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AN UNDERWATER ICE STATION ZEBRA

**Recovering a Secret Spy Satellite Capsule
from 16,400 Feet Below the Pacific Ocean**





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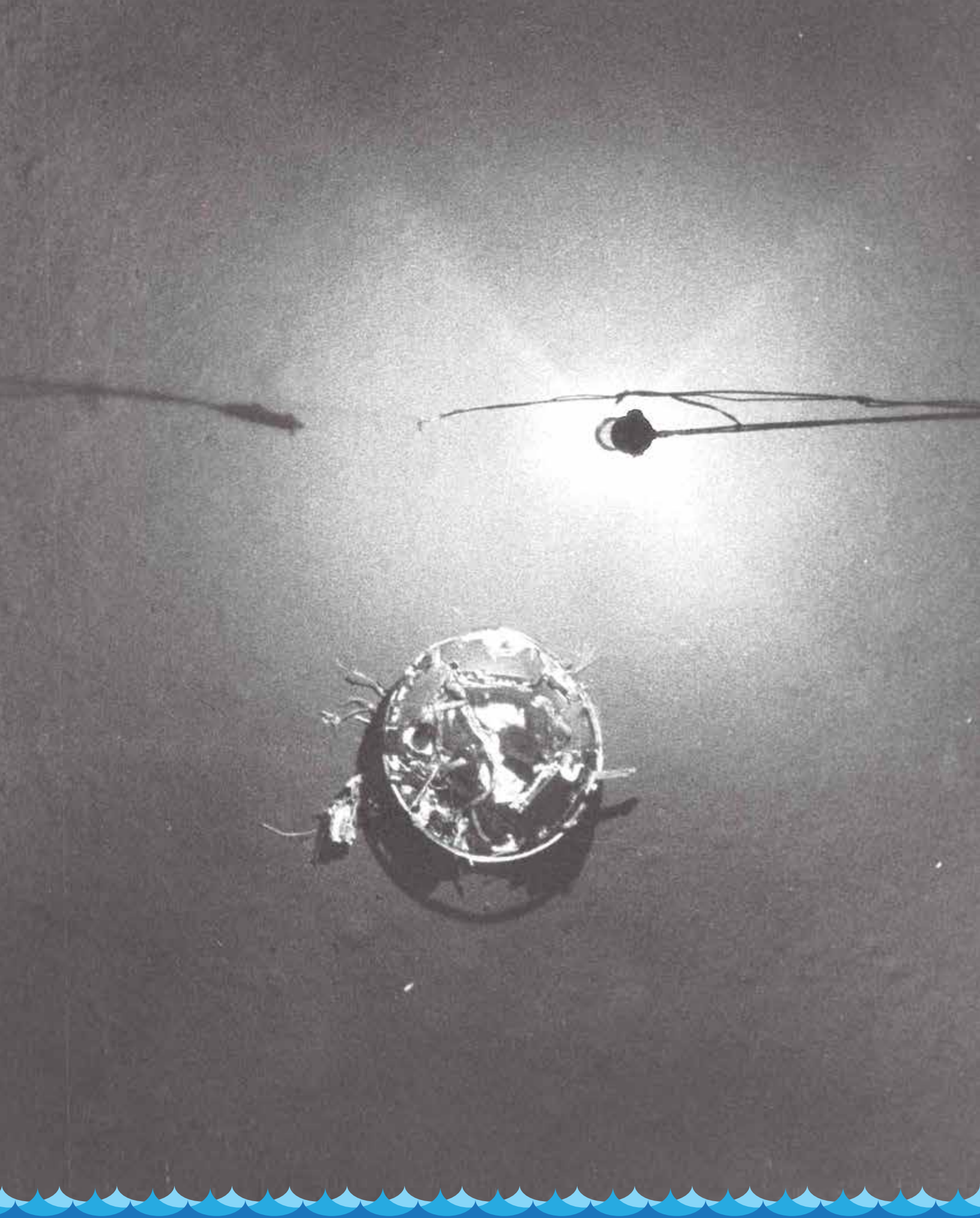
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Cover: *Trieste II* (DSV-1) under tow at night.
(Credit: Naval Undersea Museum, Keyport, WA)

Opposite: *Trieste II* (DSV-1) stowed in *White Sands* dock well.
(Credit: CIA)



AN UNDERWATER ICE STATION ZEBRA

Note to Reader

As a standard practice, the Historical Collections Division (HCD) collaborates with outside academic institutions, presidential libraries, think tanks, and museums to carry out its mission of releasing historically significant collections of declassified Central Intelligence Agency (CIA) materials to the public. Leveraging the capabilities of multiple organizations more effectively utilizes scarce resources with the ultimate benefit to the American public of greater knowledge of intelligence activities at reduced costs.

In this release, describing the underwater recovery of a HEXAGON satellite film capsule, HCD has broken new ground. For the first time, we have collaborated with an independent, peer-reviewed, publication to release a group of documents. The enclosed article on this little known underwater operation (starting on page 5) originally appeared in the volume 19, number 3, 2012 issue of *Quest: The History of Spaceflight Quarterly*. With *Quest's* agreement, we have reprinted the article as published to make it available to the public without charge.

The declassified CIA documents are posted to the Agency's public website at <https://www.cia.gov/library/publications/historical-collection-publications/>

Disclaimer

All statements of fact, opinion, or analysis expressed in this booklet are those of the author. They do not necessarily reflect official positions or views of the Central Intelligence Agency or any other US government entity, past or present. Nothing in the contents should be construed as asserting or implying US Government endorsement of an article's statements or interpretations.

Opposite: Part of the HEXAGON film bucket photographed
on the ocean bottom at 16,400 feet.
(Credit: CIA)



Information Management Services, Historical Collections Division (HCD),

in partnership with the Directorate Information Review Officers, is responsible for executing the Agency's Historical Review Program. This program seeks to identify and review for declassification collections of documents that detail the Agency's analysis and activities relating to historically significant topics and events. HCD's goals include increasing the usability and accessibility of historical collections. HCD also develops release events and partnerships to highlight each collection and make it available to the broadest audience possible.

HCD's mission is to:

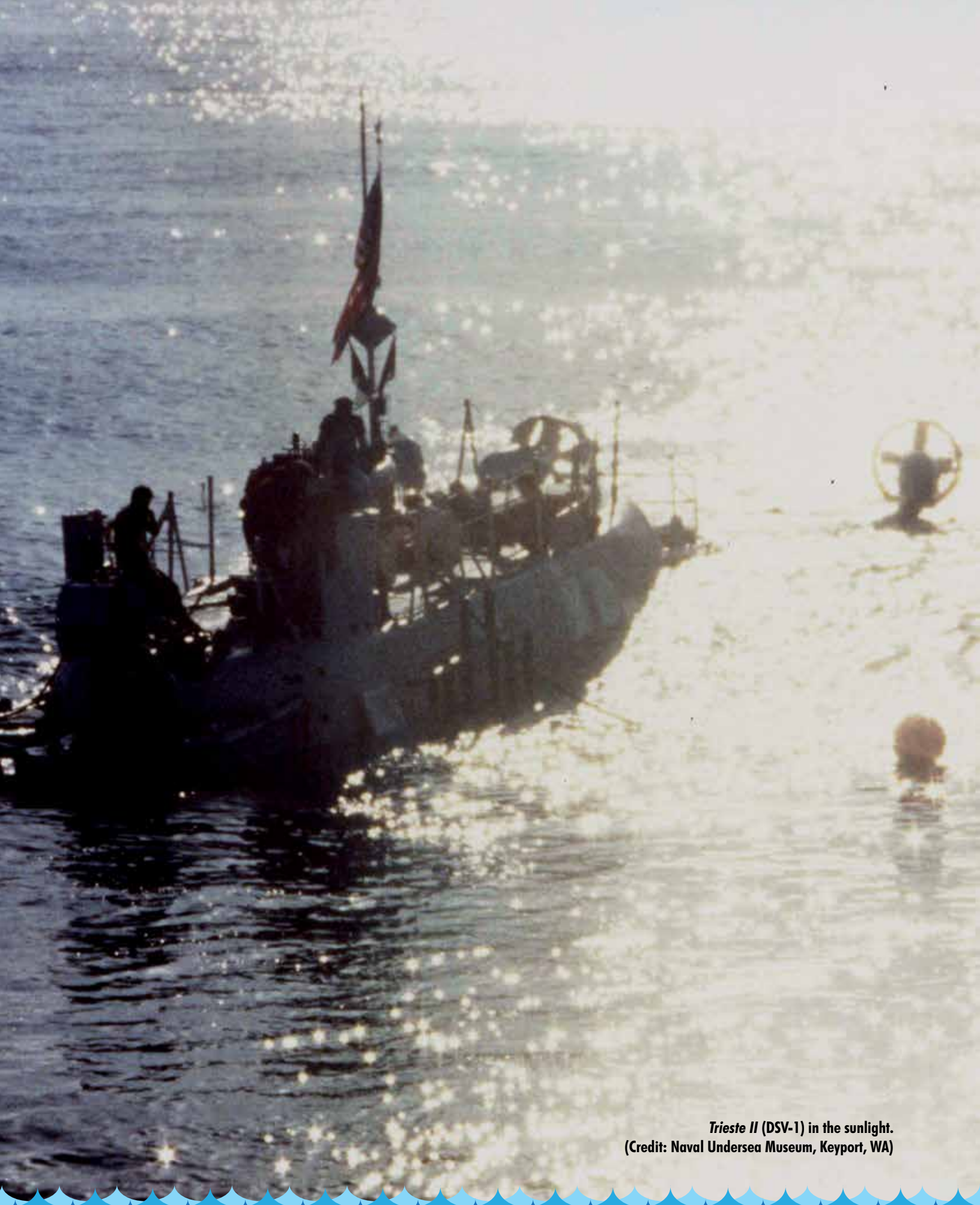
- ★ Promote an accurate, objective understanding of the information that has helped shape major US foreign policy decisions.
- ★ Broaden access to lessons-learned, presenting historical material that gives greater understanding to the scope and context of past actions.
- ★ Improve current decision-making and analysis by facilitating reflection on the impacts and effects arising from past foreign policy decisions.
- ★ Showcase CIA's contributions to national security and provide the American public with valuable insight into the workings of its government.
- ★ Demonstrate CIA's commitment to the Open Government Initiative and its three core values: Transparency, Participation, and Collaboration.



The Naval Undersea Museum in Keyport, Washington, collects and interprets the history, science, and operations of the underwater Navy. With over 40,000 artifacts and 8,530 library holdings, the museum is an important repository for information and items related to undersea weapons, submarine technology, diving and salvage artifacts, and submersibles. Exhibits comprising more than 17,000 square feet of gallery space examine and showcase 150 years of naval undersea history and technology. Standout artifacts include the sail from the Cold War submarine USS *Sturgeon* (SSN-637), submersibles *Trieste II* (DSV-1) and *Deep Quest*, and the end cap from underwater habitat *Sealab II*. The museum is one of twelve official Navy museums and is accredited by the American Association of Museums.



Published since 1992, *Quest* is the only peer-reviewed journal exclusively focused on preserving the history of spaceflight. Written by professional and amateur historians along with people who worked in the programs, each quarterly 64-page issue features articles chronicling the making of the space age, plus rare photos and interviews on human spaceflight, robotic exploration, military programs, policy, international activities, and commercial endeavors. These are the stories that fascinate and captivate; that give behind-the-scenes insight into the space program.



Trieste II (DSV-1) in the sunlight.
(Credit: Naval Undersea Museum, Keyport, WA)

AN UNDERWATER ICE STATION ZEBRA

Recovering a KH-9 HEXAGON Capsule from 16,400 Feet Below the Pacific Ocean

By David W. Waltrop

The 1963 Cold War thriller, *Ice Station Zebra*, by Scottish author Alistair MacLean is a high intrigue espionage story of American and Soviet agents vying to recover film from a satellite that had crashed in the Arctic. The novel and later 1968 movie adaptation of the same name starring Rock Hudson, Patrick McGeehan, Ernest Borgnine, and Jim Brown, although fictitious, resemble the real-life episode of a film capsule from an American CORONA spy satellite that went down near Spitzbergen, Norway, in April 1959, and may have been recovered by the Soviet Union.¹ The Spitzbergen incident is not the only time when parts of a U.S. spy satellite landed in the wrong place. In August 1964, pictures of another CORONA capsule appeared in local newspapers after it accidentally landed in Venezuela.² In May 1972, suspected fragments of a KH-8 GAMBIT satellite came down in farmland about 75 miles north of London, England.³

However, one of the most amazing stories of a wayward piece of an American spy satellite occurred during the first KH-9 HEXAGON mission. A film capsule from that satellite crashed into the Pacific Ocean on reentry. The Central Intelligence Agency (CIA) and U.S. Navy led a secret operation to retrieve that capsule from a depth of 16,400 feet, the deepest underwater salvage then attempted. What follows is not just a CIA or Navy narrative. It is a story encompassing the National Reconnaissance Office (NRO), Department of Defense (DOD), and private industry. It is an account in which decades before the phrases “joint duty,” “multi-INT intelligence,” and “interagency collaboration” gained popularity in America’s national securi-

ty lexicon, a diverse group from various organizations with unique talents came together to undertake a dangerous mission, never before attempted.

The First KH-9 Mission

The first HEXAGON mission (M1201) lifted off from Vandenberg Air Force Base, California, shortly before noon on 15 June 1971. Like the CORONA and GAMBIT satellites before it, HEXAGON photographed “denied areas” and returned the exposed film to Earth in recovery vehicles (RV), called “buckets,” ejected from the satellite. The buckets re-entered the atmosphere, were slowed by a parachute, and then waiting Air Force C-130 aircraft captured them in mid-air near the primary recovery zone north of Hawaii. CORONA and GAMBIT initially had one bucket, but as technology improved, both carried two, which increased a satellite’s on-orbit life and allowed operators controlling a satellite to return part of the film load without ending an entire mission. Technology improved to the point that the first HEXAGON satellite had four buckets (Figure 1) and the largest film supply—175,601 feet (1,350 lb)—of any U.S. satellite up until that point.⁴

Despite high battery temperatures and voltage problems eight to ten hours into the mission, the new HEXAGON operated normally. On 20 June, the first bucket, with 40,000 feet of film, separated from the satellite and re-entered the Hawaiian recovery zone. Pilots from the 6594th Test Group based at Hickam Air Force Base, Hawaii, responsible for conducting the mid-air recovery of buckets, spotted the descending object, but because of its badly damaged parachute, allowed it to land in the water. Divers retrieved it before it sank. The second bucket returned 52,000 feet of film six days

later. This time an aircraft caught it and its less-damaged parachute in mid-air. During recovery of the third bucket on 10 July, the main parachute had apparently snapped off. The 1,100 lb incoming object, traveling between 400 and 500 feet per second, hit the ocean with a projected 2600Gs of force, sinking on impact.⁵

Accounts vary on what the recovery crews saw as they waited in circling ships, helicopters, and airplanes for the bucket’s return. Several mistakenly reported signals from other aircraft as coming from the bucket’s water-activated beacon. A helicopter crew saw the drogue chute, which deployed first to pull out the main chute, with a strap hanging from the main chute attachment point, indicating that the main had detached from the drogue. They observed the drogue hit the water, float for approximately one minute, and then sink. A search of the area where the bucket came down found discolored water, possibly from a location dye marker, for about 100 square feet, along with bubbles, but no debris.

Due to the parachute problems on the first two buckets and the loss of the third, satellite operators placed only 50 percent of the film onboard the fourth bucket to lessen its weight. On 16 July, that bucket entered the recovery zone and a C-130 caught it in mid-air.⁶

Notwithstanding the problems encountered, the first HEXAGON mission was called an amazing success. While the parachute failures presented major concerns, the battery overheating, voltage anomalies, and other difficulties seemed easily corrected. The 123,601 feet (930 lb) of recovered film far exceeded that carried on the first successful CORONA (20 lb), and the typical KH-7 GAMBIT (45 lb) and KH-8 GAMBIT “dual bucket” (160 lb), flights. The imagery from the first

HEXAGON bucket alone covered more than two-thirds of all known Soviet missile sites, and a set of photographs taken on one pass over Albania permitted the identification, by class and weapon type, of that country's entire inventory of aircraft and ships. These accomplishments, plus a 2.3-foot best resolution, led a National Photographic Interpretation Center officer at Eastman Kodak's film processing center in Rochester, New York, to say after receiving the first bucket's film: "My God, we never dreamed there would be this much, this good! We'll have to revamp our entire operation to handle the stuff."⁷

Losing the third bucket's precious film, however, was very disappointing.

Planning the Salvage Operation

Dr. F. Robert Naka, deputy director of the NRO (DDNRO), and Carl E. Duckett, CIA deputy director for Science and Technology, soon authorized the Office of Special Projects, the Agency element responsible for reconnaissance satellites, to make informal inquiries with the Navy about the possibility of recovering the item from the ocean floor. Navy, CIA, NRO, Air Force, and industry representatives met at CIA headquarters on 27 July to formalize the details.⁸ The Navy proposed using the *Trieste II Deep Sea Vehicle I* (DSV-1) to effect the operation.

The Navy operated three deep-sea submersibles named *Trieste* from 1958 to 1984. Each vehicle, called a bathyscaphe, used a lighter-than-water gasoline-filled float to carry a pressure sphere in which the pilots would ride. The *Trieste I*, built in 1953 by Swiss physicist Auguste Piccard in Trieste, Italy, and soon purchased by the U.S. Navy, gained international recognition when on 23 January 1960 it became the first piloted craft to reach the bottom of the Marianas Trench, the deepest part of the ocean. The *Trieste I* (in 1963) and *Trieste II* (in 1964) then surveyed the wreckage of the nuclear powered submarine USS *Thresher* after it sank in the North Atlantic on 10 April 1963 with the loss of all hands. A third ver-

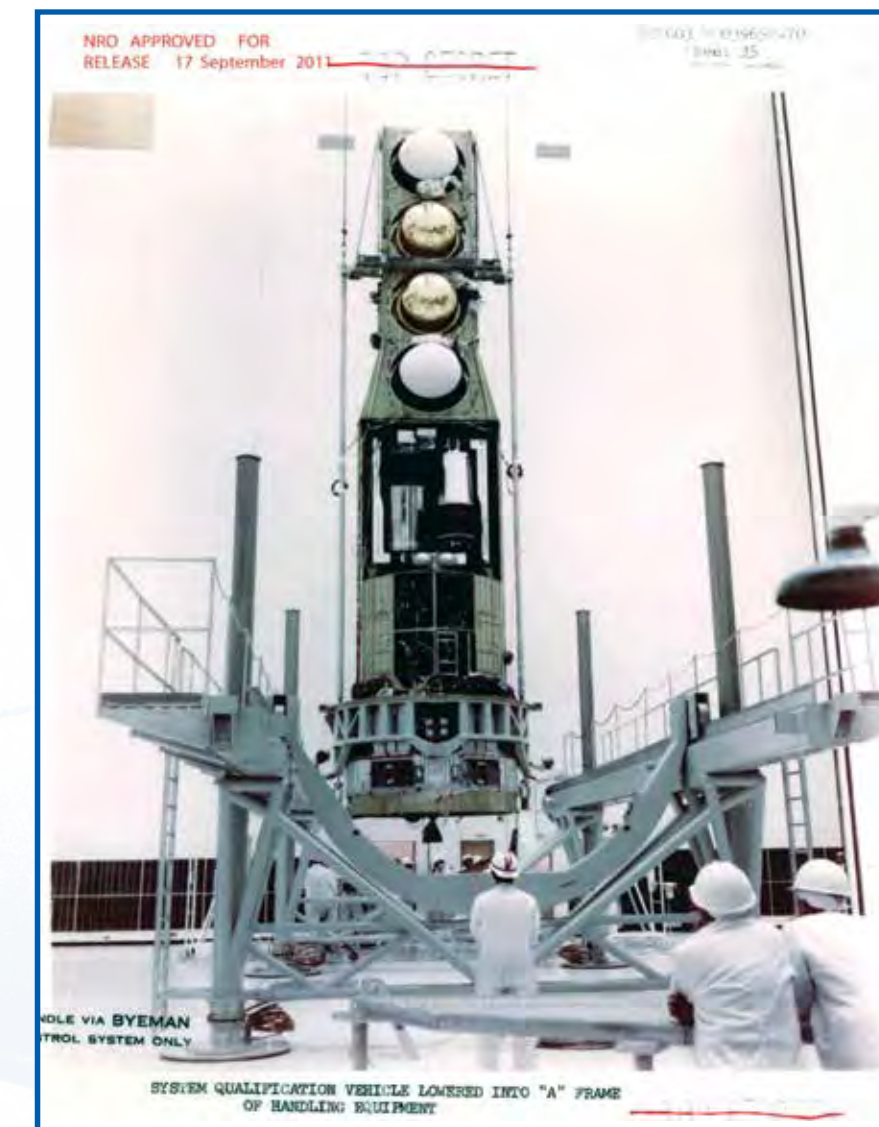


Figure 1: KH-9 HEXAGON satellite with its four buckets clearly visible.

Credit: NRO

sion, eventually designated *Trieste II* (DSV-1), surveyed the USS *Scorpion* after it sank on 22 May 1968 in more than 10,000 feet of water about 400 miles southwest of the Azores.

Although the *Trieste II* (DSV-1)'s maximum achieved depth was only 13,000 feet at the time of the CIA headquarters meeting, the Navy expected a planned test dive to 20,000 feet later that August to demonstrate no trouble in reaching the deeper depth.⁹ Moreover, documents say that since the Navy had already intended to deploy the submersible to the Hawaiian Islands from August through October, the *Trieste II* DSV-1 could effect the

bucket's recovery on a non-reimbursable basis.¹⁰

Determining the bucket's location on the ocean floor would be the operation's hardest part, but based on the Navy's experience, there appeared to be a "very good chance" of success. Locating the impact point as accurately as possible was crucial. From that point, it was necessary to predict the sink rate and the affect of water currents on the sinking object, which depended on estimating the damaged bucket's shape, its effective density, and velocity at point of impact. With a general search zone identified, the Navy would use NRO funds to hire a

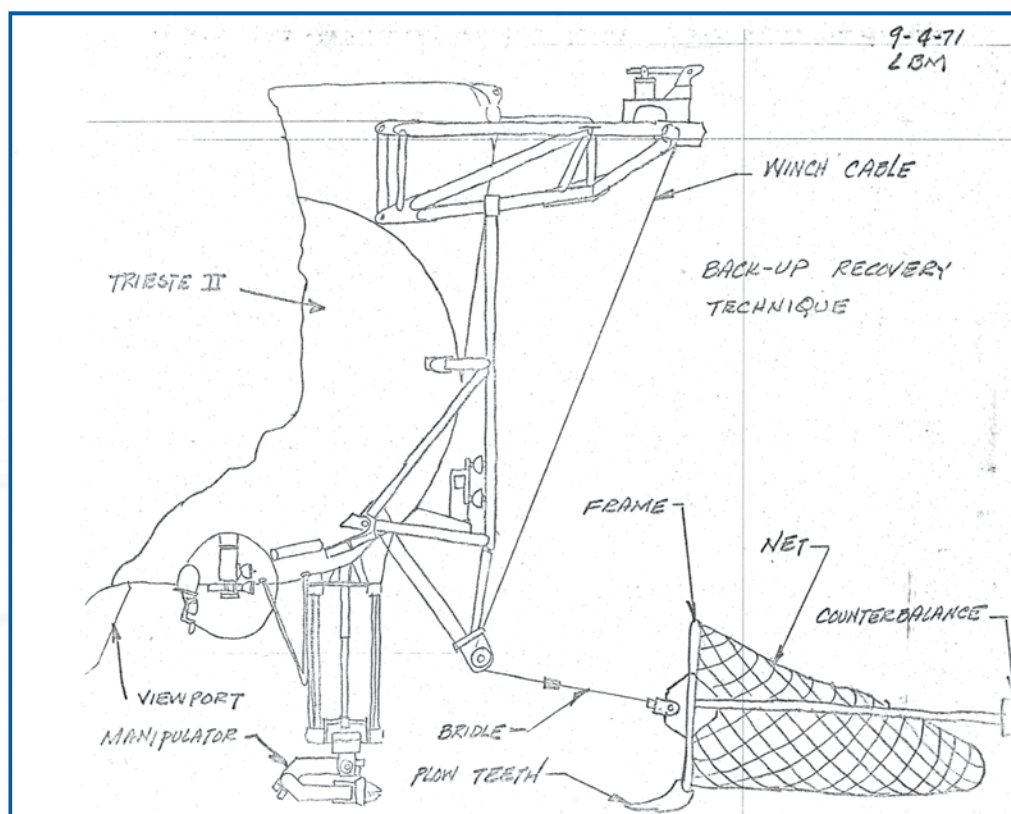


Figure 2: One of Perkin-Elmer's proposed net salvage methods, which the Navy feared would stir up the ocean bottom.

Credit: NRO

team led by Dr. Fred N. Spiess, director of the Marine Physical Laboratory (MPL), Scripps Institute of Oceanography, to find the bucket and place Deep Ocean Transponders (DOTs) on the ocean floor that would later direct the *Trieste II* (DSV-1) to the target. Dr. Spiess' connection provided the perfect cover: if uncleared crew or public asked, the recovered item was an MPL instrument. The Navy's estimate for ten days of search time, plus four days travel time, was \$100,000.

One key question remained, would the film still be useable? Surprisingly, an Eastman Kodak test immersing a 10,000-foot sample roll of film in simulated Pacific seawater at deep sea pressures for five days indicated that a considerable portion of the imagery might be recoverable if the salvage team could keep the film wet and away from light until processed. The test found that initial exposure of the roll's edge to salt water caused the film's emulsion gelatin to swell, effectively sealing the roll's center against further intrusion. To ensure security of the classified payload and keep sun-

light from ruining the film, at a depth of less than 120 feet divers would cover the object with canvas before transferring it to surface ships. They further planned to surface at night if possible to reduce the chances of exposure to light. Eastman Kodak personnel would then tediously despool the film by hand at their Rochester processing facility. In a memo summarizing the 27 July meeting, Donald W. Patterson, CIA HEXAGON Sensor Subsystem program director, concluded there was "a good chance of recovering the RV, and that the film would be useable with some small degradation."

An Army major on the NRO staff added some points about the value of retrieving the film in a separate note summarizing the meeting for under secretary of the Air Force and director of the NRO (DNRO) John L. McLucas. "The third RV contained the most imagery of the four," he wrote; "Further, this imagery was acquired on that part of the mission when the weather was particularly favorable, especially in Western Russia and Eastern Europe." He explained the time

needed to fix the parachute problem might significantly delay the next HEXAGON mission, making the bucket's film more critical to satisfying imagery requirements, and that the recovered items might help solve the parachute problem. The operation would provide experience in the event of other losses. The major concluded, "The potential gains from the recovery of RV-3 would far outweigh the moderate funding required. It is appropriate that an attempt be made."

McLucas agreed. With the basic plan set, on 10 August he sent a memo to Robert A. Frosch, assistant secretary of the Navy for research and development, asking for help arranging "the necessary Navy and Scripps support." The NRO Staff Major's points must have persuaded the DNRO who wrote, "Recovery of the film would be most desirable since the imagery recorded was from a particularly productive portion of the mission. Additional information as to the nature of the parachute failure might also be obtained."¹¹ Frosch responded eight days later that the Navy would be "pleased to assist,"

but cautioned “success of the operation depends upon locating the reentry vehicle, by no means a certainty [since] the small size of the package and accuracy of the reported sinking position make location a difficult task.” The *Trieste II* (DSV-1), he wrote, could start recovery operations after 5 October. The USNS *De Steiguer*, a survey ship capable of towing a camera-equipped search fish at a depth of more than 20,000 feet, would be available to Dr. Spiess for a ten-day search to commence on about 1 October.¹²

Overcoming Obstacles

Various teams began determining light levels at different depths, prevailing sea currents, ocean bottom conditions, and executing the other required tasks, but several concerns quickly arose. Frosch’s prediction about the accuracy of the reported impact point was prophetic as many groups had widely divergent views on its location. The Satellite Tracking Center had three points: an original point, a point later changed due to a calculating error, and a final point. The drogue chute’s location, which recovery aircraft determined based on the two- to three-mile accuracy of their Loran C navigation systems, showed another point. The main chute deployment point led to yet another spot. Calculations based on wind direction, ballistic trajectory, spacecraft ephemeris, as well as an independent government assessment, yielded different results. Based on these various inputs, the search team eventually defined a 1.5-mile wide by 8-mile long search zone 350 miles north of Hawaii.¹³

Leonard B. Molaskey, a Perkin-Elmer program manager responsible for devising a method to raise and transport the bucket from the Pacific to Eastman Kodak’s film processing center, encountered problems owing to the sunken object’s unknown condition.¹⁴ Opinions varied on whether it was still intact or had broken apart at impact or during its descent into the high-pressure deep. Initial plans called for attaching a hook with a cable to the bucket and hauling it to the surface, but

fears that corrosive seawater might have weakened key beryllium structural elements, caused the group to reject that idea in favor of methods that would envelop the sunken item. Molaskey’s team considered several net options (Figure 2), but those too were inadvisable as discussions with the Navy found such a device “would undoubtedly stir up sediment on the ocean floor to the extent that the operator’s visibility would be reduced essentially to zero for periods of up to an hour.”¹⁵ The final approach used a “hay hook” design to descend over, and close around, the bucket before bringing it to the surface (Figures 3 and 4).

The shipping container designed to transport the salvaged item to Eastman Kodak’s processing center (Figure 5) had to be large enough to hold the “hay hook,” with the bucket inside, along with the canvas to protect it from uncleared personnel and sunlight. In addition, the container needed to be capable of being moved while full of water, filled from the top and drained from the bottom (since Eastman Kodak planned to reuse the seawater during despooling), and have wheels for easy transport. It could be no bigger than 72 inches high, 65 inches wide, and 78 inches long to fit through a door at Eastman Kodak. To prevent bacterial growth on the film, and with the inadvisability of using fungicides, the salvage team needed to maintain the container (with bucket, hook, and canvas inside) at a temperature of 40 °F or less for the journey to Eastman Kodak.¹⁶

Most problems were well on their way toward a solution by about mid-September. Perkin-Elmer subcontracted with the Pennsylvania-based Container Research Corporation to build the shipping container, and it was on schedule for delivery to the Submarine Development Group I, the Navy unit directly responsible for the salvage operation, at San Diego, California, where crews readied the *Trieste II* (DSV-1) and support ships. The Navy’s Underwater Research and Development Center agreed to fabricate the Perkin-Elmer “hay hook” by 17 September. Plans were also underway to procure a

cooling unit to keep the bucket below 40 °F.¹⁷ Further promising tests of the HEXAGON film concluded that a very thin edge of film (about a quarter inch) would likely be fogged, then a two-inch edge with a latent image degraded in exposure but probably still usable, followed by 2.5 inches of good photography. This news gave one CIA officer reason to be optimistic when he reported on 14 September, “The operation is proceeding smoothly and everyone connected with it is enthusiastic and feels that there is a reasonable chance of success.”¹⁸

Then potential disaster struck. A flash flood in Glen Riddle, Pennsylvania, on 14 September left the Container Research Corporation’s engineering, purchasing, sales, and management offices in about six feet of water and a foot of silt. The HEXAGON container, on a higher level, escaped damage and its cover was located intact in the silt, but not before the raging waters had washed away the skids and all but at least one of the casters used to support the device. On Perkin-Elmer’s direction, the Container Research Corporation shipped the undamaged components as scheduled. They arrived on time at the San Diego dock a few days later, and “although somewhat marked up and scratched from the flood” appeared sound.¹⁹

Executing the Salvage Operation

The operation came together in the last week of September. In addition to the shipping container, crews delivered the “hay hook” to the San Diego dock, security cleared the essential Scripps and Navy personnel, and the group settled on a plan to construct a wooden refrigerator to keep the bucket below 40 °F.²⁰ Before actual recovery operations commenced, however, a series of land and sea trials occurred to test the hook’s functionality and allow crews to practice transferring the item from the *Trieste II* (DSV-1) to surface ships. In the first test, on 20 September, the hook, suspended from a crane, successfully lifted a loaded 55-gallon drum off a sandy beach from various positions (nose down, on its side, etc.) and

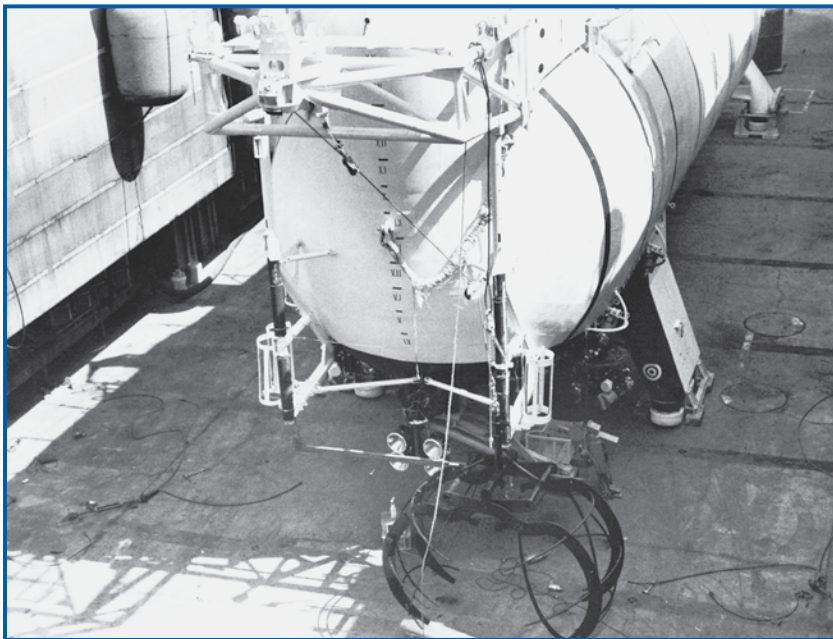


Figure 3: Perkin-Elmer designed "hay hook" attached to the *Trieste II*. Credit: CIA



Figure 4: Perkin-Elmer "hay hook" in the open position.

Credit: CIA

at different depths in the sand to simulate immersion in the ocean bottom. The 900 lb hook was 150 lb over specifications owing to the installation of counterbalance weights, but it initially appeared to operate well. A closer

inspection, however, revealed it failed to open to the full 70 inches as designed. Molaskey nevertheless believed shortening the center rod on both sides by about three inches would easily correct the problem.²¹

An Integral Operating Unit (IOU) composed of the USS *Apache*, USS *White Sands*, and *Trieste II* (DSV-1) left San Diego for the "at sea" test site 60 miles offshore on 27 September. At 11:00 AM, the next day, Lt. Cmdr. Malcolm G. Bartels, the *White Sands* and *Trieste II* (DSV-1) commander, outlined the test procedures. Two officers, Lt. Cmdr. Phil C. Stryker Jr. and Lt. Richard "Dick" H. Taylor, would join Bartels in the three-person craft. The *Trieste II* (DSV-1) would carry an NRO-provided dummy bucket, tethered to its forward port skag, 4,200 feet to the bottom to avoid searching for or possibly losing it. The submersible would test the hook's opening and closing abilities, then back away 50 to 100 yards to determine the sensitivity of the dummy bucket's pinger and the receiving equipment onboard the *Trieste II* (DSV-1). If all went well, the submersible would recollect the dummy bucket, surface, and practice transfer operations to the *White Sands*. The IOU would then sail directly to the search zone off the Hawaiian Islands.²²

Plans called for the oceangoing tug *Apache* to tow the *White Sands*, a World War II era auxiliary repair dock with limited independent maneuverability, to an operating area, with the *Trieste II* (DSV-1) stowed in its dock well (Figures 6 and 7). Launching the *Trieste II* (DSV-1) required flooding the dock well and towing the submersible out to sea through the *White Sands* stern gate. Once launched, the approximately ten hour-long pre-dive checkout procedure, which included loading about 67,000 gallons of aviation gasoline and 30 tons of steel shot ballast into the small craft, would occur.

Following the completion of pre-dive procedures, the first test dive commenced at 3:45 PM on 29 September. Onboard the *Trieste II* (DSV-1), several sonar, television, camera, navigation, and electrical problems occurred almost immediately after submerging. Reaching the bottom, the manipulator arm had difficul-

ty cutting away the dummy bucket. The submersible had to rise off the bottom, dangling the object from its skag to cause enough tension in the tether to cut it. A lack of depth perception out the viewport made maneuvering the hook over the bucket extremely difficult. Although they came close, the crew was unable to lower the hook over the object on this dive. During these maneuvers, the winch cable jumped the pulley and broke, dropping the hook. Having lost 900 pounds unexpectedly, the small submersible shot up 400 feet before its crew could release enough gasoline to stop the ascent. Back on the bottom, the hook and dummy bucket were difficult to find; it took 45 minutes to find both. Unable to retrieve both objects in its mechanical arm, the *Trieste II* (DSV-1) surfaced with the hook hanging straight down. The three-man crew finally returned to the *White Sands* at about 2:00 AM on 30 September.²³

A meeting occurred a few hours later to choose a course of action for the remainder of the test. Cmdr. John Bradford "Brad" Mooney, representing Capt. Samuel R. Packer, commanding officer of Submarine Development Group I, strongly advocated the need to perfect a recovery technique with all due haste. During the course of the day, with the *Trieste II* (DSV-1) still under tow to avoid the lengthy period needed to stow and relaunch the submersible, crews repaired the craft's electrical problems, recharged batteries, repositioned the winch line, replenished shot and gasoline, and completed other preparations for the next dive. The crew added black, white—and eventually international orange—strips, to increase the hook's visibility, installed a plumb bob in the hook's center to aid in positioning it over the bucket, and again modified the mechanism to enlarge its opening span. After completing these tasks, and testing the hook's expanded opening radius by lifting it with the *White Sands* crane, problems with the *White Sands* fresh water supply forced the IOU back to San Diego on 1 October.²⁴

The ships returned to the test site

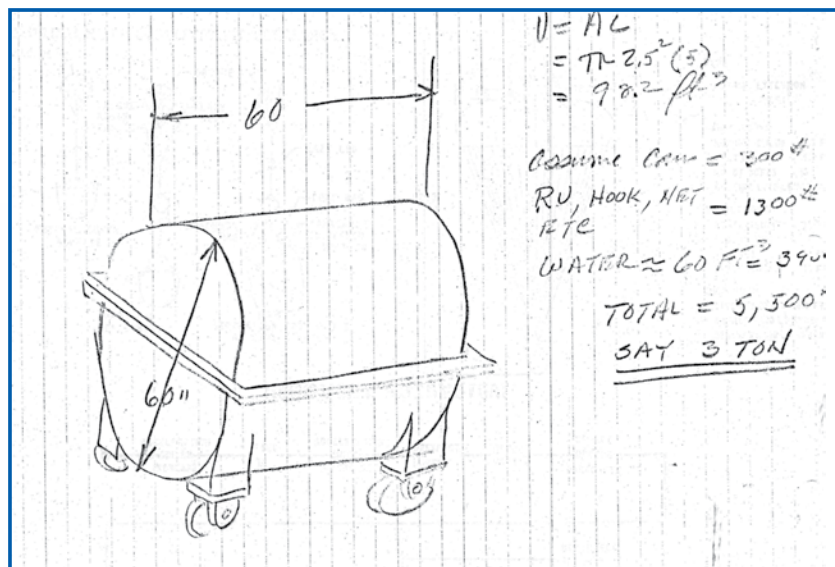


Figure 5: Early sketch of Perkin-Elmer designed shipping container intended to transport the salvaged bucket to Eastman Kodak's film processing center in Rochester, New York. Credit: NRO

five days later where the *Trieste II* (DSV-1) was unable to locate the dummy bucket on the ocean floor and experienced another navigation computer failure causing the submersible to surface about five miles from the target point. This caused concern not only for the equipment problems, but because the *De Steiguer* was already transiting to the search zone. The *Trieste II* (DSV-1) did not locate the dummy bucket until the test third dive on 11 October, but with the submersible's power running dangerously low, and no time for additional test dives, Bartels, Stryker, and Taylor instead exercised the hook without actually maneuvering it over the dummy bucket. That gave the men confidence they could collect the item given enough time. When the *Trieste II* (DSV-1) surfaced and was back onboard the *White Sands*, the IOU headed for the search zone. On 20 October, the *De Steiguer* reported it found the lost bucket and had photographed it with the camera on the search fish (Figure 8).²⁵

While transiting to the search zone, the *White Sands* crew built a wooden refrigerator on deck as planned. The eight-foot tall, by eight-foot wide, by eight-foot long contraption consisted of a three-quarter inch

plywood box constructed around a two-foot by four-foot frame insulated by one-and-a-half inch glass wool blankets with the aluminum side facing the box's interior. An outside cooling unit blew air into the box through an opening behind the cooling coil. On 2 November, as the IOU approached the search zone, discussions among the crew discovered that the device could not cool "8,000 pounds of sea water to below 40 °F in the outside ambit of about 90 °F in bright sunlight." The crew painted the unit's exterior white, constructed a duct to recirculate the cooled air, taped off all seams, and insulated the unit as much as possible in order to improve its cooling abilities. They then undertook the difficult task of placing the shipping container—which when hanging from the ship's crane, swung like a "house wrecker's ball" in even the smallest rolls—inside the cramped refrigerator box and filled it with seawater to start the cooling process. During this period, pieces of insulation fell into the shipping container, requiring the crew to overflow the container with water to remove the contaminants and send out calls to the mainland for more insulation.²⁶

As crewmembers handled the refrigerator and container problems,



Figure 6: *Trieste II* (DSV-1) stowed in the *White Sands* dock well.
Credit: CIA

others readied the *Trieste II* (DSV-1) for launch. At 8:30 PM, the *White Sands* started flooding its dock well, and by 10:30 that night, had taken the *Trieste II* (DSV-1) undertow. Since the refrigerator had cooled to only 56 °F on 3 November, the *White Sands* began making regular ice to place inside the makeshift refrigerator and called in additional airdrops of dry ice and insulation to cool the contraption. With the airdrops in progress during the early afternoon of 4 November, the *White Sands* headed for “zero DOT,” one of the transponders the *De Steiguer* placed to mark the sunken bucket’s location. The *Apache*, meanwhile, released additional DOTs. As the *White Sands* approached zero DOT, Bartels, Stryker, and Taylor



Figure 7: A crane lifting U.S. Navy’s *Trieste II* (DSV-1) sub.
Credit: CIA

descended toward the bottom in the *Trieste II* (DSV-1). At about 8:00 PM, one hour and 45 minutes into the dive, they paused 300 feet above the ocean floor. Relaying range to the DOTs via a hydrophone, while the *Apache* and *White Sands* tracked their position, the men began searching for the sunken item. Although they received several sonar contacts, they made no visual sighting, and feared they might be in the wrong location. The dive ended around 2:00 AM on 5 November without finding the bucket.²⁷

A meeting with two *Apache* officers from the dive’s navigation team later that morning to plan the next attempt decided that the *Apache* should survey the field from the surface to confirm the location of the underwater DOTs. During the meeting, however, bad weather moved in and grew steadily worse over the next days with 30-knot wind gusts and eight- to ten-foot swells reported on 7 November. Weather conditions postponed the *Apache*’s navigation survey because the *White Sands*, unable to maintain headway against the high seas, required the *Apache* to provide a tandem tow for the *White Sands* and *Trieste II* (DSV-1), which could not be stowed in such difficult sea conditions.²⁸

On 9 November, with *Apache*’s fuel running low and weather conditions worsening, the ships headed toward the operation area’s southernmost sector. Growing concern that heavy seas might damage the *Trieste II* (DSV-1), undertow for such length in rough weather, caused the IOU to reduce the tandem tow’s speed to the minimum two knots needed to maintain steerage. On 10 November, the USS *Current* relieved the *Apache*, which headed to Pearl Harbor for refueling. The *Current* towed the *White Sands* and *Trieste II* (DSV-1) to the lee side of the Hawaiian Islands where crews stowed the submersible onboard the *White Sands* before the *Apache* returned to tow the *White Sands*, with the *Trieste II* (DSV-1) inside, into Pearl Harbor on 15 November.²⁹

The next day, Rear Admiral Paul L. Lacy Jr., commander, Submarine Forces, Pacific Fleet, met with Cmdr. Mooney, in charge of the operation at sea, and his officers, and then privately with the onsite CIA representative, to decide whether to postpone operations until fairer spring weather arrived. The decision was to try again immediately with additional Navy support. After refitting all ships, including replacing the makeshift wooden refrigerator built in transit with an eight-foot by eight-foot by twenty-four-foot walk-in freezer capable of maintaining temperatures as low as 0 °F, the IOU left Pearl Harbor on 21 November. This time, Capt. Packer replaced Mooney as the officer in charge to add his full authority. The Navy also assigned two other tugs, the *Abnaki* and *Coucall*, for greater flexibility. When the IOU reached the search zone on 24 November, the *White Sands* separated its towline allowing the *Apache* to conduct the DOTs survey, which bad weather had postponed during the first recovery attempt. The *Apache* located all DOTs despite fears the *De Steiguer*-placed DOTs, which only had a one-month life expectancy, may have expired. Analysis of the survey and discussions with Dr. Spiess indicated that the *De Steiguer*, which had experienced navigation problems enroute to the search area, might have misreported at least one and possibly two DOT locations.

Armed with this new information, crews felt they could vector the *Trieste II* (DSV-1) directly to the bucket, avoiding an elaborate search.³⁰

Weather delayed the next dive until 5:45 PM on 30 November. On the way down, Bartels, Stryker, and Taylor again encountered mechanical problems with the *Trieste II* (DSV-1). The Doppler sonar failed. A leak in the starboard shot release caused the submersible to develop a 25-degree list to port, and the men felt they lacked control until reaching a depth of about 7,000 feet. Around 15,000 feet, a computer power failure lost part of the navigation memory. Riding with the trail ball (a device hanging below the submersible to alert the crew when they were approaching bottom) out to about 35 feet obscured the ocean floor so they winched it in to 10 feet. This caused the submersible to move forward since the cable, due to the list, assumed a slight angle to the rear, pulling the craft down slightly. Attempts to lower the ball failed. As a result, the *Trieste II* (DSV-1) had to either slow down or slide the skag along the bottom to move, making steering difficult.³¹

The men eventually received a signal from one of the DOTs and drove in that direction until losing contact due to a dead zone between the sonar's 30-yard minimum range and the 30-foot maximum visual range out the viewport. The crew then spotted the sunken bucket passing about two feet off the starboard skag. They stopped immediately, but the submersible's momentum carried it beyond the target. They maneuvered to bring the bucket into view when the low voltage battery light activated. The crew was unable to plant a new DOT next to the target, and with little power remaining (4 of 65 battery cells were depleted to the extent they reversed polarity), had no choice but to end the mission. They surfaced at 4:15 AM on Wednesday, 1 December.³²

Steadily deteriorating weather again halted dive operations. Twenty-knot winds, two-foot seas, with over six-foot swells battered the ships on 2 December, followed by 30-knot gusts two days later. Near tragedy struck once again when on 5 December the *White Sands*, towing the *Trieste II* (DSV-1) in high seas, slowed or briefly stopped. Momentum carried the submersible into the *White Sands* stern, causing the towline to slacken and wrap around the larger ship's port station-keeping propeller. In changing towlines, a swell caught the small submersible and set it adrift. The *Apache* managed to take the submersible in tow, without collision or damage to either vessel, except for the *White Sands* now inoperable engine. An inconspicuous note in the *Apache* deck log captured the drama: "*Trieste II* is adrift. Commenced making various courses and speeds to take *Trieste II* in tow."³³ The IOU returned to Pearl Harbor days later with plans to resume operations after Christmas.³⁴

With salvage activities temporarily halted, retiring HEXAGON Program Manager Col. Frank S. Buzard sent a message to NRO Staff Director Col. David D. Bradburn and NRO Deputy Director Naka on 7 January 1972 expressing thoughts about a Soviet attempt to recover the sunken item in the event "we decide to abandon the scene for a short period

or permanently." Security marked concerns almost from the effort's start. As early as 16 August 1971, the deputy assistant for NRO security cited CIA findings that "the Soviets have no capability to recover the capsule," and no evidence they know it crashed. The CIA concluded that while the Soviet Navy maintains a tug equipped with communications equipment that could presumably monitor U.S. reentries in the Pacific Ocean to support its nuclear submarine fleet, the tug was nowhere near HEXAGON's recovery area on 10 July.³⁵ Buzard, on the other hand, referencing Defense Intelligence Agency reports, found the opposite: the Soviet Union may have the ability to recover objects from 33,000 feet, and speculated they likely know the bucket landed in the ocean. Buzard explained Moscow and other governments "have the same territorial rights in the ocean as we. If we abandon the site they can move in," and pointed to a Soviet ship keeping station in the North Atlantic directly over one of its downed November class submarines for over a year-and-a-half "presumably to preclude any U.S. effort to recover hardware." Since the IOU's salvage operations, "have established a precise area of extreme interest, which the Soviets must be aware," he warned, "we should not abandon the site until our objective is achieved." Buzard recommended, "If we abandon the site without achieving the objective, we should perform all actions that make it appear as if we have retrieved 1201-3



Figure 8: Photograph of the sunken bucket's intact upper structure, taken by the USNS *De Steiguer* search team on 20 October 1971 at 16,400 feet. Credit: CIA



Figure 9: First piece of debris the *Trieste II* (DSV-1) sighted 25-26 April 1972.

Credit: CIA



Figure 10: Second piece of debris the *Trieste II* (DSV-1) sighted 25-26 April 1972.

Credit: CIA

[designation for third bucket from HEXAGON M1201] including those communications which would be ordinarily needed for.”³⁶

The IOU left Pearl Harbor again for the search zone five days after Buzard sent his note, but bad seas forced the unit back to port in early February without conducting dive operations. Poor weather and the need to dry dock the *White Sands* for repairs postponed salvage operations until the spring. No evidence was found to indicate the Navy followed Buzard’s advice to keep station over the bucket, but it seems unlikely given the poor weather conditions. The IOU next departed Pearl Harbor for the search site on 8 April.

At about 5:00 PM on 25 April 1972, Bartels, Stryker, and Taylor started their third dive for the bucket. Following a two-hour descent, and a three-and-a-half-hour search, they sighted a tangled mass of metal and screen wire harness 18 to 24 inches long and eight to ten inches wide (Figure 9). They next sighted two jagged gold foil pieces six to eight inches across (Figure 10). Transiting to a large sonar contact 800 feet away, they found what appeared to be a six-to-eight inch long piece of nylon webbing with a two-inch metal ring attached, and then, finally, the missing item embedded in the sea floor 18 to 24 inches.

Evidence as to the object’s condition varies. A 29 April message said it appeared intact with a hole in the center of the aft thermal bulkhead and multiple strands of film streaming out another hole at the 9 o’clock position about two or three feet, undulating with the sea current. Photos of the salvage operation and post-recovery analysis, however, indicate that the bucket probably broke apart and that the film stacks (Figures 11 and 12) had detached from the structure and were laying exposed on the ocean floor. Only the bucket’s upper stage remained intact. This upper structure possibly appeared in the 20 October photos the *De Steiguer* search team took and could account for the apparently inaccurate 29 April report that the bucket was intact.³⁷

Ninety minutes of careful maneuvering, and six attempts later, the hook was in position to retrieve the film stacks. The submersible rose off the bottom, held motionless for ten minutes to allow silt and mud to drain (Figure 13), and once everything appeared secure, started a careful ascent, but the action proved too much for the fragile item. Ten minutes later, pieces of film began breaking off in lengths varying from one inch to two or three feet (Figure 14). Almost halfway to the surface, the film started breaking into two to three foot segments. By the time the *Trieste II* (DSV-1) neared the surface around 2:30 AM on 26 April, more than nine hours after starting its dive, pieces were hanging through the lines of the hook. To minimize surface swell, the hook was lowered to about 35 feet while a five-person dive team from the *White Sands*, 3,000 to 4,000 yards away, raced to the scene in small boats. The film stacks nevertheless continued breaking apart and disintegrated into a cloud of reddish brown dust about ten minutes before the divers arrived. All that remained were unusable shreds of film three to six feet in length hanging from the hook. Nothing suggesting a satellite remained for others to find.³⁸

At 3:33 PM on 26 April, the *Apache*, with the *White Sands* in tow, changed course to 120 degrees true and departed “from the MPL research site” for the last time.³⁹ An Eastman Kodak analysis of seven strands of recovered film later concluded the film “separated into pieces due to externally and rapidly applied forces,” probably at the initial impact point, not prolonged exposure to seawater, depressurization, or the ocean floor’s high pressure and low temperature. The impact had been severe enough to transfer paint in two places as the film roll hit, or was hit by, nearby parts of the assembly. The number 300 (Figure 15) was partially legible on one occasion.

Epilogue

After the parachute failures on the first Hexagon mission, McDonnell-Douglas and the Aerospace Corporation designed a stronger



Figures 11 and 12. Film stacks on the ocean floor, 25-26 April 1972.

Credit: CIA

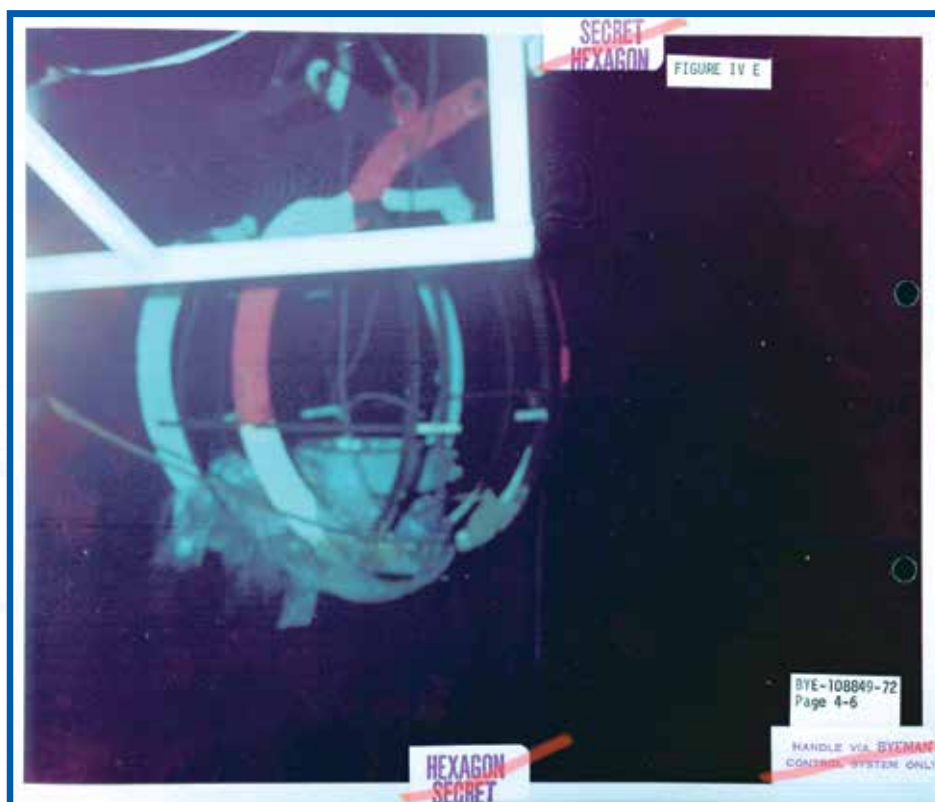


Figure 13: Film stacks inside the recovery hay hook shortly after leaving the bottom, 25-26 April 1972. Credit: CIA

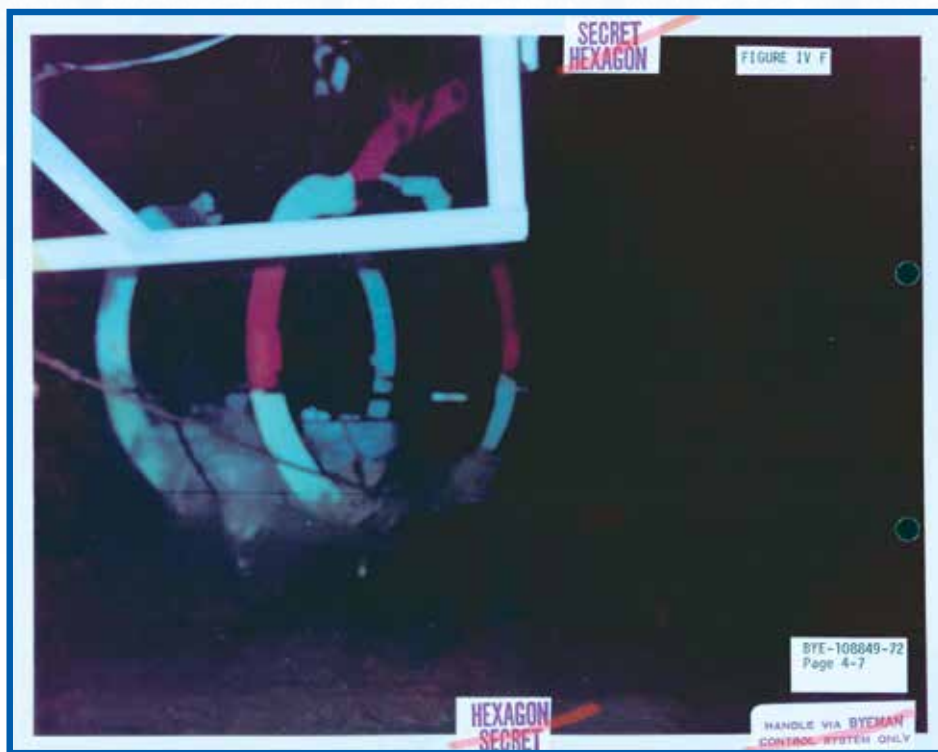


Figure 14: Photo showing the film stacks disintegrating in transit to the surface, 25-26 April 1972. Credit: CIA

“extended skirt” chute (Figure 16), manufactured by Para Dynamics in El Monte, California. The Irving Air Chute Company designed a new drogue chute. Tests proved the new chutes were vastly superior to the original devices designed by the Goodyear Aerospace Company. Analysis of the recovered chutes from the first two and fourth HEXAGON buckets found the main shroud lines overstressed by a factor of two, which resulted from a failed design and a testing oversight that did not account for the high-shock of initial chute deployment. Calling the old chutes “at best marginal,” NRO Historian Robert Perry concluded in his recently declassified 1973 HEXAGON history that it seemed almost miraculous crews retrieved three of the four buckets: “by all odds,” Perry wrote, “the ratio should have been reversed.” As an added measure, technicians “baked” the new chutes at 370 degrees for eight hours to set their shape before installation into the bucket. To ensure quality, Aerospace and McDonnell-Douglas representatives inspected and packed each chute using a new vacuum technique, which extracted air to reduce volume. The parachute deployment altitude was also lowered to 40,000 feet so thicker air could further slow the descending object. The added time to correct the design defects delayed the second HEXAGON launch until 20 January 1972, but the new chutes worked perfectly on all four buckets.⁴⁰

A 24 May 1972 CIA memo for the record summarizing the salvage operation identified several lessons learned. It maintained that an integrated search and salvage effort could have avoided the search team’s confusing data, which sent the *Trieste II* (DSV-1) looking in the wrong location during the first dive. It recommended creating a method of readying the *Trieste II* (DSV-1) independent of weather conditions, because the Navy needed two or



Figure 15: Photo taken during Eastman Kodak's post-salvage analysis of recovered film shreds showing the number 300 imprinted on the film. Paint transfer due to the extreme impact shock caused the imprint. Credit: CIA

three days of calm seas to prepare the submersible once launched, and criticized the craft's "relatively poor" reliability noting, "Major system failures occurred on each of the three dives." The memo stated the IOU's lack of mobility limited the number of dives, because the ships, moving at about three knots, needed at least three days to transit from Pearl Harbor to the search zone, missing dive opportunities and requiring extended periods at sea waiting for improved weather. It ended saying the success of the second HEXAGON mission considerably reduced the intelligence value of recovering the film from the ocean bottom; the motivating factor became showing the ability to perform a deep-sea recovery.

The magazine *Undersea Technology* published a three-paragraph article on the salvage operation in July 1972. Although it did not mention any classified aspects—only that the *Trieste II* (DSV-1) recovered a "small electronic package" during the "deepest operation of its kind ever successfully accomplished in the world" and named the key personnel and ships involved—it did cause a discussion between NRO Deputy Director Naka and the Navy on its source. The Navy told Naka it did not authorize the release.⁴¹

On 4 November, six months after

the operation to recover the HEXAGON bucket ended in a cloud of dust, the CIA launched the 170-crewed *Glomar Explorer*, built by eccentric billionaire Howard Hughes, to conduct a larger, more ambitious, undersea salvage operation. Publicly, it would extract minerals from the ocean floor, but its true mission was to retrieve a Soviet Golf-II submarine, which sank in March 1968, 1,560 miles northwest of Hawaii, in 16,500 feet of water. The outcome of both operations turned out oddly similar with part of the Soviet submarine falling back to the ocean floor during its attempted salvage on 8 August 1974.⁴²

The HEXAGON capsule recovery ranks in the top of bold operations undertaken in intelligence and undersea exploration history. Although the film stacks "slipped from our fingers at the last moment," it was the world's deepest successful salvage up until that point, accomplished against staggering environmental and technical odds.⁴³ A strikingly brief reference in the *White Sands* ship's history file at the U.S. Naval Historical Center says, "The period from 2 August through the end of the year was occupied by a major effort in preparing and conducting the deepest salvage-recovery operation yet attempted by man."⁴⁴ Chief of Naval Operations Admiral Elmo R. Zumwalt Jr. presented the Integral Operating

Unit with a Meritorious Unit Commendation for "this singularly significant achievement," which "provided the United States Navy with the capability to conduct deep-ocean search, location, and object recovery operations in 80 percent of the sea areas on Earth." DNRO McLucas also praised the crews of the ships involved in a 15 May memo to Secretary Frosch, writing they "established and demonstrated a unique capability vital to the security of the United States."⁴⁵ Locating such a small object at such a depth, and in such a remote location, under difficult sea and weather conditions over an eight-month period was a remarkable feat utilizing innovative salvage techniques, navigation equipment, and concepts in ocean survey and navigation. It deserves a unique place in history.

About the Author

David Waltrop is a program manager in the CIA Historical Collections Division. He served previously as the National Reconnaissance Office (NRO) deputy chief historian and co-editor of NRO's quarterly corporate publication. All statements of fact, opinion, or analysis expressed in this article are those of the author and do not necessarily reflect the official positions or views of the CIA, NRO, or any other U.S. government agency. Nothing in this article should be construed as asserting or implying U.S. government authentication of information or Agency endorsement of the author's views. The CIA and NRO have reviewed this material to prevent the disclosure of classified information. Citations to CIA records were omitted.

For More Information

For information on this operation, including declassified photos and documents, and a copy of this article for download, see the CIA public website:

<https://www.cia.gov/library/publications/historical-collection-publications/index.html>

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Notes

1. NRO Review and Redaction Guide for Automatic Declassification of 25-year old information, version 1.0, 2008 edition, p. 178-179. Available at www.nro.gov, declassified records, frequently requested records.
2. Frederic Oder, James Fitzpatrick, Paul Worthman, *The Corona Story*, 1987, p. 96-98. Available at www.nro.gov, Declassified Records, Frequently Requested Records.
3. Robert Perry, *A History of Satellite Reconnaissance: Volume 3A Gambit*, 1974, p. 297-298. Available at www.nro.gov, Declassified Records, Gambit and Hexagon Special Collection, Gambit and Hexagon Histories, Document 4.
4. Frederic Oder, Paul Worthman, *The Hexagon Story*, 1988, p. 97. (henceforth, *Hexagon Story*). Available at www.nro.gov, Declassified Records, Gambit and Hexagon Special Collection, Gambit and Hexagon Histories, Document 7.
5. Memo, L. Molaskey to Distribution, SUBJ Recovery of RV - #3, 27 July 1971, National Reconnaissance Office Archive and Records Center (henceforth NRO ARC), Job 199900043, Box 4, File 24; Memo for the Record, SUBJ Status of Recovery Effort as of 14 September 1971, 14 September 1971, NRO ARC, Job 199800074, Box 5, File 157.
6. *Hexagon Story*, p. 97.
7. Robert Perry, *A History of Satellite Reconnaissance: Volume 3B Hexagon*, 1973, p. 104-105 (henceforth Perry, *Hexagon History*). Available at www.nro.gov, Declassified Records, Gambit and Hexagon Special Collection, Gambit and Hexagon Histories, Document 5; *Hexagon Story*, p. 97, 101.
8. For accounts of the 27 July CIA meeting in this and the following three paragraphs see: Memo, L. Molaskey to Distribution, SUBJ Recovery of RV - #3, 27 July 1971, NRO ARC, Job 199900043, Box 4, File 24; D. Patterson, Memo for the Record, SUBJ RV-3 Recovery Planning Meeting, 28 July 1971, NRO ARC, Job 199800074, Box 5, File 156; Memo to DNRO McLucas, SUBJ Possible Recovery of Hexagon Mission 1201 RV-3, 3 August 1971, NRO ARC, Job 199800074, Box 5, File 156.
9. Documents indicate the Navy had certified the *Trieste II* (DSV-1) to 13,000 feet at the time of the 27 July CIA meeting, but operation participants say the Navy had certified the submersible to 20,000 feet, with a maximum achieved depth of 13,000 feet.
10. Operation participants do not recall this existing deployment to the Hawaiian Islands, in comparison to the documents, but cannot rule out such a mission.
11. Memo, DNRO McLucas to Assistant Secretary of the Navy for Research and Development, SUBJ Deep Sea Recovery of Hexagon Reentry Vehicle, 10 August 1971, NRO ARC, Job 199800074, Box 5, File 156.
12. Memo, Secretary Frosch to DNRO McLucas, SUBJ Deep Sea Recovery of Hexagon Reentry Vehicle, 18 August 1971, NRO ARC, Job 199800074, Box 5, File 156.
13. Memo for the Record, SUBJ Status of Recovery Effort as of 14 September 1971, 14 September 1971, NRO ARC, Job 199800074, Box 5, File 157.
14. Richard Chester, *A History of the Hexagon Program*, p. 159-167. Available at www.nro.gov. Declassified Records, Gambit and Hexagon Special Collection, Gambit and Hexagon Histories, Document 1.
15. Memo, L. Molaskey to Distribution, SUBJ Trip Report - Recovery of RV #3, 20 August 1971, NRO ARC, Job 199900043, Box 4, File 24.
16. Memo, L. Molaskey to Distribution, SUBJ Recovery of RV #3 - Meeting at NWC 7-30-71, 2 August 1971, NRO ARC, Job 199900043, Box 4, File 24; Memo, L. Molaskey to Distribution, SUBJ Telecon to <DELETED>, 4 August 1971, NRO ARC, Job 199900043, Box 4, File 24; Perkin-Elmer Contract Authorization, 3 September 1971, NRO ARC, Job 199900043, Box 4, File 24.
17. Memo, L. Molaskey to Distribution, SUBJ Trip Report - Visit to San Diego RE Recovery of RV #3, 1 September 1971, NRO ARC, Job 199900043, Box 4, File 24.
18. Memo for the Record, SUBJ Status of Recovery Effort as of 14 September 1971, 14 September 1971, NRO ARC, Job 199800074, Box 5, File 15.
19. Memo, T. Urban to L. Molaskey, SUBJ Trip to Container Research Corp. Glen Riddle, PA on 9/14/71, 15 September 1971, NRO ARC, Job 199900043, Box 4 File 24; Memo, L. Molaskey to Distribution, SUBJ Trip Report - Recovery Hook Test Program - San Diego, California 20-21 September 1971, 24 September 1971, NRO ARC, Job 199900043, Box 4 File 24.
20. Memo, L. Molaskey to Distribution, SUBJ Trip Report - Recovery of #3 - San Diego, California - 23 and 24 September, 29 September 1971, NRO ARC, Job 199900043, Box 4, File 24.
21. Memo, L. Molaskey to Distribution, SUBJ Trip Report - Recovery Hook Test Program - San Diego, California 20-21 September 1971, 24 September 1971, NRO ARC, Job 199900043, Box 4, File 24; Memo, L. Molaskey to Distribution, SUBJ Trip Report - Recovery of #3 - San Diego, California - Activities of 9-22-91, 30 September 1971, NRO ARC, Job 199900043, Box 4, File 24.
22. Memo, L. Molaskey to Distribution, SUBJ Trip Report - Recovery of #3 - Activities of 27 September through 3 October 1971, 4 October 1971, NRO ARC, Job 199900043, Box 4, File 24.
23. Ibid.
24. Ibid. Molaskey's trip report describes a fresh water problem on the White Sands, but recovery participants do not recall this causality.
25. Memo, L. Molaskey to Distribution, SUBJ Status of RV-3 Recovery (Telecon to Cdr. Mooney, Sub Dev. Group I), 8 October 1971, NRO ARC, Job 199900043, Box 4, File 24; Memo, L. Molaskey to Distribution, SUBJ Telecon with Lt. Cdr. Doyle, 12 October 1971, NRO ARC, Job 199900043, Box 4, File 24; Memo, L. Molaskey to Distribution, SUBJ Status of RV-3 Recovery, 13 October 1971, NRO ARC, Job 199900043, Box 4, File 24.
26. Ibid.

27. Ibid.

28. Memo, L. Molaskey to Distribution, SUBJ Trip Report – Recovery of RV#3, 18 November 1971, NRO ARC, Job 199900043, Box 4, File 24.

29. Memo, L. Molaskey to Distribution, SUBJ Trip Report – Recovery of RV#3, 22 November 1971, NRO ARC, Job 199900043, Box 4, File 24; USS *Apache* (ATF-67) Deck Log for November 1971, National Archives and Records Administration, RG 24, Box 89.

30. Memo, L. Molaskey to Distribution, SUBJ Trip Report-Recovery of RV #3, 22 November 1971, NRO ARC, Job 199900043, Box 4, File 24; Memo, L. Molaskey to Distribution, SUBJ Trip Report-Recovery of RV #3, 10 December 1971, NRO ARC, Job 199900043, Box 4, File 24.

31. Memo, L. Molaskey to Distribution, SUBJ Trip Report – Recovery of RV #3, 10 December 1971, NRO ARC, Job 199900043, Box 4, File 24.

32. Ibid. Molaskey's trip report says the crew attempted to use the submersible's mechanical arm to plant a new DOT next to the target, but the arm would not operate correctly, possibly owing to the list and battery problems. Operation participants, however, adamantly contend the arm never worked below 10,000 feet. The pilots would never have attempted to use the arm during the actual bucket recovery.

33. USS *Apache* (ATF-67) Deck Log for December 1971, National Archives and Records Administration, RG 24, Box 89.

34. Memo, L. Molaskey to Distribution, SUBJ Trip Report – Recovery of RV #3, 10 December 1971, NRO ARC, Job 199900043, Box 4, File 24.

35. Memo, SUBJ Recovery of RV-3, 10 August 1971, NRO ARC, Job 199700059, Box 3, File 89; Message 1048, 10 August 1971, NRO ARC, Job 199700059, Box 3, File 89; Message 2437, 12 August 1971, NRO ARC, Job 199700059, Box 3, File 89; Memo, SUBJ Recovery of Hexagon R/V, 16 August 1971, NRO ARC, Job 199700059, Box 3, File 89.

36. Message 0123, 7 January 1972, NRO ARC, Job 199700059, Box 3, File 89.

37. Message 2294, 29 April 1972, NRO ARC, Job 199800069, Box 3, File 1.



Figure 16: KH-9 HEXAGON Mark 8 “extended skirt” parachute with bucket below.

Credit: NRO

38. Ibid.

39. USS *Apache* (ATF-67) Deck Log for April 1972, National Archives and Records Administration, RG 24, Box 89.

40. Perry, *Hexagon History*, p. 105-106; *Hexagon Story*, p. 101-103.

41. “Trieste Recovers Electronics Package from 16,400-ft. Depth,” *Undersea Technology* (July 1972), p. 25; Memo for the Record, SUBJ (A) Message 4390 Dated 14 August 1971 and (B) Hexagon, 23 August 1972, NRO ARC, Job 199700059, Box 3, File 94; Message 4390, 14 August 1972, NRO ARC, Job 199700059, Box 3, File 94.

42. “Project Azorian: The Story of the Hughes Glomar Explorer,” *Studies in Intelligence*, 1985. Released by CIA on 12 February 2010.

43. Memo, J. Draim to DNRO McLucas,

SUBJ Deep Sea Recovery of Hexagon, 9 May 1972, NRO ARC, Job 199800074, Box 5, File 152.

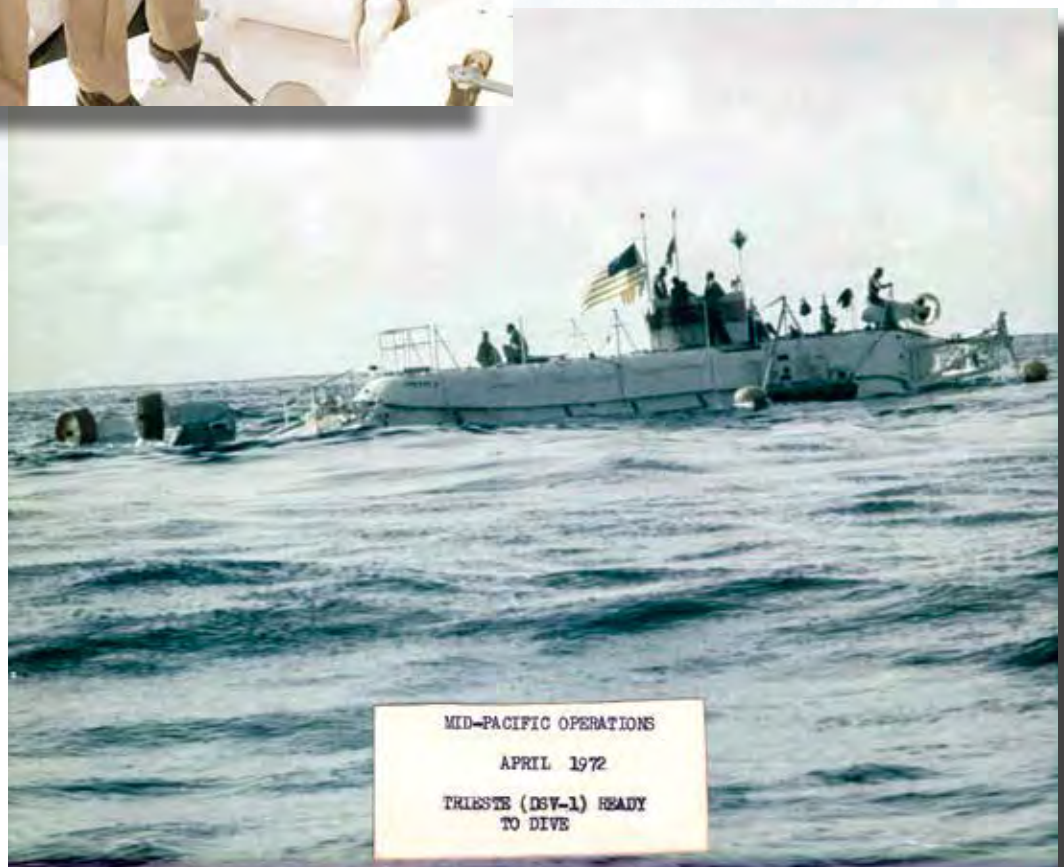
44. Memo, C. Hudiburgh to Commander Submarine Group One, SUBJ White Sands (ARD20) Command History 1971, 3 May 1972, U.S. Navy Yard Washington, DC, Navy Archives Ships File, Box 859A.

45. Memo, DNRO McLucas to Assistant Secretary of the Navy, Research and Development, SUBJ Deep Sea Recovery of Hexagon Reentry Vehicle, 15 May 1972, NRO ARC, Job 199800074, Box 5, File 152.



Left: *Trieste II* (DSV-1) pilots Lt. Cmdr. Bartels (left), Lt. Taylor (center), and Lt. Cmdr. Stryker (right).
(Credit: Richard Taylor, Jack Myers)

Right: Photo possibly showing *Trieste II* (DSV-1) before last dive on the HEXAGON bucket. "Mid-Pacific Operations" was the recovery's unclassified name.
(Credit: Naval Undersea Museum, Keyport, WA)



Selected Declassified CIA Documents

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Copy 13 of 15
28 July 1971

MEMORANDUM FOR THE RECORD

SUBJECT: RV-3 Recovery Planning Meeting

1. A meeting was held to plan the possible recovery of the third HEXAGON RV from Mission 1201. Attachment I is a list of attendees. Attachment II is the agenda.

2. The Navy proposed the use of the deep submergence vehicle Trieste. At the present it is certified to a depth of 13,000 feet. A test dive is planned to 20,000 feet in August. No trouble is anticipated in demonstrating this capability. The location of the RV would first be determined prior to deploying the Trieste. The impact point must be determined as accurately as possible (action - SP-7). Based on the impact point, it is necessary to predict the sink rate and the effect of the currents on the descending RV. P.E. and McDonnell Douglas need to estimate the shape of the RV, the effective density to determine the location on the ocean floor and the terminal velocity to assess the penetration (action - P.E. and McDonnell). A good current profile of the area is available and will be supplied (action - NAVOP 03U2).

3. The Trieste will use a cable with a hook to retrieve the RV and/or take-up. P.E. and MWC are to define the potential attach points, the weight in water, and the weight in air (action - NRO and NAVOP).

4. The RV will be located by a search team contracted for by NAVOP 03U2 with funds supplied by the NRO. The estimate for ten days of search time plus four days of travel time is \$100K. The NRO is looking into the best method of transferring the funds (action - NRO).

5. During the recovery operation, voice contact will be available with the Trieste. They will be photographing the RV using 1600 watt lights. They will hook the RV with the boom hook. Some advice

GROUP 1
Excluded from automatic
downgrading and
declassification

~~HX SECRET~~
SPECIAL HANDLING

HANDLE VIA BYEMAN
CONTROL SYSTEM ONLY

Hx SECRET
SPECIAL HANDLING


SUBJECT: RV-3 Recovery Planning Meeting

may be necessary from HEXAGON personnel. Ninety percent of the ship's crew are contract civilian personnel, so this should not be a security problem. Probably the three men in the Trieste, four divers, the film processor, and the leader of the search team will need to be cleared (action - OSP).

6. At a depth of less than 120 feet, the RV/TU will be covered with a canvas bag by the divers and transferred to the surface ship. The RV/TU will be placed in a light tight can, partially filled with water. If it is possible, an existing can will be used (action - SP-7 and OSP). Eastman Kodak, P.E., and McDonnell Douglas will determine the probable amount of damage from an analysis of the impact, update their analysis as a result of photographs, and obtain the equipment necessary to despool. The despooling will be by hand and will be a slow process. OSP will function as the contact point for the Navy and will coordinate the effort (action - OSP).

7. The search team will start modifications on 16 August and start the search on 24 August. The Trieste will recover the vehicle sometime in September. The despooling operation should plan on starting about 27 September.

8. The consensus was that there was a good chance of recovering the RV and that the film would be usable with some small degradation.


DONALD W. PATTERSON

HEXAGON Sensor Subsystem Program Director

Attachments a/s stated

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Page Two

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(S) NATIONAL RECONNAISSANCE OFFICE

WASHINGTON, D.C.

THIS DOCUMENT CONTAINS INFORMATION RELATING TO THE NATIONAL DEFENSE

OFFICE OF THE DIRECTOR

August 10, 1971

MEMORANDUM FOR THE ASSISTANT SECRETARY OF THE NAVY FOR
RESEARCH AND DEVELOPMENT

SUBJECT: Deep Sea Recovery of HEXAGON Reentry Vehicle

On July 10, 1971, the third reentry vehicle from the first HEXAGON photo-satellite mission was lost in the vicinity of Hawaii due to parachute failure during descent. Based on informal discussions between elements of the NRO and the Navy staff, it is our understanding that the Trieste II will be deployed in the general vicinity of the impact area over the next few months and could probably be made available to effect recovery of the reentry vehicle if its exact location on the ocean floor can be determined.

We also understand that the services of Dr. Speis of the Scripps Institute of Oceanography could be made available to locate the RV on the bottom if NRO funding support is provided in the approximate amount of \$100K.

I would appreciate your assistance in arranging the necessary Navy and Scripps support to accomplish this salvage effort. If break-up of the RV did not occur on impact, there is a good chance that much of the imagery on the film will survive the salt water immersion. Recovery of the film would be most desirable since the imagery recorded was from a particularly productive portion of the mission. Additional information as to the nature of the parachute failure might also be obtained.

Our initial contact with the Navy has been through CDR E. E. Henifin (OPNAV 232). If you agree, we will proceed with further discussions with this point of contact as regards the detailed planning for the search and salvage operation.

John L. McLucas
John L. McLucas

Copies to:
CDR Henifin, OPNAV 232
Mr. Patterson, CIA/OSP ✓

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MEMORANDUM FOR DIRECTOR NATIONAL RECONNAISSANCE OFFICE

SUBJECT: Deep Sea Recovery of HEXAGON Reentry Vehicle

REFERENCE: Your Memo of 10 August 1971

1. The referenced Memo describes the loss of one of the HEXAGON reentry vehicles near Hawaii on 10 July 1971 and advises that CDR E.E. Henifin, USN (Op-232) has been primary point of contact for preliminary discussions on recovery.

2. Navy is pleased to assist in this recovery effort.

3. Present planning for this recovery operation includes:

a. Employment of USNS DESTIEGUER, a survey ship capable of towing a search "fish" to more than 20,000 feet;

b. The services of Dr. Fred Speiss and a team of experts from the Marine Physical Laboratory Scripps Institution of Oceanography to provide the search fish and direct the search operation;

c. The use of TRIESTE II, with support ships and divers, capable of lifting the lost reentry vehicle and securing it for safe transfer to port;

d. Search operations by DESTIEGUER are now scheduled to commence about 1 October 1971 for some ten days;

e. Recovery operations by TRIESTE could commence after 5 October 1971.

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4. The success of the operation depends upon location of the reentry vehicle, by no means a certainty. Bottom conditions are believed reasonably favorable, but the small size of the package and the accuracy of the reported sinking position make location a difficult task. Recovery can be effected if location is achieved.

5. Funding as stated in your Memorandum is probably adequate and presents no problem at this time.

6. Discussions are continuing between Mr. Patterson and Op-23 on details of the operation.

7. I shall keep you advised as planning progresses and hope that the operation can be terminated successfully.

Robert A. Frosch

Copy to:
Mr. Patterson, CIA/OSP

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14 September 1971

MEMORANDUM FOR THE RECORD

SUBJECT: Status of Recovery Effort as of 14 September 1971

1. The recovery is proceeding on a schedule to begin the search operation on 3 October and the salvage on 16 October. This memo is to document several of the concerns that have arisen while planning and setting up the operation.

2. The first question was the amount of damage sustained by the recovery vehicle upon water impact. The impact shock was estimated at 2600 g's. A review of the problem by several structural engineers indicated that the vehicle was in one piece; however, the cannister was hydroformed around the payload and ruptured in several places. Many of the main structural elements were beryllium and were probably broken. As a result, there were no structural hard points that were available for lifting so that an enveloping type of pick-up device was needed. Figure I shows the recovery aid. Simplicity of design was a key parameter to assure functioning under adverse conditions.

3. The second problem was locating the impact point to a high degree of accuracy. Several different groups made assessments of the location with widely divergent results at first. Figure II shows the various impact points. Point A is the originally predicted impact point by the Satellite Tracking Center (STC). Point B is the final STC recommended impact point. They had originally recommended point H at 164° west longitude, but on questioning found an error in their calculations. Point B is also the reported location of the drogue chute by the aircraft using Loran C (accuracy of 2-3 miles). Point G is the main chute deployment point (50,000 feet) reported by the aircraft. At that time, however, they were having problems with spurious responses so that point G is discounted. Point C is calculated from Point B using the wind direction aloft. Point D is calculated as a ballistic trajectory from point C. Point E is the impact point calculated by the recovery vehicle contractor using spacecraft ephemeris both before and after RV separation. Point F is our independent Government trajectory calculation. The conclusion is that the search area is as shown, an area 1.5 miles wide by 8 miles long.

4. The third question was the status of the payload. There are materials such as beryllium which are subject to corrosive effects from sea water. Also, the payload was possibly affected by alternate cycles

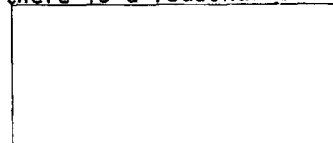
SUBJECT: Status of Recovery Effort as of 14 September 1971

of wetting and drying. It was decided to maintain the recovered vehicle in sea water until it could be returned to laboratory-controlled conditions. This entailed use of a special shipping container.

5. Throughout the planning of this operation, the support from the Navy has been excellent. Much is new and to be learned on both sides. I have been working on a day-by-day basis with the Deep Submergence System Division (DSSD) in the Pentagon. A meeting was held with the Submarine Development Group I in San Diego to plan the salvage operation. It was agreed that it was highly desirable to have a practice operation. We are furnishing a test recovery vehicle to the Development Group on 16 September. A practice mission will be run in 6800 feet off San Diego. If this is successful, the Trieste will proceed to the recovery site. A meeting was held with the Naval Undersea R&D Center (NUC) to review the design of the recovery aid and to evaluate other possible available devices. The other devices were fairly complex with hydraulic or motor actuators. It was concluded that for the application that we had in mind, the proposed design was better. An alternate design, similar to a fishing net with a scoop was also felt to be promising. NUC reviewed the detailed drawings and later (with some pressure from the Navy) agreed to build the recovery aid and meet the sailing deadline of 16 September for the Trieste.

6. A brief discussion was held with Dr. Fred Spiess, who is heading the search operation with the Desteiguer. A practice search operation was proposed, and he felt that it was probably worthwhile if it could be worked into the schedule at Honolulu, but not mandatory. The parameter that would be evaluated would be the strength of return from the RV. The main unknown is the characteristic of the sea bottom at the recovery site. The bottom contour maps show a flat bottom, but these are based on scattered soundings. The search equipment can locate the navigation aids that are dropped. These are aluminum cylinders one foot in diameter and three feet long, somewhat smaller than an RV. The search is the most difficult task of the operation, in my opinion. If the recovery vehicle can be located, I feel that it can be recovered and the payload will be useful. In view of the uncertainties associated with the search, such as spurious responses from rocks, a RV potentially buried up to 40% and probably covered with a thin layer of silt, the criticality of the search and the time and effort being expended, I strongly recommend that a knowledgeable individual accompany the search ship.

7. To conclude, the operation is proceeding smoothly and everyone connected with it is enthusiastic and feels that there is a reasonable chance of success.



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REPORT ON THE ANALYSES OF RECOVERED 1201-3 FILM SAMPLES

(KODAK High Definition Aerial Film 1414 (ESTAR Ultra-Thin Base)

H FILE
NO. 412

1201-3

SUMMARY:

Seven pieces of 6.6 inch wide KODAK High Definition Aerial Film 1414 (ESTAR Ultra-Thin Base) were received for evaluation. Examination of salvaged material indicates the film separated into pieces due to externally and rapidly applied forces. After extended soaking, the emulsion adhesion characteristic was reduced.

DISCUSSION:

Seven wet pieces of Type 1414 film were received for processing and analysis after having been immersed in sea water approximately nine months at a temperature of about 1.5°C and 7,100 psi. The film was assessed to be unprocessable due to extensive loss of emulsion, distortion of the fragments, and the need to dry the pieces before splicing. The pieces were only air dried to facilitate analyses.

a. Handling

Attempts were made to reassemble the pieces as a continuous length of 6.6 wide film. Only two pieces had one common irregular shaped matching edge. See Figure No.1 (Parts 1 and 2). This match-up was made after the pieces were dried

b. Lengths

Four lengths are about 58 inches long. This is approximately one-half the circumference of a roll with an overall diameter of about 34 inches. The one piece (Part 7) is 93 inches long and is probably one outer convolute.

c. Applied Forces

1. Shock forces were severe enough for the film assemblies to hit or be hit by nearby mechanical assemblies. The force was sufficient to cause paint transfer in two places. Referring to Part #5 of the sketch red paint pigment was imbedded into the pelloid film base. On Part #7 the number "300" is partially legible. (See 20X enlargement). The material imbedded is brown-yellow paint pigment on the base side of the film. The pigment location of "300" and a length of 93 inches indicates this strip was probably an outer convolute.

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2. High Pressure, low temperature effects on molecular structure of film base are considered nil for the conditions described. Depressurization tests from 7,000 psi to atmospheric pressure at 3°C after four weeks sustained conditions were made. Dropping from 6,500 - 7,000 psi to ambient pressures in less than two seconds produced no discernable changes in three different tests.

3. A "shattering" force may be defined for this purpose as that force necessary to cause separation of the material in such a period of time that elongation (stretch) does not occur but shearing does. Polymer consultants indicate maximum elapsed time for fracturing must be on the order of milli-seconds. Tests were made to determine if edges could be created by rapidly applied forces which were similar to edge profiles of the recovered film.

Microphotographs were made of cross-sectioned film edges. Different types of edges were generated using repeatable methods. These were then compared to three cross-sections of film edges generated at different points in the film rolls.

Figure 3 depicts four typical edges. The first edge is produced by very rapid snapping of the film (a "fracture"). The "wedge" profile is typical of this type film break and is caused by tensile shearing. The second edge profile illustrates the fracture and separation occurring on the recovered film. Three physical samples all showed this characteristic cross-section. Third edge was produced by nicking a salvaged film sample with scissors and applying tearing forces by hand. This edge shows relaxation of the film base and recovery shrinkage resulting in a slightly thicker but short edge profile. The fourth picture is the edge profile typical of film slitting.

Figure 4 shows opposite edge profiles of a film sample removed at the interface of Parts 1 and 2. The edges were within 1/32 inch of being matched across the full width of the film. Thus an exact fit of the two profiles was not attained due to this displacement but the film profiles are typical of tensile shear failure. The lower photograph is a 40X of the "matched" edges.

By comparing the edge profiles, the "recovered film" most closely matches that caused by sudden tensile shear failure.

CONCLUSIONS:

1. The film stacks structurally failed in tensile shear.
2. Depressurization was not the cause of film fracturing.
3. Transfer of yellow-brown and red paint pigments were caused by film stacks being free to move or impacted by moving objects.
4. The chemical molecular structure of the film support was unchanged due to prolonged exposure to high pressure and low temperature.

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IT IS RECOMMENDED THAT THIS BE FORWARDED TO THE ASSISTANT SECRETARY OF THE NAVY FOR RESEARCH AND DEVELOPMENT IN VIEW OF THE FINE SUPPORT FROM THE NAVY FOR THE DEEP SEA RECOVERY OF THE HEXAGON RECOVERY VEHICLE.

QUOTE: I WOULD LIKE TO THANK THE MEN OF THE TRIESTE, THE WHITE SANDS, THE APACHE AND THE DE STIEGER WHO, THROUGH THEIR PERSEVERANCE AND DEDICATION TO DUTY, ESTABLISHED A UNIQUE CAPABILITY THAT ENHANCES THE SECURITY OF THE UNITED STATES. THIS WAS THE FIRST TIME THAT AN OBJECT OF THIS SMALL SIZE HAD BEEN LOCATED AND THE FIRST TIME ANY OBJECT HAD BEEN RECOVERED FROM THIS DEPTH. YOUR RESPONSE TO A REQUEST THAT REQUIRED AN EXTENSION OF THE KNOWN CAPABILITIES WAS OUTSTANDING. THANK YOU. UNQUOTE.

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END OF MESSAGE

[Redacted Signature]

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HAROLD L. BROWNMAN
D/OSP

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(Credit: Naval Undersea Museum, Keyport, WA)



FIGURE 1-2. TRIESTE II (DSV-1) EQUIPMENT CONFIGURATION



Crane lifting *Trieste II* (DSV-1).
(Credit: CIA)



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