the third floor but mostly on the first and second floors.

**RAUSA:** Who was the admiral in charge?

**SPANGENBERG:** Towers. The whole operation was small enough so that within a day or two of our arrival Frisbie took Gil Weiss and myself on a tour and introduced us to all of the section heads at the time. The head of the engineering branch was Cdr. Pennoyer, "Horse" was his nickname. He was located about ten yards from where our office was. The Class Desk officers were in the same corridor. There was the fighter desk, Cdr. Hatcher had the job when I got there. Cdr. Eddie Clexton had the dive bombers. Cdr. Mort Fleming the cruiser and battleship based planes, the SOCs, and OS2Us and so on. Cdr. Farnsworth had the patrol planes, VPs and then there was a training desk. Cdr. Farhney had that operation most of the time. He was called Trainers and Special Devices, or some such title. He was still spending part of his time up at NAF. Of course, with tours of duty, people changed. Eventually Cdr. Fleming's job, the VSO Class Desk, which also handled torpedo planes in those days was simplified by establishing a VTB Class Desk.

In addition to those guys, we went on up to the Chief's office and I was introduced to Adm. Towers. A large part of the organization near the Chief's office in the ninth wing was eventually transferred over to OPNAV. There was a training group up there that ran the whole Naval Aviation training program. "Military Requirements" was up there, and "Plans and Policies." Civilian attire was the norm in order to keep "military presence" in Washington to a minimum. That policy ended with Pearl Harbor. I can remember Plans

and Policies was then Capt. D.C. Ramsey. There was only one admiral in the bureau then, Adm. Towers. Ramsey wore a pair of slacks and a black cambric jacket all the time. He was easy to find. The point of this is that the whole organization was very small; I can't imagine a new employee coming into NAVAIR today, for example, being taken around and introduced to the heads of all the things that are now called divisions.

My first day after the introduction to all of the divisions, Frisbie threw a "BuAer" manual on my desk. That was a document, perhaps thirty pages in those days, of the rules of how to write letters. Bear in mind I'd come from the Naval Aircraft Factory and we worked on making drawings and doing analyses and reports, but we didn't write letters. I doubt that I'd ever written a single official Navy letter at NAF. Gil Weiss's experience was the same. When we had questions, we asked Miss Fricker who was a CAF-2 and a superb stenographer. She ran the office basically. As an aside, there was only one clerical position in the Engineering Branch Head and Class Desk spaces, a Miss Pelton. Very capable.

**RAUSA:** Do you recall at that time what aircraft were cooking?

**SPANGENBERG:** To a degree. Knowing you were going to ask me that I tried to dig through some of the few records that I have. That's probably something I ought to say and I think you already know this. When you remember these things your memory gets awfully selective and the events that you remember one way you'll read years later a completely different way. For example, in reading Ed Heinemann's book, some of those tales I remember but not the way he describes it and some of the stuff is just basically wrong in the way programs started.

**RAUSA:** That's the way he remembered it and I think that's true.

**SPANGENBERG:** Probably a historian ought to find everybody from the period; I'm sure he could find conflicts.

When I came down to BuAer I got a raise to a P-3. Gil became a P-2. P-3s were paid \$3200. We thought that was a lot of money in those days. But I was a junior in this whole thing and when there would be an important meeting on a new airplane or when the evaluation meetings were held by the Chief of the Bureau or something like that I never went to those things. Frisbie went, and he would tell us some of the things that happened, but not everything that happened. Frisbie was not a guy that did a lot of talking. In fact one of the problems that we always had was getting his knowledge out of him. We had to ask questions to know what was going on. Well, anyway, you asked about the airplanes then under development. The VTB competition had been held and they were building both the TBU at Vought and the TBF at Grumman. At that time the TBF had been selected for production and so we were doing a fully concurrent development program on that one. That led to some innovations in contract guarantee writing. On the fighter side, the F4U was under development and was the subject of one of the early lessons I learned. The airplane of course was roughly twice the weight and size of the previous generation of fighters. There were a lot of people, experienced naval officers as well as the general public and civilians around the place, who thought the F4U was too big to ever be a success. I remember listening to a guy whom I thought knew a lot. I had received a letter from somebody up at NAF who asked me what my opinion of the F4U was. I hadn't been in the business long enough to really know so I just quoted the general impression was that, according to this guy, that it was too big, too heavy, it would never be a fleet fighter. Obviously it didn't turn out that way. It didn't

take long to learn that you'd better be careful to whom you listened. I remember John Shepherd, you probably know him.

**RAUSA:** The name rings a bell.

**SPANGENBERG:** A fine Naval officer and he always told the story that when he started on a new tour that he had to look around for that little gal in the red tennis shoes to get his information on whom he should believe in the organization, and whom should he avoid for advice.

In addition to the F4U, and what came out of the same competition in 1938 was the twin engine Grumman XF5F, a peculiar looking airplane, two-wing mounted engines, maybe 1820s, but with no fuselage forward of the wing. There was a cartoon that said "first put the engines on, then you put the wing, then you put the fuselage." There were a lot of people that wouldn't even consider the twin engine airplane again for a fighter.

### **TAPE 3 of 16, SIDE B**

In the fleet we still had F3Fs operating, but we were going into the F4F. F4F-3s were in the fleet. F4F-4s started about the time I got there. A famous story about Bill Schwendler at Grumman was that he used a pin through an eraser to find out how out how he could get a folding wing using a slanted hinge pin.

**RAUSA:** I never heard that before. He put a pin through an eraser?

**SPANGENBERG:** You know one of those long pink erasers. He stuck a pin through that and screwed around and when he swung the eraser, simulating the wing, it moved

from a horizontal plane and put it essentially in a vertical plane of 90°. Then that idea was used in the Grumman F4F and TBF type of wing folding.

**RAUSA:** You touched on the aircraft that were underway at the time. Do you recall about the time you got involved in any particular one or were you kind of working several.

**SPANGENBERG:** Basically there was plenty of work in that office to do without getting involved in any one airplane, in a new program, that type of thing. The first evaluation job I ever did was a Curtiss Wright 21 airplane that had been submitted to Anacostia by the contractor. They were proposing it as a light weight fighter and Anacostia had written a report. Frisbie threw this on my desk and said write an evaluation report. I didn't know what that was. So I went back and I looked through his pink file of the letters that had been written before. Eventually I sat down and wrote a report based on what Anacostia had said, and compared it with the fighters we had under development. Must have been an all right kind of a job. I remember drafting a letter that finally went out to Curtiss Wright, "no thanks." The government knew they weren't going to buy them. *[GAS: As I edit some of this history in 1998, I can't help but think that today someone in OSD would buy the design as the low in a high-low mix.]*

There were some other personalities that were important in this area in that time span. Working directly for Cdr. Pennoyer, the head of then "Engineering Branch" was a Cdr. L.C. Stevens, with a title of "Experiments and Development." He was a wonderful gentleman as well as being a very astute technical naval officer. He did the entire R&D budget all by himself and went up on the Hill and defended it. He ran the whole R&D

effort. He was an overloaded individual too. Somehow or another he had started handling invention letters from the public thinking that this fell into the category of Experiments and Development, and surely there were going to be some great ideas that everybody was overlooking that would come in. Well, he soon found out that's not what invention letters that you got from the general public were. The letters were a time consuming task. You had to always be nice to the individual. Apparently Stevens had tried to give that job to other people and he had not found anyone that wrote letters that he was willing to sign. Well, with a new boy in the field, Frisbie apparently had told him that maybe I could do it. He wandered down to our office and gave me an assignment. Frisbie had told me he was coming. So he gave me about three letters, samples he had written and signed. It became relatively easy to start writing responses to invention letters. That eventually took a good deal of effort.

**RAUSA:** He liked what you did so you got —

**SPANGENBERG:** Well, I satisfied, I could write a letter and there's no doubt in my mind but what I would never have gotten where I was if I hadn't had the ability to sit down and write a fairly decent letter. It did not seem like a very important thing to me at the time. I thought everybody could do it. As you went along you found out that some of those guys working for you, you spent all your time rewriting that which they had written. Technically they just couldn't put it down on paper. I was glad that I had a good series of English teachers back in grade school and high school. I guess that's where you learn it. My friend Gil Weiss could write a letter but it was sometimes twice as long as it might have been.

**RAUSA:** It's an art I think to be able to do it concisely and get the point across.

**SPANGENBERG:** Well, that was a continuing job and I did it for years. All through the war I was writing those letters. Probably ought to tell you about some of my favorite inventors.

**RAUSA:** Are those letters still around?

**SPANGENBERG:** They're back in files. I didn't keep anything.

**RAUSA:** I'll bet those files don't exist either.

**SPANGENBERG:** They may or may not. As far as files existing that again was just an awful story. When I started in the bureau there was a file room/mail room. It was a combined operation. Some of the old hands would go down to the mail room every morning and read through the "yellow" copies of all the correspondence that had gone out the day before. Frisbie never did that. I guess we were always too busy. Apparently some people wanted to do it and I imagine that the naval officers, guys that wanted to get into the policy part of the business probably would find it extremely helpful. They sure would be way ahead of some of the people that hadn't read them. How did I get off on that?

**RAUSA:** Well, we were talking about how Stevens came down and roped you into writing invention letters. So that took a lot of your time and then you were also working on —

**SPANGENBERG:** Another thing that happened was that the bureau as a whole was understaffed. They probably needed twice as many people to do the job that they should have been doing. Structures was woefully understaffed and so when they found out that there were a couple of new guys down there at Design Coordination they asked for help.



Frisbie finally agreed. So I went down there for a couple of months and worked in what was then the Structures section. This was also invaluable because I learned the personalities of the guys in Structures and later, of course, I was working with them and could understand their philosophy. It varied with each individual.

The long-time head of Structural Requirements was a fellow named Ralph Creel. Creel in that month or two that I was in Structures sat across from me at a double desk. (I had never seen one before.) He sat on one side and I sat on the other and he assigned the work I was supposed to do. I looked at a stress report on a Bell XL (Navy version of a P-39) landing gear. I didn't like their loads analysis. I guess I made Ralph real happy. Ralph was the hardest guy on contractors that ever lived. Contractors complained about him. All the contractors said "That God damn Creel." He wrote them letters almost accusing them of skulduggery, of trying to get around the requirements. Nasty letters. We argued all the time. They, the contractors, weren't really that bad and you had to work with them. Actually, despite the fact that everybody "hated" Creel, when he finally retired he got more job offers from the industry because he knew the specs system, knew how things worked. He was the soul of integrity, probably too much so. He got some kind of a big award, not from a Navy organization or an aeronautical group, but from the SAE. He taught me things of course. I argued with him about the whole art of vibration analysis. I had taken a course under Prof. Timoshenko so I knew the language, but I couldn't do that type of work. That didn't stop Ralph Creel from saying contractors should do it, while I didn't think that we should ask the contractors to do things that we didn't know how to do. We argued about that. He was probably right to a degree but he overdid it. Eventually we'd always compromise. Anyway, I went down

there for a couple of months, learned that job, and probably about the time I got back from that assignment was when McCalmont's illness, cancer of the intestines, occurred. Well, we learned quickly. I had not gotten into any of the writing of the letters of acceptance or the letters requesting trials. There was a lot to learn in that area. When McCalmont went out Gil Weiss picked up the weight and balance part of the job and then his career from then on pretty much concentrated on the weight side of our activities. I concentrated on writing letters on the trials and the acceptances and that sort of stuff and doing the drawing approval that came into the shop, looking over the control layout, etc. Basically the contractors would send in a glorified layout of what they were going to do, a wing folding mechanism for example, and we would look that over and see if it was in accordance with the design specifications and whether it made sense, was essentially foolproof, or as near as we thought we could get to foolproof. Did a little criticizing of mechanical details that should have been caught by the inspector at the plant but not as much of that, usually I just took a fairly general look at the arrangement. Eventually all of that work got put into a separate section when we expanded for World War II, and finally it was transferred to "Equipment and Materials."

I guess the first competition that I really got involved in to a limited extent was the PBB, or it became the PBB. It was a twin-engine seaplane which would fly off the water at perhaps 60,000 pounds, but for doing extremely long-range missions it was to be catapulted from a barge-type vessel at a much heavier weight. The competition had been started before we got there and it was in the winding up stage. It was an important part of my learning process overall because they ended up by selecting Vought Sikorsky as the winner. Sikorsky had merged with Vought. You probably remember that Sikorsky

had built flying boats. The Navy had a PBS and they built a commercial boat version not long after, the VS-44. Anyway, Vought won the competition but Vought had enough business and the Navy wanted to expand its flying boat industrial capacity (from Sikorsky, Consolidated, and Martin) to get Boeing into the military boat business. They were already in the commercial end of the business. The Boeing design proposal, however, had been below par and finished I suppose number 3 out of 3 or 4. So it was decided that on "industrial statesmanship" grounds they would give the contract to Boeing but it was done honestly, the Navy handled it honestly, by writing to Vought and saying, "You've won the competition. We're going to give the award to Boeing. We want to give your data to Boeing as a starting point in redoing their design." We paid them for the effort. In those days, a proposal probably cost \$10,000 or something on that order. Up to that point at that time, that whole era, we did not pay a contractor for proposal work. It came out of his pocket. In this case we paid him for his work and I don't suppose he was happy but he was satisfied. That became an important keystone in my learning, how do we deal with questions of that nature.

**RAUSA:** Would this be around 1940?

**SPANGENBERG:** Yes the PBB. I think my chart shows it starting late '39, so it was '39 and '40. Anyway, that is what was done. Boeing was called and told that they had a lousy design. "Here's the data on Vought design. Go back and give us a proposal that does what that does." They weren't going to copy the Vought design. No two designers ever think the same way. They then submitted a new proposal and eventually the Navy went ahead and gave them a contract. The airplane was a success, a pretty good flying boat, but the Navy traded it away later in return for some PB4Ys, a Navy version of the

Army Air Corps' B-24s. So the Navy gave up that beautiful Renton plant on Lake Washington at Boeing in Seattle and then Boeing was out of the Navy business for a while. They never did build us any production seaplanes.

**RAUSA:** One thing I want to ask. At this time was it almost a certainty in your mind that we were going to be involved in the war?

**SPANGENBERG:** Oh, yeah.

**RAUSA:** So there must have been concern about getting the right aircraft to do the job.

**SPANGENBERG:** Right. And one of the tasks that came along at that time, the way you got a different airplane was to write to the contractor and say give us a proposal for doing this, that or the other. Our fleet fighters, the F4Fs certainly were inadequate. We knew they were going to be inadequate. I still remember writing those letters. One to Brewster, do you remember the Brewster Buffalo, the F2A? I wrote a letter to Brewster and I drafted the letter to Grumman and said give us a proposal with putting a 2600 engine into the F2A for Brewster and into the F4F for Grumman, modify the airplane to suit, and include these items: take out the emergency flotation that was a standard part of airplanes in those days, put in wing mounted 50 cal. machine guns instead of the 30 and 50 cal. firing guns through the props. Install armor and self-sealing tanks, the development of which was just starting, and make it a combat airplane. We gave them the performance specs we wanted them to meet. Shipped the letter out, after the usual coordination with the whole engineering branch.

Shortly thereafter another competition was run which resulted in selecting the F7F. That was the first competition I think that I had been involved in to some degree

from the beginning. An interesting part of the competition process was that when a competition came in we would hang up each competitor's general arrangement and inboard profile drawings all around our office. They usually filled the room. We would put them up early in the morning and then all the senior officers and civilians in the bureau would get invited to come and inspect the proposals. The chief of the bureau would be invited. Towers must have come down on occasion but I don't remember him specifically. But I remember Adm. Marc Mitscher who was then the assistant chief, coming down. He looked at the F7F proposal and said, "That will never go on an aircraft carrier. It's too big."

**RAUSA:** He was an early aviator.

**SPANGENBERG:** Oh, yeah, he was an early aviator. He must have been assistant chief. He was a good guy. In fact, nearly all the people that I ran into at that time, awfully good guys. Actually Mitscher was right. The thing never did become a fleet aircraft.

**RAUSA:** What did he see in it?

**SPANGENBERG:** It was just too big, too heavy. That wasn't the reason that it wasn't a successful carrier plane. At the time the barriers in use on the carriers were not able to handle a twin-engine design.

**RAUSA:** Did you do much traveling at this time or were you pretty much right there in the office?

**SPANGENBERG:** Did very little traveling. In my whole career I never did a lot of traveling. The office representative in the early days was always Frisbie. Frisbie went to every mockup and if there were a conference at a contractor's plant because of some

technical problem he would go. Eventually I got into the business. It seemed like I waited a long time, but in reality it was only a couple of years before I really started getting involved.

One of the few things that I ended up with when I retired was my personal file and for some reason I kept all my travel orders from the time I got to Washington. So I went back and looked through those and found out how much traveling I did, which wasn't very much. I made 144 total trips throughout my career. That is, official trips. Of those 35 were on TFX and F-111, one quarter of all my travel. That should give you a feel for how screwed up that program was. There were only 7 on the F-14 and on the F-14 you tended to make more trips to Grumman because it was close. You could run up there and back in a day. Three on the S-3 and then six on the HLH, two on the CH-53. Most of the others were single time mockup trips. I guess only 85 of the 144 trips had to deal with Navy aircraft programs specifically. The others had to do with going down to NASA, etc.

**RAUSA:** Where were you on the day that World War II started?

**SPANGENBERG:** On December the 7th? I was listening to the broadcast of the football game. Redskins then? It must have been.

**RAUSA:** What were your reactions?

**SPANGENBERG:** Shock.

**RAUSA:** Even though you knew there was going to be a war you still were shocked?

Do you recall what your feelings about the aircraft that you had available at the time and how that was going to affect your job?

**SPANGENBERG:** I'm afraid I didn't have any great philosophical thoughts.

**RAUSA:** Did you think that the bureau now was going to get big, going to get some more people?

**SPANGENBERG:** I suppose. And the bureau had been growing. In retrospect a hell of a lot of very intelligent planning was going on in the late thirties. Actually later in my career whenever there would be a spare time I would collect data on what we had done. How many airplanes we had bought, and so on.

#### **TAPE 4 of 16, SIDE A**

The thing that everybody tried to do on that Sunday, December 7, 1941, was to try to find out what they wanted us to do. The announcement that came out at the football game was, "All military personnel report to their offices." All the captains, admirals, ensigns all got up, left the football game and went to the Munitions and Navy Buildings. All of us civilians didn't know what we were supposed to do. We tried to call and we were told to relax and I suppose eventually there must have been a radio announcement telling us to report on Monday.

**RAUSA:** This was Sunday, right?

**SPANGENBERG:** Yeah.

**RAUSA:** So you were going to go to work the next day anyway.

**SPANGENBERG:** Sure. When I first came to Washington — there were probably a few things we should have said. The things that surprised the hell out of me was that at Philadelphia there was a fairly high degree of security. You didn't fool around with any

confidential material. It got locked up before you threw the cover over your drafting board or before you went away. We even locked up "restricted" data which was another category that existed then. You had to show your badge to get in and out of the Navy Yard.

When we arrived in Washington, there was no security to speak of. Here were all the secrets of the nation and we didn't even lock file cabinets. It was strange.

**RAUSA:** After Pearl Harbor now did all of a sudden your work intensify or were you already working pretty hard to begin with?

**SPANGENBERG:** We were working hard then. When I came down to Washington we were on a five-and-a-half-day week. We worked seven hours a day and four hours on Saturday. The seven-hour day started around 8:30 on paper but in order to park you had to get there at 7:30. So most people were in there at 7:30, 7:45, around that time. Some of the characters would sit down and have coffee and read the newspaper. Others, like myself, would go to work. We were already there, why not? We normally went home more or less on time. Once the war came along we went on a forty-eight hour week. We worked eight hours a day supposedly, six days a week and we civilians got paid overtime, but at a rate only the government could calculate. It was a dollar and forty cents an hour, the overtime rate of pay.

**RAUSA:** Now we're in 1942 and we're building up.

**SPANGENBERG:** We were building up before that.

**RAUSA:** So you didn't really notice any big change?



**SPANGENBERG:** It was just more of the same at the beginning, a lot more of the same. Another thought, out of context, but before I forget it – our office got monthly production reports so that we could keep up with the writing of specifications for weight reports and for other things. It gave us a source of data that I found invaluable, and then in later years we kept those kind of things and kept records, I did anyway, of production quantities and rates. When I could get my hands on any cost data I kept records on that. I sure wish I had kept all that data, but I didn't. I left it in the files when I left. I think it really bothered me that more people didn't do what I was doing, trying to get a full grasp of all the variables in this business.

So, I had all this data on how many airplanes we bought every year. I finally started putting it down, probably in the late sixties when I had gotten to a point in our organization where I became a spokesman for how we bought our aircraft. I was asked to give presentations. I went back and tabulated all this stuff and lo and behold in those early days starting in '39, '40 and '41 we had started buying trainers. We bought trainers and transports. We didn't buy very many combat airplanes, but we didn't have anybody to fly them anyway. I was really surprised when I saw how logical the buildup was. Lots of trainers and the auxiliary kind of support airplanes and transports. All those DC-3s we bought and the R5Os.

The same thing was going on in the ship side. The Essex class carriers had all been started. They were almost ready to go by the time of Pearl Harbor. We must have commissioned Essex in '42 maybe. Another thought on the planning – I remember participating in a study on putting twin floats on an SB2C for a 2600 mile one-way flight

mission. It was for providing close air support in an attack on the Gilberts. That scenario never happened.

**RAUSA:** But somebody was thinking about it which is interesting.

**SPANGENBERG:** It was the only time I ever was involved in something that was going to be a one way mission. It was necessary since there was no way you could build a 5200 mile range airplane.

**RAUSA:** Was there a time at the beginning of the war where you were alarmed by our loss rates of aircraft or didn't you worry about that?

**SPANGENBERG:** We probably didn't know about it. One of the important things that happened for the education of people like myself was that all that gunnery film, gun camera stuff. When any action film got back into the bureau, the chief would set up — we had a projection room at the time, tiered seats, whatnot — and a great many people would get invited to see showings of that stuff so you got an immediate feel for what the situation was out there. Fortunately, we also had this Navy rotation policy that often gets bad mouthed, "it's stupid to rotate an officer from the fleet, etc." To us civilians, the feedback was invaluable.

**RAUSA:** You mean having a combat veteran come in and take —

**SPANGENBERG:** Right. All naval officers, ninety-nine percent of the naval officers that I've ever dealt with have just been very fine guys. People you wanted to work with. I remember Emmitt Riera when he came back. He probably had never been in Washington before. He got put on the dive bomber desk. He and his buddy, they would tell sea stories, anti-aircraft fire, so solid that they had to break out the rafts and paddle

through it. That type of thing. [laughter] Well, you knew that was an obvious exaggeration but it sure gave you a good picture of what was going on. We knew that we had a lot of problems with the F4F fighting against a Zero in any kind of a dogfight. We also knew that we were always going to be in difficulty trying to build an airplane that would compete with the Zero. Actually compete with a land-based airplane which was really what we tried to do. We always tried to get the carrier plane to be competing on an equal basis aerodynamically with a land-based and if we could do that we were doing a better job than they were. We had a built-in weight requirement that went with folding wings and so on. There were a lot of requirements we had to build into our carrier plane that the land-based guy didn't have to do. The Zero was a land-based sort of an airplane. It had less strength than we were designing so that they had that kind of advantage. We also probably tried to have a little more legs in our airplanes than the Japanese were doing. We didn't know that at the time. In fact we knew little about what the Zero was. The thing that really hurt when you were working back there was the guy that you'd been working with last week or last month and then you'd get a combat report that he'd been lost.

**RAUSA:** Did that happen a lot?

**SPANGENBERG:** It happened too often. Once is more than enough. Lil and I had met a naval officer, Ed Allen, when we were up in Philadelphia and had become social friends. He was working in a different part of the organization at NAF than I was so I didn't really know him too well professionally. Probably in flight test or something like that. An awfully nice guy. He was lost at Guadalcanal on a dive bombing mission. He was flying SBDs. Bob Dixon was his squadron commander. I remember much later,

when Adm. Dixon was chief, BuAer, my wife and Mrs. Dixon discovered their mutual friendship with the Allens.

**RAUSA:** During those war years, George, do you have a sense of which aircraft you thought were the best and which ones you thought were a mistake or didn't measure up?

**SPANGENBERG:** Well, we probably bought too many types of airplanes during the war. Once we were into World War II most of the procurement rules got suspended. We didn't run a full design competition until the war was over, but rather tried to keep all the competent contractors busy.

We probably ought to cover some of those early airplanes and see what happened to them. One of the early competitions after the PBB, the catapultable seaplane and the F7F, was a big competition for an airplane we were going to call the PBJ, a relatively small, amphibian flying boat, smaller than a PBM, to be used for coastal patrol anti-submarine work. It was a big competition. We got as far as determining the winner, though I can't remember who it was, but then the whole project got cancelled. It was decided they would have spent altogether too much time trying to find a submarine visually from an aircraft. That was undoubtedly a wise decision. It would have been too little, too late.

I have a chart (*ed: see Exhibits - Chart1, Naval Aircraft Starts*) listing the aircraft "starts" by year from 1935 through 1970 that we can use for reference.

**RAUSA:** A "start" means you gave a contract or that just means you were looking at it? Essentially you just bought a couple, is that what you're saying?

**SPANGENBERG:** The "start" refers to a program initiation, usually with a model designation assigned but some of them didn't go all the way through to completion. I think that all had some kind of a contractual start, but my "start" may be earlier than the contract date. You can look through some of these previous listings. The F5F and then F4U came out of the same competition in '38. F4U was a single engine and the F5F was a twin engine. The FL got into it. Do you remember the FL?

**RAUSA:** No. Was it a fighter?

**SPANGENBERG:** It was a carrier version of the Bell P-39. There were advocates in those days of the sleek kind of an airplane look you could get with a water-cooled engine. The Airacobra was being touted by the Air Corps as the best of all possible worlds, and somebody got us involved in that. I later got involved in it as they tried to build the thing. It had a conventional landing gear instead of the P-39s tricycle because at the time we really didn't have any tricycle gear experience on carriers. Didn't know what would happen and some of the early results weren't very good.

The SB2A and SB2C dive bombers were from Brewster and Curtiss. The PB2M contract was for about a million bucks to build the biggest airplane in the world at the time. J3F, that funny looking airplane, SO2U and the SO3C. Anyway, this chart was really done to show that we weren't buying enough airplanes when we got down to the decade of the '60s.

**RAUSA:** But up there you said you were buying too many.

**SPANGENBERG:** Well, undoubtedly we were during WWII.

**RAUSA:** I'd like to get a copy of that to include when they transcribe this. That would be very helpful for researchers to have that. I've never see a compilation like that. That's interesting.

**SPANGENBERG:** This is the kind of stuff I ended up doing in my "spare " time. Some of it was to try to get people's attention. In order to make sensible decisions anyplace you have to know what's gone on before. I was always a great believer in the saying that if you fail to heed history you're going to repeat it. But unfortunately most people don't really believe that. They won't repeat their own mistakes but they're real happy to repeat other people's mistakes.

**RAUSA:** Of those planes during the war were there any particular ones that you were especially proud of or thought that you had a particularly important influence on their success?

**SPANGENBERG:** I can claim all the successes with the good airplanes and the ones that didn't work out I didn't have anything to do with. [chuckles] As a matter of fact the F6F obviously was a wonderful airplane and I can claim that I wrote the letter telling Grumman to put a 2600 into the F4F.

**RAUSA:** Into the F6F or the F4F?

**SPANGENBERG:** No, the idea was to get a new Grumman fighter based on the experience with the F4F and obviously we were going to have to build a bigger airplane. We probably had some informal studies with Grumman along that line. That's the way we normally worked. We'd say unofficially – either my office or probably more likely the Class Desk guy on a visit would tell them – they would get together and talk a little bit

and put a study together and then we'd formalize it by asking them to do something and then they could start charging money to the government. The early one undoubtedly was charged against the F4F, some F4F production contract.

The F7F was a good airplane but we weren't really ready for it as a carrier airplane. We didn't know enough about emergency arresting procedures for twin engine, tricycle gear airplanes.

The F14C was a dog.

**RAUSA:** Was that Grumman?

**SPANGENBERG:** No, that was Curtiss. It was next to the last of the Curtiss fighters. It started again with a liquid-cooled engine. The air-cooled vs. liquid-cooled argument raged all the time. There were some people that just thought a fighter had to be liquid-cooled. Better streamlining. Our powerplant people were obviously really very strongly air-cooled, thank God. Then eventually the engine that was being built for the F14C petered out or didn't work for the F14C and they re-engined it with a 3350. It became the F14C-2, but it didn't go anywhere.

The F5U was the "Zimmer Skimmer." Are you familiar with that one?

**RAUSA:** I've heard of it, yes.

**SPANGENBERG:** It had an interesting background. Charlie Zimmerman had been at NACA. He was always interested in short takeoff and landing airplanes and he got this concept of building a low aspect ratio airplane. He put propellers on the wing tips and rotated the propellers opposite to the vortex that naturally exists at the wing tip, going from the high pressure to the lower pressure side of the wing. By running the propeller in

the other way you'd unwind the vortex and get the equivalent of a high aspect ratio. With the huge props you would get extremely good landing and takeoff performances.

**RAUSA:** How many engines?

**SPANGENBERG:** Two. The design we built had two R-2000 engines and a cross shafting system with the propellers at the wing tips, low aspect ratio. It started with no tail surfaces but it accrued some horizontal surfaces. I have forgotten now whether it had vertical surfaces. It must have had some vertical surfaces.

The problem was how to do the weight and performance analysis. You know with all this talking I haven't talked about performance. I have to get into it right now to a degree. The performance work was really done under Walter Diehl who was an aero and hydrodynamicist naval officer; he started at the Navy Building when they first opened the doors in 1917 before it was quite completed. They built that building in six months. You couldn't get the drawings done in six months today. It was all on filled ground. Diehl was the only naval officer I knew that stayed in one job his whole career after he got to the Navy Building. The story was that he kept a resignation in his desk drawer and every time they tried to move him, he "quit." He was really the father of naval aviation in my day.

**RAUSA:** Was he well liked?

**SPANGENBERG:** He was a wonderful individual and very, very sharp, but basically an engineer. Most of the aero people at the time were, my school for example, you got a lot of theoretical aerodynamics, sources and sinks, circulation and Kutta-Joukowski transformations but you didn't really learn how to run the performance on an airplane.



Diehl wrote a book called *Engineering Aerodynamics*. He developed a performance estimating method that worked. Some contractors didn't think it worked, but for us it gave the right answers. And working for Diehl at the time was Buck Loudon, a long-time civilian, and Jerry Desmond, another not as long-time civilian. Jerry was maybe five years older than I was and he was doing most of the performance work himself, occasionally Loudon still did some, but Jerry was the performance man. He'd come from Navy Yard wind tunnel work, and did the work well. Nobody really knew how to estimate performance any better.

Zimmerman tried to sell his concept as an individual. He tried to sell the airplane to the Navy. The Navy would have nothing to do with an individual so they told him to go get associated with a normal manufacturer. He finally got a job, or rather got his concept accepted, at Chance Vought. Chance Vought submitted a proposal to the Navy. When the Navy looked at it – it had to be a fighter of course. In those days we could not fund research programs which was what this should have been. But as a fighter it was supposed to do 500 mph.

**RAUSA:** That would have to be in a dive. You can't do that –

**SPANGENBERG:** As I said it depended on who you listened to. I still remember drawing those V-max versus altitude curves. We had one way out here at the front that finally went 500 mph. Contractors "best estimate" and the next, perhaps over 15, 20 knots slower was contractors "worst estimate." Another 10 knots worse than that was bureau's "best estimate" and finally, the bureau's lowest estimate. So we gave the decision maker these choices and we obviously thought we were going to be between our estimates and Vought Zimmerman thought they were going to be between theirs. It

was a very interesting proposal. They tried to build the airplane and the thing that really killed it was we couldn't build the mechanical drive system to get power to the props.

**RAUSA:** To drive the props up.

**SPANGENBERG:** To drive the props.

**RAUSA:** What was the span, do you remember?

**SPANGENBERG:** About twenty feet or so. I wonder if that's in that book of all Navy airplanes.

**RAUSA:** I doubt it. Was one built?

**SPANGENBERG:** Yes. The airplane was built. They had considerable trouble during wind tunnel tests and getting low speed characteristics.

**RAUSA:** You sound like you were pretty interested in that concept.

**SPANGENBERG:** Well, it was different and if it worked we really had a world beater at the time.

**RAUSA:** You mean because of the potential performance.

**SPANGENBERG:** Right. I think that we predicted that it was going to be a heck of a lot faster than the F4U and that was a 400 mph airplane.

**RAUSA:** Would there be problems with the props out there and G forces out there unloading and stuff?

**SPANGENBERG:** Obviously there were, and surprisingly what it turned out to be was it developed blade stresses and at these kind of speeds and with any kind of maneuvers they were just out of this world. You couldn't build the propeller and so Zimmerman and Connie Lau, a Chinese aerodynamist who worked for Vought, used to tell the tale they

were walking across the bridge near MIT and they suddenly got the idea that they'd eliminate – well, in addition to blade stresses they also had moments being exerted on the airplane that made it unstable – so to eliminate the problem they decided they'd put a helicopter-type hinge in the propellers so the moments could not be transmitted to the rest of the aircraft.

**RAUSA:** So that one kind of died its own death.

**SPANGENBERG:** It died its own death because we could never get the powerplant transmission system to pass the test.

**RAUSA:** The plane did fly though?

**SPANGENBERG:** No. It never flew. They finally destroyed it. It should at least have gone to a museum. I understand the low powered, low speed research V-173 that did fly is in storage at the Garber facility..

**RAUSA:** It should be a big attraction.

**SPANGENBERG:** In fact some of the lessons from that you know you can still see happening in the later VTOs and the STOs. You couldn't sit the airplane on the ground in a level attitude. It fouled up all our specs for how to make a drawing. It had to be at perhaps a 30° angle of attack in order for the props to clear the ground. And it failed basically because you couldn't build a transmission system transmitting power from R-2000 engines. There must have been around 1500 horsepower a piece I suppose. R-2800 was around 2000 so it was less than that.

Helicopters of course weren't existent at the time.

**RAUSA:** What ever happened to Zimmerman?

**SPANGENBERG:** He stayed with Vought for a while but then went with Army aviation and I lost track of him.

**RAUSA:** Which one do you want to talk about next, the SB3C?

**SPANGENBERG:** The SB3C and the SB2D were dive bombers intended to replace the Hell Diver started in 1938. As you can see there's not much overlap. This was in '41.

**RAUSA:** The SBD is already in the system.

**SPANGENBERG:** SBD but not the SB2D.

**RAUSA:** Okay. How come the SBD is not on here.

**SPANGENBERG:** It was already there.

**RAUSA:** Yeah, BT-2.

**SPANGENBERG:** Yes, you remember the SB2C Helldriver was already underway and scheduled as the SBD replacement. The next step on the VSB series then was to start the development of the SB2C replacement in 1941. A competition was held with Curtiss and Douglas selected as winners. I had virtually nothing to do with that competition as Mr. Ivan Driggs had been hired by Cdr. Stevens and was assigned to Design Coordination as a P-6, thus taking over as the number two man in the office to Mr. Frisbie. Ivan had been the first Chief Engineer at McDonnell Aircraft and, in fact, had pressured me to accept a job there rather than going to the Bureau of Aeronautics in 1939.

**RAUSA:** Tell me about the airplanes.

**SPANGENBERG:** The requirements specified for the airplanes were overdone, especially in retrospect. Upper and lower remotely controlled turrets, bomb bay, tricycle

gear, two place, powered with the new R3350 engine. Curtiss and Douglas were each to build two prototypes initially, but Douglas was authorized to start production prior to flight tests. The Curtiss SB3C was never completed as Curtiss concentrated on the BTC started the following year. The SB2D was built, although it was far from successful. The airplane was overweight, performance goals not met, and so on. The best thing about the program was that it appeared to teach Ed Heinemann and all the Douglas, El Segundo crowd a great lesson in the merits of simpler design approaches. The Navy also learned that lesson. Before continuing with the SB2D story, though, I'd better bring in another fact.

**RAUSA:** And that was?

**SPANGENBERG:** It must have been in 1942 that there was a major change in the direction of carrier based attack airplane development. To increase airplane performance, and hopefully to reduce combat vulnerability, decisions were made to make the dive bombers single place, eliminating the scouting mission from its requirements, and including that mission in the torpedo/horizontal bombers. That decision then led to contracts for the single seat BTC at Curtiss and the two crew TB2D at Douglas in 1942. I personally was not involved in the conferences leading up to those decisions but all the major officers and senior civilians involved in the design process participated. You may know that in those days BuAer had full responsibility for naval aircraft development, requirements, procurement, training, etc., so it made getting everyone involved easier than when some of the functions moved to the Pentagon.

**RAUSA:** What's that PBO on the list?

**SPANGENBERG:** That was a land based patrol bomber, a modification of the Lockheed Lodestar transport. The British, I believe, bought it first as the Hudson. But back to the SB2D. It was our first project with the newly NACA developed laminar flow airfoil sections, the 6500 and 6600 series, which really worked better in the wind tunnel than in actual service where dirt and surface imperfections on the wings kept the predicted lower drag from being achieved. I remember Capt. Diehl taking me into a room at Langley when we were down there for some kind of conference. They were preparing a wind tunnel model using a pretty good size model, probably a ten, fifteen foot span model. Eastman Jacobs was the aerodynamicist that was the father of the so-called low drag wing which had a so-called bucket in its drag curve. If you could achieve that of course it gave you a big advantage in drag. But to get the bucket even in the tunnel the model had to be glass smooth. Diehl said, "I want you to remember this." We peeked in the door and there were about six guys with wet/dry sandpaper, pumice and felt pads polishing the wing. Diehl closed the door and we crept out of there again.

**RAUSA:** Because he knew that you weren't going to be able to do that with a real airplane. The SB2D didn't even look good, the airplane.

**SPANGENBERG:** No. It looked awful. It violated Diehl's rule that if it doesn't look good it won't fly good. [laughter] .

**RAUSA:** Did you know Heinemann at the time?

**SPANGENBERG:** Sure.

**RAUSA:** Did you get along with him pretty well.

**SPANGENBERG:** Oh, yeah. Loved Heinemann.

**RAUSA:** He always spoke highly of you.

**SPANGENBERG:** And Heinemann's real strength was a good understanding of the entire airplane. He did a superb job of trying to find out what the Navy needed and trying to give them what they needed and he also had a superb engineering organization.

**TAPE 4 of 16, SIDE B** (continuing)

Leo Devlin, Heinemann's number one guy, in particular, seemed to be the really practical engineer behind Ed. For a number of years there was another fellow named Leonhart who was an administrative type of individual. He died early. Then the rest of the organization was awfully good. Good group of project officers and very strong aero. There was Gene Root and later Van Every. I guess when we got down to detail kind of work I probably worked more with Devlin because Heinemann was "working" the higher-ups.

**RAUSA:** Were other companies set up as well as Douglas at the time? Like Grumman always had a good reputation.

**SPANGENBERG:** They all did. I shouldn't say they all did. Some didn't. Few of the Air Corps contractors seemed to understand the Navy's needs. They were set up wrong or something was wrong. At Grumman at the time they had Schwendler as the engineering brains. Jake Swirbel production brains. Dick Hutton and Bob Hall. Bob Hall was the older guy. He was the idea man and the salesman. Dick Hutton was a brilliant preliminary design guy. And Vought had some great characters. Paul Baker. Paul is still around somewhere.

**RAUSA:** I think Leo Devlin is still around.

**SPANGENBERG:** Yeah. I haven't seen Leo for years now. Since I retired I don't get to places and Leo never did come to the east coast very much.

**RAUSA:** But the point is regardless of the technical nature of the business you were in, the individuals were key to the success. How well they did their jobs and how dedicated they were and that sort of thing.

**SPANGENBERG:** Agreed. Now getting back to the SB2D. As I think I've mentioned, the design was put into production early in its development. When it reached flight test status it seemed obvious to most observers that it would not be successful. The contractor proposed all kinds of "fixes" trying to keep the program going including making it into a single seater, and then proposing adding an auxiliary jet engine. None of the changes could save the program, and eventually it served only as the means by which the extremely successful BT2D/AD series emerged.

**RAUSA:** Back to the chart, the year 1942 shows 8 starts, can we begin there?

**SPANGENBERG:** Well, the first two we can cover quickly. The BTC and TB2D projects resulted from the decision to make the dive bombers single place and for the horizontal bombers to pickup the scouting missions. Although I can't remember much of the details, both programs failed. The BTC probably grew out of the SB3C program as a single place design around the R3350 engine when it started, but before its demise I remember a R4360 powered design labeled as COE for "Cab Over Engine". This came about due to the length of the four bank R4360 engine. As the designers raised the cockpit to get adequate down vision over the nose, it became apparent that the pilot was



almost higher than the top of the engine, and visibility could really be improved by moving the pilot over the engine. As I recall, the project was cancelled soon thereafter. The TB2D survived somewhat longer, was ordered into production, but only the early prototypes were built. It was a two cockpit, single engine design using the 4360 engine, Pratt & Whitney's largest. The airplane was large and it must be said, unloved. The Navy's attack tactics had changed and negated the need for the type. Horizontal bombing was inferior in results to dive bombing, and the dive bombers were fully capable of handling the torpedo mission.

**RAUSA:** Where are we timewise now in reference to your chart?

**SPANGENBERG:** Talking like this, I obviously get all out of sync with the chart for the obvious reason that by the time I finish talking about a model, a few years had elapsed since its start. I really don't have any idea how to make this a really coherent story. Maybe since we have been talking about attack airplanes and Douglas we should just finish up with the BT2D/AD story and its competition.

**RAUSA:** OK.

**SPANGENBERG:** Back in time then to 1943, Douglas was producing SBDs and developing the SB2D and TB2D. Curtiss was producing SB2C Helldivers and working on a replacement with the SB3C and/or BTC. The general scheme of things seemed to me to be to keep every manufacturer busy hoping that one of the many projects would pay off. The attack or dive bomber field then was fleshed out with the BK at Fleet wings and the BTM/AM at Martin, both single seat designs, the former around a R-2800 engine and the latter around a R-4360. Neither of these manufacturers had any, or at least,

recent carrier aircraft design experience. Fleetwings had a new exhaust system design which it was hoped would overcome its handicap of a slightly smaller though more proven engine, while Martin relied on a hope that the R-4360 would show the growth in power that its R2800 brother had already exhibited. Both developments could be considered successful as flying machines; Martin produced a hundred or so, I think, while Fleetwings stopped with the prototypes. In one sense their major contribution may have been to inspire Douglas, El Segundo to become a far better competitor for the Navy's carrier types.

**RAUSA:** Maybe its time to talk about the AD which was a bit late for WWII but did yeoman service in Korea and later in Vietnam. Why was it so successful when its predecessors were not?

**SPANGENBERG:** Well, Zip, I know you know much of the history from your collaboration with Ed Heinemann on his life's story. Incidentally, I had not known of your part in that until I looked up something in the book recently. I enjoyed Ed's history.

As you know, Douglas was in deep trouble in 1944 with its Navy programs, and had been trying to salvage the SB2D/BTD production line with minor fixes. The bureau was not pleased with their efforts to say the least. Finally, as Ed Heinemann describes the situation, it came down to an overnight design session in a Washington hotel for a proposal presented the next day. I was not a participant in that session, nor in the ones which preceded it, though Mr. Frisbie was. My contribution started as soon as the design proposal reached us. My job at the time included checking the contractor's weight estimates, probably the most important single variable in the design process. An optimistic one can lead to structural failures and catastrophe while pessimistic ones lead

to a non-competitive design in the warfare arena. As an aside, during my entire career in Washington, Mr. Frisbie, and later I, insisted on keeping the weight control function in our division. It is essential to the job of monitoring any aircraft development. Periodically, we had to fight off those so-called management experts who believed the function belonged elsewhere.

Back to the BT2D. In this case, I found the Douglas proposal weights to be substantially higher than what I believed they should be, assuming an average design capability. We in the bureau, of course had a substantial advantage over any single contractor in making weight estimates, since we had the records of all the aircraft already built. Each manufacturer was lucky if he had any records other than those of his own designs. Weight data was but one part of proprietary design information closely held by all the manufacturers. I was able to show Leo Devlin, Heinemann's very capable assistant, that many of Douglas' design items were much heavier than those being produced by other Navy contractors. An example, I remember, was that the SB2D rudder pedals were nearly twice as heavy as those on Grumman and Vought designs. Douglas took the message to heart and started what became probably the most effective design weight control effort in the industry. My original estimate was that the airplane's weight empty was at least 1000 lb. (or roughly 10%) heavier than it should have been. Douglas, at the working level agreed, but contractually they were unwilling to guarantee that figure. Eventually, a compromise was reached that they would set a design goal 750 lb. under their estimate, while holding the higher guaranteed value. At first actual weighing, the weight was under by 1200 or so lb. Eventually, the Society of Weight Engineers (SAWE) made Heinemann an Honorary Fellow of their organization,

and his organization did excellent jobs on the subsequent A3D, A4D, F3D and F4D designs.

**RAUSA:** I knew part of that story, but not all of it.

**SPANGENBERG:** Of course, the design simplification message was everywhere evident in the BT2D as opposed to the SB2D. No bomb bay, simplifying the structure. Use of the F4U main landing gear, one of the lightest to that date considering the job to be done, simple slotted flaps, and so on.

**RAUSA:** Do you mind if we stop here. We're really getting into it now. This is fascinating.

#### **TAPE 5 of 16, SIDE A**

**RAUSA:** Back to airplanes, were you starting to get into jet-powered technology at this time?

**SPANGENBERG:** Well, yes, of course. We have to back up a bit again. As the chart shows we started the FR Ryan "Fireball" in 1942 along with the McDonnell FD/FH Phantom, the first a composite power plant with an R-1820 in the nose and a centrifugal turbo jet in the rear. The FH was our first all jet fighter, a twin engine arrangement with Westinghouse 19" axial flow jets. The Navy had a very real problem in attempting to get into the jet age. By their nature, pure jet engines have low static thrust as compared to an engine propeller combination, giving us a very severe problem for carrier take off and landings. Policy considerations also dictated that our major manufacturers concentrate all their efforts on producing aircraft to win the war in which we were then engaged. The

jets were not really ready for that one. To give you an idea of the thrust available problem, the original engines in the XFD were rated at less than 1200 lb. each of take off thrust. An R-2800 engine with a 13 ft. propeller produced on the order of 7000 lb. of takeoff thrust. It took years before the advent of turbofan engines and larger catapults eliminated that design problem, a very real one, not always appreciated.

**RAUSA:** What was the next big project after the Skyraider, do you remember? We're talking now '56, '46.

**SPANGENBERG:** We probably ought to consider a couple of the other interesting programs that people may not know the beginning of. One of them is the HK-1, better known as the Spruce Goose, the Kaiser-Hughes program. It arrived in the bureau as a great unknown. We never heard of the thing. Suddenly then Capt. Stevens who ran the R&D programs called Frisbie and myself in and said they had a new program and we were to evaluate it. Well, we didn't have any data and it's hard to evaluate without data. Eventually we found out that the contract had already been let with the Reconstruction Finance Corporation to build these two huge wooden airplanes to defeat the submarine threat by getting cargo to Europe. Apparently there had been previous negotiations and the Navy must have said "no thanks, we're not interested in the program " and I guess the Air Corps must have done the same thing. So the program got directed probably from the White House. That was the rumor at the time. Later some Hughes guys told me that it was Grover Loening, a name you must remember.

**RAUSA:** Loening amphibians.

**SPANGENBERG:** He was well known in aeronautical circles. He was always inventing something or another. He convinced somebody that was the way to go. He got involved with Kaiser and the first contract that was let said that they were to build this 400,000 pound flying boat, roughly twice the size of the Mars which we had under contract with Martin. That was the biggest flying boat that anybody had ever done up to that time. As I recall the new proposal was for a 400 foot wing span, wing area was something over a quarter of an acre.

**RAUSA:** How many engines?

**SPANGENBERG:** Eight. Eight 4360s. The contract was for \$18 million. Hughes was supposed to build these two airplanes out of nonstrategic materials.

#### **TAPE 5 of 16, SIDE B**

Production was to be done by Kaiser who then you know was building ships basically.

**RAUSA:** You mean it was Hughes' concept.

**SPANGENBERG:** I think it was a Grover Loening concept and then he got Hughes to do the design work in cooperation with a few other guys. I was told later that Gene Root who was Douglas' aero and hydro guy had been instrumental in doing the aero part and the hydro design. Hughes didn't have any flying boat people that I knew anything about. The design aerodynamically and hydrodynamically was fine. A conservative design. Beam loading on the hull was about right and the shape was right. It was a relatively short contract, two or three pages; it said that the Air Corps, the Navy and NACA should all cooperate in this venture. They didn't tell us what we were supposed to do or

anything else but we were to cooperate. Well, the first step was to evaluate the thing. We didn't believe the weights by thousands of pounds on that first go round. We finally got a spec and a general arrangement drawing and the thing as I mentioned was all wood. The Navy hadn't built any wooden seaplanes for a number of years either. God knows I had no experience in estimating the weight of a wooden boat. But you looked back at the records and tried to work it out. Most of the intelligent people in the business thought the whole idea was ridiculous, building a boat in wood of that size. If you haven't heard of it there is a "square cube law." It has always been talked about in aeronautics. The lift goes up as the square of the linear dimensions. The weight goes up as a cube of linear dimensions. So eventually you should reach a point where you can't build the thing because it will be too heavy, it won't fly. And the only reason we've been able to go from 100,000 pound airplanes to 700,000 is we changed materials and changed the design. If you try to build a Boeing 747 exactly like you built the early Loening Amphibians for example or the early Boeing Clippers, you just couldn't do it so you change design and materials as you go along. Hughes was faced with a problem of not being able to use modern materials.

I recently reviewed my travel orders to see when I went out to the coast to get a first hand look at the Hughes HK-1 as well as the Lockheed R60 which we will talk about a little later. I found that in the fall of 1943 I made two trips, the first in late September and the second just before Christmas. The primary purpose of the first trip must have been to gather data for evaluating the HK-1 and also to check on the status of the Lockheed R60 "Constitution" program. I remember being tremendously impressed at Hughes with the magnitude of that project. First, the building in which the manufacturing

of the HK-1 was taking place, was as remarkable as the boat itself. The building was roughly as large, and as open, as a dirigible hangar, and built entirely of wood. To an amateur woodworker as I was, I drooled at the number of wood clamps everywhere. The structure of the boat was to be of laminated construction, built up of 1/8" thickness stock. The capstrips for the wing beams were roughly 8 inches square, as I remember, which seems to translate to 64 laminations. Lots of glue. At that time, the wing jigs were still being built, the wing was to be built with the chord in a vertical position. A story later circulated that when the wing was moved to the horizontal the ribs unloaded and punched through the web of the main beam.

**RAUSA:** Do you remember any other experiences on that trip?

**SPANGENBERG:** Oh, a few. I was undoubtedly but one of several officers and civilians who made that trip. Capt. Diehl, then probably a Cdr., was probably in charge, at least of me. My orders said that the trip would include visits to Air Corps projects in the area, so I accompanied Diehl to see two such projects, one at Douglas, Santa Monica, and the other at Northrop. At the latter plant, Mr. Northrop greeted Diehl like a long lost brother, and served as our guide in examining the XB-35 flying wing. Apparently, Diehl had not been to the west coast for years, and Jack Northrop was an old friend. As an aside, Diehl always traveled by other than aircraft, by train on long trips and by boat to the NACA at Langley Field. He was not a pilot, though he had "observer" status. I can recall a half set of wings. As you may know, Diehl was not a proponent of tailless Aircraft, so the obvious friendship with Mr. Northrop surprised me a bit. The other Air Corps project was the medium bomber, or attack program at Santa Monica, the XA-42, with the name, or nickname, of the "The Mixmaster" due to its counter-rotating propellers at the tail of



the airplane, driven by buried engines in the fuselage. Every effort was being made to keep drag to a minimum. To that end, the two crew members, sitting side by side, each had a very small bubble canopy with only their heads being enclosed. From a drag standpoint, it looked great, but when one sat in the mock up it was apparent that crew communication was seriously affected. It was a very strange feeling, by turning your head you could see the other guy, but that was about all. Couldn't see his hands, so communication would have to be solely with the intercom. Eventually they went back to a more conventional arrangement. The airplane did not go into production as far as I can remember.

**RAUSA:** What now?

**SPANGENBERG:** Let me complete the Spruce Goose story. Remember, I said I made two trips. The second occurred around Christmas time. We received instructions that an evaluation of the airplane was to be done for the decision makers in the program. The Navy and Air Corps members were to be headed by Dr. Ed Warner who was then head of CAB, the Civil Aeronautics Board. Dr. Warner had been head of the aero department of MIT for years before he took the Washington job, had written books. *Airplane Design* by E.P. Warner has been one of the standard textbooks. A true genius. I think he was head of the department at MIT when he was twenty-one years old. He was Doolittle's professor. A really great guy, a genius, strange but great. They appointed this committee then to look into the airplane and this was done at some high level. It must have been the RFC and/or WPB. The Navy members were then the head of what is now AIR-05. It was probably just called head of engineering then. Capts. Hank Oster and Walter Diehl and there were two Air Corps guys, a Col. Bristow and Col. something else. And then

the Navy officers had two or three of us as technical helpers. Everybody went to the west coast from here by train except for me and Dr. Warner. The officers always went by train when time permitted as they got mileage instead of that \$6 a day that we were getting in those days. So an officer could travel to the west coast and make enough money that he ended up with some money left over and those of us who went by airplane ended up \$50 or \$100 in the hole every trip with that \$6 a day allowance. Dr. Warner and I got on the airplane and sat together. We took off in a DC-3 from National Airport and he said, "Well, got to read a book first." So he sat down and read a Dr. Moto or a Charlie Chan mystery story. We had taken off around eight o'clock, I suppose. About eleven o'clock he finished it and said, "Well, let's go to work." And so we started doing payload range calculations. I was doing the weight, fuel, payload stuff and he was doing the range calculation. I was running a slide rule. He could do in his head these operations that I was doing and he would get the answer before I did, so he really only used me to check his results. I just couldn't believe it.

**RAUSA:** How old was he then?

**SPANGENBERG:** I suppose in his sixties.

**SPANGENBERG:** He was amazing. We got to Los Angeles, got off the airplane and the Air Corps met him with a couple of young officers with a car. He wouldn't have any part of it, using a military driver. So he went into a Hertz rental place and said, "I think I probably have an account here." They looked it up. "Oh yes, Dr. Warner, you haven't been here since 1923" or some such number. We got a car there at the Burbank airport. I had one of those little maps and he said, "Okay, we're to go to the Town House." It

was down the street from the Ambassador Hotel. I had never driven in Los Angeles and didn't know a thing about the place. He hadn't been there for years apparently but I'd navigate by the map. He was driving with his derby hat on. We got to the Town House finally. By then it started to rain. It was December in Los Angeles when it does rain. I had a gaberdine topcoat. I picked that up and started out. He started off without a coat. We were rooming together. We did that in those days, we shared double rooms. I said, "Dr. Warner, aren't you going to wear your coat?" He said, "Never wear a coat in California." [laughter] Stuck his derby hat on and off we went in the rain, drove to the Brown Derby and had lunch. It was quite a trip. We went out to the plant and met Howard Hughes. He pleaded that we give him a good report. The airplane was worth building and all that sort of stuff.

**RAUSA:** How did Hughes impress you?

**SPANGENBERG:** As a very competent engineer, was obviously getting a lot of bum advice from people, but he had recognized by that time that he was in trouble with wood construction, and he really wanted to rebuild it in metal. At that time they were doing a static test of the horizontal stabilizer. The wing was too big to test and they didn't want to risk that I guess. But they built a horizontal stabilizer which was almost exactly the size of a PBM wing. That will give you some feel for how large the plane was.

While we were there they ran the first static test and it failed about sixty percent of design load, roughly half of ultimate load. They beefed it up, but it got worse I think every time they tested it.

Talking to the Hughes engineers who all had a very strange, strange to me, relationship with Hughes. If Hughes told them you shan't give out any weight dope, for

example, they didn't do it. They never did. The weight engineer at that time, a young man named Crabtree, later became well known in the weight circles in industry, stayed with Hughes I guess his entire career, and he would never tell the Navy what the actual weight of that airplane was. God, I wanted to know to see how close I came on my original estimate. I never found out.

**RAUSA:** And they weren't obligated to tell you by contract?

**SPANGENBERG:** No. The contract was worthless for us. When we finished out there, the Navy, Air Corps and Dr. Warner were all in agreement that the program was a dog. A couple of Mars would do everything except carry the single huge load. The specs said that they should carry a sixty ton tank. That was the only main payload mentioned. They had a mockup of the airplane. The interior was absolutely blank. It was just all the frames, open frames through that whole hull to put this "sixty ton tank" in but there weren't any tracks or hold downs or anything to really carry the thing. And then it turned out that there wasn't any sixty ton tank. There were smaller tanks and there may have been a bigger tank.

There were all kinds of other problems recognized by this Army Navy group and Dr. Warner. The engine control problem was one. A conventional cable system appeared impossible with the eight engines and length of the system. Eventually a pneumatic system was used. There appeared to have been no steps taken to order what was considered to be GFE, including even the engines and propellers, then of course under wartime production priority control. Dr. Warner surprised the board by telling us we were only a fact finding body and that the group would not make any recommendations on whether the project should be continued. So all the constructive

recommendations eventually were headed by an "If the project is continued, such and such should be done." Like, provide engines, propellers, and electronic equipment, have a complete mock-up after defining the loads to be carried, etc., etc.

On the humorous side while we were out there that first night Howard Hughes took us to dinner. The coffee shop of the Town House Motel. He came in and he had his aides with him, one guy's job was to pay the bill. Walter Diehl who was the soul of integrity – he overdid it in my opinion – we got through the meal, the bill was probably \$2.32 apiece or something like that. Walter pulled out money, put his share on the table. Hughes' aide is sure that he's going to get fired if he allows Walter to pay his own part of the bill. They carried on. Walter ended up paying his \$2.32. The rest of us took a gratuity. [chuckles]

When we got back to Washington to show you Dr. Warner's competence we all went over to his office with our data. He called in his secretary and he dictated a sixty page report.

**RAUSA:** With all the data in it.

**SPANGENBERG:** Right. He'd ask for this, that. We'd give him data. It was incredible. I wouldn't have believed anybody could do it.

**RAUSA:** So that was kind of the end of the Spruce Goose as far as you were concerned.

**SPANGENBERG:** As far as we were concerned. You may remember that Hughes himself finally made its only flight in it a few years later. Took off and flew a few hundred

yards before setting it down on the water. Someone bought it and turned it into a restaurant of something at Long Beach.

A later program of almost the same kind of ilk started from above. Do you remember the R60 called the Constitution? It was a big transport, Lockheed project and it turned out, again, it was one that arrived by Capt. Stevens or Cdr. Stevens, whatever he was in those days, coming into the office and telling us we have a new program. It's the first we'd heard of it. When I say we I mean in general the working level. It turned out that on that one, Pan American had been working with Lockheed to build an over-the-weather transport. Up to that point there had been no pressurized civil transports. Lockheed had a design on paper and they had reached a point in the design process that they couldn't carry forward because of wartime priorities and so on. The Navy was elected to become the developer of the airplane by "higher authority" let's say. I don't know who. So we were told we were going to buy the plane. First thing of course was to see whether or not we could justify it as a Navy transport. We had a tough time. At that time the C-74 for the Air Corps was under development. Each airplane was powered with R-4360s. The C-74 was a conventional single fuselage airplane. The R60 was a double bubble and pressurized. I'm not sure the 74 was pressurized. Anyway, it may have become a prototype for one of the Douglas commercial transports after the war. It was a good airplane. Well, when we evaluated the R60 again we couldn't really justify it. Its basic weight was too much. So when we did payload/range calculations we were worse off than we were with the conventional transports or with the Mars. It looked to us like Pan Am had a loser so the next step in that operation was to call in Pan Am and say how do you justify this thing. Well they justified it completely on an over-the-weather

North Atlantic schedule to fly nonstop to Paris, the design mission of the airplane. It ended up in an airline kind of analysis as being superior by virtue of getting more flights completed than the pressurized aircraft. We didn't know anything about airline analysis, but we learned.

**RAUSA:** This was a program that came down to you from above.

**SPANGENBERG:** And as I said we were told that our country had to compete with the British who had the "Brabazon" as I recall, a big transport under development. And the idea was that the Constitution would become a commercial transport. We were providing the money really to get it built on an R&D basis and it would later be bought by the airlines.

In those days the military did most of the expensive development in one way or the other. The bombers provided the technology for big transports usually.

**RAUSA:** So that project never got off the ground either.

**SPANGENBERG:** Not as a production program, though we built two airplanes and operated them.

**RAUSA:** But they never went into production beyond that.

**SPANGENBERG:** No. We operated them for a long time. They could do things that no other Navy transport could do because they were so much bigger. It was close to 200,000 pounds. That was an interesting one and I was surprised when we got in that mockup of the airplane. It was in a hangar at Burbank. Anything Lockheed did in those days was kept awfully secret. Other manufacturers would let others in the industry at least know what was going on. Lockheed kept it secret. They had a big locked hangar.

**RAUSA:** Was Kelly Johnson there then?

**SPANGENBERG:** Oh yeah. He was the big secret guy. I had an experience back in Michigan when I was still in school. Kelly was there running a test on the original Electra for them and he had his curves spread out on the drafting table.

**RAUSA:** This was at the wind tunnel you had.

**SPANGENBERG:** Yeah. It was down in the aero department, we had just two or three offices. I was a student assistant at the time so I had an office in there and a desk. I went by this drafting table with all these wind tunnel curves and he had a lift curve that went up normally but then broke at a moderate CL, six tenths or seven tenths, flattened out and then went up again. It was not the kind of a CL curve anyone wants. So I said, "Goodness, Mr. Johnson what's that?" Kelly Johnson said, "Confidential." Covered up all his curves. If you told that to any Lockheed employee without saying who it was, they knew who it was. I remember later talking to Dick Heppe about it.

But to the R60 mockup. You got in that airplane in a closed hangar and the vision was just awful. You wouldn't believe how bad it looked. I wasn't a pilot or anything. It must have been a preliminary mockup that we were having. There were some pilots from what is now Patuxent and everybody had the same impression. You couldn't see out of the cockpit. They finally opened the doors of the hangar and then the vision became quite acceptable. It looked like a normal transport. I just couldn't believe that feeling. It was very strange. I can still remember how queer it was.

**RAUSA:** Did they stay with that cockpit design for the two that they built?



**SPANGENBERG:** Yeah. Actually on the drawings everything looked all right. The field of vision actually was fine. The airplane was high off the ground and well beyond anything we had in the service. They actually finally put some kind of an indicator in it to let the pilot know when the main wheels hit. It probably had "spin up" on the wheels.

**RAUSA:** Was that about the same time as the Spruce Goose in 1942 or was that later?

**SPANGENBERG:** It was early in the program. You ought to be able to find that one too. It was '43.

**RAUSA:** Where shall we go now, back up to '44, '45, or do you have some others in there?

**SPANGENBERG:** The PB4Y is in that general time period. Probably the most interesting part of its introduction to the Navy is the trade-off which I understand was made. You remember I told you the story of the seaplane PBB. Boeing had built the Renton plant on the shore of Lake Washington to produce it. It was determined that the Air Corps needed that production facility for B-29 production more than the Navy needed it for another seaplane. A trade was made, the Navy lost the plant, but received B-24s in return. These became the PB4Y-1 and later PB4Y-2.

**RAUSA:** When you talked earlier about the FR and FH and jet power was it obvious to you that this was going to be the wave of the future?

**SPANGENBERG:** Sure. The big debate in those days in the powerplant realm was whether it would be gas turbines driving propellers, turbo-props, or whether it would be a pure jet. Turbo-fans hadn't entered the argument. Capt. Spangler, then Powerplant Division director, was a strong proponent of turbo-props and swore that we would never

have pure jets. Ivan Driggs who had left our office and taken over preliminary design from W. D. Clark, also favored the turbo-prop. Fighter desk people, Cdr. A.B. Metzger , in particular, argued for pure jet.

**RAUSA:** Did you get deeply involved in any of those designs?

**SPANGENBERG:** Yes. Of course.

**RAUSA:** You were involved in all of them? In other words, virtually every aircraft in the acquisition process, whether we bought it or tried it out, you were there as the weight guy.

**SPANGENBERG:** Early on as the weight guy and always as the coordinator of all the things we did in the engineering group. In order to help you understand what we did, I ought to run through the little pitch we did for how we buy airplanes.

**RAUSA:** Did it apply then?

**SPANGENBERG:** Sure. The Navy's method of buying airplanes didn't change except superficially from the time I started until I retired. We changed contract types and the way we funded things and whatnot but the engineering part of the analysis remained the same. Essentially we ran design competitions, then made our choices on the basis of a proposal submitted by industry. That is, we evaluated those proposals, determined what the weight, performance and whatnot would be on our estimates, selected the best airplane of the bunch and that's all there was to it. It was really a very simple straightforward process and we never had any problems. When we got through we would debrief the losers, tell them why their airplane wasn't the best.

**RAUSA:** Were those sessions argumentative?

**SPANGENBERG:** Not as a rule. Oh, on occasion. On occasion they'd think we were crazy. We would give them our numbers. The debriefing process normally went that I would debrief them, assuming that I was the guy that ran that competition and I was most of the time, and I would give them our weight numbers, our performance numbers. Usually the people we debriefed were the Heinemann, Devlin, Gene Root level. I mentioned the Douglas people because I know you know that group. They'd be in with five or six of their project engineer and up types. Following that they would send their weight people in and talk to my weight people. By that time I was doing less of the actual weight estimates myself. Somewhere in the fifties, Keith Dentel had taken over the weight estimating part of the game. I would still check them using my back of the envelope kind of methods. He used much more sophisticated weight estimating methods than I ever used. I still argue whether mine weren't just as good.

**RAUSA:** Did you want to say anything more about the acquisition process?

**SPANGENBERG:** Well, only if you want to hear it.

**RAUSA:** Go ahead. I think that would be important.

**RAUSA:** We've jumped to 1965 for a moment and we're going through a presentation that George has given on the acquisition of aircraft process in the Navy. We'll supply a written addendum to the tape for your purposes.*(ed: although I have no way of knowing exactly what was being shown here, this may be included in Exhibits A, specifically Exhibit A-5)*

George then explained about the difference between the Main Navy and particularly the W Building, a 2 story building, as compared to the ones in Crystal City

which are vertically oriented, 12 stories . Can you pick it up from where you said you'd walk down the passage way?

**SPANGENBERG:** In the old W Building or in Main Navy I'd walk down the passage way and I might see Chuck Francis, the avionics fire control guy or the AEW guy, Leo Puckett, or perhaps the seat guy, Bill Thomas, and we would exchange items and not require a memo. I might have a question come up or he might have a question of me but just walking down the hall I'd see these guys and we would talk. We might end up going to get a cup of coffee at the snack bar or something like that if there was an issue.

Once we got over into Crystal City we got the elevator between us and you didn't see people. The Electronics Division might have been on the sixth floor, I never went to the sixth floor, I was on the eleventh. It made a real difference to us. It went from the horizontal to the vertical. It was something nobody I think had anticipated but it really cut down on that informal contact. Everybody doesn't need it of course. There are some parts of the organization that probably didn't give a damn. But those of us who were in the coordination business — I would meet the head of the aircraft division when I was still a GS low level something or another. You got to know people a lot better just by seeing them.

**RAUSA:** Were the doors usually open to the offices?

**SPANGENBERG:** The door into some part of the office was always open in the old Navy and W buildings, but not after we moved to the high rises at Jefferson Plaza.

**July 18, 1990**

**RAUSA:** This is July 18 with George. We're in the middle of World War II now, the F8F now.

**SPANGENBERG:** The F8F program started primarily to provide fleet pilots with higher performance fighters than we had with the F6F and F4U. Leroy Simpler was in Military Requirements, just back from the South Pacific. So the preliminary design people, all of us got together and kicked around what could be done. What was the best we could do. You took the best engine which was the R-2800 and built the best fighter you could around it, sacrificing "nice to have" items, but leaving in all the important things. Started with 4-50 caliber guns, as I recall, later switched to 4-20mm. Had no seat adjustment. They took out all seat adjustments just as a weight-saving device.

**RAUSA:** Meaning no matter what size the pilot was he had to take what he got.

**SPANGENBERG:** Yeah. And if you look back over history you'll find that the tallest guys in the Navy, fighter pilots, seem to squash themselves into that cockpit. On another item, I remember Simpler arguing very strongly that the master armament switch should not be tied in through the landing gear which was a standard requirement in those days. If the gear was down the master armament circuit was broken. But he had one case where he had taken off in an F6F and before he got the gear up he had a Zero in his sights but he couldn't fire because the gear was still down.

**RAUSA:** Was he a captain then, Simpler? Or a commander?

**SPANGENBERG:** He could have been a commander. It's hard for me to remember what rank people were at one time when you knew them first as a lieutenant perhaps and then they became captains or admirals later on.

The F8F was a good airplane. It was one that developed more rapidly than any of the subsequent airplanes, concurrent production of course. It was supposed to come in two versions, a two speed supercharger version and then later a two stage supercharged engine version. One of the unusual weight saving items incorporated in the F8F was the provision of break away wing tips at high "g" loads. When the tips left, the remaining wing was still adequate for carrier recovery. The scheme was finally abandoned due to asymmetry problems. At the war's end the airplane had been built, tested, developed. One squadron was on a carrier going west, Cdr. Joe Smith had the squadron and was just itching to get out there with that airplane before the war ended.

**RAUSA:** Who was Joe Smith?

**SPANGENBERG:** He was a fighter pilot.

**RAUSA:** They knew they had a good airplane.

**SPANGENBERG:** It had the best performance you could get with a R-2800 engine at the time and still land on a carrier. We had been winning the war with tactics and better pilots but not with superior performance against the Zero. It could always out-turn our planes. For years the F8F was also our example of what a good engineering organization could do coupled with a competent contractor and going from start to full development of an airplane, full production of an airplane. We were supposed to get up to something like 500 a month production but the war ended before we got that far.

I have some curves in this report that shows the timing of airplanes. Years after go-ahead versus airplane deliveries. We had 140 airplanes just a year and seven or eight months after go-ahead.

**RAUSA:** Incredible.

**SPANGENBERG:** The AD was a good example too. We can look at that more.

We had two airplanes that never went anywhere but were interesting for other reasons. The XF8B was a Boeing airplane, Wasp Major engine, counter-rotating props, big, I thought a fairly ugly airplane, and the XF-15C a R- 2800 powered airplane with an I-40 jet booster, similar to the FR arrangement. Neither of them went beyond the experimental stage. But both were interesting for different reasons and in a comparative sense also.

The F8B was started with an unsolicited proposal from Boeing who believed that they were better than the Navy at determining requirements and in fact they disagreed with the Navy's fighter requirements. The Air Corps B-25s were doing skip bombing and claiming great successes. Boeing came in with a proposal for a single seat attack fighter around the biggest engine available, the R-4360. They had limited experience in dealing with our senior specification writer in the bureau who was of Italian descent, a man in his sixties at the time, named A.D. Micotti. Micotti had been writing specs for the Navy for years and was excellent at his job. However, Boeing's experience with him earlier in trying to write the specs for the PBB led Wellwood Beal, then the chief engineer at Boeing, to say that he'd be damned if he was going to sit across the table and have Micotti yammering at him all the time. So he sold the Chief of the Bureau on the idea of doing a "best effort" kind of thing. No military specs were required. Boeing set the configuration. The airplane had a bomb bay capable of carrying a torpedo or bombs. The result was a moderate success as a flying machine, but inferior as a naval carrier

airplane in all of its possible uses, VF, VB, or VT. Its development cost was roughly twice that of the F15C, an equally unsuccessful airplane, but of approximately the same weight and complexity. Elimination of mil specs, touted as a cost saving measure, proved to be a false hope then and probably is now. Those who espouse the theory all seem to forget that if you don't use all of history's "don'ts" which is what military specifications represent, then you have to develop your own, a formidable task. In my experience, at least, I judged mil specs to be a significant help, rather than hindrance. Non applicable requirements could, and were, waived, but the provider must be informed of the operational needs of the user.

**RAUSA:** We seem to have skipped over a couple of planes shown in 1942, the P2V and SC. Any comment on those?

**SPANGENBERG:** I really don't remember much about the beginning of the P2V, but it was obviously an important program. It undoubtedly grew out of the PBO/PV experience and the growing awareness that land based patrol aircraft were going to take over the job of the seaplanes. The airplane, as you know, was twin-engined, R-3350 engines, with an easily remembered wing geometry, 1000 sq. ft. of area, and 100 ft. span, giving an aspect ratio of 10. One of the early Neptunes, nicknamed the "Truculent Turtle" set the world's distance record in a flight from Australia to Columbus, Ohio in 1946. Cdr. Tom Davies, then the Class Desk officer on the program headed up the crew on that flight. They landed a bit short of their goal of reaching Washington (and a hope of Bermuda), but it was a record which lasted for years. My contributions to the program were minimal.



The other skipped program was the last of the battleship/cruiser based airplanes in the fleet, and it was also near the end of the road for Curtiss who produced it. Those ship based, catapult launched seaplanes with a landing recovery in the ship's wake were probably the toughest design jobs in naval aviation. The maximum gross weight of the SC was 9000 lb., 2000 lb. heavier than its predecessors, allowed by improvement in the catapult. Historically, the designs were underpowered, and obviously at the low end of the performance spectrum. I cannot remember any of the naval aviators whom I knew who were happy with their VSO or VOS assignments. As you know, carrier aviation finally took over the basic scouting and spotting jobs in the fleet. I suppose the hydrodynamic knowledge and skills in both the design and operational parts of the Navy are long gone.

A short sea story, Zip. One of the early tasks given me in Washington was to update the bureau's design specification for towing, mooring, and anchor gear for seaplanes and flying boats. This was occasioned by a then new need to have the capability to warm up engines while still moored, but then to release from the mooring and take-off without outside assistance. I remember reading the spec and being thoroughly confused as a landlubber by all the nautical terminology. Mooring bits, pendants, lizards, and even lines instead of rope were not part of my vocabulary, and more importantly perhaps, not in usage by any of the aero engineers and draftsmen that I knew. My major contribution then was to rewrite the specification in more nearly lay terms with suitable definitions of the equipment items. Well, enough of that.

**RAUSA:** You mentioned the XF15C just now, I don't remember that one.

**SPANGENBERG:** It was the last of the Curtiss fighters, a tricycle gear, composite power plant design similar to the Ryan FR, but with a R-2800 engine and a larger jet auxiliary. Still a centrifugal turbo jet, though. Jack Pearson was the fighter class deck officer when it started and a strong proponent of getting the most performance possible in his fighters. I remember going to the mock-up of the airplane at the Curtiss plant in Buffalo, traveled by train. C.T. Booth was the Mil. Req. officer. I believe I have a small book of snapshots given to us as a souvenir of the event. The program did not reach production as pure jets became practical.

**RAUSA:** Do you have those pictures here?

**SPANGENBERG:** Yeah – I'll show them to you when we quit.

**RAUSA:** Let's try to do a couple more before winding up this session.

**SPANGENBERG:** Ok. Might as well see if we can finish off the chart for 1943. Some of them have already been covered. The F2G was the Goodyear produced F4U Corsair with an R-4360 engine replacing the R-2800. Only a few were built before production was stopped at the war's end. The F2M was a short lived program. It was a re-engined FM, the General Motors produced Wildcat. The last airplane worth mentioning in that year and not already discussed earlier is the P4M. That was another reciprocating engine plus jet attempt to get higher performance with adequate range, this time in a patrol aircraft. It was proposed and produced by Martin. Only a few, 20 or so, I believe, were built. My most vivid recollection of the project was when the contractor's brash young (my age) project engineer referred to the bureau's Experiments and Development

officer as "Steve", and received the response, "That's Captain to you, son". Those of us in the room almost applauded.

**RAUSA:** I'd like to get away shortly, by ten o'clock if possible.

**SPANGENBERG:** Ok, let's do the FJ, the first model noted in 1944 as a start. Most of the other designs have been talked about before we got more nearly organized with the chart.

The background of the FJ, of course, is that North American, although one of the country's major manufacturers, had not been involved with the Navy except for trainers. They were as completely Air Corps, as Grumman and Vought were Navy. NAA wanted to participate in Navy business, and they were finally allowed to do that as the WWII pressures eased. The result was the FJ-1, a straight wing, jet powered with a J-35 GE engine, and obviously a competitor with the F6U and F2H. I believe we have already discussed those. The scuttlebutt was the Air Corps was annoyed with the Navy for contracting for the design. However, some time later they ordered the design with only minor changes. Later, as swept wing data became available, their plane became the well known and very successful swept wing F-86. My most vivid memory of the FJ-1 is that of a trip made to NAA in company with Tom Tyra, then head of the Fighter Desk, and Jock Sutherland, the Project Officer. Tyra was a very quiet, very intelligent officer, number one in his class. Sutherland, highly motivated, was on his first tour in Washington after carrier duty in the Pacific. The trip was arranged at the last minute to inspect a preliminary mock-up and have discussions with Mr. Kindelberger and Mr. Rice, President and Chief Engineer respectively. The three of us left Washington in a

commercial DC-3 at about 6 pm on a Friday evening just after New Year's, 1945. After a rather rough trip, we landed at Los Angeles about 10 Saturday morning, stopped at a barber shop and reached the NAA plant about noon-time, worked the rest of the day until early evening when we attended a dinner party with NAA engineers, their wives, and a few secretaries in the company dining room. Obviously, we were exhausted and were only interested in getting some rest. About 9:30 or so, one of the wives said to us, "Well, you Navy guys sure don't act like the Air Corps."

To finish the story, the three of us were lodged in a vacant private house for the night, worked the next morning (Sunday) and then were driven to another location in the hills above the plant for a dinner party with mostly sales personnel. I was scheduled to depart on a 5 o'clock flight. Time became a problem, and I was driven to the airport by Vance Breeze, a noted test pilot, who exhibited his low level driving skills so that I made my flight by minutes. Unfortunately, that flight then terminated at Nashville due to weather at 8 in the morning. Seven hours later I flew to Cincinnati arriving at 6 pm where that flight terminated due to weather. Finally arrived in Washington by train the next noon, Tuesday, and proceeded to work. My travel was paid for, and my subsistence totaled \$28.50. Tom and Jack returned a couple of days later. That's enough for the FJ-1. Production was cut back to about 30 aircraft at the war's end, but the plane did see carrier service. We later bought a version of the swept wing F-86 as the FJ-2 and eventually the greatly modified FJ-4s as attack planes, competitive with the A-4.

**RAUSA:** Where were we?

**SPANGENBERG:** I think we last talked about the FJ, so on the chart we must be covering the 1944 starts. The F2H Banshee evolved as the follow on to the original Phantom from McDonnell. The timing of the design was dependent on the development of the J34 Westinghouse engines, which permitted the design of an airplane with a reasonable combat capability. It is probably worth noting that until the advent of McNamara as SecDef in the 60s, engine development preceded that of the airplane, primarily because that process required more time. Airplanes were usually not started until the engines were scheduled to have passed their 50 hr. tests prior to scheduled first flight. As with our prime airplane contractors, our major engine manufacturers had not been allowed to do any significant development of jet engines until the WWII demands of adequate conventional engines were met. P&W and CW thus entered the field later than Westinghouse and GE. Vought was allowed to get into the jet fighter game with the F6U powered with a single Westinghouse J34 engine, with no afterburner initially. The design was constructed primarily of Metalite, an aluminum sandwich with a balsa core. The airplane was somewhat underpowered and the Metalite construction, as feared, gave problems both in construction and in maintainability. A relatively small number, 30 perhaps, production models were built, fitted with a newly developed afterburner on their J34.

Continuing on with the 1945 starts. After the F6U comes the F2R, a turbo prop plus jet follow on to the FR. It didn't get beyond the prototype stage. The TB3F is the next one which we haven't mentioned, although someone will ask what happened to the 2F. I obviously missed it. It did precede the 3F, but was cancelled after the mock-up. It

was to be a twin engine replacement for the TBF series, and was wisely aborted when it became obvious that it was too big to be a useful carrier based design. The requirements for the type were then cut back to allow the single engine plus jet TB3F, a two place, no defensive armament design of reasonable size. The jet engine was eliminated after the prototype and the airplane evolved into the ASW hunter-killer pair, the AF-2W and AF-2S. The JR2F Albatross, a replacement for JRF Goose, was started at the end of the war largely as a reward to Grumman, giving them a possible entry into the post war commercial amphibian field. It was a successful program for both the Air Force and Navy. Which reminds me of another old story told by Capt. Diehl; we go back to the JRF, also used by both services and commercially. An Air Force officer visited Diehl asking for help in solving hydrodynamic problems which they were having with the amphibian. Capt. Diehl thought for a minute, and then started laughing, offending his visitor. Walter then told him the irony inherent in the problem. The Navy had never experienced the Air Force's problem, since nearly all its JRFs were used as utility planes, assigned to air stations and flown as landplanes. Only the traditional land based Air Force was flying them as seaplanes and running into hydro problems, probably porpoising and spray.

The last two starts on the chart were for a J2F replacement built by Columbia, prototype only, and the HRP, Piasecke's tandem helicopter. We bought a few of the latter.

We have just about covered the aircraft started during the war years. Note that we had no design competitions, but rather initiated new aircraft by direct negotiation with both our major and minor producers. With the war's outcome no longer in doubt, we

returned to our normal method of aircraft acquisition. The first fighter competition then since the F7F in 1941 was for a night fighter, and awards were made to two very different aircraft, the Douglas F3D and the Grumman F9F-1. The Douglas proposal was as expected with two J34 engines mounted well forward under the wing. Grumman surprised everyone by submitting a four engine arrangement with J30 engines. The very different design solutions were due to the definition of the combat portion of the design mission for the airplane. Historically, all previous problems had required maximum thrust/power to be used but in this competition, the combat position was specified to be at 400 mph, well below the maximum speed of the Grumman design. This came about due to the project officer's insistence that any higher speed could not be used tactically at night with the radar then available and guns as armament. If full power was used for combat the Grumman design was woefully short legged. Well, as you know, the Douglas design went into production and served the Marines well as in the Korean War, while the Grumman contract was changed within a few months to the single engine XF9F-2 dayfighter, the beginning of the successful Panther series.

The next competition ended up with the selection of the HUP and HJS, prototypes of each were built for a fly-off at Patuxent. That then led to production of the HUP for plane guard duty on our carriers. I had little to do with that competition as it was handled by someone else within the division, probably Otto Lunde.

The last two competitions in that busy year were for a primary trainer, and for a basic trainer, won by the Fairchild NQ for the first and the North American SN2J. Both developments were successful, but only the prototypes were produced. Again I was not involved to any significant degree. It is my feeling that both of these trainers followed

what appeared to be a well planned study by our training group in the bureau, but were overtaken by demands for "standard" Air Corps and Navy primary and basic trainers.

That reminds me of a related experience. In 1943, I was sent to Wright Field in company with one of our training officers and an engineer from Ships Installation to evaluate some Air Force designs for possible naval use, all as a result of the "PT-BT" standardization effort. The latter had been underway for some time, I was told. At Wright Field, we were given drawings of two proposed trainers, one from North American and another from Douglas, Santa Monica, both entries in an ongoing competition. The NAA design was one that eventually became the T-28, with a very short coupled tricycle landing gear which failed to meet the geometry requirements then in effect for providing adequate taxiing stability. The Douglas design used a buried engine with an extension shaft forward to the propeller, so that it easily met the standard geometry requirements. The Air Force had also required that the proposals be suitable for catapult and arresting. The short coupled design's geometry did not meet our standards for catapulting, while the buried engine design did. The Air Force had no experience with short coupled or narrow tread tricycle gears while we had both with the FR and PBM-5A. We were asked to give the Air Force our comments on which of the arrangements we would prefer. It appeared to us that the Air Force wanted to use us to eliminate the short coupled gear design, or probably designs, since we had been told that the two proposals were "representative" of the entries in their competition. Eventually, we informed them by letter that despite the less satisfactory geometry we would prefer that rather than having to live with the problems inherent in a buried engine design for a trainer. The competition



secrecy practiced by the Air Force made a deep impression on me, but not a favorable one, then or now.

**RAUSA:** It looks like we've reached the end of the war in our discussion of the airplanes on your chart. What had happened to your job?

**SPANGENBERG:** Guess we have skipped all that. Obviously, our group expanded during the war, and major organizational changes took place throughout the bureau. Our original four man Design Coordination-Contract Airplane Design gang must have expanded to about twenty before one of the reorganizations took the mechanical equipment design tasks away and put them in what had been the structures section, later named "Design Elements" and then "Airframe." On paper at least in the first couple of years of the war, I was no longer #2 to Mr. Frisbie. I've mentioned Ivan Driggs being added, and subsequently Ed Green from Martin was hired and also Dwight Maier from Republic. One or all of these men may have been shown on organization charts as my bosses during that period. I always had the feeling, however, that Mr. Frisbie really considered me as his eventual successor. Mr. Green was transferred with the Mechanical Equipment section and Mr. Maier left before becoming fully indoctrinated as part of naval aviation, I presume because of all his previous experience with Army Air Corps designs. By 1944 I was called Head, Design Evaluation and by 1946, Assistant Director. In 1946, then, we had Mr. Frisbie and myself heading a two man Aircraft Proposals Branch, a six man Weight Control Branch and a three person clerical section. The Division stayed at about the same overall size, and with the same responsibilities until I retired. The clerical staff was reduced from three to two, and at times the

proposals or weight branch would gain an engineer. Overall, we had a very competent, stable, and dedicated group, where everyone knew his job and did it. The branch heads handled virtually all the inevitable bureaucratic management paperwork, I hated it, and did as little of that as I could get away with. We can discuss this more after we get through our list of airplanes.

**RAUSA:** Ok, let's see, the F10F must be next – I'm sure you must have thoughts on that one, since it didn't go anywhere.

**SPANGENBERG:** Thinking about it now, I'm inclined to believe we really didn't do a good job on that design, but it was anything but a clear cut case for or against. We were still in the early part of the jet age. Technical data was becoming available on the drag reduction possible with swept wings at high mach numbers. Some of the data was coming out of Germany. As with the jet engine, increased sweepback did not come easy for the Navy, as it decreased maximum lift but also increased the angle of attack for maximum lift, aggravating our take off and landing problem. To be competitive at the high subsonic and supersonic mach numbers, we had little choice but to use the concept. One solution might be to build variable sweep wings. The fighter class desk, headed by A.B. Metsger set up a research project in which Bell aircraft modified an Air Force fighter aircraft with a swept wing, and flight characteristics determined. A problem with airplane balance became obvious between standard and swept wing positions. That could be solved by translating the wing, done subsequently on a research airplane, but it meant weight and complexity on the F10F. A better solution on all subsequent variable sweep aircraft was to use a single pivot outboard on each wing, and in effect vary the

sweep on only the outboard portion of the wing. The gains derived from the moderate sweep on the F10F, 35 degrees I believe, were not enough to compensate for the added weight and complexity. However, the variable sweep turned out to be the least of the F10F's problems. A major debate involved the switch from pure mechanical control systems to power boosted or pure power systems with their added complexity.

Grumman came up with a novel solution in which the pilot controlled a small delta wing airfoil mounted rigidly forward of the horizontal tail and which provided the control power to move it. The control power was quite adequate as had been shown in wind tunnel tests, but unfortunately the state of the art at that time was not adequate to predict the dynamic characteristics. Lag in the response resulted in a Pilot Induced Oscillation (PIO) situation. The design was also afflicted with the J40 engine with its myriad of development problems. The program was wisely cancelled. As I remember, the cancellation effort was led by the project officer, a most unusual happening, as project officers and program managers are almost universally sales managers who try to keep their programs despite all faults. "Red Horse" Myer rated high in my book.

**TAPE 7 of 16, SIDE A**

**RAUSA:** What about the F7U Cutlass? Wasn't that in the same time period?

**SPANGENBERG:** The XF7U was a result of the Navy's first real fighter design competition after the war. It was to build a day fighter. It was a big competition. The proposals came in two sizes, powered by Westinghouse J-34 engines or GE J-35s. Small engines and bigger engines. The small engines weren't quite enough to do the

job. The bigger ones were. The Navy had a reputation at the time for building only conventional airplanes. Most of industry thought we were well behind the Air Corps and unwilling to take aerodynamic risks. We had no tailless airplanes. In fact a lot of them thought the Navy was still in the biplane days, and that Walter Diehl our number one aerodynamicist, would never approve a tailless design, but he did. The Vought design had by far the best performance of all the proposals. A lot of things we were worried about, but all the engineers checked off on it. Walter Diehl said "at least we'll solve the subsonic tail buffet problem."

**RAUSA:** The F7U was not supersonic.

**SPANGENBERG:** It was not, it was subsonic, somewhere in the .9 Mach bracket, between .9 and one. I thought that the decision to build the original XF7U-1 was a good one and the airplane was a successful flying machine. Unfortunately the thing that happened to it was they made it into an all weather fighter by adding in the first of the Sparrow missile systems and the weight went up by something like fifty percent. When it did that we ran out of all our design margins. You should have had a bigger airplane if you're going to try to do that.

**RAUSA:** Was the biggest problem the lack of stability?

**SPANGENBERG:** Not really. It was a good enough airplane. The Blue Angels flew it for solo demonstrations.

**RAUSA:** Whitey Feightner.

**SPANGENBERG:** Whitey actually bent one. Did he ever tell you that story?

**RAUSA:** No.

**SPANGENBERG:** They were doing an air show and some light airplane wandered across the air field right in the middle of the show. I don't think they ever did find out who it was but all of a sudden it appeared right in front of Whitey. He had to honk it around pretty good and overstressed it.

**RAUSA:** The problem with the F7U then was it gained weight and it became more difficult for the pilots to handle?

**SPANGENBERG:** Well, your takeoff speeds went up. You lost your margins on catapulting. The planned higher thrust Westinghouse J46 engines didn't turn out. Eventually the original engines didn't show up and we had to fly the early production airplanes with J35s, one of the early jet engines. It was slightly underpowered with 35° swept wings and with the tailless configuration, you'd get a horribly high angle attack in order to get enough lift to come aboard. And then the increased weight of course it just added to all those problems. We knew we had a problem in the first place but when it went to the all weather version, F7U-3, it just got — we tried to do too much. We in the Navy. The engineers didn't like it any better than the fleet did. We broke backs of pilots with the nose gear slamming down. The way it ended up it was not a successful airplane but I still think that our choice of the XF7U from the competition was proper.

In more or less that same time frame, '47, we got the results of all the German swept wing and Delta wing research. Douglas had a team over there in Germany, came back, gave us a research proposal for a design that eventually became the F4D. We had that program going for about a year before it became time to do another fighter competition. In those days it was called an interceptor. This was a short legged fighter,

high performance. It was supposed to get off the deck, get up, and intercept incoming bombers. A competition was eventually run with Douglas entering the F4D which they already had under Navy contract as a research project. McDonnell entered the design that became the F3H. The official decision probably says that McDonnell won the competition and we just continued the F4D program. In fact the F4D Skyray was by far the better airplane. I didn't think we should have bought the McDonnell airplane myself but we did and then it was touted as a great idea to have competitive programs going anyway. "Douglas will keep McDonnell honest and vice versa." That series of airplanes were all built around the J-40, one of the big powerplant busts that the Navy had. The Westinghouse J-46 and the bigger J-40 engines. They really screwed up a bunch of our airplanes.

Douglas had the great good sense when the J-40 went sour to substitute the J-57 engine for it. The J-57 had been started by the Air Force as a bomber engine and Pratt had tuned it enough and developed it with an afterburner so that it became a very useful fighter engine as well. Incidentally it showed that the Navy was willing to buy somebody else's development product. Air Force and Navy were developing their own engines. We had all of the even number engines, the Air Force had all the odd numbers so a 57 was an Air Force-developed engine, 58 was a Navy-developed engine. We had no hesitancy to use the Air Force-developed engine. It was the best engine around. Anyway, in order to put the 57 into either the F3H or the F4D you had to open up some of the frames in the fuselage. The engine was a little larger in diameter, an inch or two over the original J-40 engine. Douglas bit the bullet and put in the J-57.

McDonnell tried to live with its frames and put in the J-71. The J-71 was not nearly as good an engine as the J-57. It gave us all kinds of problems.

**RAUSA:** The F3H.

**SPANGENBERG:** The engine itself gave us problems. One of the early operational squadrons flew through a rainstorm and two in out of the three airplanes, the engines seized. The water going through the engine had cooled off the case enough that the rotor seized. Things like that.

The other thing that happened to the airplane was the same thing that happened to the F7U. It went from an interceptor which our Op Requirement people finally decided we couldn't afford. You could not dedicate deck space to a squadron of high performance airplanes with short legs. They obviously got to altitude a lot faster but they didn't get there fast enough to stop an incoming threat that way. And eventually of course we went to the CAP system where you got the fighters out far enough that you could really intercept somebody. The requirement then was basically an escape for both the F4D and the F3H.

And then when you went to an all purpose fighter again they got into trouble. You lost all your design margins plus the fact that we had to substitute engines. The F3H in particular was not a good fleet airplane. The only thing that was good about it was the guys came back. I still remember Pete Booth telling me it was solid as a rock in a groove. Couldn't move it. (laughter). It was not my favorite airplane. The aviators that I worked with later in my career. John Lacouture and others said "I think you made a horrible mistake with the F3H." I agree that the Navy made a mistake on two counts.

The F4D was the real pick from the competition, and then the change from interceptor to general purpose came later. Both the F4D and F3H suffered. Those planes were really the end of the subsonic era.

And that year we did the A2J which was the second step towards a nuclear bomber. It had started with the XAJ as a demonstration project, while the A2J then was supposed to have enough performance really to do the nuclear attack job. It had turbo props in lieu of the R-2800s, and dropped the jet engine as a booster. It had good performance.

**RAUSA:** Was that a production airplane?

**SPANGENBERG:** No. It never got that far.

#### **TAPE 7 of 16, SIDE B**

**SPANGENBERG:** The A2J was really overtaken by the A3D to succeed the AJ. Nobody wanted to do composite powerplants if you could do single powerplants. There was great controversy within the Navy's powerplant development organization. I think I mentioned this once before. Seldon Spangler was an advocate of turbo props. He didn't think jets would ever make it on a carrier, and tried his best to steer airplanes in the direction of turbo props. Most airplane people didn't want to go that way. A.B. Metzger was one who pushed very, very hard within the Navy for pure jets. Most of us were kind of in the middle. The pure jets at the time couldn't quite do the job and everybody recognized a composite way to go was poor choice. All of us recognized I think that you



couldn't get there from here with a turbo prop if the other guy without carrier constraints was going to be using jets. We would be in trouble.

In fact the historians probably would like to take a look at that jet versus prop thing with one of the early Patuxent tests that was done with an F8F versus a P-80. The Air Force had the P-80 Shooting Star developed and the F8F was our best reciprocating engine fighter. And it turned out in those tests that a P-80 could never shoot down an F8F as long as the F8F never made a mistake. But the F8F in turn could never shoot down a P-80 unless he made a mistake. If he tried to get into a turning dog fight the F8F would win. But the F8F was solely at the mercy of the P-80. You couldn't get away from it. It should have taught a lot of people a lot of lessons. It was good that Patuxent did it, it educated a lot of the people.

We had a P5Y, started as a patrol plane, ended up as the R3Y, as a transport. Patrol planes, seaplane development was obviously winding down. Their great advantage was being able to land on the water and with water everywhere all over the earth that you could operate from. But the logistics of handling the seaplane tenders and whatnot and as the airplanes got bigger that got to be more and more of a logistics problem. And the airplane technology advanced so you could do it from land and then it was tough for the seaplanes to continue.

There has been enough done on the research programs with the D558 programs so I don't think I have to talk about that.

The F2Y was a strange program, and not well done. It proves you can't do long-range planning I think. It started off and ended up too as a seaplane fighter. There were a lot of research programs going on at the time. One of them was the development of a

seaplane at Convair called the Skate which was a kind of a combined wing/fuselage arrangement that would also be a reasonably decent hull. There was a development up at the Naval Aircraft Factory along the same lines. We call it a "float wing". We ran a kind of a competition for that, ended up with – I think Curtiss was playing around with it too. Eventually the contract went to Convair for the Skate but instead of building the Skate, things changed and they ended up building a Mach 2.0 supersonic, ski equipped airplane. Airplane development was better than I expected. They racked the airplane up in an air show demonstration. The airplane went out of control due to PIO, Pilot Induced Oscillations, and it crashed. It was the last hurrah for the guys that were trying to promote seaplane fighters.

**RAUSA:** This F2Y. Was that the Sea Dart?

**SPANGENBERG:** Yeah.

**RAUSA:** Beautiful airplane.

**SPANGENBERG:** Oh, yeah. Pretty. We used to have a requirement in our general spec. An airplane had to look good. It met that criteria.

Next on my list seems to be the WV, which frankly I scarcely remember. It must have been the first of the early warning prototypes with radomes on top and bottom of a Lockheed Constellation. Little in the way of airframe development, but a major step in electronics.

Next we reach the start of the Douglas A3D, the Skywarrior, popularly known as the Whale.

**RAUSA:** Heinemann seemed pleased with his efforts on the beginnings of that program, but his account of it was confusing to say the least. I'd like to hear your version of the events.

**SPANGENBERG:** Well, I sure agree with the confusion part. Until I read Ed's book, I had always thought he had an advantage over the other competitors since I knew he was on some naval research advisory board, and I assumed he knew more about the state of development of the atomic bomb than I did, or for that matter, than others in the competition. Actually, I now believe he was just smarter than the rest of us.

I had better stick to my remembrances of that time period. Navy carriers were threatened by the advocates of airpower alone being all that was necessary in the atomic age. The Air Force had been made a separate arm, co-equal with the Army and Navy. The large flush deck carrier in the design stage was under attack and was later cancelled. The AJ, although initiated as a demonstration project to show that carriers could operate airplanes large enough to carry the "bomb" had been put into production, but it was not completely credible as the deterrent of the future. Higher performance in both speed and range was obviously necessary. Studies were being done by everyone for both Air Force and Navy. RAND produced a well publicized bomber study for the Air Force. That study concluded that very large, very high aspect ratio designs using turbo-prop engines were the preferred solutions for the Air Force. Similarly, studies done under Ivan Driggs's direction in the bureau indicated turbo- prop designs in the 100,000 pound class were necessary to meet the requirements then being suggested; probably at least a 1000 mile radius with a 10,000 pound bomb.

Eventually, the bureau invited proposals in two competitions, one labeled a "special attack", using "innovative approaches", and the other for near-term, conventional designs. The only "Special Attack" proposal I remember was from Convair for a two stage arrangement with a twin jet, delta wing design launched from a mother aircraft which carried it from the carrier. I can't remember the details, but the high performance stage of the design was quite similar to the Air Force's B-58 delta wing bomber started later. The Navy bought nothing from the competition, not a surprise.

In the conventional competition, Douglas, El Segundo alone submitted a twin jet engine design, while both Lockheed and Douglas, Santa Monica offered four engined jets in the 100,000 pound class. I believe we also had one or more designs using turbo-props. Heinemann's design was admittedly stretching the state of the art in trying to meet the stated requirements, and I believe he was really betting that the 10,000 pound bomb would come down appreciably in weight, and that the carriers would be larger with higher capacity catapults and arresting gear. The bureau, of course, was betting on the same things. I seem to remember a relatively long period of negotiation before we were able to define the airplane well enough to let the experimental contract in the spring of 1949. I wonder now in 1998 as I edit these transcripts whether Jerry Miller unearthed the bureau records on the competition in his research while a Ramsey Fellow at Air and Space. We were either very lucky or very astute in establishing the final design requirements at a fixed gross weight of 68,000 pounds, with a 6000 pound bomb. The J40 engines initially specified had to be replaced by J57s, actually helping the program.

Overall, the A3D has to be listed as one of our most successful development programs with many versions of the design seeing service, including counter-measure, photo, transport, and tanker. The Air Force bought a couple hundred with J-71 engines.

**RAUSA:** Heinemann talked about having competition at the beginning of the A3D's development. You haven't mentioned it.

**SPANGENBERG:** Sorry, I had forgotten that, and I really don't remember the details of the Curtiss design, but I do remember the episode. We carried Curtiss along for a few months as competition for Douglas. That action was instigated by Adm. Pride, then Chief, BuAer, as he said, "To keep a poker up Douglas's -----." Frankly, I always opposed such actions as cost and time consuming for both the bureau and the contractors, without any real benefit. However, the practice has persisted and is now standard policy to have a period in which to get "Best and Final Offers" from two companies before announcing a winner. I suppose it sounds good, but I consider it speculative theory, at best. Wonder how many other design proposals I've missed.

**RAUSA:** The Curtiss plane, was it ever built?

**SPANGENBERG:** No. We cancelled it after three or four months. The notes only say CWVA so it probably never got to the point where it had been given a designation.

Then we get into the fifties. Did you get around to reading that *Gold Book* article?

**RAUSA:** Yes. I went through those. I copied all that stuff.

**SPANGENBERG:** It really summarizes most of the story of the tactical airplanes from the fifties on. I did not cover the other types of aircraft. On this list of "starts" we have the HSL, the first aircraft in the fifties. It came from an ASW competition and at the time

I guess the biggest powerplant in a helicopter was probably the R-1820. Bell proposed a tandem helicopter around a R-2800 engine which gave them a substantial increase in power. It was a good engine. Well liked. We knew enough about the engine. They designed their helicopter around it. It had much better performance than anything else. Bell was proposing a tandem helicopter for the first time and everybody had their fingers crossed on that. Piasecki had been the only one that had built a tandem before. Contract went to Bell and the program as a whole was not overly successful. They had flying quality problems with it.

**RAUSA:** Do you recall the designation of the tandem?

**SPANGENBERG:** HSL. It ended up with primary usage as a mine sweeper rather than going into the fleet as an ASW model.

The S2F came from a tough competition. It was the first carrier-based ASW airplane that had a chance of doing the job. Up to then you couldn't do the job in a single airplane. You couldn't do it well enough anyway. You remember we had the AF Guardian, had an S version and a W version. One carried the search radar and the other carried the weapons. That's a poor way to run a carrier. So it was time. And as I said it was a good competition. Grumman won the competition because it had by far the best aerodynamic configuration for getting single engine performance. You could lose an engine with that one and at proposal time fly away with ease either on takeoff and obviously much easier on wave-offs. The ability to do that required lots of span. You remember that we had to go to an overlapping wing fold which is the thing that really kept the other designs from being competitive in the competition because they elected to

stick within the folded span requirements but then with a conventional kind of a wing fold they didn't have enough span to solve the single engine problem. I thought that the Navy's requirement was pretty good. The airplane was a good solid design, lasted a long time.

**RAUSA:** You're talking the S2F.

**SPANGENBERG:** Yeah. We built later versions of it as the first of the early warning airplanes.

**RAUSA:** That would be the E-1 Tracker. Successful airplane.

**SPANGENBERG:** The Tracker and the CODS. In a long successful series.

Had another helicopter competition. Got Kaman into the act with the syncro twin rotor trainer. Then the HRS, the Sikorsky helicopter with the engine mounted in the nose. The other services built that one too. I had little to do with those competitions, Otto Lunde handled them.

Next on the list are three helicopter models, listed as the HRH, HCH, and HR2S. All came essentially from the same competition with only the HR2S reaching service. The Marines issued a requirement for a troop/cargo carrier for the amphibious assault mission with a 300 knot maximum speed and a 50 mile radius. That speed requirement is one that persisted for years and is presumably now to be met after almost 50 years with the V-22. In 1950, it was considered quite unrealistic by most of our technical community, need I say, including me. McDonnell, however, proposed a compound helicopter with two T-56, wing mounted, engines driving propellers for forward flight. The pressure jet rotor was powered by air pumped through the rotor and ignited at the tips.

The Air Force had the H-16 at Hughes under development in an even larger size, but without the compound features of wings and propellers. McDonnell had a small tip mounted ramjet powered helicopter flying. All were interesting projects from an R&D standpoint, but with little prospect of service use. The HRH design then gave birth to the HCH, a heavy lift design with the same pressure jet rotor system, but without the wings and propellers. It had such high fuel consumption that even its proponents soon gave up any hope of practical service use and the program was cancelled. The HR2S, on the other hand, powered with two R-2800 engines, was a real success and provided Sikorsky with the experience for later production of their SkyCrane model and eventually of course the CH-53 series.

**RAUSA:** That pressure system never succeeded?

**SPANGENBERG:** Well, it succeeded in driving the rotor.

**RAUSA:** But it had no lasting value.

**SPANGENBERG:** No.

And the next set of peculiar things were the tail sitter VTOLs. Up to that point in time the Navy had supported VTOL development in a pure research type of way. We were the first ones to fly jet engines, for example. They put vectoring controls on a centrifugal jet engine, probably a J-33, added a seat above the jet and pilots could maneuver the contraption. Believe it was done at Ryan. If you had been around in those days you could go wherever we had that thing, fly it, and you'd get a certificate you could hang on the wall.

**RAUSA:** Was this the one they called Pogo?



**SPANGENBERG:** No. This led to Pogo.

We'd been fooling around with VTOL in a research phase. Everybody wants VTOL. The only problem is we could never pay the price to get it. It's still almost true today in a real general sense but you like the advantages that it gave you. By that time fighter requirements were into at least high subsonic, low supersonic speeds. The power thrust to weight ratios were over one to meet high speed requirements. So the general feeling had been that when you got to the point where there was enough thrust to meet high speed requirements, this was more than the weight of the airplane and you should be able to get VTOL without significant penalty. Well, we never quite got there with reciprocating engines, but with gas turbine power it looked like we could. And the easiest way to get there was tail sitters because they didn't require a heavy landing gear. You also didn't need a high lift system. You do it all with the engine. Kelly Johnson made the remark in some paper that he gave one time, VTOL did all the grunt work. Tail sitters or wire hangers or something of that nature would take off and land first and eventually you could get one that would land that way and then kneel down and crawl away. It was a problem what to do with one of these vertical things if you wanted to work on it. We decided it was time to do that. Congress would no longer fund "research programs". So the services had to develop a requirement that showed some operational end use. The Navy developed a requirement for "a convoy fighter" which then would be deployed on merchant convoy ships to Europe. Every merchant ship would have a couple of these fighters and one of the joys in the competition was to figure out how do you recover them. There was a lot of relatively innovative kind of things to do from the

pure tail sitter or grab and then maybe pull them down with a cable or something as they have done now with helicopters on small ships. Or landing into a huge net that you would fly up and stay in the vertical mode and go in and with a probe device on the belly and you'd grab something. There were a lot of those kinds of ideas. Out of that competition came the tail sitters, XFV and XFY, Lockheed and Convair. The Convair design was a pure Delta wing with upper and lower vertical tails so that in a sense it looked almost like four wings. It had small wheels and struts at the end of the two wing tips and the two tail tips. No means of getting it into a horizontal position in the operation. It was supposed to land on a deck. Hopefully, of course, you had enough control to land safely.

**RAUSA:** Did these two aircraft have a lot of accidents in the development stage?

**SPANGENBERG:** No. They didn't have any accidents but then they never flew very much. In fact we didn't have any accidents. They were powered with T-40 engines. The Lockheed airplane looked more like an airplane and it had dual upper V and inverted lower V tail surfaces with small aft landing gears on each tip. It landed vertically on the four tail tips.

The Convair was a more stable platform because the wing span was greater than the Lockheed tail spans. The ground contact points were further apart on the Convair.

The Lockheed airplane only flew after taking off and landing in a horizontal attitude with a big jerry built landing gear added to it. The T-40 engine was certainly not the world's most reliable and the pilot's life depended solely on that engine working. You had no possibility of auto rotation as you have with the helicopter so anytime you got into

the vertical mode you were really depending on that engine continuing to work. Another factor was that as you got close to the ground the tail sitters lost control effectiveness due to ground proximity. Ground effect in essence helps on landing speed but does not help in the VTOL mode. That led to ideas for landing and take-off from a perforated area.

I went to the mockup on the XFV. Very strange to sit in the cockpit in the vertical attitude. Your view of the ground obviously is awful. I didn't see how they were going to do a landing unless they built a tower of some kind that a pilot could see by looking sideways. At least they had to have better necks than I had.

**RAUSA:** Was the original concept they had like rear view mirrors. Did they use those.

**SPANGENBERG:** We had big rear view mirrors. Just like backing up an automobile except you can't open the door, or help with your body turning around. One could imagine landing aids that would help. You'd have some kind of a scaffold arrangement and a landing target that you could line up with something. But as I say Lockheed never got to vertical landings. Convair did on a few flights but the airplane really had no place to go. It finally dawned on everybody that you just can't build an operational fleet vehicle with a tail sitter arrangement. You try to think of how the hell do you handle it. For example, you'd have to put it in a horizontal position to work on the engines. That program died. I really don't count it as one of our failures because everybody really considered it to be a research vehicle, although we sure didn't need two.

The next step after that was to do a jet VTOL. The Navy actually started along that line. The project ended up with the Air Force doing it with a Ryan Wire Hanger. Did you ever see the Wire Hanger? What was it, the X-13?

**RAUSA:** No.

**SPANGENBERG:** It had a carrier truck about as long as a fire engine hook and ladder. The plane could be raised from a horizontal to the vertical, held on a big wire mesh arrangement. The pilot used a hook for recovery not unlike the old CAST recovery hooks that we had on seaplanes. He got to the vertical, flew horizontally, translated and finally grabbed a horizontal cable as the plane dropped down. They put on demonstrations of that in the local area. I remember going and watching it at the River Entrance of the Pentagon and at the time they had a bunch of rose bushes growing down there along the road. The recovery vehicle was sitting down there. The airplane took off from the recovery vehicle, translated over the lagoon. You could see the water whipping up in the typical pattern that you get from the down flow and then he came back and landed on the net. Destroyed about \$100 worth of roses, just ripped them out of the ground. [laughter]. That was a successful research program but the Air Force couldn't figure out what to do with it.

At that point in our history VTOL and V/STOL enthusiasm was running very high. When turbo-prop engines became available, it became possible to provide more thrust than the take-off weight of fighters, for example. The enthusiasts then sold, or tried to sell, the idea that the advantages of VTOL were now available for all of naval aviation. I remember Capt. Stevens, after being briefed by Mr. Driggs on the results of some

tethered model testing at the NACA, coming into the office with Mr. Frisbie and me, and telling us he expected that we should have an all VTOL carrier complement within ten years. That gross over-optimism actually surfaced again in 1977 when "Proceedings" published an article under then CNO Holloway's byline proposing an all V/STOL force, since he had been advised that the state of the art now permitted that goal with no significant penalty over conventional aircraft. That belief is as erroneous now as it was in the 50's and 70's.

**TAPE 8 of 16, SIDE A**

July 25, 1990

**RAUSA:** Now up to time period of about 1952, talking the P6M. Mr. Spangenberg has his notes neatly laid out here in preparation for this briefing. [laughter]

**SPANGENBERG:** There are always things that I think about that were interesting items that come with it. That's really all we're doing. The things that were a little unusual at the time.

The P6M was the last cry I guess of the — maybe the first too — of the real high speed attempts with a seaplane. It was not popular at the working level with most of the engineers but it was with some. I don't know whether you've heard of Fred Locke. Fred Locke was a very unusual airplane designer, seaplane background type, and he had been laying out things in the old Research Division, preliminary design outfit, and he had one high speed seaplane thing in which the airplane would land upside down. It had a rotating cockpit in the thing and that way he was able to achieve a lower drag, high

speed hull design. I can't remember the details but it was a good looking design. Probably impractical.

The P6M was a strange competition. There were only two designs in it. Convair and Martin and it was one of the first where the Navy thought one design was way underweight and the other one was way overweight. We often had them where we thought the contractor was understating what the weight of the airplane would be but in this case we were sure that Martin was way under and we were sure that Convair was way over. There was something like a 20,000 pound difference between the two proposals. We couldn't accept either one so we did a debriefing, sent them back to the drawing boards and they came in with a second proposal and Martin was selected to win in that one although you could have flipped a coin, just about. It was also the first competition in which we had to take the briefing of the competition results up to the Assistant Secretary for Air in those days what would be today the R&D Navy Secretary. Floberg was also an aviator. I suppose that's the real reason we got up to his level. Up to that point in time we had never gone beyond the uniformed Navy in a competition.

The P6M itself of course was not a success. They lost two of the airplanes in accidents. The tail came off one and I forgot what happened to the other.

**RAUSA:** Were there more than two?

**SPANGENBERG:** We built more. They had more than two under construction. It was a concurrent program so they probably had five or more of them under construction at the time. In my opinion the requirement was just nonexistent. The basic mission was supposed to be to deliver 30,000 pounds of mines. Had a rotating bomb bay which was

part of the hull which obviously would give troubles in service anyway to try to get that thing sealed. Never did get around to that, really working out that part of the airplane as I recall. But in any event, the joke that — I remember Bob Francis, the A3D Class Desk officer. He and I used to talk frequently about airplanes and whatnot and our favorite story on the P6M was we could buy two A3Ds to do the job and they would cost less than one P6M. Would do the job better and the thing we didn't realize was we could buy the carrier to operate the A3Ds from the money we had left over. That was about it. It was the last of the seaplane, at least the high speed kind of seaplanes.

The next interesting one I guess on here is the F11F and the money for getting that came out of the cancellation of the F10F, the variable sweep design that we talked about before. We had money left over and they called it the XF9F-9. It was a brand new, well designed airplane. It was a little too early to start a new fighter with the next generation of engines, the J-79 and the J-57. But Grumman did a good sales job. It was not a competition. It was a negotiated procurement. Joe Gavin who later became president of Grumman was working on the board at the time. That was an interesting tale too. Joe had been in the fighter desk at the bureau. He was number one in his class at MIT, smart guy and a real nice guy. When the war was over he got offers from virtually every airplane outfit in the country I guess to go with them and they all were going to make him a program manager. I and perhaps others advised him he better get his hands wet first and Grumman was the only one that offered him a job where he would start on the drawing board. Joe took that job. You really learn more quickly, I think, how airplanes are designed and what makes a good one by working on the board.

So Joe did the powerplant installation as I recall on that. Later became project engineer on the job. Later became president of Grumman. Good guy.

**RAUSA:** When you say it was a negotiated procurement how does that differ from the normal bidding process?

**SPANGENBERG:** Well, you don't bid. The contractor comes in with a good proposal and you just buy it and then attempt to justify why you do it. Later on today we ought to talk about the beginning of the A-4 which was done the same way.

**RAUSA:** The F-11F you say was a good design?

**SPANGENBERG:** It was an excellent aerodynamic design. It just didn't have the engine that it should have had right from the beginning. Grumman couldn't really afford to try to achieve the level of performance that the Navy was likely to want for the next fighter so it was really regarded as an interim step between a truly supersonic fighter. It was supersonic but just mach 1.1 or 1.2, something like that. It was regarded as an interim fighter but the aerodynamics of the airplane were excellent and it was a well laid out design. Didn't have quite enough fuel in it.

**RAUSA:** Do you recall how many we bought of those? Did we have several squadrons?

**SPANGENBERG:** We probably had four or five squadrons I suppose.

**RAUSA:** Did they have missile capability?

**SPANGENBERG:** Yeah. Sidewinders. But it was primarily a gun fighter. It was the one that shot itself down, probably one of the stories you should have heard about in the fleet. Testing the guns in a dive, the airplane ran into one of its bullets.

**RAUSA:** How did it do that?



**SPANGENBERG:** Well, I suppose it had a high trajectory bullet and the airplane caught up to it.

**RAUSA:** Did the pilot survive?

**SPANGENBERG:** Yeah. It was a famous story for awhile. The main reason the airplane didn't go anyplace was the engine was a grand flop basically. There was really no engine in this country —

**RAUSA:** Which engine was it?

**SPANGENBERG:** It was an afterburner version of the British Sapphire. Curtiss Wright had the license to build the engine. It existed as a non-afterburning engine but for the F11F they had to develop an afterburner to put on it. That development lagged and they had engine development problems. The first couple of airplanes as I recall flew without the afterburner and then gradually they got the thing running. The designation was J-65. It was not a good engine. At the end of the program J-79s were put into the airplane on an experimental kind of a basis. Grumman had I think two of the airplanes and it was a Mach 2 plus airplane and a very high performance machine.

In the international arena Grumman tried to sell it to Japan in lieu of the F-104s and there were sales efforts in Germany as well. Both of those countries would have been well advised to buy the F11F-2 we called it then, Tiger King.

I remember Gordon Ochenrider who was Grumman's sales guy at the time. It was before he got to Washington. Gordon would come back from his attempts to sell it and he was just completely naive in the international field. The story was that he wasn't paying the bribes that others were, trying to handle it honestly. He didn't sell the airplane

and it was a far better airplane than the one against which he was competing. My opinion.

Well, the next one on the list is the A4D and it's probably been well enough covered by everybody. I glanced at Heinemann's recollections on the start of the airplane and as I remembered it there was a lot more effort initially on Ed trying to build a fighter interceptor type, very high performance and again it turned out that the Navy just didn't have a big enough market to interest Douglas really in developing such an airplane or the Navy in buying one. You'd like the performance but the interceptor really couldn't quite do the job. Deck launched intercepts against the high performance threat didn't quite hack it and then you didn't want to invest that kind of a deck space in trying to buy just a small capability.

Anyway at the same time the Navy had been trying for a long time to get a replacement for the AD started. Douglas itself had study contracts for follow on to the AD, all using turbo props. 557 program I think it was and they were ugly airplanes and not at all attractive. I see Heinemann said that they were all in the 30,000 pound bracket and I suppose that's right. I don't remember. But I know that they were not attractive. Finally he turned the thing around and made it really the first jet fighter attack design. It was a nice little airplane. Everybody liked it. The thing I remember most about justifying that procurement was writing a letter from — I suppose we had to write to CNO or maybe to the Secretary or somebody to justify a sole source procurement rather than having a competition and the thrust of the letter was it would be unfair to industry to have the competition because Douglas was so far ahead, had already spent so much money on it and the chances of it turning out to be a better airplane or a better deal than we could

negotiate with Douglas at the time was very remote. Blackie Kennedy was the OPNAV sponsor. He was a project guy on attack planes in what's now OP-506. He was a good guy too. There were such excellent working relationships within the bureau and with the CNO at the time.

**RAUSA:** It was less bureaucratic, right?

**SPANGENBERG:** Much less bureaucratic. Whenever there was any kind of a problem the OPNAV guys would be over with BuAer or BuWeps whatever we were then. I guess we were still BuAer and always in close communication and worked together without a lot of paperwork.

**RAUSA:** Was the A4D — did you think it would be the great success it was even then at the outset?

**SPANGENBERG:** Well, I don't think any of us thought any airplane was going to last twenty years or twenty-five years in production. Up to that point in time you were developing engines on maybe a three to five year cycle and the next engine development then went into a new airplane development to take advantage of it. Of course we finally reached a plateau where you couldn't make much of a jump in airplane performance and the engines had kind of flattened out too. That really explains it I suppose. We were not having the kind of step improvements that you had been getting all through the reciprocating engine days. But nobody thought any combat airplane would last twenty-five years.

There were a couple more helicopters that year but we can skip those.

1953 saw the beginning of the F8U program and that was an excellent competition after we got it squared away. A big competition. Called a day fighter and the armament at the beginning was guns, and/or collision course rockets. It carried sixty, two inch, air-to-air rockets. The rocketry stuff never did work out. Within that competition – well, the beginning was very strange. In that article I wrote for the *Gold Book* I pointed out that they had asked me to write on long-range planning which really never has worked anywhere that I know about. Pete Aurand was the project officer on the fighter desk and Pete was one of those that believed you needed nothing but subsonic performance and simplicity would be the big thing. Do it better, turn better, the air combat arena and whatnot. So the competition actually started as a subsonic airplane. Fortunately – I suppose fortunately – Pete got detached and went to his next tour and as soon as he got out of the bureau I think within the next week a simple change went out to all of the bidders saying change Mach .9 or .95, whatever it was, to Mach 1.2. So it became then a true supersonic airplane. The minimum speed requirement was 1.2 and most of the designs came in over that.

Vought won the competition hands down. Their big competitor in a sense was North American. It was strange in that not unlike the P6M competition we knew the Vought design was underweight as proposed. It was in the low 20s, 21,000 or thereabouts for design mission.

But North American came in close to 30,000 pounds for an airplane that was almost the same. They each had variable incidence wings. They were necessary in those days in order to solve the angle of attack problem and get back aboard in the best manner. That was part of the reason too for the A4D's long legs in addition to getting

enough ground clearance. You had to get enough angle of attack in order that Delta wing could get up to a decent lift coefficient.

Back to the F8Us. We had variable incidence on the two principal proposals. In our mind Vought was going to be something over 1,000 pounds overweight but even at 1,000 pounds overweight or 1400 or whatever it was we thought it would still be a better airplane and perfectly acceptable in the fleet. North American at 30,000 pounds though would be about where we thought that the airplane might end up as a top of its growth line and there it was starting that way. And obviously if you propose a 30,000 pound airplane you can build it. Eventually we decided that we had to go with Vought. It was a better airplane of all those that were proposed. Later Lee Atwood, then president of North American and a very fine engineer, was convinced that the Navy had given the contract to Vought because they needed the business. He gave a speech before probably the Industrial Preparedness Association, one of those trade organizations, and in his written version of the speech there was nothing in it about that competition but as he actually gave it there was a paragraph added on the Navy's way of doing business or the military's way generally speaking of having design competitions. He said design competitions had to be run honestly and that the evaluators had to put aside any thoughts that they were trying to regulate the economy of the country and so on and just pick the best design. From the manufacturer's standpoint winning the design competition was the key to getting a production contract which was a reason that they were in business. An airplane company could not exist on experimental contracts alone. Everything that he said was right down our alley. We thought we had done exactly what he had asked for and for a number of years I quoted that paragraph of his whenever I

gave a source selection briefing to anybody. Atwood didn't know it but he was outlining the rules of the game as we thought they should be played.

**RAUSA:** But in his own way he was complaining.

**SPANGENBERG:** He was complaining. Well, as you know that one went on to become a great airplane too and one that should have been bought in large numbers overseas. We sold some to the French. Later on, another country, I believe the Philippines, picked up some refurbished F-8Hs.

**RAUSA:** Was that a Mach 2 or 2 plus?

**SPANGENBERG:** No. It started as a 1.4 and I don't think it got up to Mach 2.

**RAUSA:** This was the first variable incidence wing aircraft that you had dealt with, is that right?

**SPANGENBERG:** Yes.

**RAUSA:** Did that present any special problems?

**SPANGENBERG:** Not really. People were worried about it. Mechanically it's very straightforward. It's no tougher than folding the wings essentially.

**RAUSA:** I mean the aerodynamic aspects weren't worrisome?

**SPANGENBERG:** No. One of the reasons, it was a high wing airplane. It would have been tough to do a variable incidence with a low wing airplane. Get sealing problems and so on. The high wing airplane it didn't really bother very much. Of course you also wanted the high wing low tail for getting through Mach 1. Good airplane and successful development and the timing of the program we used for years as the way you ought to develop an airplane.

Unfortunately some of the think tanks around the country and the people who were not close to the actual development, claim that the F8U was a prototype because we had two airplanes labeled XF8U-1. So in one of the big studies done by RAND years later, they came to the remarkable conclusion that it cost neither time nor money to prototype, test and then buy. And the reason that they came to that conclusion was that they did not properly separate prototype programs from concurrent programs and since there was an XF8U-1, they included it in their prototype kind of a program, but it was really concurrent from day one. It had all been planned that we let the first contract for two airplanes but then within the next year we bought five and then twelve and then twenty or something in order to get a smooth production buildup. We bought enough experimental or early production airplanes to get the test flying done. If you have two airplanes it takes forever. And if you do them as pure prototypes you've cut corners all through the thing and you don't have a representative sample. I probably have a hell of a lot more to say, don't have to say it really, but I'll give you some of the prototype papers and articles that were written because it's an important part of the acquisition process. People should know that we stopped prototyping before World War II. The F4U-1 Corsair was the last fighter that we did prototype before ordering it in production.

**TAPE 8 of 16, SIDE B**

I guess that's the end of this quick prototype thing.

That was the only airplane we started that year according to my chart. Starting in '54 was a very unusual competition of things that were marked helicopters ROE and

RON. This was another crazy Marine idea. [laughter] They were going to put every Marine into the air so we had one-man helicopters. You could put them under your arm and carry them around with you. Assemble them in the field.

**RAUSA:** Observation helios?

**SPANGENBERG:** You could go to war with them I guess. If a Marine got trapped anywhere you'd drop him one from a airplane, he quickly assembled it, read how to fly in one easy lesson and took off. They thought they'd give Marines flight training in these little helicopters. Every Marine would get one. It was a weird competition. We had about forty-some entries of all sizes, shapes, descriptions and ended up – this was ROE so it must have been Hiller was one of the ones and the other one was Gyrodyne Gyrodynes were little coaxial machines. They were weird. Obviously the thing was a complete fiasco.

**RAUSA:** Did they fly some of these?

**SPANGENBERG:** Yeah. They flew. Other people got into the act too. I remember Goodyear built one.

**RAUSA:** These were open cockpit?

**SPANGENBERG:** Yeah. You just sat out there in the breeze with a stick in front of you and the rotor kind of strapped on your shoulders [laughter].

**RAUSA:** You guys must have gone crazy.

**SPANGENBERG:** We did. That was a busy year too. F4H got started that year also. Lots of things were going on. Eventually the Gyrodyne thing – or modification of it – became the DASH drone helicopter. Another program. The DASH was the first radio



controlled helicopter program and it probably would have been a success if the Navy had been smart enough to put a total aviation unit aboard the ship and operate the drones as well as doing the job of building and furnishing them. But the concept sort of had the surface fleet personnel doing the operation and they just didn't have enough training.

**RAUSA:** Well the DASH lasted for a while.

**SPANGENBERG:** Oh it lasted quite a while. But the Marine one-man helicopter didn't. It was a screwy one. The F4H also finally got underway that year. That's covered to a degree in that *Gold Book* article. McDonnell was running out of F3H production so they were submitting proposals once a month I guess on another version of the F3H. We were still calling it F3H. F3HA, B, C, D, E, F, G, H – finally got up to H. Good selling job by McDonnell. The bureau fought against the idea because it was a year too soon to start a new fighter.

**RAUSA:** What was the fighter outfit?

**SPANGENBERG:** F3H and F4Ds.

**RAUSA:** They were the main fighters.

**SPANGENBERG:** Fighters in the fleet. The F8U was still in development. We ran an informal competition. The final McDonnell proposals were gunned airplanes, 4-20s, still single-place and the F3H-G was a J-65 powered airplane. The F3H-H was a J-79 powered airplane. In those days we did not allow an airplane to start until the engine had reached PFRT which is a preliminary flight rating test, fifty-hour test on that engine. If you did that by the time you got to your full qualified engine test you had a production

airplane ready to go. It was a good concept then and would be now. McNamara screwed all that up because he insisted on a total package approach. Couldn't start an engine until you started the airplane and you had to wait for the war to develop before you could do that.

We did an informal competition as it were but without getting formal bids from anybody. We had proposals at the time from a number of manufacturers. Probably the early F4D-2, the design that became the F5D.

**RAUSA:** Sky Lancer.

**SPANGENBERG:** Yeah, later. Was in hand. There was a Grumman proposal that had jet engines plus a rocket in it. That was laying around. We hadn't really done anything with it. And all the McDonnell designs. Those are the ones I remember most clearly.

The F3H-H used two J-79s but as I said we weren't ready to specify that engine yet. The performance of the airplane with two J-79s was excellent. Two J-79s would make any airplane pretty good. Their F3H-G was the same airplane but with J-65s, a much lesser engine. And it was a lousy design I thought.

**RAUSA:** Did it look like the F-4?

**SPANGENBERG:** Yeah. More or less.

**RAUSA:** It just looked unorthodox, didn't it?

**SPANGENBERG:** The F4H as it started didn't look quite as strange. Didn't have the droop tail yet and the wings didn't have the broken wing look that they eventually developed. But it was a single-place airplane and armed only with guns. But a hell of a lot of pressure from the industrial statesmanship side of the Navy organization, as well

as from McDonnell saying we have to have something to keep the factory going and so on and so forth. I remember writing the memo, it's back there in Navy files somewhere, that the only way you could possibly justify the F3H-G was to buy it as a stepping stone while you awaited the arrival of the J-79s which as it turned out is exactly what they ended up doing. And manipulations that I wasn't involved in ended up then with them giving a contract to McDonnell for the AH-1. Lo and behold it had become an attack plane. An afterburning twin engine single-place attack plane. A type that didn't exist in any plan that I knew anything about. Short on range. Very strange and I don't know how it all happened. After about I suppose six months there was a big reconfiguration study and the airplane then was changed over to that which we know today. Became a two-place airplane, no guns, except in a pod and armed with four Sparrows as primary armament with a fair amount of emphasis still on the air-to-ground mission.

**RAUSA:** In other words you were thinking in terms of a fighter/bombers not just a fighter.

**SPANGENBERG:** All of our fighters have been fighter/bombers. They ended up that way. They started as fighters. If they were good they had enough capability to carry bombs, F6Fs had always done it, F4Us had done it. I think everything had done it. We hadn't had any pure fighters. The only one that stayed pure I guess was the F-8.

**RAUSA:** I think they did some bombing with the F-8.

**SPANGENBERG:** Probably shot rockets with it. I guess you could rig up bombs somewhere.

**RAUSA:** On the in-board wing maybe.

**SPANGENBERG:** But it stayed purer than most. Anyway, the Class Desk officer, I think Charlie Smith started the thing.

**RAUSA:** Was Julian Lake in there somewhere?

**SPANGENBERG:** Julian was probably in electronics at the time or he had been anyway.

In the early development part of the game C.B. Smith or maybe Frank Timmes was the first project officer. Anyway, the big hassle was could we afford to get guns into the thing in addition to the Sparrows and we couldn't afford that extra thousand pounds and still get it on and off the boat. It ended up without guns and was the two-place configuration.

**RAUSA:** Did that bother you?

**SPANGENBERG:** Making it two-place?

**RAUSA:** Not the two-place but not having the guns?

**SPANGENBERG:** Well, I think all of the operators wanted guns in it but when it came down to the crunch you either had an airplane without guns that you could operate, or it looked like you could operate, with the arresting gear and catapults we had on the ships or you didn't. There was not a hell of a lot of "growth" in the airplane. We didn't have any big margins. In fact that was probably the most critical time then and a little bit later when we had the F4H, the A3D and the A3J—it became the RA5C. Those took up more catapult and arresting capacity than the airplanes since then. I remember writing a paper on that, doing a study of some kind. Answering a query from Ships Installations where

do we go from here? How much bigger do we have to keep making these things?

Aerodynamically it looked like it would be about at the peak there and I guess we were.

Anyway, the F4H then got changed from the single seat armed, gun armed, lousy, underpowered airplane to a well powered two-place missile carrying airplane and it became the fighter for the fleet. We didn't get the final radar until five or six years later but that was in the works too. Everybody had reached a conclusion then that you had to have some kind of a missile capability, that guns alone just wouldn't hack it for the high performance threat against the fleet. So it marched on.

About a year later the advocates of single-place single engined airplanes rose again and we started the F8U-3 as a competitor to the F4H. Both of the airplanes were laid out as production programs. The F8U-3 was modeled after the F8U-1. That is, you learned to use the aerodynamics of the F8U-1, and put the big engines, the J-75 engine in it. It was a Sparrow-armed airplane too. Again without guns. Vought did a superb job. The cliché after 1958 was that the F8U-3 was the best airplane we ever cancelled.

**RAUSA:** So the F8U-3 lost out to continued production of the F4H.

**SPANGENBERG:** Right. Both airplanes were scheduled for production and were designed with superb programs. Vought did a better job in development than McDonnell did. They started perhaps a year afterwards and flew at almost the same time, first flight. And then Vought did a much better job of fixing things up that showed up in flight test. In 1957 Congress was screaming. We had to cancel one. Up to that point in time the Navy had never had less than two fighters in production at the same time. Jim Russell was Chief of the Bureau and he testified that we can't afford to ever get down to having our

fleet defense dependent upon any one engine or any one airplane. If you have a bad episode with one and have to ground the airplanes or the engines you didn't want the fleet without some capability to defend themselves.

**RAUSA:** Vought must have been very bitter about that.

**SPANGENBERG:** Later they were. They were obviously extremely disappointed. It was just one of many disappointments for Vought at about that time where the Navy was really getting itself into a money crunch. But in 1957 Congress told us to cancel one. We ran a big paper evaluation. Neither airplane had reached flight status, and finally got Congress to delay it a year. By that time we had flight tests by PAX and could make sure that our paper estimates were all right. In the normal sense the F8U-3 won the fly-off. It had by far the best flying qualities. It was the best flying airplane, best flying fighter at least that the Navy had ever developed according to the PAX reports. Good flight control system. It carried only three Sparrows instead of four as a compromise in trying to get the best airplane. It would do everything on internal fuel that the F4D did with a 600 gallon tank. It had better legs. It had higher speed. Climbs were about the same. Ceilings were about the same.

**RAUSA:** Then why did McDonnell win? Was it a political decision?

**SPANGENBERG:** No. It was one-place versus two-place. At the time there was a growing conviction in the fleet that you needed two guys to do the all weather fighter job. There was a big all weather fighter conference at Patuxent and they came out with "a unanimous report." I can't believe that of Navy fighter pilots.

**RAUSA:** The fact that it had two engines, that was important to you.

**SPANGENBERG:** That was incidental in my opinion but it was an advantage. People would prefer two engines to one engine as long as you didn't pay too big a penalty. But the one-man, two-man decision was primary with the feeling that one man under good conditions could do the job. You had about a twenty percent advantage of cost with the F8U-3. But under the real tough conditions where the studies were done and presented I guess at that fighter conference and I know that were being done in the radar community, the F8U lost out. The kind of radar detection ranges we had, the conversion from when you first saw the enemy to where you could get in a position of launching missiles, it came down to the difference of two radar sweeps that made the difference between success and failure. You sure had a hell of a lot better chance to do that with a radar operator, meaning two-man.

Later the decision for two-man was almost universally accepted. Some of the biggest proponents for single-place, white scarf flying, fighter days came back after they had an F-4 squadron in the fleet. I remember distinctly talking with a bunch of Israelis, I can't remember the fighter pilot's name, but he was known as the king of single seat fighters. Hell of a nice guy. But anyway, I said, "Commander so and so won't agree with me but I thought the right decision had been made." In fact I wrote that in that F8U-3/F4H evaluation memo: "The day of the single seat fighter is over. Let's not make this mistake again. To develop a whole airplane around that concept, have it turn out to be a better airplane and then not buy it. We shouldn't do that again." Anyway, we were talking to the Israelis, and they brought up one-man versus two-man, they were probably getting ready to buy F-4s at the time. When I made the statement the Commander said,

"I don't disagree." He said, "having that second guy in back, radar operator, is just like having a wing man who doesn't get lost." Even in the air combat arena that second guy was worth his weight in gold. So as far as I was concerned I thought that the decision had been made in perpetuity that we would go with two-place. And it was of course then for the next twenty years until the F-18 came along.

Those were tough times. It was tough for Vought. I guess I didn't mention when the F8U-1 was selected one of the big "disadvantages" of Vought was that the fact that they had just screwed up the F6U or should never have started the F6U and then the F7U was anything but the world's best airplane. So there were a lot of people that said don't give Vought another one. But it really proves that you have to make a decision on the basis of the design proposals in front of you and not on the record of what they did the last time because every one of the manufacturers has screwed up at one time or another. And in fact if they're about to go out of business they'll do a lot better job for you than the guy that's sitting there with two or three projects on the back burner while the first team works on the one that is further ahead. That's some of my philosophy. I don't think it's worth talking about it any more.

T-34 was an off the shelf type of deal. It was interesting in those days for me, a non-aviator, to listen to pilots talk about their early training and what they wanted to get out of it. They didn't want a very complicated airplane for primary flight training. They really wanted the wind in the face feel, and so you would learn to enjoy flying as opposed to having a complicated procedure that you worried about all the time.

**RAUSA:** But the T-34 had already – wait a minute, what year are we talking about?



**SPANGENBERG:** It's '55.

**RAUSA:** So they just started coming in.

**SPANGENBERG:** We talked about the F8U-3 where the actual start was in '56. There was the HU2K Kaman's entry into a major fleet requirement for the first time. And that was a competition which I thought and Pete Brown, the rotary wing desk officer thought that Vertol had won the competition. Tommy Thomas was the aircraft division officer at the time. He had been involved in the AD and the A3D and the A4D. Good friend of mine. But he was also a good friend of Charlie Kaman. The Kaman helicopter as proposed had a very wide blade rotor system. Our aero and structures guys didn't think that it would work. They were going to have a bearing-less rotor, using technology from the oil well drilling experience or something. Tommy won the argument on who won the competition and so they bought the thing from Kaman. It was the highest speed helicopter we had at the time but the rotor system got changed to a more conventional one and that oil well experience was dropped.

**RAUSA:** Was it a prelude to the Sea Sprite?

**SPANGENBERG:** It was a Sea Sprite. It started as the HU2K. It had a long successful experience but we thought, Pete Brown and I, that Piasecki won the competition. I still think they did. [laughter]

The TT-1.

**RAUSA:** The Temco Pinto.

**SPANGENBERG:** And the T2J. The T2J came out of a big training study done at the time. Getting a new basic trainer. It was a well thought out study in a well laid out

procurement plan to buy the T2J. Enough airplane work at the study level had been done.

**TAPE 9 of 16, SIDE A**

**RAUSA:** You had just said that North American won the competition.

**SPANGENBERG:** Won the competition. It was around a J-34 engine, single engine airplane as it started and went on for a while. T2J-1 was redesignated as the T-2A. It was a successful development and it's had a long life. We're still flying T-2s. The twin engined T-2B with J-60 engines followed after a couple of hundred T-2As.

At the same time at the very last minute Temco had been trying to sell that silly little TT-1 thing as a jet primary trainer. OPNAV approved the plan as an adjunct to the T2J and we bought a dozen or so for tests as primary trainers. We hadn't done our homework, studies hadn't been done and the bureau was scarcely involved in the decision.

**RAUSA:** Where are they located?

**SPANGENBERG:** At the time they were down almost next to Vought in Dallas. You remember later that they became Ling-Temco Vought (LTV). Ling was a financier type, and the owner of Temco.

**RAUSA:** Well we actually bought some Pintos, didn't we?

**SPANGENBERG:** Not many, shouldn't have.

**RAUSA:** They went into production or we just had some experimental?

**SPANGENBERG:** It may have been a production program right from the beginning but it was a slow buildup type and we didn't buy very many (14 total).

**RAUSA:** What was the main problem? Was it underpowered?

**SPANGENBERG:** Grossly underpowered. You went through a mud puddle and it flamed out the engine. Literally.

**RAUSA:** Did we hurt some people in that era?

**SPANGENBERG:** No. Eventually the guy that's now president of Gulf Stream, his name was Paulson, big promoter. He later bought some of those TT-1s and some years later did a demonstration out at a Dulles air show. He was trying to sell an upgraded version to the Navy. He was unsuccessful, and we didn't buy the scheme. He had a few of them flying around. He was trying to sell it commercially and to any military training outfit that was willing. When he flew out here at Dulles he tried to do a high speed dive and pullout, but the canopy came off, hit the tail. I don't know whether the pilot got out or not but the airplane crashed.

**RAUSA:** Before we go any further, with respect to yourself George has your title changed over the years? Are you still the weight guy now?

**SPANGENBERG:** The weight thing for me was always incidental. I did the weight estimating but I did not run the weight control program and after World War II we had competent people in the weight group that did weight estimates. I continued to do some of my back of the envelope thing just to satisfy myself that we were always in the right ballpark.

**RAUSA:** What was your title at this time?

**SPANGENBERG:** I had lots of titles over the years. I became "Director, Evaluation Division" in 1957; before that I was "Assistant Director." But I was also in Contract Airplane Design all during the period when I was involved with approval of drawings and that kind of stuff. And running the competitions was also Contract Airplane Design responsibility.

**RAUSA:** So you're dealing an awful lot with —

**SPANGENBERG:** We were looking at the whole airplane from the time I went to Washington. I would not have come to Washington looking at a piece of the airplane. I would rather have gone to industry or stayed with NAF where you had a better feel. I didn't want to get into details such as only ejection seats, or only powerplants. In fact the powerplants is worse than that, it could be only development of engines or development of intake systems, accessories or fuel tanks. I didn't want that. So I've always been a "generalist." That's a guy who knows less and less about more and more until he knows nothing about everything. But I knew enough about all of the disciplines that I could talk to our performance people, the flying quality people. I could talk their language. I had more trouble talking the electronics language so I really had to depend a lot more there on the people I knew from their reputations and their experiences. I depended upon them. The Puckets and the Plunkerts and Chuck Francis when he was down there. To a far greater degree than I had to in the airframe part. I could argue with a structures guy. To a degree I could argue with some of the aero guys though I really depended upon them for specific performance numbers and flying qualities.

When we ran a competition, for example, or any time during the program I probably had more to do with what the performance guys were working on than did their division director because we would get requests from CNO or from the Secretary of the Navy. We had one from Kissinger, "Kissinger Wants to Know," when he was national security adviser. It took a big study to get a lot of performance data, and of course, he wanted it immediately or sooner. Our Assistant Chief had let me often control the workload of the performance people. If I told them it was more important to do the design competition than it was to get the performance chart out on some airplane they would shift their priorities and all work on the competition.

I believe I also had a very close working relationship with all those working level guys in our technical community. Unlike too many, if I wanted to find out something from the performance group I walked down there and talked to them and they would come up and talk to me. When we'd have a "fire drill" at night often the performance guy working on it would come up to my office, we'd sit down and do twenty or thirty radius problems, for example, to satisfy some congressional request or something. So I was kind of coordinating the airframe part of the game.

You really couldn't differentiate some of what I did from what a class desk officer's job description said. We worked very closely together. Each understood the other. The working level really understood the whole system better than our Assistant Chief did.

Adm. Schoech never did figure out what I did and what Fred Gloeckler did. He would telephone me and I'd run down to his office and he'd give me a job. At first I would tell him this is really Fred Gloeckler's job. He did the same thing to Fred. Finally instead

of doing that, going back and telling him, he'd give me a job and I'd give it to Fred if it was Fred's. Fred would give it to me if it was mine.

**RAUSA:** Was Schoech BuAer or Assistant Chief?

**SPANGENBERG:** He became Assistant Chief of the Bureau, but at the time I was talking about he was Assistant Chief for R&D.

Schoech went from R&D assistant chief out to the fleet, the 7th Fleet I guess, and then when he came back he became assistant chief.

**RAUSA:** Eventually he became OP-05. I think his picture is on the wall there.

**SPANGENBERG:** Could be. Yeah, he was. He was OP-05 for a while. He was also CNM. He was our first Chief of Naval Materiel. Schoech was a wonderful individual. We always said he couldn't spell his own name. We all liked Schoech. Schoech always supported his working level guys. You never had any question but he'd be on your side. If we were going to argue with the Air Force, Schoech could always be depended upon to support you. When Gelantin took over for Schoech you couldn't always depend on him. He didn't back up our numbers. We got into serious trouble during F-111 days. What he did in a big meeting with McNamara's crew was to substitute his judgment for ours. We had Navy numbers for the performance of the F-111B. We also had contractor numbers for the performance and we had Air Force numbers. Air Force numbers were always just a little bit worse than contractor numbers. Our numbers were a lot worse. Gelantin said, "Well since the Navy numbers are under the contractors numbers and the Air Force is in the middle we'll believe the Air Force. And that was wrong. And we knew

it was wrong because we knew the Air Force numbers were not those of their own performance analysts. God, I was angry.

**RAUSA:** Still are.

**SPANGENBERG:** Yeah. The working relationships between the civilians and the military, it's a two way street. If they were going to respect us or expect us to respect them they've got to respect us and in my experience we never had a problem. I shouldn't say never but 99 1/2% or so. Naval officers and civilians got along very, very well. Far better than in the other services.

Well, back to our models. A3J came along after the T2J. It was a fairly closely held beginning of a program.

**RAUSA:** Was it originally slated to become a nuclear model?

**SPANGENBERG:** The thing that started it was a continuing series of studies of North American on a thing they called Nag Paw which was a subsonic low flying airplane, attack airplane. They carried on with that, it must have been for a year and never got to the point that it sold. Suddenly, suddenly to me at least, the supersonic version of Nag Paw arose, directly from North American. Linear bomb bay, God, we had never even heard of a linear bomb bay.

**RAUSA:** What is a linear bomb bay?

**SPANGENBERG:** You eject the bomb out of the rear of the airplane. Just have a long tunnel. When you pushed the button the bomb ejected backwards at roughly the speed of the airplane.

**RAUSA:** Was that for a horizontal delivery?

**SPANGENBERG:** Right. And it eliminated the problem of opening bomb doors at supersonic speeds which had not been very successful. It hadn't been very good at high subsonic. We had trouble – most airplanes had trouble – we had trouble getting bombs out of the A3D initially. Then they finally put a deflector plate or something that cleared it up. The supersonic guys were having trouble, that were trying to solve the same problem. So this was an answer to a single problem. You got kind of screwed up with what to do with drop tanks and the drop tanks finally got stuck on the end there and you ejected those before you ejected the bomb.

The A3J program started with – as far as I was concerned, it kind of arrived on the scene. The OPNAV officer was Roy Eisner, later head of Patuxent. A very emphatic strong-willed guy. He was convinced that unless we had a supersonic nuclear delivery capability that naval aviation would disappear. It was one of those time spans again. And so the airplane was really justified by others. We evaluated it to make sure that it would go on and off the boat.

**RAUSA:** It was a beautiful airplane.

**SPANGENBERG:** Best looking airplane we ever did.

**RAUSA:** Two engines.

**SPANGENBERG:** Twin.

**RAUSA:** Did they have a BN or RIO in the back? All you had was two little windows back there.

**SPANGENBERG:** The bomber did have a 2-man crew. Eventually it became the reconnaissance airplane, with a reconnaissance capability orders of magnitude better



than anything we had been able to do before. We always had photo versions, probably every one of the fighter airplanes.

**RAUSA:** So it was better than the F-8, better than the Crusaders?

**SPANGENBERG:** Oh, yeah. It was orders of magnitude better. Bigger cameras and electronic reconnaissance means incorporated as well. And in connection with that development they did that reconnaissance capability aboard ship. It became a separate unit unto itself. From an airplane's standpoint, the airplane had all kinds of troubles. Detailed little problems had been going on in North American for a long time. I was never sure exactly why. They appeared not to have enough designers that had made mistakes before. They were making them all for us. The AJ-1 was a prime example. They put the hydraulics on top, electronics on the bottom so the hydraulic fluid leaked all over the airplane instead of putting it on the bottom where at least you could put a drain hole in and let it run outside.

The linear bomb bay caused no end of problems. A lot of the wiring and stuff had to be wrapped around that bomb bay if you had engines on the two sides so you didn't have good access to places to put things in the fuselage. Eventually it devolved into a reconnaissance airplane. They attempted at the end of the line – we had a J-58 engine program going which was to be a Mach 3 engine, bigger than the J-75 and the proponents of the RA5C attempted to get that next step and eventually to compete with the SR-71. And they did studies but the Navy just couldn't afford it. However, our J-58 engines did go into the SR-71. In the meantime along the way on the A3J they decided

to give it a super performance capability and they played around with putting rockets on the airplane so you got a very high performance capability for a very short length of time.

**TAPE 9 of 16, SIDE B**

I think John T. Shepherd was the first project officer on the airplane and he has remained a close friend for a long time.

**RAUSA:** This is the Vigilante now.

**SPANGENBERG:** Yeah. He was the project officer at the time that they were doing this rocket engine installation and my first experience with him was not very satisfactory. I had written a memo after getting some performance checked and we figured that with the radius of the airplane we were going to be lucky if we got to the outer ring of destroyers [laughter]. The super performance rocket just took up too much fuel. But soon we became close friends.

And we put the radome on top of the WF. The design began on the old S2F. We got our first early warning airplane. We had the AD-5W before that.

**RAUSA:** Whose idea was it to put the dome on the top of the WF-2? Wasn't it the first aircraft to have a dome on top?

**SPANGENBERG:** It was I guess.

**RAUSA:** Did that come from industry or from the Navy? The Super Connie had a dome. Maybe that was first. Did that bother you having a big dome up there for aerodynamics?

**SPANGENBERG:** Nobody liked it but it was better than putting it on the bottom.

Actually, the radome was so large it had to be on top. I think we had tried out the

scheme on a TF before doing the real thing. We anticipated problems. I think it actually turned out to be less troublesome than we thought it would.

The next year, '57 now, we started the A2F which became the A-6 and that's covered in that *Wings of Gold* article. If you believe in long-range planning, boy, that's not the way to do it. The plane came out of a Marine requirement for very short field takeoff with a couple 500 pound bombs and a 300 mile radius. The Congress would not approve the program for the Marines alone so the Navy had to think up a mission. The Navy thought up a long-range mission, lots of drop tanks and 750 or 1,000 mile radius, something on that order. And the combination really worked out very well but it's sure not any justification for spending a lot of time on long-range plans. The original airplane had tilting tail pipes, which could be deflected maybe thirty degrees in order to get the thrust component acting to help offset the weight of the airplane, increase the lift and give it an STO capability.

**RAUSA:** For the takeoff and landing evolution.

**SPANGENBERG:** Right. Eventually they disappeared from the production program but the program started with those tilting tail pipes for a long time. The early airplanes also had problems in slowing down. Well, the first problem that came up was the drag turned out to be higher than Grumman had estimated and after we had evaluated the thing at the competition time they had to put more span on the airplane which helped the airplane. And then later they had to put those wing tip speed brakes on to solve the "slowing down" problem and they worked out well. The early speed brakes had been inadequate. The electronics gave us all kinds of trouble in the early days and strangely

enough a lot of it was just plain connectors. Nobody had anticipated the degree of service problems that you got trying to put those sixty pin connectors together and that led eventually to all the potting material problems and whatnot that we got later on. The airplane itself obviously was a great success. The Marines dropped their short field requirement and the airplane eliminated tilting the tail pipes. But the basic configuration gave good low speed characteristics, and was easy to fly. Everybody liked to fly it apparently. You could get lots of excess wind over the deck for coming aboard and taking off. The airplane obviously had lots of growth potential. But having started it with that requirement for four drop tanks and a big bomb to do that long-range Navy mission we had enough store stations to handle the growth of the airplane and enough capacity in those stations. Successful airplane. I won't dwell on that. Everybody knows it.

The next one on the list is a VF/VTOL which I did not talk about before and eventually we ought to talk just one session probably on it or I'll give you some of the VTOL papers that had been written over the years (*ed: see the "V" Exhibits*). The VF/VTOL was a jet powered airplane that played around initially with a jet powered tail sitter similar to that Ryan type in the studies. We ran a competition. It was ridiculous. We should not have run a competition. It was not a firm requirement. It should have been labeled as a research airplane if we wanted to do jet VTOL. It eventually ended up with — we invited twelve people to bid, only two bid. In those days industry was pretty honest with us. If the Grummans and the Voughts and the Douglasses weren't bidding, that was a good signal there was no potential in the procurement. In this case we asked twelve guys to bid. We got bids from Bell and from Ryan. I think Ryan proposed the Wire Hanger kind of a thing but I really don't remember. Bell proposed a lift engine

arrangement. It had two J-79 flight engines and nine lift engines arranged vertically in the fuselage in between the two J-79s so the pilot only had to contend with an eleven engine contraption. It was awful. The memo we wrote from the competition was don't buy anything. The VTOL clan however declared Bell to be the winner and we'd negotiate something else. So for about six months they played around with the concept that eventually the Air Force took over. It had engines on the wing tips which rotated. Two engines on each wing tip.

**RAUSA:** The XVTOL.

**SPANGENBERG:** Well, we called it the VF/VTOL at the time. It never developed a designation because we never got to the point where we thought we were really going to buy it.

**RAUSA:** Is this the one that did go on and make some carrier landings?

**SPANGENBERG:** No. The Air Force took it over and developed it and they've got a number for it, somewhere in the VF series, F series, somewhere there's that contraption. It had tilting nacelles on it. Jet engines on the tips. I want to say J-79s but it seems like that's too much to have four engines. I'm remembering a four engine – anyway, it didn't go anywhere like most VTOLs have no place to go except for research which is fun to do because you like all the advantages that you might get some day.

**SPANGENBERG:** Then we did the Mohawk, the OF. This was a joint program with the Army. In those days the Department of the Defense would not let the Army do any development so when the Army wanted to start a new program they had to shop either the Air Force or the Navy. Most of the time they seemed to end up with us, with the

Navy that is, because we didn't charge them anything for getting involved. It had to become a joint airplane for budget justification reasons so the Marines and the Army got together on a joint requirement. The main thing that it provided was side-by-side cockpit with enough power. It was a pretty good flying airplane. It had enough capability to do the bird dog job a lot better than other things were capable of doing. We were still flying the Cubs, the OEs and so was the Army. The Air Force really wasn't flying anything in those days for that mission.

I still remember the Marine guys arguing with the Army guys on whether it should be side-by-side or tandem cockpits and some of the same argument had gone on at the early days of the A2F.

**RAUSA:** Which do you prefer? Depends on the aircraft?

**SPANGENBERG:** It depends on what you're trying to do. The fighters I thought had to be tandem just for aerodynamic reasons. The subsonic stuff, the advantages of hand motions and communication without having to depend upon the ICS I thought were generally overpowering and during one conference one of the Marines, obviously one of the sharp Marines – we were working in a working environment where we had partial bulkheads and the guy went over into the next room and then tried to be a part of the conference. He could hear but he couldn't see. It was a very dramatic way to prove that you're better off sitting at a conference table than have guys on opposite sides of a bulkhead without any visual stuff going on.

The airplane was a great success. The Marines dropped out of the thing in order to buy C-130s for tanking.

**RAUSA:** Are we talking about the Mohawk now?

**SPANGENBERG:** Yeah. We the Navy had done an excellent job of providing a useful airplane to the Army for close support. The Army could not put bomb racks on an airplane because of the Air Force/Army fight about who does what. The Air Force had not done adequate close support for the Army at any time, according to the Army. They did their version of close support which was anything but what the Marines call close support. In developing the airplane we had some 600 pound resupply containers which we put on wing stations. We got as far as testing the airplane with firing the guns and dropping bombs from those resupply container stations. Patuxent cleared the airplane and at the last minute the Air Force found out about it and prohibited the Army from ever using that capability. We thought we had foxed the Air Force and given the Army a close support capability not as good as they could have had if they had bought some Navy airplanes or had been allowed to by the Air Force but the Air Force seemed very jealous of that. And then we got out of the program and eventually the Army took over. The Army normally took over management after the development because they were allowed to buy "off-the-shelf" airplanes.

We did a P6Y which was the last of the seaplane projects and that was an ill considered requirement to have a huge dunking sonar from an open ocean flying boat. Convair won the competition with a three engine airplane. Had lots of boundary layer control so it could land at maybe thirty-five or forty knots in any kind of sea state. It then did the ASW mission by hopscotching across. You'd land, dunk the sonar, pick the sonar up, take off and whatnot.

**RAUSA:** This was all jet?

**SPANGENBERG:** No, props, I think. I think it was turbo props. The old seaplane hands were not happy with this concept. They could only foresee very, very seasick crew members among other things and trying to land in sea state six or seven with an airplane even if it was going slow is a very dangerous kind of operation. We ran the competition, got the airplane and it would have been a very successful low speed short takeoff kind of flying boat, probably with a fair degree of payload capability as you would operate it maybe on a commercial basis but the requirement went away very quickly with the budget crunch and they stopped that. Thank God.

Maybe we can do the E-2 and we'll be through with that year. That started as a W2F. It was the only competition that I was involved in that I thought was dishonest. The winner didn't win. Vought won the competition. It was a replacement of course for the WF-2. Bigger radar, whatnot. Vought came up with the idea of the retarded wave antenna which allowed a thinner radome, much thinner than the WF-2. The Vought arrangement had the radome light enough that they could locate it at the tail of the airplane so it looked strange. But all the wind tunnel tests were excellent. The performance was excellent. The weight, cost, flying qualities, everything. They won the competition. The original Grumman entry was a conventional radome with the dish rotating within it. In those days we wrote a memorandum winding up a competition, signed by our Assistant Chief to the Chief and via all the other Assistant Chiefs. There had been agreement. "Okay, Vought won, we're going to go ahead", and that's what the memo said.



I went on vacation and while I was in Hartford with my family, I picked up the paper and lo and behold the Navy announced Grumman was the winner. I came back after the vacation to find out what had happened? Why? And it turned out that the head of the production division said Grumman is running out of fighters, the F9Fs were through. They were too far away from the A2F to be satisfied with its production. So he said Grumman needs the work and they ought to get it. The total Navy buy at the time was something that was programmed at seventy airplanes. Well, from my standpoint I didn't see that the Grumman production problem was going to be solved by the E-2 by any means, what they were looking for then was hundreds of airplanes.

**RAUSA:** Are you saying you favored the Vought proposal?

**SPANGENBERG:** Oh, yes. Everybody did. It was the winner of the competition. Hands down I thought.

**RAUSA:** So that was a political thing.

**SPANGENBERG:** That became industrial statesmanship as it were. I was very, very upset because I thought we had a system that worked and it worked because we were honest and this I thought was dishonest. I pointed out to my boss, Mr. Frisbie, who apparently had gone along with this thing because the Chief, or the Assistant Chief or somebody said to. I think Adm. Schoech was the one that backed down. He was our Assistant Chief at the time.

**RAUSA:** Had you not gone on vacation could you have made a difference?

**SPANGENBERG:** I think I would. I would have raised hell. When I got back I got told to go pick up my memo. I said, "You've got a signed and approved memo that's in the

system and here you're giving the contract to another guy." So I got told to go pick the memo up and I refused. I wouldn't have anything to do with it.

**RAUSA:** You had already submitted it.

**SPANGENBERG:** Yeah. Schoech had signed it. So it had gone through the system and had been approved. Finally they got one of the further down the line guys at that time, Charlie Butt, who later became Head of the Proposals Branch. Charlie got told to go pick up the memos and destroy them. So Charlie went and picked them up but he didn't destroy them all.

**RAUSA:** But the decision was made above Schoech then. He was told to approve that.

**SPANGENBERG:** Well, the Assistant Chief for Production went to the Chief of the Bureau, whoever that was at the time, and convinced Schoech that industrial statesmanship should win the game.

**RAUSA:** So it was a Navy decision.

**SPANGENBERG:** Yeah. It was done within the Navy but I thought it was dishonest because I said the least you can do is to say to Vought you won the competition and we'll pay you for your efforts or something like that. But for other reasons – this was what we'd done on the PBB years before when again Vought had won the competition and they decided they needed another producer in the seaplane field but they announced that Vought was the winner, paid him for his proposal work, turned the work over to Boeing and then Boeing submitted another proposal that we eventually bought. And I thought they should do the same thing.

**RAUSA:** But they didn't.

**SPANGENBERG:** They didn't.

**RAUSA:** The Vought guys must have been furious.

**SPANGENBERG:** I wouldn't debrief them. I wouldn't tell them why they lost and the word got around.

**RAUSA:** But you knew those people well.

**SPANGENBERG:** Sure. They knew they had won. The retarded wave antennae gave them such an aerodynamic advantage and no one else had it.

**RAUSA:** And what this translates to was a thinner dome —

**SPANGENBERG:** Eventually that technology went into the E-2. But that technology was in the Vought proposal, it was not in the Grumman proposal so Grumman redid their proposal eventually and picked up the Vought technology.

**RAUSA:** In other words Grumman had more friends in the bureau than Vought.

**SPANGENBERG:** I think that the production chief's decision was wrong because it didn't solve the problem he was trying to solve and it screwed up our 100% record of being honest in my opinion. You'll find that I've written this in some of these presentations I've given. I thought that we had an honesty record that I called 98%. We lost a couple of percentage points because of the overturning of that decision. Other ones got overturned but we couldn't help it. The Bell X-22 got overturned outside the Navy. The PBB1 flying boat one was handled honestly. The F-111 I didn't count because it was Air Force management and it was overturned outside the Navy. I've got a letter still from I guess Detwiller, then at Vought, to Jim Russell saying what the hell do we do

now? Do we still play the game? Do we get into the next competition? Are you going to tell us whether we have a chance and so on?

**RAUSA:** That must have been frustrating as hell.

**SPANGENBERG:** Oh, it was and Vought ended up in deep trouble. The F8U-3 was being cancelled. The Regulus program was being cancelled and one other thing down there. Anyway, they were really in more trouble than Grumman.

**RAUSA:** Is this a good point to stop for the day?

### **TAPE 10 of 16, SIDE A**

August 1, 1990

**SPANGENBERG:** Okay, we're now about at the '58 - '59 time period and we kind of skipped over but in '57 Mr. Frisbie retired, my old boss, and I became the director of the division. Gil Weiss who was then head of the weight group moved up to assistant director. Keith Dentel took over the weight group. That basic arrangement lasted up until around 1970 or so, when Gil Weiss retired (as soon as he could at age 55) and Keith Dentel then moved into the assistant directorship.

Back to the airplanes. In '58 we started the P-3 and I won't dwell on that with an off-the-shelf airplane basically with a follow on to the P-2 series, P2V series. Then in '59 we started the Eagle/Missileer competition. We did the Eagle and then later the Missileer which was a forerunner of the TFX and of the F-14. The whole development series really started back in '55.

**RAUSA:** Was the Missileer an actual aircraft?

**SPANGENBERG:** The whole thing started with the threat projections being such that it was becoming very difficult to protect the fleet against Mach 2 raids coming in. You had to have something better than we had with F4/Sparrow capability aircraft. All the studies said you just couldn't get there in time to shoot down enough and the surface-to-air missiles just couldn't handle the degree of the threat either. It turned out that studies in the mid-fifties indicated that the state of the art in radar was such that we could do a long-range radar search type of thing and get it into an airplane. Took about a five foot dish to do it. This then led to probably the biggest study effort in the Op analysis field that at least the Navy had done up to that point on how best to do the fleet defense mission. That study was known as RAFAD and out of that came the determination that the only real way to do the job was with a CAP airplane and long-range missiles. It was far superior to trying to do the high speed intercept and so on. With the threat then being projected as Mach 2 kind of performance and launching missiles against you it was imperative that they get stopped or at least well thinned out by one hundred miles out or thereabouts.

At the time we started on that the Air Force had gone the other way and started the XF-12 airplane which eventually became the SR-71, with Mach 3 kind of performance but using single shot missiles. That airplane as you know was a very large airplane, 100,000 pound category and very long, impossible to operate from a carrier unless we got much, much larger carriers. That option of going that way really wasn't open to us and also it was a very expensive way to do it. All those Op analysis studies said that we couldn't get there from here. So Navy sold to the Congress a program to do

Eagle Missileer. Eagle was about a 100 mile missile with mid-course guidance and terminal homing. The missile itself weighed on the order of as I recall 1300 pounds a piece, something on that order. Then the fire control system was being done by Westinghouse. I just mentioned there was a five-foot dish. The Eagle missile and fire control system part of the program started a couple years before the airplane did and the TF-30 engine got started about that time in order to provide the engine and the missile system in time to match the airplane. Our habit in those days was to get the long lead items under way before you did the air frame because really the air frame has a shorter development time required. At the time of the Eagle competition, Grumman had won a whole batch of competitions. They had the E-2 going on, the Mohawk going on. They had won the A-6 competition.

The Chief of the Bureau then was Adm. Bob Dixon and he told Grumman unofficially that he didn't think that they should win the next competition coming up. They were going to get overloaded. Unfortunately, Grumman was really on a roll there. They had done a reorganization, put good guys in charge of all the forward looking programs and had a good crew. Grumman ended up by foxing the Navy by not bidding as a prime but as a sub-contractor to Bendix. Bendix won the Eagle competition and Grumman was heavily involved in the effort.

The Eagle program went along fairly well, well enough that the airplane part of it got started on schedule in 1959. That was a pretty tough competition. It was a controversial airplane in the sense it was such a low performance airplane. It was to be a subsonic airplane, two turbo fan engines, two place side by side and as I said with this five foot radar dish in the nose. The air frame part of the game was really not too difficult

a technical job. It would have been obviously a lot easier than it would have been doing a supersonic type of airplane. That competition then ended with Douglas winning it with a very straightforward design with six missiles mounted on the wings, three on each side, externally. Straightforward airplane.

One of the interesting things out of the competition was a Vought entry which had predicted extremely low missile drag as mounted on their airplane based on wind tunnel tests. What it had amounted to in effect was that they ended up with positive interference drag. Usually you can take the drag of a pylon, the drag of a missile, put the two together and you add another hunk of drag to it for interference. In the case of Vought they were showing that the combination of a pylon and the missiles was less than the total of the two individual drags. Our aero guys didn't believe that and it became a big issue. If they had been right they would have been a more serious contender for getting the award than they were. With our performance estimate they were definitely in second place.

Subsequent to the award to Douglas, Vought turned all their drag data over to Douglas. This was not the first time that this type of thing had happened but it's worth mentioning that in these competitions that the losing contractors if they have something worthwhile in it will normally give it to their competitor in order to get a better plane for the fleet. It's worth mentioning because every once in a while there's a federal program or an OSD directive that we should do "technology transfer" or try to pick the best items out of each airplane and so on. It happens automatically if it's worth doing.

Unfortunately with the Missileer, McNamara's arrival on the scene came along. The outgoing administration did not want to let a full development contract until the

incoming administration approved the program. So we kept Douglas on a low level engineering effort probably under \$1 million to do some preliminary engineering but then left the decision whether to go ahead in May to the incoming administration.

McNamara's crew, as you know, then said the Navy has a new airplane started, the Air Force has a new fighter started called TFX in the Air Force terminology. They're going to fight the same enemy, why don't they do it with one airplane? And the general impression that the working level guys had was the conversation must have been almost that casual, if they're going to fight the same enemy they can do it with one airplane. It later developed into a God awful mess. The whole TFX story has had books written about it.

As a sidelight I guess I read three of the books and in no case did the authors of those books talk to me. Never. And most of them are wrong. All of them are wrong. Parts of the books are correct but the inferences drawn as to why we did things and why we didn't do things are all wrong. The first one was supposed to be McNamara proving to the services that he could wear them down. The military was fighting civilian rule and that wasn't the case at all. The Air Force and Navy were really only doing a technical job that McNamara's crew was screwing up and it was just awful.

**RAUSA:** And this hadn't happen before where you had the DOD staff intermingling into the development of an aircraft?

**SPANGENBERG:** No. Up to that time in my understanding, in my experience what happened, the OSD staff might question you on something but they'd accept the reasoning or the technical input from the services. McNamara's crew just didn't believe



us and they had a bunch of honest to God incompetents. But the outcome of that mess was the McNamara group cancelled the airplane, the Eagle continued into early 1960 and it finally got cancelled I think in May of 1960. So thus ended the Eagle Missileer concept but it set the stage then for the things that came later, the TFX.

I think we ought to skip that then and go back to these other airplanes that were involved because they were a series and they kind of set the stage of the way we procured airplanes in the future. We got into fixed price contracting at about that time. What had really been happening in the development field is that the Navy had the A3J which became the RA5C, the E-2 and the A-6, all under development at the same time using cost plus contracts. The overruns every year on each of those programs was enough that the Navy kept having to cancel out the little tiny R&D programs that are the seed for the future and it was just raising havoc with the whole R&D development because of the overruns on the major weapon systems. In part we thought we had solved the problem before when we went to the FIRM plan, which stood for Fleet Introduction of Replacement Models some years before. We had said then that we will only fund airplanes with R&D funds through the mockup stage and after that it would be production funds. This is starting to sound contradictory so I'm screwed up somewhere on the things that happened. Actually we did do that and then a whole series of airplanes that we did in that 1950 time period were only funded R&D-wise at very small levels and everything else was done on production funding where the big money was and where then you had more flexibility to operate. As an example, the F-4 got started with perhaps no R&D funding. We did it on the tail end of the F3H contract and so on. The A3J, I think something like \$4 million was all the R&D money that was involved.

Anyway, that allowed the Navy to start too many airplanes by getting this windfall when they did the switch over. Instead of having to fund a whole program out of R&D we only had to fund the beginning of it. It allowed us to start in one year more airplanes than we could have under the old rules.

Money was becoming more important in reaching decision phases in our competitions. Up to sometime in the fifties we scarcely mentioned money when we did a design competition. The concept had all been approved with paper studies within the Navy and reenforced by airplane studies by the contractors that gave you a second check on what the designers in the bureau were saying could be done. And then when we got an item in the budget we would do a competition, but we wouldn't fund anything until we really had congressional approval to get the program started. McNamara's crew changed all of that and the change is still causing problems today. Now you must get a program well started before you have any approval on the Hill whether you're going to be allowed to continue it.

The Marines then came up with another requirement, this time for a 4,000 pound payload helicopter which eventually became the CH-46. At the time Sikorsky had in production what we called the HSS-2 when it started and it became the SH-3 in a model designation change. Two turbo props powering the helicopter. It was an ideal size for this 4,000 lb. payload helicopter. The Marines were working closely with Sikorsky, put a rear ramp on the airplane and it was a shoo-in really, that's the way we were going to go. We ended up having a competition, however, and at the time Vertol was flying a civil version of a design that really started back with the HUP. Vertol's design commercially was called the V-107. They were demonstrating it, trying to sell it to airlines for mid-city

airport to the outlying airport kind of transportation or inner city of Washington to Baltimore. In the civil version it was probably about a twenty place, 16-20 place design. Pretty nice flying machine. They took everybody for rides in it. They entered the competition basically against the Sikorsky design. Sikorsky should have won hands down but Vertol ended up by doing an excellent technical job. They too had gotten the Marines up there to have informal mockups and so on all before the competition was held. They ended up with an excellent technical design and then for the cost they ended up bidding fixed price — we were going to buy 200 helicopters. They gave us a fixed price bid based on the fact that at the time they sold us 200 they would sell 300 on the outside. So their average price then was down the learning curve and you averaged out 500 helicopter production and the Navy then got the benefit of an average price for 500 and they quoted it for the Navy's 200 which put it well under the Sikorsky price. And with a better technical evaluation all through we ended up buying the CH-46.

Sikorsky got very unhappy and though we didn't know it at the time they went to Deputy Secretary of Defense Gilpatric and told him that unless they won the next one they were going to be out of business. They just didn't have enough business to continue, applying "industrial statesmanship" pressure before the next event. The next event was the CH-53 and that competition was for a payload of 8,000 pounds, twice the 4,000 pound design payload of the 46 and lo and behold we expected Vertol to win that one based on their Chinook experience. They had the Chinook in production by that time, for the Army. It was a little too tall to fit on the carrier and so they had to do something about reducing its height but we thought that they could save the entire rotor system and transmission, engines and so on and win that one. Well, Sikorsky came

along, did a lot better job on the proposal than Vertol did and underbid them, again on a fixed price basis but we were only scheduled to buy 100 of those so Sikorsky bid fixed price on the basis of 100 helicopters.

**RAUSA:** How did you feel about that?

**SPANGENBERG:** That was fine. It was good for the Navy. The price was not so low but what we thought that Sikorsky might lose money on it but they wouldn't lose a lot and the chances were good that they would sell that design to other people and they ended up doing that. It became the Jolly Green Giant for the Air Force and we ended up buying a good deal more than 100 of the helicopters too. And it became the base for the CH-53D and CH-53E. It was an excellent program.

As I said we finished the competition. We ended up at the end of the road with Sikorsky winning this one and I remember still we were sitting down with — I think Col. Holloway, program manager for the project, and myself and two of the other people that had been involved in getting the final series of briefings and approvals underway. We were outside of the Secretary of the Navy's office. You usually made an announcement on a Friday afternoon late enough that the stock market had closed. That had been mandated beforehand. We were looking through the papers, the file of folders and lo and behold there was a note in there: "Notify Gilpatric before you make a decision." I didn't know about it at that time. Col. Holloway knew about it. It was his note. And he said, "What have I done?" Here we've notified everybody, an announcement is going out and we haven't told Gilpatric, then as I said the Deputy Secretary of Defense. Holloway called the Chief, the Chief called and received authority to continue.

## **TAPE 10 of 16, SIDE B**

. . .so everything worked out all right. God knows what would have happened if the answer had been wrong from the Gilpatric angle. The technical part of the CH-53, it actually used the same rotor geometry that had been on the HR2S, the old twin R2800 engined design – previously our biggest helicopter. Added one blade to it, went from five to six blades on the CH-53 and they also had more or less that same rotor system on a development that they were selling to the French at the time. I forget the designation but it all tied in. Sikorsky always seemed to do a good job of taking previous models and using pieces of them to put together the next program, saved on the development effort and they were using things they had a lot of experience with so usually the results were pretty good.

The next thing that came along and again was an awful mess and one that has lots of lessons in it was something called the Tri-Service Transport. It shows up in the Navy starts as the X-22 because that was the outgrowth of it for us. But the important part really was that which came before. The VTOL issue which since the start of the helicopters has had over enthusiastic advocates always claiming "now is the time" that we can do a full production go ahead with something that will replace, in this case it turned out to be large transports. The feeling had been bruited about in the technical press, and is the kind of thing that still happens. A VTOL advocate will write an article on now is the time for the Navy to switch over to VTOL. In this case, it was a "blue ribbon commission." Unfortunately, the whole effort was classified Secret and the

overclassification as usual screwed things up quite a bit. The technical committee ended up with about six technical subcommittee reports. All of these were well done and technically sound. The summary report was written by the chairman of the committee who was Prof. Courtland Perkins, then head of the aero department at Princeton. Cort is a real nice guy whom I consider a friend, but he's too often overenthusiastic. His Summary Report largely disregarded the subcommittee reports. It said "now is the time." The state of the art is such that we can build a transport-type VTOL that will meet the requirements of all the military services. The Tri-Service Transport was born. The Tri-Service Transport then was just as impossible as TFX was. We were a little ahead of TFX time-wise I think. But it was the same kind of a mess. The Marines had their requirement which was basically the CH-53D requirement as far as number of troops and so on for the fifty mile radius but they wanted it done at 300 knots, about where we are today with the V-22, over thirty years later.

The Army requirement, I can't remember exactly what it was but it was a medium range distance requirement coupled with a heavy lift requirement, probably well beyond the Marine lift requirement. The Air Force came up with an air-sea rescue mission that they would go 750 miles to pick up a pilot that had ditched.

**RAUSA:** 750?

**SPANGENBERG:** Right, radius. Again we had this mishmash of requirements. You knew it couldn't be met by any single airplane. When I was thinking of that – you remember I showed you the source selection briefing and there was a picture of an admiral throwing a dart at a board. You might want to look at these cartoons. These

particular sketches were given to me after the competition. They were done at North American who ended up getting no award in the competition. It should give you a feel for the things that were going on at the time. They actually put it out as a pamphlet and it was widely distributed in black and white form. Why I got these I don't know. I guess they thought I deserved them. [laughter] [ed: see A-2 viewgraphs for several of these]

**RAUSA:** Who drew these?

**SPANGENBERG:** They were done at North American.

**RAUSA:** [looking at sketches] I remember that.

**SPANGENBERG:** [showing cartoons] That was the evaluation and they're looking at the North American entry of the Tri-Service Transport. This next one shows the folding sequence where the tractor pulled it out and it collapses down. The weight problems are solved. The weight guys at North American were all somewhat overweight themselves. I can't remember their names. I told you we would get off with a full load. [laughter] The payload comes out the bottom. [laughter]. I've heard of close support but this is ridiculous. This ain't how it worked out on the simulator. [laughter]

**RAUSA:** These are funny. Weights and measures. 17 times 30 times 50.

**SPANGENBERG:** The meaning of that is the requirement was for the VTOL to operate aboard the LPH-2 for the Marines which was an older converted small carrier. It has a seventeen foot height hangar deck-type. You couldn't be more than thirty feet wide and fifty feet long. This really should have been twenty-seven and a half passing in the hangar deck. An impossible requirement to meet.

**RAUSA:** These are great.

**SPANGENBERG:** The flight handbook doesn't mention it going down. Ah, that's better going up.

**RAUSA:** That's the best one, that last one. Those are precious. Were they ever published anywhere to your knowledge?

**SPANGENBERG:** As far as I know, as I said at the time of the competition they were put out in 8 1/2x11 black and white copies.

**RAUSA:** Those are great. Don't ever lose those.

**SPANGENBERG:** But what do I do with them?

**RAUSA:** If you like I can take them and have them copied on our Xerox machine. We have a zoom thing on it and then I can send it down and make it part of the thing.

**SPANGENBERG:** Go ahead.

**RAUSA:** I'll get them back to you.

**SPANGENBERG:** Maybe you can think of what to do with the originals. They're not going to do me any good.

**RAUSA:** Let me think on that. There's got to be a place that we can get those published because they're funny.

**SPANGENBERG:** And it's an indication of the contractors' look at the problem. It's obvious from looking at those things that they knew they were in a mess, that you couldn't meet the requirement. So they're poking fun at themselves, they're poking fun at the military for doing all this. Actually I thought that it was a healthier relationship we had in those days.

**RAUSA:** You don't poke fun today.



**SPANGENBERG:** No and you should. We got along and the whole country was better off. If the military put out a requirement that was no good, that industry just either looked bad or they raised a howl. And they stopped doing that.

Now back to the actual competition. The Navy got the job of running it by direction. I can't remember how that happened. From my standpoint we were just told that the Navy has a job to be joint with the Army and Air Force and up to this point in time I really hadn't worried very much about joint programs. I assumed that we would kind of all do our own thing and get together at the end. I got a phone call from either the Air Force or the Army people who said they'd like to send some people in to talk about "criteria." I said fine, come on in. I expected a couple of guys to walk in and they ended up with twenty.

**RAUSA:** They came to Washington.

**SPANGENBERG:** They came to Washington and walked into our old W Building, the temporary building we had back of the Munitions Building. I didn't have a conference room set up and my office was about twelve feet square. We all crowded in. It was ridiculous. But I learned then and later really when we got involved in TFX that any place we went with either the Army or Air Force we'd send two guys, they'd send twenty. The program manager of the Air Force TFX was not the world's most experienced, and was not an English major. When he was going to visit he'd say, "We're going to have a visitation." [laughter] I got curious. We looked up "visitation" in the dictionary and it was something like, it had a religious connotation, a miracle, you know. Hordes of people arriving. Back to the TST, we finally wrote a compromise spec, put in the requirements

like they told us to put in, but knowing that it was all impossible. The designs came in and we had all kinds of airplanes. That North American thing that I just showed you, the sketches and the charts with the funnies on them was a four engine, four turboprop tilt wing. Vought also had a four engine turboprop tilt wing. We had a tilt rotor design, twin engine tilt rotors, twin tandem ducted fans. Douglas and Bell had the twin tandem ducted fans and that configuration was the only thing that would come close to meeting the Marine requirement from a space standpoint. You could fold the wing conventionally and have ducts. In the case of Bell, the forward ducts were on the fixed part of the wing and they had aft ducts that tilted. The Douglas design had the ducts not on the wings but on the fuselage and they all tilted. The Air Force had underway a couple of research programs, one of which had been started by Curtiss Wright on their own which were tilt props in a twin tandem arrangement of propellers and engines. That must have been eighteen or nineteen foot diameter props, rotated up and became in essence similar to the ducted arrangement that was good for the Marines but using rotors rather than ducted fans. I'm sure we had the V-22 kind of arrangement in there too. Lots of configurations. All of them were better for one service than another. Those twin tandem ducted fans were the best for the Marines. The ones with big wings, the tilt wing device was best for the Air Force and you really couldn't meet the Army requirement with anything that would meet the other two.

At the end of the preliminaries we agreed that the Army would go do their evaluation, the Air Force would do their evaluation, we would do ours and we'd get together at the end. It was the only competition of this nature we ever had where the winning design by one service was ruled unacceptable by the other two. [laughter]

Proving the ridiculousness of the whole concept, at least on that aspect of it. If you looked at the results it also proved the ridiculousness of the evaluation methods of some of the other services too because the Air Force had actually selected as their winner that Curtiss Wright arrangement which didn't do their mission nearly as well as the tilt wings did and which they themselves said had unacceptable flying qualities. In our system, an airplane that was predicted to have unacceptable flying qualities was dropped from consideration right then and there. You didn't let it add up points in a logistic system or something else and win the competition.

We ended up by going to the Assistant Secretaries of the Air Force, Navy and Army and saying we can't get there from here with this proposal. We told you before we couldn't do it, now we've got proof that we couldn't do it. The Navy position was we will withdraw. Let's let the three services get their VTOL money and do research that serves a useful purpose. The Air Force and Army secretaries said no, we've been told to do it, we'll go ahead.

Eventually we got DDR&E Brown's permission for the Navy to withdraw. At first he was going to make us pay for one-third of the deal anyway even though we weren't going to participate anymore. I didn't mention earlier that in trying to stop the program from going forward the Navy had suggested that now was not the time for a full-scale effort, but it would be worthwhile to step up to maybe half scale since previous efforts in the field had been even smaller scale than that. The final outcome was that the Navy was allowed to take some research money and do a half-scale effort of a twin tandem ducted fan.

The Air Force was given the job of managing the full-scale development. They elected to have a second competition between the tilt wing designs. They selected the Vought design, which became the C-142. After eliminating the Navy folding requirements it became somewhat more feasible. In the original Vought design the folding sequence as proposed was: install an auxiliary tail wheel, tilt wings to 90°, fold propeller blades to plane of the wings, and fold wings aft alongside the fuselage. It was just ridiculous. The North American design was just as bad, as indicated by some of the cartoons. All of the designs tended toward mechanical monstrosities, particularly for Navy or Marine use. I remember I took pictures of the control system in a mixing box of the Grumman proposal which was most complex. There must have been twenty-five bell cranks all within a two foot square area going in all directions. I was trying to convince, not an engineer, but a secretary of the service that this was a pretty complicated kind of device and the chances of it all working were pretty remote.

Five C-142s were built. At least one survived and is in the Air Force Museum at Dayton. It was a great air show airplane (as is the Harrier) but was virtually useless as a military transport. The 1960s was not the time.

We ran a second competition for roughly half-scale models of the two ducted fan designs proposed by Douglas and Bell. Douglas had acquired the rights and/or experience of the Doak Aircraft Company who had been flying a small ducted fan design with the ducts mounted on the wing tips. Douglas was trying to get into the VTOL game for I believe the first time. Douglas then won the competition, I thought, hands down, but didn't receive the contract. It was one of the ones that was on my list of things where the winner didn't win. Douglas had found out that pressures were being applied, I'm not

sure how, and they ended up by giving us a fixed price bid to do the whole works. They would have lost their shirt. They underbid Bell by a little bit but on a fixed price basis while Bell bid cost plus. The engineering evaluation was all Douglas. The decision went up to our secretarial chain. I gave it to the secretaries. I can't remember now whether we went beyond that or not in giving briefings but I know that we ended up with getting called to the Executive Office Building. That was semi-humorous too. We were scheduled to be up there at let's say at two o'clock.

**TAPE 11 of 16, SIDE A**

August 1, 1990 continued

**SPANGENBERG:** We weren't sure at the time with whom we were going to meet. We were told to go up there to that building next to the White House. We sat at Main Navy waiting for Adm. Stroop in his car, probably a program manager and myself and Stroop, except Stroop wasn't there. It was about ten minutes past the appointed hour when Stroop finally showed up and we were, as you might expect, nervous, jumpy. Stroop in his inimitable way said, "Ah, relax guys. They're always late." And sure enough he was right. We got up there and it was Larry O'Brien and Tommy (the Cork) Corcoran that we were to talk to. So we gave them the briefing, said Douglas was the winner and we wanted to go ahead. They then started asking questions and their questions were on the order can Bell build the — yes, they can build it but they didn't win the competition. Well, they went along on this vein. Then they said, "Who has the most experience." Well, obviously Bell had a lot more VTOL experience than Douglas who had none except that

which they had picked up from Doak, at least none that showed in the way of any flying programs.

Bell of course had been fooling around with these kinds of devices for a long time. They had a group up there that were very inventive but they really could never quite get their ideas to practical applications in my opinion. They didn't belong in the same ballpark with Douglas and the Grummans and the Voughts and McDonnells that we worked with but they were always interesting.

Well, as it turned out we got told to let the contract to Bell and we did. Douglas did not protest, although I thought they should have. In fact I urged them to because I thought it was important for the integrity of the acquisition process.

**RAUSA:** Why didn't Douglas want to protest?

**SPANGENBERG:** Well, they were afraid they would make people angry. We were getting into that area where the contractors were stopping any criticism of anybody who might be their customer. We went ahead with Bell. The X-22 turned out to be a good research vehicle. The program cost two or three times what it was supposed to cost. I don't know whether its been scrapped yet. It was turned over to Cornell Labs and became a test bed for checking out flying quality criteria for all kinds of vertical lift machines. So it served a useful purpose. It was more useful than the C-142 was which really contributed nothing to the technology except I suppose it taught us that the way the power controls and the flight controls were tied together just didn't work. A pilot needed to grow another set of hands.

The windup of the X-22 then was after the TFX investigation had started, a staff guy on the Hill got hold of a memo I had written on the TFX decision-making process which mentioned that we had only had two or three reversals in all of our history of the people at the political level changing the decision, the most recent one being the X-22. Well that staff member worked for the Stennis Armed Services Committee in the Senate and he grabbed that and Stennis ended up having an investigation which he conducted rapidly. Got it all over within two or three days of hearings. The X-22 investigation report of course is in the records. They condemned the secretaries for the reversal of the decision unanimously on the committee with the exception of Senator Symington who had been Secretary of the Air Force at one time. And he insisted – his rationale was that the secretary always had to have the right to reverse decisions and make decisions and so on. In my mind he was wrong then as he was on many other occasions. He caused us trouble later on the F-14 program trying to substitute a carrier based modification of the F-15.

In retrospect we were proven right all the way through. Douglas would have done a better job for less money. They would have lost money on the program. Might have soured relations between them and the government, though. When you talked to Heinemann did he ever mention that?

**RAUSA:** I'll have to ask him.

**SPANGENBERG:** I'll skip F-111B again because it's a book in itself. In 1962 the Marines – it seems like the Marines were always coming up with requirements that we spent our time running competitions to fulfill. They had a requirement for a light

helicopter, LHA, Light Helicopter Attack? I've forgotten. Anyway, they expected to buy one that had been a French design that had been flying in this country and to which some American manufacturer had the rights. The Alouette, I believe it was called. Anyway it was a small helicopter. Pretty decent little flying machine but there were too many other designs that were close enough to doing the job that you couldn't do a negotiated procurement on it. So we ran a competition. Bell, Bell South I'll call it, entered the Hughie, HU-1, which had been in production for the Army. It overkilled the requirement by being fifty percent bigger perhaps or something on that order and yet it cost much less. It was already in production so that we ended up by recommending that the Marines buy that and they did. And that then was the start of Hughie production for the Marines. It was another good decision. It was one that gives a lie to the people who think that all the Navy does is do gold plate requirements, run competitions, and do development just for the fun of it. If one can get a better product at a lower price, the services want to do it, at least the Navy did, as much as anybody at DOD, Jack Anderson, the GAO, or anybody else.

Next one that came along was the C-2 and this was done on an ECP. We had long needed more of a COD capability than we had in the C-1. Those kind of requirements however are really at the bottom of the pile when it comes to development money. So the E-2 was coming along and Grumman and the attack class desk working together really came up with a concept of let's do a little bit of a change to the E-2 so we gave Grumman an ECP and they simply put a new fuselage on the airplane. Very simple change we assured everybody. At the time it was a good decision. I was disturbed in



later years that it didn't get replaced. It should have been replaced by versions of the S-3 which we had but we couldn't sell over in OSD.

The next mess in 1964 was a COIN program.

**RAUSA:** Counter insurgency.

**SPANGENBERG:** Counter insurgency. And on my first note it says a ridiculous OSD-sponsored program. It again started with a Marine requirement. How many of these have started with Marine requirements?

**RAUSA:** Most of bummers seem to be Marine requirements.

**SPANGENBERG:** And the requirement for the Marines was virtually identical to the one that started the OV-1 Mohawk in which the Marines had dropped out of in order to use the money to buy C-130s. That requirement was still there. However, there were two ex-Marines then working in OSD and these were very gung-ho energetic – I don't want to insult them too much. They were not aeronautical engineers, let's say. They knew what they wanted but in the classic case they didn't have enough engineering background to know what was possible and what was impossible. And they had the idea that you could build an airplane – it seems to me it was to be 5,000 pounds. It was a low weight – they fixed a low weight and they also fixed a low price. If any historian ever gets this far in looking at it they should research these numbers. It seems to me that they wanted a unit production price of \$100,000 and a gross weight of 5,000 pounds or so. Studies were done up at Johnsville in this case, I guess probably through our research division. I really wasn't involved in the studies themselves but the results kept coming out that they could build a \$100,000 airplane that wouldn't do anything or they could build a 5,000

pound airplane that would do a little bit but they couldn't meet the OSD and Marine requirement with either one.

The OSD COIN people kept adding requirements to the basic Marine list that tended to be ridiculous. They wanted to be able to operate from dirt roads anywhere so they set a span limit of thirty feet which made an impossible kind of an airplane to do all the things you had to do. It had to be very short takeoff and landing. They actually tried to get in a ski requirement so they could operate off of snow and ice. They even toyed with the idea of putting water skis on it. It had to be designed for rough ground. So eventually we ended up specifying a rough field operating requirement and eventually built a rough runway at Patuxent to test the thing with, humps and bumps. That's a harder job than you think. Everybody talks about rough field capability but nobody ever defined what a rough field was and it's no mean engineering task to define that. Again, we ended up – DDR&E finally wrote us a letter that said despite two disappointing experiences with the Navy we're still going to dictate that you run the competition for the airplane. The two experiences were as mentioned that they couldn't get it for a \$100,000 and they couldn't get it for 5,000 pounds.

So we ran another joint competition. And again we had lots of competitors. Everybody entered the thing. And most of them tried to meet the requirement. The Convair group out of San Diego was enamored enough with their design that they started building a prototype on their own during the time that we were still preparing for the competition. This I think was in part a way to try to influence us to give them the award.

The final straw that broke the camel's back on this was another outfit in OSD got into the act. It was from the Aid to Developing Countries part of the Pentagon. They added a cargo requirement to the airplane that was supposed to be used by some natives in South America, to land on the side of mountains with half a dozen passengers or a few thousand pounds of cargo in the rear end. When started, we were looking at an airplane that could have been something like a repeat of the Mohawk as it had been in its early stages before the Army added all its electronic equipment to it and made it into an all weather battlefield reconnaissance design. It could have been a 7 or 8,000 pound fairly decent spotting airplane. In the competition the only one that came close to that really was a Lockheed design that ignored some of the requirements. Unfortunately you couldn't break the rules to say select that one. But it would have been the best airplane for the primary mission because it ignored the cargo requirements.

North American ended up having the best airplane. Lots and lots of questions about the ability to do any single engine work with a thirty foot span and those two turboprops. They went ahead and built it. Convair built theirs also, but on their own. We got as far as flight testing on the North American and it was obvious that it was not a satisfactory airplane, as predicted. So to get out of the mess – by this time we had a joint program office. Capt. Joe Coleman was running the program for the Navy but with a staff including Air Force and Army officers. It was a well run program from the administrative standpoint and as far as I can remember there was no real friction between the services once we got started on it. The airplane was obviously unsatisfactory, so to make it useful we ignored the span requirement, put ten feet more span on it, then it became a forty foot span airplane instead of a thirty foot span

airplane. You could then meet the single engine requirements and flying qualities got much better. It's a useful little airplane. We never bought the 500 airplanes that DOD said we were going to buy and we never operated in South America as far as I know. It was one that again proved that you can't do the impossible.

**RAUSA:** The OV-10 has no connection with that COIN project.

**SPANGENBERG:** That is the COIN.

**RAUSA:** That plane's been around a long time then.

**SPANGENBERG:** Yeah. It started in '64.

**RAUSA:** The Marines are still using it and I don't think they had lot of them.

**SPANGENBERG:** No, they only had a few.

We had a development contract with fixed price options on that, the same way we had done on all the other designs after the CH-46. The CH-46 was fixed price through 200. The CH-53 was fixed price through 100 and the OV-10 was fixed price through 500. Now going fixed price through 500 I thought was a mistake. You shouldn't do that. The burden on the contractor is just too great, even with clauses providing some protection from inflation. My notes say the OV-10 aircraft ended up as usable, despite the OSD added requirements. Another OSD mandated joint service program. The next real success will be the first one. And North American undoubtedly lost money on the contract.

All these contracts did lose money on the early lots of the fixed price contracts. When we bought the 201st CH-46 the price went up and when we bought the 101st CH-53 the price went up and that caused great consternation in Congress. Might as well

tell you the rest of the story while we're here on that too. On the A-7 program, which we'll talk about I guess next, we had a contract through about 200 airplanes. The last lot was for 140 production planes. The airplane was going great. The program manager found some additional money somewhere and wanted to buy another half dozen or so airplanes to add onto that 140. We asked Vought for a quote and they came in. The extra airplanes cost more than the ones already on contract, despite the fact that supposedly you're going down the learning curve so they should be cheaper. Well that caused great problems. You can't sell the idea on the Hill that you want to buy seven more airplanes and they cost more than the ones you've already got under contract. Which then led the programs from that point on to put "variable lot pricing" in all the production options. We made the contractors give us quotes that had what we expected to buy, a normal rate at which they did their basic price setup but then give us quotes on what happens if you buy as few as 50% less or 50% more. As we'll find out later, that got us into real trouble on the F-14 program. We were mandated to buy but half the original lot size, and the F-14 variable lot pricing formula was screwed up. The unit price didn't go up enough if you cut the rate in half, but having it under contract allowed us to cut the rate of production much easier than if say we cut the rate and got told to buy half as many but with the unit price increasing by thirty percent. We had a better chance of holding the original deal and getting what we needed from Congress. We could always negotiate with the contractor, but we ended up really being in trouble with variable lot pricing and it made the writing of the contract very, very difficult. It became very complex.

Now we're back to the A-7 and this is really tied in with TFX as well. At the time TFX was underway we had VAX and the Navy all ran around with lapel buttons that said "VAX I like VAX." The ones that said "We don't like TFX" we didn't dare wear in the Pentagon. [laughter] We obviously needed more capability than we had in the A-4. We had tried earlier to do a swept wing version in lieu of the delta on the A-4 which would have given us the capability, at least it would if we had a fan engine to put in at the same time. But that program, the A4D-3 at the time, had to be cancelled as we ran out of money. We had a batch of studies too, sea-based strike study must have been done about then. Anyway, all the studies showed we needed roughly twice the capability of an A-4. All the contractors did studies. Vought was playing around with versions of the F-8 without changing the engine. Grumman was playing around with all kinds, from brand new airplanes to A-6s, versions of the A-6. And North American was doing the same with their follow on to the FJ-4 or something of that nature. Anyway, Northrop was playing around too. We ended up being forced into an "off-the-shelf" competition. OSD again didn't want us to do a full development, price was too high and we were playing McNamara games again. We did an "off-the-shelf" requirement which said in effect that the airplane had to be a modification of an airplane already developed. It was a good competition I thought and we ended up with four designs basically. I think we had only those four manufacturers, Northrop dropping out.

**RAUSA:** Who were the four now?

**SPANGENBERG:** Douglas, Vought, North American and Grumman. Grumman submitted a kind of a stripped A-6. The other three designs were very close to doing

about the same kind of a job. Vought had bitten the bullet, given up on holding the fuselage of an F-8 and the engine of the F-8 and did a brand new airplane really. The vertical tail was the same, at least it was the same shape. Eliminated the variable incidence, thickened up the wing, put on a better high lift system, retained experience from the F-8 and some of the systems they managed to save, probably a mistake because putting in ten year old hydraulic components really doesn't make sense. You ought to update as you go along. But they were kind of forced into it you know with the kind of off-the-shelf program. The deal ended up really – Vought got the contract as you know but the competition was extremely close from the technical standpoint between North American and Vought. Their two airplanes were almost the same on payload range which was the real criteria in the competition.

On the other hand, Vought and Douglas were almost identical in cost but with Vought having a substantial payload radius advantage. Why Douglas wasn't a heck of a lot more competitive on price I think was the thing that bothered me the most at the time because what they had done, as I recall now, you know its been a while, they split the wing and added span to it in order to make it become aerodynamically closer to what it should be. And yet they had to compete from a price standpoint with these other guys. I remember talking to myself into why the difference and looking in detail at cost quotes which you normally would expect other people to do. But it was bothersome, and it turned out that there was a great difference in those days in the labor rates in Texas versus Long Island and Los Angeles. There was no question but what the General Dynamics and the Voughts and whatnot had something like a 30% edge in labor costs. Vought was eager too. They did a good job.

**RAUSA:** How close was it before Vought won? Was it real close?

**SPANGENBERG:** As I said it fell into these two categories, very close technically but not with cost with North American, and very close cost but not technically with Douglas. Thus, Vought was a hands down winner. In getting permission to run this the Navy had done a big study, op analysis, and we must have done thirty different missions from six Mark-81s, twelve Mark-82s, from little payloads, every combination you can think of, Rockeyes, Walleyes, everything. All grossly not needed by anyone experienced in the art. You took a look at the payload range curve and you knew what all the answers were going to be but we had to reduce it down and show the bombs per buck or something to get the whole job done. We did more radius work in that competition than we had in all the competitions we ever had before put together. Drove us crazy. And we had to produce all those results when we went over and talked to OSD at the end of the game. We presented it straightforwardly. You want the lowest cost thing to do the job and you want to buy the best product and Vought was a winner, no question about it. I remember briefing DDR&E and Gene Fubini, the irascible Italian, nuclear physicist, was in the room, came in and he came in specifically to ask what he thought would be embarrassing questions. I presume someone had given Dr. Fubini the information.

**SPANGENBERG:** Anyway, the so-called whiz kids were all listening. Fubini came in and asked me two or three questions. I happened to be giving the presentation so I answered the questions. They were not questions that were particularly embarrassing to me but Fubini thought that they were going to be. He got quite angry, stood up, walked out and said, "Somebody told you my questions." And off he went. Later he headed up



some kind of a study and he included me in the group and we became pretty good friends.

**RAUSA:** He was angry that day though.

**SPANGENBERG:** He seemed to be. I said he was an irascible Italian. Well, we got through that. Got the contract under way and I told you the story on the price. It turned out well. We went from the day we let the contract to fleet introduction in three years which was the best we had done in a long time. One of the best we've ever done. It just shows what can be done if you've got a good requirement and in this case we had a good requirement; it was not overstated. We weren't stretching for the stars but we were getting basically a two to one improvement in attack capability. Well worthwhile. And along that line right after World War II the studies that were done on how big is the earth, where is the opposition going to be and so on, all said that the Navy really needed a 600 mile operational radius from the carrier and laid out where we wanted to go. From that day on we tried to get there and we haven't gotten there yet. In fact we've backed up a bit. With the combination of the F-14, the A-7 and the A-6 we had hoped to get an honest-to-God 500 mile operational radius where you could do a useful mission. We could come close to that. The F-14 ended up shorter than we wanted but primarily because we didn't get the new engine, got forced into some compromises we didn't have to make and shouldn't have made. But with that combination of airplanes we were getting closer to where we wanted to be.

When we get to the F-18 range performance it's obviously a step back to what the A-4 was. That made the fleet very unhappy. The fleet guys that were operating then

and saw what was coming came back to Washington and just raised hell. I got called in, after I was a consultant, with a Navy captain and God he was angry and we talked for about three hours on how we got to where we were. It was I'm sure a great help to him because he was scheduled for a three year tour in Washington and he came in with the idea that the Naval Air Systems Command was nuts.

**RAUSA:** Do you remember who this guy was?

**SPANGENBERG:** A Japanese name.

**RAUSA:** Was he an oriental?

**SPANGENBERG:** Oriental, yeah. He was an American, born in this country but of oriental descent and a good guy. But he was unhappy with the F-18 requirements. He was having to plan operations and all he did was try to find drop tanks and tankers. He couldn't do with that airplane what they were doing in the fleet with the older airplanes. It really bothered him.

**RAUSA:** They're still having trouble then.

**SPANGENBERG:** You can't help but wonder, yet the guy's flying it love it.

**RAUSA:** It's a safe airplane.

**SPANGENBERG:** Down there in Pensacola my own reputation of not being in favor of the F-18 was known to a lot of those young guys. They were all asking me why. They said I had to be wrong. I wasn't against the airplane as an airplane but I was against it as a follow on to the A-7.

**RAUSA:** Is that a good place to quit? Do you want to go a little bit further?

**SPANGENBERG:** To wind up the A-7 discussion. Somewhere down the line OSD directed the Air Force to become part of the program and the Air Force really wasn't happy to do this but the capability was one that they sure didn't have. They however had enough questions and raised enough points on "their" requirements as opposed to Navy requirements that they were allowed to make some fairly major modifications.

**TAPE 11 of 16, SIDE B**

The first thing that they did was to say that the airplane was underpowered which it was. Our engine developments had all been cancelled in favor of Air Force engine programs. The Air Force however was allowed to develop the engine that became the TF-41, the Allison engine that ended up in the A-7, started with the Air Force A-7D. The engine was well behind the airplane in development and the early history with the engine was awful for the Air Force. They should have started the engine a year earlier but again probably couldn't because of the McNamara edict that you had to start everything at once. You couldn't justify a new engine until you justified the airplane. Same with fire control system. The Air Force also put in a much more up-to-date weapon control system, attack system.

**RAUSA:** In the D.

**SPANGENBERG:** Yeah. We at the beginning were using all off-the-shelf items because we had to and we had a semi-all weather kind of updated system under development but it was not as far along as what the Air Force put into their A-7D. Later of course we picked up much of that same avionics, went to the fleet as the A-7E. It was

almost rejected by the fleet as all together too complex. It went through a period of about six months with Op Eval saying that degree of complexity could not be handled and the then program manager Shepherd doing all kinds of studies on "what do we do", "how do we get out of" the troubles. Eventually the system got worked out and the fleet learned to live with it. And you had to have that capability. We would have been extremely shortsighted if we hadn't gone ahead with it so the Air Force introduction into the program helped the Navy capability in the long run. And obviously the Air Force got a capability that they didn't have anywhere else. It was good for the services but these bi-service and tri-service programs really only work when you start with the Navy designed air frame.

**RAUSA:** As we learned in the T-45, right.

**SPANGENBERG:** The T-45 was after my time, a modification of the British trainer - Hawk. Well, we've gone through all of these things before. We've done them all. During the TFX days we dug up a list of fifty airplanes that the Navy and Air Force had used of each other's models. Now admittedly most of them were transports and were modifications of civil aircraft and a bunch of trainers. Not very many combat airplanes but there were some. The Air Force bought SBDs during the war, called them A-24s. They bought some SB2Cs and so on. We had bought the T-28. When it made sense to buy them we bought them but you can't start with an Air Force airplane and get a good carrier suitable design for the Navy. It requires major redesign.

The F-86 we got as the FJ series had to be redesigned completely before it became satisfactory as an attack airplane.

**RAUSA:** I think that's one of the key lessons. We've learned but haven't learned.

**SPANGENBERG:** Yeah. The working level always knew it. I think most of the operational Navy knew it but none of the OSD people believed it. They just don't believe it, which is one of the big problems.

**RAUSA:** Okay. Want to stop there.

### **TAPE 12 of 16, SIDE A**

August 9 -14, 1990

**SPANGENBERG:** I'm going to try to continue this oral history. Zip had conflicts so he's not with me today but if I don't get going we'll never finish. I'd like to start with taking a couple of the programs that are not on the Navy chart of new starts and whatnot because they were done with joint programs for somebody else. Start with the LOH program which to the best of my recollection must have been in the early 1960s (actually 1964). At the time the Army was prohibited from doing their own development. I suppose the rules that were set up when the Department of Defense was prepared and the Air Corps got out on their own. The Air Force took over the old Army Air Corps and the technical capability left for the Army in the aeronautical field was quite limited. So whenever the Army needed a new airplane they shopped either with the Navy or the Air Force in order to do the development.

In the case of the LOH the Navy "won." I'm not sure how the Army ever did these selections, but we normally had a few Army officers in the bureau in the program office assisting the program that they were running. In many cases they became the project

officers themselves. The LOH for Light Observation Helicopter, as the name implies, was to be a small helicopter. It was intended for "nap of the earth flying," and was being fairly heavily promoted. I believe Gen. Von Kann was the primary sponsor within the Army. The helicopter was to be powered with a 250 horsepower Allison engine and for some reason the Army had made the decision that "it would never grow." In other words, the manufacturers were encouraged not to provide any growth potential in their designs. This later led into all kinds of trouble. In any event, it was my first real contact with the way the Army would run a source selection but we ran a design competition for them in their normal way. The Army elected to send a batch of people to the bureau who sat in the various technical divisions. For example, we had one Army fellow in the weight group, we had another one or two in the performance group, some in powerplants and so on. There were probably ten or twenty of them assigned to the bureau during the evaluation process and they worked along side the Navy people without any real trouble. And we hope we indoctrinated them in the right way to do business.

The Army had Ft. Rucker, their operational test group, involved in writing the requirements and when we did the evaluation we ended up with the Army at Ft. Rucker taking a look at the airplanes and doing their own evaluation. We did a normal evaluation in BuWeps fashion, and ended up with Fairchild being our first selection. A little unusual because Fairchild was not a name that was familiar in the helicopter business but at the time Hiller was in the process of being bought out by Fairchild or maybe they had been. But anyway all of the Hiller background showed up as a Fairchild submission. An ex-Navy fighter pilot and Class Desk officer Syd Sherby was running the aircraft program by that time at Fairchild and Fairchild submitted an excellent design.

We picked them as the winner. We then got together with the Army group at Ft. Rucker who had picked the Bell submission as their winner.

The airplane that created all the controversy later was a Hughes proposal which was really the lightest weight project that had been submitted. We didn't check their weights by a wide margin and when we didn't check their weights the helicopter was not very attractive to us. The people at Ft. Rucker felt the same way. The Army had previously announced that they were going to pick two airplanes and build five prototypes before they decided on which one to put into production so there was no real problem between the Army and the Navy on selecting the airplanes with the exception of the Army's what I guess today would be called the source selection authority or the advisory council.

We went to the Army group that was sitting as a council to make the selection and found out that only two of the seven members of the board had any aeronautical background at all. One was a locomotive specialist and the others had background in the infantry and so on. It made it very difficult to talk with pluses and minuses of a helicopter competition when the people you were talking to really didn't talk the aeronautical language. Adm. Shoech who I believe was the Chief of Naval Material at the time was invited to sit on the council so he helped out in that regard. We ended up by making our presentation, the people from Ft. Rucker made theirs and they then excused the evaluation group and the council itself did the decision making. In essence all they did was to ratify what we had told them and it was announced initially that Bell and Fairchild were the winners and they would go ahead with building five airplanes each.

A short time later we learned that the procurement plan had been put on hold. Reportedly, Gen. Von Kann had insisted on including the Hughes design in the development program despite its lower rankings by both the Army and Navy evaluators. The Army then changed the rules of the competition. Although they had been prohibited from developing any aircraft, they were permitted to procure production quantities "off the shelf." The Army then proceeded to permit Bell, Fairchild, and Hughes to build five aircraft each without mil spec compliance and to submit them for test and evaluation. In that next step, a few years later, the Army conducted a two-step competition, first a technical evaluation at Ft. Rucker in which Bell was eliminated followed by a cost/operational competition. A second round of cost quotations was then requested, after which Hughes was awarded the production contract for something over 700 LOHs. The trade journals reported that Fairchild claimed their cost figures had been leaked to Hughes, allowing the latter to submit a lower bid. Knowledgeable cost analysts later reported that the Hughes fixed price bid was less than the basic material cost of their helicopter, probably making it the largest percentage "buy-in" in history. Following the technical elimination of Bell, that contractor corrected his deficiencies by significant redesign and produced the highly successful Jet Ranger. That helicopter then was awarded the next LOH production contract underbidding Hughes. The time required from project initiation to service use for the LOH was about twice as long as for the A-7.

The next program is not on the Navy charts but one in which we got involved back in the fifties and that was the X-15 program. The X-15 of course was a follow-on to the Air Force's X-1 and X-2 high speed research vehicles as well as the Navy's D-558 Skystreak and Skyrocket. Heavy NASA involvement and I believe that the beginning of



the program was primarily that of NASA who really wanted to get some very high Mach number data and particularly to investigate the problems associated with the high heat that you have to have if you get to the Mach numbers 3 ½, 4 and so on. The Navy had been involved in the beginning of the program but I was not. Probably Abe Hyatt and perhaps the people in the high speed aero technical committees of NASA were involved.

My introduction to the program really came when I got a set of the proposals in answer to an Air Force RFP. All the proposals were "Secret" which didn't help any. We had one copy each and we were only given a couple of weeks to do the evaluation and get back to the Air Force. We evaluators then had to really get up to date in a hurry on what had gone on before since we had not really been involved in the project. The Air Force had done the specs, had written the RFP and had received the proposals and eventually got around to sending us, as I said, one copy each. I can't remember the details but I would guess that the Mach number, the requirement was established in terms of a Mach number and an altitude. I believe the altitude was 250,000 feet, the Mach number was probably on the order of 3, 3 ½ or so, perhaps a little higher than that.

The thing NASA really wanted however was to get a red hot structure to see what kind of problems we were going to get into with the expansion and contraction of that structure. They were shooting for a 1200°F structure assuming that it was made of steel. The proposals, only three that I remember, were the North American proposal, the eventual winner of the competition, a Bell proposal and one from Douglas, El Segundo. The El Segundo proposal was probably the most amazing of the bunch. Where the requirements had been written in terms of speed and altitude, with the hot structure not

specified, Heinemann had come in with an ingenious solution. It was undoubtedly a combination of Heinemann, Gene Root, Van Every, Leo Devlin and the rest of the gang at El Segundo. Instead of submitting a steel structure that would get red hot they submitted a magnesium structure. Everyone was very surprised at that, but it turned out that if one followed the exact rules that had been laid down in the RFP, that the magnesium structure had enough mass that it just acted as a huge heat sink. You could accomplish the performance mission with that magnesium structure. And with the magnesium structure the airplane was lighter and cheaper and all the rest of the good things that went with it. If you really believed that the requirements were those that had been sent out to industry, it looked to me like Douglas won the competition. And the discussions of course with the Air Force and NACA or NASA, whichever it was then, it was determined that what they were really looking for was a high temperature structure and to find the solution of that problem, so Douglas lost out.

The Bell proposal was an aluminum structure protected with a bunch of steel plates kind of like fish fins and no one was very enthusiastic about that approach for fear that you'd lose one of the protective plates due to one cause or another and the whole airplane could well get itself in deep, deep trouble. It was an interesting set of problems that showed up of course in the project. The air conditioning system for the pilot was obviously another very difficult problem to handle with those kind of temperatures. The rocket propulsion was one of the largest that had been tried in the aircraft field up to that date. Eventually we met out at Wright Field with the Air Force and the NACA people and they made the decision to go with North American. We really had no quarrel with that decision. It was a good decision. Overall the whole program was a success. I think

everybody will agree looking back on it. It provided a lot of information usable when the space program came along. I think that's all we need to say about the X-15 program. The Navy participated in the flight test program to a limited degree. Forrest Peterson was one of the test pilots

The next program that also is not on the chart is the CH-53E and that's because it didn't get started until after the chart was drawn, and also an HLH which also would not have been on there because it turned out to be an Army program. The whole effort really started when they deployed the CH-53A which you will remember was started in '63, flew in '64 and then deployed in early '67 to Vietnam. When it reached Vietnam the Marines found that they had a problem, they had so few of these helicopters available to them and if one went down in enemy territory they could not retrieve it. The other helicopters, CH-46 for example, could be picked up either by the Army Chinooks or the cranes, CH-54, or by the H-53s and brought back. It apparently became a severe enough problem that the Marines got together and came up with a requirement for a crane-type helicopter with self-retrieval capability. In other words, if one went down a similar helicopter could go in and pick it up. The Marines were really working quite closely with Sikorsky at the time and Sikorsky then came up with a study for a modification of the CH-53 in which they added a seventh blade, increased the rotor diameter from 72 to 81 feet, added a third engine of the same type as the other two and went to a crane-type configuration similar to the CH-54 which was also one of their designs, of course. At the time it was estimated that configuration would give a lift capability of about eighteen tons and that became really the selling point for the program. NAVAIR was willing to buy the design. In other words, if performance and the

weights were agreed upon, we wanted to buy it on a directed procurement. However, the ASN (R&D) decided that we should have a competition and let other manufacturers bid. The program then ran into budget problems. The crane configuration of course was a pretty specialized one and eventually when everyone finally got together on the specification requirements, a conventional fuselage on the helicopter was required. We ended up losing a couple tons worth of lift capability when we did that so the helicopters that resulted were more like a sixteen ton lift capacity.

We had proposals from Sikorsky, Vertol and Hughes, that I remember, perhaps there were others too. The Hughes was the least attractive of the three proposals. Vertol submitted a version of the Chinook. The Chinook was always a competitor for the CH-53 but the height of the helicopter was enough so that Vertol never did get around to really working out an arrangement where it fit well on the ships. The tandem arrangement of course always gave a nice compact spot, an advantage for shipboard use. Well, Sikorsky ended up winning the competition and we had only lost a couple of years fooling around with the competition rather than going with them in the first place. But it's also clear that having a conventional fuselage on the design was a good decision.

When the item went into the budget it was unfortunately called the "Marine HLH." At the time the Army also had an item in the budget for an "HLH", and as presented initially, the Marine version was described as an 18 ton lift, the Army design as 22 ½ ton lift capability. The Army wanted the ability to lift any of the containers that went on container ships which explained the 22 ½ ton lift requirement. It was basically a crane-type helicopter, although they could put container pods on the bottom to carry people as well. The Army did not have their program well defined and for several years they

refused to define their long-range plans and only talked about technology, an R&D program, or a prototype program.

At the time within OSD there was an active duty Army colonel assigned to DDR&E. Naturally, he pushed very strongly for all Army programs over those of the competing services and did his best to, I'll say, mislead, he probably said, to educate, his bosses into the fact that we could have a joint program, with no need for separate Marine HLH and Air Force HLHs. In his version of the DCP (the Development Concept Paper), part of the acquisition process at the time, he claimed by combining the two programs the country could save a half a billion dollars. This related to the one billion that McNamara had claimed that he could save on the joint TFX program. The Navy's stand on the DCP was actually signed by the assistant secretary of the Navy, the R&D secretary, Mr. Frosch. It seemed to him that we could probably save money by doing separate programs, that the extra costs that the Marines would suffer from the size of the Army HLH was enough to pay for the development of the Navy HLH. Well, it became a big issue for a long time. The general feeling was that among those that just glanced at numbers that you certainly ought to be able to compromise with a single project if you're only talking the difference between 18 tons and 22 tons. Unfortunately, that wasn't the whole story.

The Army requirement also said they should do the lift at what I believe was a 4,000 foot altitude and at 95° at that altitude, a tough requirement. The Marines also had a high temperature requirement but it was 90° at sea level, really our standard hot day requirement for the Navy.

After the big argument on the DCP and with nobody being able to agree, a joint Army-Navy-Industry study was set up in which the participants tried to arrive at a common helicopter to serve the needs or meet the requirements of the two services. It turned out about as expected that the biggest one that the Marines could accept provided too little capability for the Army and the smallest one the Army would accept was too big for the Marines to operate from most of our ships.

About the same time there was a budget hearing in the Congress and Mr. Foster, who was then DDR&E, was asked a question, "Why can't you combine them?" and in widely read testimony he promptly said, "Oh, we can. There's no problem to that." He obviously did not know the background at all. Well a joint program then got directed, despite the studies, by Mr. Packard, then DepSecDef. It was an extremely stupid decision and since Mr. Packard was not a stupid man, all I can conclude is that he had to have had bum dope. Eventually the working level part of the Navy and of course the Marines finally got to see Secretary Chaffee, Secretary of the Navy, and appealed to him. He would not permit us to go directly to Mr. Packard but he said give him the dope and he would go to Packard, which he did. Packard made the decision then, "Well, we'll go ahead with this joint competition with the Army requirements being specified as the most difficult to meet but that it also should have shipboard compatibility requirements." If the industry proposals then confirmed the statements that we were making to Packard, he would reconsider the decision.

So the next step of course was to run the competition. Actually the Army ran it. But we had to work with them on getting the specs out and then of course later we had to evaluate the proposals when they came in. The Navy's main input to the spec of

course was just ship compatibility. The Marines wanted full shipboard compatibility with the LPH-2 (a former Essex class CV) and this of course gave them more problems than if they had specified a larger ship. OSD finally directed the Navy, or the Marines really, to require shipboard compatibility only with the larger LHA class, the first ship of which was under construction. Since the total number of these ships wasn't really very large there was a lot of opposition to the fact that the shipboard compatibility requirements had been cut back. The Army set up their typical remote location kind of an evaluation board. Evaluation was held at Ft. Eustis, I believe. We had one representative that we sent down there and then evaluated the helicopters in place at NAVAIR. We had five competitors who submitted proposals — Boeing Vertol, Sikorsky, Hughes, Kaman and even Gyrodyne. All the designs came in just about as we expected. The Army versions running about 120,000 pounds gross weight, and really impossible to operate in any normal way from ships. Obviously you could put them aboard the big carriers and you could operate from the decks of the LHAs but there wasn't much clearance with the island and getting them down below was impracticable. The Army ended up by recommending the Boeing Vertol design, a tandem helicopter similar to the ones that — well, it was a big Chinook in a crane version. Had 90 foot rotors, was 150 feet or so long, with a huge operating spot on any ship. We obviously couldn't accept any of the designs.

Eventually Packard reviewed the situation. Some of the Army DDR&E people still wanted the joint program I presume because they thought that we would never get approval for two heavy lift helicopters at once. So we really argued that we (the Marines) didn't have a heavy lift helicopter, we certainly were on the low side of what the Army

was trying to do. Packard finally allowed us to get started again with the CH-53E. We finally got a go-ahead for the CH-53E in November of '71, a decision delayed from January of '68, so we had almost a four year delay between the time we wanted to buy the capability and the time we were allowed to get started. The situation then went from bad to worse as the acquisition system was being changed by the proponents of prototyping, "fly-before-buy", and so on. The CH-53E production release got delayed until actually 1976, although Sikorsky had built two prototypes and then two preproduction models before that production release. The first real production delivery didn't come about until late in 1980. I've always used the program as one of our best examples of how not to buy aircraft. It's very, very expensive to stretch things out that long. If a program is going to take ten or fifteen years to go from concept to fleet it's going to have a lot of changes and the costs are going to skyrocket. And when it gets there it may well be obsolete.

**TAPE 12 of 16, SIDE B**

A schedule comparison of the CH-53A with the CH-53E should be instructive. If you compare the two programs, the E obviously took years longer. In fact the first production E was the fifth actual aircraft built. It was delivered some nine years after go-ahead while the fifth A was delivered in less than two years from go-ahead. The four-year delay in getting the E started was about four times as long as the delay introduced in the 53A program by those in OSD who forced the poorly conceived Tri-Service Transport Program on the services. Again, it's not the right way to buy aircraft.



To finish up the HLH, the Army went ahead with its Vertol design, but advertised it as only a technology program, with some calling it a prototype program. In their Congressional testimony, they claimed they had made no cost estimates of either the engineering development or production. This caused them all kinds of trouble in Congress of course and why they took that tack I'll never know. If they had never made any cost estimates as they claimed they should never have been allowed to get started and all the delays could have been avoided. They ran the program for a while, let an engine contract, but eventually cancelled the program after a year or two. I think that probably ends my official involvement with helicopters. I had retired before the Black Hawk and the UTTAS came along. Those were programs that probably should have ended up by replacing the CH-46 as well. A replacement for the 46 could have been a marinized version of the Army's Blackhawk.

Now that we've cleaned up the HLH situation and looking back at our chart of Navy starts it looks like we've pretty well finished them up with a few exceptions. The EA-6B in 1966 was a fairly straightforward modification of the A-6 to get a countermeasures version and made a four-place airplane from a two-place airplane and a completely new avionics suit of course. It's hardly worth talking about though and I have nothing to add to the story other than it was the most efficient way to achieve the capability.

In '68 we bought the Jet Ranger as a new helicopter trainer. First time in a long time we bought a new helicopter trainer and that was straightforward. Not much of a story there.

In '69 we started the F-14 and S-3. We skipped over the F-111 and the TFX and because that ties in with the F-14. I'll skip that again for the time being, but let's finish off the S-3 which will then complete our chart which takes us up through 1969. We had long needed a replacement for the S-2, and for at least ten years studies had been performed trying to get a configuration and an ASW system that offered enough improvement over the S-2 to be able to justify the development. Most of the studies during that time were done using turbo-prop T-64 engines but there was never enough advantage shown by doing a slightly new air frame and without having enough of an advance in the ASW system itself. Finally in the period from the mid-sixties on system improvements came along. As I recall, the studies were done at Johnsville putting together new systems for both the P-3 and for a carrier-based ASW airplane. Simultaneously, a high bypass ratio fan engine was started, the TF-34, at General Electric. The combination of those two developments allowed us to finally get to the point where we could justify a new ASW carrier-based airplane. The period was one in which major justification studies had to be done. I was not involved to any degree in those, but I believe that a good many of them were done as funded studies. At the time there was an ASW office in OPNAV that coordinated all the ASW activities and all of the NAVAIR system studies had to be coordinated with that office. Probably the major players in the airplane side of the game at least during that period were Grumman, Lockheed and Douglas. They all had funded studies and as I said I really wasn't involved to any great degree.

When the program finally got approved a few months after the F-14s then obviously I did get involved and we started the total acquisition process. Things went a

great deal slower than was necessary mostly because of the changes in the acquisition system coming down from OSD. In the past we had been either ignoring or working our way around such directions without really changing our system. In this case we had a new program manager. He was new to the bureau, or rather, new to the System Command as we had been renamed. (I'll probably continue calling it bureau because it's easier to say.) He was a Navy captain, Pete Elliot. He had brought along a civilian who had been a Navy electronics technician with him in the fleet, Don Lewis. Both of them were well qualified in the ASW game and certainly knew what they were doing. The problem the new program manager had however was that not knowing the background of all of the fights in the system acquisition business. He tended to believe the OSD directives rather than ignoring them as I, at least, consciously did. He was afraid that the DDR&E and company then would not approve the whole program unless he followed the "book" in every respect. So the RFP got to be a two inch thick document instead of the normal quarter of an inch thick document. It was a word game, took time and whatnot. We really kept our sanity pretty well.

At the same time we had a new CNM, Adm. Galantin who was a submariner who had virtually no background in the air side of the game, didn't understand our system and he tried to make us do things more like the "book" too rather than "our" way.

When the system was finally set up rather than defining the ASW system completely the door was left open so that the contractors could do their own definition of the total system. There were specs set out for many parts of the system but putting it all together was really not done in this case so we ended up running simultaneously an air frame competition and an ASW system competition.

Probably when we get around to talking source selection and acquisition procedures you'll find out that I really tried to run aircraft competitions by defining everything that we could so that basically we ended up running only an air frame competition. And the reason for that obviously was we knew how to do that and it was a lot tougher to try to do a competition in which you had two major variables.

The program was finally outlined and as set down in the RFP was that we would have a competition. We'd select two contractors initially for a competitive period and eventually settle down to one. I can't remember the details of what we told them about how that was to go but that was the general scheme. We had trouble with Adm. Galantin who wanted us to quantify our selection criteria which we had never done in the past. We had always claimed that all we had to do was buy the best airplane, and justify our selection by telling everyone why we thought so, in engineering terminology.

When we talked to Galantin I tried to convince him that we knew what we were doing, we had a good record but he still made us give some kind of quantification to the criteria so we gave him some lip service by saying that the most important factor was "technical" and with less important – it's really not less important but we told him it was – items of "logistics", "management", and "cost". He was finally satisfied and we finally got the RFP out.

As I said, the competition was really in two parts, the air frame and the ASW system. In this case the program manager Pete Elliot and Don Lewis, together with the electronics division pretty much handled the evaluation of the ASW system and came up with their rankings of the systems involved in the various airplanes. I concentrated as

usual on the air frame part of the game using our conventional methods with all the divisions being involved.

We were lucky in that Lockheed came up to be first in the air frame part of the competition as well as first in the ASW system part so we didn't have any problem in determining the winner. Well, the business of Lockheed ending up as number one for a carrier-based airplane I think startled some people. It certainly wouldn't have happened if they had not had Vought as a partner. It was a teamed arrangement. Watching the preliminary design studies of Lockheed's over the years for carrier-based designs I believed that they would never win a competition by themselves because of a lack of experience in that field. As soon as they signed up Vought and Vought started doing the airplane part of the game they became much more competitive. Vought of course had a long background in carrier-based airplanes.

The number two airplane surprising to us was General Dynamics but they were definitely a better overall second choice than the others. McDonnell Douglas air frame had really been knocked out on flying qualities counts and Grumman just didn't quite measure up in either the air frame or in the ASW system. Well, the choice to us was clear-cut enough at that time that we tried to get CNM Adm. Galantin to go along with the idea of skipping the second definition phase of defining the airplane but to go ahead and just finish up doing the job with one contractor. But he was unwilling to do that and directed us to go ahead with the way the book was written since that was how DDR&E had approved the program. So we had to go through the second step. I'm quite sure that had to be funded and when you have to fund, when you have to sit down and negotiate

and write a contract for just a portion of the whole game, it takes time, costs money and really isn't necessary.

I suppose I should mention the reason for why GD was surprising. They had not really done much in the way of carrier-based design other than the TFX. They were afraid that the stigma of the TFX had so branded them in NAVAIR's mind that they wouldn't get a fair shake in the competition. They were sure we'd throw them out just as soon as we saw the nameplate. But we really didn't play the game that way. After the final decision was made in favor of Lockheed we had a letter from General Dynamics to the Commander of the Air Systems Command really congratulating us on running a fair competition.

As I already indicated, Lockheed won that second phase of the competition. I suppose that was close to what they now talk about as "best and final offer" although it went on longer and was less of a bidding contest. Before we were able to announce Lockheed as a winner however we ran into a complication with our own CNM financial people and our secretary for logistics or whatever he was called, I&L of Financial Management maybe, questioning whether or not Lockheed was in any financial condition to undertake a contract. The Air Force C-5 had Lockheed in trouble. They were getting guaranteed loans from the government. It obviously became then something that the managers on high could question since they were usually not in a position to question anything else. That held us up for quite a while. We had to show the differences between our kind of a contract and the C-5 contract.

Just as an aside on all this for those that don't know the story the C-5 really got in trouble right from the start in that competition run by the Air Force, and reported in a

congressional hearing. It appeared that the Boeing design had won the C-5 competition, and that decision got overturned by the Secretary of the Air Force or OSD, I can't remember which one, primarily because Lockheed had a lower price than the Boeing. Unfortunately, however, there was a reason for the difference in price. The Lockheed airplane was a little too small but the decision went to Lockheed and then they were pressured by the higher ups in Defense Department to "not change their cost" while increasing the aircraft size by something like ten percent. They made a lot of other changes but they were held to that original cost quotation. In addition, the whole procurement was done under a contracting scheme called Total Package Procurement, and that didn't help either. In Total Package Procurement the air frame contractor is held responsible for buying the engines and the equipment that's usually GFE where the government would take the responsibility if any of those items went overweight or over cost. Even then Lockheed would have been all right financially if the Air Force had bought all the items that were initially on the contract. As I recall there were three lots, lots A, B, and C. They had actually bought the first two, lots A and B, and they had given Lockheed a letter of intent for the last and big lot. At the time of their financial crisis that contract had not been definitized. Well, the way the contract was set up each lot was priced, but included a correction factor for the actual price of the preceding ones. And if you worked out the mathematics of what the contract called for, the loss on the final contract, if they had bought all the airplanes, would have been minimal and would not have caused a problem for the contractor. But since they never reached that point Lockheed found themselves unable to proceed without getting some loans that had to

be guaranteed by the government. Eventually they all got repaid of course and the government made money on the deal.

Well our contract on the S-3 was going to be a fixed price incentive contract for the R&D quantity, I think it was nine airplanes, and then fixed price ceiling options for a total buy of up to 200 aircraft and with variable lot pricing included through all of the lots. It's a tough kind of a contract and one that gives an overwhelming advantage to the government. We got that contract all negotiated and were ready to close it up and then about the same time or maybe even earlier while all that was going on another part of OSD, Assistant Secretary Ignatius, he decided that 200 airplanes weren't enough to be worth buying anyway and so then we had to show him that well, we could buy a lot more if the airplane was a success as we expected it to be. We could buy a Q version and a COD version. We could also buy a training version, early warning version and so on. But that again took another two or three weeks while we made up new viewgraphs and showed him what those airplanes might look like.

Eventually it all got settled and we were about to sign the contract when DDR&E's latest innovation to solve all of our acquisition problems came along, Milestone Contracting. We had thought that we were running slightly ahead of their time requirement that you put that feature into each and every new contract but unfortunately we got caught again. The concept was simply one that in the OSD scheme of affairs you had a lot of individual points during the contract that you were supposed to achieve on schedule. If you did not achieve any of those milestones the whole schedule was slipped correspondingly downstream. This was tough particularly on a contract like we had with ceiling options and the contract already running several years into the future, adding the



business if you miss one little milestone and slip the whole thing until you got around to correcting that. It was just an impossible kind of a thing to ask of a contractor. And grossly simplistic. It wouldn't solve any of the real problems we had.

Well, as I said, we thought we had the thing licked and we worked over a weekend getting ready for the final negotiation, signing and getting approvals when we were trapped again. The Sunday paper reported a speech that DDR&E John Foster had given to some industrial association in which he said that every contract from that day forward would have milestone contracting provisions included. So we knew pretty much that we had been had again. But we worked up a presentation to show him why we didn't need it and went to one of the higher level conferences in which I was included. We had everybody, all of the Navy secretaries and most of the OSD secretaries from Packard on down. Mr. Packard was then DepSecDef. Foster was there and the rest of his crew. As I said the Navy secretaries, OP-05, the commander of the Systems Command and then a few of us working characters.

I was giving the presentation which we had structured to try to show the difference between what other people had done, and why we didn't need the milestone contracting. We already had tight engineering control, tight schedule control and could change things when we needed to change them. Mr. Packard interrupted me at about the third chart and said in very stern tones, "We're not here to discuss *whether* we're going to have it, we're here to discuss *how* we're going to have it." Well, needless to say I blew my stack. I was really upset. Eventually Adm. Baughman who had replaced Pete

Elliot as the program manager took over and did our backup presentation on how the hell we do milestone contracting if they were to put a gun to our heads.

Incidentally I'd lost all respect for Packard and the rest of those people over there. With episodes like this and their complete lack of understanding of the acquisition process in the working world, at least in the aircraft industry, as opposed to their theoretical world. We'd held out high hopes for Packard when he first appeared.

This is another aside. When he was being considered for the DepSecDef job, it had not been announced yet, we were asked to give him a presentation on the F-14 and it was all done with great secrecy. We weren't really sure for whom we were working up a status presentation. We met with Mr. Packard in NAVAIR's board room.. Capt. Mike Ames, the F-14 program manager, gave him a presentation on the F-14. It was a good presentation, showed him where we were, why we were doing what we were doing and so on. When we got through he said, "Well, you guys seem to know what you're doing. I'll leave you alone. Call me if you need me." And we thought, God, this is the first Deputy Secretary of Defense in years that has recognized what he knows and what he doesn't know. But it wasn't long before he stopped leaving us alone to do our jobs.

We ended up in the S-3 by minimizing the number of milestones. For example, we put in on the R&D lot only "integration of a complete ASW system" in a bench run, not saying how well it performed, "first flight" of the airplane. First flights and bench runs of an integrated system can be done with a fair degree of being able to predict when you're going to be able to do it. You could do a first flight just as a liftoff if you had to. I imagine if he had known more he would have made us do more. Lockheed charged us a

few million dollars for putting the milestone provisions in the contract and we lost another month or so. And it served absolutely no purpose.

On the whole the S-3 then turned out to be a good program. We had some flying quality problems basically because the airplane in order to meet the long time endurance requirement had to have a lot of span and then it had too little drag in the landing approach condition. That was probably the major flying quality problem then, getting enough drag on the airplane so it would get down on the deck.

Then, ironically, of all those modified airplane versions which we'd been forced to show before we were allowed to proceed, none were approved. OSD forced the Navy to accept inferior solutions to both tanker and COD mods.

Looking back at the time the requirements were started it would have been easier to do a COD version of the airplane for example if we'd had a little more space in the original airplane. When the requirements were established, however, we still had the CVS class carriers with older and less powerful catapult and arresting gear. By the time we actually got the airplane in service of course the CVSs were long gone. Well enough for the S-3 program. I believe Lockheed delivered the 200 aircraft called for in the contract under the fixed price ceilings specified. A successful program in my mind despite OSD.

After all my deferrals, not willing to get started talking on the F-111B and then the transition into the F-14 it's probably time to get onto that. As everyone must recognize that's a big subject and that's one that took a good deal of our time and effort over a ten year time period. The whole story probably needs to be said in some kind of perspective and to do that rather than trying to talk the whole story again I think we should insert in

the record here a memo that I wrote in 1980 that came about when Grumman and the Navy were being sued by the descendants of a Navy pilot who was killed in an F-14 crash at Oceana. I was asked to assist the lawyers that were handling the defense side of the case. Basically the suit claimed negligence on the part of the Navy and the contractor. There was some question about whether the Navy could be sued or whatnot. But I had been asked by the Navy people to get involved with these people. I think it was all a gratis kind of an operation. Anyway, the law firm of course didn't have any background at all on the F-14 and to understand some of the things that were going on they asked me to give them a brief history. So this memo that I wrote which I'll identify as Exhibit VF-1 is really an education for a lawyer. It's written in nontechnical terms but it can give everyone a general picture of what went on from the mid-fifties up to the time we finally got the F-14 under contract.

In addition to that story I probably ought to mention that there's all kinds of data already available on individual parts of the program. The McClellan Committee hearings, first and second sets, and their final report is probably one of the better sources. The final report was a good one. It was written by Charlie Cromswell, an ex-Navy aerodynamicist who went to work for the McClellan Committee during the second set of hearings. The first set of hearings were not officially concluded but were just adjourned when President Kennedy was killed. They were put off for a year or two before the committee went back and finished up with the second set and wrote one final report on the whole thing. Officially this was done by the Government Operations Committee, chaired by Sen. McClellan and usually referred to as the McClellan Committee Hearings. In addition to that there have been several books written on the subject of TFX/F-111,

but I have found none that come close to presenting the history of the program as I saw it.

*The TFX Decision* by Robert Ort came along in 1968 and that seemed to say that the whole problem was the services not wanting to go along with civilian control and so on. Just plain malarkey. Some of his facts are right but all the conclusions are wrong as are reasons for the actions of the services. In Mollenhoff's book *Despoilers of Democracy* he has a couple of chapters on both the X-22 program reversal and the reversal of the TFX decisions. Those are pretty good. He has a few facts in there that I didn't know about until I read the book, well after the incidents that happened. He blames Gilpatric and Korth. It says that Korth was forced to resign. I thought he just resigned. That's probably a matter of opinion. Korth, to me, at least at the beginning, seemed to be an innocent bystander.

One of the fancier books, it was probably written as a Ph.D. thesis was something called *Illusions of Choice* by Robert Coulam in 1977. He does not identify all the people that he talked to but groups them as government employees or whatnot. Some people thought I had talked to him but I had not. In fact none of the book writers had ever talked to me and I thought probably I had more facts than any other one individual in the whole situation simply because I had been involved longer than anyone else. And I understand that there were theses written for the Armed Forces College and so on and so forth. If a person wanted to do research they undoubtedly could come up with file cases full. The last book I actually read dealing with at least parts of the problem was one written by Cdr. Andy Kerr (Ret.) and published by the Naval Institute in 1987.

Kerr was a legal assistant to SecNav Korth and did his job well. Unfortunately he did not have a full understanding of the TFX/F-111 acquisition for the year or two before his involvement.

**TAPE 13 of 16, SIDE A**

August 15 -18, 1990

I had marked a memo entitled "Brief History and Background of the F-14" as Exhibit VF-1 of this particular project and I talked a little bit about the other data that's available.

I guess now it's time to get started on more of that history. Going back to the various time periods involved the studies after the cancellation of Missiler and leading up to the TFX-F-111 program . Almost all the work was done by Fred Gloeckler and his research division. It was a group that did preliminary designs and cost effectiveness analyses on airplanes. Also involved were naval officers in OP-O5. These were strenuous times for them doing a multitude of various and sundry tradeoff studies and trying to compromise between an Air Force TFX and a Navy TFX.

A word of caution on the business. Most of the preliminary design people whether in government or in industry tend to be somewhat more optimistic than are the other parts of the organization that are building and testing, being concerned with the operational side of aircraft development. I guess this has always been true. And part of the reason that the TFX got into so much trouble was so much of the early USAF work had been based on NASA studies done by John Stack and the high speed aero part of

the Langley research organization. Many of the designs when we finally got a look at them in detail, usually years later, were much too optimistic. The cockpits were too small. The radar antennas ,when shown at all, were maybe a foot in diameter instead of two or three feet in diameter. The preliminary design people tend to get results that are a little more optimistic than they should be. You'll see references on occasion to the fact that many of us believe that the so-called "Navy TFX" designs were probably incapable of being built but they were much closer to being realistic than were those of the Air Force or those of OSD.

Well, back to the subject at hand. I think the easiest way to do this is to take a look at a whole series of memos that I first put together for Adm. Moorer when he took over as CNO in the late sixties. We were then involved in the start of the F-14 program. The TFX F-111B was still costing a lot of money and he wanted to know if there wasn't a history of the program. Well as far as Gloeckler and I knew (the meeting where this question was raised also included OP-05 Tom Connolly, and probably COMNAVAIR and was held in Moorer's office) no real history had been written. Adm. Moorer then asked that one be done and since we didn't have time to write one I assembled for him a whole batch of memoranda that had been written since the program was started which when read would give him an idea of what had gone on.

Since the last dictation on this very complex subject I had taken the opportunity to go back and read some of the stuff that has been written by others on the subject and I'm a little confused right now as to how best to approach this problem. I reviewed the final report of the so-called McClellan Committee, actually called the Committee on Government Operations of the Senate by the Permanent Subcommittee on

Investigations. The final report wasn't written until 1970 but it is an excellent review of the whole situation. A fair amount of detail is missing but all of the facts seem to be in there and if anyone is really interested in the subject they should go back and get at least the final report. If they ever start reading the hearing reports they will find it so interesting that they will probably get hooked and have to read for a couple of days.

Perhaps I'll stick in a couple of these things that I originally talked about that we included for Adm. Moorer. The first one I think we probably should talk about it is a memo that I wrote in early '65, this is four years now after the beginning of the program, but it's called "Review of Project Initiation," and is identified further as Exhibit VF-2. The reason for writing it basically was to get on the record what appeared to be, to me, that some of the information used in that early decision was wrong. The decision maker if he actually used any of those facts presented by the committees that reported to him could easily have made a big mistake. Unfortunately, all the stuff was held very closely early on and most of us that finally got involved had never seen most of the early studies.

In this "Review of Project Initiation" I point out that I came across in trying to find out how this all started a Project 34 report. Project 34 as I was told was just one of sixty or seventy projects that McNamara assigned or got started when he took office at the beginning of 1961. I'm not sure that all the other were as bad as Project 34 was but I wouldn't be surprised. Project 34 ended up like many of these things. DDR&E ran it and working groups were established and so on and so forth. The facts in the memo that are really important in the long run were the facts that you can see that the Navy made a sincere effort to try to compromise, to reach the goal that McNamara wanted. The Air Force did no compromise of their position on the things that caused all the trouble. In



addition to that the real item that drove McNamara and all through the years was his claim of a billion dollar saving.

This memorandum that I wrote in February of '65 gives some of the data from that Project 34 report which shows that the data used by the Air Force and the Navy on costing out the programs were completely non-comparable. So I concluded from all this that the decision makers had bum information but they probably would have made the wrong decision anyway after seeing the way their thinking went. In later years in making presentations I pointed out that the Air Force used such a high learning curve "slope" that when their bigger and heavier airplane bottomed out at the end of their production run it was down to where it cost only about half as much as the lighter weight Navy airplane. This is obviously ridiculous. If instead of compromising on an airplane that costs somewhere in between the two, as OSD finally did to get their billion dollar saving, if they'd told us to build nothing but the big heavy Air Force airplane they could have claimed a cost saving of \$2 billion. This may be hard for everybody to understand but if you look at the curve sheets you can see it very clearly.

Years after the "Project Initiation" memo, I made a set of three charts summarizing the "Air Force", "Navy", and "DOD" estimates of aircraft weight, performance and cost during that year of 1961. These may be easier to read than the ones in the basic memorandum, and I'll include them as Exhibit VF-2.

The next memo that we ought to talk about is one that I wrote after the conclusion of the source selection process and after the announcement was made in November of '62 that the winner was General Dynamics. The memo says that it was written primarily for the record. Anyway, I wrote it as an internal memo from myself to

our assistant chief, then Adm. Fawkes. It was intended to be given to everybody that was going to get involved in the hearings that had been announced by Sen. McClellan so that we'd all be on the same team as far as our recollections of what had been going on for the last year or so. This memorandum is identified as Exhibit VF-3.

The TFX history is complex and one may not really understand the magnitude of the task that was given to us. In a normal airplane development the Navy normally planned to spend perhaps three months writing specifications for the airplane, for the proposal data that had to be submitted, for the flight test program that would follow after the development and so on. In this case we were told on a joint program by the Secretary of Defense that we had two weeks to prepare the specifications and one month total to get out the RFP. This could only have been done by people that didn't understand the whole process. I think everyone at the working level who was involved was just utterly aghast at the time schedule that we had been given. Also bear in mind that all this was done with the working level divisions within the bureau really not having participated to any degree in this program. So they really were starting from scratch in each division writing their own requirements for their specifications and so on. Also of no help was the fact that the requirements were all going to be put into an Air Force "work statement" instead of our normal specification program.

One of the interesting things that happened to me during the period was two or three days before the 1 October 1961 deadline for the RFP to go out I got a phone call from Adm. Pirie, then OP-O5, and he asked me to go to a meeting in the Pentagon which was scheduled as I recall sometime that late morning. I found out later that the reason I was selected to go was that DDR&E had called for the meeting, but did not

want any military people to attend. The Air Force representation came from the secretariat level in the Air Force. The R&D secretary attended the meeting. A lot of DDR&E people were there. Our R&D Secretary Wakelin was out of town and they couldn't find another civilian more qualified, so I got selected to go to the meeting.

When I got to the meeting I found out that we were supposed to approve the work statement. Well I checked, of the people that were there I was the only one that had seen the work statement so I suggested that perhaps we had better postpone the meeting until the others had a chance to look at it. This was done and the meeting reconvened at something like seven o'clock that evening in the Pentagon. Dr. Brown was supposed to chair the meeting and he was twenty to thirty minutes late in getting there. He walked in followed by a half dozen of his staff and so on. His first words were after looking around the room and seeing no military uniforms, "Well, what have *they* done to us now." He was obviously referring to the military. Those were the first words I had ever heard from Dr. Brown directly and it didn't enhance my opinion of him at that time. My opinion really hasn't changed over the years that he might have been a fine nuclear physicist but he sure didn't know airplanes, nor the aircraft acquisition process.

In rereading this memo (Exhibit VF-3) now it seems clear that I could have written one two or three times as long. We failed to detail all the problems that we had in working with the Air Force. Among other things they had insisted on a page limit for the proposal. As I recall they allowed something like 300 pages for their basic proposal and some 500 pages of backup material. In our system of running design competitions we had never limited the number of pages for a variety of reasons, all of them in my opinion very sound and practical. In this case there were requirements written for the data to be

submitted. The data to be submitted took far more than the 300 page limit. There was no way a contractor could comply with the limit and still meet his data requirements. The fact that the whole thing was secret was also a real headache.

As one can undoubtedly gather from the tone of the writing in my memorandum the Navy was greatly disturbed by the quality of the Air Force's evaluation, results, effort, whatnot. There's no doubt that we were truly surprised. After some reflection on what had happened because we knew that the Air Force had plenty of well qualified engineers in all areas, they undoubtedly had probably twice as many as we did and yet they were not able to do a decent job on the TFX evaluation effort. I believe the fault lay with their organization. At one time the Air Force had basically a functional organization. There was an aircraft lab, a powerplant lab and so on in which the engineers in a given discipline worked together in a single group, pretty much the way we in the Navy were organized.

In one of their management reorganizations the Air Force adopted the SPO concept, the System Project Office, which was a true vertical organization. The thing that happens in the real world is that the first SPO that comes along picks off the best weight engineer, the best aero man, the best powerplant man, the best ejection seat man and so on. When the next program comes along they take the second best, etc. By the time the F-111 program got set up it was probably the eighth or ninth of the SPOs with the result that those assigned to that program were really the lesser lights of the Air Force organization. Some of us had known a few of the engineers involved but most of them were young and inexperienced. For a specific example in the weight area where we had depended upon the Air Force to do the first weight analysis we were told later

that the only weight man they had on the program was a GS-9 individual who had little or no experience in weight estimating, having been used in other aspects of weight and balance control prior to his assignment to the F-111 SPO. Although he worked hard, he just didn't have the experience to do the job. The weights came to us two weeks late and seemed so questionable we were forced to do a real quick analysis of our own which was rough by our standards. We were quite disappointed.

Another thing I ought to mention when you read this memorandum is it refers to the SSB, the Source Selection Board. In today's nomenclature that is the Source Selection Advisory Council. It was a relatively small board of one member each from the various commands, TAC command, Systems command, Logistics command, and the Navy member was Adm. Ashworth, our R&D admiral and my boss.

At the time I wrote this memo as you can see on page five I had said that the decision to recommend Boeing went through the whole military system, but I later found out that was not correct. When it got to the level of Gen. LeMay who was the commanding general of the Air Force at the time, he recommended that two contractors be continued in the competition and Adm. Anderson went along with his decision. During that first round then they ended up – the final decision makers going to the secretary recommended both Boeing and General Dynamics. There was no feedback provided to the SSB, Adm. Ashworth, or our working level.

After the first round of the competition was over and we had eliminated four of the proposals, we were really unhappy with the designs. We got direction basically from the Secretary of the Air Force and approved by some higher authority in OSD to go ahead and do a second competition, try to get some satisfactory proposals that would meet the

requirements. Well obviously the contractors were told they had "deficiencies" the first time around. By that time the Air Force had run their engine competition and decided that the GE engine was really not going to be ready in time. It was a paper engine, wasn't even under contract. It should never have been included in the list of engines that could be used. However, without it, the task of the contractors to propose designs meeting all the requirements was made even more impossible. Both contractors had deficiencies to be corrected. The Navy told the contractors the way we had checked all the performance items. In the case of the Air Force, however, they really didn't tell the contractors the answers, but just told that they had a "problem" with a cost or with the mission requirements, or whatever. It doesn't help a contractor very much to say you've got a "problem" without telling him what it is.

So when the second round came in things were a good deal worse than they were before. This then was reported up the line of course all through the Washington briefings. Again we recommended that we stop the program, go back to having a Navy airplane and an Air Force airplane with each running our own development. This recommendation obviously was not accepted.

The SecDef and so on told us to go ahead with the third round and this was a very short one. We were told to report back and tell them what the differences had to be between the Air Force and Navy versions in order to get satisfactory airplanes for each. Neither contractor was really given enough time to do the job and the stuff that came back from General Dynamics showed it was similar to a two or three week effort as you might expect. However, Boeing came in with a brand new proposal, a great deal better airplane for the Navy. We would have been real happy to go along with that. Our

problem however was the Air Force in their evaluation of the third round proposal ended up by saying that the radius requirement which was supposed to be that 200 miles dash distance was better than it was in the first submission. This seemed to us to be obviously impossible. The Boeing proposal had put on 15% more wing and there was no way that the low-low-high mission was going to get better. The Air Force checked it at 185 miles which was close enough to the 200 that they really didn't make a point with the contractor that this was a deficiency. We knew that eventually the Air Force was going to find out that it wasn't going to go that far and that they would then get us into a mess by immediately making changes in the design such as adding more fuel, that made the Air Force airplane better but made our airplane worse.

The other thing that happened during that third round was that in the cost proposal the Air Force in their evaluation system had used "cost standards" which were not told to the contractors. It was the Air Force estimate for a generic type of TFX airplane basically. The way the point system was set up , the higher or the closer the contractor's cost proposal came to the Air Force estimate, the more points it got in the point rating system. The contractors were both bidding well under the cost standards and again the Air Force told them that they had a problem with the cost estimates, but they didn't say whether they were high or low. If I had been a contractor I would have done exactly what the contractors did. Each time they bid they bid a little lower than they did before which basically increased the problem. These kind of problems all through that year or so that we fooled around with these evaluations almost drove us crazy. It was very difficult dealing with a group of people whose rationale you never understood.

I might also mention at the briefing given the contractors for that third round, Capt. Shepherd, the Navy assistant to the SPO program manager, in his talk about what was going to happen said that the third round was to define the differences between Air Force and Navy models, and his advice was, "Let the chips of commonality fall where they may." In other words, get the airplane for the Navy that was satisfactory and get one for the Air Force that would meet their requirements. If they were different, so be it, but define the differences.

When we finally received the fourth round of proposals the Navy's design from Boeing was the same as that which had been submitted in the third round and was definitely a pretty decent airplane. We under the circumstances were willing to accept it. It was bigger and heavier than we wanted but it looked like that was the only kind of an airplane we were going to be able to get, and we needed something to get out in the fleet to replace F-4s. At the time our plan was that we, the Navy, did not want to make a decision on the total program on who was going to get the contract because we honestly thought the program was going to be a failure and that if the Navy made the contractor selection we would get blamed for the program failure and we didn't want that to happen. We wanted to get the airplane that would do our job but we wanted the Air Force to make the decision. Fortunately, the Air Force officers from the Tactical Air Command who were rating the operational portion of the competition in the Air Force's scheme of things were all in agreement with us, that the Boeing design was much better. We thought we had probably achieved our goals of letting the Air Force take credit for the selection decision. After all, they had responsibility for management of the program.



Unfortunately, I guess in retrospect, we said that we had no significant preference between the two which was not really true. We had a significant preference. Those words came back to haunt us, particularly me, many times over. It was a mistake. "No significant preference" showed up in the evaluation board recommendations to the Air Force and went into the Air Force's final write-up. The Navy voting member on the Source Selection Board or what would now be called the Advisory Council had been very direct, this was Adm. Ashworth. I might also comment at this time that Adm. Ashworth and I guess Whitey Feightner, the fighter project officer at the time, myself, and the other Navy people that were involved all knew what each other was doing. Adm. Ashworth had been briefed on what our evaluation was. We talked completely openly and he told us he would take no action that we wouldn't agree with and of course he did exactly that. He acted properly and with a great deal of intelligence and so on. We had not known Adm. Ashworth long, he'd only been there a short time replacing Adm. Fawkes. He ended up by being one of our favorite admirals, that is the easiest way to say it.

I guess I can also mention a bit about the last paragraph where we said that the Navy method of letting everybody know what we were doing and discussing it openly seemed to us to make a lot more sense than the way that the Air Force operated as will come out later in some of this history. Might as well describe it now I suppose. The Air Force Evaluation Board reported their results to the Source Selection Board. After their evaluation results were presented they withdrew. They were not aware of what the decision of the Source Selection Board was and yet they continued to do the same briefing all the way up the chain of command first through the "Using" Command, and

the System Command, the Logistic Command and so on up to the chief of staff and finally to the secretary. All the time the briefers were not aware what the decision was. They talked in their peculiar code language, giving everybody a letter like contractor X and contractor Y. The actual decisions were in a very brief decision paper from each level from the Source Selection Board through the using commands to the chief of staff, were carried in an "Eyes Only" envelope. The message could be as brief as "The Source Selection Board recommends contractor X." A second and separate message contained the identity code, "Contractor X is \_\_\_\_." I thought then and now that the secrecy restrictions were grossly overdone, and probably contributed to the selection reversal. I'm still not convinced that when the secretaries got their briefing whether they knew or not what the Source Selection Board had recommended. Today the written record all looks like they knew but I'm not sure that they did. When they did the briefing I think the envelope was delivered to Secretary Zukert in the conference room. I was sitting on the sidelines and I didn't see him read it.

The other thing I might mention is that the Air Force held their whole procedure secret, not only what they were doing in it but the actual procedure itself and later on when the McClellan investigation committee got into the act the Air Force made the committee agree that they would not disclose some of the aspects of the way they did their business. Why that should have been secret I have no idea.

Well, as everybody knows now the decisions through that round were all unanimous by the military that Boeing was the winner, that we recommended Boeing be given the contract and the results were presented to the secretarial level during a morning session. In the afternoon they briefed Harold Brown who had been unable to

attend the morning one. He didn't make any real comments other than to show his enthusiasm for Air Force's ferry mission requirement.

### **TAPE 13 of 16, SIDE B**

That mission as described in the proposal had the airplane taking off from an east coast base, landing in North Africa somewhere, and apparently after a refueling, the pilot was given his strike coordinates and sent off on a bombing mission. Presumably he'd carried the bomb along with him. Dr. Brown thought it was a great capability. Most of the operational people there were not quite as enthusiastic.

The full evaluation was not briefed to McNamara. As I understand it, McNamara decided that he only had time for a partial briefing and Col. Charlie Gayle, the SPO program manager, and Capt. Shepherd, our Navy assistant, took perhaps fifteen or twenty viewgraphs and gave McNamara a very short briefing. They reported back to us, or Shep did, eventually that there was no real discussion at the time and there was no way for us to know what in the world it was that the actual briefing contained. We know darn well that it didn't contain the recommendations of the Source Selection Board because Col. Gayle, the program manager, wasn't privy to it. He was only at the evaluation board level so he couldn't focus the presentation on what should have been the advantages of the Boeing design over the General Dynamics design. When you're talking to the secretarial level you better sure not let him be faced with facts that the raw point score was very close, perhaps 672 to 670 or you know very well he can make the wrong decision. And that might well have been the thing that caused all of the problems.

In any event, the services got overruled and General Dynamics was announced as a winner, I think on the 24th of November. From that point on then the Air Force started on the paperwork leading to a contract. Boeing was unhappy obviously. The trade journals all talked about the overturn of the decision.

Senator Jackson of Boeing's home state requested the Government Operations Committee, chaired by McClellan, to investigate the award to make sure that the government was going to buy the best airplane at the best price , which we obviously believed was not being done. The timing was such that by the time the committee got around to announcing that a full investigation was being initiated, it was the day that the contract was to be signed. The record shows that McClellan called DepSecDef Gilpatric and requested that the contract not be signed. At the same time the senator had written a letter requesting this, and had it hand-carried to the Pentagon. Gilpatric, for what he claimed later were the best interests of the country, told the Air Force to go ahead. So the Air Force went ahead and signed the contract at Wright Field. The contracting officer got questioned by the McClellan Committee investigators later and he knew nothing about the request from the Congress to not sign the contract.

In late December, just before Christmas sometime perhaps the 21st, the contract was signed, and the McClellan Committee announced that they were going to have an investigation. The investigation was really not very well done. The McClellan Committee's most recent investigation I guess had been of the Costa Nostra, a mafia racketeering type of thing. Their staff was equipped to handle that type of subject but none of them were experienced in national defense issues. McClellan obviously was. He was on the appropriations committee as well and of the other senators who were

involved, some were well informed and others were not. But the staff initially was in very sad shape to do this kind of an investigation.

Well that Source Selection memo – my timing on writing it might well have been because of the fact that investigation was coming up and I really thought that everybody on our side of the thing should have the same facts and refresh everybody's memory as to what had happened in the last year and a half. As soon as the investigation was announced the legal counsels and so on and so forth tried to get informed on what was going on. I remember going over to the Navy counsel's office in the Main Navy Building. At that time we were in the W Building which was back of Munitions, one of the temporary buildings put up during World War II. It was a two block walk to get over to the chief counsel's office of the Navy. The chief counsel looked over the Source Selection Board record. I had a little folder, my memorandum and I had copies of the recommendations of the boards and so on through all four of these rounds of evaluation and so on. He said, "Oh, my God, we've really got a mess on our hands." There was no question but that he recognized the problem immediately.

The reaction however of the Secretary of the Navy was anything but that. I remember getting a call from Cdr. Andy Kerr, Korth's legal counsel, and Kerr wanted to know what the defense was for Korth and I said there wasn't any defense. Well, we ended up in a meeting in Korth's office I think the day before he was to be asked questions by the staff investigators. We had the usual group, the Chief of the Bureau, OP-O5 and so on, program manager, Adm. Ashworth was there, probably eight or nine of us.

Secretary Korth told us directly that he really had very little to do with the decision. He admitted that he didn't understand all the factors anyway. The whole program was supposed to be under Air Force management. He said that they had shoved a document at him finally and he had signed it in the place where it said SecNav. Then he asked the group what should he say to the investigators. When no one else answered the question, I made a recommendation to him and the group to tell them exactly what he had just told us, that he had nothing to do with it, that the Air Force had made the decision and go talk to SecAF Zukert rather than talking to him. His words were, "Oh, I couldn't do that. This is all part of the secretariat," or something of that nature. From that point on he was in deep trouble and he got in worse and worse. Andy Kerr, the legal aide did a superb job of acting as defense counsel but in doing so he got crossways with all the rest of the Navy because he essentially came to be on the side of OSD while the rest of us were anywhere but on that side. I think Kerr made a mistake. Korth should have taken our advice and he would have been a lot better off. As people probably know he got accused of conflicts of interest because of his banking connections in Texas and he was actually forced to resign. Whether he deserved that or not I have no way of knowing. Cdr. Kerr later did not get selected for captain and retired from the service.

From that point on we really had a juggling act on our hands. We were trying to get a new airplane started and at the same time the McClellan Committee hearings started on the 26th of February. When McClellan started those he announced in the first hearing what the ground rules would be and so on. They would call witnesses. Witnesses would be under oath. The services were allowed to have two

representatives, the wording was "two representatives and not more than three from the Navy." The Air Force and SecDef also were to have "two and not more than three people" that could sit in. Both Boeing and General Dynamics were allowed to have two witnesses sitting in all the time and McClellan announced that he expected the hearings to last five or six days. What actually happened was hearings went on fairly expeditiously at the beginning and then they got spaced out for a way, and went on until sometime in November. Then President Kennedy got shot and the hearings just stopped. They wrote no report, reached no conclusions. The hearing record was out in book form but the committee didn't make their report.

I guess I also should mention that the hearings, FIRST SERIES they ended up calling it, were all classified, closed sessions. The public wasn't allowed in as you could gather from that, only two people from each of the services. In any event they ended up with something like 2700 pages of testimony, really not a well conducted hearing in my opinion. The fact that the hearings were closed and much of the data was classified either confidential or secret created real workload problems for many of us. When the hearings were on there had to be a security review committee that would go over the transcripts as they were issued and delete the classified material. Somehow or another I ended up on that too along with Cdr. John Hill who was then in OP-506. In some cases I would testify in the morning and then sit in the Pentagon that night going over testimony and deleting the classified material. The days got awfully long at the time.

The other thing that was peculiar about the whole thing was if I had been McNamara I would have told everybody to shut up and say as little as possible. But McNamara issued a directive to both the Air Force and Navy and said cooperate to the

fullest degree. Well obviously we cooperated to the fullest degree. Every time we cooperated we got SecDef into more trouble which then annoyed him to no end. He had elected at the beginning of the hearing to have the services present their position and then he was going to come in on that fifth or sixth day and clear up all the confusion and expected to wind up with a laurel wreath I guess.

What really happened of course was that the first day they called Mr. John Stack who had been the high speed aerodynamics expert at Langley who had cooperated with the Air Force and worked on the early Air Force program with Gen. Everest and Gen. Momyer that were pushing the low altitude supersonic mission for the Air Force. By that time Stack had resigned from the government and was actually just going to work for Republic which had been one of the competitors in the competition by the way. I thought it strange to start with Stack, but as I learned later, they thought he would take thirty or forty minutes but he took the whole first day. From then on it went like that.

Since the Navy had been told to cooperate we cooperated. There were many nights that we spent with Capt. Ike Kidd, then Adm. Anderson's aide, providing comments, questions, going over data and whatnot at the request of the committee. There was a great deal of work. At the same time we were trying to go ahead with the airplane. They were tough days.

Much of the early maneuvering of the committee concerned a mistake they had found in the way the point scores were tabulated because the Air Force had mentioned that the point scores, the raw scores and the weighted scores and all that jazz had included the AMCS fire control system for the Navy to be part of the Air Force point score system. I'm not really sure why they did that, but they did, and when the final



scores were tabulated they forgot to weight the scores for the AMCS. The weighting system had been approved officially by the Source Selection Board. (In reality it was devised by an ad hoc committee of the Air Force.) Anyway, when the AMCS score was weighted it changed the totals from General Dynamics being a few points ahead to Boeing being a few points ahead. The committee apparently expected that to be a real shocker and McNamara would immediately say he made a mistake and picked the wrong contractor. Unfortunately, of course, the point score by itself had little to do with the decision and the Air Force finally testified that they used point scores to aid in the evaluation but not to be a decisive factor. It would have been a lot easier for everyone if they never had used a numerical scoring system. I mentioned the standards before and the cost standard was one that you got the most points by being closest to the Air Force standard which was higher than the bid so the higher the bid the higher, within reason, the point score you got. Sure enough GD which had bid higher – perhaps \$50 million, maybe more, than Boeing – got a better point score in the cost area because they were more expensive which of course was contrary to the way we did business. There are so many things that just defied the imagination during that whole episode. Rationally I couldn't figure them out anyway.

Well, a month later the McClellan Committee got to the Source Selection Board itself and they testified. The early witnesses like myself and the people that had been on the evaluation board, the program manager, and so on had all been told we could not write statements to present to the committee. So then we had to depend upon the committee to ask the right questions to develop the facts and they seldom did. Most of the committee was opposed to McNamara and company but he had a couple of

defenders on the committee, Muskie of Maine was a McNamara supporter as well as Javits of New York, although Javits was seldom there. Muskie was there most of the time.

When I finally was called they were still going through commonality and point counts and whatnot and whatnot. I finally lost my cool or something and said something that the commonality issue was all poppycock, that what you're really interested in was getting the best airplane at the lowest price. It didn't make any sense to award a contract because one guy had 72% commonality and the other one had 56% or 70% or whatever it was. Part count commonality has no real bearing. It obviously is only a means to reduce the cost of a program so you should really be doing your decision making on the basis of cost not on commonality count. But that argument went on for years.

In any event we went through the hearings. They were at the point where Zukert had been on the stand for I think seven or eight days, the longest period of any witness. He seemed proud of the fact — had a sign on his desk proclaiming his record. They had already heard Korth and Gilpatric, then Kennedy got shot and the whole thing recessed. They didn't restart the hearings for three years, in 1966. They ran the second series then with 678 pages of documentation. Those were open hearings. The censorship stuff on security matters had disappeared. By that time the subject matter was unclassified or largely so, so we didn't have that working level security review committee which reduced our workload a bit.

The final report was written just before Christmas in 1970 seven years after the start of the hearings. Anyone who wants to get a good history of the whole program and what the big decision items were is well advised to read that report. It was entitled, "TFX

Contract Investigation, Report of the Committee on Government Operations, U.S. Senate, made by the Permanent Subcommittee on Investigations. Report No. 91-1496. 91st Congress," and dated December 18, 1970. One of the reasons the report is so well done it was written by an engineer instead of the lawyers that had been on the staff when the thing started

I guess that's an interesting story, too. Sometime about when the second set of hearings started I got a call from the committee and wanted to know if I knew Charlie Cromwell. I said, yeah, I knew Cromwell, he had been an aerodynamics engineer with the Navy, a flying qualities man, good engineer, but he had resigned from his job and set up his own business as a tree surgeon. That didn't go well because of the labor situation. He couldn't get people that he could depend upon, Charlie said later. So he applied for a job up on the Hill and got to the McClellan Committee. McClellan Committee looked into his background and hired him. From that time forward the committee investigation made a heck of a lot more sense and the final report, as I've said, is very well done and I recommend it to anybody that's really doing research on this whole program.

I probably ought to get back to the development part of the game. Within perhaps two or three months after the program was under contract, the Air Force, as we had predicted, found out that the airplane didn't go far enough for them so they suddenly announced to the Navy that the airplane had been lengthened, their version had more fuel in it and the structural weight was going up. The increase was marked for them, something like 10,000 pounds as I recall. This sent off great shockwaves with us. I remember Adm. Schoech called a conference and we all met in the board room with lots

of people from General Dynamics and from the Air Force. Adm. Schoech pointed out that life couldn't go on that way, that this was a joint program and we could not tolerate those kind of weight increases. It was actually that which we had anticipated would happen and it did. The weight increases went on anyway. The Air Force really couldn't back off. The airplane as it turned out was short legged anyway, they had no choice but to put in more fuel. I guess that must have been in 1963 and the program went along with weight status reports coming into us on a monthly basis. On the Navy airplane, the weight had been going up and it was up by perhaps 1,000 pounds when suddenly we found out that the weight was really up by a great deal more than that. We sent our senior weight engineers, Keith Dentel and Ray Hook, down to Ft. Worth to look into it. It turned out that the contractor, General Dynamics, had really been keeping two sets of books. He reported a weight increase to us of 2,000 pounds all in one fell swoop when it was actually 5,000 pounds. They had not reported 3,000 pounds on the basis that there would be a weight reduction program that would get rid of it. Well, with any kind of a weight increase of that magnitude of course we were in deep trouble.

In February of '64 we reported on a complete reevaluation of the F-111B airplane in Exhibit VF-4. I won't go and describe all the things that happened at that point. We really wanted to cancel the airplane but politically we couldn't do that. We recommended that General Dynamics stop work and redesign the Navy airplane. An eminently sensible position which was not accepted at higher levels.

The more I think about this the more things I remember that someone might be interested in about the peculiar things that happened during the period that the hearings were going on. I can remember being in Adm. Anderson's office with Whitey Feightner

and we had been bringing him up to date on the whole TFX happenings that were going on and the investigation which was then starting. I remember Adm. Anderson saying to both Whitey and myself, "If anything ever happens to you two from a career standpoint let me know, I've got enough data in my file cabinet that will blow the top off this building." Kind of strange. I had never given any consideration to any vindictive personnel actions up to that point in time.

It was a little surprising then that Adm. Anderson himself shortly after he testified that Boeing was a better airplane in the competition ended his naval career by being forced to resign and given a job as ambassador to Portugal. I think for the record he claimed that he had not been fired but I don't think any of us were really convinced of that. And then at the same time Adm. Ashworth suddenly got orders to go to the Med and head the Sixth Fleet. I can remember the counsel of the McClellan Committee telephoned me as well as some of the naval officers and questioned us on the transfer of Ashworth. I was told by the committee that if I ever heard anything that was being done to Ashworth to keep him from progressing in the Navy to let them know. Well, you couldn't really complain at that time. Ashworth didn't complain to me about getting the Sixth Fleet, but he never returned to Washington duty and after that tour he also retired. Now that I think about it, though, it does seem strange that so many officers connected with the F-111B/F-14 programs retired immediately or after a single tour out of Washington, and none were promoted. Anderson, Ashworth, Schoech, Rees, Ames, Shepherd come to mind immediately. Vindictiveness?

I recall another episode affecting me personally. I guess it was probably during the first evaluation period. Our aero people telephoned me and told me that they couldn't

find the dimension for the flap chord on the General Dynamics design. Well, I didn't think twice about it. I just picked up the telephone and called the local General Dynamics office, told them we couldn't find the flap chord dimension, could they provide it for us. Within the day they came back and told us what the dimension was. It was the type of thing that we did routinely when we ran a competition. Within a few days though I found out that I was on the pan. General Dynamics had notified the SPO that the Navy had asked for information and had made unauthorized contact with the contractor. Obviously, I had not gone through the SPO, nor had I talked to the contracting officer in Dayton. Apparently all of these were things that I should have done in order to get the dimension of a flap chord so that we could calculate performance. It just didn't make any sense but the Air Force actually sent a letter to the Chief of the Bureau recommending that I be reprimanded, a letter go into my file and so on and so forth. Adm. Hines was our deputy chief at the time and he called me up, asked me what the hell I'd been doing now. I explained the thing and he laughed and dismissed the whole thing. Whether something ever went into the file I have no idea, never looked at my file. Maybe I should.

One other strange deal was I was working at home on a Saturday afternoon, writing up something on the justification for what we were doing and I had a phone call from the staff of the McClellan Committee. They requested that I come down and see the senator that afternoon and so I said well, I'll have to check it out with the Navy. They said okay, let us know or some such thing. So I immediately telephoned the CNO's office. Ike Kidd had the duty that Saturday afternoon. Ike said, "Okay they've requested that you go down there, you do it, and I'll clear it with the Secretary of the Navy's office." It was at the time in the program that the Secretary of Defense had gotten "itchy" and

SecNav was also, and there was lots of worry going on about who was doing what to whom. Actions of this sort were unprecedented in my experience, which at that time had been over twenty years in Washington and involvement in over sixty new Navy aircraft.

But, I proceeded to go down with my briefcase full of stuff to see Senator McClellan. I parked and went into the Old Senate Office Building, got up to Senator McClellan's office and the gal on the outside said, "Just a minute, Mr. Spangenberg," and I waited outside. One of the staff guys came out and he said, "Something funny is going on. You are to be told that you cannot see Senator McClellan." And I said, "Oh, is that so? Okay." About that time Senator McClellan said that he wanted to see me so I walked into the office and he was extremely angry. His face was flushed and he said, "Mr. Spangenberg I've been told that you cannot talk to me," and then he went on a diatribe about McNamara and the things that he was doing to the country. Incidentally, in McClellan's office that afternoon he had his whole Democratic staff and Republican staff people on the committee and they were all waiting. I don't know what they were going to ask me, I never did find out but anyway I listened to McClellan. McClellan said he was going to "get" McNamara if it was the last thing he did. He had lost a son or two during World War II and he was a very patriotic guy who didn't like the kind of things that were going on.

Anyway, I left and started home but thought I'd better check in with CNO which I did. It was now late Saturday afternoon. I went down to Ike Kidd's office. Ike waved me in and said, "Thank God you came in." He said, "Sit down and listen." He called the yeoman and dictated a memo and went through the things that had happened. Apparently after my telephone call to Kidd he called Capt. Spence Robbins, our

legislative liaison officer, but Robbins had already been called that he should come down to the Pentagon for something. His wife didn't know what was going on. Ike was a little perturbed and apparently called SecNav's office and they were very upset, according to what Ike was dictating to the yeoman. When it all happened Ike said that he was talking on one telephone to the McClellan Committee and the other telephone to SecNav's office. He had told them that he gave me permission to go down and they told him that he couldn't do that and then SecNav's office apparently told the McClellan Committee that I couldn't talk to them. Well, it was all a great mystery to me. I didn't know what was going on. Kidd was angry and it was not apparent how anybody could have done this unless somebody's telephone was tapped, either CNO's, mine or Ike Kidd's or somebody's. To finish the tale — early the following week, a letter or memo arrived in my IN basket from SecNav advising me that I should not talk to Sen. McClellan or his staff without permission from SecNav's office. I had not been advised that the restriction was "in the mail."

**TAPE 14 of 16, SIDE A**

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Now back to the F-111 development program. In a 5 February 1964 letter to the CNO a recommendation was made that we stop the airplane until we could get a redesign that would meet our requirements. Obviously that wasn't accepted by the secretaries who eventually decided that we should go ahead, keep the weight improvement programs going, and the contractors would be asked via the SPO to send



in some studies for a fall back design. The fall back designs then came in near the end of July of that same year 1964 with a minimum of data. General Dynamics showed us four designs which were all in the SWIP (superweight improvement program) category. Grumman had a little more data on a design that they identified as CWIP, the Colossal Weight Improvement Program. It had a completely new fuselage and saved considerably more weight than the GD designs did. As accepted, the decision in that case was to continue with only SWIP, the least costly, hold the contractor to his schedule and to make some management improvements. The latter turned out to be the assignment of an admiral (Bill Sweeney) to Wright Field to become the deputy program manager. It really solved none of the technical problems. Some more of that detail is in that letter of 14 August 1964 which I'll mark and put into the record as Exhibit VF-5.

Sometime either early or later, I'm not quite sure which, there was a relatively formal fighter study done in OPNAV. I guess it was entitled the "F-111B Requirement Study." I wasn't involved to any great degree other than to provide weight and performance data to the study people in OPNAV. Gloeckler was more involved as you would expect. Adm. Zumwalt, then OP-096, headed up the study. Zumwalt was considered a protege of Secretary Nitze and was probably influenced to be kind to the F-111B. The requirement study I thought was a complete waste of time because its conclusion was that the F-111B was worth buying assuming that it met its requirements. The requirements hadn't changed since the first study which had been done a year or two before, when the F-111B started. We had signed off then that if it met the requirements it was an acceptable airplane to put into the fleet and would do a useful job. By this time, however, we knew that the F-111B was not going to meet the

requirements, so telling us that the airplane was satisfactory as long as it did just didn't make any sense.

The airplane continued on its merry way with the secretarial level holding the schedule sacrosanct but with the airplane gradually getting worse and worse , though they did approve some changes in the design as we went along. The new high lift system got designed and approved, an upgraded engine, the P-12 was scheduled to go into the airplane, work on new inlets or changes to the old one and weight reduction programs were continuing. The only problem with all of this was that every time there was an improvement it got incorporated farther and farther down the production line so it looked like we were never going to get a representative airplane where we could prove with hard data, which was a requirement being levied upon us, that the airplane wasn't going to meet its requirements.

Well, obviously the airplane never did and kept going down hill. Maybe as a side issue of this could be of interest on the kind of problems we were running into at the time. Executive management reviews, EMRs, were being held perhaps once a month where the SPO reported to the secretarial level what the status of the airplane was and so on. Included in those briefings were tabulations of weight and performance as calculated by the contractor, the Air Force and the Navy. These always showed up as the contractor being the most optimistic, the Navy being the most pessimistic and the Air Force in the middle. Some kind of a committee, ad hoc committee, got appointed to try to get some kind of an arrangement worked out where the Navy and Air Force would get together beforehand and show only one set of data. To do this we ended up by sending performance estimators to Wright Field to reach agreement on the basic parameters,

low speed drag, high speed drag, thrust, etc. Similarly, the weight people had gotten together and agreed on the basic figures which would be used. The next EMR came along and the differences were there just as big as they had ever been. We immediately got in touch with our opposite numbers in the Air Force to find out what had happened. Their reply was that they were directed not to give them their "best estimate" but rather to give them an "estimate of the best" which might be achieved if you're optimistic enough. I guess the issue of the differences between Navy and Air Force estimates on weight and performance never was satisfied.

With the airplane getting worse and worse and yet with apparently no real way to get the thing killed a lot of studies were going on both in and out of the Navy on our options. One of the concepts that came along was that we would accept the fact that we were going to have to have one squadron of F-111Bs on board our carriers, and they would be used for the FAD (Fleet Air Defense) mission only. Then we were to find ways to get a reasonable capability for meeting the so-called OFR (Other Fighter Requirements), fighter escort, close air support, etc.

Out of that acceptance of reality came a concept of an airplane called VFAX. There were attempts made to buy VFAX. It appeared in some of the Navy preliminary budgets but never made its way all the way through. VFAX, as defined then, was an airplane about the size of the F-4, in that same weight class, had a variable sweep wing and the requirements were set out to be that the airplane would truly match the capability of the F-4 as a fighter and the A-7 as an attack plane. The cost effective studies then all showed that one squadron of F-111Bs and three squadron of VFAX was better than buying two squadrons of F-111s and continuing A-7s, or with two squadrons

of F-111Bs and two of VFAX. That approach of one squadron of F-111Bs and three of VFAX really was a Navy position then as a way to solve the fighter problem for the better period of a year, a year and a half I suppose.

A few years later a VFAX showed up again in the development plans leading to the F-18. The terminology of VFAX was used again but you should bear in mind that the original VFAX was a very capable airplane and the later VFAX was marginal at best, being somewhat less than the A-7 in its attack capability and really no better than an F-4 as a fighter. In the cost effectiveness studies that were done it was rated below an F-4 because the later VFAX was a single-place airplane, while the original was a two-place airplane.

The 14 August letter which summarizes the things that happened in the July 1964 submission I've labeled as Exhibit VF-5. Incidentally, all this period, these enclosures, the February and July ones are covered in the second set of hearings of the McClellan committee.

As the years went by with the F-111B showing no improvement and the Air Force version actually showing in its flight test that it too had very serious deficiencies and would not meet Air Force requirements, there was more data appearing in the trade press about the problems that were going on and more word started reaching the congressional committees. In 1967, the Congress during the appropriation and budget process refused to commit any production funds for the F-111B after Adm. Connolly in a hearing finally made a statement, which Jerry Miller relates in a "Foundation" article, to the effect that there's not enough thrust in all of Christendom to make the airplane satisfactory.

Up to that point in time, though, the Navy in the appropriation and budget process had gone along with OSD and continued to support the airplane. Much earlier Tom Connolly had made the statement that made all of us at the working level cringe when he testified after a flight in the airplane that the airplane "flies like a lady." There were lots of comments then about the size of that particular lady. The game that our senior officials had to play seemed to me to be "Either go along with us or else." The "else" being a cut of a major budget item. Most of the OSD decisions were political affecting the F-111, not technical. Obviously this led, after a few years, to all kinds of requests for the "lessons to be learned" from the experience. Adm. Fawkes had asked Gloeckler and myself to prepare something on the lessons learned and I finally wrote a memorandum on 13 March 1967 on the subject which is pretty self-explanatory. I'll include it as Exhibit VF-6. The only thing I might add is that this "lesson learned" business is a good deal more difficult than one might expect because there were damn few lessons really that I learned other than to be more forthright, and obnoxious. We might have been better off becoming "whistle blowers" and appearing in the public press yelling our case rather than sticking within the system and trying to get the airplane changed. But the guys at the top learn different lessons than those of us at the bottom of the chain. A second memo, Exhibit VF-7, written slightly earlier, deals with the same subject, but with a request initiated by then SecNav Nitze. Everything he stated as a lesson that he had learned were things that people that had been doing airplane development already knew. One thing that the lessons learned, as I point out in the memo, is that the deadlines that were established and so on and the way that the system worked were always ridiculous. We always ended up with a day or two or even less to respond to

secretarial decisions. I guess I never did suggest that they let the working level talk directly to the policy level instead of having several layers in between. That should have been said.

I'll continue my version of history now with the VFAX program which of course evolved into the F-14. Some of the early stuff on this may be of some interest and may not appear elsewhere. In the year or two before the end of the F-111, as has been mentioned, lots of studies were being done both in and out of the Navy some funded, some unfunded, on how best to solve the needs of the fleet for an F-4 replacement. The big effort finally came about when it was apparent that the F-111B was not going to make it and the concept then became one of taking an airplane similar to the VFAX and adding the Phoenix missile system to it. I'm not sure how many other people were inventing that airplane at the same time but I remember being in Fred Gloeckler's office with a group of Grumman people for a VFAX discussion. The more you looked at the total situation the more you became convinced that a better solution would be to get a new fighter that would carry Phoenix and still have enough performance to do the other fighter missions. In essence, VFAX with the addition of the Phoenix system. Fred Gloeckler was the guy that first suggested it I believe. In short order Grumman came up then with some studies with that kind of an airplane. They all looked attractive. Another formal full scale study then ensued. Adm. Zumwalt in this case was the designated leader of the study while Capt. Mike Ames was usually my point of contact. It was a big effort. The cost effectiveness studies that used to be done routinely in Gloeckler's shop with his small group escalated to major efforts extending over a month or more of work

with many people involved in the whole game. The "back of the envelope" studies were just as reliable when done by those knowledgeable in the field.

Needless to say, that fighter study then justified the need for the new airplane, with the designation, VFX. We had the usual trouble with OSD on setting the program up. They wanted to approve every sentence in the specification and in the RFP. The RFP, in trying to comply with the rules coming out of OSD at the time, got to be two or three inch thick document rather than the half inch thick document that we were used to. But it was decided that it was better to try to comply with the rules than to fight the system.

Another big difference at the time was that in the usual case we did not fund design competition efforts. We let the contractors gamble really on who was going to get a production contract. You got a production contract by winning the experimental contract. This time OSD forced a funded effort for the four companies which had been active in this design area.

We finally ended up with contracts for development of proposals. We paid the contractors to submit proposals for the VFX, including Grumman, North American, McDonnell Douglas and General Dynamics. The proposals were submitted, we evaluated them, and Grumman was a hands down winner. All of the airplanes were variable sweep wing designs with the exception of North American. I think all of the design studies up to that point had concurred in the fact that one got a better airplane using variable sweep. The Navy did not agree with the performance claims of North American. NASA generally agreed with our position, forestalling any real controversy in the political arena.

When we started this program the normal number of production airplanes to be bought was something like 463 with a normal production rate of eight a month or 96 a year. If we had our way we would have had the contractor bid fixed price on six R&D airplanes and then with production ceiling options for perhaps another 100 airplanes. We tried to get that kind of a contract through OSD but they refused and forced us to include fixed price ceiling options for the entire planned buy. I felt that this was quite unreasonable. The financial risks seemed too great for any manufacturer to assume. The program as initially laid out contemplated we'd start the program with the TF30-P12 engines which were already in the F-111B and fully developed, but we planned to shift over to a new engine then under development under the management of the Air Force, a Pratt Whitney design. It would give us a marked increase in thrust and with better specific fuel consumption. The airplane then would be called the F-14B.

The second step envisioned in the airplane was to install a new avionic suite that would have an all weather attack capability built into it so that you could do the job of the A-6 without a major increase in complexity of the system. It was a good idea, and the technology was believed to be available. That would have been the F-14C. The F-14C dropped out of the picture first and eventually our new engine got cancelled as well so we were stuck for a long time then with the engines that had been developed initially for the Missileer and then used with an afterburner for the F-111 program.

I think its been well publicized elsewhere that the basic design mission of the F-14 included four Sparrows, and that the six Phoenix FAD mission would be considered an overload. We also had the complete A-7 level of attack capability built into the system from the beginning though that feature was dropped later. The reason



for its elimination was to reduce costs associated with flight test clearance of Navy conventional stores at all wing sweeps. At the time, the production program had been cut back to levels that made it appear that all the F-14s would be needed for the pure fighter roles.

Back to the VFX competition. The evaluation of the proposals went off very well with Grumman selected as the winner almost hands down. However, to meet the rules that were being handed down by OSD, it was determined that we should carry two people through until we negotiated complete contracts. McDonnell Douglas was selected to provide the competition for Grumman. The people that are really not involved in the process all seem to think that competitive step is necessary, that it keeps the first contractor honest and so on. In my experience it's a step that just complicates the acquisition and increases total cost. The people doing the negotiating know full well whether or not they can negotiate a contract. If they need competition then make the decision on a case-by-case basis to do it but don't make it a requirement and don't do the program that they later got into of "best and final" offer where you try to make the contractor reduce his price usually already too low. It just gets you in more trouble, at least on major procurements.

The thing that eventually gave us most of the contract problems in the F-14 was the variable quantity lot requirement that we had. I probably talked about it back when we talked about the A-7 though we had added this then in order to provide more flexibility. If we wanted to increase the quantity of aircraft we wanted to have contractual coverage and not have the contractor "hold us up" for larger prices than the prices for the airplanes already under contract.

In the F-14 program what really happened was that Grumman in pricing the variable lot quantity apparently made the fatal assumption that their business base would continue to be the same whether they were building 50% of the specified F-14 contract numbers or whether they were building 150% of those numbers. So then their variation of price with production rate was very very flat. A curve sheet that shows the problem will be attached with Exhibit VF-7 (*ed: called the Variable Lot Pricing Graph*). That curve sheet shows that the F-14 had about one-third the increase in unit price when you cut the production rate in half and that the S-3 had and one-quarter of the increase specified for the F-15. Unfortunately, these facts were known to us at the time we negotiated the contract. I remember distinctly talking with our contracts people and they agreed that the price variation quoted for the reduced rate and really for the 150% rate too were not reasonable. They informed Grumman that we believed they had a problem with the VARLOT pricing. Grumman, after study, informed us that they didn't agree so the clause remained as bid. It is seldom that a contracting officer will suggest raising a bid price. It just isn't done. So in this case Grumman was told only that there was a problem. In retrospect, we could have avoided lots of problems if we had been more specific. It is not unlike the Air Force telling the contractor that he had a deficiency but not telling whether it was high or low. If I had it to do over, I think I would find a way, hopefully ethical, to let the contractor know the specifics of our concerns. The effect of that VARLOT mistake was huge. The unit price differential between the normal and half production rate was so low that it invited the budgeteers to cut the quantity of airplanes being procured, and actually they did just that as soon as we got to the point where they could take advantage of that contract clause. The discussion went like this: "How much

does the price go up if we only buy half as many?" "Well, it only costs another few percentage points." "Oh, well, then let's do it, it won't break the contract." We would have been in far better shape if we had never had at least the low side of that variable lot pricing clause. Some years later Grumman got into trouble with the lot 5 or 6. When they could no longer produce the airplanes for the option price at the half rate, Grumman had another chance to recover. I remember a trip to Grumman with Adm. Tom Connolly, Mike Ames and probably Scotty Lamoreaux in connection with this problem. My recommendation at the meeting was that Grumman could ask for relief under the ASPR by admitting that they had made a mistake and that the Navy was aware that it was a mistake. We could then treat it as a mutual mistake and rewrite that clause. For reasons I still don't understand Grumman elected not to do that. It probably would have created a hassle at the time but it would have saved a lot of effort farther down the road and we might have been allowed to produce more aircraft.

Well, all and all, as everybody knows the F-14 program went very well. To kind of indicate the difference between the F-111 and F-14 programs, I made three trips to Grumman on the F-14 including the visit as a member of the mockup board, while on the F-111 program I had been forced to travel some thirty-five times for conferences scheduled to solve problems. The F-14 went like a Navy airplane should go. We had some problems. We recognized those problems and solved them. Dive brakes had to be redesigned and we had a big hassle on the design of the landing gear. We saved a few hundred pounds with a clever redesign. All kinds of troubles were predicted on that one, but as so often happens, when you recognize a problem, with a good detail design job you can solve it before it appears. Well, without belaboring the point the overall

development went well. The airplane flew for the first time on December 21, 1970, a month or two ahead of schedule.

### **TAPE 14 of 16, SIDE B**

The flight date was easy for me to remember because it turned out it was my wedding anniversary. On the day of the first flight Adm. Connolly had called on that morning after I was at work and told me that we were going to fly up to Grumman that day. He had the CNO airplane and Mike Ames, Scotty Lamoreaux and myself joined Adm. Connolly and we flew to Bethpage. None of us other than the Admiral knew the purpose of the trip. We got up there and learned that the first flight was scheduled that afternoon. As usual, there were a few little paperwork problems to clear and the flight was a couple of hours late. Mike, Scotty and I waited together in a car at the edge of the airport. The pilots came back, gave us a thumbs up and said that in their opinion they thought we had a winner. So everybody was pretty happy. About the time then when we started to go back to Washington the weather closed in and we had to stay overnight. Grumman had a hastily arranged dinner party during which a telephone call to my wife was put thorough telling her I wasn't going to quite get back in time for our 35th anniversary.

We had a disaster on the second flight of the airplane a short time thereafter when the airplane crashed on final approach after a complete hydraulic failure. We eventually had to replace all the titanium lines in the hydraulic system with stainless steel due to resonance problems causing fatigue failure. The pilots almost brought the airplane in before losing all their hydraulic fluid causing loss of control, The pilots ejected

at very low altitude just before the plane crashed at the edge of the field and were not seriously injured. And of course then the program was delayed for a few months while we solved the problem of the hydraulic lines.

The program progressed, I thought, normally in '71 until trouble arose in the cost area while negotiating the target price of lot 4, undoubtedly due to that VARLOT foul-up. Somehow or another the negotiations escalated up to the DepSecDef level with Mr. Packard and Grumman CEO Evans. From then on, there was obvious OSD bias against the F-14 program. Mr. Packard reached the conclusion that the airplane was too expensive and instituted programs seeking a lower cost alternative. I was not involved in any of those skirmishes, but I hope someone will provide that history. Capt. Mike Ames must know.

The initial look at low cost alternatives of course revealed the fact that there weren't any and undoubtedly DepSecDef was told that. The second phase in low cost alternatives came about I think during a congressional hearing when Senator Symington suggested that we get a carrier version of the Air Force F-15. He claimed that the studies were all available and ready to go. That turned out not to be true. The F-15 program people, Al Jarret from McDonnell came into town. He was one of the technical guys at McDonnell on the F-15 program, but formerly was at Vought, knew the Navy requirements well and was respected in NAVAIR. We spent the day trying to determine the status of their F-15 Navy studies. We soon found out that we couldn't deal directly with McDonnell. The Air Force objected. We had to then work through the Air Force in order to get any data. At the time Gloeckler and his group were doing a fair share of that work but eventually we ended up with no solutions. In the end, the F-15 mod was shown

to be considerably more expensive than the F-14 so it didn't make any sense. The only real proposal we had was for a version of the F-15 carrying four Sparrows which really put it into the effectiveness ballpark of the F-4. Probably a little below because it was proposed as a single seat airplane instead of a two seat airplane. We tried to get from McDonnell Douglas a proposal to also carry the Phoenix so we could get a more direct comparison of capability but the Air Force informed us that McDonnell Douglas could not do that type of a job within the time, money and resources available so we never did get a Phoenix carrying proposal on the F-15. It seemed like the Navy conducted a thousand cost studies, and every time we did a study, we found out it was cheaper to just buy more F-14s than try to buy half as many and then supplement it with something else.

About that time Clements replaced Packard and I guess at the DepSecDef level the situation really went from bad to worse. Clements was not a person who really understood the aircraft business nor how we did business nor anything else. I wasn't the only one that thought that. After one of the acrimonious episodes between the Navy and OSD on the subject of F-14 alternatives Clements invited me to lunch, just the two of us sat there and talked for an hour or so. He started off by introducing himself and saying that he didn't know a damn thing about aircraft but he sure as hell knew a lot about oil rigs, while I assured him that I didn't know anything about oil rigs but that I did know something about aircraft and aircraft acquisition. The meeting was very amicable and I explained what I thought were the facts of life to him but apparently it made absolutely no impression. From my vantage point, he continued causing problems with every step and I didn't know whether he didn't understand what I said or whether he was just incapable of absorbing it. Strangely, I later talked to Ed Heinemann and he had a similar

experience where he had gotten crossways with Clements on something, went through the same kind of an exercise, thought he'd convinced him and at the end of the game Ed walked out happy but the next time they met on the same subject Clements was right back to his original viewpoint. He was either incapable of being convinced by facts or he just didn't understand the whole situation.

While we continued trying to find alternatives, continued trying to do the program, the whole OSD conglomerate were doing things that caused all of our programs to be studied in detail, overdone in studies and so on and so forth. Among the various things that I can remember now is that the high-low mix program started, and the prototyping (with a capital P) came to the fore. Within the Navy, Adm. Zumwalt and Tom Davies, then the R&D admiral in CNM, were pushing the idea of the SCS, a sea control ship. Also going on were studies of the cost of large and small carriers by NAVSHIPS probably related in part to the SCS but also related to some VSTOL work that was going on. Some of these things we'll have to talk about in a little more detail.

Might as well talk about the high-low mix concept first. OSD, after they found out that there was no single low cost alternative to the F-14, came up with the idea of a high-low mix. The OSD opined that we didn't need one-for-one replacement of F-14s for the F-4, but that half of the F-14s could be replaced by some lesser capability (and cheaper) aircraft.

The whole high-low mix thing had been started with a study by one of the think tanks. For OSD, Al Simons, who headed up the TACAIR part of DDR&E, seemed to be the chief sponsor. He invited us all over to hear a presentation by the think tank after they had finished their study. The study was entitled, "Designing to the Budget

Realities." What the think tank had done was to take the long-range plans of the services, add them together, and to their apparent surprise found out that those total expenditures down the pike were well over current OSD budgets. So they concluded something had to be done about it. Well, of course this had always been true. At any time, past or future, when one added up long-range plans the totals would exceed any current budget. The budgets would get closer to fiscal reality in the next step when you got to the short-range plans. Something like the FYDP, the five-year plan then in effect in the Pentagon, and then you really got into fiscal reality when you did each year's budget. But in any event the study ended up by saying that perhaps a way to solve the whole problem was to buy some high capability aircraft to meet high capability threats and then to buy a bunch of low capability aircraft to meet the low capability threats. To them it made sense. To all of us the idea appeared extremely naive, particularly for carrier aviation. Against our high threats it was going to take everything we had and then some. The other side may not be willing to send their JV squad against us so that the fracas can be rated a toss up.

The thing that was most disturbing I think to all of us was that all of these kind of ideas came along with no real study of effectiveness to see whether they would work. On the other hand, every time we made a move or offered a new program we had to define it in the greatest of detail from a cost effectiveness standpoint. They, OSD, the bad guys in my book, never did. After I retired I got around to writing a couple of papers on the high-low concept which were published in two different magazines. I'll talk about them later when I get around to discussing the acquisition process, but my generalized



study convinced me that the cost of a 50-50 mix was substantially higher than buying an equal number of the better aircraft.

The other thing that was being pushed to a great degree was prototyping. For some reason there are people who believe that prototyping will solve all of our problems. We had given up prototyping before World War II because it cost too much, took too long, and really wasn't necessary with the state of the art at that time. But some of these people, that had really not been involved before, seemed to say that prototyping would solve not only all known technical problems but also all known fiscal problems. Again, while we all considered it ridiculous, it cost us an enormous amount of time. That lesson of history is almost universally ignored.

Well the high-low thinking of course impacted on us with OSD starting to say we didn't need the Phoenix capability. The Marines complicated the problem by jumping in and out of the program – one year they were in, next year they were out. When they were in, the replacement of their F-4s when added to the Navy's replacement required something like 729 airplanes. When the Marines dropped out the numbers dropped considerably.

In early '73 Clements appointed an ad hoc committee headed by Dr. Flax who was well-known and usually well respected man in the aero field. He had headed the Cornell Aero Labs, had a good reputation and most people liked him. Clements asked the group to look into the modernization program of naval aircraft. The Flax committee report, as well as all other studies, said that we needed something better than the F-4 but the Flax group also wanted something less expensive than an F-14. We would have

been happy too to get F-14 capability with less cost but we didn't know how to do it, then or now.

Sometime in the spring of '73 I made the decision to retire, not because I really wanted to but I had already been working a year or two too long if I wanted to optimize my retirement annuity. The retirement system provided that if you continued to work you gained two percentage points each year on the percentage of your salary that you would receive as the annuity. If one retired, however, you received a cost of living increase each six months plus one percentage point to take care of the fact that COLAs, so-called, were always six months late. It didn't pay to continue working. My friend Fred Gloeckler had retired a year earlier. Also Gil Weiss, my old buddy that had come down and been my assistant ever since I had been in the bureau had retired even earlier. It didn't make financial sense not to leave, particularly when I had no desire to move into the industry side of the acquisition game.

Well, despite the fact that I was retiring I continued to work on the project at hand – I guess the problem at hand was really DepSec Def Clements. He finally sent us a memo on the 7th of June, a copy of which I'll mark Exhibit VF-8. It's a memo for the Secretary of the Navy concerning the fighter modernization program which directs us to look at a prototype program that he had studied. Actually it wasn't quite as bad in the 7 June version as it had been slightly earlier. By this time he had narrowed down the things that we were to study to versions of both the F-14 and the F-15 and some kind of a modified F-4J and we were supposed to show him – let's see what he said we were supposed to do – "The Navy will develop for my approval management, development, test, production and funding plans for these aircraft which will include" , and so on. We

were to get this back to him by the 13th of June so he had given us one week to do the study. Fortunately of course we had been doing so many of these exercises that we were able to put it together quickly. Those of us at the working level of course didn't have anything like a week because our answer had to be put together, go to the CNO, CNO to the Secretary of the Navy, Secretary of the Navy to Secretary Clements. Well, the whole thing was so stupid that I guess I blew my stack again.

Then on the 11th of June after we had complied with the request as well as we could, I found that I couldn't get anybody to take any official action on the total problem. I ended up writing a memo from me to Secretary of the Navy protesting the whole scheme. A copy is attached as Exhibit VF-9. I sent the memo direct to SecNav, hand-carried it to his office, but sent copies to CNO, CNM, OP-05, COMNAVAIR, his deputy and to my immediate boss AIR-05. I was still trying to work somewhat within the system. Well, most of the people that were involved in between either said nothing to me immediately or telephoned and said, "Great idea. Let's see what happens." All except Ike Kidd, then CNM, who was not pleased and directed me to go get my memo back. I wasn't about to do that so I said no thanks and told him I'd prefer to let the memo stand. He apparently then called Adm. McClellan, COMNAVAIR and directed him to retrieve my memo. Someone did, because CNM's copy was returned to me. Unfortunately, SecNav Warner was out of town so he didn't become aware of the situation until later.

There was another part of the exercise which had increased my frustration. Mr. Clements had requested funding estimates for his prototype scheme including development, testing and production. NAVAIR prepared the data and forwarded them either to or via CNO. We were then told that the total package was not desired, but only

the prototype plan figures were to be forwarded. That made no sense to us, but NAVAIR complied. From our viewpoint, a rational decision on the OSD plan could only be made by totaling the three individual prototype plans plus the production costs of the selected prototyped model plus the production costs of the reduced numbers of F-14s, and comparing that to the normal F-14 costs.

The problems all were headed for a climax in a hearing scheduled for 19 June before the TACAIR subcommittee of the Senate Armed Services Committee. In preparation for the hearing, the staff of the committee requested a meeting with Navy representatives. Adm. McClellan headed a small group, including me, in response. OSD had sent two individuals, apparently to monitor the conference. In response to the staff's request for cost information on the proposed DepSecDef F-14 Alternatives/ Prototype Plan, they were given the official correspondence which contained only the prototyping costs. After the OSD monitors departed, the staff asked Adm. McClellan whether he had any data on the total cost picture. Adm. McClellan said he had been directed not to have the numbers so he didn't have any. The staff guys apparently anticipating the answer then asked the rest of us and when they got to me I had the numbers. So we provided the numbers on what our estimates were for doing the Clements-directed program of prototyping, two years later make the decision, put into production and so on. Then we compared it with just buying more F-14s, which, of course, was the cheaper way to go, as well as being much more capable.

On the basis presumably of the fact that the committee didn't think that the actual numbers would be given to them, nor would the working level recommendations ever reach them they requested that I be an official witness as opposed to just being a

backup at the hearing. They knew that backups could be told not to show up while witnesses had to appear unless they were excused by the committee.

On the morning of the meeting I got a phone call from CNO's office, Adm. Mickey Weisner was then OP-09 and was acting CNO. He asked me to join Adm. McClellan and to come over to SecNav's office. We of course complied. At SecNav's office we went over the whole issue with Secretary Warner. He had read my memo before Adm. McClellan and I arrived. He agreed that the thing didn't make any sense so he said to us, "You stay here. I'm going to go see Mr. Clements," which he did. We sat and waited. Eventually about twenty minutes before hearing time he telephoned us and said proceed to the Old Senate Office Building and I will meet you there. So Adms. Weisner, McClellan and I got into a car and off we went. On the way to the building Mr. Warner and Mr. Clements caught up to us and signalled that they wanted to say something so riding side by side on the SW freeway, Warner told Weisner not to go inside but to remain outside and not let me go inside. So we did as directed and met Secretary Warner outside and Warner said that Clements had decided I should not appear. Clements would explain to the committee why and that they could call me as a witness later. So I went back to the office. They went ahead and held their 19 June 1973 hearing. In that hearing Mr. Clements had no statement to give, but told the committee that he'd work from prepared notes. The prepared notes and his non-existent statement appeared in the hearing record later. He said that after he had studied the fighter modernization program he reached the conclusion that the Navy didn't need Phoenix capability in all of its airplanes and that there were no lower cost alternatives that the Navy had found so he was embarking on a prototype program to determine what was

the best non-Phoenix carrying airplane to go with the Phoenix carrying F-14. He still wanted the Navy to prototype a stripped F-14 and to get an F-15 carrier suitable airplane from McDonnell to prototype and he'd drop the idea of prototyping a F-4 upgrade (which of course had never made any sense to us). He defended his program in the usual manner of "preliminary data, more later, etc." The testimony from Warner and Adm. Weisner was less adversarial about the prototype program than I hoped. Well they didn't really argue against the program but concentrated on supporting the budget request of 50 F-14s. As usual Clements had pretty well cut their feet out from under them by saying that everybody was in agreement and that the Navy was supporting the program. I knew personally that they did not but somehow or another in these things it's very difficult to get crossways with the Secretary of Defense. It shouldn't be, but it is.

I went ahead and retired officially on 23 June, the day after my 61<sup>st</sup> birthday. Three days later I appeared at a hearing before that same committee where I gave them my ideas and my version of history and what we should and what we should not do. This was the '73 version. The hearing was not well attended. Senator Goldwater and Senator Cannon I believe were there at the beginning. Goldwater stayed around for a while but most of the questioning ended up by being done by Charlie Cromwell with all the senators missing. This was usually the case. If the secretaries and admirals weren't there the Senators didn't appear. Strangely, though, the hearing report reads as though all the senators were present and there was a lively colloquy. My statement to the committee is attached as Exhibit VF-10. It is a good summary of the prototype program and contains whole cost data. Well the outcome of that exercise was that the Congress

refused to fund the Clements prototype program so I guess I considered that we won a small victory but we sure hadn't won the ball game.

From that point on — bear in mind now I'm out of the Navy and the idea of using less than a one-to-one replacement of our F-4s was still in being. The total number of airplanes being talked about then was in the low 300s.

After I retired I was approached to see if I wouldn't continue in a rehired annuitant role. In that role I could work part-time, primarily to provide consulting services to my old office and I would be paid the difference, on a daily basis, between what my daily rate of the full salary had been and what my annuity would turn out to be. The going rate was, I believe, \$105 a day then for a consultant but because of my rehired annuitant status, the actual pay was about \$45 per day. A few years later it was about \$5 or \$10 a day because the COLAs kept increasing the annuity and so the annuity kept getting closer and closer to the salary at which I had retired.

A brief recap then as to where we were at the time of my retirement. Grumman had produced or had agreed to produce through lot 5 on the contract something on the order of 122 airplanes. They were being produced at the minimum contractual rate of 48/year. They had refused to build lots 6 and 7 under the terms of the contract because they would have gone bankrupt. They later negotiated a new contract price. That 122 airplanes was through fiscal year '73. The overall program had been cut back as OSD directed. We had to go to one squadron per carrier instead of the two that had always been planned. At that time the Marines were back in the program after dropping out earlier. The studies all said that if we were to complete the VF modernization, that is replace all the F-4s, if we were to do that without any production gaps we needed 174

more F-14s in fiscal years through '77. So we would have had then a total in the program of about 400 F-14s.

The new engine that we were supposed to get in airplane number 68 had been, or was in the process of being, cancelled and the later GE-101 engine hadn't come along far enough yet that it was being actively considered.

From an acquisition policy standpoint, forcing Grumman to fixed price ceilings for 463 airplanes, normal quantity, that we had done in the original contract was obviously a mistake. It had been forced upon us by OSD however. As I believe I had said before, we should have held the fixed price ceiling requirement to only about 100 aircraft. That would have been more or less equivalent to the 200 that we had on the A-7 program and the 100 that we had on the CH-53 program. When you try to go too far the system falls apart. The contractor should not have to risk his entire company.

That's the story of the low cost alternatives to the F-14. It will be apparent to anyone with even a moderate background of airplane design that the program pushed by OSD had absolutely no hope of success.

#### **TAPE 15 of 16, SIDE A**

At this point we probably should take a step backward and examine the lightweight fighter program for the Air Force which eventually really impacted on the way the F-14 program went from 1973 on. The "Prototyping with a capital P" program, as it was dubbed by Adm. Suerstedt, started in the early seventies. OSD had again endorsed the thought that prototyping would solve all problems. Industry in general tended to



support it at least in the trade press. I suppose people that supported it were the have-nots, those companies that had no programs going.

Anyway, in the early seventies OSD went to all the services and asked them to submit possible projects for inclusion in the new Prototype program. Many people thought in a wishful thinking kind of a way that the dollars involved in the Prototype program were going to be extra dollars and wouldn't come out of our normal budgets. Adm. Suerstedt ended up being our representative on the Prototype program and after lots of discussion the Navy eventually ended up with their number one priority program that we would like to see funded was the S-3 COD Program. We hadn't been able to get it funded in the normal budget process so some thought that this ploy might work.

In addition, a bunch of smaller programs mainly in the electronics field were included. Some ASW work, sonobuoys and some AEW work too I believe. The Air Force submitted their list of things and about half way down the list of perhaps ten projects was a lightweight fighter. The lightweight fighter scheme of course had been promulgated by the "gum on the windshield" fighter types in and out of the Pentagon for a long time. Those people of course were part of the background noise that confused everything that was going on in the real world. It seemed obvious and even more obvious I guess in retrospect, that what the Prototype program may have been designed to do was to get a lightweight fighter started. So the one that really got funded in this big program was the lightweight fighter for the Air Force. It was set up to be a very simplistic kind of an airplane. Minimum fighter requirements and minimum control by the Air Force. The airplane would have no radar in it, armed with gun and Sidewinder, short radius, maximize the dog fight capability. In the source selection the primary requirement or

criteria for the selection was to minimize life cycle cost. To that end, the rules of the competition strongly emphasized use of an engine already in service. In actuality, it pretty well boiled down to that if you were going to win the competition you had better have the F-100 engine that was already in the F-15 program in your airplane.

It was apparent to me that the Air Force was kind of in a bind because they had looked at lightweight fighters when they set up the requirements for their F-15 and had rejected them. Their choice of F-15 requirements seemed to be to get the most capable fighter possible which would not conflict with the F-14. Those of us in the Navy thought that the airplane in reality probably didn't offer much over the F-4 program at least as far as air to air capability. They obviously could not get a new program of their own if it was going to be in the ballpark with the F-14 so they picked the best one they could.

When the lightweight fighter then came along they obviously didn't want that to be an F-15 competitor as it turned out to be for us. The Air Force actually stated that the light fighter program was solely a technology program with no production contemplated. It was only to investigate concepts, new technology and so on. Well, they ended up by getting proposals from General Dynamics, Vought – then called LTV – Boeing, Northrop and Lockheed, all with the F-100 engine. Northrop also submitted a twin engine design using GE J-101 engines.

The Air Force, after the proposals were in, invited the Navy to come out and take a look so perhaps four or five of us went out, I among them. Whitey Feightner was there I remember, probably Lamoreaux, not very many. In the very brief look we were given at the proposals it seemed fairly obvious that Kelly Johnson at Lockheed had just ignored all the rules and tried to build the best airplane he could that would be, let's say a

replacement for the F-104. It did have a reasonable capability with enough fuel to have a decent radius but it obviously wasn't going to win that competition under the ground rules. General Dynamics, Boeing, LTV and the Northrop single engine, were all very similar.

The Northrop twin engine design seemed not to be considered very seriously by the Air Force, undoubtedly because of the way they had set up the life cycle cost ground rules. It essentially doubled the life cycle cost if you had two engines. Not quite but almost. Certainly enough to take it out of the competition.

When the Air Force finally made a decision, the winners were announced as the General Dynamics design and the Northrop two engine design. Shortly after the announcement, Boeing came into NAVAIR, and showed me their design and told me that in their debriefing by the Air Force that they had been told that they were the number two airplane and they were quite upset that the award had gone to Northrop's twin engine design. I listened sympathetically but there was really nothing that I could do. I suggested that they go talk to some policy makers in the Air Force and see whether or not they couldn't get a better explanation of why they didn't win and so on. I guess within a week after that LTV came in and told me the same story, except that they were number two. Obviously, I was as puzzled as those two contractors, since under the ground rules told to us, a twin engine design would not be competitive.

In a colloquy in a hearing before the Senate Appropriations Committee in '75 something came up on the lightweight fighter and I made a remark that Air Force selection decisions normally were made in Washington rather than at Wright Field where the engineers were. Gen. Stewart was there and he immediately took umbrage.

Adm. Lee spoke up defending Gen. Stewart and the Air Force. Well, after the hearing was over, Gen. Stewart had told the committee that the recommendations out of Wright Field were Northrop and General Dynamics and I said to Gen. Stewart, "You couldn't have selected the Northrop twin engine design" and told him that both Boeing and LTV had come in and told me they were number two. His statement to me was, "Well, I never said that we selected at Wright Field the Northrop twin engine design." So apparently the game was that Wright Field said GD and Northrop, according to Stewart, and certainly all the single engine designs were quite similar from our limited look. From the tales to me there were apparently at least three second place finishers. When the source selection decision-making process reached the Secretary of the Air Force, the Source Selection Authority, it is probable that the question, "Why should we prototype these two airplanes that are almost identical," was raised. It seems reasonable to me, particularly in a program not intended for production. I would only raise the question of fairness to all the competitors. As I understand the procurement, each contractor was paid about \$50 million in what was called a cost plus contract, but with a ceiling which in effect made it a fixed price contract. Each contractor probably put in at least that much of his own money before he finished. In the Air Force fly off, GD was of course selected as the winner with its F-16. I was not involved in any of that but then of course as everybody knows it became promoted as a multinational airplane. They finally put the program into the budget but without cutting back on the F-15 program as it was then planned. They were planning to buy about as many F-15s as we were planning to buy F-14s. But they got away with not getting any lower cost alternatives thrown in their face

to cut back on their own program. (1997 update: USAF had 930 F-15s and 1253 F-16s in their inventory while Navy had 361 F-14s and 1003 F-18s.)

Well, now back to what was going on in the Navy with regard to the low cost alternatives to the F-14. Although Congress had refused to fund Clements ill-considered Prototype program in '73 the issue was continued and he and OSD insisted upon the Navy getting a low cost alternative. By fall of '73 the Navy had come up with a scheme to have something called the F-14X as the best solution to the program and they scrubbed all the things that they could out of the airplane but left the provisions for them in the program. They took the Phoenix system out but they made sure that they could put it back in again. The game being played was to try to satisfy Clements and the rest of OSD with something that seemed to meet his requirements but which in fact the Navy could later, when the need arose, retrofit the airplanes and make them fully capable F-14s.

In the 1974 series of hearings Clements told the Tactical Air Committee and then I presume later the appropriations committee too that the Navy had been directed to buy a lower cost alternative fighter to the F-14. Apparently by that time they had ruled out the F-14X, the ploy that the Navy was trying to sell and settled down to VFX. Another fighter study was organized. This one was Fighter Study 4, I believe, headed by Capt. Jerry O'Rourke and was a big well staffed organization again. I remember I was asked to sit in on some of the meetings and was asked to comment on some of the conclusions that they were reaching. At the same time on occasion I'd get slightly involved back with my old office in a consulting role there too.

Through most of '74 the Navy fought the scheme of low cost alternatives and lightweight fighter/low capability approaches to the problem quite vigorously. In the budgets prepared within the Navy, F-14s were included. By the time they went through the system, however, the F-14s had been cut back and the VFAX or F-14X or NACFs were back in the picture. I remember Capt. Halleland telling me I was crazy to continue recommending that we never give in to the lightweight concept. Lightweight in this case meaning low capability. He said we either get the low somethings or we get nothing which was the way these things seemed to end up. We certainly didn't win many. Well the fighter study came up with a reinvented VFAX and got permission to go out to industry with something called a pre-solicitation package for a Naval "air combat fighter". It was to be a bunch of studies to define an airplane that again was to be equivalent to an F-4 in capability and to just about match an A-7. They really had given up on the idea of being "better than" as we had done with the first VFAX back in the F-111 days. No one considered trying to really build a high capability, variable sweep airplane. From my viewpoint they were all on the low side of the capability equation. With Capt. O'Rourke involved, a VTOL capability kept bobbing up and there were some that professed to believe that you could get a VTOL version of this Naval "air combat fighter" by some kind of a simple modification such as adding lift engines.

Well in the final congressional action and I believe this was at the end of 1974 Congress got into the act and said that the NACF, the Navy Air Combat Fighter had to be a carrier version of whichever airplane the Air Force selected as their air combat fighter. So in essence the Navy was told that they had to make a version of the F-16 if that became the airplane the Air Force selected or a version of the F-17 if that were the

airplane the Air Force selected. That action made it really impossible to reach the goal of being more or less equal to an F-4 and an A-7 in capability. Well sometime late in '74 the Secretary of the Navy, then Mittendorf, wrote a letter or a memo to SecDef and said that the Navy would go along with the program and outlined the events that they would do, gave them a schedule of events.

A Navy competition then was held near the end of '74 and both GD and Northrop were asked to submit proposals to meet Navy requirements. Each was to maximize commonality with the Air Force ACFs, the air combat fighters of the Air Force, and they were to do the best they could meeting the VFAX requirements. The Navy was then going to pick the best airplane out of the batch which they did.

I was surprised looking over some of my old papers to find that in at least one of the source selection plans I was listed as a consultant to the advisory council, headed by Adm. Lee. I didn't participate either at the advisory council level or at the evaluation board level or at any other level. I was not involved in that competition.

Well I guess as everybody knows by spring the decision within the Navy had been made that they would select the version of the F-17, the twin engine airplane from Northrop/McDonnell Douglas. It required so many changes over the 17 that it was renumbered as the XF-18. The Navy had eliminated consideration of the General Dynamics F-16 Navy version primarily on grounds of carrier suitability according to hearings that were later held. Vought, who had teamed with General Dynamics, formally protested the award. It was the first formal protest in many, many years in a Navy aircraft competition. We had never had one during my term. They should have had a

couple perhaps but didn't. The GAO, who was the arbiter in such events, turned down the Vought protest and the F-18 program went ahead.

In early '75 the Senate TAC Air Committee had hearings on both of the lightweight fighters, Air Force and Navy. Dr. Currie, then DDR&E, spoke for OSD while Adm. Houser, then OP-05, and Adm. Lee, COMNAVAIR, were the spokesmen for the Navy. The Air Force in the same set of hearings told what they intended to do with the F-16. The F-18 data showed that the bypass ratio on the engine had to be increased, to get more thrust and better SFC for cruise. Overall weight increase was something over 8,000 pounds, from 25,000 pounds to 33,000 pounds. There was really very little "commonality" left with the F-17, but it didn't matter anyway since the Air Force had bought the other airplane, the F-16.

Well, my final hurrahs I guess on the subject were then in 1975. I was asked to appear at a hearing by the House Armed Services Committee, Research and Development Subcommittee on 9 April 1975. That request for an appearance came out of the blue as far as I was concerned. I had no idea what they wanted or what the goal of the hearing was, but I appeared. I'll put a copy of my statement in the record, call it Exhibit VF -14. Shortly after I arrived at the hearing room Adm. Moorer appeared. It turned out that he was also to be a witness. I had no idea that he was coming; though he may have known that I was to be there. He and I sat at the same table and took turns more or less answering questions. I gave my statement; he gave his comments. I was very thankful that it turned out that he and I were at least on the same side. Neither of us were in favor of low capability aircraft aboard aircraft carriers.



Another CNO study group was set up. This one had a title dealing with attack. Attack requirements or some such thing. Adm. Fred Koch headed that one. His deputy was Capt. Jimmy Foster. Adm. Koch had not been involved in any of these exercises before but Capt. Foster may have been, probably in Fighter Study 4. Anyway he was definitely in favor of a high performance capability for an attack plane and felt strongly that the A-7 speed was not adequate. He based this on some work when he was still in the fleet and then ran some exercises where they were able to penetrate two targets with an F-4 when they were unable to do it with a more heavily loaded and slower A-7. He became a strong advocate then for the F-18 concept. I had minimum participation in the study. I went to a few meetings, probably wrote a few papers for them and commented on many of the other papers but only as they requested. I was not a full participant in the group.

The whole effort still didn't make any sense to me that we would stop buying our most capable airplanes in favor of something that was intended to be cheaper and which in my opinion had less capability than the airplanes we already had in the fleet. Now admittedly any new airplane, such as the F-18 turned out to be, with a completely new avionics system was going to have marked advantages in reliability and maintainability. However, it was too short legged, and is still too short legged. It went back to the capability from a payload range standpoint that we had with the A-4s and F-4s. The improvement step from that level had been made a decade earlier when we developed the A-7 and then later when we were able to get rid of the F-111 and get the F-14.

I ended up testifying before the TAC Air Subcommittee of the Senate Armed Services Committee in October 1975 and also later before the McClellan-chaired

Defense Subcommittee of the Appropriations Committee. I'll probably have to talk about that one a little more. My statements before both of those hearings I'll put in the record at this point too, as Exhibits VF-12 and VF-11 respectively.

Before going on let me describe a puzzling incident following the House Armed Services Committee appearance when Adm. Moorer and I were on together in April of '75. Following the hearing, perhaps a few days later, Adm. Kent Lee, then head of the Naval Air Systems Command asked me to come in and have a cup of coffee with him, which I did. He started off by saying that he had read the statement I had given to the House Armed Services Committee (a copy of which I had sent to him) and that he agreed with all of it except the last paragraph which of course were the conclusions; that I thought that the Navy air combat fighter concept was unsound and shouldn't be supported, but that we should continue the F-14 and A-7 at least. This was astounding to me. It was not apparent to me how you could agree with a couple of pages of the statement and then not agree with the conclusions. This bothered me at the time. After a good deal more discussion on the subject of complexity in fighters and so and on so forth he made another astonishing statement to me. He said, "You know we should never have started the F-4." And I said, "You mean the F-14, don't you?" He said, "No, I mean the F-4." Well, at that time the F-4 had been in the fleet for something over ten years and I had thought that was a capability that we were trying to improve on rather than to degrade from, so I was absolutely astounded. I wonder if he ever made that same comment to Adm. Moorer. (In 1997, I understand that Adm. Lee now says he did mean the F-14 as the airplane that should not have been started.)

Another back track. While looking at my really very poorly filed and quite incomplete records I came across the memo written for Fighter Study 4 entitled, "The Fighter Study Dilemmas," dated 26 September 1973. It (Exhibit VF-15) needs inclusion here only because of a few sentences in it bearing on Dr. Flax's report that was mentioned earlier. The dilemma of course was the fact that both Mr. Clements and Dr. Flax stated that our adversaries were more capable so we really needed something considerably more capable than the F-4J, but it also had to be considerably cheaper than the F-14A. The dilemma was that we hadn't found any such solution and of course neither Dr. Flax nor Mr. Clements was providing one.

Another memo that I will attach, Exhibit VF-13 in here too is another review dated 21 October 1974, a year later than Exhibit VF-15, mentioned above. It was written because of the similarity noticed between the NACF and TFX negotiating situations. The engineers involved did not want to repeat history. My feelings, at least, were consistent during the whole period and still are.

Now the next to the last memo in this batch, Exhibit VF-16 was one that I drafted in July of '75 while I was still a consultant at NAVAIR which analyzed the F-18 program as I saw it and showed, to my satisfaction at least, that the airplane offered too little, too late, and cost too much. As is noted, I had drafted the memo, left it to be typed, and sent on its way while I went on a two week vacation. Unfortunately after that I ended up with a bout of pneumonia and it was a good month and a half before I got back to find out what the reactions were to my memo. I discovered that no one on my "copy to" list had received it. It turned out that Adm. Foxgrover, then AIR-05, had stopped the memo and was holding it to return to me. A note attached to it said that he, Adm. Foxgrover, had

shown it to Adm. Lee who was then the Commander of the Naval Air Systems Command. Adm. Lee had seen it and criticized me for my lack of support of the program, especially since I was a NAVAIR consultant. About that same time I was told that Navy files were no longer to be made available to me. The official "rehired annuitant" status pretty much ended.

Now back to the two hearings in '75 in which I was involved. The first was a TAC Air Subcommittee of the Senate Armed Services Committee hearing on the 8th of October, held in the afternoon. The Navy and Marines testified first. Adm. Holloway, Adm. Houser, Kent Lee, the Commandant of the Marines and Jack Linden who had taken my old job, all testified first and in support of the program of course. Then the committee had Grumman and myself testify together sitting at the same table. This caused some rumor that I was working for them and I was not of course. This was Grumman's first and only time to comment officially on the F-18 program. Their presentation was a good one I thought, very straightforward and factually quite accurate. My statement of course really summed up everything that I had said before and I don't think it really requires any more elaboration than just reading it, Exhibit VF-12.

Grumman's action in appearing before the committee and offering testimony opposing the Navy's advocacy of the F-18 was apparently unprecedented. Manufacturers normally do not argue publicly against their best customer. The committee members remarked on this fact, which probably increased the anti-F-14 and Grumman bias in OSD and with the "simple is better" officers. To me, the Grumman data seemed unassailable.

## **TAPE 15 of 16, SIDE B**

Next was the Defense Subcommittee of the Senate Appropriation Committee and that hearing was held on the 21st of October 1975 and was a very trying and disheartening experience for me. The whole Navy team from Adm. Holloway on down through Adm. Houser, Gus Kinnear, Adm. Lee, were all sitting in what seemed to be bleachers behind me when I testified and of course all the navy spokesmen were supporting the position of Mr. Clements who had testified first. Adm. Houser went next and then I finished up that portion of the hearing. As far as I was concerned the Navy justification for the whole F-18 program seemed quite contrived. They apparently used results that had been put together for the TAC Air Study. I think Capt. Foster was the primary author of Adm. Houser's statement. My statement is Exhibit VF-11.

Adm. Houser's statement did not dwell on the cost per se but only stated that the cost curves showed that the F-18 as expected was a good deal cheaper since it was a good deal smaller. The statement actually showed two curves for the F-14 for presumably follow-on procurement and with production rates of either 60 and 108 aircraft per year. The F-18 was shown at 108 per year but with and without the R&D expense. If you eliminated the R&D the lower curve on the sheet of course was the F-18 and this was also done in constant '75 dollars and the impression was that the F-18 was a good deal cheaper. Well, if you looked at the chart more closely you could see that the crossover point was at about 430 aircraft if you bought the F-14 at 60 per year and at about 540 aircraft if you produced the F-14 and the F-18 at the same rate. Obviously because of difference in timing the choice of constant '75 dollars also favored the F-18.

If one added in the operating costs where the F-18 was lower, the crossover point would have come down some. But the actual cost comparisons that were discussed were for a completely different set of conditions. That which they actually showed – in Houser's statement we're talking about now – was for a very peculiar set of assumptions. I presume the data came from the TAC Air Study but I never saw any backup on this. They showed two different mixes of aircraft with the curves fairly close together, and with equal total cost by fiscal year '85, then about ten years away. The two curves represented a mix of 744 F-14s, 186 A-7s and 275 of something called a VALX as compared to a mix of 224 F-14s, 202 A-7s, a few more, and 800 F-18s. Well the total numbers in the mixes are close but it doesn't appear that the effectiveness is anywhere near the same so why they picked that particular mix is as baffling to me today as it was then. I really don't understand it. I suppose it gave the "right" answer.

I might also mention that the Attack Requirement Study itself did not include the rather obvious complement of aircraft aboard a carrier of what had been planned. The mix of two squadrons of F-14s and two squadrons of A-7s was what appeared to me to be the obvious base against which you might compare all the other mixes that you were testing but that mix was not included. They never put more than one squadron of F-14s aboard when they did the effectiveness study. As near as I could tell then and now the whole exercise was one that we might call adversary truth where you tell only that which tends to convince the other guy that you're right. Regretfully, the true comparisons were not included.

To finish up this part of this history. My statement includes my thought that any dissent from an OSD established position is very difficult to achieve for a service and

almost never happens. I described it as almost blackmail in the way I had seen it work in my own experience. Mr. Clements was not pleased to say the least and after I had finished my remarks he offered a rebuttal saying at the end of the hearing that he was sure that my dissents were never stifled. Well, that remark led me the next day to write a letter to him on the subject of dissents in general. A copy of that letter I'll insert here as Exhibit VF-17. The only feedback I ever got from it was a call from Adm. Houser asking if I'd ever received a reply. I had not then, I never did, and my frustration level on the whole thing remains just as high today as it was then. Let us say that this completes my version of the transition from trying to replace the F-4s with the Missileer first, followed by TFX, F-111, F-14, and finally the F-18. In my opinion the whole exercise certainly does not reflect credit on DOD and in particular on the Office of the Secretary of Defense.

Just one more afterthought. After that last hearing, Adm. Houser came up to me and put his arm around my shoulder and said, "Don't worry George, we're going to get our two squadrons of F-14s per carrier". I hope he's right, but there had to be a better way to do it.

The F-18 continued to be controversial into the eighties. By 1977 the Navy had changed direction again and Under Secretary Woolsey finally recommended to Secretary of Defense, then Harold Brown, that the F-18 program be cancelled. The Navy would go with the F-14, A-7 option and the Marines would go with F-14 and the AV-8 Harrier. The *Armed Forces Journal* published a story in July '78 and drew a number of parallels with the TFX. At the request of the editor, Ben Schemmer. I provided some comments to him on the article and he then published my comments as a

brief article the next month. I did not think the F-18 was really parallel to the TFX. The program costs had increased far more rapidly than anyone had predicted and in 1981 the *New York Times* stated in an article that despite increasing the total number of aircraft from 811 to 1377, over a fifty percent increase in the quantity, the unit price had gone up from \$9.9 to \$33 million each. I have no idea as to the accuracy of those numbers. It seems almost unbelievable. Now I think I'm at the end of F-18s.

I think I'll start talking now about more of the Prototyping Program and the projects that we got into as a result of it. I've mentioned the "Prototyping with a capital P" which had started the lightweight fighter and also mentioned that NAVAIR had recommended a COD version of the S-3 as its first choice if there was going to be a Prototyping Program. I strongly opposed the whole scheme which had been started by Al Simon, the Tactical Warfare head in DDR&E under Dr. Foster. The reasons given for the program all seemed ridiculous to me and I think anyone that had much experience in the acquisition field agreed that the things they said the program was going to do for them just couldn't happen. They just didn't know what they were talking about. But Dr. Foster supported it and Mr. Packard did also and he directed the services to implement the idea. Dr. Frosch, our R&D secretary was designated as the official Navy honcho and Tom Davies who was then MAT-03, the R&D admiral in NAVMAT, was the man that we dealt with more than we did Dr. Frosch. I think I mentioned before that Hank Suerstedt really ran the program in NAVAIR. He was later assisted by Capts. Hal Cody and Von Gerichten as I recall.

At the time that all this was happening in '69, '70, '71 time period Adm. Zumwalt's sea control ship was being widely touted. At least everyone thought it was Adm. Z's sea



control ship but in talking once with Adm. Davies I'm not so sure but what he wasn't the instigator. He told me that he thought that the small ships of the Navy, the frigates and the destroyers were completely useless in doing the ASW job because their sonar gear was inadequate to do the job. He believed that an equal investment in a cheap vessel with VTOL aircraft would be a more effective solution. Of course helicopters were then available for the ASW part of the game but there were no high performance VTOLs for any air defense of the ship. So a high performance VTOL then became one of the Navy's prototype nominations. I suspect that most of NAVAIR was as confused as I was about the whole program, where we were going and why. But Davies ended up sending a letter to industry inviting proposals for prototyping aircraft to put aboard the sea control ship. This was again unprecedented in my experience. That type of operation was the responsibility of the materiel bureau or command. NAVMAT had never done it before.

In his request to industry to submit twenty page proposals he told industry that there would probably be a requirement for a long endurance sensor carrier, I guess he was thinking ASW, AEW, and also for a high performance VTOL fighter. He gave no definitions of the mission for the ship or the aircraft so all the bidders were strictly on their own. He told industry that specifications were really not required, that the projects would be handled with a minimum of bureaucratic control. The project sounded like it came directly from OSD.

The proposals arrived at NAVMAT as scheduled. NAVAIR then was asked to evaluate them with a deadline of a week or two. Obviously, we had too little data and too little time to do any kind of a normal evaluation and so it was kind of a once over lightly affair as far as we were concerned. The proposals, of course, were all over the ballpark.

Long endurance sensor proposals, we must have had twenty or thirty of them and they ran from small research kind of test beds to versions of the C-130. We had all kinds of tilt wings, tilt ducts, deflected thrust, tilt rotors and so on. High performance models included some Harrier versions, some lift cruise designs and a thrust augmented wing design.

We gave MAT-03 a presentation on our results and recommendations such as they were. My final chart was one that said, "You want it bad, you get it bad." We said if we had to go ahead with this idea that our recommendations for a prototype in the sensor area was a North American thrust augmented wing proposal, a subsonic airplane using a modified OV-10. It was a small airplane, wouldn't have cost very much money and we might have found out something about thrust augmentation for a modest price. And if we had to have a VTOL fighter, we said you really had to get started with a lift engine so that later on you could have a real competition for a lift-plus-lift cruise device.

MAT-03 took all of our charts. I was told not to come to any further presentations and he modified those charts that he wanted to modify, left out those that he wanted to leave out and went forward with his presentation up the line. I never saw his pitch. Eventually out of it all came the XFV-12A thrust augmented wing as the Navy's VTOL prototype. Well, to make a long story short, after getting enough data to evaluate the weight and performance, NAVAIR predicted that the design had no capability for service use. It could almost take off with no payload, but with some fuel. I labeled it as "Ground Hugger-1" and a few years later that label was proven accurate. It, however, did get off the ground once at NASA when it was suspended by a crane while they were trying to measure the thrust augmentation ratio out of ground effect.

In early 1977 Adm. Bud Ekas, who had taken over the MAT-03 job from Davies, was struggling along with the question of whether or not to continue funding the XFV-12 and asked me if I was interested in doing a short consulting job on the program. I told him that I was undoubtedly considered all together too biased on the subject for him to have me do a formal consulting job but I would be willing to go back and dig out the records that were in my old office and put them together for him, which I did. My letter to him then is going to be marked Exhibit V-1. Unfortunately I do not have a copy of the report itself. He had one, a folder put together with a bunch of tabs in it but Exhibit V-2 which is basically an annotated table of contents gives some clue as to the contents. Anyone wanting to dig out the rest can probably find them in the official records of NAVAIR or NAVMAT.

Jumping backwards about three years or so, about six months after I retired, Ed Heinemann asked me to participate in an ad hoc committee which Dr. Potter, who had taken over from Dr. Frosch by that time, had asked him to head. The committee was asked to review the various VSTOL programs that were then floating around in NAVAIR. All were intended to meet the sea control ship fighter requirement (still unstated). Apparently the committee members met a few times on the west coast before I got involved. I guess I was a consultant on that one rather than a member of the committee. But anyway after the first meeting here in Washington I wrote a memo to Ed Heinemann which gives some of my thoughts at the time on the whole project, the ad hoc committees and so on. It will be marked Exhibit V-3.

Potter I guess wanted recommendations on the degree of risk involved and time to go with versions of the Harrier, whether to go with the lift-plus-lift cruise or with the

thrust augmented wing proposal. NAVAIR did the evaluation work, did the weight and performance that we reported first to Heinemann and Heinemann then sent it on to Dr. Potter and reportedly had a two hour discussion with him.

The final outcome of the XFV-12 program of course was that it was a complete failure. The recommended lift engine for the lift-plus-lift cruise design which we considered quite feasible, was never built, and the sea control ship itself finally faded away into the sunset. There were a lot of lessons to be learned from that program but whether anybody will ever dig into it to see what they were is questionable. I was extremely disappointed in the way the Navy did the whole thing. The sea control ship was not defined. Professor Hazen who was on Heinemann's committee, recognized the same problem and he wrote a paper or two saying that it can't work that way.

NAVAIR said throughout the period that there was no possibility of getting a useful fighter for service use out of the XFV-12 program. We did think that you might be able to get it off the ground in the prototype version. But, regardless of these opinions, the people in OPNAV continued to support the project. Jerry O'Rourke and some of his cohorts seemed to believe that if you had a high risk program it also meant you had a high payoff program. And certainly the contractor was claiming great things for the airplane. But it was one of the few times that OPNAV just refused to take anything from NAVAIR seriously. Also, in the beginning MAT-03 was in the same boat, so the NAVAIR technical community basically was ignored and the programs were continued in the budget. Dr. Frosch was unaware of the controversy at the technical level. When he eventually found out he blew his stack, called a meeting and had everybody from the CNO and CNM down through MAT-03, COMNAVAIR and finally myself in to discuss the

situation. He ordered loud and clear that there should never be another program sold to him without telling him both sides of the story which the decision maker really deserves of course. Well, it was not one of our bright spots and almost completely a Navy failure, rather than OSD's.

I suppose we might as well go on and finish up the rest of the VSTOL story. I was not directly involved in the programs to any significant degree after I retired but eventually the Navy in that '77 time period got into the VSTOL bug again with the help of some very optimistic individuals. I remember an article appearing in *Proceedings* in which Adm. Holloway, then CNO, under his byline, stated that the state of the art was such that you could get VSTOL for no significant penalty. He may have even said no penalty. Well if you can get VSTOL without paying a penalty, of course everybody wants it, me too. But unfortunately that's just not the case. And the Navy ended up with another big study program with contractors involved and they studied VSTOL A, B and C. "A", as I recall, was the sensor carrier ASW, AEW, etc., "B" was a high speed design, while "C" was to be deployed on smaller vessels to do more than helicopters could do. At the time, ship studies were going on. The sea control ship probably was fading out but they were studying something called a VSS, a small size carrier not well defined, and probably other types as well. Later I saw some of the studies and it seemed to me that the ship costing that was included in those studies was very questionable. Catapult and arresting requirements added to a ship, multiplied the price of the ship to such a large degree that it didn't make sense. As I said I really didn't get into the decision making part of that game at all. Fortunately, all the projects faded away.

An American Enterprise Institute symposium also considered the subject of VSTOL in its program on the future of the Navy, "The Navy Into the Twenty-First Century." AEI eventually published a report on the proceedings. I gave them a paper, very brief, on what the rationale was against doing VSTOL and basically it's simple enough. At that time and now there are some missions we can do with VSTOL from a ship, from a carrier but there are other missions that we just can't do at the present state of the art. So to do those missions you need catapult and arresting gear and conventional airplanes. Once you have that ship capability, it makes no sense to pay the VSTOL penalty for the other mission types. I provided comments on two or three other papers that were included in the AEI report. An interesting paper was given by Norman Polmar which pointed out that if he used the total Navy ship building budget he could build 50 carriers instead of only one or two CVs plus large numbers of subs, cruisers, destroyers, etc. He then asked the question of "which would you rather have". The answer seemed obvious to me. Of course he hadn't bothered pricing out the air groups that went aboard those fifty carriers. It's a question I've long been curious about. I've never seen a study, though it may exist, as to the optimum mix of surface ships, we used to do lots of work on optimizing carrier complements, but not ship mixes. Obviously, however, not my field.

My last hurrah on VSTOL was a joint Navy-NASA conference on the whole VSTOL program at the end of 1981. I was called by Russ Perkins who had taken over what was left of my old job, and who was involved with planning the affair. He wanted someone to present a paper on the rationale against VSTOL at the VSTOL conference. He had not been able to find a volunteer. There were plenty of VSTOL proponents, of

course. But no one really wanted to get up at a VSTOL conference and tell them that there were real problems with the concept of an all VSTOL Navy. Kind of like the skunk at the garden party. But I agreed to do it and I put together a presentation. I'll make that the final exhibit, Exhibit V-5, for VSTOL. I don't think it needs any elaboration.

The reason we were opposed to VSTOL for doing the Navy job was that it was impossible to do all the jobs with VSTOL and once you had the carrier we could do them with CTOL and we could do them better and cheaper. That story is true today. We all recognize the advantages but sometimes the price is too high. I think that it's clear from the presentation that you pay a significant price to get VSTOL. Enough said.

#### **TAPE 16 of 16, SIDE A**

September 1-2, 1990

I'm going to talk first about the acquisition process. This is the area in which my major expertise lies. I have probably written more about that or at least I have more of the writing that I have done still available so hopefully I can do less talking and let the written word take care of most of it. I was interested in the acquisition process throughout my whole career. Our design competition system at the end of my career was basically the same one we started with except modified as we went along to correct any problems that arose. Even the 1939 system was a great deal more effective than is today's OSD-directed "Source Selection System." Probably we were at our most efficient sometime during the fifties, before McNamara.

The first paper that I'll put into the record I'll call Exhibit A-1, A for acquisition, and it's a history of the process as I knew it. There were several of these kind of papers written, all pretty much similar. There was a time after I retired when someone was trying to put together a corporate memory series in NAVAIR. I don't believe that project was ever finished. This particular paper was one I put together for part of a training program which was run by VPI in those days. I normally gave a paper at these things — at least I did for seven or eight years after I retired. The description of the process you will find as we go along in these various exhibits tends to overlap quite a bit and there is a fair degree of duplication between them. I can't really avoid that.

The second exhibit marked Exhibit A-2 is a presentation describing the source selection process which was given at the 1969 industry planning briefing in Columbus, Ohio. This type of a briefing was held, I was told, perhaps every third year when the Army would give a briefing one year, the Air Force the next and then the Navy in order to let industry know what was going on in R&D. My job was to tell what would happen to a proposal after it got submitted so this is a good presentation of the way source selection worked. Our process of course was called Design Competition, in our mind, a preferred method of source selection.

One thing probably not mentioned in that presentation was the fact that proposals at that time were always unfunded so we didn't have to worry about letting contracts to get a proposal into our hands. Up until the McNamara days at least the bid and proposal expense was recognized as a legitimate part of a company's overhead and this allowed the contractors with production contracts to charge off their bid and proposal expense to overhead, which was a simple and straightforward way to handle the situation. When



McNamara's crew came in they first outlawed bid and proposal expense with I guess the feeling that it discriminated against those manufacturers who didn't have contracts. In the overall picture I believe we had a better system when it was unfunded.

Eventually there was so much outcry against eliminating all bid and proposal expense as a legitimate part of overhead, they went to a system in which a negotiation was held each year between the contractor and the government to identify projects on which the B&P expenses could be charged to overhead. We didn't go to the funding routine until we were forced to by OSD after the TFX episode when somebody suddenly found out that the contractors were having to spend a lot of money in the third and fourth rounds of that work. They were funded to a level of a million dollars on the third and \$2 or \$2.5 million on the fourth round. The contractors were spending much more than the compensation, but it seemed to make OSD feel better. Later we had to run miniature competitions on both the F-14 and S-3 competitions in order to give modest fees to all the people that submitted proposals. It just added one quite unnecessary step to the process.

After I retired in '74 I had a number of requests to give talks to various organizations on the way we did business. I think that everybody expected me to come up with some secret methods of winning competitions or something of that nature, but I couldn't and my usual tale to a contractor was that if you submit the best proposal you're going to win. So don't worry about trying to organize any kind of a Washington insider contest or something or talk to your congressman and so on. The best way to win was expend your effort in getting a good airplane.

The next exhibit, marked Exhibit A-3, is a paper given at the annual meeting of the Society of Aeronautical Weight Engineers. Our division in NAVAIR had always supported the weight engineering society. In fact Gil Weiss was probably one of the founders of the group. I elected to give them the talk when they asked me to do it. In addition to talking about what our process was in this paper I also discussed how our system differed from that of the Air Force. We had Air Force speakers on the program that year so if they were in the audience they heard what I thought of their system if they didn't already know. And as you can see when you read the report I didn't think much of the way the Air Force did their job. You've probably already gathered that from previous remarks anyway.

Exhibit A-4 is a draft set of words to go with a set of charts which are attached which was a presentation to the Society of Experimental Test Pilots, in their convention, again in '74. John Konrad of Vought, who was on the program committee, thought he had a great idea in setting up a panel discussion in which I was to participate. The other panelists were to be Senator Cannon, then chairman of the TAC Air Subcommittee in the Senate, Mr. Packard who had recently been DepSecDef and Dr. Currie who was then DDR&E. The general idea of course was that I would educate these three key individuals in defense procurement as to the facts of life in aircraft design and acquisition as seen from the working level. The words written in those draft set of words are somewhat more succinct than the actual words that were used in the convention. I know that the SETP taped the whole thing for their report on the convention that year and that all of the actual words and the remarks of the other panelists were there.

The whole scheme fell apart of course when first Mr. Packard cancelled out his appearance I think on the basis of the fact that he had been recently asked to chair that Blue Ribbon Committee on procurement matters. He said he would be too busy. Senator Cannon developed urgent Washington business so he couldn't come, and then Dr. Currie cancelled the day before the meeting with a sudden illness, a very short lived illness by the way. The general rumor was that he had said if anyone thought he was going to get on the same platform and argue with Spangenberg he was crazy so he didn't show up either. So we didn't accomplish the purpose at all.

I had no particular argument with the people that took their places. Mr. Hotz, the editor of *Aviation Week* replaced Packard and there was a retiring congressman that took Senator Cannon's place. It didn't do any good to talk to him. He wasn't going to be there to influence things in the future.

Actually the presentation was well received and I think it gives a clue as to not only the way we were buying airplanes but the background of why we were doing it that way.

The next exhibit is marked Exhibit A-5 and it's called, "Program Analysis and Evaluation," a very strange title for what's actually in the exhibit but the title got assigned by somebody. It's a good compilation that was put together again for one of those VPI training courses. I think this was in 1977 and it has more information on the whole development process and lists our successes and failures, prototyping, concurrency and some lessons learned on some of the past proposals. I may have covered parts of this earlier in this oral history.

Exhibit A-6 coming up next is a 1978 letter that I wrote to Russ Light at Boeing. Russ was a long-time acquaintance and a friend. He had written to me expressing his and Boeing's disaffection with the whole military aircraft acquisition process. My letter to him needs little amplification and I'm only including it to show my reaction to some of his complaints which were probably not unlike those of many of the others in the industry. I was really quite annoyed with all of industry when in the later years they went along with programs and policies that they knew to be ill advised. The excuses usually were, "Well it's the only game in town so we've got to go ahead with them."

Earlier in my career the AIA, Aircraft Industries Association, had served what I thought was a very useful purpose, commenting on all kinds of matters from specifications, newly proposed specs to old specs, new programs and so on. They commented back to the services as a group. Individual companies were not identified so they were protected against possible retaliation. In that way the comments could be really forthright as to what industry thought. By the time of the McNamara years my impression is that something changed so that the group was less effective. Also I suppose I could have been cut out of the loop. One source of industry feedback in the '60s was called DIAC, Defense Industry Advisory Council, usually composed of senior industry spokesmen, for example, Mr. Allen, then president of Boeing was on the council at the time of the Dr. Rubel incident. Unfortunately, a man like Mr. Allen just wasn't aware of many of the kind of details in the acquisition process that the guys that worked for him were worried about so he probably wasn't effective in counseling McNamara and his crew as to either the real problems or the real solutions.

I'm not sure whether I talked about the Dr. Rubel affair before or not but since I mentioned it let me say a few words on it. Rubel was a deputy something or another to DDR&E in the period while TFX was going on. He proposed a change in the acquisition rules on source selection procedures by separating evaluation and recommendations. He wanted only evaluation results to come to the OSD level without any recommendations from anyone down below. His reason, stated in plain bold English, was in that way the decision maker had complete freedom for his decision instead of being faced with a recommendation "so thoroughly justified that it was almost impossible to change it." Sen. McClellan brought it up during the TFX hearings. It was just impossible for me to believe that anyone would make that kind of a recommendation and then try to justify it.

Well going on, the next exhibit marked A-7 is a point paper that I put together in 1977 after I had retired to help out my old office respond to a request for some schedule data on a number of specific aircraft programs. The request had come from the DSB, Defense Science Board, summer study project. That group normally held a week or a two week session sometimes at the Naval War College and attempted to put together papers and whatnot under the direction of DDR&E. I say direction of DDR&E – what they usually tried to do was to use a group to legitimize some of their theories on how to change the system. I was sent up to participate in one of these the year after I raised a fuss on the S-3 program about milestone contracting. It was obvious that the group to which I was assigned was supposed to write papers backing up milestone contracting and prototyping as a way of life. We ended up by not doing either and wrote one saying that we had plenty of contract flexibility already and the real problem was all the OSD-

directed programs such as "value engineering", "design to cost", and "cost reduction". There must have been fifteen of those kind of programs that had caused us trouble over the years and were still causing us trouble. The reason I put this paper in is that while it duplicates stuff that is in some of these other papers it shows details of all of the major fighter program schedule points, the date of start, when first flight occurred, what the production buildup was and so on which might be helpful to someone in the future.

Exhibit A-8 is a 1974 memo entitled, "Multiservice Aircraft Procurements." I have forgotten who asked me to do it, someone needed background on that particular subject. Most of the projects have already been covered in the earlier part of this history, however this memo puts this particular subject together fairly well and at least gets the stuff all in one place. Hopefully everyone will conclude that joint development is really a one way street when you're talking Navy carrier aircraft and Air Force tactical aircraft. We can always get together on noncarrier types like trainers and transports, in the tactical field you cannot go from an Air Force airplane to a Navy airplane without major changes. You can go the other way and that's been demonstrated time and again. The F-4 and A-7 are among the demonstrators of this fact.

Now the rest of the exhibits in this history are all pieces which got published in various trade journals. All of them originated by request of the magazines involved. In some cases I suppose the request was intended to generate controversy as with this next Exhibit A-9 which got published in *Armed Forces Journal* and was entitled, "Cheap Fighters: The Impossible Dream." The following month the *Journal* published an article by a Commander Waller called "Cheap Shot Revisited" to set up the controversy or to

enlarge the controversy. And then a few months later Jerry O'Rourke wrote one saying that both articles were both right and wrong and what we really needed was VFAX instead of the point that I had been writing about which was that a pure lightweight fighter was not worth buying for the Navy. You'd always lose the war if you stuck with that approach. Jerry of course had headed Fighter Study 4 and so his recommendation for a VFAX was not unexpected. I still think my argument was right and I think over the years most of the Navy has always agreed that we couldn't get there from here trying to do "a gum on the windshield" lightweight fighter.

In September of '74 the *Aeronautics and Astronautics* editor asked me to write another one on either a lightweight fighter or prototyping and I demurred saying that I had already done that in another publication. After talking a while I agreed to have them publish one on the high-low mix entitled "High-Low Mix: Solution or Problem." This is marked Exhibit A-10. The background of this is that I had done a study on my own I guess within the year after I retired. I wanted to look into this business of a high-low mix because every time we'd ever tried to look at "low cost alternatives" to this, that or the other thing, including the F-14, we were never able to find a solution that was cheaper than just buying the plane that was the high capability machine. In this high-low mix paper I tried to see what would happen if you started from scratch and did a split-buy between a high capability and a lightweight simple kind of design but both designed to go the same distance. The answer came out to be that it cost some 40% more to split an 800 buy between high and low capability machines than it did to buy all 800 high capability ones. As I said the answer was surprising to me that the differential in cost was that high. The only reaction I received was one from Abe Hyatt who called from the

west coast. He was then working for North American and he sounded excited. He said, "Well, what do those guys say about it?" Those guys, of course, being OSD. Well, I never heard a darn thing from anybody. In fact I seldom heard a thing from anybody on anything I ever wrote.

The next exhibit, Exhibit A-11, is on the same order. It was written a good deal later, 1981 and was published by a trade publication that didn't last very long called "Military Science and Technology." Again the editor asked me to write something countering a Chuck Myers article. Chuck Myers had been in the Pentagon, a firm advocate of lightweight, simple to maintain airplanes. Whether fighters or attack didn't matter. He had long been one of our chief opponents in the whole period when we were trying to get F-14s. In this article I obviously took issue with Chuck Myers but also probably with most of the rest of the OSD thinking of the seventies. My arguments on the issue remain persuasive to me.

The next exhibit, Exhibit A-12, entitled, "Aircraft Acquisition Management Malpractice" was published in the fall of '81 issue of *Wings of Gold* and it summarized my feelings on the entire acquisition process and how we'd been going down hill mostly due to OSD actions. A few internal Navy things hadn't helped either. Our whole process had become far less efficient. It took a lot longer to get anything done, cost more to both government and industry and I felt then and still feel that it really was management malpractice. Just a shame that we couldn't sue somebody on it. Again there was no reaction from anybody.

Well, the next of these published articles, Exhibit A-13, was one that got published by ANA in the *Gold Book*. The background of this was that I was asked to



write an article on long-range planning. Long-range planning is one of my least favorite subjects. In fact I had never seen any long-range plans that did any good. So rather than writing an article on the need for long-range planning I wrote one taking a look at all of our fighter and attack programs from 1950 on, telling what the planning had been or if there had been any at all. The paper, I believe, shows pretty well that long-range plans had little to do with whether or not the Navy got a good airplane out of any of the programs that we had. I won't belabor the point because I think most of the data in that article is either self-explanatory or we've already covered it in the earlier part of this history when talking about each of the programs by themselves.

The last one is a piece which I had written as a letter to the editor of the *Armed Forces Journal* in 1980 commenting on an article in the July issue which had compared the F-18 to the failed TFX. The editor, Ben Schemmer, advised me that he would prefer to publish my letter as an article, and I had no objection. The article is identified as Exhibit A-14, and is a review of the F-18 program initiation. However, it also included a thought I still endorse – that the country can't really afford the OSD. This completes the acquisition part of this history.

A few unrelated thoughts to wind this up. I should mention that BuAer, BuWeps, NAVAIR, all had what I thought were excellent morale and the relationship between officers and civilians was without any problem that I could see. Later I found that some of my civilian friends held strongly to positions that retired military officers should not take civilian positions and what surprised me too was the rancor that those individuals had on that because the officers involved were damned good engineering managers. In

one instance, I was on a personnel board and voted that a retired Navy captain get the job as a civilian assistant in AIR-05, and took a lot of flack from some of my friends. But other than that type of thing we had an awfully good relationship between everybody and it was one of the few agencies in Washington at least that you didn't have to worry about somebody sticking a knife in your back. Some of the other agencies, the CAA/ FAA, were notorious that way. You could only work half the day, the rest of time you had to protect your six o'clock.

Along the same lines perhaps with little different twist – when I was at NAF I had little contact with Naval officers except when I was on the radio control project. When I was in the main engineering department you didn't get any feedback from Naval officers or enlisted people or anyone, that is it's strictly all a civilian operation. It's just like working for a company in industry. When I got to Washington we had officers around and we had more officers then than we now have in NAVAIR on a percentage basis I'm sure. And I thought that the fact that we had this mixed organization was extremely healthy. It really helped me in understanding what the fleet needs were and what the requirements were. If you could get a bunch of naval aviators together and listen to them just tell sea stories you could learn more in a fifteen, twenty minute session than in a dozen structured training lessons.

All during World War II we had a good feedback program too with gun camera combat coverage shows in the old Navy movie auditorium and also the carrier approach films that they take regularly. We had the opportunity to get out and watch sea trials of new airplanes. We have fewer new airplanes now so there are fewer of those available today, and I don't know how much they're being utilized. I haven't heard of any of the

engineers in my old office recently ever getting to take any of those kind of trips. It's too bad because you really need that feedback.

The next item is one that I don't know anything about so I can comment on that freely. Secretary Lehman, I believe, put into effect an officer career path of program management. In other words, a Naval officer becoming a career bureaucrat. I think this is stupid. Providing the continuity in the system is a job ideally done by civilians. They stay there long enough to know the job, pass on the lessons learned, and the history that goes before and so on.

#### **TAPE 16 Of 16, SIDE B**

Why in the world you should use military career officers to do that kind of a job is well beyond me. There are many things that Lehman did that didn't make sense and this is just one of them.

Well the next item I think is pretty self-evident and probably everybody knows this, but we were a lot more efficient outfit when we had our entire technical community working together in the bureau or in the command, whatever we were. Over the years a lot of the technical effort got decentralized, usually because of headquarters head count. There was a ceiling on people in the Washington area as well as a ceiling on the total effort and this really hurt. We decentralized much of the ships installations effort for example to Lakehurst. A lot of the powerplant work to Trenton, a lot of the structures work went up to NADC and every time we made a move like that we really lost the capability to get things done efficiently. I think we transferred something like six people

out of Ships Installations and the Lakehurst operation quickly grew to a hundred. It was one of the kind of things that just tended to drive you nuts working for the government. And of course in later years it got even worse because with program management growing and technical jobs shrinking it became impossible I suppose to do the jobs within house and so they went to a contract route with "beltway bandits" and that in my opinion was another big mistake. The maintenance group was doing it before I left. In a competition, we received many more words than ever before but disappointedly less valid technical judgments.

I don't think I've said anything before on organizations and reorganizations and so on. One of the old stories in Washington was that when we got a new chief for the bureau that he was only going to be there two or three years. He didn't have time to make his mark by getting his name on a new airplane program so he got it instead on a reorganization and there may have been a grain of truth in it, particularly if he had been one that just took a course at Harvard Business School. Of all the big organizations and reorganizations that I can remember the only ones that I thought really did any good were when they eliminated the Bureau of Supplies and Accounts in World War II and let each bureau do their own contracting function. That was a good move and increased efficiency of the whole operation and the other one was in more recent years when Lehman eliminated NAVMAT. It was undoing an organizational step that had been taken during the McNamara years. I always thought that McNamara insisted that the Navy put the Naval Materiel Command into the act so that the system looked exactly like the Air Force and the Army and that his next step was going to be unification of the services, which would have been a disaster. Within my experience the only good reorganizations

were the ones that undid ones that had happened before. There are two or three of those. I could say a lot more on this organization thing but I won't.

And the final item that I sure ought to get into the record somewhere is the standardization of procedures, to which I'm totally opposed. It caused many of our problems in the acquisition process. Standardization may be fine for nuts and bolts and so on. The Air Force and Navy for years did good standardization in that area of hardware and that is really useful. It's helpful to the designers, to mechanics, to everyone, but it sure doesn't make any sense to me that we should necessarily buy airplanes the same way that the ordnance organization buys cannon or shells or that we should buy airplanes the same way we buy ships. Industries are different. The procuring organizations are different, different strengths, etc. Why can't we optimize rather than standardize so that we do each job the best way rather than some amalgam. I've never understood it. The standardization effort on the way we specify airplanes was a very expensive step for the Navy. After years of study, OSD finally directed that the Navy adopt the Air Force designation system. We stopped having F4Hs and had F-4s, stopped having F3Ds and had F-10s. Even worse was that they made it all retroactive. We had to go back through all the files and relabel so many of the aircraft and all of the work that went before. It was really ridiculous. But then most of the things OSD has done over the years I consider ridiculous. So I'll end this "oral history" on that high note. I wonder if Zip Rausa is going to agree that this is ended but I think so.

## Epilogue#1 – 1 August 1997

The time is now August 1997, about seven years after completing the taping of this so-called oral history. Due to the efforts of Adm. Jerry Miller, a transcription has now been accomplished, and I have marked it up. More editing will be necessary. I also feel that some updating is desirable. Therefore:

First, the personal side. My health remains good after a bout with bladder cancer diagnosed and treated in 1990. In 1993, I was pleasantly astonished when appraised of my selection as an Honorary Member of the Golden Eagles. Late that year, my good fortune ended when I lost my wife. We were three weeks short of our 58th anniversary, and she missed the birth of our great grandson by almost a year.

Professionally, I must admit that I have done almost nothing other than to write a few "Letters to the Editor" when particularly egregious "solutions" to some of naval aviation's most pressing problems appeared in trade journals. From my perspective it is hard to find anything positive in the changes effected in defense acquisition organizations and procedures. OSD has continued to grow in size. Using the 1995 DOD telephone book for reference, OSD approximates in size the entire NAVAIRSYSCOM. "Too many Chiefs and not enough Indians" comes to mind. Also, I seem to remember James Forrestal, our first SecDef, suggesting that his staff should consist of only about a half dozen aides. As to NAVAIR itself, it was reorganized by VAdm. Bowes, during his tenure as COMNAVAIR, accentuating TEAM philosophy, integrated product teams, and other popular management buzz words. My old division disappeared, its functions absorbed elsewhere. VAdm. Bowes declined my invitation to him that I gather twenty or so retired officers and civilians to give him our "lessons learned" over the years. As I write this, NAVAIR is in the process of moving out of the Washington, D.C. area to NATC, Patuxent River, while, simultaneously being integrated with personnel from Johnsville and China Lake. I cannot conceive of a move of this nature being countenanced by any of the flag officers under whom I served. Distancing the technical community from OPNAV and the Congress is, in my opinion, a grave mistake. All the advantages we in naval aviation's technical community had over our Air Force counterparts (located in Dayton, Ohio) have been ignored. Even more serious, perhaps, is the precipitous loss of experience occasioned by earlier than planned retirements, and resignations of those unwilling to move from the D.C. area to southern Maryland.

For a brief update on the aircraft programs, as I see them:

- a) The low side advocates in the High-Low Mix game prevailed in the fighter case. As of early this year, we had 361 F-14s, half the number, without attrition, we had planned to procure, and all produced at about half the production rate for which they had been initially priced. F-18s were developed at about the 1975 planned rate. At the beginning of this year 1,050 aircraft were on hand for the Navy and Marines, for use in both fighter and attack missions. The airplane cost had increased substantially and it was short legged as had been predicted. Overall, however, it was considered a success by its proponents. To increase its capability a major

redesign (25% increase in wing area) was authorized and is now in flight test and early stages of production. The design apparently will also become the all weather attack airplane on our carriers, although with less payload/range capability than the A-6, now retired, some 40 years after its initiation.

- b) The A-12, programmed as a stealthy, high capability A-6 replacement was started in 1983 and canceled in January 1991. The action was directed by SecDef Cheney after he was informed of a massive cost increase in the development program not long after he had testified to the Congress that the program was going well. The A-12 was highly classified and the full story on the reasons behind its failures has yet to be told. Four naval officers including the Program Manager, COMNAVAIR, and OP-O5 were forced into retirement. NAVAIR, as the contracting agency, canceled the contract for default and attempted to collect the \$1.3 5B already paid to the McDonnell Douglas-General Dynamics team. That team then counter-sued denying any repayment, and asking for an additional \$1.6B, and has "won" the two court decisions announced to date. At cancellation, the program had gone through 2 competitive phases of "Concept Formulation" and "Demonstration and Validation" with a Northrop-Grumman team. The latter team was then eliminated for the "Full Scale Development" (FSD), which covered the building and testing of 8 flight and 5 ground test articles. The fixed price incentive contract specified a target cost of \$4.0B with a ceiling of \$4.8B plus three ceiling price options for a total of 54 aircraft. It has been reported that the Northrop-Grumman bid was about 20% higher for the FSD phase at \$5.9B. I have been told that NAVAIR's technical community was on record prior to contract that the weight, performance, and cost figures could not be met. In the investigations of the program, it appeared that the PM chose to ignore weight and cost increases reported to him during development. The Navy's management of the A-12 program was eerily reminiscent of that by the Air Force (and OSD) in the F-111 program.

The final program that merits discussion is now designated JSF for Joint Strike Fighter. The JSF project grew out of an amalgam of some DARPA programs: an "affordable fighter" for the Air Force and advanced strike technology program for the Navy and some V/STOL or STOVL work for the Marines. As OSD's predilection for "jointness" grew, and other proposed modernization projects were eliminated, a "JAST" program was born in 1994, with the award of three Concept Definition contracts totaling \$2.2B. By October 1996, the program was redesignated JSF, one competitor, McDonnell Douglas, eliminated, and two Concept Definition contracts awarded to Boeing and Lockheed Martin for \$3.7B. The JSF is to replace the F-16 for the Air Force with a total buy of about 2000 aircraft. The Navy is expected to buy 300 carrier based, stealthy airplanes, initially proposed as A-6 replacements, but later described in somewhat ambiguous terms with both attack and anti-air capability. For the Marines, 640 aircraft are planned as F-18 and AV-8B replacements. Great Britain is involved

also, looking for a V/STOL to take over from their Harriers. The Air Force persuaded all services to accept a single engine, single crew concept. "Commonality" between versions is quoted in the 80-90% range. In my opinion, the chances of technical success are minimal except for the Air Force version, and for that service, it seems improbable that it could compete in price with more F-16s, updated if necessary. The Air Force's stated highest priority tactical aircraft is, of course, the F-22, obviously the high end of the high-low mix (both cost and capability). The F-16, possibly followed by a "JSF", will be the low end of their VF mix. An Air Force study widely reported, shows the F-22 to have a 10:1 exchange ratio advantage over the Russian SU-35 when both are armed with AIM-120 equivalent missiles. That study shows the F-15F to have a positive 1.5:1 exchange ratio, while all other US aircraft analyzed show negative ratios; F-15C 1:1.3, F-18E/F 1:3, F-18C and F-16C both at 1:3.8. The same study shows a marked advantage for two European fighters over the low end of the Air Force mix and the high end of the future Navy fighter. The JSF will not improve the situation for the Navy or Marines. It is evident to me that the Navy has elected to give up its one area of advantage in the air-to-air arena. Navy system effectiveness analysts had shown a marked advantage since the early 1960's first for the two place F-4 with its pulse doppler fire control and Sparrow systems, and then with the F-14 with both Phoenix and Sparrow Missile capability.

As I now review the record some 24 years after my retirement and 22 years after my last official testimony on the Navy's fighter/attack programs (October `75, Senate Appropriation Committee), I am more than ever convinced that we, the technical community, were correct in the positions we espoused. Just as convincing, of course, is that we didn't make our case within the Navy, or OSD, or in the Congress. The F-111, F-16, F-17, and F-18 programs were clearly not in the best interests of our country. Within the system, we tried, and we failed, to convince those above us to buy the most cost effective alternatives available. The fleet pilots of tomorrow deserve better.

**Epilogue #2 - 16 July 1998** (*unfinished, found in G. A. Spangenberg's files after his death on Nov. 13, 2000*)

It is now almost a year since the first Epilogue to this history. Adm. Miller arranged for the Naval Institute to take over the task of completing the project, but to date nothing further has been done due to workload and health problems of Paul Stillwell, the Institute's man in charge.

Last week saw the death of Gill Weiss who had come to the Bureau of Aeronautics with me from NAF in 1939 and who had headed the Weight Control Branch until 1957 when he became my Assistant Director of the Evaluation Division until his retirement in 1970. Our "Technical Community" has lost another of its members who contributed so much to naval aviation during the years starting with the World War II build up.



Earlier this year I participated in a tour of NATC, Patuxent River with the Golden Eagles during their reunion, and yesterday four of us "old hands" were given a tour of the NAVAIRSYSCOM facilities during which current operating procedures were explained to us. Nothing we saw or heard was at all encouraging for the future of carrier aviation. Management levels from the top to the working level must be double that during most of my career. Military design specifications, the real heart of our acquisition process can no longer be used. Apparently, test specifications can still be used, and provide one means of preserving some recognition that the lessons of the past have value in the present. Substitution of "commercial" specifications for the military ones had been publicized by OSD reform advocates as a cost saving measure by those whom I classified as "speculative theorists" with no real knowledge of the subject. The importance of the issue seems not to be appreciated above the working level in the Navy. Military design specifications were essentially a compilation of things to avoid, and not a catalogue of requirements stifling innovation. I have mentioned our experience earlier in this history of the F8B/F15C experience when the "no military spec" developed airplane cost twice that of the one which used them.

I found a disturbing lack of knowledge at the higher levels of the Command on the acquisition problems experienced on certain of our past airplane procurements. Fixed price contracting was suggested as a primary cause for the A-12 fiasco as well as for Grumman's inability to complete the final production lots of the original contract without financial relief. OSD officials have on occasion ruled out fixed price type of contracting for development, but then advocated such peculiar programs as "Design to Cost" (1970s) and "Cost as an Independent Variable" (1990s). The logic of using "Cost Plus" contracting to solve government budget overruns escapes me, although it obviously would solve those of the contractor. As I'm sure I mentioned in the F-14 discussion, that cost problem was due to Grumman's faulty quotation on the variable lot provisions in the contract, which failed to increase the contract price adequately when the production rate (on which the costs were calculated) was halved.

The A-12 project was not on my watch, but none of the information released to date gives me any indication that the fixed price incentive contract induced the contractor to spend more money than he would have on a cost plus contract. The -----  
(ed: *unfinished epilogue, but obviously Spangenberg continued to think and worry about Naval Aviation, as was his want.*)

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