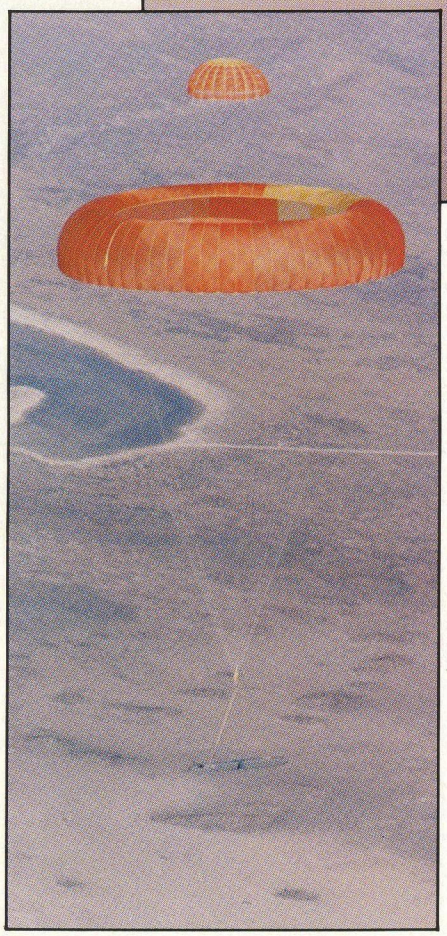


With its poles deployed, a 6514th HH-53C positions itself to snag an air-launched cruise missile (left), which descends beneath a special parachute (far left).

Snagging Cruise Missiles With The 6514th

Deliberately flying a helicopter into another object, even a soft parachute, just isn't normal. But then neither is retrieving tactical missiles—unless you happen to fly for one particular Air Force test squadron.

By J.J. Barber
Reporting from Hill AFB, Utah

THE FIVE-MAN crew of the Sikorsky HH-53C scans the sky intently as the aircraft churns through the thin, frigid air at 12,000 feet over western Utah. Their eyes search for a billowing, doughnut-shaped parachute system. The chute's passenger: an air-launched cruise missile. Suddenly a crewman spots the bright orange parachute and the flight crew quickly position the giant HH-53C to accomplish its unusual mission: snag the chute and missile in midair.

"It's actually a preplanned midair collision," says Maj. Jerry Tonn. He is flight commander of the U.S. Air Force's 6514th Test Squadron, assigned to the missile-retrieval mission. "Most pilots throughout their training and flying are taught to stay away from everything else in flight.

"With us, it's just the opposite. We try to hit something."

The "something" is a 20-foot, 9-inch (6.3-m)-long Boeing-built AGM-86B cruise missile with a 12-foot (3.6-m) wingspan, capable of carrying a nuclear warhead 1,500 miles (2,400 km) while skimming nap of the earth at 550 mph. Midair recoveries assure that these missiles, which bear a price tag of more than $1 million apiece, can fly again another day.

One-of-a-kind task

Thanks to this unique helicopter retrieval, the Air Force can efficiently test and evaluate missiles, as well as drones and other non-piloted vehicles. It also allows Strategic Air Command B-52 bomber crews to train in live, airborne missile launchings. Retrieving, refurbishing, and reusing missiles, says Tonn, "saves tens of thousands of dollars per missile flight."

This one-of-a-kind mission is no easy task and no two retrievals are the same. Thus, training is continuous; 80% of the squadron's aerial recoveries are of training devices. Also, special equipment is needed and the helicopters are extensively modified. But as the 6514th completes its 15th year, crews and helicopters of this Air Force Systems Command unit have proven equal to the job's unique demands.

The squadron, part of the Air Force Flight Test Center at Edwards AFB in Southern California, was formed in May 1970. Three years later, the 6514th was transferred to Hill AFB, close to operations being conducted at the Utah Test and Training Range, which encompasses 1.8 million acres (728,000 ha) of desert and mountains just west of the Great Salt Lake.

The 6514th once operated both HH-53Cs and the smaller Sikorsky HH-3s. But the latter aircraft were subsequently reassigned to Tyndall AFB in Florida, where they perform the similar mission of recovering target drones used in fighter training.

In addition to missile retrieval, the 6514th's two Super Jolly Green Giants carry out other tasks at Hill such as heavy-lift work, moving target material, and recovering wreckage. The squadron also flies four-engine Lockheed C-130 turboprop transports and Cessna O-2 twin-engine light planes.

The O-2s (Skymasters) primarily transport personnel and parts to and from the

range, and sometimes serve as slow-speed chase planes. The C-130s' primary mission is logistics support; however, they also assist in training helicopter crews by dropping parachutes with dummy loads for the HH-53s to recover.

Support at Hill

The 6514th's 30 helicopter mechanics keep a busy pace because the big Sikorskys average 40 to 50 hours a month. "We do everything [on the helicopters] except depot maintenance," says Lt. Col. Bill Jones, squadron commander.

The mechanics work under the gun, for if an HH-53 isn't available, a cruise-missile launch will be scrubbed. "But as far as I know," says Tonn, "during the history of the ALCM [air-launched cruise missile], they've never had to cancel a mission because we weren't ready."

Being ready means more than having a helicopter available, however. It also requires a specially trained HH-53 crew comprising a pilot, copilot, flight engineer, winch operator, and pole operator. A slip-up by anyone could damage or destroy a load—or an HH-53.

The test squadron at Hill has a little over 200 enlisted personnel and officers, says Lt. Col. Bill Plutt, chief of the operations branch. About 160 are in the maintenance branch and the remainder in operations.

The squadron's HH-53 pilots average 1,000 to 1,200 hours of helicopter experience. Pilots are chosen selectively and must have at least 300 hours in the HH-53. But even experienced aviators, says Tonn, often fail to adapt to flying head-on toward a parachute.

Getting ready

Just what do crewmen in the 6514th do on a mission?

Typically, a midair retrieval operation starts the day before the launch of an ALCM from a B-52 or, in other instances, the recovery of a Teledyne Ryan BQM-34 series subsonic drone. Maintenance is coordinated to make sure an aircraft is ready a day in advance, giving the crew time to check out all systems.

The flight crew also conducts a briefing on the eve of a launch. Details involving coordination with all Air Force units participating in the launch, control, chase, and retrieval are outlined. Mission profile, weather, event times, radio frequencies, and call signs are discussed. Tonn adds that the missions are flown strictly daylight VFR.

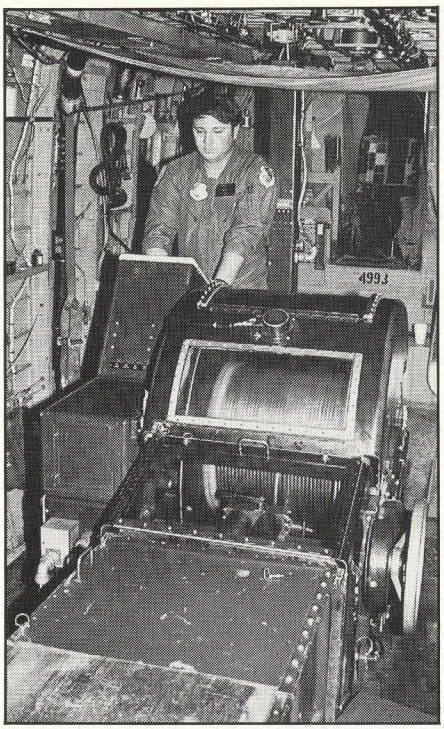
Then, on mission day, the HH-53 takes off and flies to a rendezvous point to wait for the missile. "We are at our orbit point 45 minutes prior to scheduled recovery time," says the flight commander, "but we are not at the recovery altitude of 12,000 feet.

"Because we don't have oxygen, we don't make it a practice to go above 10,000 feet for long periods of time. Normally, about 15 minutes prior to recovery is when we climb to recovery altitude."

Squadron pilots find the high-altitude environment does not provide optimal flying conditions for the helicopter, which is throttled back to 55 knots during retrieval. Tonn says the altitude taxes both pilots and aircraft because, although the "engines work fine," the rotor system is not as efficient in the thin air.

The gear in back

The Super Jolly Greens are rigged with a rather complex device for the retrieval. A 7/16-inch braided steel wire cable, running from a special computerized winch just back of the cockpit, is strung down a trough cut through the HH-53's belly. It then runs under the fuselage and back into the open rear of the helicopter, where it is connected to a very strong nylon-rope loop assembly.



Tech. Sgt. Bob Rose mans the control panel of the HH-53C's winch system.

This loop assembly is, in turn, attached to two 24-foot (7.3-m) long aluminum poles, in a manner similar to the outrigger on boats trolling for large gamefish. Mounted on the end of each pole and attached to the loop assembly is a seven-pound (3-kg), stainless-steel machined hook. Between the two poles and hanging free from the loop assembly is a 15-pound (6.8-kg) three-pointed hook. Upon snagging a missile parachute, the resulting tug—when it reaches 250 pounds (113 kg)—pulls the loop assembly and hooks free of the poles.

Of course, major modifications had to be made to accommodate the retrieval gear, the most obvious being the permanent removal of the HH-53's rear ramp and door. The back of the helicopter is always open. Also, the floor had to be structurally strengthened to bear the heavy strain imposed by the retrievals.

The zoom maneuver

After a 3,150-pound (1,430-kg) ALCM completes its mission, Tonn explains, it enters a "zoom maneuver," in which it goes from low altitude to high altitude and then deploys its retrieval system. The zoom point, he adds, is close to the HH-53's orbit.

Well before an ALCM reaches the zoom point, the HH-53's pole and winch operators, nicknamed the "backenders," complete their retrieval preparations and checklists. As the helicopter climbs to the 12,000-foot altitude and throttles down to under 70 knots, the pole operator slides the twin poles with the attached loop assembly and hooks out the open tail section and then lowers them hydraulically to about a 45° angle beneath the fuselage.

The winch operator waits for a final update from mission control, which receives telemetry on the fuel remaining in the ALCM. Mission control thereby calculates the missile's final catch weight and flashes the figure to the helicopter.

"The weight of the missile plays an integral part in presetting the winch for our catch," Tonn explains. "We program the winch to maintain a constant line tension of 1.5 times the weight of the missile. That's the tension that we use to slow the payout [of the winch cable] and stop the system."

"It's a big, computerized fishing reel," says Tech. Sgt. Bob Rose, a 6514th flight engineer, describing the winch. "The primary job of the winch operator is to recognize malfunctions and react to them in approximately one to three seconds."

Activity in the HH-53s can be fast and dangerous. The backenders must work without safety lines, which can mean trouble in an open cabin and where there is a spinning winch and high-tension cable. Hence these crewmen wear parachutes and helmets with visors down. Up front, the pilots sit in armored seats.

Eyes peeled

With checklists completed, the flight crew waits for the swiftly approaching ALCM. But Tonn explains, "It's almost impossible to see the missile [approaching]. What we look for are the chase birds, which are F-4s and have a tendency to leave an engine-smoke trail. Then we follow them around [visually] on their final leg and up to the zoom point."

Even if the retrieval crew can't spot the chase planes or missile, they remain in constant radio communication with the chase aircraft and mission control, which monitors everyone on radar. In addition, chase-plane pilots will alert the helicopter to the chute deployment with the message, "Door cover off."

"We're normally about two miles [3.2 km] away from the recovery point when it deploys, and it takes 2,000, sometimes 3,000, feet for the chute system to fully inflate," says Tonn, explaining why the helicopter generally orbits below the zoom altitude.

Ground elevation in western Utah is about 4,500 feet and retrievals are generally initiated above 1,000 feet agl. So, according to Jones, the helicopter crew has approximately 6,500 feet of airspace in which to catch the missile, which is descending at approximately 1,500 fpm.

"When the chute system gets down to our altitude," says Tonn, "we make an observation pass first to check out the chute system to make sure the integrity warrants a catch."

A special parachute

This is no ordinary parachute. The system consists of a drogue or stabilizing chute that

(Continued on Next Page)

pops out first from the bottom of the ALCM. The drogue, in turn, pulls out the 71.8-foot (21.8-m)-diameter, doughnut-shaped main chute and a 13-foot (4-m)-diameter engagement chute. This engagement chute is what the retrieval helicopter snags.

On one side of the engagement chute, load-bearing sections are connected to a load-bearing line. This high-strength Kevlar line runs down one side of the main chute to the missile, where it is linked to a tension-actuated release mechanism that cuts free the main chute on engagement.

On the opposite side of the engagement chute from the load-bearing line is an aiming gore, a distinctively colored panel that serves as the target for retrieval approach. "We worry about [blown] panels in the engagement chute, because if there is any damage, [the chute] won't be billowed the same all around and will tend to dart about," says Tonn.

If the chute looks catchable, the HH-53 pilot normally sets up a right-hand pattern, similar to an airport landing pattern—downwind, base, and final. This gives him the best view of the descending missile.

Should the pilot lose sight of the chute while flying the catch pattern, the backenders direct him until he again makes visual contact. Further complicating the situation is the need to match the helicopter's rate of descent with that of the missile.

"The way we do that," Tonn explains, "is to constantly keep the chute system on the horizon by line of sight. As long as it's there, we've got the descent rate matched."

What cannot be matched, however, are the erratic movements—up, down, sideways, and around—that engagement chutes can sometimes make. These are caused by blown chute panels, wind shear, thermals, or instability of the main chute. But, according to Tonn, after an intensive six to eight months of training, pilots develop the ability to anticipate where to aim the helicopter when the chute moves erratically. And they follow an in-house adage: "You never go down after a chute, because it could come up and get you."

"You've got to put the aircraft where the engagement chute is," Tonn states, "and we have to put the parachute in a 12-by-13-foot [3.6-by-4-m] window directly beneath the aircraft."

Bad snags

Trolling for parachutes is not an easy exercise. Chutes have been snagged on the HH-53's sponsons and auxiliary tanks. Once, says Tonn, a malfunction caused an HH-53's landing gear to lower during a retrieval and catch the engagement chute.

Such instances invariably occur because the chute "goes squirrely," says the Air Force major. "You reach a point, say within 10 seconds of contact, that if the chute system does anything radical, you're at its mercy.

"The best you can do is some sort of violent nose-up maneuver to get it to hit the belly of the aircraft, rather than the rotor system."

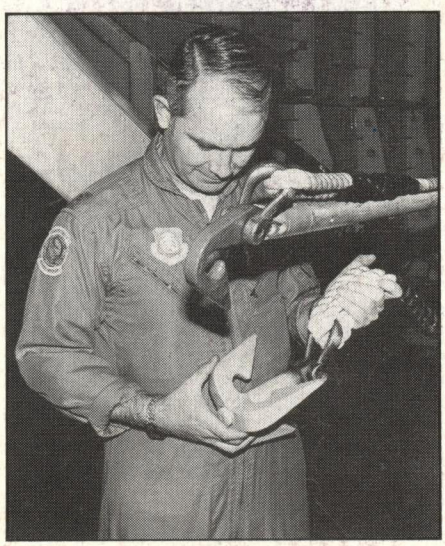
In approaching the chute, the pilot aligns the Super Jolly Green with the aiming gore. Thirty seconds before the catch, he alerts the backenders. "Just as the chute system passes under our feet," says Tonn, "we call, 'coming through' to alert the winch operator and pole operator."

Of course, several things can go wrong and Tonn says making more than one pass to snag a chute is not uncommon. In fact, as many as eight passes may be required during the five or six minutes within which a retrieval can be made. Therefore, Tonn says, two helicopters are used, if available, on ALCM retrievals to increase the chances of a successful snag. Only one helicopter is normally used on other types of catches.

Some flubs

Tonn describes some possible flubs. "If we miss the [parachute] system on a pass and the winch does nothing, the pole operator calls, 'missed pass.' If we hit it [with the hooks] and go through the engagement chute without getting a load-bearing member, the operator calls, 'tear through,' which means we go around and try again . . . as long as we didn't damage the engagement chute sufficiently to cause it to collapse.

"If [a hook] catches a load-bearing member and exerts enough tension to release the main chute, and then the hooks let go, that's called a 'false engagement' and the package goes to the ground with nothing to slow it but the collapsed engagement chute."



Maj. Jerry Tonn inspects the treble hook on a loop assembly used to snag chutes.

Sometimes the release mechanism on the missile malfunctions and fails to release the main chute. This can bring some serious problems, as the HH-53 is now trying to tow a large drag chute at 55 knots.

"That happened to me," says Tonn, "and I went from our normal catch attitude of 5° noseup to better than 45° nosedown instantaneously and went from 55 knots to zero airspeed.

"In the process, the winch was peeling off cable so fast that the back end was full of smoke. Then 14,000 pounds [6,350 kg] of measured tension snapped the load line [on the chute] and the missile separated from the helicopter."

Most catches are successful, however. The hooks normally go into the engagement chute, catch a load-bearing member, and hold. When the main chute is detached and free, the winching operation begins.

The winch operator cannot see the catch; however, on a control console next to the winch, he watches an instantaneous account of winch-brake pressure and cable tension.

"In a normal operation," Tech. Sgt. Rose explains, "the cable tension will go up and the brake pressure will follow it. It lets the brake go on and off with hydraulic pressure to allow cable payout and permit the vehicle [missile] to accelerate to the speed of the helicopter."

The winch, which has 390 feet (120 m) of cable, thus works much like a fishing reel. When the missile reaches the helicopter's speed, the payout of cable halts.

Winching, like snagging, can be tricky. The 6514th established emergency procedures in case the payout of cable cannot be halted through normal procedures. As a last resort, a guillotine on the winch housing severs the cable to jettison the package.

"One of the safety precautions," says Tonn, "is that no one is allowed to stand in line with the winch drum. We had a winch malfunction once, and the cable started peeling off and shattered the winch drum.

"The cable then came off the drum and slapped along the top of the aircraft—cutting wires and stringers—then came down into the cockpit and cut the center console between the pilots in half." That pucker-producing instance is why the pilots' seats are armored.

With the snagged missile accelerated to the helicopter's speed, the winch operator begins reeling in cable. When he sees the missile through the trough in the HH-53's belly, he alerts the pole operator, who retracts the poles and assists in the reeling operation.

The missile is drawn up to a stowed position, usually within 20 feet (6 m) of the helicopter's belly. Because the cruise missile is winged, aerodynamic forces may cause it to become an unstable load. There are other factors as well, including damage to the missile-stabilization chute. If the missile becomes unstable, more line is reeled out and/or the helicopter maneuvers to compensate.

A padded pad

During the reeling operation, the Super Jolly Green heads for a special docking pad on the range to deposit the missile. This final step involves bringing the HH-53 to a 30-foot hover over the 25-foot (7.6-m)-diameter docking pad, which is covered with bean bags, so the missile can rest on a soft cushion.

Whether recovering missiles or drones, the midair procedure remains basically the same. In some instances, however, the parachute system and the load's weight may vary. Tonn says the test squadron can retrieve objects weighing between 250 and 4,000 pounds (115 and 1,815 kg).

Once a missile, drone, or training device is safely docked, the HH-53 crewmen can have the aircraft rerigged and ready to retrieve another vehicle in less than 10 minutes. In case of emergency, the flight crew can rerig while in flight. "I've made as many as five recoveries in one day," says Tonn.

"When we come back after a recovery, we debrief each segment of the mission," the major continues. "And if we can improve a procedure, it then becomes procedure.

"That's one of the advantages we have of being in Systems Command. We actually develop the procedures and write the book."

And writing about midair recoveries makes the 6514th's book particularly unique. ■