

A Career in Simulation

Jeff Beish (Rev: 12/16/2017)

SOME SIMULATED BACKGROUND

It was Edwin Link of Binghamton, New York who in 1929 received a patent on the first-ever ground based training device designed to teach pilots how to fly. He called this device the "Pilot Maker," or the [ANT-18 Link Trainer](#) (Blue Box). Through the years following the ANT-18 more improved electro-mechanical models came along and around the time of the Korean War his company came out with the C-11 Link Trainer. I trained and worked on several C-11 trainers during my early years in simulators. An excellent U.S. Air Force technical report can be found here: [Flight Simulators. A Review of the Research and Development](#)

In the early 1950's several aircraft companies began producing flight simulators, mostly analog, electrical-mechanical monsters that featured hundreds of servo units, thousands of relays and other electronic components, all kinds of motors and generators, and vacuum tube amplifiers. Some companies designed alternating current (AC) electrical systems and some direct current (DC) electrical systems and all were a combination of mechanical and electrical systems to simulate the each aircraft flight controls and instrumentation. In 1954 General Precision Instruments (GPI) merges with [Link Aviation](#).

The digital computer revolutionized the flight simulator field by providing an easier method of modifying the various aircraft systems and gave us more flexibility while adding many more types of systems to the training. The new digital machines incorporate many of the electrical-mechanical design features of the old analog trainers; but grew in size -- ten fold. Three degrees of freedom motion systems began to give the training a more realistic feel of aircraft flight motions and as time passed these motion systems would provide nearly realistic flight motion "Q's" with the introduction of six degree of freedom motion systems. A modern flight simulator has been designed for every known type of aircraft and combines most, if not all, of engineering technologies in the modern world into one machine to train air crews in normal and emergency procedures. Technicians working on these machines are required to have knowledge in all manner of mechanical devices, hydraulic systems, electrical and electronics systems, computers and in some cases a high degree of knowledge in aeronautical engineering and other related mathematics. A high degree of knowledge in aircraft systems, avionics, radar fire controls, navigation are required...the list goes on.

Joining the United States Air Force

I attended basic military training at Lackland AFB, Texas [01 Mar 1960 - 07 Apr 1960, Air Training Command (ATC)]. Our training instructors (TI's) were: SSGT Linan and SSGT Parnell. (They were called "drill instructors" in the past). We attended eight weeks of basic training at Lackland AFB, Texas and then finished three more weeks of basic training after arriving at Chanute AFB, Illinois (09 Apr 1960 - 29 April 1960) to attend Flight Simulator Operation and Maintenance training.



Graduation photograph of the 3703 SQ, Flight 264, April 1960 at Lackland Air Force Base, Texas

Boot camp was not easy; however, I managed to stay on the good side of the TI's and graduated without any troubles. We still had several weeks left in basic training but would finish up at our technical school base after leaving Lackland.



Barracks at Lackland AFB, Texas, Basic Training

My Beginning in Simulation

Early in 1960 I attended Flight Simulator Maintenance School at Chanute AFB, Illinois for basic electronics, Flight Simulator Operation and Maintenance training. The school made available the B-36 (Curtiss-Wright), F-86D (MELPAR), and C-119 (Curtiss-Wright) flight simulators for hands-on training. Before technical school began we attended eight weeks of basic training at Lackland AFB, Texas and then finished three more weeks of basic training after arriving at Chanute. Much of the time for new students was spent white washing curbs, K-P at the chow hall, and cleaning up around the cold and drafty pre-WWII open-bay barracks. A few times we transplanted trees

around the base golf course. Finally we began school, after getting up at 0400 and marching around from place to place.

NOTE: Flight Simulator Specialist School, United States Air Force (USAF). Covered basic electronics, electro-mechanical systems, and aerodynamics associated with flight simulation. The Chanute simulator school remained open until November 1985 when the last class graduated. The Chanute simulator school remained open until November 1985 when the last class graduated. The first training devices school at Chanute began with the Link Trainer Mechanics School from January 1939 to March 1944 and was re-designated as Training Devices Specialty Field in September 1947. In January 1976 the field was split between analog and digital systems. During the early 1980's the Air Force began phasing out the enlisted airman participation in the career field. By 1990 the career field was completely converted to contract maintenance and only hand full of airmen remained. ([AFEHRI File 100.091](#) by: SMSgt G.A. Wehrs (USAF)). [Chanute was closed 30 September 1993].



Chanute AFB, Illinois. ATC, Attended Flight Simulator Maintenance School and finished basic training (07 Apr 1960 - 22 Nov 1960). The Flight Simulator Maintenance Class of 1960. Back, Left: SSGT David Adkins, A3C Masato J. Yamashita, A1C Fritz L. McClory, SSGT John M. Evans, A3C Donald A. Stephani, TSGT Verne T. Berry. Kneeling, Left: TSGT James H. Pitts, SSGT Frank A. Ruecles, A3C Jeffrey D. Beish, SSGT James C. Marksam, TSGT Verne T. Berry A3C John D. Spaulding. NOTE: John M. Evans, Donald A. Stephani and John D. Spaulding would work for Singer-Link with me later on in the late 1960's.



B-36 on Parade Field at Chanute AFB, IL (Currently at Castle AFB, CA Air Museum)

My friend, Mas Yamashita, and I were transferred to Naha AB, Okinawa and traveled to Travis AFB, San Francisco, California via Hickom Field, Hawaii and Wake Island AB, Pacific Ocean. Then a temporary assignment (TDY) at Ashiya AB, Japan to help disassemble the C-130 simulator to be shipped to Naha AB, Okinawa. Then we were off to Kadena AB, Okinawa and finally to Naha AB. [USAF ended use on 31 May 1971].

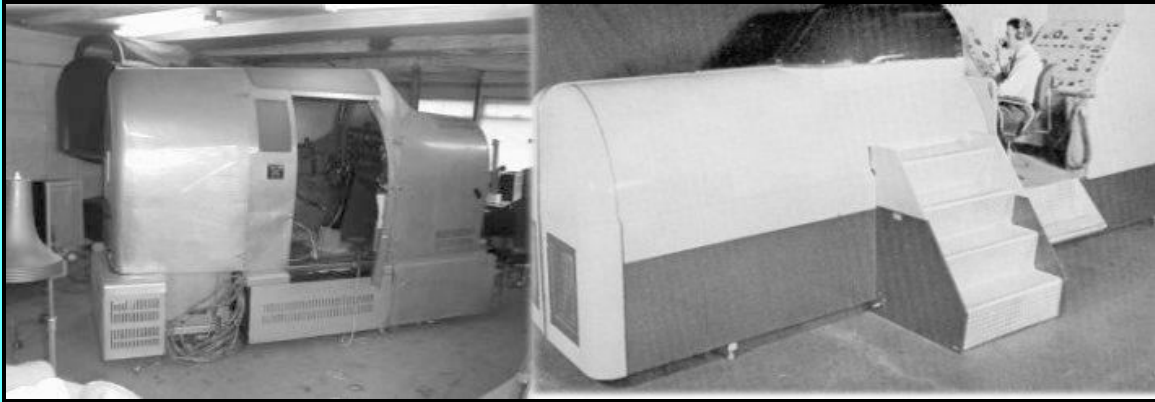
From late 1960 until mid-1962 I was stationed at Naha Air Base, Okinawa, [PACAF, 5th Air Force, 313th Air Division, 51st Fighter Interceptor Wing, 51st A&E Squadron]. My primary duty was a technician for the Curtiss-Wright C-130 cargo and Link F102 fighter aircraft flight simulators. We also had a Curtiss-Wright P3 and Link C-11B cockpit trainers. MSgt Paul J. Hodana arrived at Naha at the same time and was deputy NCOIC under CMsgt Floyd Miller, Tsgt Tony N. Lucas, Ssgt Barton, Ssgt Brittain, SSgt Cherry, SSgt Manfordini, SSgt Okuna, Tsgt Hanefan, A1C Brant, A2C Bud Davis, A2C Mas Yamashita, and A2C Beish.



Simulator shop at Naha AB, Okinawa

During on-the-job-training (OJT) the Air Force offered trainees the *Capital Radio Engineering Institute* (CREI) Electronic Engineering Technology correspondence course. Three of us trainees signed up and completed the course in 14 months. The Curtiss-Wright Tech Rep, Joe Cositor, talked me into starting college so I signed up for the University of Maryland Extension courses at the base library. We were given credits from University of Maryland to be applied toward our associate's degree with CREI. Joe conducted OJT classes each day until we took the Simulator Specialist 5-level testing and continued helping us with college classes there afterward. It was hard to work the schooling into my busy schedule. The other Curtiss-Wright Tech Rep was named Lee Hamma.

Early Curtiss-Wright simulators were AC analog servo type computers made at the Curtis Wright Corporation, Carlstadt, New Jersey. In the 1950's they made most of the cargo and bomber aircraft flight simulators and typically these machines contained hundreds of tube amplifiers and servo units. They also required constant maintenance and adjustments. They had no motion or visual systems to make more realistic training. The P3 cockpit trainer was also a Curtiss-Wright AC analog machine while the Link C-11B trainer was a mixture of AC and DC analog computers. The Link F-102 was DC analog.



LEFT: Curtiss-Wright P3 and RIGHT: Link C-11B cockpit trainers.

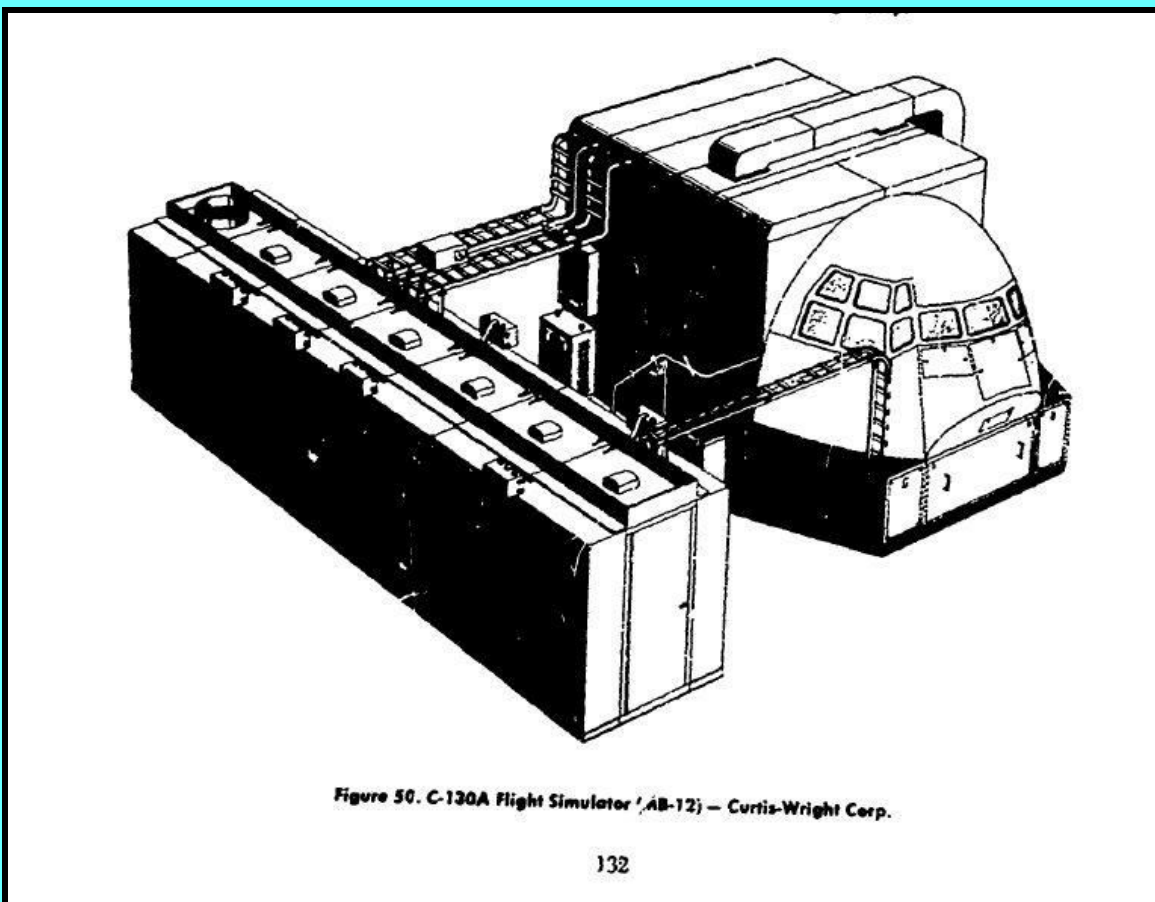
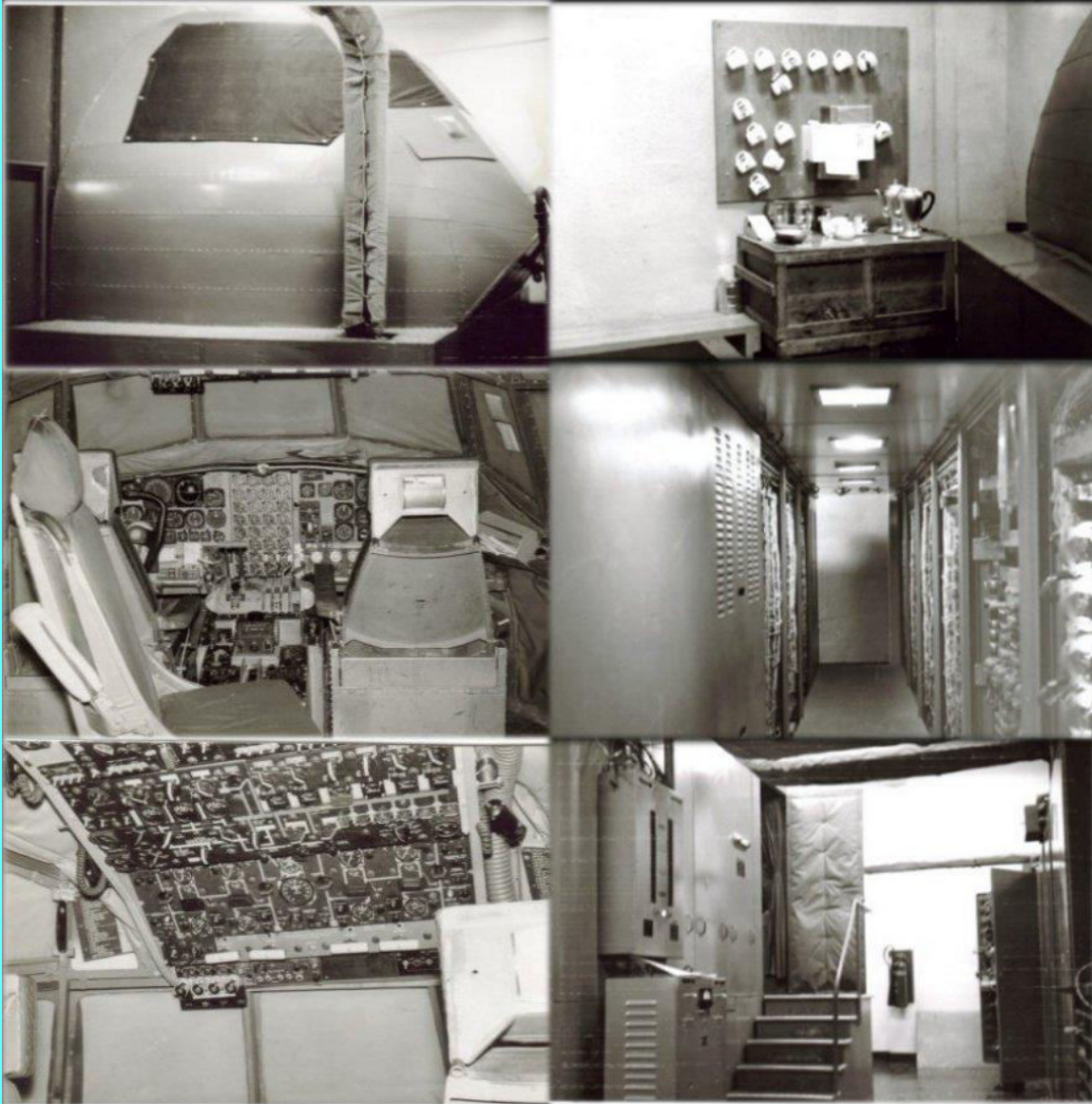
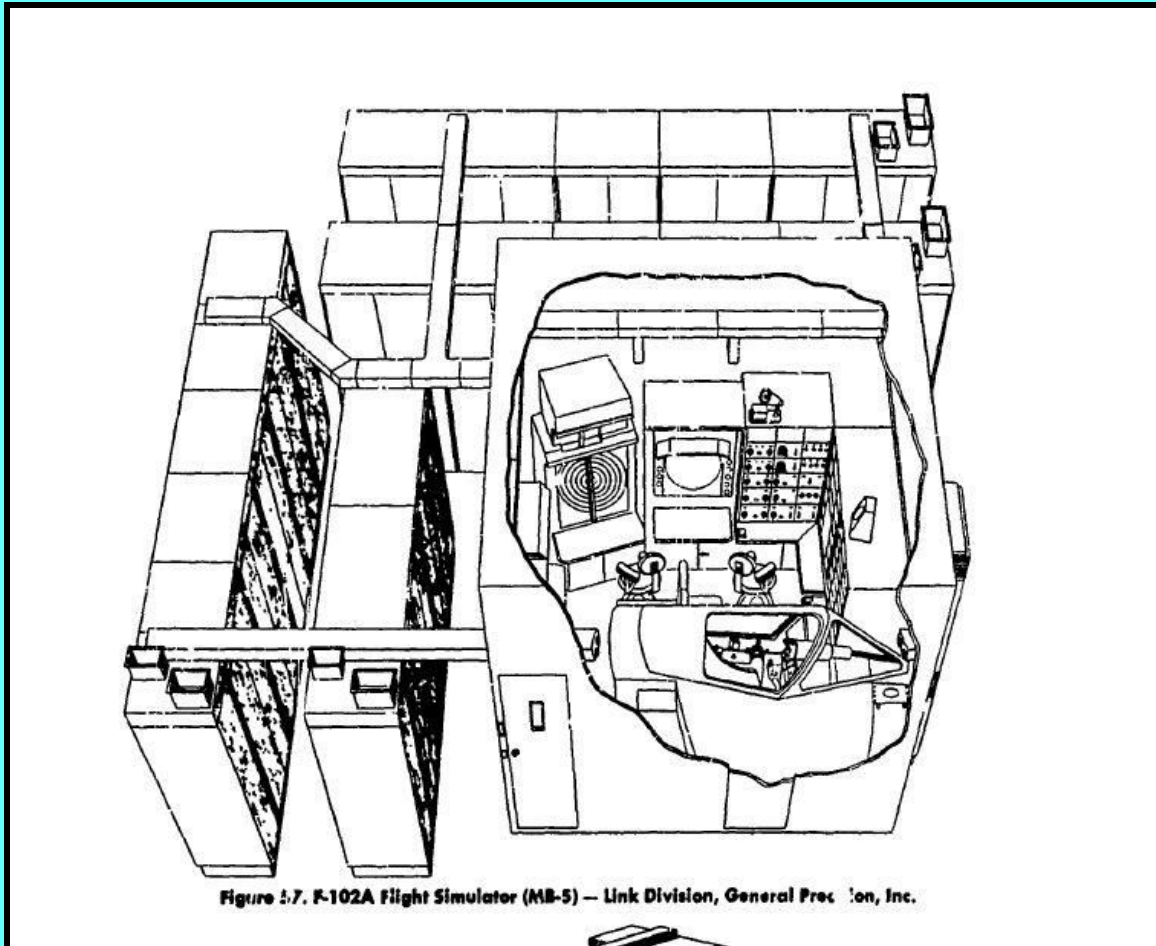


Figure 50. C-130A Flight Simulator (AB-12) — Curtiss-Wright Corp.

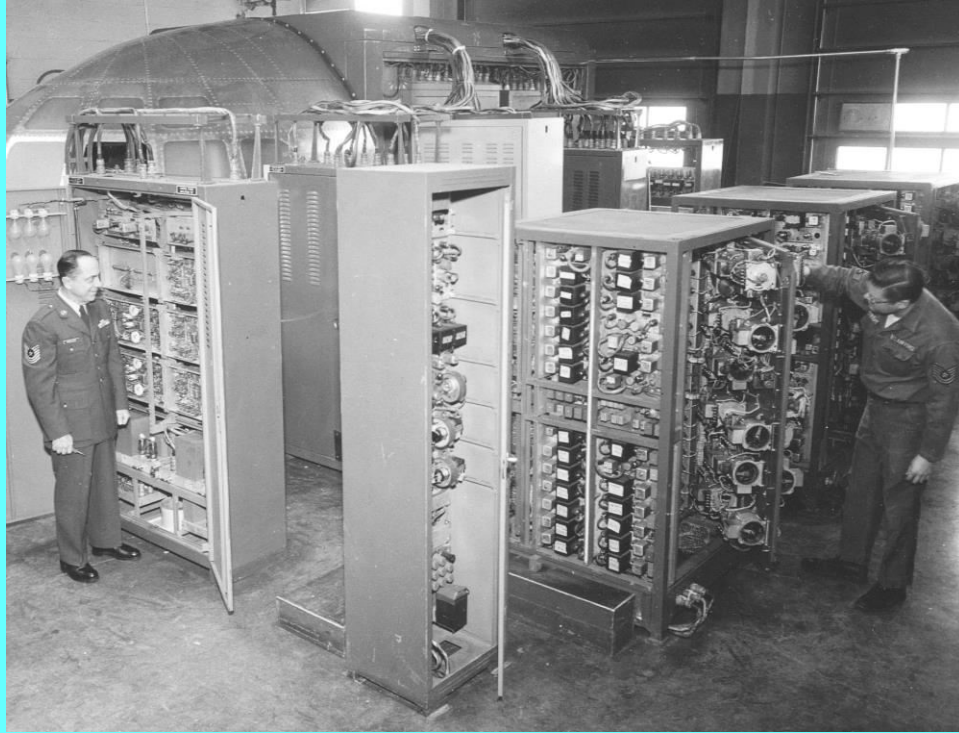


Curtiss-Wright C-130 Flight Simulator. UPPER-LEFT: Outer Cockpit. UPPER-RIGHT: Coffee Station. CENTER-LEFT: Flight Station Instrument Panel. CENTER-RIGHT: Inside Analog Computer Cabinets. LOWER-LEFT: Overhead Instrument Panel. LOWER-RIGHT: Instructors Area Entrance.



Also, I was interested in flying so I started logging hours in a J3 Cub to get a private pilots license. The flying club there was free and I logged in about half the time required for a private pilot license during my stay at Naha.

In mid-1962 the Air Force transferred me to Westover AFB, Massachusetts, SAC, 8th Air Force, 57th Air Division, 814th Operations Squadron. There I began working on the Air Force's newest bomber; the B-52D and the KC-97 air-refueling simulator. Both of these were made by Curtiss-Wright. Occasionally I would help out with the old Curtiss-Wright KC-97 simulator that was housed across the street in the same building as the ERCO KC-135 simulator (<http://lifeafterlink.org/kc135.shtml>). [Westover AFB, MA closed May 1974. Wright-Patterson AFB, OH still open, Turner AFB, GA closed July 1974 and McCoy AFB, FL closed May 1973].



Curtis-Wright KC-97 Simulator (The Aviationist: <http://theaviationist.com/tag/flight-simulator/>)

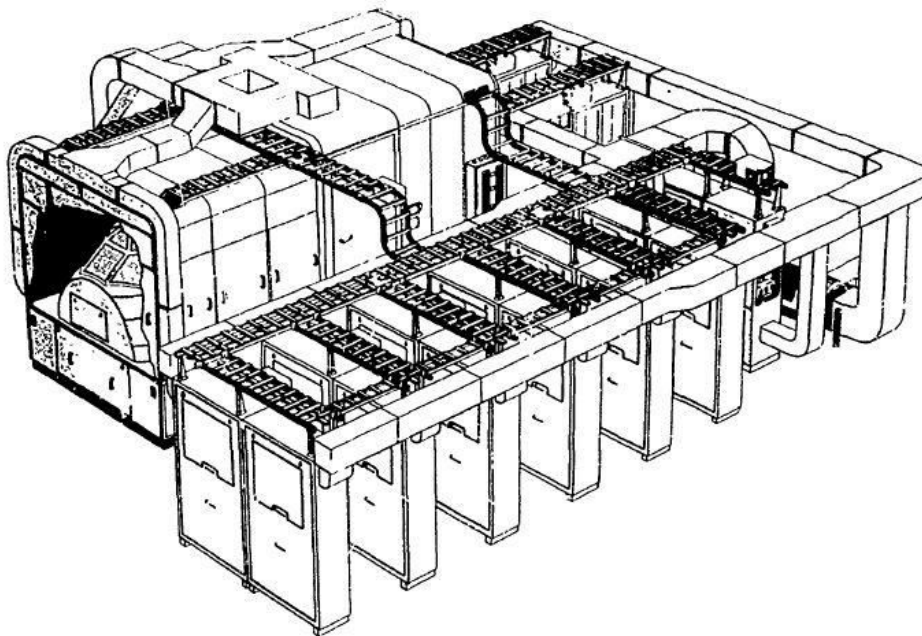


Figure 45. B-52G Flight Simulator (T-1) -- Curtis-Wright Corp.

Later in October 1962, during the Cuban missile crisis, the Air Force extended my enlistment by 1 year. This was due to a shortage in personnel required to bring us to readiness if necessary to go to war with the USSR. We went on alert due to the Cuban missile crisis and I was reassigned to the nuclear war recovery and damage control team. That lasted several weeks and ended, happily, right before we were to begin total nuclear war against the USSR. Some people say it would have been the end of the world; however, this was not true because they did not have the capacity nor will to take us on with those weapons. Our orders were to remain at station after the SAC bombers and refueling aircraft were launched, we only had a few minutes to live. All SAC aircraft were capable of takeoff within 15 minutes. This was a bad time for us because Westover AFB was on a prime target for the USSR.

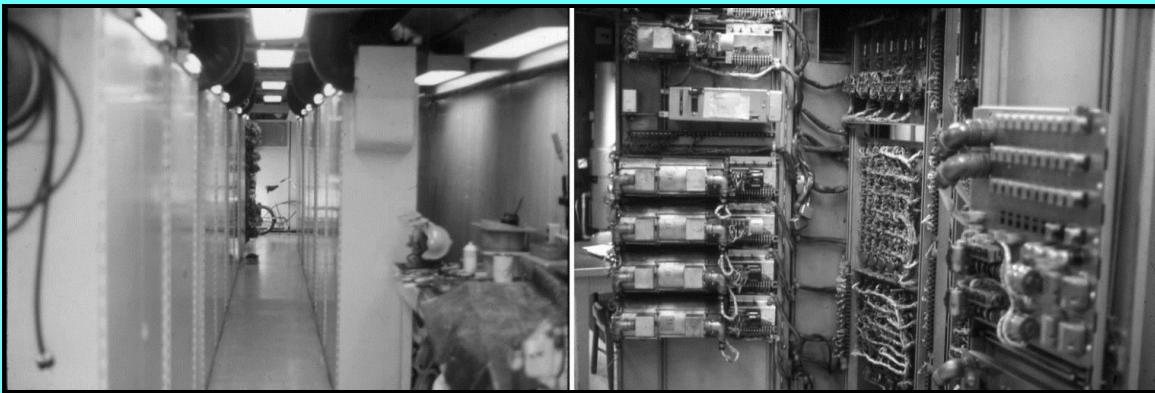


**TOP LEFT: Main Gate at Westover AFB, Massachusetts. TOP RIGHT: Typical winter scene of our barracks.
BOTTOM: Front door of our 814th Operations Sq barracks.**

We were supposed to begin traveling on the B-52 mobile Flight Simulator in October, but the crisis delayed our orders until January 1963. From that time on I spent more time on temporary duty (TDY) on the Mobile B-52 Flight Simulator than time at Westover. After leaving the Air Force I lost track of the mobile simulators and never found out how long SAC ran that program. Rumors were that the mobile simulator programs carried on until the mid-1980's. **NOTE:** The KC-135 Mobile Flight Simulator began in December 1961 followed by the B-52 a month later from Castle AFB, CA.



The B52 Mobile Flight Simulator on tracks at McCoy AFB, in Orlando, Florida in 1963.



B-52 Mobile Simulator LEFT: electronics cabinets in railcar. RIGHT: inside servo/electronics cabinet ([wildfire-productions](#))



B-52 Simulator Instructor's Trouble Console and Cockpit
(<http://www.fairchild.af.mil/news/story.asp?id=123427483>)

Due to the shortage of these simulators and the mission of SAC we needed to keep the air crews at their assigned bases on alert a considerable amount of time in case of war. Taking the training device to the crews was not only the cheapest way it was also the most efficient way to keep them near their aircraft at all times. SAC was hard work. We located the B-52 mobile simulator at three different air bases each month; Wright-Patterson AFB, (Dayton, Ohio), Turner AFB, (Albany, Georgia) and McCoy AFB, (Orlando, Florida). Only a few technicians I can remember: CMSGT Grant, MSGT Frank A. Digiota, MSGT Henry L. Gatewood, MSGT Harry E. Stoeckel, TSGT George F. Southland, TSgt William C. Smith, SSGT Robert C. Crothers, SSGT Milford E. Holiday, SSGT Ira D. Peterson, SSgt Paul H. Pugliese, SSGT William F. Stutsman, A1C Darell D. Grass, A1C William W. Reirden, SSGT James E. Sanford, A1C James N. Sterner, A1C Chuck Hinz, A2C Ramon C. Gonzales, A2C Ronald L. Leap, A2C John K. Smith. There were at least 20 more airmen and NCO's.

The B-52 mobile simulators consisted of two converted WW-I hospital railroad cars. One car had expandable sides so to walk around the cockpit section and cabinets that housed the electronics and electro-mechanical servo systems. The other car had additional equipment cabinets, an office area and, after a couple of years, a small comfort area for the escorts. When the mobiles were moved between bases one of the personal would ride on the train, so we had a pull-down bed, toilet and sink. We also had a small refrigerator and cabinet space for food and supplies.

Usually it only took four days of travel to the next base, but at times we would stop for a few days for railcar maintenance along the way. The 180-ton cars were extra heavy due to the thick concrete floors and simulator equipment. Railroad engineers were never real happy about hauling us around and on at least two occasions the cars derailed in a tunnel causing much confrontation between the Air Force and railroad officials. I was escorting the B-52 mobile from

McCoy AFB to Wright Patterson AFB when the trailing car derailed in a tunnel in Tennessee. While only minor damage was done to the equipment, it surely made the train engineer very nervous. If memory serves me they were repairing tracks in the tunnel and the car broke a temporary tie and only rested up against the tunnel wall. All stop, back up, repair tie and on we went.

Riding escort was usually fun and interesting to say the least. Railroad employees were always friendly and helpful, especially when we had problems with cars. One cold Christmas day two escorts were sidelined in a rail yard and ran out of generator fuel. "No problem," said a fireman as he came over with a yard engine to haul us to the fueling area to fill the tanks and get the heaters back online.

Continuing University of Maryland Extension courses I managed to get in a few more hours towards a Bachelor's degree. Time was really limited for college but when time permitted I would attend classes.



Class- 03043, Closed Circuit TV, SMK-22 School, Chanute AFB, IL, 14 May 1963. Left to Right: A1C Richard E. Weeks, A1C Jim N. Sterner, SSGT Donald S. Goodwell, A1C Edwin E. Noser, A1C Jeffrey D. Beish, SSGT Jerry D. Hodges, and Mr. McNancey.

Technical School: Visual Attachment and Closed Circuit Television Maintenance School, USAF. Basic closed circuit television systems, electro-mechanical servo systems, and image simulation equipment.

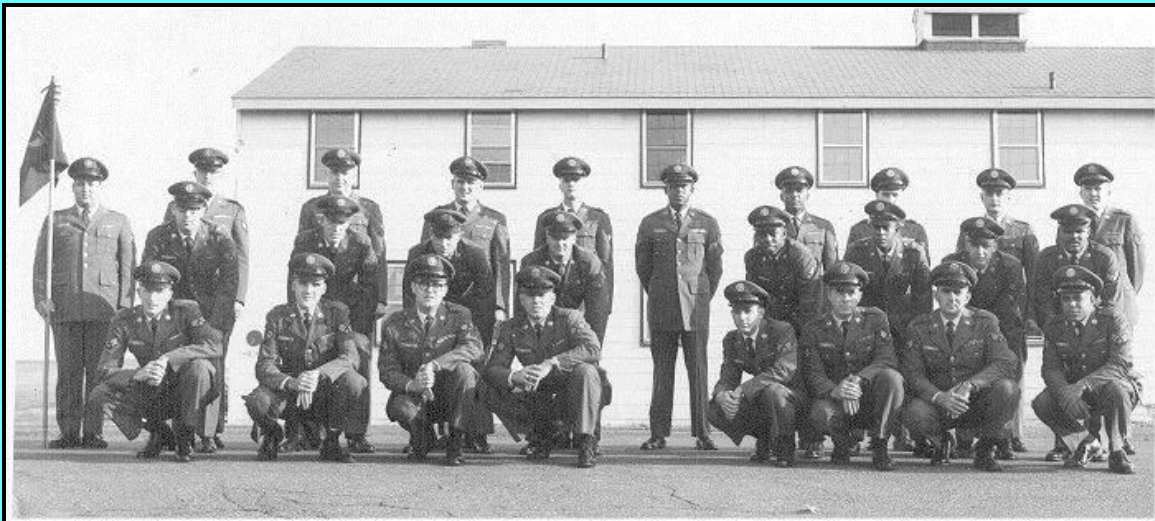
Technical School: Basic Electronics Systems Schools and On-the-Job-Training courses, USAF. Advanced to the technician level as required for my job classification in the U.S. Air Force.

Technical School: Instrument Flying and Aircraft Operation School, USAFI Achievement III School, and Effective Writing School, USAF

During the period from August 20th. - October 15th, 1963 I was called upon by the government to travel to Southeast Asia (Vietnam) to assist in the training of special CIA covert surveillance units. We had assembled the main components of a C-123 flight simulator at the airport in Saigon then moved them to the new close by air base. Installation was nearly complete when persons unknown destroyed some of the installation and a few of the crew were killed. My memory is completely gone of that day and weeks afterward. I will never know why my friends had to die and I was spared. As the years have passed my dreams of that time reveals to me that the installation was not completely destroyed and most of us got out alive. Maybe the trauma of the event clouded my memory or inserted some weird memories that never really happened; one will never know and it was a very long time ago.

A night landing system was installed on the B-52 Mobile Simulator during late 1963 and later, maybe early 1964, a simulated land Mass Radar system was installed. This featured new type of vacuum tube ([Nuvistor](#)) and solid state technology for which we were given training by the manufacturer while at Wright-Paterson AFB. Both systems were not reliable and was down much of the time.

I re-enlisted on March 1, 1964 and remained stationed at Westover until the end of January 1965. Upon returning from my last TDY to Westover I attended the SAC NCO Prep School and added some college credits to my Bachelor's degree with some of the various study groups in the Prep School. Also, I finished up the hours to get my private pilots license and did a solo there at Westover right after Prep School.



Class 64-I, 25 November 1964, Westover AFB, MA, Strategic Air Command, Noncommissioned Officers Preparatory School. Second from right, middle row: A1C Jeffrey D. Beish

Then it was onward to Bergstrom, AFB, Texas, SAC, 2nd Air Force, 340th Bomb Wing, Headquarters Squadron Reporting in at the B52 Simulator department I was assigned as technician. CMSGT Harley C. Barker was the NCOIC, assisted by MSGT "Bucky" Cain. Our chief Simulator Officer was Colonel Parker, who was a WWII hero. Parker had managed one of the largest escapes from a Germany prisoner camp. MSGT Richard Simmons, TSgt John Fisher, A1C Dave Hatch and many others, whose names are forgotten, were in the B52 Simulator section and went TDY on the Mobile Simulator many times. We located the B-52 mobile simulator at three different air bases each month; Carswell AFB (Austin, Texas), to Dyess AFB, (Abilene, Texas), and Columbus AFB, (Columbus, Mississippi). Airman Hatch and I began experimenting with solid

state electronics design as a hobby. Curtiss-Wright Tech reps: Don Dreiling and Jim Taylor (Bergstrom AFB Closed 1993).



The B52 Mobile Flight Simulator on tracks at Carswell AFB, Texas in 1965.

1965 - General Precision Instruments (GPI) buys Link

During September 1966 SAC closed down operations at Bergstrom AFB and most of the technicians in the B52 simulator shop went to Castle AFB, California. The B52 NCOIC transferred over to the KC-135 simulator and took over. He requested that a few others and me to accompany him to Carswell AFB, Texas and we did. From late 1966 until early 1968 I was stationed at Carswell AFB, Texas, SAC, 2nd Air Force, 7th Bomb Wing, Headquarters Squadron where I cross-trained into the KC-135 flight simulator section. We moved into base housing there. I remembered the housing from the movie "Strategic Air Command," Jimmy Stewart et al.



LEFT: Base housing unit; September 15, 1966 -February 29, 1968. RIGHT: Our son Donny and me in our 1965 Pontiac LeMans.

Carswell was a large base in Fort Worth situated beside a large aircraft and submarine company, General Dynamics. I was assigned to the KC-135 simulator there but we didn't get started right away because of problems in shipment of the simulator from Bergstrom. The NCOIC of the Small Arms Range was in the hospital for a few months and they asked for an NCO to be temporarily NCOIC so I volunteered and was there for a month or two. Also, for a few months General Dynamics hired me part time to help out in testing some to their electronic diagnostic systems and I gained experience with completely different types of electronics. Also, I continued to take college courses when time permitted. Time was limited though, but I did manage to gain some hours. The CREI course had been advanced to include solid state electronics.

The KC-135 simulator arrived and I was assigned back to the simulator shop. We began TDY trips again to the KC-135 Mobile Simulator to Barksdale AFB, LA and other bases. While the KC-135 mobile only had one rail car that that time it was similar to the B-52 mobile cockpit car. During OJT for the simulator technician 7-level testing the Air Force offered trainees the Capital Radio Engineering Institute (CREI) Electronic Engineering Technology. Since I had completed my associate's degree through CREI and the University of Maryland and set me up to finish the credit hours needed for a Bachelor's degree in electronic engineering. My college hours were piling up. This mobile simulator was temporarily located at Barksdale AFB, (Bossier City) Louisiana, Clinton-Sherman AFB, (Sherman) Oklahoma and at Little Rock AFB, (Little Rock) Arkansas. CMSGT H.C. Barker, MSGT Minger, TSGT Tom Hemmings, TSGT Riemann, TSGT Savage, SSGT McGathery, SSGT Melton, SSGT Melton, SSGT Rex W. Moore, SSGT Tucker, A1C Bright, A1C Hatch, A1C Markle, A1C Thraillkill, A2C Licandro A2C Wright (Carswell AFB closed 1993).



The KC-135 mobile simulator

End of My Enlistment in the U.S. Air Force

I served two enlistments in the U.S. Air Force for a total of eight (8) years, obtaining the rank of Staff Sergeant (E5), and received an honorable discharge in February 1964 and again in February 1968. My DD Form 214's reflect that I was a Korean War-Era Veteran and a Vietnam War Veteran. My primary duty assignment was to operate and maintain analog and digital computerized flight simulators, radar, and visual effects simulation as a Flight Simulator Technician.

Singer-Link Group Employment

1968 - Singer buys Link

After being discharged from the U.S. Air Force and to further my career in civilian life I was hired by Link Aviation in Binghamton, New York (original manufacturers of Flight Simulators). Link Aviation was a subsidiary of General Precision Inc. and a few years later it became Singer-Link Company in Binghamton, New York. For five years I was a Customer Support Representative, then Senior Field Engineer, Project Engineer, and Electronics Engineer. Field Engineers were responsible for computer programming, depot level maintenance, and electronic systems design for the flight simulator systems. I am an experienced designer of analog servo systems, digital computer and advanced electronic interface circuits, and computer programmer for modern computers.



A Singer-Link Business Card and Engineering Reference Book

In early October 1967 two of us Air Force technicians, TSGT Tom Hemmings and me, flew up to Binghamton for a job interview at the Hillcrest plant. We met with Carl Smith and Lou Slodki for the interview and then took a tour of the plant. That evening we met with some of the Link field engineers, Jim Wrye, Tip Lyons and a couple others for dinner and drinks. We returned to Carswell AFB in a few days and on March 07, 1968 we both reported to work at the Hillcrest plant as Field service representatives (07 March 1968 - 31 Jan 1973; my employee # E368).



Link Aviation at the Hillcrest Plant, Binghamton, NY (Life After Link Photo) <http://lifeafterlink.org/index.shtml>

There were around fifteen people hired at the same time as Hemming and I were and about half were retained after the first few months. My bosses were Jake Wilfley (Manager), Carl Smith (Dept. Manager) and Lou Slodki (Field Service, deceased). During the years at Link I moved from field service department to field engineering then to R&D engineering. Dean Bates (Customer Service Engineering Manager), Ron Cannon was manager of the Field Engineering Department, Fred Wright (Field Service Manager). We had about 450 engineers in the department. Our main function was to install new simulators and field modifications, etc. I started at Link as a Junior Field Engineer and left the company in the top ranking as Senior Field Engineer.



Singer-Link at the Kirkwood Plant, Binghamton, NY (Life After Link Photo) <http://lifeafterlink.org/index.shtml>

My first assignment was in planning and designing of the Navy's Vigilante (A3J) flight simulator to the RA5C and installed modification at the Naval Air Station, Albany, Georgia (former Turner AFB). I then moved down to the Kirkwood plant and met Charlie Dean (deceased) who was the lead Field Engineer for the project. Of the half dozen Link engineers I only remember Joe Almen and Charlie Dean. After the planning we traveled to Albany, Georgia on a U.S. Government contract maintenance and engineering for the U.S. Navy RA5C flight simulator and I had the opportunity to work with one of Links premiere design engineers, Merl Crabb. During that time we redesigned several of the engine and fuel management systems, then a major design and overhaul of the flight systems.

The RA5C basically employed analog systems except for the engine simulation where tube operated digital computer was used to compute the engine performance. This system was called the Digital Function Generator (DFG) and was later resigned using solid state integrated circuits for the more modern GP4 and GP4-B digital computers as the Digital Arbitrator Function Generator (DAFG).

In August 1968, after the major objectives of this project were complete, I was reassigned to Loring Air Force Base in Maine as a Field Engineer for KC-135 and F106 Flight Simulators. We lived in small village near the base named Limestone. The Link tech-rep for the F106 there

needed help so I assisted him occasionally. One of the GI's (name forgotten) there was stationed with me on Okinawa in the C130 department. I went to Kincheloe AFB, Michigan TDY on the KC-135 Mobile Flight Simulator. We first lived in a small two-room house outside Limestone where I had to carry in buckets of coal oil for the stoves and heater. It was very country. As luck would have it the U.S. Air Force disbanded 8th Air Force command and my contract was terminated only after a few months. Thank heavens we did not have to stay in northern Maine very long. [Loring AFB closed 1994, Kincheloe AFB closed 1994].

My next assignment was as a Project Engineer with the Air Force Advanced Controls and Displays Research Laboratory at Wright Field in Dayton, Ohio. I learned to design digital systems while there and continued with my EE education. Bill Austin was the manager and senior engineer of the Controls and Displays Laboratory where I worked. This laboratory was part of a larger system of the Air Force Research and Development command. The building our laboratory was in had housed an old pre-NASA centrifuge for high-G training.

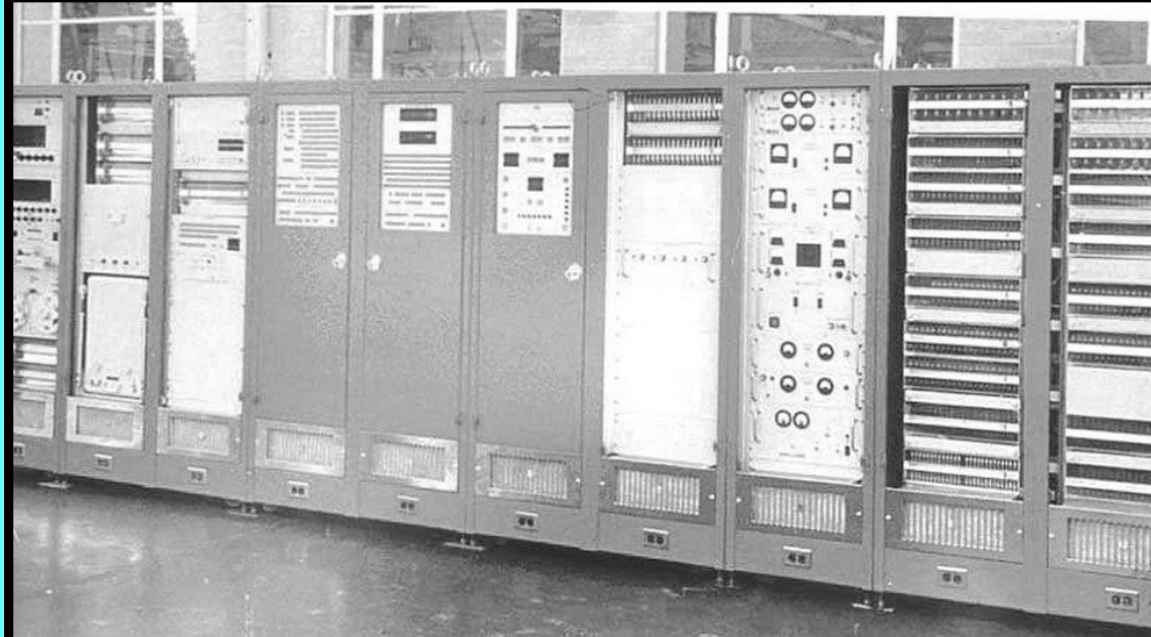
One of my projects was designing systems for first XC-142A VSTOL aircraft simulator with [the Link Mark-I digital computer](#), the first digital computers used in simulation. We collected parts from damaged aircraft until the last one crashed and burned sometime in 1969. We also had an OH-13 helicopter simulator that was driven by Link Mark-I, the first real time digital computer and one of the first digital computers in my experience.



The Tri-Service VSTOL Aircraft, c. 1958-1984



Tri-Service/Vought-Hiller-Ryan XC-142A
Tilt Wing Turboprop



TOP LEFT: VSTOL Test Aircraft. TOP RIGHT: OH-13 helicopter. BOTTOM: Photo of a Link Mark-I Digital Computer

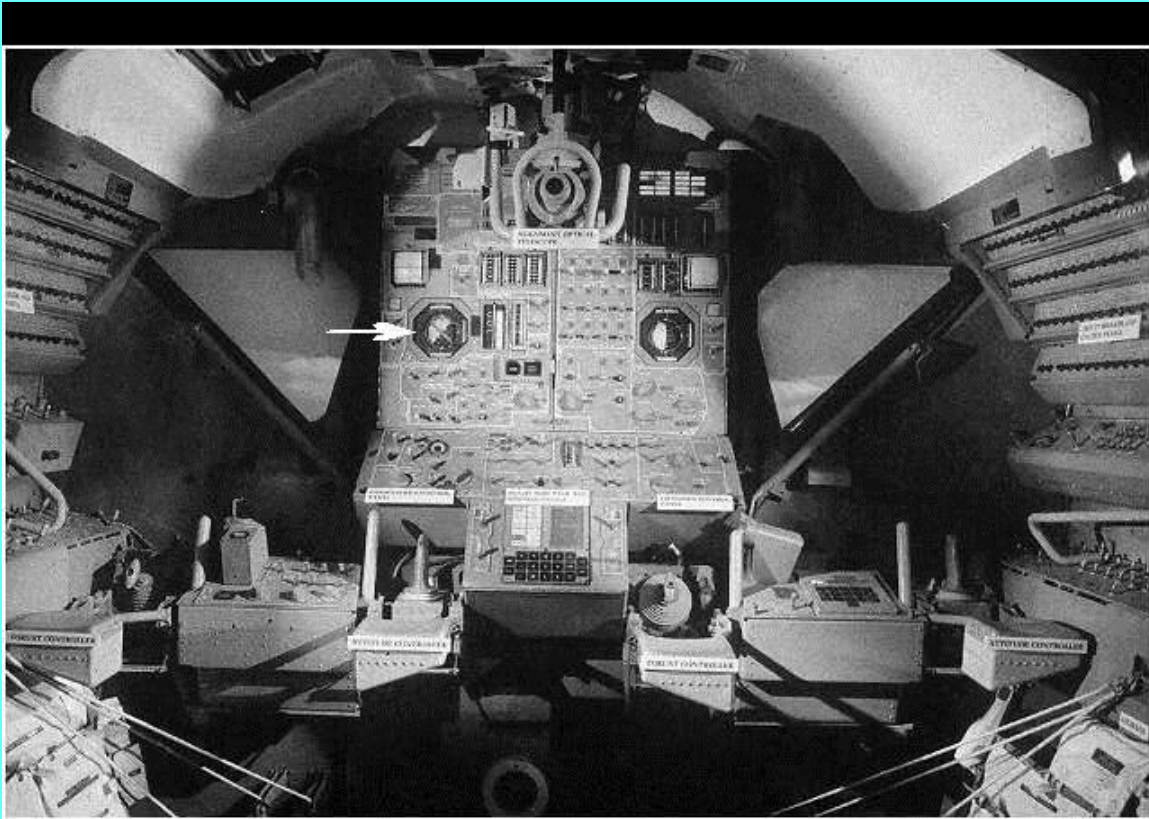
At times this simulator used a [large analog/model CCTV visual system](#) that filled an entire 40-foot room and [Giant Analog Flight Simulator | Modern Mechanix](#). The projected ended.



Large Analog Visual System

Another interesting project was to design a test bed for the newer integrated instrument panel for the Lunar Module that was due to be put on the Moon. We used an electronic version of the Norton bomb sight used in WW-II bombers. We included altitude, rate of climb and attitude indications on a CRT display that was eventually used for the Lunar Module but aircraft indicator systems from that time forward. The test bed was a beginning and we produced ideas that carried on through the aircraft industry.

The instrument package for earlier LEM machines was heavy and not as reliable as modern instruments that had been developed during the late 1960's. The CRT or digital instrument package we had developed was never used in the LEM 11 - 17; however, they did adopt several of our ideas in the lighter and more efficient Integrated Attitude Instrument seen in the image below.



© 1993 Smithsonian Institution

Apollo Lunar Module controls and instrument panels (Arrow indicates the Integrated Attitude Instrument).

During that time period I attended a college class provided by United States Armed Forces Institute (USAFI) for solid state electronics and gained more credits in my CREI course. Up until the end of 1967 my electronics work was mostly in vacuum tubes and a beginning in transistors circuits as a hobby. The USAFI class brought me up to date on solid state devices and later on into modern integrated circuits. These were the early analog, op amps and the like, and RTL and DTL digital circuits. There is nothing better than learning new technologies while designing electronics with those new devices.

Technical School: Mark I and Mark II Digital computers and Linkage (interface) School, Singer-Link. The first digital computer to be used in flight simulation. This computer was designed specifically for real-time applications.

My pet project was to redesign the vertical scale on the standard black and white attitude indicator. The experiment was to then expand the vertical scale twice the indicated degrees, just for the fun of it I had the instrument shop color the gyro face blue and green. After that aircraft attitude indicators were designed with double the vertical scale and, yes, a blue and brown color scheme!

We lost the contract so I returned to Binghamton, New York for GP-4 Computer and Linkage School. See: [A Brief History of MK1 and GP4.](#)

Technical School: GP4 and GP4B Digital Computer and Advanced Linkage Schools, Singer-Link. The first digital computer to use integrated circuits. This computer was designed

specifically for real-time applications. The class was also attended by me, John M. Evans, Jack Campbell and several Link engineers and technicians from Pakistan (see photo below):



Members of the Link GP4 and GP4B Digital Computer and Advanced Linkage Schools (Sep 1969 - Jan 1970)

In January 1970 I was then assigned to American Airlines in Fort Worth, Texas as Field Engineer for B707, 727, BAC 111, DC-9, and B747 Flight Simulators. We lived in an apartment in Arlington, Texas. This assignment was stressful due to the shift changes each month from day, to afternoon then midnight shifts. Several technicians and engineers that I had worked with in the Air Force were also at American Airlines; Lee Dreiling (brother of Don) and Jim Taylor (Bergstrom AFB) and one who was sat Chanute when I was there. We left for Binghamton April 17, 1970.

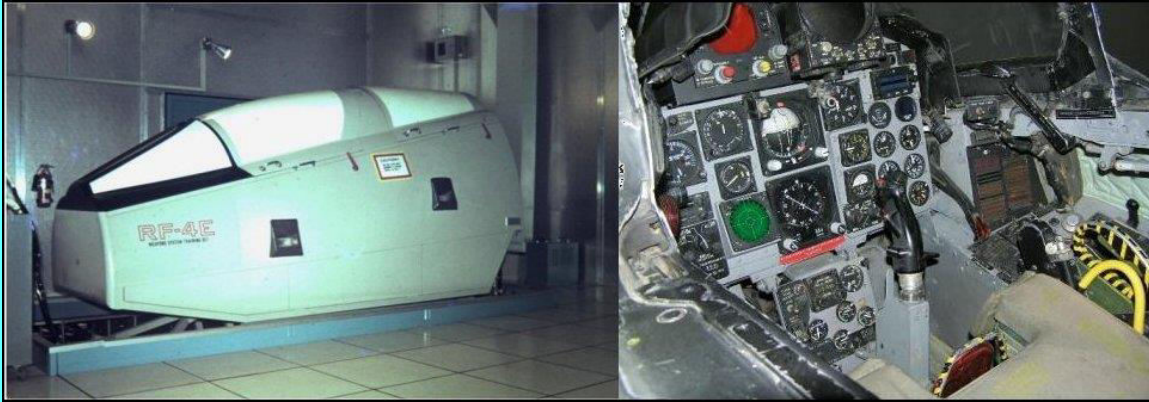


A Simulator Bay at American Airlines Training Academy in Fort Worth, Texas

After the airlines assignment I was put in charge of an engineering group of six engineers to modify the F4E flight simulators for RHAWS modification at Davis Montham AFB, Tucson, Arizona from April – September 1970. Two engineers flew in from the Link plant in Palo Alto, California who helped us out were Charlie Doggett and Rich Jensen. This was a stressful and difficult assignment in that we worked long hours and many sleepless nights to get the first F4E simulator accepted by the Air Force. Since this was the first computer replacement and interface redesign our procedures and engineering practices had to be the standard for the other 17 Air Force F4E flight simulators. The second machine at Davis Montham went smoothly and faster.

I was scheduled to lead the group at Hamilton AFB, Novato, California; however, I declined and opted to join as a regular engineering crew member at Eglin AFB, FL instead. Then it was on to Eglin AFB, Fort Walton Beach, Florida; September – November 1970, and finally to Seymour-Johnson AFB, North Carolina. What would have been the easiest and fastest to do was the hardest because the GP4B computer we received from the plant had many problems and would not run at all. Our boss, Ron Cannon, sent Jim Wrye and Cliff Cartwright down to help and we got the system up and running. We finished that project in three weeks.

After the F4E modification assignments I was sent to Bremgarten AB, Germany as a Field Engineer for RF4E Flight Simulator, German Air Force (January 1971 – June 1972). I left the family with my parents in Richmond so to find a home in Germany. I stayed a couple days in Freiburg then moved near the German Air Force Base at the Gasthaus Traube in the town Eshbach on the road to the air base. After the family arrived in Germany we moved to Bugginggen, Heitersheim, Mullheim, and then moved into a large basement apartment in Staufen. This was a quiet little village at the foot hills of the Black Forest and afforded us many hours of traveling around southern Germany and Switzerland. Bremgarten AB, Germany (1968 to 1993, 51st Reconnaissance Wing 'Immelmann' of the German Air Force). [Bremgarten AB closed October 1994].



LEFT: RF4E simulator front and rear cockpit shell. RIGHT: RF4E simulator cockpit inside seat area.

Art Walsh was the Program manager and our staff included Jim Wrye (lead engineer - deceased), Eldon D. ("Ike") Eserhaut (deceased), Cliff Wright (deceased) and me. Several other engineers were there for installation: Bill Reinoehl (deceased), Joseph N. Almen (deceased), Len Brozowski (deceased), and Herb Stevens (deceased). The German engineers from CAE were Fritz Schurner and Hans Helber and the German Air Force simulator liaison airman was Lothar Shaller and German Air Force officer Major Kunka.



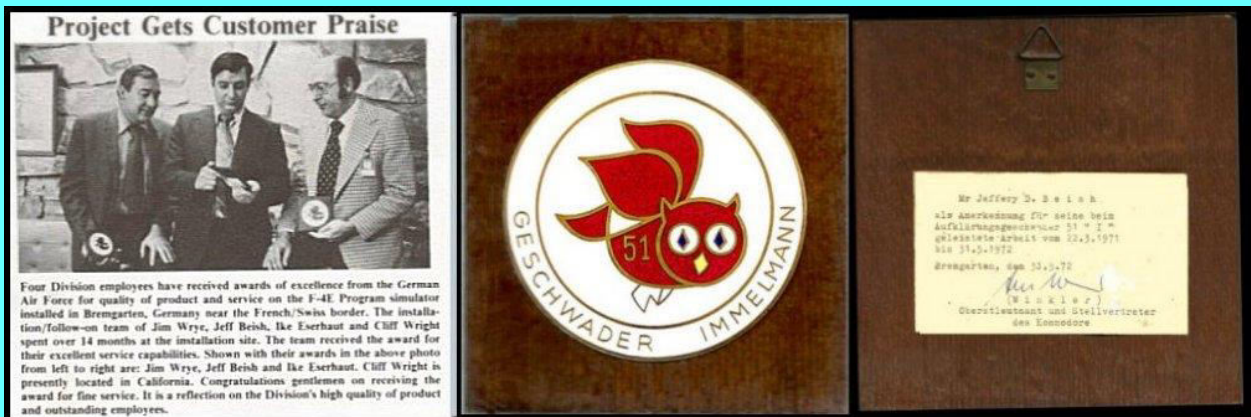
LEFT: Link GP-4 Computer attached to the RF4E in Germany (dark photograph). RIGHT: F4E Instructor Consoles (1971): Left to Right: Jeff Beish, Jim Wrye, Major Knuka (Simulator Officer), Lotar (Administrator), Joe Almen and Ike Eserhaut.

We then traveled by train from Freiberg to Bonn to meet with the German/Canadian company that was to replace us then take over and run the several RF4E's and F4E simulators we had sold them. One of the board members of the company was none other than Adolf Garland (https://en.wikipedia.org/wiki/Adolf_Galland), General of the Fighter Arm during WWII and we were invited to his home later on for drinks and talk. He lived in a penthouse type place and had a swimming pool in his living room! Heir Garland was a very pleasant man, spoke perfect English (American accent) and we had a hell of a nice time with him until wee hours, then breakfast with him the next morning.



LEFT: Me and June with friends at Cliff Wright's home. RIGHT: Major Knuka and his assistant, simulator liaison officer.

At the Officers Club at Bremgarten and behind the bars was a huge painting of Snoopy on his red doghouse. Our Link team had plenty of *ein Prosits* to Snoopy back then. Not sure why they honored Peanuts, but it had something to do with the name of their Wing. Before leaving the Wing Commander and General of the Luftwaffe gave us a bier or Prosits and presented us with a plaque:



News Clip from Singer-Link's "The Log"

The General was none other than WWII Luftwaffe fighter ace, Johannes "Macky" Steinhoff, who was severally burned as he crashed his Me 262 on take-off (https://en.wikipedia.org/wiki/Johannes_Steinhoff) and (<http://ww2f.com/threads/luftwaffe-ace-johannes-mackey-steinhoff-signed-photo-collection.33439/>).

I returned to Binghamton and was Electronic Engineer assigned to interface design for the Simulator for Air-to-Air Combat (SAAC) Flight and Visual Simulator development program. This simulator was an advanced concept with two F4E simulators with one programmed to simulate a USSR MIG-25 fighter and was hooked to the same computer system. It has an advanced visual system that wrapped around each cockpit and enabled each crew to see the other's model. My job was to integrate the 32-bit Sigma 5 computer system I/O or linkage to the visual system interface.

Since the project was to remain in-plant for three years I attempted to find another assignment. After working on the SAAC program I was asked to join the U.S. Marine Corp Harrier simulator program since I was the only engineer familiar with the Sigma-3 computer system.

Technical School: XEROX Sigma-3 and Sigma-5 Digital Computer (Formerly SDS) Schools, Singer-Link. Advanced and powerful digital computer for its time.

Technical School: Simulated Radar Landmass and Target Generation School, Singer-Link. Radar system simulation for fighter aircraft for surface mapping and air to air combat fire control.

Technical School: ADAGE Digital Graphics Computer and Terminal Systems, ADAGE Computer Company, Boston, Mass.

During the last months of 1969 I again attended college courses at Broome Technical Community College and was helped by one of our leading design engineers, Merl Crabb, who pushed me until I finished college and received my B.S.E.E. in the fall of 1972, majoring in Electronics Engineering Science for Computer Control Systems and Electronic Control. CREI was affiliated with the [New York Institute of Technology \(NYIT\)](#) that was located at the community college.

NOTE: The *Capitol Radio Engineering Institute (CREI)* changed its name to the *Capitol Institute of Technology (CIT)* in 1964, and in 1987 to [Capitol College](#) and during 2010 assumed the name: *Capitol Technology University*. They began as a correspondence school like many others advertising in the back of Popular Mechanics. Unlike the others, in 1932 they opened a residence hall and hands-on classes. By 1966 they were offering genuine bachelors degrees. In 1969 they moved to Kensington, Maryland then in 1980 moved to their current residence in Laurel, Maryland on a property that used to be the Beltsville Speedway. In 1990 they began offering a Masters program.

While it was an interesting challenge and I enjoyed working for Link the traveling began to take it toll on our family. Our son, Donny, was attending first grade in school we decided that it would be better to settle down to allow our son and daughter to grow up in a more stable environment; so acting on a tip from a friend I called the Eastern Airlines Simulator department to enquire about a job opening and afterward flew to Miami, Florida for an interview. They asked me to show up for work in February 1973. My last day at Link was **January 31, 1973**. Link was sold off in the late 1980's to several newer simulator companies. The military division was sold to a Canadian company, CAE, and the company's future was unknown to me. (For a complete story go to: [Life After Link](#).)

Onward to Florida and Eastern Airlines

Early in 1973 we moved to Hialeah, Florida where I began working for Eastern Airlines (**12 February 1973 - 04 March 1989**; employee #14776) on the mid-night shift (11:45 p.m. to 7:45 a.m.) as a flight simulator technician. I had to join the IAM union. Eastern had 18 simulators, cockpit procedures trainers (CPT) and various other training devices. Each aircraft type had a CPT and simulator for crew training and FAA check. EAL equipment included the Electra-L188 (Link), DC-8 (Link), DC-8 (Link), DC-9 (Link), DC-9 (Link), DC-9 (Conductron), B720 (Link), B727 (Link), B727 (Link), B727 (Link), B727 (Conductron), B757 (CAE), A300 (AirBus), and L1011 (Link), plus CPTs. Two simulators had VAMP visual units on them: L-1011 and B727 (Conductron) until replaced by various versions of the VITAL visual systems. (NOTE: Visual Anamorphic Motion Picture (**VAMP**))



The Hartley Building and L1011 Simulator Building. Most of our flight simulators and other training devices were in these buildings (NOTE: the small building center-right housed the L1011 simulator and is gone now).



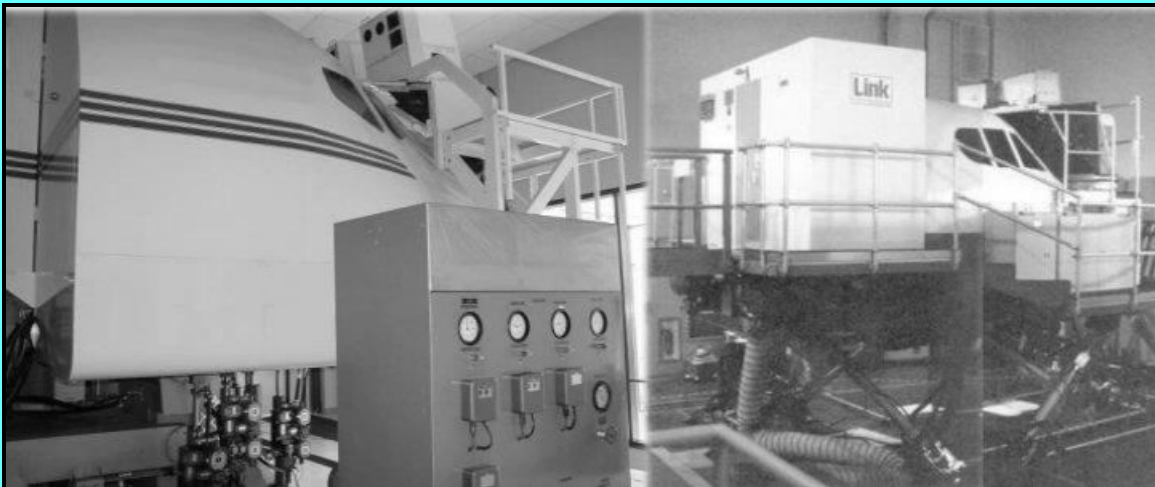
Hartley Training Center and Flight Simulator Bays Demolished ~ July 2015

An interesting note is that the old DC-9 simulator had a GP-4 computer on it that I had removed from an F4E simulator on Davis-Monthan AFB, Arizona in 1970. This computer was refurbished and sold to Eastern Airlines to be used on the DC-9. It was still in operation until 2001 when the power cabinet smoked; but it ran 24 hours a day, seven days a week from 1965 until that time. That is 36 years! We lived in Hialeah until buying a home and moving to Cutler Ridge the first week of March 1974.

I worked on the many flight simulators and assisted the engineering department in teaching the Link GP-4, GP-4B, and Honeywell DDC-124 digital computers. Also, due to my previous experience as an Electronic Engineer and Field Service Engineer with the Singer-Link Company, I was called on by Eastern Air Lines to set up and conduct classes on the maintenance and operation of the various digital computers and interfaces attached to the flight simulators. After a year on first shift (daytime) I had to return to mid-night shift because the old Mark II computer on the B-727 simulator was out of operation. Also, I was assigned to help out an old friend, Cliff Cartwright, from Singer-Link on some Eastern project.

Funny, just remembered that in the late 1970's when working midnight shift and when not too busy I helped L1011 mechanics learn cockpit procedures for them to taxi the aircraft and setup for engine run ups. They appreciated that more than I expected and they told me later that it helped them a lot in their safety practices and work efficiency.

The work of a Flight Simulator Technician is provide high level maintenance for the modern digital computers and electronic interface systems, and electromechanical and hydraulic systems used in flight simulation, simulated visual, and motion feel systems. The technician repairs computer and other electronic circuit boards, electromechanical servo systems, and other electronic or mechanical device found on a flight simulator. My primary duties as a technician were to maintain, overhaul, modify, and provide preventive maintenance for all electronic training devices and flight simulators owned by Eastern Airlines.



LEFT: Typical EAL 3-axis Link Flight Simulator. RIGHT: EAL Link AST Simulator.

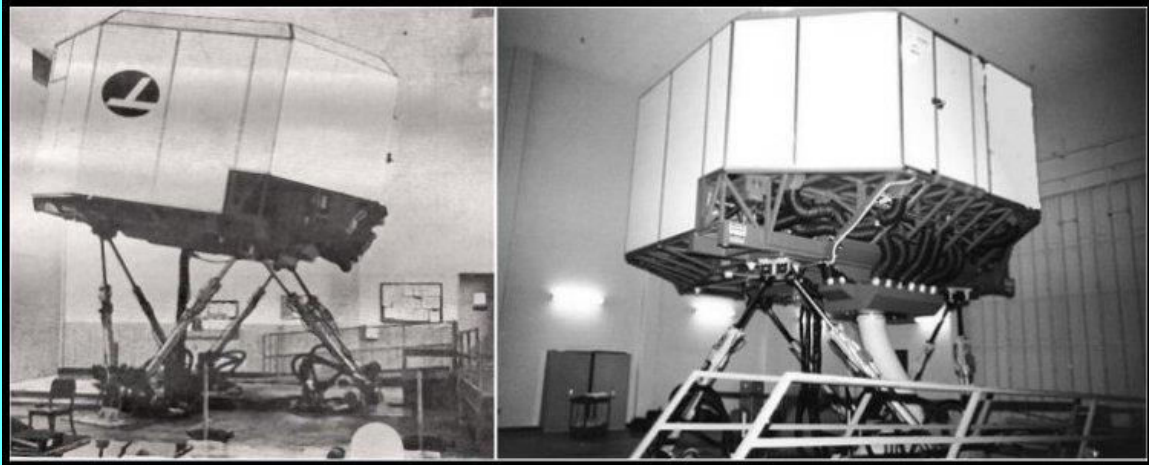
Eastern technicians: Joe Andersen, Harry Bardsley (deceased), Jeff Beish, Jim Bertram, Junior Bentley (deceased), Dick Boynton (deceased), Tom Bussiere, Paul Carter, Leonard ("Chad") Chadovich, Dave Cook, Billy Coughlin, Ralph Correl (deceased), Rick Cunningham (deceased), Jim DeCanio, Pat Dunn, Charles Fried (deceased), Tom Gangemi, Ernie Garrett, Tom Kendle, Henry Kimberlin (deceased), Jim Koraluski, Fred LaMonte, Bob LeBerge, Floyd Lewis (deceased), Bill Lindsay, Oscar Linzels, Willy Lynch (deceased), Dan Maxwell (deceased), Dick Mays (deceased), Jeff McAfee, Harold Miller, Ray Monti, Mike Morehead, Jack Morton, Earnest ("Chief") Murphy (deceased), Bill Oberpriller, Mike Pendergrass, Jim Pierce, Barbara Price, Tom Reid (deceased), Rod Rodriguez (deceased), Virgil Salisbury, Tony Scarletta, Chris Scott (deceased), Dave Sexton, Phil Smitheters, Johnny Sohle, Lew Stafford, Ron Stamper, Harry Twigger (deceased), Dave Van Auker (deceased), Larry Welch, Don Wilhoite, Matt Willams (deceased), Ed Worchester (deceased).

Management: George Allison (deceased), Dick Boynton (deceased), Lennie Bramburger (deceased), Bob Bussey (deceased), Kenny Cole (deceased), Kevin Cooper, Ernie Garrett, Perry Hertzog (deceased), Dan Maxwell (deceased), Ray Monti, Bill Rivers (deceased), Ed Ryan (deceased), Paul DeCarlo (deceased), Jane Leonardi (deceased) and Bob Taylor.

Programmers: Kevin Cooper, Bob Holzborn (deceased), John Hook (deceased), Harland Hurst (Federal Witness Protection), Vicki Jarvis Wilhoite, Dr. Jones, Bob Leberge, Mitch Migulis, Jack

Morton, Tom Peters, Barbara Price, Tom Reid, Don Rhodes, Reggie Rowe, Larry Sobelman, Don Wilhoite, Carl Wile , Ed Worchester (deceased).

While chatting with some former Eastern Airline pilots on *Facebook* (about the simulator world) we got to talking about Capt. Charles Donald Albury, one of our simulator instructor pilots who would drop in early mornings when I was doing a pre-flight and chat with me for while. He was better known by a few as Major Charles Albury (https://en.wikipedia.org/wiki/Charles_Donald_Albury), co-pilot on the B-29, *Bockscar*, that dropped thenAtomic bomb on Nagasaki August 9, 1945.

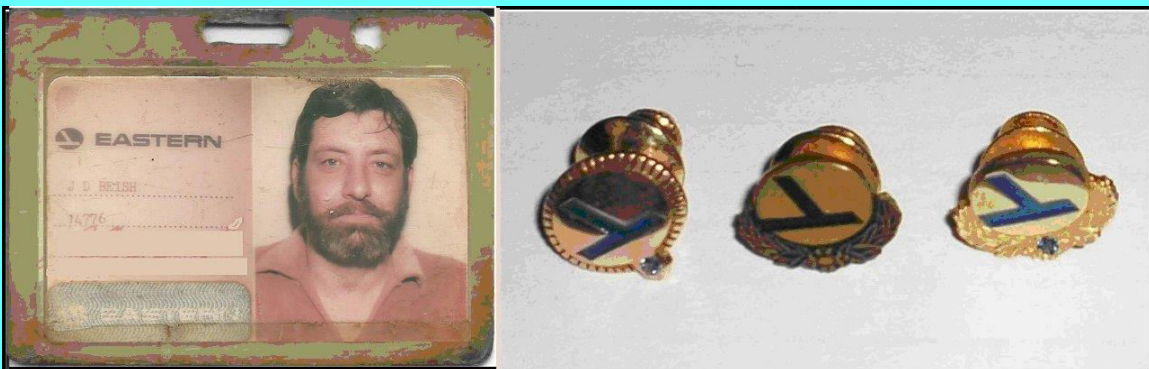


LEFT: 727 AST in March 1979. RIGHT: Typical 1980's Vintage Link AST Simulator

Technical School: Varian V72, V73, and V76 Computer Visual Systems Schools, Eastern Air Lines (EAL). Used in visual image simulation for flight simulators.

Technical School: Vital-I, Vital-II, Vital-III and Vital-IV Visual Simulation Systems School, EAL. Used in visual image simulation for flight simulators.

Technical School: Burtek 727 Cockpit Systems Simulator School, EAL. Similar to a flight simulator without visual and motion systems.



My ID Badge and Longevity Lapel Pins from Eastern Airlines



1978: Received Eastern Airlines 50th Anniversary Medallion



Eastern Airlines Plaque

During the mid-1980's Eastern Airlines struggled with increasing fuel prices and labor costs, so eventually the tensions reached a braking point and then CEO Frank Borman left Eastern and the company was sold to former CEO of Texas Air and Continental Airlines, Frank Loreozo. The working conditions changed for the worse and he made life miscible for all of the employees. I began looking for another job and fortunately met the director of the U.S. Naval Observatory

during a meeting of the Southern Cross Astronomical Society (SCAS). The director inquired into my situation with Eastern and hinted to me that a job opening at the Time Service Station would be soon available. The station is located next door to the Metro Zoo and quite close to my home. During the last few months of 1988 I visited the USNO Time Service Station and interviewed for a job with the Federal Government.

1988 - CAE Electronics buys Link (CAE-Link)

1988 - Paul Bilzerian buys Singer

1995 - GM Hughes Electronics buys CAE-Link

I remained at Eastern Airlines until 4 March 1989 when the Union and Company failed to reach an agreement with the labor contract and a strike resulted. Eastern Airlines declared Chapter-11 a week after the strike began and the employees were subsequently locked out. While out of work I walked the picket line at Eastern for ten weeks and decided to stop. During that time I made many trips to Port Charlotte, Florida to visit with my father and swimming at Ft. Myers Beach. It was not the greatest of times being out of work and waiting on the government to hire me. My wife, June, began working as an assistant for a friend of ours, Burt Rudick, who ran a stock brokerage. I found work job shopping at three small flight simulator shops at the airport and some part time work at the Silver Bluff Community School teaching electronics. On June 19, 1989 I reported to work at the [U.S. Naval Observatory](#) Time Service Alternate Station (NOTSAS) in Miami, Florida.

1997 - Raytheon Systems Co. buys Link

2000 - L3 Communications buys Link