# The Supersonic Low Altitude Missile

## Project Pluto:

**by Mark Schrader**



***"When you see something that is technically sweet, you go ahead and do it and you argue about what to do about it only after you have had your technical success."* - J. Robert Oppenheimer**

***Jackass Flats, Nevada, 27 October 1962***

**Dr. Ted Merkle, technical director of Project Pluto, was at a loss for why the three high ranking Air Force officers were paying him a no-notice call at his remote development site near Jackass Flats, Nevada. It must have something to do with recent Air Force directives to accelerate the pace of development. There certainly seemed to be good reason for it given the latest Soviet provocations in Cuba. Merkle had met Gen Bernard "Bennie" Schreiver before at Systems Command, during one of the innumerable "dog and pony" shows competing for development funds. He was a keen, no-nonsense engineer who was almost single-handedly responsible for beginning to close the missile gap with the Soviet Union. He knew the Air Force Chief of Staff, Gen Curtis Lemay, and the Strategic Air Command commander in chief, Gen Thomas Power, only by reputation. They were both hard-nosed combat commanders who understood better than anyone the concept of nuclear deterrence.**

**After a brief exchange of pleasantries, Dr. Merkle escorted the three general officers past the security checkpoint and into to the brightly lit hangar. The supersonic low altitude missile (SLAM) rested on support stands in the center of the building, gleaming in the incandescent lights.**

**The four stopped 20 feet from the world's first nuclear powered cruise missile. At just under 80 feet long, the SLAM was powered by an unshielded nuclear reactor capable of producing over 500 megawatts of power. The concept was fairly straight forward. The ram intake would suck in air, over a ton every second, superheat it as it passed through the reactor, and exhaust it out the rear to produce thrust. The technical challenges were more daunting. The components had to operate in an extreme environment of high temperatures and hard radiation. The aerodynamic environment was just as extreme. The SLAM was to operate at**

**altitudes below 1000 feet at speeds exceeding mach 3. The aerodynamic pressure loads were bad enough—the surface heating problems were worse. Still, all these technical challenges seem to have been worked through and the project was ahead of schedule.**

**The Project Pluto team had been ordered to accelerate their development as relations with the Soviet Union grew strained over the situation in Cuba. There was even more urgency when US reconnaissance flights detected Soviet intermediate range nuclear missiles being constructed at sites in Cuba. To this point, the reactor had been ground tested at full power and all the parts had held together for the five minute run at conditions simulating Mach 3. The airframe had likewise been tested in the wind tunnel at flight conditions and all systems functioned nominally. The terrain contour mapping (TERCOM) system had successfully flown in conventional jet aircraft. In the last two weeks, the reactor and airframe had finally been mated. The Flying Crowbar, as Dr. Merkle liked to call it, was ready for flight testing. But where do you flight test an unshielded, 500 megawatt nuclear reactor flying at Mach 3 just 300 feet off the deck?**

**General Power broke the silence. "When will we be ready to conduct the first flight test?"**

**"General, the system is ready now, but there is the issue of location. We feel the Pacific basin, near the Bikini Atoll, will give us the space we need and the water is deep enough to allow us to sink the reactor at the end of the test," Merkle explained. "At our current pace, we can have everything in place in 60 days…"**

**"Two days," Lemay interrupted. "I want you and your team ready to conduct a flight test from Cape Canaveral in two days." The usually outspoken Merkle looked at the Air Force Chief of Staff in stunned silence.**

**"Dr. Merkle," Lemay continued, "the President's naval quarantine is going badly. Today a Soviet submarine sank the destroyer USS Beale off Cuba. Our reports are unconfirmed as yet, but it may have been sent down with a nuclear torpedo. In addition to that, two of our reconnaissance aircraft have been shot down, one over Cuba and one near the Soviet Union. The Soviets have assembled a force of nearly 40 medium range nuclear missiles in Cuba and I have no reason to believe that they won't use them in a first strike. I believe that Project Pluto might be our last chance to convince them otherwise and avoid a full scale nuclear war. Preparations have already begun at the Cape to conduct the test."**

**"But sir, the weapons systems are not yet ready…"**

**"Dr Merkle, this will be a reconnaissance mission," Gen Schreiver explained. He was in command of Air Force Systems Command and as such, about 40% of the Air Force budget. "My engineers are ready to begin work installing a camera and sensor package in the SLAM."**

**Merkle was still trying to soak it all in. "You plan to take pictures from 500 feet at 2800 miles an hour? What about the radiation? You realize of course you realize the radiation hazard itself is formidable…"**

**Lemay yanked the cigar from his mouth, "I don't care if we make that island uninhabitable for the next thousand years. This is going to be a demonstration of capability like no other power in world can match. The Soviets will be forced to back down or we'll destroy them."**

**General Powers' face reddened slightly and he looked at his wrist watch again. "Look, Ted, lets get to work on the details of making the mission happen. We don't have time to cover policy matters right now. I've ordered SAC to DEFCON 2 and we've got bombers at their fail safe points. My targeteers are ready to provide your team with all the overflight points and terrain information they need. Let's get to work."**

**"One last thing Dr Merkle," said Lemay. "The missile looks like it's gold plated."**

**"Yes, General Lemay. The radiative properties of the gold plating help to cool the reactor core. We're operating at temperatures that are very near the combustion point for some of these materials."**

**"The Navy's going to have a field day with that, Dr Merkle. We're buying a gold-plated missile system." Lemay paused. "Paint it white for the test, okay, Ted?"**

***Ten kilometers north of Sagua La Grande, Cuba, 29 October, 1962***

**Sergeant Sasha Davidovitch Chuckov had just begun his 12 hour watch. His first task was to inspect each of his battery's V-75 Dvina anti-aircraft missiles for fuel leaks or other potential maintenance problems. His unit had been at full alert for the past two weeks and he had settled into a mostly monotonous routine. They had been briefed to expect increasingly aggressive American reconnaissance after a battery to the north had brought down another one of the vaunted U-2 spy aircraft two days ago. He hoped for the chance to fire off a few of these birds at the Yankee aggressors. The morning sun was just creeping over the ridgeline when a glimmer to the west caught his eye.**



**The cruise missile flew directly overhead at Mach 3.3. He never heard the missile, only felt the pain as his eardrums burst and the small auditory bones in his ears splintered in the 162 decibel shockwave. His chest heaved momentarily as his lungs expanded to accommodate the overpressure. He also never heard the sharp crack as the missile's fuel tanks ruptured on the launcher, the nitric acid and kerosene reacting instantly to create a fireball that killed him immediately.**

**The troops in the next valley would later describe the sound as the wail of a banshee from hell itself. The tremendous sonic boom followed by a high pitched, wailing scream…**

*Construction*

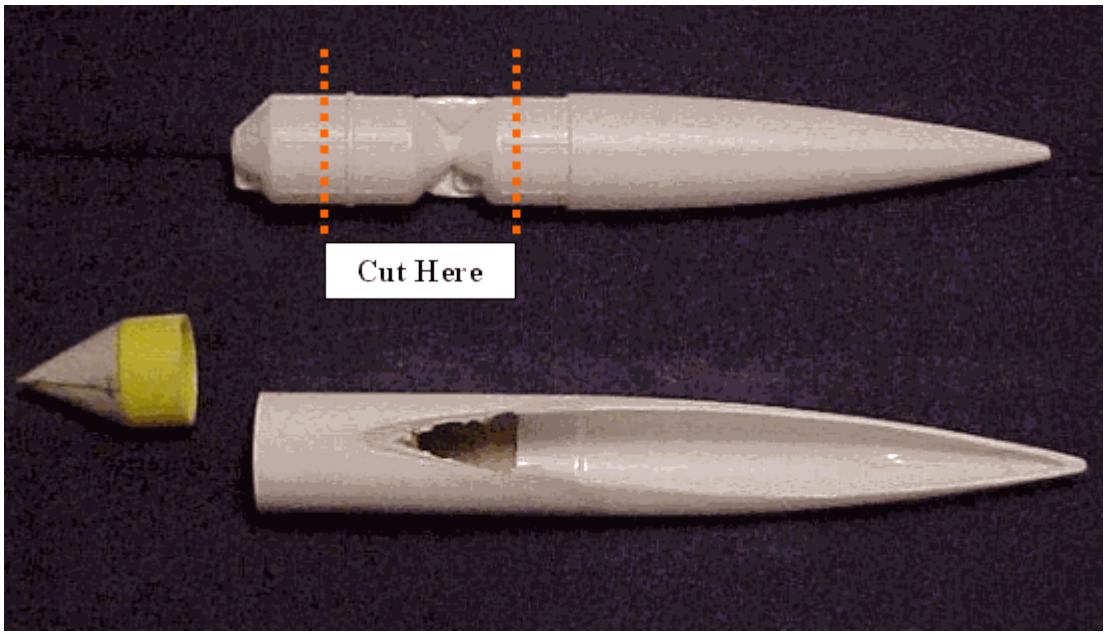


**I first read about Project Pluto in the Spaceship Handbook by Jack Hagerty and Jon Rogers. This development effort was so sinister, yet so technically appealing that I thought it would make a great and unusual "sorta-scale" subject. I really enjoy modeling systems that never left the drawing board because no one can get the calipers out and tell me my fins are too big or my nose isn't shaped correctly.**

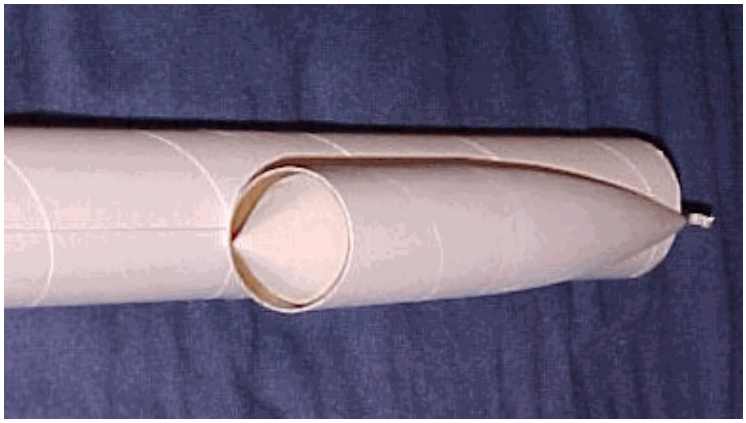
**There are scale drawings in The Spaceship Handbook for the SLAM that were a good starting point for general shape and dimensions. The PNC-55 nosecone is the same one used in Estes' Black Brant II and the body tube is 11.25 inches long (a little too long for scale) with a 24mm motor mount. The fins are 1/16" bass wood and I enlarged them somewhat for extra stability.**

*Air Intake Construction*

**I was most hung up on the ramjet air intake construction. The drawings show a conical shape, but I didn't have a nose cone of the right size and shape to use. I had an extra PNC-1090 nose cone from an Estes Heatseeker around and this was just about the right diameter. The Heatseeker also comes with a short piece of HBT-1090 body tube which I used for the front of the intake. I wrestled with the best way to cut the cone to the right shape for a long time, and then finally just began to hack away with a razor saw and Xacto knife until it was just about right. I wrapped coarse sand paper around BT-55 body tube to act as a sanding block to finish the sanding and improve the fit. I drew alignment marks on the body tube using wraps made from the program VCP. I used wood glue for the forward paper to paper joint and 5-minute epoxy for the rear plastic to paper joint. I had planned to use Fix-It epoxy clay to fill any remaining gaps and increase strength but the bond seemed rock-solid already. For gap filling, I used Squadron White Putty on the plastic parts and Elmer's Fill N Finish (FNF) on the paper parts.**




**The next step was the pointed ram intake. I wrestled with this quite a bit until I noticed the plastic tube coupler that comes with the 1090 nosecone. I cut off the raised portion of the tube coupler and glued a cardstock cone (made with VCP) to it with plastic cement. I then coated the paper with wood glue, allowed it to dry, and covered with FNF to hide any seams. After sanding smooth, I coated with thin CA. This assembly then slides nicely into intake. I glued it in with plastic cement and then reinforced with CA.**

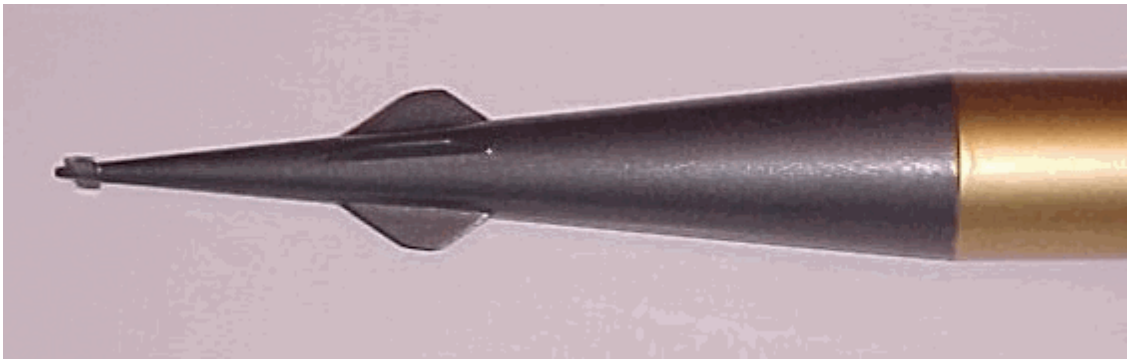


**After roughing out a slot in the air intake, the tail fin was tacked to the air intake with plastic cement and CA. I also applied Fix-It clay fillets for a solid joint. The other rear fins are surface mounted with wood glue and wood glue fillets. The ailerons are oversized to improve stability.**



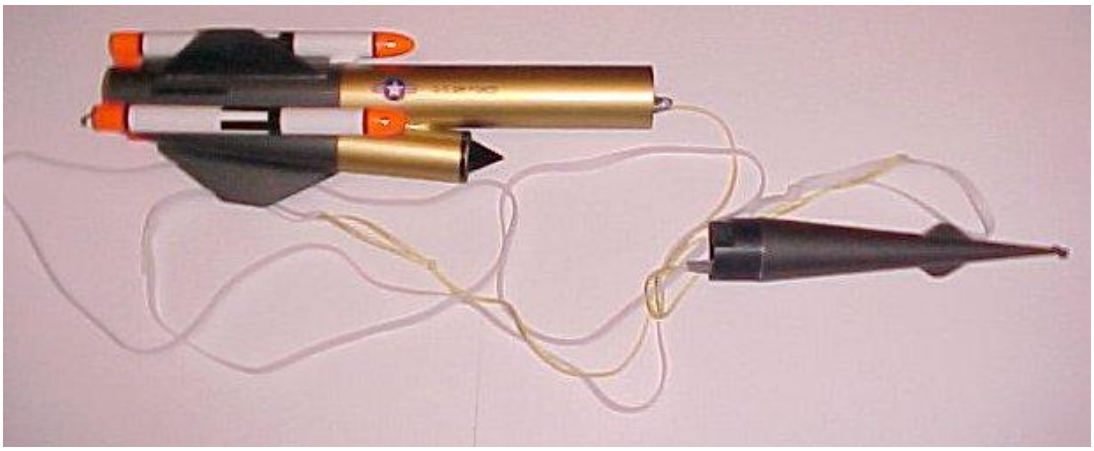

*Forward Control Surfaces*

**For the forward rudder and control surfaces on the nose, I made slits in the cone with a razor knife and mounted the thin styrene fins through the slots with plastic cement. I made these surfaces quite a bit smaller than scale, again to help with stability.**



*Recovery*

**Recovery system consists of an 18" length of 300# Kevlar ™ leader looped around the motor mount tube, a loop of 300# Kevlar ™ epoxied into the nose cone along with nose weight, six feet of ¼" sewing elastic, and a silver, 24" mylar parachute.**



*Booster Construction*

**The ground launched version of the SLAM was to use three parallel boosters to get it up to speed prior to engaging the nuclear ram jet. I made the three functional boosters from BT-5 body tube and Mosquito-style plastic nose cones. The boosters separate about two-thirds of the way up upon ejection and separate from the sustainer. They use 18" of Kevlar™ thread as shock cord. They are attached to the sustainer using square aluminum stock. I used 1/8" stock on the side of the sustainer nesting into 3/16" square stock mounted to the boosters with 1/64" brass stock for a stand off. The square stock is nice because it allows a streamlined construction with no wobbling.**





**Finishing**

**I filled all the seams and fillets with Elmer's Fill-N-Finish and sanded smooth. After priming, I used Rustoleum Gold and Testor's Metallics Gunmetal. I kept the decals simple using roundels and USAF lettering from an old Estes decal sheet.**



**The boosters are white with fluorescent orange. The striping and roll patterns are made using black decal material.**

**Stability Analyses**

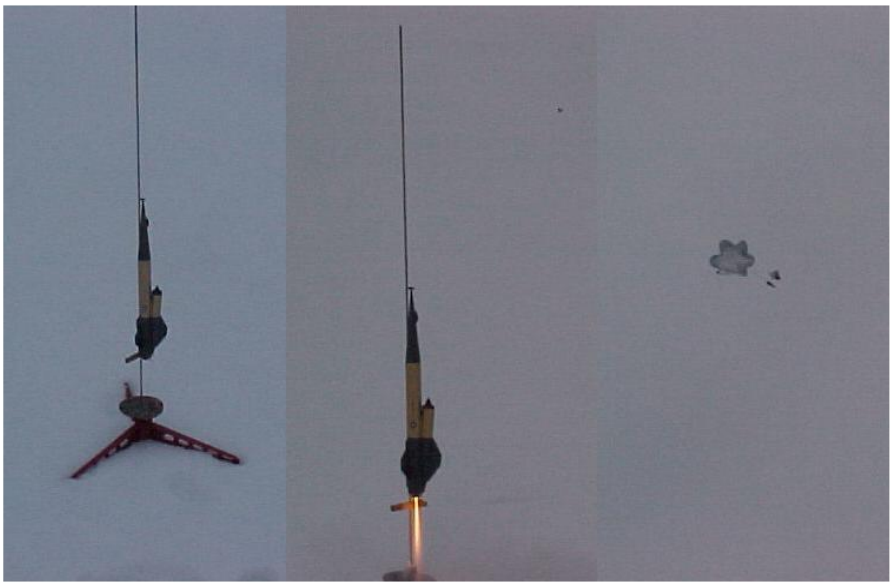
**Stability is always an issue modeling guided missiles. They are meant to be moderately unstable to be able to maneuver. Compounding the problem in this case is an irregular shape. Bruce Levison kindly offered to model this in RockSim 7 for me. I ended up adding a total of 3.5 ounces of lead split shot and epoxy into the nose cone to ensure a safe, stable flight. Final weight of the rocket ready fopr flight without engine or boosters was just over 7 ounces and the CG was 8 inches from the nose. Based on Bruce's simulations and my worst case modeling, this seemed about right.**

**Flight**

**First flight was under less than ideal conditions. Temperature was 30°F with light freezing rain. The winds, however, were calm and the snow pack on my field was still holding. With little time remaining, this might be the best chance I get.**

**I loaded the rocket with a C11-3 in the house and we took the pad and launcher out to the field. I used a four foot, 3/16 inch rod.**

**Boost was perfect—moderately slow and arrow straight to an altitude of about 300 feet. Ejection was right at apogee and the 24-inch mylar chute brought it to a soft landing in the snow 20 feet from the pad. The rocket was undamaged with only a few paint chips in the nose.**



**Now all I need are the right conditions to launch the full stack…**

**Historical Footnotes:**

**The introduction above never happened. The events depicted, however, are a mixture of fact and fiction.**

**- The SLAM wasn't ready for flight at the time of the Cuban Missile Crisis, but what if it had been?**

**- The USS Beale wasn't sunk off of Cuba on 27 October 1962. It was, however, dropping practice depth charges on a Soviet sub as a means of forcing it to surface. The captain of the submarine, plagued by maintenance problems and unsure of the situation at the surface, nearly ordered his crew to engage with their nuclear torpedo.**

**- The only U-2 shot down on 27 October 1962 was over Cuba. An Alaska-based U-2 blundered into Soviet airspace on that day but managed to escape after calling for help from US fighter-interceptors. The US fighters were armed with nuclear tipped air-to-air missiles.**

**- Gen Power did bring the Strategic Air Command (SAC) to DEFCON 2 on his own authority, without Presidential authorization, on 27 October 1962. Nuclear armed bombers were routinely operating on airborne alert.**

**- The SLAM was indeed to have been gold plated.**

**For more information:**

**Spaceship Handbook by Jack Hagerty and Jon C. Rogers,
http://www.arapress.com/ssh.html**

**The Flying Crowbar, *Air Space Magazine, April/May 1990, Volume 5 No. 1, page 28,*
http://www.merkle.com/pluto/pluto.html**

**DOE Project Pluto Information Sheet,
http://www.nv.doe.gov/newspubs/dirpdfs/Project_Pluto.pdf**