

**For the last two years I have been studying the use of Loran C in the Vietnam War. I was assigned to Operation Tight Reign in the spring of 1966 and left Headquarters Radio Station in Alexandria, Va for Loran C school as a ET3 six months out of A school. I was assign to the construction crew that built the Sattahip, Thailand Loran C Station beginning in July 1966. At commissioning our orders were modified to station crew and I served on the station until June 2, 1967.**

I recently found this write up by Mr. Whitcomb, was able to contacted him and received his permission as follows: "You are certainly welcome to use anything that I wrote about LORAN."

This is one of the more detailed write ups that I have found that explains in detail what we as US Coast Guard personnel provided with our Loran C Navigational signals. I have to say, "we were there also!" Semper Paradus

Christopher G. Dailey  
Former ET1 USCG  
1965-1969

# **PAVE NAIL: there at the beginning of the precision weapons revolutions**

**by Darrel Whitcomb**

The images are all too common now. A target is designated with a set of cross hairs, and a guided smart weapon destroys it in a blinding flash. Today, U.S. air power engages primarily with precision weapons. In the initial campaign of Operation Iraqi Freedom, 68 percent of all aerial weapons used were precision weapons. (1)

It was not always so. In fact, it was not until the late stages of the war in Southeast Asia that the use of precision weapons became commonplace. A desire for precision delivery had long haunted airmen. Several attempts, dating back to World War I and through Korea, had been made to develop radio-guided bombing. While several developments looked promising, our ability to deliver overwhelming force and then nuclear weapons supplanted them, and the efforts were not fully developed.

The initiation of sustained bombing campaigns in the conflict in Southeast Asia and the increasing sophistication and lethality of modern air defense systems once again generated increased interest in precision weapons, and several initiatives were pursued. One of the most promising concepts was a proposal to use new LASER (Light Amplification by the Stimulated Emission of Radiation) technology to guide maneuverable bombs directly to a target. This concept consisted of two components: A guiding or illuminating device which could designate the target by holding a beam of LASER energy on it, and a bomb which was equipped with an eye that could see the illuminated target and then provide guidance to a steering mechanism attached to the actual bomb which could maneuver it to the target. This concept was created and developed by Texas Instruments (TI) engineers and eventually the Tactical Air Warfare Center (TAWC) at Eglin [Air Force](#) Base, Florida, for an actual initial cost under \$100,000. Under the contract, TI produced fifty-five of the bomb modification kits, called PAVEWAY. The kits were placed on Mark-II7 750 lb bombs and MK-84 2,000 lb bombs which were carried aloft by F-4s. Another F-4 was equipped with a ZOT-Box LASER system for target illumination. Combat testing validated the concept in late 1967, and clearly showed that the Mk-84 bomb was the superior weapon. [Smart weapons](#) were now available for tactical air forces, (2)

By the summer of 1968, the system components were flowing to Thailand for use by the Ubon-based 8th Tactical Fighter Wing (TFW). The first illuminators shipped over were the ZOT-Box LASER systems. However, those units

were difficult to use and maintain and by 1970, were replaced by newer PAVE KNIFE Pods which were specifically designed to be efficiently carried by the 8th TFW F-4s.

They were accompanied by an increasing number of PAVEWAY bomb kits which would be used to convert conventional bombs into the smart weapons. As production increased, the individual cost of each kit eventually dropped to \$2,500 each. Ironically, as they became available in significant numbers, the air campaign against North Vietnam had been halted. Instead, a significant amount of U.S. air power was directed primarily to the interdiction effort against the Ho Chi Minh Trail (HCMT) in eastern and southern Laos. The overall campaign was called COMMANDO HUNT.

Used by the North Vietnamese since 1959 as a conduit for troops and supplies from North Vietnam into South Vietnam and Cambodia, the HCMT had, by 1969, grown into a massive complex of interconnected roads down which an ever increasing volume of men and materiel was flowing. Since the early 1960s, U.S. air power had been used to interdict this flow. With the cessation of air strikes over the North, though, those available sorties were added to the effort against the HCMT. The newly arriving PAVEWAY bombs were thrown into the fray, and were soon being delivered by the 8th TFW F-4s.

Also working over the Trail with the strike aircraft were U.S. Air Force forward air controllers (FACs). One of the FAC units was the 23d Tactical Air Support Squadron (TASS), based at Nakhon Phanom (NKP) Air Base, in northeastern Thailand. First deployed there in 1966, the unit used the aerial call sign Nail. The 23d TASS FACs initially flew O-1s, then O-2s and by 1968, OV-10s to patrol the HCMT from the entry passes at Mu Gia, Ban Karai, and Ban Ravine, all the way south to its exit points into South Vietnam and Cambodia.

Immediately realizing how much more effective the PAVEWAY bombs were than the standard unguided or dumb bombs, the NAIL FACs increasingly requested the LASER guided bombs or LGBs, as they soon came to be called. The F-4s generally were employed as flights of two aircraft, with the leader carrying the illuminator device and the wingman carrying the MK-84 bombs. The FACs employed them against critical points along the Trail where they could deeply crater the road bed or cause earth slides to block the road. They were also used to destroy cave supply complexes and vehicles, especially prime tracked movers, such as bulldozers, tanks or heavy equipment vehicles. (3)

As the North Vietnamese forces increased their use of the HCMT, they brought in more air defensive systems to protect it. To mitigate the growing threat, commanders at Seventh Air Force directed that more precision bombs be used. The Americans recognized that they would need more illuminators, especially at night, and published Combat Requirement Operational Capability (CROC) 25-70 which specified the need for "an OV-10A night visual reconnaissance system that would include the capability to search for, acquire, track, and designate targets for delivery of LASER guided bombs by LORAN-equipped strike aircraft"

PACAF concurred with this request and gave it top priority. In response to this request the Air Force Aeronautical Systems Division developed a proposed modification for the OV-10. The Air Staff approved it and on September 18, 1970, the Chief of Staff of the Air Force signed out a directive to the Tactical Air Command (TAC) assigning it responsibility for the operational testing, development of tactics, determination of operational suitability, and combat evaluation of the system. TAC, in turn, directed the TAWC at Eglin AFB, Florida, to do the initial testing. (4)

Based on what they had learned using the F-4s, the TAWC engineers proposed modifying fifteen OV-10s by adding a LASER designation system called PAVE SPOT. This system would incorporate a low light level capability with some magnification for day or night target identification and LASER designation capability, and would be stabilized and gimballed for moveable tracking. The actual pod would be mounted along the centerline on the bottom of the aircraft, and operated by a weapons system operator (WSO) in the back seat of the aircraft. This would preclude the use of a centerline mounted auxiliary fuel tank, necessary for long-range operations. Consequently, the OV-10 fuel system would be modified so that the aircraft could carry a drop tank on each wing for added range and endurance. The aircraft would also be equipped with a LORAN navigational device for more precise navigation. In a truly innovative move, the engineers created a way for the LASER system to "talk" to the LORAN and determine the coordinates of the target being designated by the LASER. (5)

Once the technical concept was accepted, Seventh Air Force planners decided that the OV-10s would be assigned to the 23d TASS at Nakhon Phanom. The Project would be called PAVE NAIL. The 23d TASS would use the system as another illuminator asset for the delivery of the PAVEWAY bombs. In addition, the PAVE NAIL FACs would also use the system to search for trucks, supplies, and personnel along the Trail.

In parallel with this development, several dozen F-4s were upgraded with LORAN navigational systems. This allowed them to perform bombing against targets in instrument meteorological conditions, accurately drop electronic sensors along the HCMT, or to steer to coordinates provided by the PAVE NAILS. The program was called PAVE PHANTOM. (6)

In November 1970, two OV-10s were flown to Eglin AFB, Florida, and modified with the systems which were actually built by the Ling, Temco, Vought Corporation (LTV), in Dallas, Texas. Sixteen missions were flown and six inert PAVEWAY modified [bombs](#) were delivered with LASER guidance. The average miss distance was twenty-five feet. The system worked. The deliver coordination procedure which was developed from the test was straightforward:

The [PAVE NAIL] Weapons Systems Operator, using the Pavé Spot system, acquires the target through the observation device. He then designates the target with the LASER. This gives a readout of LORAN target coordinates, elevation of the target, and the slant range to the target. The pilot then passes the LORAN coordinates and the elevation of the target to the ... F-4, who in turn feeds this information into his LORAN bombing system. Run-in headings and timing are agreed upon; and, ten seconds prior to bomb release, the [WSO] begins to LASER designate the target for bomb acquisition and guidance. (7)

In July 1971, four modification kits were shipped to Clark Air Base, Philippines, and four 23d TASS OV-10s were so modified. The aircraft were then flown to Ubon Air Base, Thailand, where the 23d TASS maintained an operating location which focused on operations over Cambodia. There, Lt. Col. Lachlan Macleay, a career fighter and test pilot, was specifically deployed to combat validate the concept. Working directly with the PAVEWAY experts in the 8th TFW, from July through September, he and a small cadre of young officers from the 23d TASS flew the aircraft over northern Cambodia, and tested all of the systems. On August 15, a PAVE NAIL crew consisting of Lt. Col. Macleay and Capt. Rick Atchison successfully directed a LASER guided bomb on a bridge. Throughout the combat evaluation, 79.5 percent of the bombs hit within forty feet of the designated targets, and confirmed that the system would work in the hot, humid skies of Southeast Asia. (8)

With this favorable report, the four aircraft were moved up to NKP and began sustained combat operations over the heart of the HCMT as part of COMANDO HUNT VII, the current iteration of the multi-year interdiction campaign. A cadre of maintenance personnel from LTV was dispatched to the base to maintain the systems. It was none too soon because intelligence sources indicated that North Vietnam was moving massive forces and supplies south along the HCMT to mount a multi-pronged invasion of South Vietnam in the very near future. Eleven more PAVE NAIL modification kits were shipped to the 23d TASS and used to upgrade a like number of aircraft over the next several months. (9)

On October 17, Colonel Macleay assumed command of the 23d TASS. Within weeks, he welcomed twenty-two navigator rated officers who would fly as the WSOs in the PAVE NAILS, and selected a dozen squadron pilots who would fly with them. After settling in, they immediately entered the training program established by Captain Atchison. Soon, the PAVE NAILS were flying both day and night missions over the increasingly dangerous HCMT. As the young pilots and WSOs gained experience with the new technology, Macleay challenged them to explore the capabilities of the new devices to see what they could really do. The eager aviators took to the task with relish.

The HCMT area had been divided into nine different assigned sectors, with two sectors, four and five, further subdivided into A and B sub-sectors because of enemy activity. In addition to the NAILS, Covey FACs from the 20th TASS located at Da Nang and Pleiku Air Bases in South Vietnam also patrolled the HCMT. Both squadrons were assigned sectors to cover for specific periods, day and night.

Generally, the PAVE NAIL FACs would not perform sector duties unless there was no FAC assigned or available. Instead, they would sometimes be assigned specific targets to hit or would be available to any FAC who found a target which warranted the expenditure of a LASER guided bomb. The [PAVE NAIL crews](#) quickly got to know the

geography of Laos. On several missions, Pave NAIL crews were also directed to fly to specific known key locations such as mountain passes, river fords, road intersections, etc., and use the LASER/LORAN to determine the precise coordinates of these positions. This data could then be used to target the PAVE PHANTOM F-4s when the weather precluded visual delivery of ordnance.

Before flying their missions, the PAVE NAIL crews would be briefed as to when aircraft with LGBs would be available. They had to make sure they had a worthwhile target. In addition to the LORAN delivery procedure initially developed to facilitate the coordination between the PAVE NAIL and delivery F-4, the FAC crews developed a simpler protocol for the weapons delivery if they had good visual conditions and the fighters could see the target. In these conditions, the PAVE NAIL would ask another FAC to fire a smoke rocket to identify the target for the fighters. The PAVE NAILS could do this themselves, but they had to stow the PAVE Pod, a time consuming process. Once the fighters had acquired the target visually, the PAVE NAIL would set up his orbit so that the WSO could then illuminate it and the fighters could roll-in and drop the bombs. When the fighter crew would call "pickle," the PAVE NAIL pilot would hack his clock, knowing that the bomb took about thirty-four seconds to drop from delivery altitude. Both the FACs and the F-4 crews who regularly worked with them became very adept at this procedure.

On one sortie in December in northern Laos, a Raven FAC asked a PAVE NAIL to put an LGB on a 130 mm field gun up on the Plaine De Jarres, in northern Laos. When the F-4s arrived, [the Raven](#) fired a rocket to identify it. When he and the PAVE NAIL were ready, the F-4 dropped a Mk-84 2,000 lb LGB. The bomb hit, but did not explode. The Raven was watching the target with binoculars and told them that they had killed the gun. The F-4 pilot protested that the bomb had not detonated. "Not important," the Raven replied, "it's dead." The bomb had actually hit the gun, and the physical energy of that 2,000 lb projectile had completely smashed it into pieces. (10)

Below, all along the HCMT, the North Vietnamese forces were constantly active as they steadily moved their supplies south for the planned offensive. U.S air power continued to bomb the road system and troops and supplies traversing it. To protect them, the enemy steadily increased its air defense forces, a fact validated by the steady toll of aircraft shot down.

[U.S. Air Force](#) rescue helicopters and escort A-1s, also stationed at [Nakhon Phanom](#), were trained and ready to rescue the downed crews. All aircrews had to be prepared at any moment to initiate or run a search and rescue (SAR) operation, especially the FACs because they were always at risk, as were the aircraft they were directing against the enemy targets. The 23d TASS provided specific focused training in SAR procedures for all of its aviators. Recognizing that the unique capabilities of the PAVE NAIL aircraft could be very useful in SAR operations, Captain Atchison worked with several other PAVE NAIL personnel to develop specific tactics for their aircraft. There was no shortage of opportunities to test and validate them.

On December 10, an F-105 Wild Weasel, Ashcan 01 was shot down near the Mu Gia Pass. Both men ejected. NAIL FACs in the area rapidly responded. However, the weather was terrible, and precluded a quick recovery. Throughout the day and night, PAVE NAIL crews directly assisted by using their [LORAN](#) gear in conjunction with ADF cuts from the survivors radio to determine an accurate position for the one survivor with whom they had contact. Once that was known, LORAN equipped F-4s were able to deliver ordnance around the survivor to protect his position. The next morning, using the LORAN derived position of the survivor, a PAVE NAIL flown by Maj. Dick Harris and Capt. Cleon Blankenbeker led the rescue helicopter down through the weather to make a successful recovery of the backseater. While below the clouds, the helicopter crew saw the body of the pilot hanging lifeless in his harness entangled in high trees. They were not able to recover the body. (11)

Seven days later, an F-4 went down at night, again in the Mu Gia Pass. PAVE NAILS immediately initiated a search. One crew, Captains Rocky Smith and Rick Atchison, made radio contact with the survivors and instructed them to turn on infrared strobes which they carried. When they did, Atchison was able to find them with the PAVE SPOT and determine their precise locations. Both men were picked up by HH-53s from NKP. This brilliant tactical innovation was rapidly accepted as a useful technique for SARs, and dramatically identified the PAVE NAIL and its crews as key elements in combat recoveries.

The next night, three F-4s were shot down, this time far to the north, near Bartholome Pass, in an air-to-air battle with North Vietnamese MiG 21s. Again, the weather was very poor, and that far north, there were no useable

navigational aids-except LORAN. The PAVE NAILS launched for SAR duty again. A crew of Captains Ian Cooke and Robert Wikstrom flew into the area and located the crew of Falcon 72. But a rescue attempt had to wait until sunrise. During the night, PAVE NAILS rotated in and out to maintain cover over the survivors. Several times they had to take evasive action from attacking MiGs. The PAVE NAILS also directed LORAN deliveries of area denial ordnance around the survivors which prevented their capture.

Back at Nakhon Phanom, continuous planning was underway to develop an approach to the survivor's locations through the bad weather. It had to be carefully done because the men were down in deep valleys. Intelligence supplied three-dimensional maps of the area. Using the precise LORAN coordinates of the survivors, Captain Cooke and 1st Lt. Dave Talley were able to lead a rescue task force of helicopters and A-1s down through the weather. The tactic worked and both men were rescued. Once again, the PAVE NAILS were lauded for the critical new capabilities that they brought to the SAR mission.

But that also had its drawbacks. All fifteen PAVE NAILS were now regularly being fringed against the HCMT, and the crews were being stretched to their limits. But SARs, when they randomly happened, completely changed the schedule, and crews had to be constantly ready. It was a very stressful time.

On December 26, the NAILS lost one of their own. NAIL 30, [Capt. Lynn Guenther](#), was shot down near Ban Karai Pass by AAA. Other NAILS immediately responded, but he had been taken by the enemy, and would not be released until 1973. (12)

As 1972 started, commanders at Seventh [Air Force](#) were now deeply concerned about the expansive growth of enemy defenses along the HCMT. They decided to initiate a focused campaign against the AAA guns. The project labeled "The Recce Gun Kill Program" would integrate intelligence data collected in near real time from radio intercept and photo assets to locate clusters of guns. Reconnaissance aircraft would then photograph the actual gun pits, and snapshot copies of them with LORAN coordinates would be provided to, among others, the PAVE NAIL crews. Loaded with that information, they would hit those sites with LGBs. Daily, a T-39 would arrive at NKP from Udorn Air Base, the home of the photo reconnaissance RF-4s, and offload a bundle of the latest pictures of gun sites.

This program went on for several months. According to photo analysis, only thirty of the 252 guns identified were confirmed as actually destroyed--not great numbers. But there was no way to tell how the gun crews themselves fared. Additionally, the non PAVE NAIL FACs also carried the photos and went after the guns. Squadron records show that from January through March, NAIL FACs attacked 237 AAA sites and claimed eighty-two destroyed, consisting of 23 mm, 37 mm, 57 mm, 85 mm, and 100 mm guns. During this same period, they also directed 767 major road cuts, and damaged or destroyed more than 300 trucks and bulldozers. (13)

However, as the PAVE NAILS accumulated combat hours, the limitations of the system became apparent. Whereas the precision capability of the system to guide LGBs and determine precise coordinates had been validated, the system could not solve the fundamental problem of the HCMT--the initial finding of the trucks, supplies, and enemy units. The PAVE SPOT system had too narrow a field of view for any type of useful searching. The PAVE NAIL FACs would use the classic FAC technique of searching with binoculars. But when they would find something, they would frequently have great difficulty talking their WSOs onto the target with the PAVE SPOT. Additionally, the system had two filters - one for day, and one for night. They could only be changed by the LTV personnel on the ground. Additionally, both filters had a tendency to blank out for a short period of time at sunrise and sunset. (14)

This dilemma was exacerbated by the actions of the enemy. After years of being pummeled by allied air power, they had learned the value of good camouflage. Whole sections of the massive road complex were very effectively covered from view. The PAVE NAIL could not solve that problem. (15)

Flying as much as they did over heavily defended areas, it was inevitable that a PAVE NAIL would be shot down. On March 18, 1972, 1st Lt. Dave Breskman and Capt. Steve Boretzky, call sign NAIL 31, were directing an air strike near a prominent interdiction point in Central Laos known as the Catcher's Mitt when the aircraft was struck by several rounds of enemy AAA. They ejected and landed several hundred meters apart. For the next twenty-four hours, rescue forces led by other NAIL FACs and A-1 Sandys also from NKP, battled with enemy forces in the area before the two men were picked up by an HH-53 Jolly Green. In the melee, an A-1 was also shot down. That pilot was also rescued. At one point, Breskman had encountered an enemy soldier. The man was armed with an AK-47, and the pilot had to kill him to keep from being captured. Breskman kept his AK-47 as a souvenir. (16)

Ten days after the NAIL 31 crew rescue, an AC-130 Spectre gunship was blown out of the sky by an SA-2 surface-to-air missile (SAM) launched from a site not too far north of the Catcher's Mitt. All fourteen airmen aboard were killed. NAIL FACs and others swarmed overhead, but there was nothing to do for the lost crew. However, every suspected enemy position in the area was heavily bombed.

Just two nights later, another Spectre gunship working over the HCMT was shot out of the sky, this time by AAA fire. Fortunately, all fifteen crewmembers were able to bail out before the aircraft went down. However, they were scattered over a thirty-seven mile area, and two of them were near enemy forces. First on the scene was a PAVE NAIL crew, NAIL 37, [Capt. Pete Morelli](#) and 1st Lt. Vic Gedris. They immediately began locating the survivors using their LORAN and radio direction finding capability. Throughout the night PAVE NAILS, other NAIL FACs, and A-1s located all personnel. The next morning, Jolly Greens were able to recover all of the downed airmen. (17)

On March 30, 1972, literally as the Spectre gunship recovery was concluding, North Vietnam unleashed their expected massive invasion into South Vietnam. Initial battles took place along the Demilitarized Zone (DMZ) which separated the two countries, and then spread to other fronts in central and southern South Vietnam. Over the next several days, the DMZ attack developed into a fierce battle between a multi-divisional North Vietnamese force equipped with modern Soviet artillery, tanks, supplies, and air defense weapons to include SA-2 missile batteries, and the defending South Vietnamese forces. The enemy advanced under a persistent cover of low clouds. To provide for all weather bombing, PAVE NAILS were sent into the battle, initially to collect LORAN coordinates of key interdiction points, and then to direct LGBs. At one point, NAIL 25, a PAVE NAIL crew of Captains Rocky Smith and Rick Atchison, was working south of the DMZ when, through a break in the clouds, they spotted large numbers of vehicles of all types. They thought that the vehicles were from South Vietnamese units until they noticed the red stars painted on them. Then the enemy gunners opened up with a huge variety of weapons to include SA-2 surface to air missiles. The North Vietnamese forces knew that they would be attacked by allied air power and were prepared to defend their forces with the accompanying strong air defense element. They called it the Meatgrinder. (18)

On April 2, those air defenses downed several allied aircraft to include an EB-66 electronic reconnaissance aircraft, call sign Bat 21. One man ejected from that aircraft, the navigator, [Lt. Col. Iceal Hambleton](#). He was down in the midst of the invading force of 30,000 troops engaged against a like number of South Vietnamese. Once again, the PAVE NAILS were called upon to perform SAR duties and began flying sorties in the lengthy mission, destroying enemy forces and guns, and plotting the locations of the survivors, key road junctions, and enemy units.

The next day, while orbiting above Hambleton, NAIL 38, a PAVE NAIL crewed by 1st Lts. [Bill Henderson](#) and Mark Clark, was hit by an SA-2 missile and downed just west of Dong Ha, South Vietnam. Both men ejected and also floated down into the huge land battle consuming the region. Clark was just along the south bank of the main river running through the area, and about one kilometer east of Hambleton. Henderson was two kilometers north of Clark. Both found excellent hiding places and were able to use their survival radios to make contact with FACs above. Unfortunately, that night an enemy force moved into the area around Henderson and he was captured. He was subsequently moved north to Hanoi and released ten months later.

Clark was able to remain hidden. For the next several days, under the cover of massive air strikes, rescue forces tried to get in to both survivors, but were beaten back by the strong enemy units. Twice, Clark was doused with chemical agents that were dropped to prevent the enemy from capturing him. On April 6, a Jolly Green made an attempt to pick up Clark and Hambleton. Unfortunately, the massed enemy guns in the area were able to shoot it down. It crashed just a few hundred yards from Clark's position. All six crewmembers aboard were killed. Four days later, a small team consisting of a U.S Marine, a Navy SEAL and a South Vietnamese Commando, were able to work their way through the enemy lines to rescue Clark and eventually Hambleton. It was the most dramatic rescue of the entire war. (19)

Initially the FACs from the 20th TASS at Da Nang supported the South Vietnamese forces along the DMZ. However, as the battle expanded, the 23d TASS was directed to deploy several FACs and PAVE NAILS to Da Nang to reinforce them. When the North Vietnamese intensified their strong attacks in the Central Highland region of South Vietnam and north of Saigon, PAVE NAILS deployed to Pleiku and Tan Son Nhut ABs to reinforce the FACs supporting the South Vietnamese forces engaged there. The PAVE NAIL crews became very adept at delivering LGBs close to friendly troops.

As U.S. air power shifted to respond to the enemy offensive, and then ultimately to operations again over North Vietnam, the air campaign against the HCMT was reduced. In April, the 23d TASS flew 357 sorties over the HCMT. By June, that monthly total was down to thirty-one. On June 2, Colonel Macleay, the godfather of the PAVE NAIL program handed over command of the 23d TASS and returned to the United States. He was succeeded by [Maj. Max Brestel](#). He oversaw the installation of AN/APR-25/26 Radar Homing and Warning (RHAW) gear on first the PAVE NAIL aircraft, and then all OV-10s. It gave them critical early warning if an SA-2 missile radar was tracking them. (20)

Three days later, the PAVE NAILS were assigned SAR duty again when Cosmic 16, an RF-4, was shot down twelve miles west of Dong Hoi in North Vietnam. The pilot was captured. The [WSO](#) was located at night by PAVE NAILS. The next morning, another PAVE NAIL crew, call sign NAIL 40, led a force of A-1s and Jolly Greens across Laos into the dangerous flatlands near Dong Hoi to successfully recover the survivor. The PAVE NAIL aircraft was the only one from the rescue force hit by the enemy guns. It sustained minor damage from one round of small arms fire in the tail section. PAVE NAILS were now a routine part of rescue operations in every part of Southeast Asia except around Hanoi.

Two days after the Cosmic 16 mission, Vampire 50, a QU-22 electronic collection aircraft, was downed by thunderstorm activity in southern Laos. The pilot bailed out, again, near the Catcher's Mitt. NAIL 28, a PAVE NAIL crewed by 1st Lts. Jennings Pewthers and Bill Barron, flew into the area, located the survivor, and determined his precise location with their LORAN. They were then able to rendezvous with an Air America rescue helicopter and guide him directly to the survivor. The whole operation took three hours. (21)

Sometimes the PAVE NAIL crews got a little adventurous. One night, there was not much going on along the HCMT, so one of the crews went looking for trucks near Mu Gia pass. They found quite a few on the east side of the pass and requested air support. Several [Navy](#) fighters responded. For the next half-hour they directed them against several convoys, and did quite a bit of damage to the enemy forces. They also noted that enemy AAA fire was very heavy. The crew thought that it was just the normal enemy reaction to air strikes in that area. However, as the last flight of Navy fighters was departing the area, the flight lead complimented the crew for their bravery. The PAVE NAIL crewmembers were taken aback by the comment when the flight lead continued, "Yeah, I sure wouldn't fly over Mu Gia Pass with my landing light on." The crew was spotted at breakfast the next morning. The pilot had a noticeable red welt on his left cheek and the WSO had a sore right hand. (22)

On September 17, 1972, a third PAVE NAIL was lost. NAIL 60 consisting of 1st Lt. Ron Kuhl and Maj. Al Bowers were flying from NKP to Da Nang on a ferry/supply flight. While crossing Laos, they lost an engine and could not maintain level flight. Rescue forces were alerted. They ejected along the South Vietnam--Laos border, near the A Shau Valley. NAIL 36, Capt. John Sundgren, covered them until A-1s and Jolly Greens were able to recover them. Bowers broke his back and was medevaced home. The aircraft was destroyed. (23)

The 23d TASS continued to operate out of Da Nang until January 28, 1973, when the cease-fire directed by the Paris Peace Accords took effect. A few days later, all 23d TASS aircraft and personnel were returned to NKP, and stepped up operations over the HCMT were resumed. (24) The HCMT saw a resurgence of use as the North Vietnamese rushed supplies to their savagely decimated units in the south. Before the cease-fire took effect in Laos on February 22, the NAILS flew another 1,142 sorties (both conventional OV-10 and PAVE NAIL) over northern and southern Laos and increasingly over Cambodia. The combined bomb damage claimed by all NAILS included 113 trucks damaged or destroyed, twenty-two tanks damaged or destroyed, seven 130 mm field guns damaged or destroyed, eight AAA guns destroyed, forty-four road cuts, and fifteen caves collapsed. However, as the squadron closed out operations in Laos, it was becoming increasingly obvious that operations would increase in support of friendly forces in Cambodia. (25)

The next month, the 23d TASS shifted its operational focus to Cambodia. Major squadron operations moved to Ubon AB, Thailand, where the NAILS joined the 23d TASS Rustic detachment located there, which had been the long-term FAC force supporting the Cambodian forces. Operating out of Ubon, and refueling at Ponchetang Airport, Phnom Penh, Cambodia, the Rustic and NAIL FACs logged as many as thirty-eight missions a day, providing classic FAC support to the Khmer Military units located primarily in the center and south of the country. They also flew long range interdiction against extensions of the HCMT which extended into northeastern Cambodia. As

before, the PAVE NAILS were used for key target precision location and LGB target illumination. They were also available for SAR support as necessary.

The most harrowing and demanding mission for the 23d TASS crews was convoy escort for supply ships coming up the [Mekong River](#) to Phnom Penh. All were covered by FACs. Falling back on an old tactic from the HCMT, recon aircraft photographed enemy gun positions along the river, and PAVE NAILS hit them with LGBs. Fortunately, the enemy forces in Cambodia were not as heavily equipped and armed as the North Vietnamese forces in Laos or South Vietnam during the [Easter](#) offensive, and there were few targets which justified the use of LGBs. Consequently, the PAVE NAILS were increasingly utilized as basic FACs until the American unilateral cease-fire mandated by the U. S. Congress took effect in Cambodia on August 15, 1973. On that date, the NAILS ended over seven years of continuous combat operations, shut down the Ubon operation, and returned to NKP.

Training programs were immediately upgraded to insure that all FACs maintained combat readiness for any possible resumption of hostilities. Practice SAR missions were organized and run with participation of rescue units. The PAVE NAILS were key participants in all of these exercises. Additionally, the 23d TASS sponsored a theater tactics conference and the PAVE NAIL crews led the discussions on SAR tactics and procedures.

But a steady drawdown in personnel, projected aircraft redeployments, a dramatic reduction in aviation fuel availability, and the high cost of contractor maintenance personnel led to a directive from headquarters to the 23d TASS to conduct an analysis of the viability of continuing the PAVE NAIL system. This analysis took place in November. It determined that:

Civilian contract support for LTV was very expensive, and the contract was set to expire.

Other LASER designation systems were now available in the theater sufficient to meet projected needs and at lower risk.

The OV-10 aircraft was a slow moving aircraft restricted to low to medium threat arenas.

In residual operations in Cambodia, the PAVE NAILS had limited targets suitable for LGBs. Most were used in traditional FAC roles.

The Role played by PAVE NAILS in SAR operations could be performed by OV-10s with LORANs. Recent developments in missile technology by adversaries indicate that the survivability of the OV-10 may be decreased.

PAVE NAIL experience is of limited value to young rated navigators who serve as the WSOs. (26)

Based on these conclusions, the 23d TASS commander, [Lt. Col. Howie Pierson](#), recommended that the PAVE SPOT Pods be removed, the LORAN systems be retained, and the wing fuel tanks also be retained so that with the remounting of a centerline fuel tank, the aircraft would have an un-refueled endurance of over eight hours. The Seventh Air Force staff, in its review, determined that the PAVE NAIL was no longer needed in the theater. It directed that the program be completely terminated. The squadron continued to fly them and train the crews. However, in May and June 1974, the twelve remaining PAVE NAIL aircraft were stripped of their PAVE SPOT gear and LORAN navigation systems and returned to standard configuration. Several of the aircraft were shipped to other theaters, and many of the pilots and all of the WSOs were sent home. (27)

PAVE NAIL had a relatively short life of just three years. Reviews of the program were mixed. The aircraft did provide critical LASER guidance capability when it was sorely needed, although the PAVE SPOT system was not effective for spotting trucks and supplies along the HCMT. The aircraft itself, though, was the main limitation; its twenty percent loss rate indicated that it could not survive in a high threat area. However, it was an innovative combination of new technologies which created an ability to precisely determine the coordinates of a position on the ground. That advance had implications well beyond target destruction. It gave our forces the ability to quickly and accurately locate key target locations and downed aircrew. Many men were rescued in those late days of the war because of that innovative use by those hard charging young aircrews. PAVE NAIL played a small part in the beginning of the precision weapons revolution. However, in its own simple way, it allowed airmen to do what they do best--harness technology for purposes well beyond its initial design. In the waning days of our involvement in the



long war in Southeast Asia, the young PAVE NAIL crews, through their innovative and creative efforts, made their own singular and distinctive contributions to the evolution of precision warfare, fully brought to fruition in later conflicts in Iraq, Bosnia, and Afghanistan.

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