EARLY MISSILE LAUNCHES FROM SUBMARINES

By
LeRoy E. Day
CDR. USNR Ret.

Introduction

Interestingly, the author of this piece, LeRoy "Roy" Day was, some years after the events described in this article took place, recruited by NASA after John Glenn made the first American orbital flight in February, 1962. Initially, Roy was brought into NASA as the Deputy Director of Project Gemini (the 2 astronaut program). He later headed a group that did the initial planning for the Space Shuttle and then continued as the Deputy Director, Space Shuttle for its development and first flight. LeRoy Day is the author of the book, "*Manned Spaceflight: Personal Reflections on the Space Program*." The reader will note that the astounding successes that the United States eventually had in its manned spaceflight program and its guided missile systems all have their roots partially in the humble beginnings of the Navy's LOON program described in this article.

Rear Admiral Lloyd "Joe" Vasey USN Ret.

On the cool foggy morning of 1 October 1946, all Navy personnel of the Pilotless Aircraft Unit at Pt. Mugu, California, were assembled for a short ceremony to mark the commissioning of the new US Naval Missile Test Center. I am identified on the end of one rank. On my left is Ensign Philip Hasell, one of my classmates from Georgia Tech, also an aeronautical engineer. At that time Pt. Mugu more resembled a "prisoner of war camp" than a Navy installation. The few buildings were a combination of metal Quonset huts, temporary beach buildings left from the days when Pt. Mugu was a fishing camp and a few newly constructed wooden structures. The one landing strip was made of Marsten mat, the metal "grid" used by the SeaBees to construct landing strips on the Pacific islands in WW II.

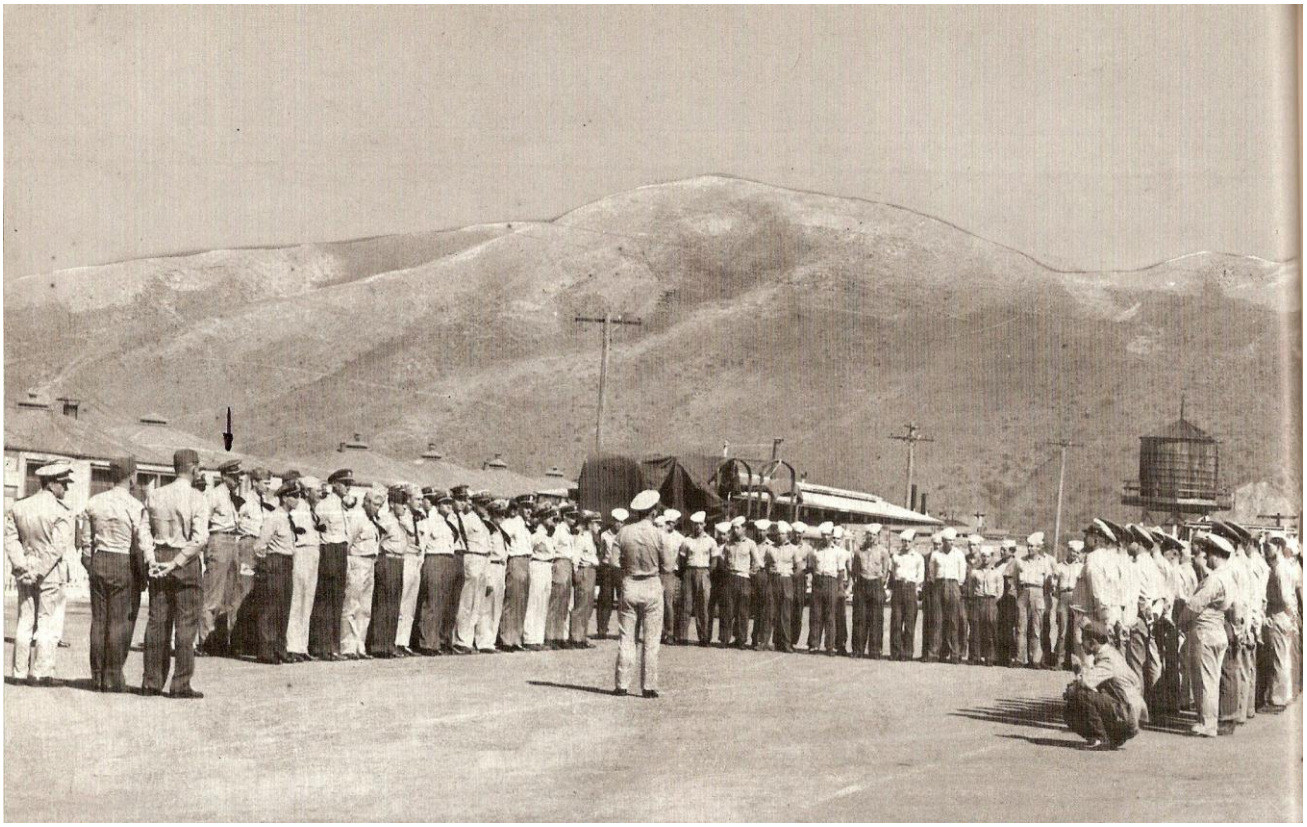

Fig. 1 Commissioning of the Naval Missile Test Center, Pt. Mugu, CA., Oct 1, 1946 (Navy photo)

I was present for this ceremony having arrived at Pt. Mugu in July 1946. There were twelve of us "newly minted Ensigns." We were all graduates of the Navy V-12 Officer Training Program from Georgia Tech. All of us had been assigned initially to the Pilotless Aircraft Unit at Mojave, California. Several of us were immediately reassigned to Pt. Mugu; the bulk of the personnel at Mojave followed over the next few months.

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The Navy was developing a sea test range for guided missiles at Pt. Mugu. Pt. Mugu had been selected because of its location on the coast of California, some 50 miles north of Los Angeles. There were also several islands offshore (the Channel Islands) which could serve as targets and tracking stations.

The initial concentration was on the development of ship-launched missiles, particularly from submarines. The Navy had contracted with Republic Aviation toward the end of WW II in Europe to make a number of copies of the German V-1 "Buzz Bomb." The Navy hoped to be able to use them in the Pacific War. However, the war in the Pacific ended before they were able to do so. The CNO had approved a plan that a missile test facility be established at Pt. Mugu in January 1945. However, it wasn't until November 1945 that a small detachment under Cdr. Jack Shoenhair actually arrived at Mugu and

began preparations to test launch the V-1 which the Navy had designated the LOON.

Initial launchings of the LOON were made using a catapult. In the six months from January 1946 to June 1946, 21 launches were made with no successes. The causes of the failures were multiple. Gradually the launches were more successful over the next year. A milestone was reached on November 5, 1946 when LOON No.38 was successfully launched with the catapult and flew a controlled flight of 48 miles. The objective of the Navy was to demonstrate a launch from a surfaced submarine and a catapult was not deemed practical for the sub application. So, the next method attempted was a rocket launch.

The LOON was launched atop a cradle with four JATO rockets. Each of these rockets had to be carefully aligned by an optical system, with close tolerances, through the center of gravity of the assembled LOON-cradle. Although the alignment could be done accurately, albeit time consuming, once the rockets fired, there were deflections in the cradle which resulted in the thrust line deviating from its static position. The result was often a trajectory that put the missile in an attitude at burnout that was impossible for it to recover. The LOON might be in a steep bank or pitched up at an angle impossible to correct before impact in the ocean. Burnout of the rockets was at about 250 miles per hour.

In the first six months of 1947, the success rate for LOON launches was about 10 percent. Among these were some rocket launches using the four JATO bottles. Despite the poor success record, one of these launches was a significant milestone: a successful launch from a surfaced submarine, the USS CUSK commanded by LCDR Fredrick “B” Clarke USN, in February 1947.

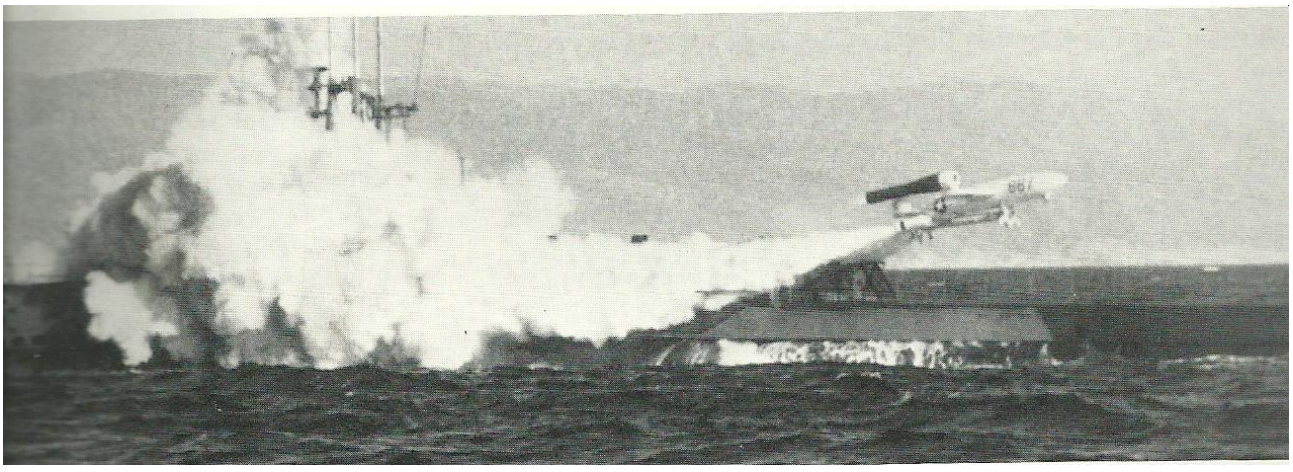

Figure 2. First Launch of the LOON missile from a submarine, USS CUSK (1947) (Navy photo)

At about this time, twelve German scientists arrived at Pt. Mugu. They were part of Project Paperclip which brought a large number of captured German engineers and scientists to the U.S. after the end of the war in Europe. They were dispersed to several military facilities: Wright Field, Fort Bliss, Pt. Mugu and others. Those assigned to Mugu were from the "small missile" side of Pennemunde, the secret German missile test site on an island in the Baltic Sea, off northern Germany. Dr. Herbert Wagner was the senior man of the group assigned to Pt. Mugu. A large contingent of several hundred associated with the V-2 program under Dr. Wernher von Braun were sent to Fort Bliss, Texas.

Three of these men who came to Mugu were assigned to the Guidance Laboratory at Mugu where I worked. At the time, I was on active duty as an Ensign. I worked closely with one man, Reinhard Lahde. We were testing and analyzing the autopilot of the LOON trying to determine why there were so many launch failures. Both Lahde and I became quite familiar with the flight control of the LOON. The LOON was steered by a rudder; it had no ailerons for roll control. One task we worked on was to incorporate a single aileron which later showed an improvement in the recovery from severe roll attitudes at burnout of the booster rockets.

Meanwhile, in the Propulsion Division of our department, they were working on the problem of improving the method of launching the LOON from a submarine. Working in that division was another German scientist named Willi Fiedler. Fiedler had had an interesting career in Germany during WW II. He was a test pilot for the production of the famed German fighter, the Messerschmitt BF-109. He was also one of two pilots who flew a manned version of the V-1 "Buzz Bomb" during its development at Peenemunde.

While in Germany, Fiedler had invented a device called the Jetevator. It was a ring shroud, gimbaled in two axes, which could be mounted at the exit plane of a rocket nozzle to alter the direction of the thrust line. If the Jetevator was driven by servo motors, it could change the thrust line a maximum of about 7 degrees in both pitch and yaw. He had verified this with tests on several rockets in the test pits at Pt. Mugu. Fiedler had the idea that the way to launch the LOON was to sling a single large rocket under it and have a Jetevator controlled by the autopilot. The result would be thrust vector control. The autopilot would control the thrust line during rocket burn

and avoid the earlier launch mishaps. He was also working on a design for a "zero length launcher" which would be more practical for sub launches.

Fiedler knew he needed a flight demonstration to gain acceptance of his idea. With the help of Robert Helmholz, a senior manager at Mugu, he was able to convince the Navy brass to give him a surplus rocket large enough to launch the LOON. He came down to our division one day and asked if I could perform an analysis of a LOON launch with the single rocket using his Jetevator controlled by the LOON autopilot. I was quite flattered and proceeded to apply my knowledge of aerodynamics and stability and control of aircraft. The boost phase lasted only a few seconds, accelerating the vehicle from zero to about 250 miles per hour. Only toward the end of the boost was the LOON flying fast enough for there to be any aerodynamic effects. In other words, I found that the task was to stabilize the 5,000 pound LOON and have its attitude at burnout such that it could fly a safe trajectory. All the aerodynamic terms were reduced to second order effects, leaving the mass and inertia of the vehicle as the controlling factors. I was amazed at the simple solution and had my results checked by Reinhard Lahde, an experienced aeronautical engineer. I determined the "gearing" between the LOON attitude and the Jetevator controlling the thrust line such that the system was stable. Fiedler took my results, rigged up the autopilot and Jetevator and proceeded to plan for a launch.

With the help of senior management at Mugu, top Navy brass and civilians from Washington were invited for the test launch. The combined rocket-LOON was planned to be launched from a short-ramp launcher of Fiedler's design. If successful, the test would demonstrate the feasibility of a thrust vector controlled launch from a zero-length launcher which Fiedler was designing. It's applicability to launch from a surfaced sub was obvious.

A large crowd assembled at the LOON launch site on the beach on the day of the planned launch. A dozen chairs were set up for the most senior Navy and civilian visitors. Willi Fiedler was introduced to describe the test and its implications. Fiedler was an excellent speaker and exuded calm confidence. I was standing behind the crowd and more than a little bit nervous, wondering if my simplified study had correctly analyzed the problem.

Fiedler gave the background of the many LOON failures and then described the test they were to see. He explained, "However careful we have been in aligning the four Jato rocket launches, it's never been good enough. The static alignment can be right through the c.g. (center of gravity) but when those rockets fire, each one is a little different, and the cradle bends just a little and that's enough to cause a misalignment.

What it does is pitches the missile into some bad attitude and the LOON hits the water before it can recover. What is needed is some way to have the autopilot control the thrust line to keep it right through the c.g. during the entire boost period. That's what we have today, using the Jetevator which I described to you earlier."

Fiedler paused, took a few questions and continued, " Now, I have set up this launch so it will be a real test of the effectiveness of the Jetevator in providing thrust control. The rocket nozzle is aligned so that the thrust line will be 1 inch above the c.g., not through the c.g. If the Jetevator cannot correct the thrust line, the missile will be pitched downward, take a ballistic trajectory and will impact the ocean about 500 yards from the beach. We've done this to provide a good test of the autopilot controlling the thrust line during boost. If there are no further questions, we will begin the countdown."

I was astonished to realize that Fiedler had rigged the launch to really demonstrate the effectiveness of his thrust control. I wasn't sure that the Jetevator could provide enough change in the thrust angle to overcome this "intentional misalignment." In the few seconds of the countdown, I became very nervous that I was about to become a "party to a failed launch." ---- 5,4,3,2,1 Fire! The LOON lifted from its short-ramp launcher with a tremendous roar and a great cloud of exhaust smoke! In fact, the exhaust plume from the rocket partially obscured the missile from where I stood and I couldn't tell if it was climbing on its intended flight path or not. Seconds later the LOON was in the clear and climbing toward the western sky at the correct angle. In fact, it looked like it was on a rail in the sky—climbing exactly as planned. The assembled crowd gave a shout and there was much clapping. The ranking admiral stepped forward and heartily shook Fiedler's hand.

Fiedler had made his point. Later, the first zero length rocket launch of the LOON using the Jetevator was made on January 26, 1949 from the USS NORTON SOUND, a surface ship. Launches from surfaced submarines followed.

The Navy had originally planned to use cruise missiles launched from surfaced submarines. Thus there followed the development of the Regulus I and II missiles. However, it became apparent that launching a cruise missile from a submarine on the surface had serious strategic drawbacks. The submarine was very vulnerable during the time required to prepare and launch the missile. The difficulty of launching in rough seas was another problem. Therefore the decision was made in 1955 to develop a missile system that could be launched from a submerged submarine. The Navy established a high priority organization known as the SP Project under Admiral Raborn. Based on his earlier work with launching the LOON, Willi Fiedler was

invited to join the SP Project in the development of the Polaris missile which was to be launched from a submerged submarine. Fiedler worked in the SP Project for some time and then relocated to Lockheed Missiles in California. Lockheed was the contractor for building the solid rocket Polaris. Fiedler became the Chief Scientist for Lockheed. I remember visiting Willi once in the 1970's when I was at Lockheed on NASA Space Shuttle business.

The SP Project reached its first major milestone July 20, 1960 with the launch of a Polaris missile from the USS George Washington submerged off the coast of Florida. In a little over a decade, the Navy had progressed from the rudimentary surface launching of the LOON to a long range nuclear missile launched from a submerged submarine.

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