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U.S. COAST GUARD ACTIVITIES—
SOUTHEAST ASIA

REPORT ON A CONGRESSIONAL INVESTIGATION OF
COAST GUARD OPERATIONS AND INSTALLATIONS
IN THAILAND AND SOUTH VIETNAM



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U.S. COAST GUARD ACTIVITIES—SOUTHEAST ASIA

INTRODUCTION

In July 1965, a U.S. Coast Guard unit designated as squadron 1 arrived in the waters of South Vietnam to form the key link in a unique coastal surveillance force. The arrival of that unit marked the inception of "Operation Market Time," a joint Navy-Coast Guard mission designed to prevent North Vietnam from infiltrating men and materials of war to the Vietcong. Since 1965, Coast Guard duties in that area of the world have gradually expanded in scope and importance.

A detailed account of those duties—with the exception of classified material—is included in this publication, which contains a report on a congressional inspection and evaluation tour of Coast Guard facilities and activities in Southeast Asia. The tour was made during August 1968. Representative Edward A. Garmatz, chairman of the House Committee on Merchant Marine and Fisheries, delegated a three-man team to make the trip and submit this report. The delegation was headed by Representative Frank M. Clark, Democrat of Pennsylvania, who is a member of the Garmatz committee and chairman of the Subcommittee on Coast Guard, Coast and Geodetic Survey, and Navigation. Representative Clark was accompanied on the trip by Albert J. Dennis, staff investigator of the House Committee on Merchant Marine and Fisheries; and Capt. John H. Bruce, congressional liaison officer for the U.S. Coast Guard.

OUTLINE OF COAST GUARD ACTIVITIES INSPECTED

Coast Guard duties in Southeast Asia are broad-ranging from a standpoint of both geography and activities. Since this report is based on visits to Thailand and Vietnam, however, discussion will be limited to activities in those immediate areas.

In Thailand, the principal area of Coast Guard concern is related to the operation and maintenance of a network of Loran stations established by the Coast Guard for the United States and allied forces in Southeast Asia. Loran is an acronym for long-range aid to navigation, and the Loran network provides a permanent electronic navigational aid which is extremely valuable—during both peace and war. The Loran network will be discussed in more detail in the section of this report dealing with Thailand.

In South Vietnam, Coast Guard activities can be classified under four general areas. These are:

1. Operation Market Time.
2. Port security and waterways—which includes explosives loading details.
3. Merchant marine detail.
4. Aids to navigation (other than Loran).

COAST GUARD ACTIVITIES—VIETNAM

Operation Market Time

Perhaps no other single Coast Guard function in Southeast Asia is making as significant a contribution to the U.S. military effort in South Vietnam as Operation Market Time. Certainly, none is more dramatic or illustrative of the special military skills of the U.S. Coast Guard. As mentioned in the introduction to this report, Operation Market Time was designed to help block the movement by water of men and materials from North Vietnam to Communist units in the south. Directed by the commander of U.S. Naval Forces, Vietnam, the operation consists of a unique Coastal Surveillance Force, comprised of units of the U.S. Coast Guard, the U.S. Navy, and certain naval craft of the Republic of Vietnam.

Two Coast Guard units are participating in Operation Market Time: squadron 1, consisting of twenty-six 82-foot patrol boats; and squadron 3, consisting of five high-endurance cutters.

The need for Coast Guard participation and the concept of Operation Market Time was born out of an incident which occurred in February 1965. On that date, a 130-foot camouflaged junk sighted in Vung Ro Bay was sunk in shallow water by U.S. aircraft. Subsequent investigation revealed the junk was carrying enough supplies to outfit an entire Vietcong battalion, and that her armament was sufficient to knock out any normal-size patrol vessel. An arms cache found on the beach nearby yielded 1,500 weapons and 30 tons of ammunition, explosives, and medical supplies. Most of the equipment had originated in Communist China and papers found on the vessel documented the fact that it was of North Vietnamese registry and that it was employed in infiltration.

Many similar incidents had underlined the need to block further infiltration, but South Vietnam's highly indented coastline made surveillance extremely difficult. To cope with the problem, the Navy requested the help of the Coast Guard, knowing that this service's fast, highly maneuverable 82-foot patrol boats were especially adaptable for this duty.

As mentioned earlier, squadron 1—which consists of 26 of these patrol boats (WPB's)—arrived in South Vietnam in July 1965, to be used for close-in shore patrol work along the coast. Squadron 1 consists of divisions 11, 12, and 13. The nine WPB's of division 11 operate out of An Thoi on the island of Phu Quoc in the south to seal off the Vietnam-Cambodian border and to patrol the Vietnam coast on the Gulf of Thailand. Division 12's eight vessels, based at Danang, patrol the northern sector of the Republic of Vietnam just south of the 17th parallel, which divides South Vietnam from the Communist north. Finally, the nine WPB's of division 13 operate along the central coast of South Vietnam, and are based at Vung Tau (Cat Lo) about 40 miles south of Saigon. In addition to attending top-level briefings by both the Navy and Coast Guard, the congressional delegation visited WPB bases at Danang and Cat Lo, and occasionally boarded some of the vessels, taking interesting and informative trips. Such trips afforded an opportunity to talk to the officers and crewmen, and to become familiar with the craft, so that a broader picture of the entire operation could be obtained.

Operation Market Time seems to be a misnomer for a mission that can almost instantaneously change from a languid coastal patrol to a dangerous firefight. Although the actual derivation is rather vague, it is generally believed the operation was named after the thousands of commercial junks that daily ply the coastal waters of Vietnam. Although most of these vessels are actually employed as floating markets for the transportation of food, and so forth, they are also ideally suited for smuggling men and arms to hidden Vietcong units in the south.

In order to appreciate why Operation Market Time is so effective, it is necessary to understand that this is actually a closely coordinated multiservice mission consisting of units from the U.S. Coast Guard, the U.S. Navy, and—as mentioned earlier—specialized craft belonging to the Vietnamese Navy.

The role of the WPB

The backbone of the operation is the 26 WPB's supplied by the Coast Guard. These perform close-in coastal patrol work, and a large portion of their time is spent overtaking, boarding, and inspecting any suspicious looking craft. Working even closer to shore is an extremely fast, highly maneuverable U.S. Navy craft, appropriately known as the *Swift*. Smaller and lighter than the WPB, the 50-foot *Swift* does not have the longer range or heavy seas capability of the larger Coast Guard boat, but it is admirably suited for fast liaison missions. Working even closer to shore than the *Swift* is a fascinating, all-wood 55-foot junk that is built and manned by the Vietnamese Navy. Especially valuable for furtive night missions, this craft has an interesting background, and it will be discussed at greater length elsewhere in this report.

Each of the 82-foot patrol craft in squadron 1 spends from 5 to 6 days at a time on active patrol, and for the most part it is a dull and routine kind of existence. But one of the crewmen aboard a WPB summed it up rather succinctly: "Life on patrol duty," he said, "consists of endless days of utter boredom, interrupted by sudden moments of terror and violence."

Some concept of the scope and intensity of Operation Market Time might be conveyed through the following statistic: Since the inception of this coastal patrol program, up to and including June 30, 1968, the U.S. Coast Guard in Vietnam inspected and boarded over 345,121 junks and sampans. Most of the boardings are routine in nature. Each Coast Guard vessel carries a Vietnamese officer, who acts as interpreter and interrogator and checks the junk's registry and the crew's credentials. The inspectors become familiar with many of the Vietnamese civilians—through previous boardings—and quite often food, medicine, cigarettes, et cetera, are distributed to help promote good will. Although most of the boardings are peaceful enough, there is always the danger of a sudden firefight at close quarters, and a constant effort is maintained to prevent complacency, and to keep the men alert and ready for instant action. Many Coast Guardsmen can tell harrowing stories about how a prosaic patrol suddenly erupted into the "moment of violence." The frequency of violent encounters and dangerous situations is reflected in the fact that—as of June 30, 1968—the Coast Guard had intercepted over 385 tons of enemy war supplies.

Not all violent encounters are precipitated, however, by a boarding action. An example of the surveillance force's efficiency, and how varied the operation can be, is illustrated by an interception that occurred about midnight May 10, 1966. The Coast Guard cutter, *Point Grey*, while patrolling in an area about 200 miles southwest of Saigon, near the Ca Mau Peninsula, spotted two bonfires on the beach. Suspecting they might be signals for a clandestine operation, the cutter waited and watched, silently, in the darkness. The vigilance paid off: a metal-hulled vessel was picked up by the cutter's radar, challenged, and finally forced aground. Suddenly intense gunfire, erupting from Vietcong positions on the beach, raked the cutter, and a savage firefight ensued. The *Point Grey* struck back with machine-guns and mortars, and other Market Time and air units joined the attack against the grounded vessel and enemy beach positions. Subjected to intense naval and air bombardment, the 125-foot trawler was finally ripped apart by a tremendous internal explosion. When the action ended, salvage crews removed 15 tons of weapons and ammunition from the wreckage. It was also estimated that approximately 80 tons of additional war materiel were destroyed by explosions during the firefight. This incident is typical of the experiences of the men who have made Operation Market Time a success. The enemy is not always a small, insignificantly armed vessel. Quite often the Coast Guard has had to slug it out with large enemy craft, many of which are large, steel-hulled trawlers that can be formidable adversaries—especially to the WPB's.

The role of the cutters

The heavyweights in the Market Time Operation are, of course, the five high endurance Coast Guard cutters, which form the final link in this unique Coastal Surveillance Force. Armed with a 5-inch gun mounted forward, they are capable of challenging all comers and they form the outer periphery of this tight naval ring. In addition to their impressive firepower, the cutters provide a host of services, including functions of supply, rapid communications, and the latest in electronic surveillance equipment.

To better understand the role of the high endurance cutters in this surveillance operation, the delegation arranged to visit aboard the CGC *Bibb*, in the port of Hong Kong, where it had arrived after being relieved from its Market Time duties. The *Bibb* is a 327-foot high endurance cutter of the *Secretary* class, carrying 17 officers and 152 crewmen, and a brief account of its activities is an excellent example of the Coast Guard's aggressive participation in the Vietnam effort.

An interview with the cutter's commanding officer, Capt. Paul W. Welker, confirmed the fact—also backed up by high-level briefings—that Operation Market Time has recently shifted from a strictly surveillance mission to a much more aggressive and offensive policy. Captain Welker revealed, for instance, that the *Bibb* recently fired more 5-inch rounds in its first patrol than other cutters fired during an entire 10-month tour during 1967. "The *Bibb* fired over 1,000 rounds of 5-inch shells in 3 weeks," Captain Welker said. In comparison, he noted that—in mid-1967—the first big cutter to join Market Time fired about 650 rounds in 10 months. One explanation for the increase in fire support missions is that the U.S. Army—as

well as other branches of United States and allied forces—have finally come to realize just how accurate the big 5-inch gun can be. Precision accuracy is needed in many of the ground strikes, because of the usual presence of friendly troops in the vicinity where naval gunfire is needed. Some of the bigger targets now being hit are enemy fortifications, buildings, bridges, bunkers, vessels, and even concentrations of ground troops.

The delegation was impressed by the exceptionally high morale of the Coast Guardsmen aboard both the cutters and the WPB's. Surprisingly enough, the primary reason given for such high spirits was always the same: the shift to a more aggressive Market Time operation. Like the heavy cutters, the WPB's are also engaging in more fire support missions. "Every WPB gets about two shots a day at Charlie," one young officer said, "and you'd be surprised at the change. It breaks the monotony, and every guy aboard feels like he's doing his share to win this war." There is also a healthy spirit of competition between various ships, as well as the pride of each officer in his ship and his men, and the desire to get every ounce of efficiency out of a ship and her weapons. In order to get the maximum range out of their 5-incher, for instance, the men of the *Bibb* often maneuver as close to shore—under cover of darkness—as they dare without running aground. To facilitate this operation, they actually use a "lead line," the technique employed on the old Mississippi riverboats, to check the precise depth of water beneath the keel.

One of the great advantages of the cutter and its 5-incher is its great mobility, which also provides the element of surprise. In many of the remote and desolate areas bordering the shoreline, the "land belongs to Charlie," the Coast Guardsmen say, because there are no Allied troops operating in the area. A cutter can sneak in under cover of darkness, wait until dawn, and launch a surprise attack. The men of the *Bibb* like to tell about one such instance: "We opened up on them at dawn, and materially damaged 22 structures and three sampans—all in one firefight. We sure surprised a lot of people for breakfast that morning."

Underway replenishment

A less dramatic although extremely important military logistics exercise has evolved as an integral part of Operation Market Time. Designed to obtain the maximum use of all ships participating in the coastal patrols, it is known as "Unrep," which is an acronym for "Underway Replenishment." Basically, it is a highly coordinated naval maneuver, in which all the fuel, ammunition, groceries, and general supplies needed are transferred aboard the cutters from U.S. Navy supply vessels. All transfers are made at sea, while both vessels are underway, so that the Coast Guard ships never have to leave their operational area, or interrupt their patrol duty to obtain the needed supplies. Some idea of the magnitude and efficiency of the Unrep effort is apparent when one considers its activity with just one vessel. In the case of the *Bibb*, for instance, the average demand for supplies calls for a rendezvous with an oiler every 3 or 4 days, an ammunition ship every 10 to 12 days and a supply ship every 8 to 10 days. All rendezvous points are planned well ahead, and are scheduled into fleet operating areas by the local service force commander. Frequencies of replenishments are planned with the objective of maintaining all vessels on patrol in a state of maximum readiness. The individual

replenishment ships issue a planned intended movement (PIM) which encompasses the entire Market Time force, indicating track line and time through the areas which are to be supplied. The individual patrol ship, such as the *Bibb*, must then plot its course accordingly, so that a rendezvous and subsequent replenishment can be accomplished without interrupting normal patrol duties.

A typical replenishment operation, as described by Captain Welker, goes like this: Several days before rendezvous, the *Bibb* radios the Unrep ship exactly what is needed in way of supplies. These supplies are assembled and made ready for expeditious handling. All details, including whether it is to be a port or starboard transfer, are worked out in advance. At rendezvous, the *Bibb* maneuvers into a proper position, then overtakes the supply vessel, which maintains a set speed and course. When the two vessels are 50 to 100 feet apart, they both maintain proper speed and course to hold this pattern until the Unrep is completed. Normally, a fuel line is hooked up forward and a high-line for food and ammunition is hooked up aft between the vessels. Most of the cargo transferred is palletized for more efficient handling, and all supplies are transferred by cable.

Transferring a supply of 5-inch shells is both delicate and back-breaking, and every man aboard the vessel is utilized in such an operation. There are 36 shells per pallet, and each shell weighs about 55 pounds. A high-line rig is attached to the upper deck, and each pallet is swung across open water, then lowered to the *Bibb's* lower deck. Each shell is removed individually from the pallet and passed, by hand, through a human chain of men. Rapidly, and gingerly, the shells are hand-passed completely around the deck and down three decks below to the magazine, where they are finally stored.

In addition to being enthusiastic and proud of the role his ship and men are playing in the Vietnam war effort, Captain Welker's remarks about Operation Market Time are worth repeating:

"The whole operation," he said, "is beautifully coordinated. It runs like a well-oiled machine. The Navy's system is well organized, effective, and impressive as hell. As for Unrep, many other nations have tried this system without success. It takes an unusually high degree of skill, seamanship, and technological know-how—and our boys have it all."

Captain Welker added that Operation Market Time is providing the most valuable training ground that has been available to young officers of the Navy and Coast Guard for many years.

Role of Vietnamese

Any discussion of Operation Market Time would be incomplete unless it included the role of the Republic of Vietnam Navy. Reference has already been made to the 55-foot wooden junk, which is used on special missions. Since it is a shallow draft vessel, capable of cruising extremely close to shore and up the countless estuaries along the coast, this junk has proven to be a valuable link in the Coastal Surveillance Force.

The delegation became interested in the fact that these junks are constructed in the Saigon Naval Shipyard, and it arranged to make a tour of that installation. Owned by the Vietnamese Government, the shipyard sprawls over 53 acres in the Saigon waterfront area. Much of the conversion and repair work it does is completed at a painfully

slow pace, primarily because of a lack of modern facilities and sufficiently skilled personnel. The shipyard is suffering from a lack of manpower; it employs a working force of 1,400, many of whom are women, and it needs an estimated 2,600 to fully utilize plant capabilities. An intensive effort is being made, however, to modernize plant and equipment and train unskilled workers for more specialized jobs.

The construction of the 55-foot junks is a fascinating but painstaking process, since each is practically handmade. The vessels are hewn from the wood of the Soa tree, which is native to Vietnam and Thailand. Extremely tough and resilient, Soa wood is ideally suited for the construction of the junks. Primitive tools and techniques are used to make these vessels, but it is felt that at least the talents of the native carpenters are being utilized. Since 1954, the Vietnam Government has launched 155 of these tough and versatile vessels, which are capable of doing about $8\frac{1}{2}$ knots, and are usually armed with .30- and .50-caliber machineguns.

Effectiveness of Operation Market Time

Since its inception in July 1965, Operation Market Time has gradually increased in strength and effectiveness. Since that time, the U.S. Coast Guard has participated in the interception of more than 385 tons of enemy war supplies (destroyed or captured); it has destroyed or captured more than 390 enemy junks and six enemy trawlers. Altogether, Coast Guard units have inspected and boarded more than 345,000 junks and sampans, apprehended or detained more than 5,800 suspects, and participated in over 931 gunfire support missions. These statistics cover the period from the inception of Operation Market Time to June 30, 1968. The increased vigilance and effectiveness of the Coastal Surveillance Force—as reflected in the statistics just cited—has practically eliminated the smuggling by sea of men and supplies to enemy forces in South Vietnam. The enemy is, of course, still getting war supplies; however, almost all of this must now come from the slow and difficult land route. The Vietcong's access to the sea has finally been denied, and this is a significant development in the highly unorthodox Vietnam war. The same evaluation of the effectiveness of Operation Market Time was made by high-ranking military authorities on the scene, and has been supported by all intelligence reports.

Port security and explosives details

Although Operation Market Time and the entire problem of coastal surveillance is a major one in Vietnam, the Coast Guard is also responsible for performing other important duties, especially in the Saigon area. One of these is port security, which includes the difficult and dangerous assignment of explosives loading.

As hostilities increased and the American forces became more heavily committed in Vietnam, there was a corresponding increase in demand for arms and ammunition. The arrival of more ammunition ships in the Saigon area, and the need for expeditious but safe unloading, became a critical situation that had to be dealt with effectively. In order to assure the safest possible handling of all ammunitions, the U.S. Coast Guard personnel now supervise all military and civilian stevedoring activities involving munitions ships. Under the port security section, the Coast Guard provides two explosives loading

supervisory teams for Vietnam. These expert teams operate out of Saigon and Cam Ranh Bay for explosives handling and also for general port security functions.

Originally, all of the ammunition destined for the Saigon area was unloaded at Nha Be, which is located about 8 miles south of Saigon. But as both munitions handling and Vietcong activity in the area increased, it became obvious that a safer and more secure and rapid system of ammunition discharging was needed. A new system was initiated and the first of four new ammo discharging bases was established at Cat Lai in 1967. A gradual transition was made, with the view of eventually eliminating Nha Be as an ammunition port, especially since this area is used extensively for the discharge and handling of petroleum. This new system employs an offshore loading operation, utilizing barges. After the ammunition is loaded into the barges, it can then be discharged directly to the shore, or shuttled to some other unloading area in the vicinity and moved inland by road or air. This expedites the unloading, facilitates rapid ship departures, and helps to quickly deploy concentrated quantities of high explosives, making them less vulnerable to enemy sabotage. At Cat Lai, three ships can be unloaded at one time by utilizing the barges. In addition to Cat Lai, explosives loading operations are now underway at Cam Ranh Bay, Qui Nhon, and Danang. The Danang operation was started in July 1968, and during that month the Danang facility discharged 20,608 tons of explosives. Figures for the same month at the other three locations are as follows: Cat Lai, 47,923 tons; Cam Ranh Bay, 27,296 tons; and Qui Nhon, 37,642 tons. This comes to a total of 133,469 tons of explosives unloaded during July 1968.

The delegation visited all four of the explosives loading areas mentioned, and it was impressed by the efficiency of the Coast Guard personnel working on this dangerous and difficult operation. This is especially true, in view of the adverse conditions and the many problems encountered. These include inadequate ramps and unloading facilities on shore, an unstable Vietnamese work force, and physical obstructions—such as low bridges—on the waterways and canals used by the barges. Attempts are being made to eliminate all these problems as rapidly as possible.

The large number of all kinds of supply ships, in addition to the ammunition ships, which call at South Vietnam, has placed an additional strain upon the Coast Guard's port security detail. The extremely heavy shipping activity caused by the unnatural demands of war, coupled with sometimes primitive native techniques of transportation and cargo handling, have placed a tremendous responsibility upon the Coast Guard detail in charge of port safety. During the first 6 months of 1968, for example, a total of 1,531 merchant vessels departed from eight major South Vietnamese ports. Such heavy water traffic, and all the accompanying problems it brings, presents a constant challenge to Coast Guard personnel.

Other responsibilities of the same detail include supervising proper shoreside stowage of cargo, especially hazardous materials, supervising general shoreside handling of all cargo, and guarding against vulnerability of both ships and facilities to fire, other hazards and enemy attacks.

Other Vietnam duties

The merchant marine detail is also involved with all the normal personnel problems which arise concerning U.S. merchant seamen. Sickness, deaths, accidents, assaults, smuggling, and all the diverse responsibilities assumed by Coast Guard in U.S. ports are handled in the same way in Vietnam. Again, in this situation the workload is heavier, because of the intense volume of shipping experienced in the war zone.

Aids to navigation

The thousands of allied merchant ships, military craft, and Vietnamese junks involved in the war effort place a tremendous strain upon existing port facilities, and they require a dependable, well-coordinated system of aids to navigation. Maintaining and improving this system is still another responsibility of the Coast Guard, which to date has established 53 lighted buoys, 33 unlighted buoys, 12 ranges, and five day-beacons. To properly service and maintain these vital navigational aids, the Coast Guard dispatches, at 6-month intervals, one of its 180-foot buoy tenders. In addition to repairing existing aids, these ships are constantly increasing the number of these devices in Vietnam's many ports and rivers. The Republic of Vietnam also owns one buoy tender, the *Cuu Long*, and is gradually assuming more responsibility for maintaining aids. At present, however, the Vietnamese Government has neither the manpower nor the facilities to assume complete control of this important work. Until that time comes, the Coast Guard will continue its present duties in supplying sufficient aids for allied shipping.

COAST GUARD ACTIVITIES—THAILAND

Loran C: Electronic aid in peace and war

Originally conceived as a peaceful aid to navigation, a sophisticated electronic system known as Loran C—which cost approximately \$15 million to install—is making an enormous contribution to the allied war effort in Southeast Asia. Technically, Loran is referred to as a hyperbolic system of radio navigation. The complexities of the system are difficult to explain to the average layman, but the manner in which it is used by American forces in Vietnam might best be illustrated by the following hypothetical operation:

From a remote outpost in the interior of Thailand, an electronic impulse flashes invisibly from a slender, 625-foot tower.

Somewhere over a Vietnam jungle, the navigator aboard a mile-high B-52 picks up this pulse on a sophisticated electronic device; a second impulse—this one from another direction—is received and recorded.

Using the two readings, the navigator bends over his plotting board, and makes a few rapid, simple calculations.

Within minutes, he has pinpointed an enemy target beneath the dense jungle foliage, and the bombs are dropped with deadly accuracy.

Although the operation described above is hypothetical, it is also a fairly accurate account of how the Loran system is constantly used by all branches of the allied forces—thanks to the U.S. Coast Guard.

The original system, known as Loran A, was designed and implemented by the Coast Guard. The ultimate in navigational aid, Loran A enabled ships and aircraft to pinpoint their own location to within 500 feet of actual position anywhere in the world. That system is now used by aircraft and ships of all nations, and probably has done more for safe travel at sea and in the air—as well as for search and rescue operations—than any discovery since celestial navigation.

It is readily apparent that the Loran system has military as well as commercial applications, and it was natural to expect that a more sophisticated system would evolve from this technological innovation. The Coast Guard did, in fact, develop a more sophisticated system, and it came to be known as Loran C. Like its predecessor, Loran C can and is used for navigational and commercial purposes, and ships and aircraft can use it in all weather conditions over land and sea to obtain higher accuracy position information at greater distances than those obtained with Loran A. The range capabilities of Loran C make it particularly desirable in remote areas where suitable transmitting sites are limited and where coverage of vast ocean areas is required, and these capabilities are admirably adaptable for Southeast Asia. These inherent accuracy capabilities provide a tremendous military potential, and it was natural that this system was installed for military use in the Vietnam war.

How Loran works

A brief discussion of how Loran A works will enable a general appreciation, if not an understanding, of the more complex Loran C. Prior to the advent of Loran, plotting the exact position of a ship or aircraft was a laborious task, involving a series of difficult computations which demanded all the concentration of an expert navigator. And even the most experienced navigator, working as rapidly as possible, would require about 45 minutes to accurately plot his position. Provided, of course, that bad weather did not hamper celestial observation. Obtaining the same information with Loran never takes more than 3 minutes, regardless of weather.

Two or more Loran transmitting stations constitute a system, and at least two are needed for fixing a position. Technically, the Loran stations generate, identify, and measure hyperbolic lines of position. The fixed shore stations transmit short bursts of radio energy or pulses. Aboard the ship or aircraft, the only instrument needed is known as a Loran A receiver-indicator, which can be purchased for as little as \$500. This instrument receives the pulses from the shore stations and displays them, allowing the navigator to measure the difference in time of receipt. The measurement procedure is so simple, the average layman can learn to perform it in a few hours. Once a measurement reading is obtained, its location on a special chart which accompanies the device gives the navigator his exact position. The simplicity of Loran A, and the inexpensive receiver needed has made this system available to everyone. Loran C, however, is a far more complex and expensive operation. The average aircraft receiver for Loran C, for instance, costs approximately \$400,000.

In Southeast Asia, the Coast Guard is operating three stations in its Loran C system. Two of these are located at Udorn and Utapao, in Thailand, and the other is at Con Son Island, off the southern tip of the Republic of Vietnam. The delegation visited all these installations,

and received comprehensive briefings in addition to making informative inspection tours.

Value of Loran C

As indicated in the hypothetical case presented in this report as an example of the military application of Loran C, this superb system is capable of incredible accuracy. In addition to its value as a navigational aid, Loran C is now being used to pinpoint targets such as troop concentrations, enemy facilities, and so forth. Coast Guard authorities have estimated that it is 10 times more accurate than any other Loran system, and that any target area can be hit within 19 feet of dead center. The system has not as yet received wide recognition by all branches of the armed service, and there is still a need to train more military personnel—in all branches of the service—in the use of Loran C. It might be added here that the Vietnam war will probably serve as a proving ground for this ultrasophisticated electronic system, which, in addition to its military value, should eventually prove to be of tremendous value to peacetime navigation, as the more common Loran A is now. It might also be noted that this Loran C system, set up and operated as it is, under adverse war conditions, is providing a valuable training ground for Coast Guard personnel. The staffing of the Loran stations requires the services of well-trained personnel who qualify as radio electricians, electronic technicians, and general radiomen as well as electronic maintenance personnel. A look inside one of the Loran C stations in Thailand, as a matter of fact, should impress even an experienced electronic technician. These stations are crammed with row after row of expensive and complex machinery and electronic equipment. It should be repeated that the Loran system in Southeast Asia cost \$15 million to install, because these figures emphasize the tremendous investment, in both men and equipment, that the Coast Guard and the U.S. Government has made in just this single facet of the war effort.

CONCLUSIONS

The fact that the entire Loran C system for Southeast Asia is operated by just 16 officers and 115 men of the U.S. Coast Guard impressed the delegation, and is indicative of the overall efficiency and competence of that branch of the U.S. Armed Forces. This same military and professional competence was observed in every phase of Coast Guard activity inspected. It is also interesting to note that a relatively small complement of approximately 1,400 Coast Guard personnel successfully operates all the many diverse activities being carried on in Thailand and Vietnam. The delegation would like to take this opportunity to commend the valuable contribution being made by this small but efficient branch of the armed services to the total U.S. war effort in Vietnam.

