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WOL Oral History Supplement

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Building 90 - A House Full of Memories by Frank Koubek

Do you remember Building 90? It was located just across the road from the tennis court on the road to the “Back Area” only a stone’s throw from the “Main” WOL Building (Bldgs. 1 to 5). Whether it still stands I do not know as I have lived in Cincinnati for the past 19 years. (Editor Note: Alas, it was demolished with all the other buildings except Building 1 in the front area.) What I do know is that Bldg. 90, living or dead, reminds me of an old house in a neighborhood that has seen lots of changes. Whenever I drive through such an area here in Cincinnati, I look at the grand, old homes and the same thoughts go through my mind: “Each and every one o these old houses has stories to tell about the families who inhabited it over the years.”

Building 90, in a way, is like one of those grand, old houses. Over a period of some 50 years, Bldg. 90 saw many occupants come and go, with each leaving behind an interesting tale of their tenancy there. More than any other building at WOL, Bldg. 90 probably had the greatest variety of people occupy its spaces.

As near as I can tell (I came on board in 1956.), Bldg. 90 was probably built at the same time as the Main Administration Building----circa 1946. In the latest issue of The LEAF (Vol. VIII, Issue II—Spring 2006 on page 8), John Nachman writes that in 1948 or 1949, he had a vacuum and special, high purity atmosphere melting facility located in the basement of Bldg 90–later relocated to Bldg. 24. This confirms my belief that Bldg. 90 has its origins in the middle to late 1940's.

When I joined WOL in 1956, Bldg. 90 was primarily known as the Marine Barracks Building—housing U.S. Marine Corps guards who provided the security for WOL. I still remember their impeccable uniforms and snappy salutes as we passed through the security gates showing our I.D. badges to them. In talking with some of the Marines, I learned that many of them were Korean War veterans, and they considered being at WOL a posh assignment----great quarters and chow and plenty of night life in downtown Washington, D.C. Their Bldg. 90 barracks was certainly far better than most barracks of the post-war era.. At Bldg. 90, They had small, but comfortable bedrooms (not the dormitory open style of most service people), quiet surroundings, with very little extra duty to pull, and a recreation area in the basement, which included table tennis and a bowling alley, along with other amenities. Of course, there was a galley and dining area (first floor—right side) and a food storage area (basement) complete with walk in refrigerators connecting the galley to the food supply via a dumb waiter to lift the food. There was even a one cell brig—complete with bars----located on the first floor to the left of the main entrance!

I first began to learn the details of the Bldg. 90 layout in 1958 when my group (High Temperature Materials) in the Nonmetallic Materials Division was granted permission to occupy what was once the galley on the first floor. We needed a large, open space to install a monster of a Hi-intensity, Water Stabilized, Electric Plasma Arc facility for testing candidate heat resistant materials intended for the Polaris Fleet Ballistic Missile (FBM) program. Since the Marines had been moved out of WOL prior to this time, (Civilian guards were hired to replace them.), the old galley room (redesignated room 90-1000) was an ideal spot for out Plasma Arc facility. This device featured a 1.5 megawatt, 3 Phase A.C. input (3 large transformers adjacent to the building) and a large mercury vapor D.C. rectifier capable of supplying 2500 amperes of current at 600 volts D.C. About half of this energy was expended at maximum output (300 volts-2500 amps.) through a doughnut shaped graphite electrode having a 2 inch diameter hole. An electric arc with 750,000 watts of energy was funneled through this small hole by a constricting high pressure water vortex. This caused the plasma gases (oxygen and hydrogen—from the water) to reach temperatures in excess of 25,000K! Thus, an ultra hot, ionized plasma gas was produced having temperatures similar to the stagnation temperatures experienced by missile re-entry nos tips and heat shields. Materials to be tested were moved by a remotely controlled specimen holder into the plasmjet. Because of the arcs noise level (greater than 125 DB) and ultra high temperature, ear and eye protection were mandatory. We eventually built a sound proof inner room enclosure around the equipment complete with welder's grade dark glass window panes for safe observation of test runs. Before we built the enclosure, our testing had to be done before 0800 or after 1700 hours due to numerous complaints from neighboring tenants!

Electric current to plasma arc was regulated by a "liquid rheostat"----a large rectangular steel tank having steel electrodes with a conductive solution of sodium carbonate circulating through it and a heat exchanger (to cool the liquid) at 200 gal/min. Electric current was regulated by raising or lowering (hydraulically) fiber glass panels separating the steel plates. Yes, the plasma arc was quite a contraption and was only the second (and probably the last ever built---later versions used compressed air to stabilize the arc jet----the WOL wind tunnel people later had such a device---circa mid-1960's?). Our plasma arc equipment had its origins at the University of Chicago. We contracted with them to provide us with a similar arc system as well as guidance in its initial operation.

I'll never forget the big day when we were to make our very first test run. It was Friday afternoon—circa 1959. I had mixed feeling about its working the first time without a hitch and wished that the VIP's invited to watch had not come (some 20 people). Sure enough, there was a hitch—w could not get it to run and everyone departed—disappointed! What a downer! We were not daunted, however. We worked that Friday evening, and most of Saturday, before we located the problem. In looking over the wiring on the mercury vapor rectifier (Ignitron), I noticed that two wires connected to one of the Ignitron tubes appeared to be reversed (Ironically, the Ingitron manufacturer rep inspected it several weeks before and said that is was OK and ready to operate!). I pointed out the misplaced wires to the University of Chicago scientist on hand to help us get started and he agreed with me. We reversed the two wire connections and VOILA—success—we had our first successful test run. The next week, we invited the VIP's back to see this noisy monster go through its paces and as they say: "The rest is history."

The WOL plasma arc was one of just a few large plasma arc jets in the U.S. The one at the University of Chicago was located at an old trolley car station to take advantage of the availability of D.C. power there. Another arc facility at AVCO in Massachusetts used 2000 truck batteries it supply the D.C. power. Later, in the 1970's and 80's, the biggest of them all was a 50 megawatt arc located at Wright-Pat AFB in Dayton, OH.

A Washington Star newspaper reporter learned of our arc facility, and, after interviewing us and seeing the equipment run, published an article entitled: "Inferno in a Fruit Jar." The swirling water constricting the arc was contained in a plexiglass cylinder bigger than the size of a very large fruit jar—thus, the moniker placed on it by the writer. I was not enthralled with the fruit jar title, but did not learn of it until "after the damage was done!"

During the late 1960's, the Plasma Arc facility out lived it usefulness, and was dismantled and the space int sound proof inner room was used to house a plasma arc ceramic coating facility. This was a hand held small gas stabilized arc jet through which fine particle oxide ceramic powders were injected, melted, and blown onto a metal substrate. Using our new Scanning Electron Microscope (SEM)—also located in Bldg. 90m we were the first to publish a technical paper showing the columnar, hexagonal crystalline structure of aluminum oxide melt sprayed coatings using three dimensional (3-D) microphotographs.

Our SEM was first located in the basement of Bldg. 90—circa 1968—just beneath our upstairs ceramic lab. This location wa chosen because the manufacturer recommended a quiet, vibration free area. The WOL SEM was the first to be located at any of the Navy laboratories and, it was only the second produced by the manufacturer (They owned the first, prototype one.). The 3-D microphotographs it produced were far superior and easier to produce than the older (and now archaic) electron microscopes and proved to be useful for not only the Nonmetallic Materials Division, but for many other groups at WOL.

In 1959, my group (Hi-Temp Mtls) was moved to a large "office" space on the second floor of Bldg 90 so we could be close to our lab facilities downstairs. This large "office" space turned out to the former head (latrine) and bathroom for the Marine guards—complete with urinals, toilets, showers, etc. When we moved in, most of the plumbing had been removed (except for the urinal pipes), but the yellow ceramic tiled walls and red ceramic floor tiles remained. We eventually had black vinyl floor tiles installed over the red tile, but we always felt we were working "in the Men's Room!"

The Plasma Arc room on the first floor (90-100) eventually evolved into a carbon-carbon composite fabrication research facility (1970's) and then an oxide ceramics research lab (1980's wherein a gas fired kiln and several electric kilns and other equipments were installed for use by the temperature materials group until WOL closed in the 1990's, and the group moved to Carderock along with the rest of the Materials Division personnel. Thus, we were among the very first to move into Bldg 90, and the last to leave!

The above pretty much describes my recollections of the stories of "My Family" at Bldg.90 during this time. My memories of them have dimmed, however, so in the interest of being accurate and comprehensive, I will not try to expound on them. I'm sure that those of you who "lived" at Bldg. 90 during those times have lots of interesting stories to tell about "your family." Let's hear from you. Send your inputs to the Editor of The LEAF.

Editor Note: I worked in Bldg.90 from 1965-1972 as a member of the Systems Analysis Office headed by Dr. Anson Solem. We were part of the NAVMAT's ASW Systems Project Office. We occupied the right side of the first floor of the building and most of the second floor. The rest of the second floor was occupied by the Naval Tactical Support Activity, headed by Al Letow. They were there from about 1966 until a year after NSWC closed. During the same time I worked in Bldg. 90, a Mine Museum was briefly housed in the basement of Bldg. 90, and the NAVSEA's Mine Staff (Including Rudy Schuetzler and Jack Shreve) had there office in the basement of Bldg. 90. This was very convenient for the WOL Underwater Systems Department mine project management as this group was their sponsors. The left side of the first floor of the building was home to the Underwater Explosion Branch.

Infrared/Radio Fuze (IRAC) by Bob Trautvetter.

In the mid-50's, I transferred from the Naval Research Laboratory to the Naval Ordnance Laboratory (White Oak), and joined the Fuze Group developing the IRAC Fuze. This fuze used the design of the existing Radio Fuze, and combined it with a newly designed infrared detector and optics that would detect the hot metal of the tail pipe of the target aircraft.

The detector and the optics were designed to take advantage of the rotating projectile, and together they determined the relative positions of the projectile and the target aircraft for the best effectiveness of the explosive. The IR detector, electrically, was a bridge circuit with the battery supply connected across one pair of the bridge connections, and the output was taken off the other pair of connections. The optics focused the hot spot of the aircraft on this rotating bridge detector generating a sine-wave signal at the output terminals of the detector. The frequency was a function of the projectile rotation rate, about 400 cps.

The Radio Fuze circuits also generated a sine wave from the Radio Frequency (RF) energy, but as a function of the closing velocity. As the projectile approached the aircraft, the Doppler frequency generated decreased to zero, and if the projectile did not hit the aircraft, the Doppler frequency would then increase again as it continued past the aircraft. The electronic circuits were also tuned to 400 cps. As the projectile-to-aircraft distance got closer the signal energy also increased. This combination of the increasing energy and the 400 cycle tuned circuits produced a signal that would trigger the detonator within the projected "kill zone" of the explosive.

In the IRAC fuze electronics, the trigger circuit had two inputs and required a signal from both sources to activate the detonator. In most cases, the radio fuze half of IRAC would produce its signal first, and basically pre-arm the electronic circuit. Then, when the hot metal of the aircraft passed through the "field of view" of the infrared optics, the electronic signal generated would create the second signal for the dual trigger circuit, and activate the detonator which set off the projectile's explosive. In some approach shots, the IR signal came before the radio fuze signal.

The field tests held at Dahlgren were disappointing. All of the shots resulted in the "Pre's." The RF energy was triggering the IR circuit at the same time that the Radio fuze half was being triggered, with no IR source in sight. Redesign and repeated tests continued to have the same result, and so the project was eventually canceled.

Back in the lab, while the program managers were downtown discussing the problem, and canceling the program, I became inquisitive and took a closer look at the hardware. The design was perfect. It was well known that the IR detector was also a perfect detector for the radio frequencies of the Radio fuze. To filter out this RF energy, a large capacitor was connected to the IR detector at the same point as the battery supply. A typical "can" capacitor was used (A "can" or shell completely covers the capacitor in metal except for the one end where the second lead of the capacitor is attached. The shell is normally grounded, shielding the "hot wire" of the capacitor, making a perfect filter circuit.). This is when I discovered that all of the fuze units that we had been using had the capacitor inserted upside down. The shell was "hot." This reduced the effectivity of the shielding over a hundredfold. I reversed the capacitor and ran a test in our "test can" in the lab. The largest signal that I could measure was 3 millivolts. Before reversing the capacitor, the signal were in the hundreds of millivolt range.

To this day, I can't remember what I did next. I don't even remember if I checked the physical drawings to see if it was an assembly error. All of the supervisors were downtown, and it was late in the day. I wasn't one to get on the phone and scream. So, when the people came back to the lab, I told them of my findings. I know no one got reprimanded or fired for the mistake. I did write it up as and entry in my lab note book. The IRAC fuze project was dead. Eventually, they redesigned the package, and project IRON (IR only) was born.

Some months later, I was asked if I would transfer to the Guidance Group because they needed manpower for the upcoming field test of SUBROC.

Editor Note: Bob worked at the WOL from 1956-1982.

SUBROC Stories by Henry Hoffman.

Editor Note: In the previous oral history on IRAC, Bob ended by noting he transferred to the Guidance Group to work on SUBROC. This group was headed by Henry Hoffman. Henry later moved to NASA. Recently, he was asked to prepare a briefing for the NASA Engineering and Safety Counsel to provide a series of Guidance, Navigation, and Control "sea and space stories." He planned to discuss SUBROC and called WOLAA to see if we had pictures and material about SUBROC and AAP. During our phone conversation, he told me several stories about SUBROC; thus this is really an oral history.

*__Color of SUBROC Test Vehicles.__ SUBROC tactical vehicles were painted all white. During testing, this made it difficult for the camera tracking to stay on the depth bomb for its final trajectory when the depth bomb and rocket motor separated. The problem was solved by painting the depth bomb orange. Sure enough one of the pictures in the WOLAA archives shows the depth bomb a bright orange and the rocket motor being white.

***Stationary Underwater Testing.** Before firing from a submarine, a lot of testing was done from test stands underwater. These tests were conducted off San Clemente Island. This allowed the project to test igniting the rocket motor underwater, and assessing the trajectory up and out of the water. Henry noted on one test that the SUBROC went down to the bottom rather than up and out of the water. Interestingly, the on-board telemetry, tracked the contour of the bottom as SUBROC traveled its failed trajectory.

*__Land Shots.__ Most missile projects had some great "blooper" film footage in early testing. Henry noted land shots were conducted at China Lake. One SUBROC found its way directly over a camera station, making that camera operator's day. He also noted a German scientist was part of the testing team. He had acquired the skill of standing behind the launch of SUBROC at China Lake and was able to predict the trajectory of the shot almost as well as the telemetry of the bird and range. His skill was acquired by working on the German V1 and V2 rockets during WWII in Germany. They did not have the telemetry capability we had, and they had to improvise using eye sight.

*__First Submarine Shot.__ Finally, the projects testing got to a launch from a submarine. Originally, the Thresher (SSN-593) was to be the test platform; but she was lost at sea. Her sister platform, the Permit (SSN-594) was the test platform. During land tests, the ignition sequence had worked. On the first shot from Permit, the rocket motor did not ignite. The shot was a dud. I remember this really caused long meetings at NOL to discover what caused the problem. It of course stopped testing til a solution was found. Henry noted that a monitor circuit was designed to safe the rocket motor igniter if it was open before firing. On the submarine, the monitor circuit opened when the umbilical cable separated at launch, thus dudding the missile. The circuitry was redesigned so cable separation and the monitor circuit did not dud the system. Great detective work found and then solved this mystery.