R. A. Erdrich, 1st Experiences Article

by Richard A. Erdrich 'Dick'
Editing by John Skonnord, formatted by Lowell Benson.

INTRODUCTION

Mr. Erdrich was employed by UNIVAC, Sperry, Unisys Defense Systems, and Lockheed Martin in the Twin Cities for 47 years! After the Legacy Committee was formed in late 2005, retirees and employees were asked to write brief career summaries. There was absolutely nothing brief about a 47-year career, so Dick asked John Skonnord of Lockheed Martin {Publications & Design Services} to assist in putting together stories of his almost five decades of computer work history.

In December 2024, Dick gave Lowell a disc containing 17 stories along with text sheets and photographs – we've decided to post them in three articles as shown in this Table of Contents. I, Lowell, feel quite fortunate to have been directly associated with him during several of his 16-bit computer stories.

Contents

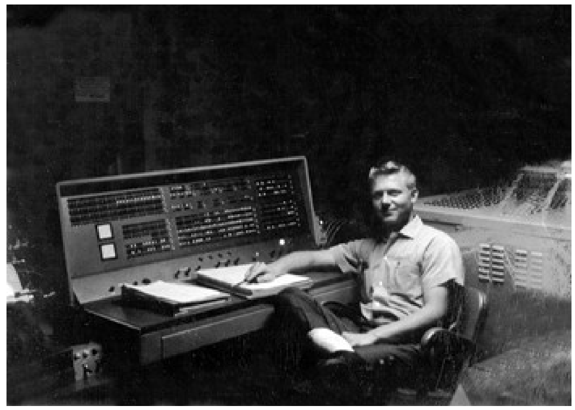
Formatted for the Legacy Anthology with Microsoft Word.

In addition to these specific career story groups, Dick has contributed items to the Legacy Anthology: chapter 44, Interfaces; chapter 51, 24-bit Computers; chapter 52, 32-bit CPUs; chapter 54, 16-bit Computers; chapter 57, AF computers; and an Our Stories posted for June 2010, 200 Nanosecond Memory edited by Lowell Benson with text inputs from Curt Hogenson, **Dick Erdrich**, Don Mager, Ken Pearson, et al..

1.0 30-BIT COMPUTER STORIES

Chapter 52 - 30-bit Computers. Introduction to our 30 Bit ISA Computers; This 30-bit Instruction Set Architecture (ISA) is the longest LEGACY thread. This 30-bit line started with the AN/USQ-17 lab/shipboard systems in the mid-fifties. The last 30-bit production unit delivery was the 499th CP-901 in 1992, a 35-year history of manufacturing equipment with this basic architecture, https://vipclubmn.org/CP30bit.html.

1.1 AN/USQ-17



This picture of me was taken in the fall of 1959 in the ASDEC area of the Naval Electronics Laboratory in San Diego, California. It shows AN\USQ-17 Serial Number 4 during installation checkout. Serial number 4 was built in the spring of 1959 and brought up to full operation during the summer.

The move to San Diego was accomplished with very few problems which was a characteristic of all the Univac solid state computers. I had worked on the prototype Video Processor and the USQ-17 checkout crew and, as an employee of Military Field Engineering, sometimes referred to as Field Service, was moved to San Diego for the winter to support both pieces of equipment which had, coincidently, shipped at about the same time.

1.2 Real Time Data Handling System (RTDHS)

This shows the Real Time Data Handling System (RTDHS) 1206/CP-642A installation in the FPS-16 Radar building on Ascension Island (South Atlantic) in the fall of 1961. Alex Durr (shown on the right), an employee with MILGO Electronics Co. in Miami, Florida is pictured with me. MILGO built the A=>D (Analogue to Digital) and D->S (Digital to Signal) hardware (shown on the left) that interfaced the computer with the FPS-16 Radar. I had been a member of the checkout crew that installed the prototype FPS-16 at White Sands Missile Range in 1958 while still in the Army and had detailed knowledge of the Radar, so our integration time was very short.

Picture 1a. Dick Erdrich and Alex Durr.

CP-642A Customer - BUSHIPS Environment - Shipboard First Delivery - September 1961 Quantity built = 142
Vol/Ft^3 = 54 Wt/Lbs = 2320 Pwr/Wts = 2000 Mem/Cyc = 8 usec. Mem/Cap = 32k core I/O rate = 30 kw/sec I/O channels - 14 duplex channels, -15v signal level.

Ernie Lantto was the Project Manager for the RTDHS project and recruited me to help with the conversion of the CP-642 to the CP-642A and integrate the system. This involved removing the door mounted maintenance panels on the CP-642 and designing the Over-the-Door Console which created the CP-642A. This was my first involvement with design work and pretty much convinced me that that's what I really wanted to do as a technology career.

I installed and checked out the system on Ascension Island in the Pacific in early August and Ernie came down later to finish the Operating Manual while I worked on software integration and sell-off. The system worked very well, allowing the Ascension Island Radar to remotely transmit data to our computer and, using orbital parameter data provided by the Range Safety Computers at Cape Canaveral, lock onto the incoming Re-entry Vehicle (RV). The prime function of the system was to update the local track data as the RV began its entry and provide track prediction as the RV went through Black-Out and, upon emerging from Black-Out, reacquire track until splashdown. A lot of the U.S. improvement in ballistic missile impact accuracy was accomplished using this system for measurement.

Some of the things that happened along the way in getting this system running and selling it off might be of interest.

The system was designed to receive teletype data over a VHF (Very High Frequency) radio link from the range safety computer building at the Cape. This data would consist of 6 computer words with corresponding check sums and there would be 6six blocks of this data. The data was geocentric X, Y, and Z position relative to the center of the earth and the corresponding velocities X Dot, Y Dot, and Z Dot. The plan was to be able to extract a minimum of one valid data word from each block received. The first problem that occurred was that the Univac Teletype Adapter had only been used at a 100 Word-Per-Minute (WPM) baud rate and had never been used at its optional baud rates of 60, 75, or 200. We had to run at the Atlantic Missile Range standard of 75 WPM. The receiver building at Ascension Island Auxiliary Air Force Base had about 20 receive teletype units so after a little negotiating with the NCOIC (Non-Commissioned Officer In Charge), I had one of his troops punch up a loop test tape for one of the units so we could transmit continuously and patch it into one of the Radar building lines. At the Radar Building I had to first change speeds on the teletype unit. This involves mechanically changing a gear on the unit and, never having done it before, required the normal amount of screwing around. Finally, having achieved a mechanical baud rate of 75 WPM, to change the electronics of the teletype adapter to 75 only required the movement of a four-pole rotary switch from 100 to 75. Of course it didn't work.

I went through the prints but, never having seen them before, didn't have a real good understanding of what was going on. The one thing I did notice though was that there were a lot of one-shot flip-flops in the design and a lot of capacitors that were being switched to change speeds. After some consultation with Ernie in St. Paul he decided to send somebody down to take care of it. I knew Bob Malnati, the engineer that had designed it, and assumed that he would be the one that came down. Instead, they sent Bob Oulicky, who, at the time was either a technician or an engineering assistant but apparently had worked with Malnati during the initial checkout. The teletype adapter logic was built into the back wall of the teletype cabinet. If you were sitting at the keyboard and typing your knees would be looking at the covered chassis. The modules faced the front, and the chassis had to be lowered forward to get to the taper pinned back panel. The only way to do any scoping was to lie on the floor and with all the capacitors in the design most cards could not be extended. We did have some test points on the cards though so we could usually work with the chassis up. Bob Oulicky stayed for 2 weeks and gave up. It still didn't work but he planned on talking to Malnati when he got back, and they would try it back at the plant and send me the fix. He left and I continued to work on it. I finally stumbled across a signal that I didn't understand and after studying it realized why it wasn't working and discovered a rather large capacitor missing from one of the one-shot circuits. I took two capacitors from the 60 WPM selection circuitry and soldered them into the missing position, and everything worked, kind of. I called back to Ernie with the news before Oulicky and Malnati had even looked at the problem.

My problems were not over, however. The teletype data coming up from the receiver building was very dirty. I could never get a complete *Quick Brown Fox* test message through without errors. I knew I had no chance with incoming orbital data. I had worked on some teletype equipment while in the Army [along with just about every other kind of electronic equipment imaginable] so I had an idea of where the problem was. The teletype system worked off a current loop because the character decoding was done on a rotary shaft controlled by an electrical solenoid. The solenoid was controlled by the presence (Mark) or lack (Space) of current. A secondary current loop could be implemented that was slaved to the decoding shaft and would faithfully repeat the action of the primary current loop through a set of secondary spare contacts. These receiver units had never used the secondary spare contacts, so they had never been set up. I took a scope down to the receiver building and tweaked the spare contacts until I had a clean square wave coming out. A call up to the Radar building verified that the test message was now coming through error free. I wasn't done yet, however. The NCOIC pointed out that I might not always get that teletype unit because of traffic flow and maybe wanted to set up a couple more. I ended up setting up all the receiver teletype unit's primary and secondary spare contacts. These guys didn't have access to a scope and didn't know how to run one. For all their radio and teletype work they used a multimeter or a VTVM. Having an oscilloscope available to do this adjustment was appreciated. I still wasn't out of the woods.

The data from the Cape came in to the receiver at the Receiver Building and a current loop was controlled by the incoming signal and connected directly to our Teletype Adapter. We could not get an error free message across the link. We could get a single word correctly from time to time but never enough to form a complete message. After looking at the signal from the receiver it looked like the circuitry that was converting the RF (Radio Frequency) to the Current Loop was fast enough to react to noise glitches in the RF envelope and these were being reflected in the current loop. The teletype adapter would strobe the incoming teletype code at precise times and some of these times were during the occurrence of an RF glitch. Given the time frame we were working in I knew there was no way we were going to be able to quiet down the RF noise, so I decided to use a mechanical filter. The teletype unit we were using had both a reperforator (Tape Punch) and an auxiliary tape reader. These units are shown on the lower right side of picture 1A.

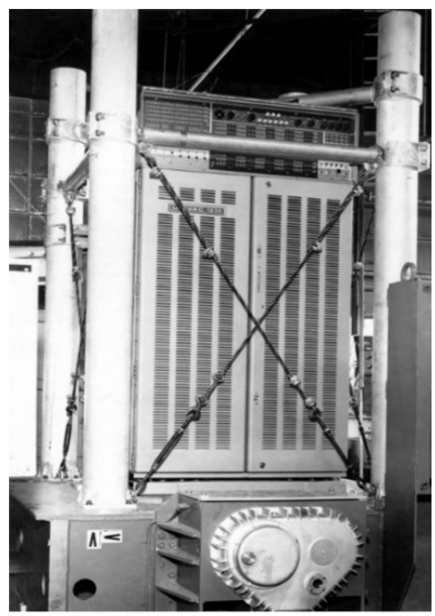
The receiver and the teletype were in wide usage with good success in transferring data, so the teletype solenoid apparently wasn't fast enough to respond to the RF noise. My procedure for using this mechanical filter was to dump the incoming orbital data to the reperforator and then, when the tape was long enough, load the tape into the auxiliary reader and start the computer. The first thing the software did after initialization was to start the reader and look for the first message. If it received a good message it would shut off the tape reader and create the initial synchronization signals for use in positioning the radar. With this new scheme in place the very first block of the message we received from the Cape came error free. Looks like we've got ourselves a system. One person was not happy with this change in the system design [More properly termed a work-around]. I think that Ken Hoglund was either the system designer or one of the system designers. He was adamant about making the RF link work without having to do the mechanical filtering thing and was downright hostile towards me and my fix. He implied that when he got back to the plant he would do his best to do me in. Luckily, Ernie came down to finish the Operating manual [Something that Hoglund's people probably should have done] and he backed me up both on-site and back at the plant. To Ken's credit though, he put together a very good team and did a pretty tough job in a short time. I was most impressed by a software guy named Jim Young. He was probably the orbital integration software designer because we would make a test run on the computer that would take 15 minutes, and we would go off and pound a Friden Calculator for the next 6 hours. We still weren't out of the woods.

We sold off the functional RTDHS to Pan American Airways, the base contractor. They weren't happy about accepting it, but I think Ernie did some negotiating and convinced them that it was the right thing to do. They were not ready, however, to accept the physical installation itself. Ernie had already gone home when Pan American informed me that I would not be able to leave until they had accepted the physical installation. They didn't like the fact that I had laid our cabling hooking the RTDHS to the FPS-16 over the existing cables in the building cable runs.

One of our runs is visible in the picture crossing just above the computer and continuing over to the MILGO equipment. A building cable run connecting the FPS-16 Operators Console with the transmitter and receiver cabinets runs along the upper right. The original RCA installation team had installed the cabling like a nest of snakes. Pan American wanted me to straighten out that mess before putting my cables on top. I tried fighting it because the system had theoretically been accepted but they controlled who got on airplanes leaving there and I wasn't going to get out until they were happy. Having been on the island for over three months and with Christmas coming up I gave in. Using my previous knowledge from the installation at White Sands It only took me three days to rip all of the cabling up from the first floor of the building and lay it back in nice and neatly. Pan Am grudgingly agreed that it was good.

However, I couldn't leave until my replacement showed up! I wasn't even aware that anyone was going to replace me. A phone call back to Roy Hegler who was managing Field Service at the time resulted in Emil Waslouski being sent down. I didn't know Emil but learned later that he was our resident card shark and proceeded to clean out all the gamblers on the island until they learned better. I left on a C-121 on the 21st of December and arrived home on the evening of the 23rd.

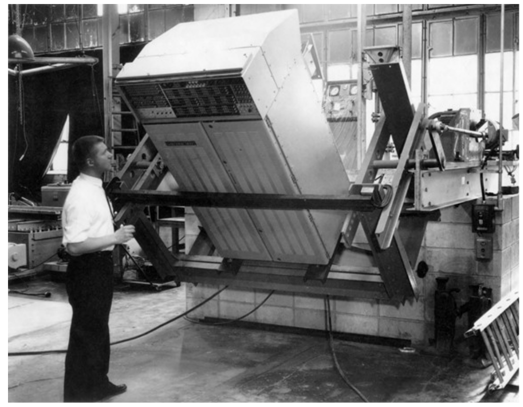
1.3 UNIVAC 1230 Computer



This was taken in late 1965 during qualification testing of the UNIVAC 1230 in plant 2. This was one of the earliest tests performed using the new LAB Inc. vibration platform. This vibration tester was still in use in the Environmental Test Area of the Eagan plant in 2007.

Between 60 and 70 of these computers were delivered to NASA for use in the Apollo program. Each NASA ground station used a pair of these configured as Uplink (Command) and Downlink (Telemetry) computers to remotely control Command Module functions. The use of these computers was instrumental in the safe return of the Apollo 13 crew.

1.4 UNIVAC 1230 Environmental Testing



This was taken in late 1965 during qualification testing of the UNIVAC 1230 in Plant 2. This was the first inclination test conducted at Plant 2 and I was the lucky guy that was chosen to run it. The test fixture was built in the Reliability Model Shop and is still in use in the environmental test area of the Eagan plant in 2005.

I had done the qualification testing on the CP-642A and CP-642B computers previously while working in Field Service and had gone to work for Paul Welshinger in the Reliability Group specifically to perform these kinds of tests and make repairs/changes when necessary. I had been assigned to Engineering during the initial checkout of the 1230 and had made many field trips in its support. Paul's thinking was that if he had somebody in his group that could fix things when they broke he wouldn't have to depend on Engineering to get their support.

In this case he was right. Although the Inclination Test was perceived to be rather benign, after starting the computer test program and the inclination fixture the 1230 failed after a few minutes. I restarted things a couple of times hoping the problem would fix itself, but it refused to. At that point I surmised that the problem was probably not in the four I/O chassis or in the five Memory chassis. That left the four Central Processor chassis as suspects. I pulled the chassis that provided the timing and sequencing and got lucky. After removing the back cover and eyeballing the inside of the chassis I spotted a 6/32 X 3/8 screw not attached to anything and after removing the screw and putting things all back together again was able to complete the test without further problem.

1.5 CP-890 Poseidon Central Navigation Computer

This series shows different aspects of the Poseidon Central Navigation Computer (CNC), also known as the CP-890 Computer. This was the first of the 3rd generation computers developed by Univac and provided the technical basis for all the following developments until the advent of medium scale integration.

An explanation of the pictures requires little exposition but the story of my involvement in the project fills in many interesting facets of the way things evolved.

Ernie Lantto hired me into Engineering on May 12, 1966. I had known for some years that the Engineering Department was where I wanted to be, but openings were few and far between and chances for a non-degreed engineer were even fewer and farther between. Fortunately, two outstanding Engineers working for Ernie were also non-degreed and there is nobody that will argue that Don Mager and Glen Kregness weren't at the top of the pile.

Don went on to become a successful department manager, then a Director. Glen was eventually pulled over to the commercial division where management felt his architecture skills would be more profitable.

Ernie and I had known each other for many years at that point. He took over the engineering management job on the AN/USQ-20/CP-642 from Findley McLeod following the initial checkout. Pete Gillis and I, Pete from Engineering, I from Field Service, were assigned to work for him. Our job was to verify every clocked circuit in the design and make any changes necessary. Pete and I worked on this task for four solid months with dozens of changes made while Ernie kept the documentation updated such that every morning we had a freshly updated set of wire tabs to work from. Following this I worked with Ernie in designing the Over-The-Door console which converted the CP-642 to the CP-642A.

Even though I was one of the early members of the CNC design team all the up-front work had been done when I arrived. I'm sure that Ernie, Don, Glen, and probably Leroy Olson had been heavily involved in writing the proposal. The major difference between this 30-bit architecture and proceeding designs was the implementation of 'hardware' floating-point capabilities. This would be the first application of floating-point functions available to any military computer user and was available to only a very few commercial users. I believe that the architecture was a collaboration between Glen and our sister division, Sperry Systems Management (SSM), in Syosset, New York. They were responsible for navigation system software and integration. I did the detail design as a part of the Central Processor design.

We would be replacing a navigation computer that SSM had designed (The NAVDAC) which, I was told, had a Mean Time between Failure (MTBF) of 20 minutes. It is of interest to note that our CNC was, for many years, the most reliable computer in Navy inventory. A white hat [Navy slang for enlisted person] that we hired when he left the Navy had attended C-School on the CNC, served the remainder of his enlistment on Fleet Ballistic Missile submarines, and never had the need to repair one.

The design responsibilities for this project were split up as follows:

- Central Processor Control Section – Leroy Olson
- Central Processor Arithmetic Section – Dick Erdrich
- Input/Output controller – Neil Macrorie
- Memory – Merle Sanford & John Bruder
- Power Supply – Bob Wyland
- I/O Drivers and Receivers – Jack Metzger and Mel Wagner

The card family architecture was done by Don and Glen with the electrical design done by Jack and Mel. The memory design was done by John Bruder, Pete Tobias, and Dave Ripley.

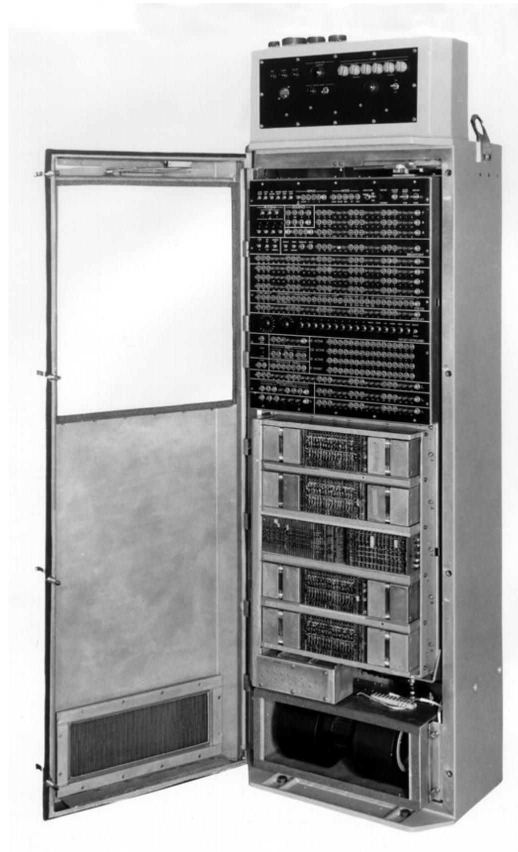
Early in the project Leroy Olson received an offer to go into management and accepted. I picked up his area of responsibility, essentially designing the entire Central Processor Section. Additionally, I was given the task of designing the three-port memory interface.

This was needed as the processor overlapped Instruction and Operand fetches, and the I/O required an independent port.

Being a workaholic at the time and having so much fun I finished my design tasks early so Don made me an offer I couldn't refuse; design a CP-890 Memory Tester to replace the one the Memory Group had designed but couldn't get working. He gave me a short schedule and a newly hired grad named Butch Brumback. I did an initial design and when presented to a group of engineering managers was chided for not providing a more versatile architecture. At that point I said, "What do you want?" and included all their wishes into the new design. Butch and I designed it, and the memory group agreed to build it. We scrounged test cards from the new module family and used a prototype wire wrap panel to hook up the cards. Unfortunately, the tech from the memory group that wired the back panel didn't understand that if you routed a wire around a pin on the way to its destination you could short (cut through) to the intervening pin. He wired everything tight, so we had cut throughs all over the place. The memory group was screaming for the tester to continue their checkout when Butch and I started checkout on a Friday morning. By four o'clock in the afternoon we knew that it was a lost cause. I decided that we would strip the chassis and rewire it. This was no small task. It used about 50 cards with 56 pins each. I elected to stay that night and strip the chassis, and Butch came in the following morning to start wiring it up. I would relieve him later in the day. We completed the rebuild and checkout over the weekend and the memory group had their tester available for use Monday morning. The design proved to be so successful that Ernie decided to formalize the drawing package.

The two Janish brothers, Mel and Marv, were in kind of a slack period and needed the work so it was done. The result was a product that was produced by Plant 3 Manufacturing and was sold to the Air Force as a part of Site Test Equipment for the 1230MTC computer systems. It also provided the core logic design for the memory testers developed by the Plant 1 Test Equipment Engineering Group for all succeeding memory testers.

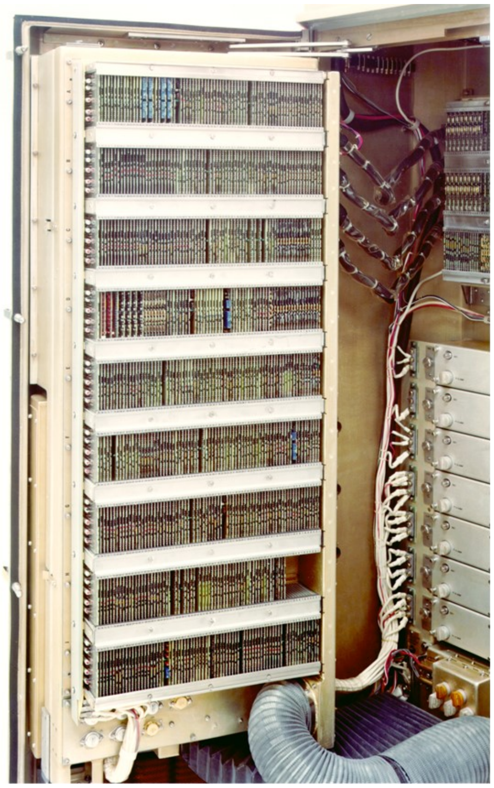
2. Marv and Mel at the Club's 2015 picnic. Twins, they never married but drove to the cities daily from their Wisconsin farm to be documentation specialist technicians for the engineering department.



Picture 4a (right). Front view of the Engineering Development Model (EDM) CP-890. The production version was similar but included an EMI tight cover for the Maintenance Panel.

The CP-890 broke a lot of new ground from a technological standpoint. Component wise, it used the first available microcircuits as its basic building block. It was planned to use a film memory chassis from the design group in plant 1 [We were at plant 5] for high-speed control memory but Don Mager made the decision to use the 16-bit memory cell, the forerunner of all of today's static memory, due to cost and space problems. Without this choice the project probably would have failed. The memory design was the first three wire core application which combined the Sense and Inhibit lines allowing the use of smaller cores. All the following core memory computers (UYK-7, UYK-8 and 1219B) used this architecture. A new module connector provided 56 pins for back panel connections and was used by Sperry computers for many years.

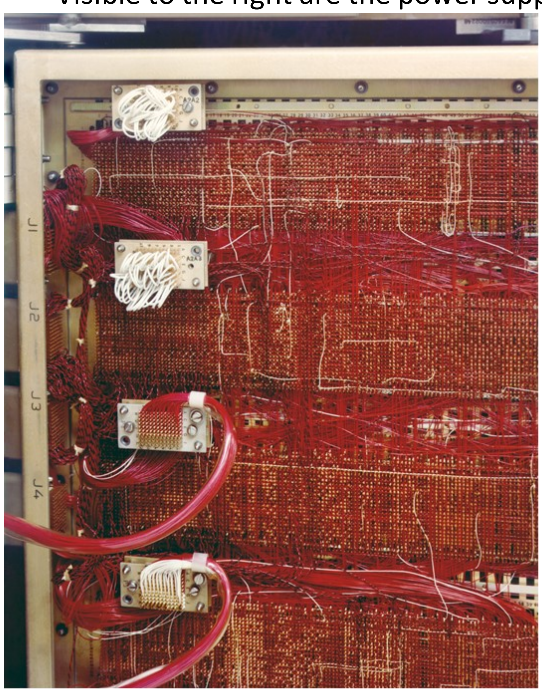
Picture 4b – left: EDM with front door open showing the relationship of the 32K-Word Core memory unit to the Maintenance Panel.



Picture 4c- right: This is the open-door view of the production version of the CP-890. The main logic chassis is hinged and pulls outward for access. Notice the creative air ducting toward the bottom. The round flexible hose supplied cooling air to the I/O-Processor chassis while the accordion ducting supplied air to the memory.

I believe that Jim Warwick was one of the principal mechanical engineers on the project involved with the cooling, but Rudy Melzer was probably involved also. He was the structural engineer for all of the earlier cabinets that were virtually unbreakable (CP-642A, 642B, 1230). Rudy had immigrated to this country from Germany after the WWII. I understand that he had been an aircraft designer for Messerschmitt during the war. The upper four rows of cards housed the I/O Controller logic while the lower rows held the CPU and memory interface.

Visible to the right are the power supply modules and the I/O Interface chassis. This is the first application of a modular power supply system with a high voltage primary converter and low voltage secondary converters. This architecture is in almost universal use today.

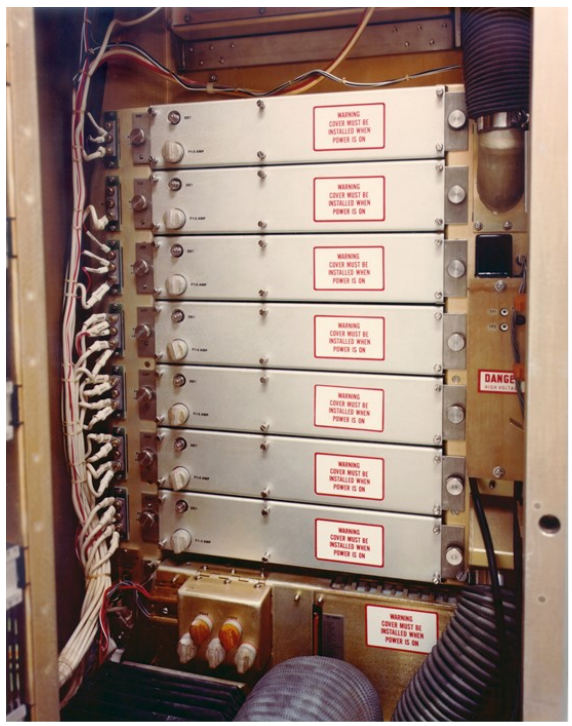


Picture 4d – left: The logic chassis opened in the middle for access to the wire-wrap back panel. These wires were wrapped by machine for the most part. In this view the white wires were manually installed after the panel was removed from the wire-wrap machine due to an inspection report. The two upper jumper plugs set the operating mode and priority for the sixteen full duplex 30-bit I/O channels. The two lower plugs connect the I/O Controller to the maintenance panel.

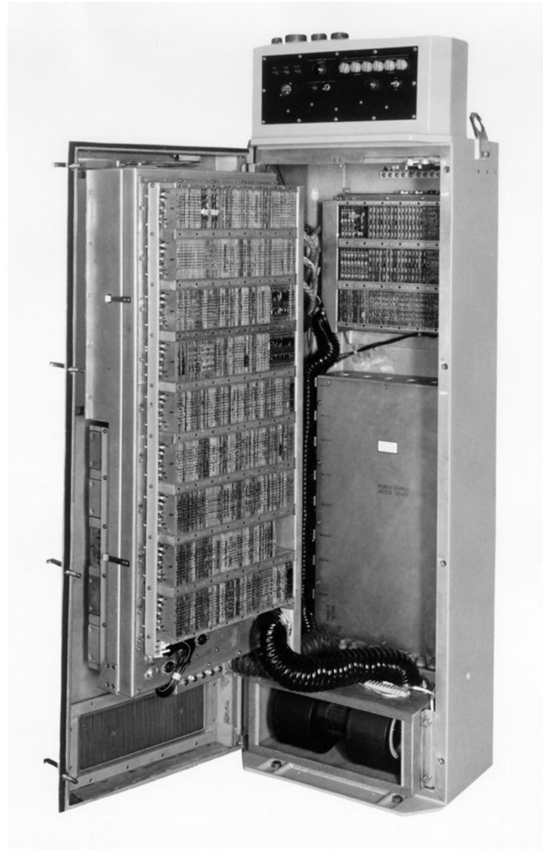
Picture 4e – left: This is a view of the production core memory unit. The eight rectangular assemblies are the core memory stacks and are removable. This is the first application where the memory stacks are a subassembly of the chassis.

Instead of being built as a part of the chassis. All future core memory designs would use this same approach with differences being only in capacity and physical size. The center row of cards contained all the current switching and control logic while the two top and bottom rows held the Inhibit switches and the Sense Amps.

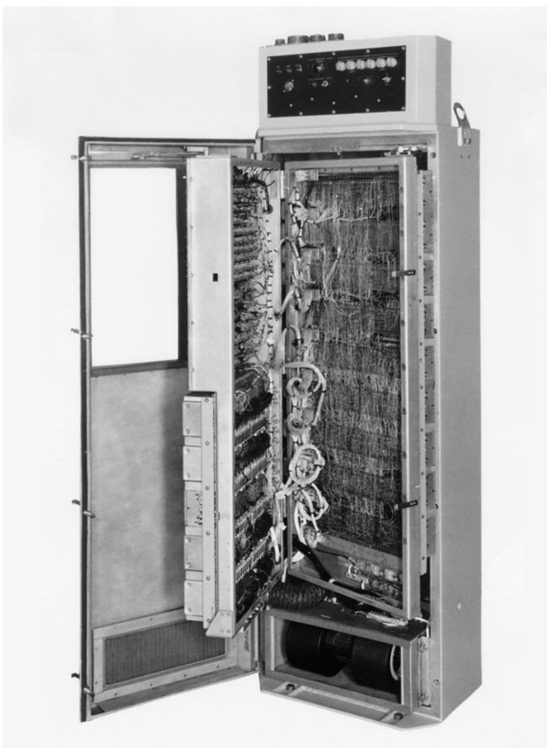
Picture 4f – right: This view shows the production power supply. The cooling hose at the top right provides air to the I/O Interface chassis.



Picture 4g – right: This is a full view of the EDM showing the prototype power supply and the I/O Interface chassis.



Picture 4h - below. This view shows the EDM with the logic chassis open. The bundles of wire in the center connect the processor chassis to the memory and the maintenance panel.



CP-890 Customer - US Navy Environment - Submarine First Delivery - October 1967 Quantity built = 197

Vol/Ft^3 = 13 Wt/Lbs = 725 Pwr/Wts = 2150 Mem/Cyc = 1.8 usec Mem/Cap = 131k I/O rate = 555kw/sec I/O channels -

2.0 16-BIT COMPUTER STORIES

These will be in the Erdrich2nd.pdf article – posted for March 2025.

3.0 ADVANCED COMPUTER DEVELOPMENTS

These will be in the Erdrich3rd.pdf article – posted for April 2025.

EPILOGUE

Thus was the first decade^{+} of Mr. Erdrich's career with UNIVAC => LMCO Twin Cities organizations. He was able to transform his Army radar electronics training into the intricacies of transistorized computer electronics. Then he boldly stepped into the world of integrated circuits with the CP-890 development team. That computer helped US submarines to navigate beneath the polar ice caps.

Dick and Lowell met in the fall of 1972 when we were assigned to develop enhanced features for the type 1616 and AN/UYK-15 computers. Both used small scale integrated circuitry, still hard-wired logic machines. Our work site was in the Plant 5 mezzanine as was the CP-890 support team led by Ray Dombeck. Our department manager was Robert 'Bob' Oulicky. More information in the next story set.

A decade after retiring in 2008, Dick was one of the eight VIP Club interviewees in the 2019 TPT documentary, Solid State: Minnesota's High-Tech History - Solid State: Land of 10,000 Secrets - Twin Cities PBS.

"No one ever asked us!"