CHAPTER 6

A PERIOD OF REEVALUATION—A MODERATE CAPABILITY

Following the CNO's action in 1956 limiting the procurement of the HR2S helicopters, the Marine Corps made three studies which significantly influenced the course of the entire helicopter program. The first study was prepared by the G–3 Division, HQMC. Completed in May 1956, it dealt with the employment of helicopters within the Fleet Marine Force during the years of 1956 to 1960. The G–3 report was followed by the publication of the Marine Corps Aviation Program for the Fiscal Years 1957 to 1962. The third report, that of the Hogaboom Board, was completed in 1957 and addressed the organization of the FMF. Although it affected the ground FMF to a larger degree than FMF aviation, it was the most detailed report of the three pertaining to the overall Marine aviation structure.

HQMC G–3 Study Number 3—1956

G–3 Study Number 3, a Memorandum for the Commandant, was completed in late April 1956 and approved by the Assistant Commandant for Air, Lieutenant General Vernon M. Megee, on 8 May. The report, "Employment of Helicopters Within the FMF During the Period of 1956 to 1960," concentrated on the distribution of all Marine Corps tactical helicopter squadrons. The primary point addressed was the question of whether the majority of helicopters would be assigned to lift one division to attain a maximum divisional lift capability, or whether they would be apportioned among each of the three divisions.

As a guideline to estimating the future availability of helicopters by type and proposed squadron organization for the period under study, the G–3 study group used a series of charts prepared by the Division of Aviation. The DivAvn helicopter estimates included the years 1956 through 1960 and reflected a gradual growth from 9 to 15 helicopter squadrons. The G–3 Study projected the anticipated growth rate of the helicopter force over the five-year period as presented in Figure 4. It was a complete reversal from the Smith Board and prior boards' reports as the total number of HR2Ss was reduced from 180 to only 45—three squadrons of 15 aircraft each. The existing nine HRS squadrons would continue to operate with the HRS and later change to the HUS when it became operational. Three additional HUS units were to be formed later. This study reflected for the first time the fact that the Navy budget had allowed for only 45 HR2Ss to be constructed by the end of 1960 and that the additional HUSs would most likely have to compensate for the lost troop lift capability of the HR2S.[1]

In view of the five-year projection, the group made recommendations ranging from the deployment of helicopter squadrons to the desired size of assault force which should be lifted simultaneously. In relation to the assault force, the study group stated that the BLT organizational structure possessed the minimal requirements for communi-

Figure 4

	Existing					
	1956	*1957*	*1958*	*1959*	*1960*	*1961*
Squadrons By Type	9 HRS	7 HRS	5 HRS	5 HRS	4 HRS	3 HRS
Helicopter		2 HUS	4 HUS	6 HUS	8 HUS	9 HUS
		1 HR2S	2 HR2S	2 HR2S	3 HR2S	3 HR2S
Total Squadrons	9	10	11	13	15	15
Total Light Helicopter	180	180	180	220	240	240
Total Medium Helicopter	0	15	30	30	45	45
Grand Total Helicopter	180	185	210	250	285	285

cations, control, and support needed to execute a combat helicopter assault and sustain operations for a limited time. A regiment, it felt, or a comparable organization, would probably be better organized, staffed, and equipped for the mission, but a corresponding large increase in helicopters, would be required. Although the final number of aircraft by number and type would evolve as the concept developed, the planners stressed that interim specific figures had to be determined. These would facilitate development of the concept and provide the aviation establishment with guidance in relation to helicopter deployment and HMR squadron distribution. In this connection, the group's recommendation was that initially each Marine division should provide for a minimum simultaneous (one-wave) lift of assault elements of one BLT consisting of approximately 500 troops, *i.e.*, two rifle companies and a command group. A combat radius of 25 miles was established as the minimum capability required to implement the vertical lift concept. This represented a drastically reduced initial assault force from the four BLT one-wave assault recommended three years earlier in ARG's Project IV. It should be pointed out that while the ARG was trying to helicopter-land the assault elements of a division-wing team, the G–3 study was interested in landing the minimum effective number of troops towards the eventual goal of lifting one and one-half divisions.[2] *

The study group's planning for FMF helicopter employment was reflected in two recommendations, both of which tended to support the existing program. The group endorsed the contention of the Smith Board that the Marine Corps needed different types, or families of helicopters. Secondly, the group believed that helicopter procurement programs for 1956 through 1960 would provide a significant increase in helicopter availability for the FMF to the extent that a substantial helicopter assault capability could be achieved. The current distribution policy of providing one HR MAG to support one division was concurred in with the proviso that the initial division helicopter assault capability should be achieved through selective deployment of newly procured helicopters rather than redistribution of the presently deployed helicopters. The concept behind the study group's recommendation was that as the Marine Corps received its new helicopters during the 1956–1960 period, they would be used to expand gradually one MAG at a time until each reached the capability to provide the single-wave BLT lift. Priority for helicopter assignment was given to the helicopter MAG supporting the 1st Division. Afterwards, the MAGs supporting the 2d and 3d Divisions would be built up to meet the minimum assault capability.[4]

General Randolph McC. Pate, Commandant since January 1956, took action on the G–3 Study in the form of letters to CG FMFPac and CG FMFLant on 4 September 1956. In addition to reiterating the essential elements of the study, the Commandant told his two FMF commanders that the new concept ultimately required sufficient helicopters to support, in combat and training operations, all Marine divisions and aircraft wings available for such operations. "This capability," he said, "will not be achieved until after 1960, but the attainment of lesser lift capabilities is an essential intermediate objective." The reason for limiting the combat radius for helicopter assaults to 25 or 35 miles, General Pate explained, was to enable Marine Corps planners to compute the future required number of helicopters. His final

General Randolph McC. Pate, 21st Commandant (Marine Corps Photo A402599).

* General Shepherd had indicated in 1955 when commenting on the recommendations of the Smith Board that in relation to the minimum helicopter lift that "[I] approve all recommendations except the phrase 'in order that Marine Corps Aviation, as a whole, have the capacity of lifting one division.' I consider that the Marine Corps must achieve a helicopter capability sufficient to lift 1½ divisions at the earliest possible time."[3]

statement directed that both FMFs provide for early attainment of a proficient, though limited, helicopter assault capability for lifting one BLT in each division.[5]

Marine Corps Aviation Five-Year Program 1957–1962

In early 1956, before the results of the G–3 study were out, General Pate had forwarded to the CNO, Admiral Burke, a basic Marine Corps aviation objective plan for pre-mobilization for each Fiscal Year 1956 through 1961. It represented the Marine Corps' requirements for the support of three divisions in combat short of general war. The plan was based upon information available at the time and reflected the requirements for attainment of the objectives to support the Commandant's new concept.

Admiral Burke replied to General Pate in May 1956 stating he favored the plan, however, based upon the projected budgetary and personnel limitations which had been imposed upon the Navy, approval of General Pate's Five-Year Plan could not be given without having adverse effect on other essential functions of the Navy. The CNO enclosed a proposed force operating level for Marine aviation for General Pate's consideration. The Commandant then directed that a comprehensive review be made of the original plan in order to develop a program that would provide for a reasonable chance of approval by the CNO. The fundamental guidance was the projected budgetary and personnel limitations which were expected to be imposed upon the Navy and Marine Corps for the foreseeable future. The main consideration in developing a revised program was that the currently authorized Marine Corps operating level of 1,424 aircraft would remain through the period. An increase in the number of aircraft could not be accommodated and any changes reflecting new helicopter requirements would have to be accompanied by a compensatory reduction in fixed-wing aircraft. This was necessary in order to maintain procurement and operating costs at approximately a constant level through the next five years.[6]

As the revised plan was being developed, it was obvious that the ultimate objective of the new concept could not be achieved, although a limited vertical assault capability appeared attainable by the end of Fiscal Year 1962. The expansion of the helicopter program during the five-year period provided for an operating inventory of 180 HUS, or light helicopters. The activation of new units would take place as the aircraft became available. It was anticipated that the Marine helicopter aviation force, as depicted in Figure 5, would have nine squadrons of 20 HRS/HUSs each and six squadrons of 15 HR2Ss each by the end of the period. The build-up to the maximum number of HR2S helicopters was to be dependent upon improved performance of the helicopter and therefore considered to be highly subject to change.[7]

The total number of helicopter squadrons in the helicopter program remained at 15 in both the G–3 Study and DivAvn's Five-Year Plan. The significant difference was that the five-year plan proposed the formation of six HR2S squadrons instead of three, and retained the nine HRS/HUS squadrons at their existing level. The more optimistic Five-Year Plan gave the CNO an estimate of what the Marine Corps desired, whereas the G–3 Study was a memorandum for General Pate and reflected a realistic projection of the program's growth in consonance with the approved budget.

Another logical planning change occurred after the CNO reduced the procurement of the HR2S. This development reflected the reversal of designations of the light (L) and medium (M) aircraft groups. In view of the small "buy" of medium helicopters, new plans were made to assign the HR2Ss to the two-squadron utility (L) groups and to redesignate them as MAG (HR(M)) and to retain the three HRS/HUS groups as light. This

Figure 5

	FY '57	*'58*	*'59*	*'60*	*'61*	*'62*	*Total Aircraft*
No. of HMR(L)s	9	9	10	9	9	9	
A/C per Sqdn	20	20	20	20	20	20	180
No. of HMR(M)s	1	2	3	6	6	6	
A/C per Sqdn	15	15	15	15	15	15	90
No. of VMOs	3	3	3	3	3	3	
A/C per Sqdn	24	21	18	18	18	18	54

was a completely opposite plan from the one proposed by the Smith Board. Essentially then, according to the revised Five-Year Plan, each Marine aircraft wing would still retain two helicopter groups within its structure with the MAG (HR(M)) having two HR2S squadrons of 15 planes each and three 20-plane light squadrons in the MAG (HR(L)). Another decision also rendered during this period placed the VMO squadrons in the light helicopter group structure. Their complement of aircraft was to be eventually reduced from 12 fixed-wing and 12 helicopters to only nine of each type.

The Hogaboom Board of 1956

In order for the Marine Corps to achieve its new concept as rapidly as possible, while still preserving its past and present capabilities, it had to undertake a vast reorganization of its forces. It had kept the organization of the FMF under constant review with the latest change made in 1955 by the Smith Board which undertook an examination of the entire aviation structure. Later on 4 June 1956, the Commandant appointed Major General Robert E. Hogaboom as president of a 16-man board* to conduct a thorough and comprehensive study of the entire FMF, including aviation, with the purpose of making recommendations for the optimum organization, composition, and equipment of the FMF. The results of this organization and composition study were to set the pattern for all major organizational changes within the FMF during the remaining part of the decade.

General Hogaboom's permanent assignment was Deputy Chief of Staff (Plans), HQMC, a post he had held since his return from Korea in 1955. In 1949 he had attended the National War College, and from 1951 to 1952 he had been the Marine Corps liaison officer in the office of the CNO. In July 1952 General Hogaboom became the assistant commander of the 2d Marine Division, and later, during 1954 and 1955, he served in Korea as assistant commander and later as commanding general of the 1st Marine Division.

General Pate provided General Hogaboom's board with a six-paragraph letter of concepts and criteria. In relation to the helicopter, he explained that the helicopter would become the principal means of achieving tactical surprise and flexibility. He mentioned that surface landing craft and land vehicles would continue to be the principal means of mobility at the objective until sufficient helicopters of improved capabilities were available to permit the landing, tactical maneuver, and logistical support of all assault elements of a Marine division. It was considered that as the helicopter capability increased, the need for surface landing craft and land vehicles would decrease.[8]

The primary purpose of the Hogaboom Board was to determine what the FMF needed to meet the initial requirements for achieving the new concept for amphibious warfare, beginning with Fiscal Year 1958. Additionally, the study was to determine the phase objectives of the FMF in organization and composition for the foreseeable future.[9]

In preparing its study, the board interviewed and gave careful consideration to a large body of Marine officers. The staffs of the Education Center, Development Center, Marine Corps Test Unit Number 1, and HQMC were the source of many highly competent and experienced officers who appeared before the board. Also the board conducted a thorough and comprehensive examination into the tactical concepts of the FMF and took due cognizance of such documents as *LFB–2* (Interim Doctrine for the Conduct of Tactical Atomic Warfare) and *LFM–24* (Helicopter Operations).

In arriving at its conclusions, General Hogaboom's board had relatively little difficulty in dealing with its recommendations for equipment and armament for Fiscal Year 1958. In many cases the members felt there was little choice in this matter as they had to take that which was currently developed and available. The basic and most difficult problem then was to find the soundest possible balance of units and equipment for the FMF organization. With respect to the phased objectives, the board projected itself as far into the future as research and development reasonably would allow.[10]

The board then proceeded in a detailed examination of the "current organizations, the organiza-

* A total of 16 officers was appointed to the 1956 FMF Organiation and Composition Board. Those named in addition to the president, Major General Robert E. Hogaboom, were:

BGen Ronald D. Salmon (Relieved on 16Jul56)
BGen Edward C. Dyer (Joined on 16Jul56)
Col Bruce T. Hemphill
Col Frederick P. Henderson
Col Odell M. Conoley
Col Herbert H. Williamson
Col Cliff Atkinson, Jr.
Col Henry H. Crockett
Col David W. Stonecliffe
Col Lewis W. Walt
Col William R. Campbell
Col Norman J. Anderson
Col Keith B. McCutcheon
Col Allan Sutter
Col William K. Jones
Maj Frank R. Young (Recorder)

tional thinking, and in the thinking of the Marine Corps in general." This was considered necessary in order to isolate those parts of the organizational structure which were incompatible with the essential requirements of the helicopter assault concept. It very soon became apparent to the board that some of the prevailing thoughts as to how these requirements were to be met were far from conclusive, and, in some cases, erroneous.[11] The board stated:

> An area which the board believes particularly requires clarification is the subject of just how the landing force as a whole is to be projected onto the hostile shore. There appears to be a considerable body of opinion in the Marine Corps today which holds that in the foreseeable future all movement from ship-to-shore will be by helicopter. Thus the "all helicopter assault" concept has somehow become the "all helicopter concept." This idea the board believes to be invalid and should be corrected immediately. It leads among other things to requirements being stated specifying helicopter transportability for all the arms and equipment of the Fleet Marine Force. This requirement is in fact written into the current issue of the Equipment Development Policy and Guide as an ultimate goal.
>
> The board believes that this line of thinking has perhaps obscured the continuing importance of crossing the beach operations in our modern concept. We believe that for the foreseeable future a substantial portion of the men and materiel required in effecting a lodgement on a hostile shore must still cross the beach in a "conventional" fashion. This is not in our opinion inconsistent with the "all helicopter assault" concept, or with the requirement for the projection of seapower ashore without the necessity of direct assault on the shoreline. Reduced to its simplest terms the board visualizes an operation wherein the flexibility of the helicopter-borne assault forces would be exploited to uncover and secure the beaches and to seize critical areas which will be required to enable us to phase in the additional means to maintain the momentum of the assault and secure the objective area.
>
> The board considers that helicopters will be employed initially to displace the assault elements of the landing force from ships at sea to attack positions ashore from which they can seize the critical terrain features.
>
> In subsequent operations ashore helicopters will be employed to maneuver disengaged units into attack positions from which they can launch an attack against critical objectives at a decisive time.[12]

In the end, the reorganizational changes recommended by the board resulted in a reduction of about 2,000 personnel in each division. A few of the more significant changes in the organization of the Marine division, although not accounting for the major reductions, may be summarized as:

1. Addition of a fourth rifle company in the infantry battalion.
2. The division tank battalion transferred to Force Troops.
3. Expansion of the division reconnaisance company into a reconnaissance battalion.
4. Addition of an antitank battalion equipped with 45 ONTOS.

Changes were also made in the Force Troop structure which affected the areas of command and communication, artillery, antiaircraft, tanks, amphibian units, and reconnaissance.[13]

In reviewing the overall structure of FMF aviation, an assumption was made that short of a general war, not more than two Marine divisions and two Marine aircraft wings would be deployed. Based upon this assumption, the board determined that the best functional balance attainable within the authorized 27 attack and interceptor squadrons was to set the ratio at 9 fighter, 6 all-weather fighter, and 12 attack squadrons. It was also determined that the wing, being primarily a task organization rather than a T/O organization such as the division, could not be categorically structured except in functional groups. The aircraft wing had to be organized, the board felt, to perform the essential air support tasks in the overall missions assigned. As shown in Figure 6 the board presented a typical Marine aircraft wing, recognizing that a structure identical in all respects to the one presented would be the exception rather than the rule.[14]

Although there were no substantial changes made in the organization or composition of the nine fixed-wing aircraft groups, it was suggested that the light helicopter group structure be modified to fulfill the transportation requirements visualized by the concept for employment of the division's reconnaissance battalion. In addition, it was considered necessary that helicopter crews be intimately familiar with the tactics and techniques of the reconnaissance battalion and be available to the battalion for training and combat operations. More specifically, operational concepts for the reconnaissance battalion envisioned continued requirements for helicopters to perform missions of observation, utility, and transportation. To accomplish this, one squadron in each MAG (HR(L)) was to be designated as a "Helicopter Reconnaissance Squadron," HMR(C), (C-Composite) and assigned an aircraft complement of 12 HRSs and the 12 HOKs. The HOKs were to be transferred from the VMO squadron. The other two HMRs within the group would retain their designation but would have the number of aircraft increased from 20 to 24. This reorganization, as shown in Figure 7 was made to insure vigor-

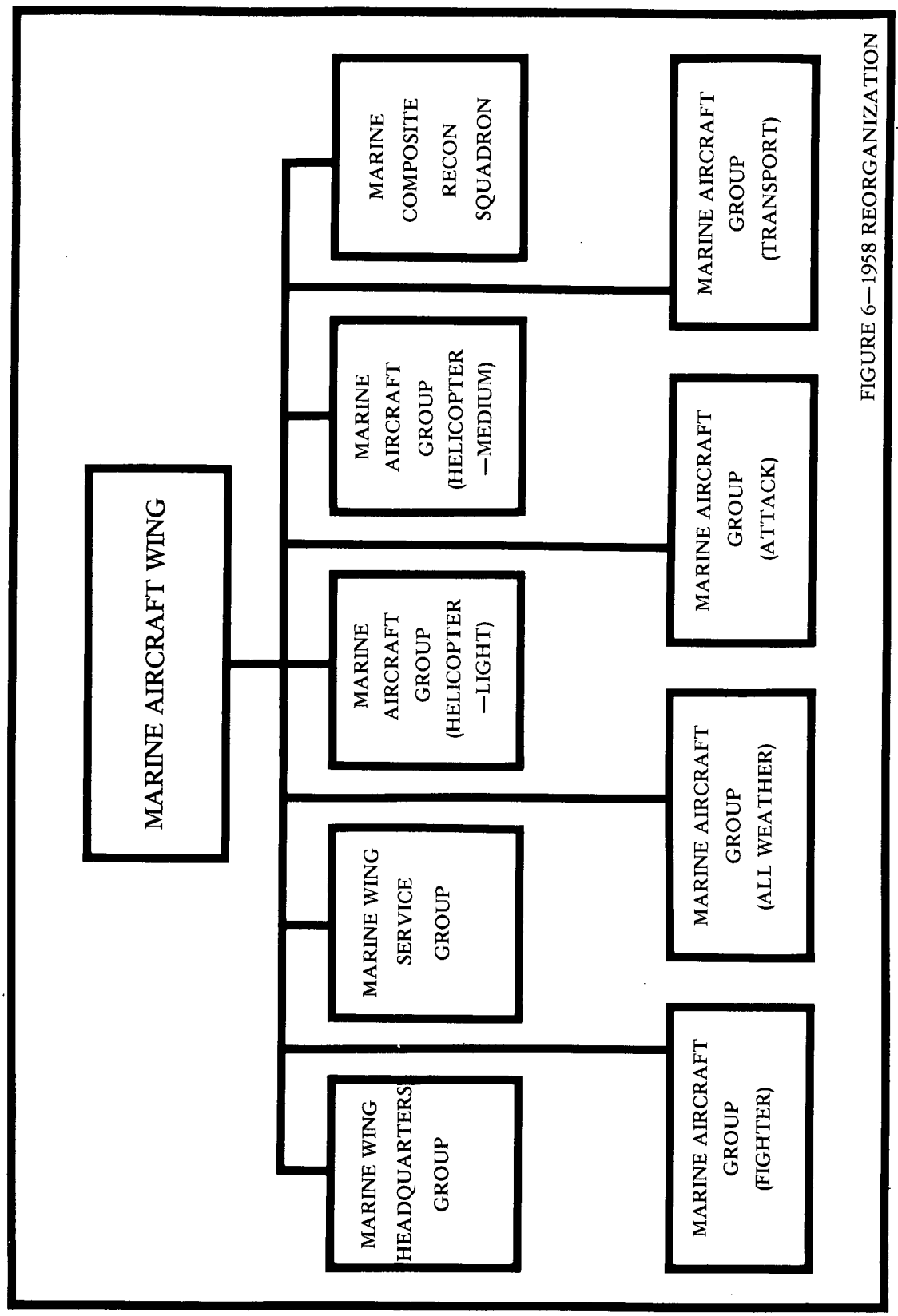

FIGURE 6—1958 REORGANIZATION

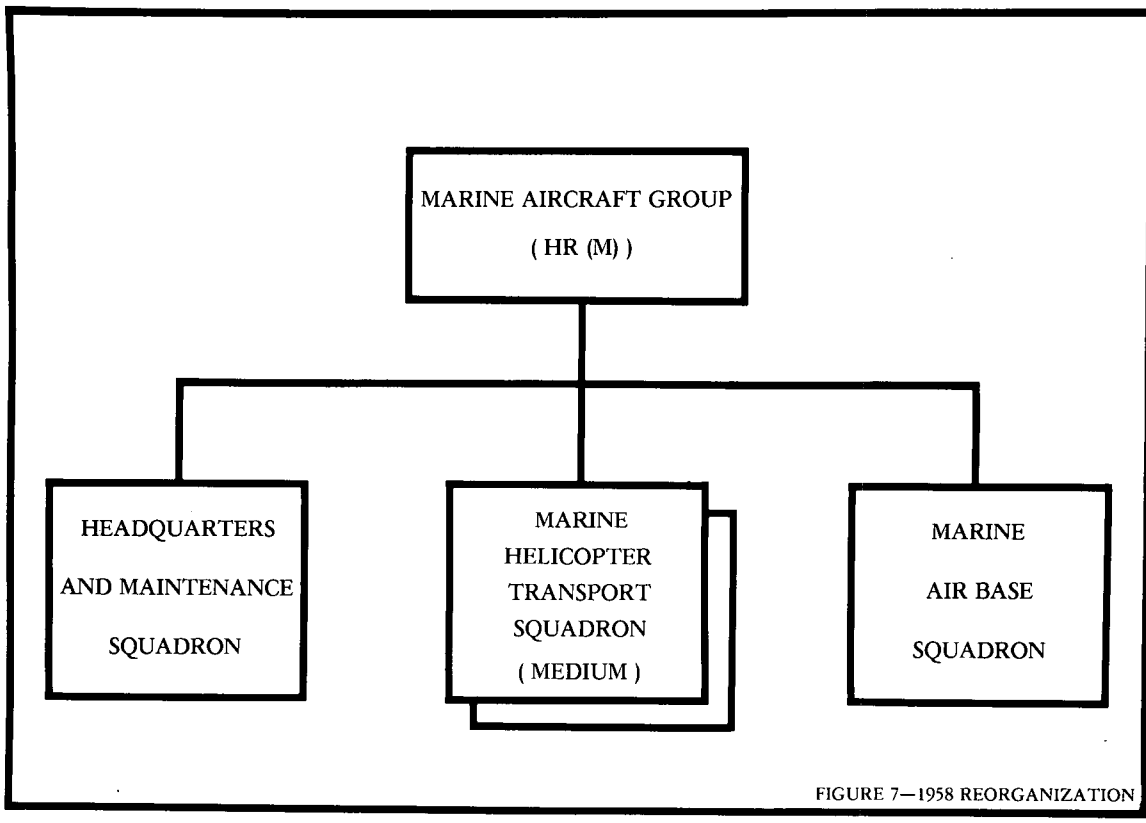

FIGURE 7—1958 REORGANIZATION

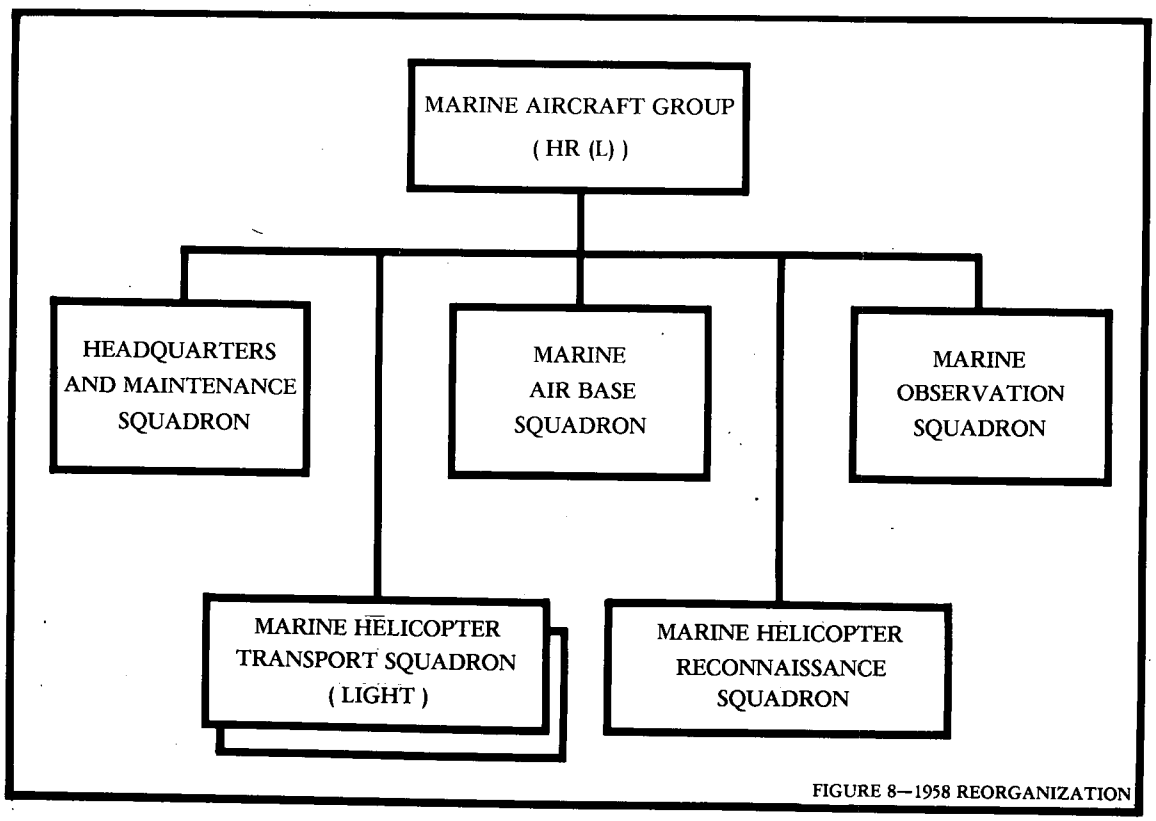

FIGURE 8—1958 REORGANIZATION

ous development of the reconnaissance aspect for this type of air support. As for the VMO squadrons, they had been assigned earlier in the year to the MAG (HR(L)) as a supported unit, one squadron to each group. The board established the VMO complement at 12 fixed-wing aircraft. The structure of the two-squadron medium MAGs in Figure 8 were not changed by the organization and composition board.[15]

The board declared that reorganization of the ground and aviation units was a practical first phase objective in light of existing equipment and tactical concepts under which the Marine Corps had to operate. It was further decided that certain areas needed immediate emphasis in order to increase the Marine Corps' capability to operate under the modern concept. Among those seen as pertaining to the helicopter were the need for additional helicopters of improved performance, more adequate and efficient amphibious shipping with emphasis on the LPH type, and assault weapons and equipment which would be helicopter transportable—particularly the antitank and close support weapons. The board emphasized the need for a gradual reduction and simplification in the number of different types of all weapons and equipment, in addition to maintaining continued emphasis on decreasing the weight and bulk of FMF equipment. This requirement paralleled the central theme of the study which was to make the entire assault force helicopter-transportable and the division all air-transportable.

From a consideration of the several factors which would influence the speed and extent of attaining a full capability to operate under the modern concept, the board recommended, in relation to the helicopter program, that the following objectives be established:

1. Phase I; 1957–1958
   a. The phasing in of sufficient helicopters of improved performance to attain a capability to land and support one BLT in each Marine division.
2. Phase II; 1958–1961
   a. The phasing in of sufficient additional helicopters of improved performance to attain a capability to land and support one RLT in each Marine division.
   b. The attainment of three additional LPH ships in the amphibious forces of the fleet.
3. Phase III, 1961–1965
   a. The improvement of the helicopter lift capability developed during Phase II.
   b. The attainment of seven additional LPH ships in the amphibious force of the fleet.[16]

As shown in Figure 9, the board recommended a graduated expansion of both the light and medium MAGs to a structure of 15 helicopter squadrons. The board failed to mention, however, the flying distance involved in the execution of the lift and whether or not the lifting of the assault elements of the BLT during the Phase I period, and the RLT in Phase II, was to be performed in one simultaneous lift. The plan closely resembled the Division of Aviation's schedule in the Aviation Five-Year Plan published earlier in July. Additionally, the phased build-up suggested a gradual increase in the number of LPH type ships to a maximum of 12; six on each coast.[17]

General Hogaboom's board completed its report and made a presentation to the Commandant and his staff late in December with the written report distributed on 7 January 1957. General Pate's

Figure 9

	FY58		*FY59*		*FY60*		*FY61*		*FY62*	
	No. Units	*No. A/C*	*No. Units*	*No. A/C*	*No. Units*	*No. A/C*	*No. Units*	*No. A/C*	*No. Units*	*No. A/C*
MAG (HR–L)	3	—	3	—	3	—	3	—	3	—
H&MS	3	6	3	6	3	9	3	11	3	11
MABS	3	—	3	—	3	—	3	—	3	—
HMR (L) (24 a/c)	6	144	7	164 *	6	144	6	144	6	144
HMR(c) (24 a/c)	3	72	3	72	3	72	3	72	3	72
VMO	3	36	3	36	3	36	3	36	3	36
MAG (HR–M)	1	—	1	—	2	—	3	—	3	—
H&MS	1	3	1	3	2	4	3	6	3	6
MABS	1	—	1	—	2	—	3	—	3	—
HMR (M) (15 a/c)	2	30	3	45	6	90	6	90	6	90

* One squadron (20 a/c) HMR(L).

immediate action subjected the newly proposed structure to field testing which was completed by 30 June. The recommendations from the various FMF testing units were consolidated with comments from the HQMC staff sections into one package which the Commandant subsequently reviewed and approved for implementation. The provisional "M" series of tables of organization (T/O) and Tables of Equipment (T/E) were also prepared and sent to all FMF organizations and by September 1958 all elements of the FMF had been reorganized. General Pate, reflecting back on the reorganization at the General Officers' Conference in 1959, said:

> The idea of the helicopter-borne assault first appeared in 1946. It was subjected to a quite thorough theoretical examination in the late 40s and early 50s. By 1956 we knew the concept was valid. Our responsibility, then, was to put it to work—to develop the ability for applying the theory to practical situations . . . [Reorganization of the FMF] was a long step forward, and an important one. Taking it broke a log jam of resistance based on the traditions of earlier days. I am not unmindful of the trauma the change visited upon some of our people—but it was something that had to be done.[18]

Forced Reduction

While the FMF was being reorganized, the entire Marine Corps had to undergo a severe reduction in personnel and aircraft due to drastic military-wide budget cuts. On 12 August 1957, the Secretary of the Navy directed that certain force level reductions be made in both the Navy and Marine Corps during the forthcoming Fiscal Years 1958 and 1959. As an indication of the magnitude of this reduction, the total officer and enlisted strength had to drop from over 200,000 on 30 June 1957 to approximately 175,000 by midyear 1959 and was to continue near the lower level until 1962.

Working with the new guidance provided by the Secretary of the Navy, the Division of Aviation revised its Five-Year Plan. The revision was published on 23 September 1957 as the Marine Corps Aviation Program Changes for Fiscal Years 1958 to 1962. One of the guidelines used in achieving the necessary changes was that no alterations would be made which might decrease the progress toward the goal of vertical envelopment. This was a difficult task as the total number of Marine aircraft had to be reduced from 1,425 to approximately 1,200 by 1 July 1959, approximately a 15 percent loss, and still further to about 1,000 by mid-1962, for a total 30 percent loss.* Three Marine aircraft wings were kept in force; however, the aircraft complement of some units was, by necessity, lowered. In addition, some units were completely eliminated and those which remained were manned at approximately 80 percent of their T/O strength. The basic structure of Marine aviation at full T/O strength as defined by the Hogaboom Board and approved by the Commandant was based on an operating program of 1,424 aircraft.[19]

Despite the austerity move, the existing helicopter structure fared considerably well, although some of the expansion called for in the Five-Year Plan had been cancelled. The medium helicopter squadrons were placed within the MAG "light" structure, one medium unit to each MAG. This arrangement eliminated the need for the establishment of the three two-squadron medium groups. In all, the greatest loss suffered by the helicopter program occurred in the medium helicopter groups as only sufficient funds remained available for commissioning three of the programmed six medium squadrons.[20]

In addition to the budget cuts, mechanical troubles still plagued the HR2S, thereby justifying the reduction in numbers from 90 to 60—three squadrons of 20 each. Another factor influencing the reduction of HR2Ss was that a new type aircraft, a VTOL (non-helicopter), appeared to be a desirable future replacement. To compensate for the loss of the fourth, fifth, and sixth medium squadrons, the number of HUSs were adjusted upward from the previous total of 180 to 210, with the latter figure to be reached by 1959 and maintained through 1962.** [21]

The reduction of the budget not only affected personnel and aircraft programs but also hampered the Navy's shipbuilding schedule. Of major concern to the Marine Corps was the serious shortage of amphibious shipping, and, in particular, the lack of helicopter aircraft carriers. This had been

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* As a comparison the Navy suffered a 25 percent loss of its operating aircraft through the forced reduction move.

** There were many suggestions on how to distribute the last 30 aircraft of the 210 light helicopters. DivAvn's revised program, 1959–1962, indicated a structure of six light squadrons of 24 each and three composite squadrons of 12 each; making a total of 180. Obviously, the increase of 30 light helicopters was to compensate equally for the difference in the reduced number of medium helicopters (90 to 60). Although two additional light squadrons were subsequently formed during the period, one in 1959 and the other in 1962, which absorbed the extra 30 helicopters, they were apparently omitted altogether from this five-year plan.

a continuing area of concern since the end of the Korean War and with the recent congressional budget reduction, the existing shortage of money for shipbuilding purposes was compounded.

Tightening of the fiscal purse strings did not mean that the Marine Corps was without a helicopter aircraft carrier. The first results of the Commandant's request for LPHs in early 1953 were realized on 20 July 1956 when the USS *Thetis Bay* (CVE–90) was commissioned after undergoing a conversion in the San Francisco Naval Shipyard. Redesignated as the CVHA–1 (Assault Helicopter Aircraft Carrier), the *Thetis Bay* was designed to afford the Marine Corps the opportunity to evaluate the vertical assault concept. Although it was not intended that the converted ship be the prototype for future LPH (CVE) conversions, it did provide the Marine Corps with the opportunity to evaluate some features desirable in new construction.[22] Later reclassified in 1959 to LPH–6, the CVHA–1 had an overall length of 512 feet, a beam of 108 feet, a displacement of 11,000 tons full load, and a maximum speed of 19½ knots. Approximately 1,000 combat troops and 20 HRS helicopters could be accommodated.[23]

The Fiscal Year 1955 budget called for two such conversions, but due to monetary shortage the second CVHA, the USS *Block Island* (CVE–106), was not started until January 1958. The conversion of the *Block Island* was never completed though, mainly as the result of an austerity move. By late 1958, the Marine Corps had gained valuable operational experience with the *Thetis Bay* and the Commandant had determined that the best solution for meeting assault helicopter aircraft carrier requirements was through new construction or by modifying other type World War II carriers. The *Block Island* was classified as the LPH–1 on 22 December 1957 although it was never used as an amphibious assault ship.

Growth and Changes Under Austere Conditions, 1956–1962

The structure of the helicopter groups remained constant from 1952 until the latter half of 1956 when changes began to appear. Some of these changes were the transfer of VMO–1 and –6 to MAG (HR(L))–16 and –36, respectively. Previously they had been attached to a Marine Wing Headquarters Group (MWHG).* Another change implemented during 1956 was the addition of the designator "light" to the transport groups and squadrons titles as envisioned in the program plans. Most of the redesignations were effective on 31 December 1956, since a distinction was now necessary as the Commandant desired to commission the first HR2S squadron in January 1957 under the "medium" designation.** [24] [25]

Following the title changes in December 1956, the Marine Corps began forming its first medium helicopter squadrons. In January 1957, HMR(M)–461, under the command of Lieutenant Colonel Griffith B. Doyle, was commissioned at MCAF, New River. The new squadron received the Marine Corps' most sought after helicopter, the HR2S–1, during March.*** [26] On the west coast, in November of the same year, HMR (M)–462 was formed within MAG (HR(L))–36 with Lieutenant Colonel Alton W. McCully as the commanding officer. The following year the third medium squadron, HMR(M)–463, was commissioned in September in MAG (HR(L))–16 under Major Kenneth L. Moos. The squadron was short lived, however, due to the scarcity of HR2Ss, and nine months later it was deactivated.[27]

The replacement helicopter for the HRS was received shortly before the HR2S. In February 1957, both HMR(L)–261 and –363 began exchanging their HRSs for the larger and faster HUS–1. Since the HUS–1 was essentially the same aircraft as the Navy's HSS–1 except for the cabin's interior arrangement, flight evaluation at Patuxent River was waived, thereby expediting its availability to the operating units. During 1957, the extent of modernization of the helicopter program can be seen by comparing its composition on 1 January 1957, in Figure 10, with that of 30 December 1957.[28]

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* VMO–2 had previously been attached to MAG (HR(L)–16.

** In spite of the forced reduction in 1957, the existing three HMR MAGs retained their "light" designation even though there were no medium groups commissioned. In 1959, however, the MAG (HR) designation was changed again to Marine Aircraft Group (MAG), dropping the "Helicopter Transport" (HR) portion of its title.

*** Although the first HR2S had been accepted in April 1956, it had been used for test purposes at the Naval Air Test Center, Patuxent River, Maryland. Also HMX–1 had been operating the HR2S on a similar research and development basis during the same year. The March 1957 date represented its initial assignment to a tactical squadron.

Figure 10

Type Aircraft	*1957 Helicopter Totals and Locations*							
	FMFPac		*FMFLant*		*HMX-1*		*Total*	
	Jan–Dec		Jan–Dec		Jan–Dec		Jan–Dec	
HR2S	0	0	0	12	2	2	2	14
HUS	0	22	0	21	0	6	0	49
HRS	83	79	47	44	10	8	140	131
HOK	22	20	3	18	3	3	28	41

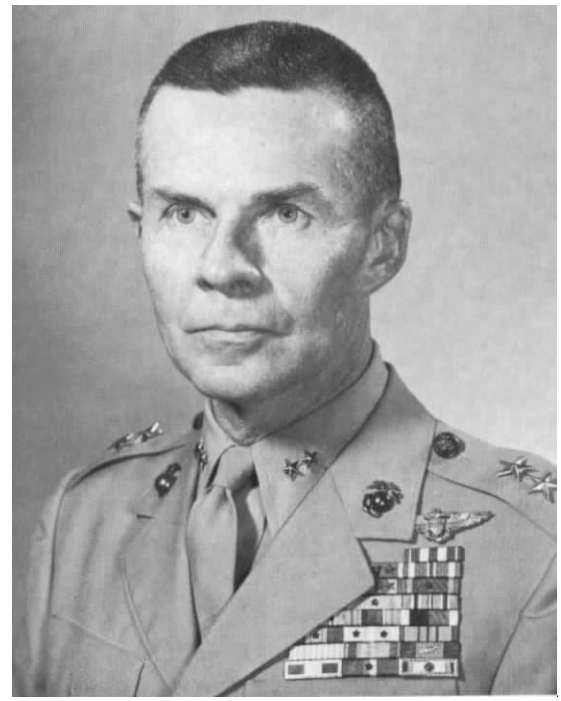
Implementation of the Hogaboom Board Recommendations

In June 1958, as the result of the Hogaboom Board recommendations and the subsequent implementation of the "M" Series T/O, the helicopter group structure underwent the recommended modification. The major alterations involved the reassignment of aircraft within the group. It reduced VMO to 12 light fixed-wing observation models and created a composite squadron of 12 HOKs and 12 HRSs. The trading of aircraft did not involve the creation of a new unit within the group, only the redesignation of one HMR(L) to Marine Helicopter Reconnaissance Squadron (HMR(C)). The remaining two light units had their helicopter strength increased from 20 to 24 aircraft each. The change of aircraft between units was made in MAG (HR(L))–26 and –36 involving HMR–263 and –363, leaving the Oppama, Japan-based MAG (HR(L))–16 under an all light HMR arrangement.* [29]

The composite structure was tested in MAG–26 for slightly less than 10 months. The New River helicopter group was then under the command of Colonel Keith B. McCutcheon, an officer who had been active in the helicopter program for many years and who had served as recorder to the Smith Board.

Colonel McCutcheon had received a Master of Science degree in aeronautical engineering from the Massachusetts Institute of Technology in 1944 as a lieutenant colonel, and later participated in air operations with MAG–24 at Bougainville, Luzon, and Mindanao. In World War II he earned the Distinguished Flying Cross and six Air Medals in the Solomons, New Guinea, and Philippine Islands combat areas. After the war, Colonel McCutcheon instructed in the Aviation Section, Marine Corps Schools, and from 1946 to 1949 served in the Pilotless Aircraft Division of BuAer. In 1950 he was ordered to Quantico where he assumed command of HMX–1. From December 1951 to October 1952 he commanded HMR–161 in Korea. Leaving the Korean area, and after a two year tour in Europe, he again returned to Quantico in 1954 to assume the duties as Chief, Air Section, Marine Corps Equipment Board. Then in June 1957, Colonel McCutcheon moved to Jacksonville, North Carolina where he assumed command of MAG–26.

The group commander gave his appraisal to the Commandant concerning the problem of operating under the new "M" Series T/O. "The greatest single deficiency," Colonel McCutcheon stated, "occurs at the group level. This is the loss of



Major General Keith B. McCutcheon, one of the leaders of the Marine helicopter program (Marine Corps Photo A413009).

* Since there were only two HMR(L)s in MAG–16, no redesignation to HMR(C) was made. The third squadron (HMR(C)–161) was Hawaii-based under MAG–13.

flexibility in carrying out assigned missions due to the reduction of light transport squadrons from three to two." He made four recommendations to General Pate:

1. Disband the HMR(C) squadron.
2. Reform three HMR(L) squadrons with 20 aircraft each.
3. Reform VMO with 12 HOKs and 12 OEs.
4. Assign HUS helicopters to all light transport squadrons as expeditiously as possible.[30]

On 31 July 1959, General Pate replied to McCutcheon's recommendations. Although no definite decision was rendered, the Commandant assured the group commander that the contents of his letter were under study along with other aviation program changes. The final results were soon forthcoming as both HMR(C)-263 and -363 were directed to revert to their prior HMR(L) designations during February 1960 and the VMOs reconstituted to their original 12 fixed-wing and 12 helicopter complement. The reconnaissance mission of the division was to be absorbed by VMOs or the HMR(L)s.[31]

By this time, however, the Division of Aviation had made plans for increasing the helicopter lift capability as proposed in Phase II and III of General Hogaboom's Organization and Composition Board Report. This action resulted in the commissioning of HMR(L)-264 in MAG-26 on 30 June 1959 under the command of Lieutenant Colonel Edwin O. Reed, a future commanding officer of HMX-1.[32] In further expanding the program, the Division of Aviation published its Program Changes for Fiscal Years 1961-1964, which allowed for the graduated increase in the light structure from 10 to 15 squadrons. The number of helicopters assigned to each of the 15 units was to vary from 18 to a maximum of 24 depending upon the total number of aircraft available in the Marine Corps inventory, and the mission of the squadron. Only two medium units were programmed to be in existence throughout the entire period due to further reductions in HR2S procurement.[33] The last squadron to be commissioned prior to 1962 was HMR-364 in MAG-36 on 1 September 1961. The relationship between the numbers of helicopters in the Marine Corps and the number projected by the Division of Aviation for the years 1960 to 1962 is presented in Figure 11.

Figure 11

Recapitulation of Helicopter Program 1960-1962

	FY 1960		*FY 1961*			*FY 1962*	
Sqd.	*Acft*		*Sqd.*	*Acft*		*Sqd.*	*Acft*	
	Planned	*On Hand*		*Planned*	*On Hand*		*Planned*	*On Hand*
VMO	72	63	3	66	89	3	63	73
HMR(L)	208	245	10	228	255	11	246	308
HMR(M)	35	27	2	26	28	2	28	31

The number of aircraft in the on hand column includes all helicopters assigned to FMF, HMX, and shore activities.[34]

CHAPTER 7

BEGINNING THE TRANSITION TO TURBINE-POWERED HELICOPTERS

Selection of the CH–46

Military planners are faced continually with the problem of obsolescence of combat equipment. This is particularly true of aircraft. In the late 1950s when the Marine Corps was faced with the problem of maintaining three combat ready divisions and aircraft wings under a severely restricted budget, it had to prepare for the replacement of the aircraft being introduced into service. General McCutcheon touched on this subject and although his remarks were made almost a decade later, they were just as appropriate for this period as they were then. He said, "Aviation is a dynamic profession. The rate of obsolescence of equipment is high and new aircraft have to be placed in the inventory periodically in order to stay abreast of the requirements of modern war." In relation to the helicopter program, this involved suitable replacements for the piston-engine-powered HR2S, HUS, and HOK models.[1]

Despite the tightening budget, the Commandant on 9 January 1958 informed the CNO that the Marine Corps required a replacement for its light (HUS) helicopter fleet. General Pate noted the inadequacy of the HUS–1 to fulfill future assault requirements and requested that 210 troop and cargo versions of the Navy's newest ASW helicopter, the twin-jet engine HSS–2, be procured during the 1962–1966 time frame. At the time, there appeared to be no other helicopter available which was competitive with the Sikorsky-built aircraft from either a cost or technical viewpoint. The recommended designation for the transport version of the HSS–2 was HR3S–1.[2]

It was not until 16 March 1959 that the CNO published Operational Requirement Number AO–17501, the second revision of the new transport. One year later, on 7 March 1960, he issued Developmental Characteristic Number AO–17501–2, VTOL Assault Transport Helicopter, as Appendix II to the 1959 operational requirement. This second revision spelled out a requirement for a helicopter capable of carrying a payload of 4,000 pounds, or 17 combat-equipped troops, over a 100-nautical mile radius. Additional requirements specified that it have multi-engines, a rear loading ramp, automatic blade-folding capability, carry a crew of three, and cruise at a speed of not less than 125 knots. It further stated that the specifications listed in the developmental characteristics had to be met by a modification of a helicopter already developed and that it must be ready for operational evaluation by 1963.[3]

While detailed specifications for the HR3S–1 were being developed by BuAer, Sikorsky discovered that in order to modify the HSS–2 to a rear-ramp-loading transport, an extension to the forward fuselage would be necessary.

Due to the delay caused by this problem, the HR3S was now being compared to another aircraft. The Vertol Corporation had developed the YHC–1A transport for the Army and the commercial version of this helicopter, the 107M, offered a high degree of competition to the Sikorsky HR3S. As a result, BuWeps * representatives in June 1960 gave a presentation in which the capabilities of both helicopters were outlined. In the proceedings, the HR3S–1 was shown to be a significantly cheaper aircraft and to have obvious logistics and training advantages; however, the Vertol 107 was presented as being fully as adequate, technically, as the HR3S–1 to accomplish the assault mission.[4]

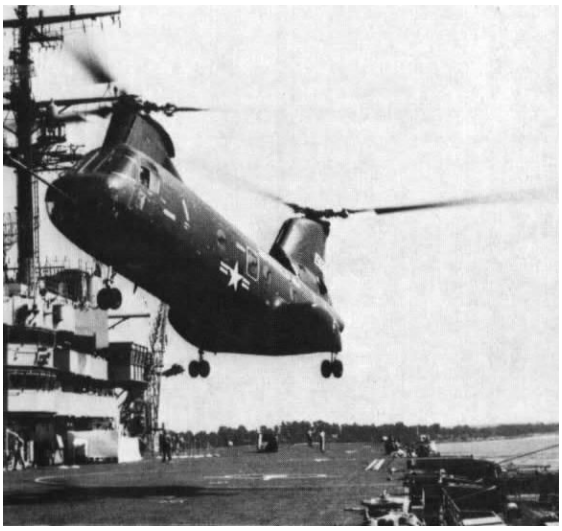
On 1 July 1960, the Director of the Marine Corps Landing Force Development Center at Quantico, Brigadier General William R. Collins, (and a former president of the Tactics and Techniques Board), informed General David M. Shoup, the Marine Corps' 22d Commandant, that the Development Center was monitoring closely the progress of both helicopters and that the data given at the BuWeps briefing differed considerably from

* On 1 December 1959 the Bureau of Naval Weapons was established and absorbed the functions of the abolished Bureau of Aeronautics and Bureau of Ordnance.

that available at the development center. General Collins pointed out that "there was a considerable divergence which, if valid, shows the Vertol 107 in a much more favorable light. It appears to be in the best interest of the Marine Corps to make a more comprehensive evaluation of the two aircraft." Accordingly, the general recommended that a comparative flight evaluation be conducted between the Vertol 107 and the Sikorsky HR3S-1.[5]

As a result of the pressure generated at Quantico for an objective comparison between the two competing designs, BuWeps assured the Commandant on 8 September that proposals from both Vertol and Sikorsky would be obtained. The next month BuWeps sent invitations for bids to the two companies. The following February, BuWeps announced its decision, declaring Vertol's design as the winner of the competition. Subsequently, the first flight of the HRB-1 was scheduled by Boeing-Vertol for June 1962 with delivery to FMF units projected for early 1964.[6]

The official military designation of HRB-1 (H-Helicopter, R-Transport, B-Boeing) was given the 107 along with the nickname of Sea Knight. The HRB-1 followed the typical Vertol design having two rotors in tandem. Two General Electric T-58 shaft turbine engines, exactly the same as those in the HSS-2, were mounted in the rear and on top of the 46-foot-long fuselage and powered the 51-foot diameter rotors. For the primary assault mission, the empty weight was listed as 11,641 pounds and a maximum gross weight limited to 18,621 pounds. The cabin section of the fuselage measured approximately 24 feet long, 6 feet high, and 6½ feet wide allowing for 17 combat-equipped troops or 15 litter patients. The helicopter was manned by a crew of three with the maximum sea level airspeed limited to 137 knots. The overall length of the prospective assault aircraft was quite long, 84½ feet. A hydraulically operated ramp was incorporated in the rear of the cabin in order to facilitate loading and unloading of troops and large pieces of cargo.[7]



A CH-46A Sea Knight lands on board the U.S.S. Guadalcanal. *The Sea Knight carried 17 combat troops at a speed of 137 knots and became the mainstay of the Marine helicopter force (Marine Corps Photo A411783).*

Choosing a Heavy Helicopter

In early 1958, in response to a request from the Office of the Secretary of Defense, BuAer conducted a study of the feasibility for a single VTOL aircraft development to satisfy the requirements of the Navy, Marine Corps, Air Force, and Army. When the study had been completed it showed conclusively that it was feasible and practical to develop a pressure-jet convertiplane/compound helicopter which would meet the requirements of all services. At the time, however, each service had their own ideas on the issue. The Army indicated that it wanted to proceed unilaterally with the development of a 6,000-pound payload, gear-driven, tandem helicopter being produced by Vertol as they felt that a pressure-jet convertiplane, as proposed by BuAer, would not be suitable for its mission. Later, the Air Force indicated an unwillingness to pursue such a development as it needed an aircraft with an extensive range capability for search and rescue purposes. The Department of Defense (DOD) reluctantly authorized the Army to proceed with its program but agreed that the Navy-Marine Corps' position of developing a pressure-jet convertiplane was feasible and technically sound and authorized the Navy to proceed with its research and development.[8]

The existing operational requirement (AO-17501) under which the HR2S had been developed, was revised by the Marine Corps to reflect the desired characteristics for such an aircraft to replace the HR2S which was scheduled to be phased out in the 1964–1965 period. The Commandant submitted the document to the CNO on 26 November 1958. On 16 March 1959, it was promulgated as Operational Requirement Number AO-17501-2, with Developmental Characteristic Number AO-17501-1 (VTOL Assault Transport) as Appendix Number One. The operational requirement stated that the VTOL aircraft should be

capable of carrying a payload of 8,000 pounds outbound to a distance of 100 miles at a cruising speed of 200 knots and return with a 4,000-pound payload. A maximum airspeed of 250 knots was also specified.[9]

By 27 January 1961, the Air Force and Army had shown a renewed interest in a VTOL aircraft and through a series of DOD actions an agreement had been reached wherein all services consented to participate in the development of a prototype VTOL transport. BuWeps, the DOD-appointed manager for the tri-service aircraft, then issued a revised statement of requirements which specified the same payload but extended the aircraft's radius to approximately 250 miles and increased the cruising airspeed to 250–300 knots and the maximum airspeed to 300–400 knots. However, for the Marine Corps mission, the requirement stated that the fuel load could be reduced so that the maximum gross weight would not exceed 35,000 pounds so long as a 100-mile nautical radius of action could be flown.[10]

By August 1961, the Navy recognized that the four-engine tilt-wing aircraft, the design which had now been selected for the tri-service evaluation instead of the compound helicopter, would be unsuitable for Navy or Marine Corps use and withdrew from the program. Long before this time, however, the CMC and CNO had recognized that any production aircraft resulting from the high-speed VTOL program would not reach the fleet in time to replace the HR2S. In view of this, and at the Commandant's urging, the CNO issued on 27 March 1961 a revised developmental characteristic (AO–17501–3) for a medium assault transport helicopter with essentially the same requirements as the convertiplane (AO–17501–2) but with a cruising airspeed of only 150 knots. The gross weight was also to be limited to a maximum of 35,000 pounds.[11]

Since it had been determined that such a short time existed before the new helicopter was needed in the fleet, a replacement aircraft would again have to be a development of an existing model. The initial competition was therefore between three major helicopter manufacturers; Kaman, Sikorsky, and Boeing-Vertol. The Kaman Aircraft Company had shown an interest in competing for the contract but dropped out before submitting a formal bid.[12]

Vertol proposed that it could meet the requirements of AO–17501–3 by modifying its Army HC–1B Chinook, an enlarged version of its 107, or HRB–1. Sikorsky, on the other hand, based its design for the large helicopter on a revision of its jet-powered S–64 Flying Crane, an aircraft being built completely from company funds for future sale to West Germany. The general description of the proposed transport helicopter revealed that it was to utilize a sixbladed single main rotor and a 16-foot diameter tail rotor. The cabin measured 30 feet long, 6½ feet high, and 7½ feet wide with a rear loading ramp. It featured a watertight hull, seats for 30 combat equipped troops, tricycle retractable landing gear, twin turbine engines, automatic blade folding, and required a crew of two pilots and a crew chief. The aircraft had an overall length of 88 feet, a gross weight of 32,000 pounds, and an empty weight of approximately 19,000 pounds. The cruising speed at the designed gross weight was listed at 150 knots with a maximum airspeed of 171 knots at sea level.* [13] [14]

Request for proposals on the large transport helicopter were sent to the competing manufacturers by BuWeps on 7 March 1962. Sikorsky and Vertol replied in May, and on 24 August 1962 BuWeps announced the Sikorsky Aircraft design as the winner. Not only had Sikorsky submitted the lowest bid, but there was a decided preference based on technical, production, and maintenance aspects of the Sikorsky proposal.[15]

The first aircraft was to be delivered during May 1964 with fleet deliveries beginning the following year. The original designation of H-H(X) was given the assault helicopter (H-Helicopter, H-Heavy, (X)-Experimental). It was later designated by Sikorsky as its S-65 and by the Navy as the CH–53A.[16]

During September 1962 the designation for all Navy-Marine Corps aircraft changed. Class HO (helicopter observation) became HL (helicopter-light); Helicopter Light (HL) was changed to Helicopter Medium (HM) and Helicopter Medium (HM) became Helicopter Heavy (HH). Squadron designations were also changed during the same year: HMR(L) became HMM, HMR (M) became HMH. The VMOs retained their designation. In addition, the Department of Defense changed the helicopter designations for the HRS to CH–19, HOK to OH–43D, HUS–1 to UH–34D, and the HR2S–1 to CH–37A.[17]

* Mr. Lee S. Johnson, President of Sikorsky Aircraft mentioned to BuWeps that the company had not, as of 14 August 1961, received a formal request for proposal. Therefore, the details of his letter (proposal) for the heavy helicopter were based on a limited knowledge of the Marine Corps detailed requirements for such an aircraft.

The CH-53A was developed during 1962 and placed in service in 1964. It is a heavy assault transport with a cruising speed of 172 knots and a troop capacity of 38 (Marine Corps Photo A412901).

The Selection of an Assault Support Helicopter (ASH)

At the same time the Marine Corps was working on the development of its heavy and medium helicopters, it also was attempting to obtain a replacement for its light helicopter fleet. A forerunner in this category was the proposed Hiller Aircraft Company turbine-powered CAMEL (Collapsible Airborne Military Equipment Lifter). This type of light helicopter received considerable support from the Development Center and was seen as an essential element of strategic and tactical mobility during the later 1950s. It was to have the capability of being disassembled for transport by air or in any class of amphibious shipping to a combat area where it would be reassembled later and made ready for flight. It was not until 1960, though, that the Marine Corps began to see results of its efforts to obtain a replacement for its HOK and OE aircraft, both of which were to be completely phased out by 1965. In the past, vain attempts had been made to obtain funding for a single VTOL observation aircraft, or an ASH. It became apparent that to offset a forthcoming inventory shortage in these aircraft, immediate funding of a new program would be required.

The decision to pursue a program to provide a single rotary-wing type aircraft was the fruit of lengthy staffing at HQMC. As a result, the Division of Aviation submitted Developmental Characteristic Number AO-17503-3 to the CNO during late April 1960 for approval and promulgation. The desired characteristics for the ASH listed the gross weight at 3,500 pounds, a payload capability of 800 pounds or three troops, and a cruising airspeed of 85 knots.[18]

The Developmental Characteristic was published by the CNO on 9 August 1960. Concurrently, however, the Army had also stated a requirement for a light observation aircraft (LOA) which was very similar to that of the ASH. The Army placed emphasis on volume procurement of such a machine as a replacement for its fixed-wing and helicopter observation aircraft. An opportunity thereby existed for the Marine Corps to establish a joint services procurement program which would greatly reduce the unit cost for both services. This was also an advantage to the Marine Corps as there was now insufficient time to embark on a new development program unilaterally.[19]

The Coordinator, Marine Corps Landing Force Development Activities (CMCLFDA), Lieutenant General Edward W. Snedeker, took a different view toward the headquarters proposal for the ASH. Snedeker, a veteran officer who had commanded both the 1st and 2d Marine Divisions and served as Assistant Chief of Staff, G-3 at HQMC, reiterated the position developed at Quantico. In November 1960, a proposed developmental characteristic had been sent to CMC specifying a helicopter with a 100-knot, 1,000 pound payload and

100-mile radius of action, which the Hiller's CAMEL was capable of meeting. The same specifications had been submitted earlier by the Development Center but it was now officially submitted as a proposed developmental characteristic since it was felt that AO–17503–3 (ASH) did not measure up to the requirements stated in either the Marine Corps Landing Force Development Center or HQMC research and development plans for that type of aircraft. A lengthy rebuttal to the concept of using one type aircraft as a replacement for the HOK and OE was also included. The letter pointed out that the Army's LOA requirement was within the framework of an aircraft "family" completely different than that envisioned for the Marine Corps. General Snedeker emphasized that the Marine Corps needed a separate replacement for each, a 100-knot ASH for the HOK and an STOL (short takeoff and landing) light attack-reconnaissance aircraft to replace and expand the mission of the OE aircraft.[20]

In March, the following year, the CNO suggested to BuWeps that a limited competition be conducted to select an aircraft to fulfill the Marine Corps ASH mission. He stated that once a satisfactory selection and model evaluation had been made, every effort would be expended to effect necessary programming of funds within the FY 1962 budget to permit the accelerated purchase of operational aircraft. Soon thereafter, BuWeps conducted a study of those helicopters under consideration for selection as an ASH. The results revealed that each prospective model failed to qualify because of one or more deficiencies in size, cost, capability, or simply lack of overall qualification. It became apparent that a compromise had to be made in regard to selection of an aircraft prototype.[21]

Time was now an important factor since the HOKs were programmed for replacement in less than two years as they had been in the VMO squadrons continously since May 1956. The Deputy CNO (Air), Vice Admiral Robert B. Pirie, had stated earlier that it would be in the best interest of the Marine Corps to accept the burden of increased size and cost of an operationally qualified model rather than gamble on a reduced capability or a possible protracted and costly developmental program such as the Hiller CAMEL or Army's LOH. He mentioned that the potential of an existing trainer, or light utility aircraft, might well be considered by the Marine Corps planners as its ASH. The Deputy CNO also recommended to BuWeps that a request for proposal be issued as soon as possible with reasonable latitude in consideration of helicopter capability of performing the ASH mission. "The imperativeness," Admiral Pirie said "of positive action leading to a selection of this increasingly critical subject cannot be overemphasized." [22]

BuWeps acted promptly to Admiral Pirie's directive. On 16 October 1961, requests for bids went to 10 helicopter manufacturers and by 27 November seven companies responded with their proposals.* [23] After considering all the factors of each proposed design, BuWeps decided on 2 March 1962 that an existing Bell-manufactured helicopter, the Army-designated HU–1B, could fill the Marine Corps' ASH role.[24]

A number of elements entered into the decision which led to the choice of the Bell HU–1B. The paramount consideration was the time factor. The Army's LOH was not programmed for production until 1965 where the Marine Corps' ASH was needed by 1963. Additionally, the LOH was to be equipped with a smaller engine than the Marine Corps deemed necessary and provisions were not made in the LOH for carrying litters internally. The Marine Corps version (UH–IE) differed from the standard Army HU–1B in that it was necessary to remove most of the Army communication and electronics and install standard USMC/USN equipment. Other changes included the incorporation of a rotor brake for shipboard operations, a rescue hoist, and replacement of magnesium skin with aluminum to reduce salt water corrosion problems.[25]

Although the UH–1E utility helicopter was a fairly large and heavy aircraft, it met or exceeded the specifications of AO–17503–3 in all categories. The performance summary listed the empty weight at 4,734 pounds, maximum gross takeoff of 8,600 pounds, and the payload at approximately 1,300 pounds with a full fuel load. A combat radius of 100 miles was given along with a cruising speed near 100 knots and a maximum airspeed of 140 knots. The single-turbine engine, two-bladed helicopter had a rotor diameter of 44 feet and an overall length of 53 feet. The cabin had large sliding doors on each side allowing straight-through loading. A total of three litters could be accommodated and they could be loaded from either side or from both sides simultaneously. Seats for five passengers were provided. Only one pilot was needed, although provisions were incorporated for a copilot.

* The seven aircraft companies submitting bids to BuWeps were: Bell, Hiller, Kaman, Lockheed, Piasecki, Republic, and Sikorsky. Cessna, Gyrodyne, and Doman were the three companies which failed to respond to BuWeps request for bids.

The UH-1E was designed in 1962 and placed into service in 1964. It is the smallest and lightest aircraft in the modern Marine helicopter service.

The first flight of the UH-1E was scheduled for February 1963 with delivery to the fleet the following month. The selection of the UH-1E was viewed as a wise choice from the developmental point of view since by the time the Marine Corps would get its first -1E more than 400 -1Bs would be in Army service.[26]

The Essex Class Carrier as an Interim LPH

While preparation and negotiation had been underway for the transition to an all-turbine-powered helicopter fleet, major changes had been made in the Navy shipbuilding program. The disappointing factor in this case was the unavailability of helicopter aircraft carriers (Amphibious Assault Ships—LPHs). Although the *Thetis Bay* was providing the Marine Corps with a floating helicopter platform for training and evaluation purposes, it was inadequate as a full-fledged assault helicopter carrier. The Marine Corps had been hopeful, however, that by the late 1950s it would have the desired numbers of LPHs but the Navy had placed a priority on other types of ships thus delaying the LPH development.

Originally the amphibious assault ship program called for conversion of CVA-55 and -105 class aircraft carriers. Knowing that converted CVEs could not accommodate fully the larger types of helicopters and that they would have a limited service life expectancy, the Commandant reversed his prior position and recommended that all such ships be built from the keel up as LPHs. In May 1956, after strong urging by the Navy and after considerable compromise on the part of the Marine Corps, General Pate agreed to a program which would provide one new LPH and one converted CVE-105 each year through the period of 1958 through 1962.[27]

With the approved five-year program to commence in 1958 and the LPH conversion and construction periods requiring two and three years respectively, an equal number of years would lapse during which the Marine Corps would be without the services of properly designed shipping from which to conduct an amphibious vertical assault. At the earliest, it would be 1960 before the first converted LPH would be operational, therefore another solution was needed. The relief came in the form of a suggestion from Rear Admiral Frederick N. Kivette, a member of the Navy's Standing Committee, Long Range Shipbuilding and Conversion.* At a meeting of the

* The Marine Corps was represented by one officer on this committee after mid-1956.

committee on 29 July 1957, he introduced the subject of utilizing *Essex*-class CVSs (ASW support aircraft carrier) as interim LPHs since some carriers of this type were scheduled for retirement.

Actually this thought had been presented as early as 1954 in a proposed CMC letter to the CNO recommending the use of CVSs or CVAs for helicopter operations. However, it is believed that the letter was never sent. Colonel James C. Murray, Head, Policy Analysis Division, HQMC, when commenting on the proposed letter, stated to the Chief of Staff on 28 April 1954:

> While this letter (the use of CVS and CVA carriers for helicopter operations) was prepared prior to the approval of the New Marine Corps concept (that proposed in LFB–17), it can now be associated with that concept.
>
> So far as I can determine, no formal discussion had been held which would provide assurance that this request will be approved.
>
> I do not feel that we should risk a formal disapproval on what might be regarded as an element of the new concept until we have attempted to gain Navy acceptance to the concept itself. . . .
>
> In summary, in the absence of any informal prior indication that this recommendation will be approved, its submission at this time may result in a disapproval which would tend to crystallize CNO opposition to the concept itself. It is recommended that: (a) the letter be delayed until the new concept has been presented to the Navy or (b) if time is pressing, that the matter be taken up on an informal basis to assure approval prior to the submission of a formal recommendation.[28]

The suggestion emphasized economy since the necessary modifications needed to make the *Essex*-class carrier into an acceptable LPH were estimated to be minimal. Additionally, the Navy could make the CVSs available to the Marine Corps within a relatively short period of time.

The outcome of Admiral Kivette's proposal was not known until 2 May 1958 at which time General Pate officially informed the CNO of the Marine Corps decision. In a memorandum to Admiral Burke the Commandant remarked:

> . . . [on] 15 March 1958 I stated that I would advise you of my views concerning the use of the CVS as an interim LPH following a report of their use during LANTPHIBEX 1-58.* [29] This report has been very gratifying and indicates that the CVS with limited modification will be a suitable type to meet existing needs until new LPH[s] are available in the fleet. . . . I recommend for your consideration that a least two CVS's which are scheduled to be deactivated in the near future, be modified to meet landing force requirements and made available for deployment with the amphibious forces as soon as possible.[30]

The *Essex*-class aircraft carrier had characteristics which made it quite compatible for helicopter operations and suitable as a platform from which to launch a ship-to-shore movement, but yet it also had some drawbacks. The shortcomings were mainly in its poor cargo-handling and combat troop-billeting facilities. Another undesirable condition, one imposed by the Navy, was the Marine Corps' obligation to provide Marine officers and enlisted men to augment the Navy crew. Those features which made the ship appealing, however, were its 889-foot flight deck, three aircraft elevators between the hangar and flight deck, 14 or more HUS launching locations, and a top speed in excess of 30 knots. Additionally, it was figured that a total of 30 HR2Ss or up to 60 HUSs could be transported when utilizing all available space. In wartime situations, an *Essex*-class ship had a complement of personnel, both ship's company and air group, that often reached as many as 2,800, a far greater capability than that of the *Thetis Bay*.[31]

Comparing the features of the *Essex*-class carriers against the newly constructed LPHs, the older CVSs appear, in many respects, superior. The newly constructed LPHs would have a 590-foot flight deck with deck spots for only eight HUS helicopters, two elevators, and a top speed of about 20 knots. The maximum number of transported helicopters would vary from 20 to 40 depending on their type and the method of storage. However, the modern command facilities, latest type cargo and material handling system, plus adequate space for the movement and berthing of combat troops would made the new ships more desirable in these areas. The new LPHs were not intended to compete with the larger aircraft carriers but rather they were designed particularly to combat load, transport, and land a Marine BLT of up to 2,000 personnel with an embarked Marine transport helicopter squadron.[32]

Accordingly, the USS *Boxer* (CVS–21) was reclassified as the LPH–4 on 30 January 1959 and the USS *Princeton* (CVS–37) reclassified as LPH 5 on 2 March. A third ship, the USS *Valley Forge*, (CVS–45) joined the ranks of amphibious assault ships on 1 July 1961 as the LPH–8.[33]

The three converted CVSs "filled the gap" as interim LPHs until sufficient number of new con-

* LANTPHIBEX 1–58 took place in early 1958 off the coast of Onslow Beach, North Carolina. In addition to evaluating the feasibility of using the CVS as an interim LPH, it was the largest test up to this time of the vertical envelopment doctrine. Helicopters from Colonel McCutcheon's MAG–26 lifted in the ship-to-shore movement a complete RLT of the 2d Marine Division. Operating from the USS *Tarawa* (CVS–40), *Valley Forge* (CVS–45), and the *Forrestal* (CVA–59), the aircraft group demonstrated the soundness of the portion of the doctrine which envisioned the simultaneous use of more than one LPH.

Figure 12

New Construction LPH			
*LPH**	*Name*	*Auth in FY*	*Commissioned*
2	*Iwo Jima*	58	26 August 1961
3	*Okinawa*	59	14 April 1962
7	*Guadalcanal*	60	July 1963 **
9	*Guam*	62	January 1965 **
10	*Tripoli*	63 **	August 1966 **
11	*New Orleans*	65 **	November 1968 **
12	*Inchon*	66 **	June 1970 **

* LPH-1 *Block Island;* LPH-4 *Boxer;* LPH-5 *Princeton;* LPH-6 *Thetis Bay;* LPH-8 *Valley Forge.*

** Projected dates.

struction LPHs were in service, with the plans for converting the five CVEs subsequently being dropped. Figure 12 gives the data on the new ships as it was planned at the time.[34]

One-Man Helicopters * [35]

Other projects, not as successful as those which have been mentioned, were subjected to lengthy and detailed evaluation. The Marine Corps sought a wide range of helicopters capable of fulfilling nearly every requirement of the ground commander.

The smallest size helicopter to undergo Marine Corps evaluation was the one-man helicopter. It was this project the Marine Corps actively pursued for over an eight-year period and was seen originally as some sort of "pinwheel" which could be strapped to a man's back and would be capable of transporting him short distances. The concept was translated in 1952 into an operational requirement (AO-17503), when the Commandant apprised the Chief of Naval Operations of the Marine Corps' need for a one-man helicopter. General characteristics of this device were:

1. Capacity—One man with combat equipment (240 lbs)
2. Operating Range—10 to 15 miles
3. Weight—50 to 75 lbs (one man portable)
4. Endurance—15 minutes
5. Speed—30 mph
6. Capable of autorotative landings
7. Require minimum training by nonpilots
8. Inexpensive
9. Packaged in a one-man load and capable of being readied for flight by one man in not more than five minutes.

In order to keep one-man helicopters from becoming an aircraft inventory item, in 1954 the CNO redesignated the one-man portable helicopter as an item of equipment, called the "Rotorcycle." In 1956 the CNO published a revised Operational Requirement AO-17505 reflecting a few changes to the original requirement which subsequently became the basis for testing several other experimental air vehicles.

Of the several types tested, none proved capable of satisfying the Marine Corps requirements. Two mandatory requirements were that it be light enough for one man to carry and simple to operate so that no specialized training for the "driver" would be necessary. The Gyrodyne RON-1 and the Hiller ROE-1 were the most promising models but they weighed in excess of 300 pounds empty, and were tricky "aircraft" which required the skills of an experienced helicopter pilot. Other models, such as Rotorcraft's "Pinwheel," Kellet's "Stable Mable," DeLackner's "Aerocycle," or Hiller's "Flying Platform," while easy to fly and maintain,

The dream of a one-man, portable, flying machine never materialized. The closest operational device was this Rotocycle (Navy Photo Np/45/5834).

* The contents of the following subsections were condensed and taken exclusively from a study on Marine Corps helicopter requirements prepared by the T&T Board, MCLFDC, Quantico, dated 2 May 1961.

proved unacceptable because of size, a requirement for exotic fuel, or the inability to autorotate to a safe landing after an in-flight power failure.

It appeared that while a valid requirement existed for some sort of small, inexpensive vehicle (not an aircraft) which would be available to the unit commander as his personal "jeep" and free him from the limitations of terrain-mobility, construction of such a vehicle would have to depend on some new technological development. Marine Corps exploration in the field of simple, lightweight aerial vehicles was cancelled by the Commandant in October 1960 and the satisfaction of this unfilled requirement, therefore, would have to rely on overland transportation or the use of a utility-type helicopter.

The Flying Crane Helicopter

A flying crane was generally visualized as a sort of heavy cargo unloader consisting of a skeleton fuselage, lift and power systems, and a pilot cab containing the flight and power controls. The flying crane's use would be to transport heavy pieces of materiel, rolling stock, engineer equipment, or large tonnages of bulk supplies. Initially, the first Marine Corps requirement for a flying crane helicopter was submitted to the CNO on 21 November 1950. The primary mission envisioned was to transfer aircraft from replenishment class 55 or 105 carriers to the *Midway* class CVLs and smaller *Independence* class CVBs. Soon thereafter, on 27 December, the CNO published a letter to all his departments setting up a requirement for the flying crane helicopter with the specification that it be capable of lifting a payload of 25,000 pounds over a radius of 10 miles.

Later in 1954, a Marine Corps Development Center study on helicopter requirements saw a need for a 20,000-pound payload XHCH–1 (Cargo Unloader Helicopter) to land the ONTOS (antitank weapon system) and 2½-ton cargo trucks. The XHCH was then an experimental helicopter being built by McDonnell Aircraft Corporation in accordance with the CNO's 1950 requirement, but it was never produced. In 1956 the Marine Corps Equipment Development Policy and Guide also saw a requirement for a cargo unloader helicopter, again with a 25,000-pound payload capability.

In 1959, the Director, Marine Corps Development Center stated a requirement for a crane helicopter. He specified in a letter to the Commandant:

> One of the most serious deficiencies in our vertical assault capability that exists today is the inability to lift heavy equipment essential to the landing force . . . It is considered that the number of pieces of equipment requiring heavy lift in support of a landing force would not be great . . . It now appears that developmental advances in rotor design and gas turbine engines is such that with proper direction, support and guidance, a helicopter capable of lifts up to 25,000 pounds could be obtained in a few years. It is, therefore, recommended that Headquarters, U. S. Marine Corps:
>
> a. State an operational requirement for a crane type helicopter capable of carrying a payload of 12,000 pounds with a minimum combat radius of 50 nautical miles. Encourage and support the aircraft industry to develop on an expeditious basis a crane type helicopter to meet this requirement.
>
> b. Program continued development of a crane type helicopter capable of carrying a payload of 20,000 pounds with a minimum combat radius of 50 nautical miles but with a greater combat radius if it can be achieved.
>
> c. Procure at an early date at least two prototypes of the most promising "Flying Crane" type helicopter for user test.

In March 1960, the Coordinator, MCLFDA submitted to CMC a "Proposed Operational Requirement for Landing Force VTOL Aircraft." Included therein was a "VTOL Cargo Unloader Aircraft (Flying Crane)" with a lift capability of 25,000 pounds. One significant fact concerning these views was that they were an expression of the "All helicopter concept" philosophy of LFB–17.

Why not a flying crane helicopter before 1960? Basically, the manufacturers could not produce one capable of lifting the desired weight. The first model of Piasecki's XH–16 was truly a flying crane as it was designed to carry its load in detachable "pods." Piasecki's second XH–16 had a large cabin and was the type which had interested the Marine Corps as an assault transport. Both aircraft failed primarily because the state of power plant and transmission development had not advanced sufficiently to match the demand. Also the Navy-funded McDonnell's XHCH–1 failed due to the same shortcomings. During 1956–1958, the U. S. Army Transportation Research and Engineering Command (TRECOM) actively studied the technical aspects of flying crane helicopters. Research contracts to conduct design and cost analysis were let to leading aircraft manufacturers. TRECOM examined the flying crane concept and evaluated the conclusions reached by the several manufacturers. Two of the most significant conclusions were: 1. The flying crane had singular requirements and design considerations which were not inherent in helicopters then in operation, and was very sensitive to changes in design, operating radius, and payload. For each payload and range combination there was an optimum power plant

(shaft drive/tip-jet drive) and rotor (single, tandem, quad) combination. 2. Flying cranes were very large, very heavy aircraft. Rotor diameters on the order of 120 feet and empty weights in excess of 30,000 pounds were representative of flying cranes designed for payloads of 12 tons and operating radii of 50 nautical miles. A pure flying crane helicopter would have been of little value to the Marine Corps as there was only a limited opportunity for its useful employment in combat and, because of its size, it was difficult to load in amphibious shipping.

To satisfy the requirement for heavy lifts without a true flying crane, it was envisioned that a heavy cargo helicopter could be stripped of its auxiliary power unit, communications/navigation equipment, and other removable equipment and operate with a reduced fuel load and minimum crew. It then could become a flying crane, of sorts, capable of lifting five or six tons of external cargo for a tactically significant distance.

Handicapped by not having a flying crane, the Marine Corps' course of action would be to continue to make up light loads, and sectionalize heavy items of equipment, and employ the future CH–53 8,000-pound payload helicopters in a limited flying crane role until technology could produce a smaller, more versatile, and efficient crane helicopter.

Robot (Remotely Controlled) Helicopters

The Marine Corps for several years had been interested in the feasibility of employing pilotless helicopters. Basically, they were viewed as being a replacement for manned vehicles on missions where survival probability would be unacceptably low and also on missions which would not necessarily require the decision-making capability of a pilot.

In April 1954, the Marine Corps Development Center, at the direction of the CMC, submitted a brief research paper entitled "Study of Marine Corps Requirements for Remotely Controlled Rotary Wing Aircraft." This study recommended the acquisition of a limited number of remotely controlled helicopters for service use in order to evaluate their effectiveness in the following roles:

(1) As an atomic weapons close support delivery system remotely controlled and positioned by radar.
(2) As a remotely controlled platform for television cameras, airborne early warning or other intelligence gathering devices.
(3) As an "umbrella" of atomic aerial mines for defense against enemy aircraft and missiles.
(4) As a transporter of battlefield illumination devices.
(5) As a vehicle utilized for the routine shuttling of supplies.

In May, after reviewing the study, the Commandant established with the Chief of Naval Operations a tentative requirement for a few robot helicopters for test and evaluation purposes.

The next year a proposal was submitted by Kaman for "The Kaman Drone Helicopter System." This proposal saw the advantages of a drone helicopter as:

(1) The possibility of operating under hazardous conditions without endangering lives of pilot and crew.
(2) The possibility of operating under all-weather conditions using relatively unskilled operators because the helicopter is, at all times, completely stabilized and locked to a remote electronic control system.
(3) The possibility of lifting very small useful loads with a proportionately small vehicle because of the absence of pilot and attendant weight items.
(4) A considerable reduction in aircraft weight to accomplish any given mission.

Similar to the 1954 Marine Corps Development Center study, the Kaman proposal saw the drone helicopter applicable to a number of Navy-Marine missions, including: ASW, battlefield illumination, troop logistical support, minefield clearance, and, by installation of drone controls, as an all-weather navigation system for manned transport and utility helicopters.

Continuing to pursue the requirement, the 1956 Marine Corps Equipment Development Policy and Guide contained a statement expressing a need for

Research in drone helicopters has continued from the days of the autogyro. HTK–1 testing in 1958 lead to the conclusion that the major use of drone helicopters would be for cargo transport (Kaman Aircraft Corp. Photo 2570–1).

remotely controlled helicopters answering the following description:

> A family of helicopters, remotely controlled by surface or airborne devices, capable of transporting supplies and equipment, in weight categories of 100, 1,000 and 3,000 pounds, for use by the landing force during all phases of amphibious operations. These helicopters will operate from vessels of the amphibious task force on scheduled or programmed routes to specific or selectable landing areas. Operators will control landing and take-off operations. Provisions for command and control during all phases of operations are mandatory.

In 1959 the Operations Research Analysis Branch at Headquarters, Marine Corps, under the direction of Dr. Alexander L. Slafkosky, made a detailed study which proceeded on the assumption that:

> If a robot cargo carrying helicopter could be developed which would be capable of handling a part of the logistical load of the manned helicopter, the limited number of manned helicopters and trained helicopter pilots might be utilized more effectively for tactical operations.

The report concluded with a recommendation that the Marine Corps pursue the development of robots in order to achieve an adequate vertical lift capability over a radius of 25 nautical miles or more.

Meanwhile, the Kaman Aircraft Corporation and the Bell Helicopter Company had been actively engaged in research and development of remotely controlled helicopters, primarily in pursuit of Office of Naval Research and BuWeps projects. They had made numerous proposals and had demonstrated successfully robot versions of their HTK and HUL models.

During early 1959, the Marine Corps Landing Force Development Center and HMX–1, at the direction of Headquarters Marine Corps, sought to determine Marine Corps requirements for robot helicopters and at the same time to evaluate the Kaman HTK–1 Drone, a trainer version of the HOK–1. Three test objectives of this project were to determine: the Marine Corps' requirements for robot helicopters, the performance characteristics desired in robot helicopters, and the operating characteristics from which to develop concepts of employment. An analysis of the report of the MCLFDC/HMX–1 project does not indicate an exhaustive pursuit of the extensive problem. However, those conclusions reached were worthy of note insofar as they reflected the thinking at Marine Corps Schools at that time.

> 1. The Kaman robot helicopter system was suitable for point-to-point cargo transport utilizing enlisted personnel as controllers. But the system was not suitable for performing reconnaissance, pathfinding, radio and radar relay and radiological monitoring missions.
> 2. The Marine Corps had a requirement for cargo carrying drone helicopters but did not have a requirement for drone helicopters capable of performing a variety of missions as: reconnaissance, pathfinding, radio and radar relay, radiological monitoring. The availability of drone helicopters, and their use as the primary means for resupply of tactical units, would result in a significant increase in the mobility of tactical elements of the Marine division.
> 3. The desired performance characteristics of cargo carrying robot helicopters were listed as having a 100 mile radius of action, 90 knot cruising speed and capable of lifting a 6,000-pound payload.

The only clear result of the 1959 MCLFDC/HMX–1 evaluation was the demonstration that a single helicopter could be droned and controlled in a local area by either ground or air controllers. Tactical or practical applications of drone employment were not evaluated.

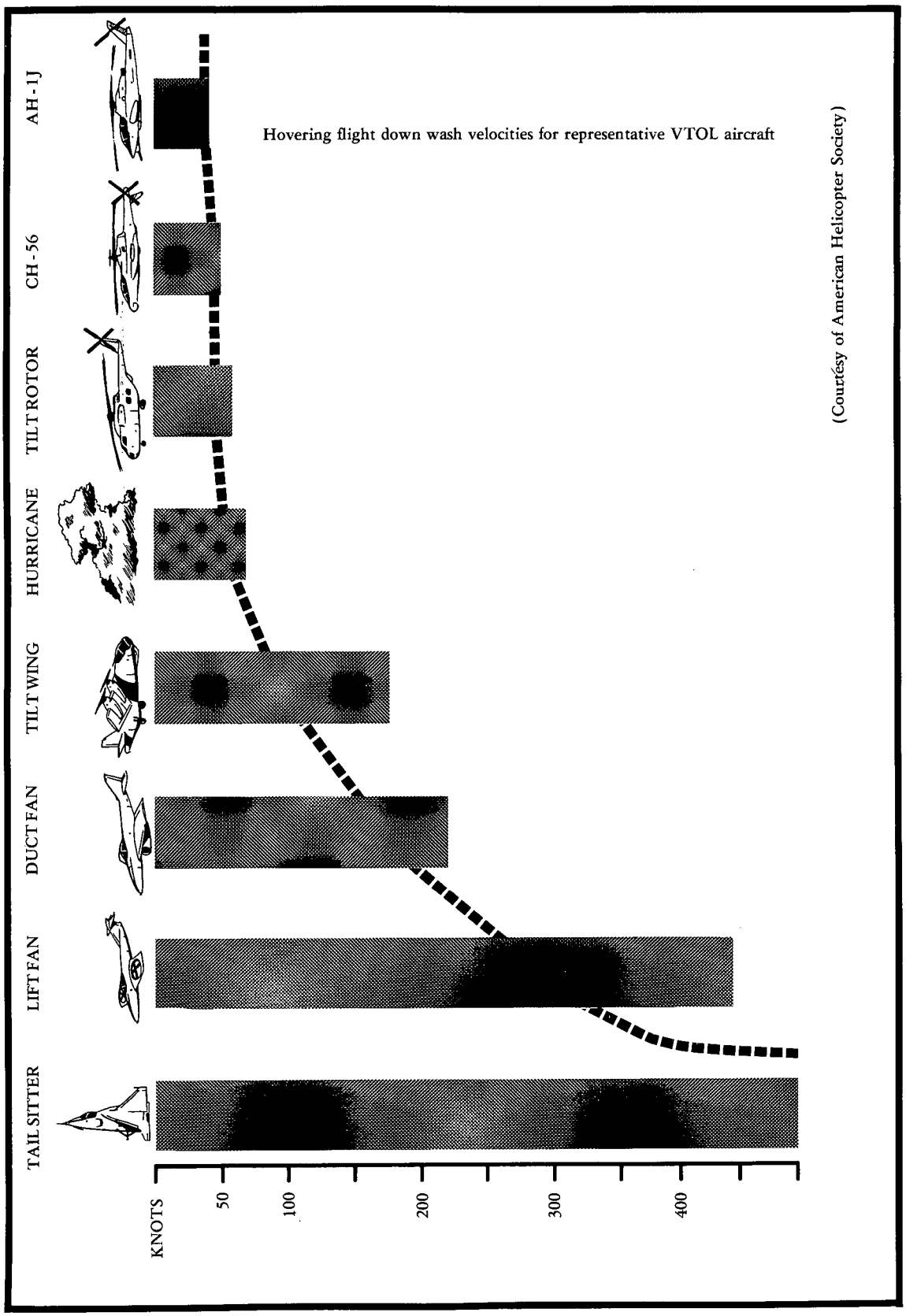
Hopeful that the Kaman system would prove successful, the Marine Corps Aviation Programs for 1959–1964 were changed on 8 March 1960 to provide for the formation of one helicopter drone (cargo) squadron during FY 63 and two more during FY 64. Commissioning these squadrons was to be subject to budgeting, development, and production variables, and not to be chargeable against the operating aircraft inventory. The formation of a squadron with drone helicopters never occurred since they did not prove to be inexpensive or so reliable and easy to operate as to provide a clear advantage over the manned helicopters.

VTOL Aircraft as They Pertain to Helicopters

Such advanced VTOL design as the compound helicopter or convertiplane, tilt-rotor, tilt-prop, tilt-wing, ducted fan, lift fan, and tail sitter had all shown promise of being operational realities and were seen by many to be a desirable replacement for the helicopter. Also there was a stated operational requirement for a 30-passenger 250-knot VTOL assault transport. Its characteristics were described in Operational Requirement AO–17501–2, which said in part:

> The concept of VTOL Assault Transport systems is considered sound and is based on the requirement for significantly greater speed, range and ton mile capability in the conduct of amphibious vertical lift assault operations and for reduced vulnerability in expected operating environment from hostile ground and air weapons.

The statement appearing in AO-17501-2 con-



Hovering flight down wash velocities for representative VTOL aircraft

(Courtesy of American Helicopter Society)

tained the fundamental basis for replacing the helicopter with VTOL transport aircraft: "Speed with which to purchase greater combat survivability and speed with which to purchase greater aircraft productivity." Obviously, all other variables being equal, the faster an aircraft could fly the less it would be exposed to enemy fire and the probability of it being destroyed would also be reduced. However, speed was not the only element of combat survivability. Aircraft design and tactics were considered more important effects on survivability than speed. It was thought that a faster aircraft designed with exposed engines and fuel cells, or an unprotected crew may actually be more vulnerable than a slower aircraft with these essentials well protected.

Speed was, however, an essential element of productivity, and an aircraft capable of carrying the same load faster should enjoy greater productivity. Speed was not the only essential element of productivity; radius of action, logistic support needs, and Marine Corps aircraft-LPH compatibility were among the many factors which could influence aircraft productivity.

VTOL transport development did not prove to be as productive as helicopters for the short range/low altitude mission representative of Marine Corps helicopter operations. One of the most important reasons for the relatively poor short-haul/low altitude productivity of VTOL transports was found in the tremendous power-to-hover requirements for these aircraft, a requirement which renders the aircraft uneconomical to operate until it can transition into conventional flight.

Another important factor was cargo handling. High-speed aircraft would have to carry cargo internally and fly at considerable altitude at design cruising speed. Large items of combat equipment easily carried externally by conventional helicopters could not be carried at all by many VTOL designs. Others, like the convertiplane, could transport heavy items but only for short distances and with considerable loss of aircraft efficiency.

Helicopter-LPH compatibility was a factor of major importance in determining the suitability of a particular aircraft for Marine Corps use. Generally speaking, the higher the payload-size ratio, the better the aircraft. Most of the VTOL designs examined in any detail did not compare favorably with true helicopters in this respect.

Inherent in the design of any advanced VTOL aircraft was the problem of "downwash," the hypervelocity winds directed at the ground during landing, take-off, and hovering flight. Conventional helicopters generated high velocity downwash winds, often uncomfortable and a nuisance, but still tolerable. As an example, the most severe downwash generated from a helicopter came from the HR2S which had a "disc-loading" of 7.5 lbs/sq. ft. The downwash of the HR2S helicopter was strong enough to blow men and equipment about a ship's deck or create clouds of sand and dirt at unprepared landing sites. The convertiplane type VTOL "disc-loading" would probably have been on the order of 10 lbs/sq ft, while those of more sophisticated designs as high as 35-50 lbs/sq ft, making well-prepared landing sites a prerequisite for useful employment.

It appeared that for the typical Marine short-range/low altitude troop support mission there was little requirement for VTOL aircraft of advanced design. Their productivity could not compete with helicopters and the enhanced combat survival potential offered by speeds in excess of 200 knots was offset by poorer productivity and logistic support problems.

The helicopter had a long infancy and was now reaching the fullness of its operational potential. This would have been an inopportune time for the Marine Corps to trade the new-found maturity of modern helicopters for a new design, still to be proven.

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APPENDIX A

ABBREVIATIONS

ACNO	Assistant Chief of Naval Operations
AKA	Attack Cargo Ship
APA	Attack Transport Ship
Asst	Assistant
BLT	Battalion Landing Team
BuAer	U.S. Navy Bureau of Aeronautics
BuWeps	U.S. Navy Bureau of Naval Weapons
CG	Commanding General
CMC	Commandant of the Marine Corps
CMCS	Commandant Marine Corps Schools
CNO	Chief of Naval Operations
CO	Commanding Officer
CV	The letters designating an aircraft carrier. The third letter is added to distinguish between the various types: CVA—Attack Aircraft Carrier CVE—Escort Aircraft Carrier CVHA—Escort Helicopter Aircraft Carrier CVL—Light Aircraft Carrier CVS—Support Aircraft Carrier
DCNO	Deputy Chief of Naval Operations
Div	Division
DivAir	Division of Aviation
Div P&P	Division of Plans and Policies
Encl	Enclosure
FMF	Fleet Marine Force
FMFLant	Fleet Marine Force, Atlantic
FMFPac	Fleet Marine Force, Pacific
HMR	Marine Transport Helicopter Squadron
HMX	Marine Helicopter Squadron
HQMC	Headquarters, U.S. Marine Corps
Lex	Landing Exercise
LPH	Amphibious Assault Ship
LSD	Landing Ships, Dock
LST	Landing Ships, Tank
Ltr	Letter
MAG	Marine Aircraft Group
MCAS	Marine Corps Air Station
MCDC	Marine Corps Development Center
MCEB	Marine Corps Equipment Board
MCEC	Marine Corps Educational Center
MCS	Marine Corps Schools
Memo	Memorandum
NAS	Naval Air Station
RLT	Regimental Landing Team
USA	U.S. Army
USAF	U.S. Air Force
USMC	U.S. Marine Corps
USN	U.S. Navy
VMO	Marine Observation Squadron

APPENDIX B

HELICOPTER DESIGNATIONS

The first letter *, in Navy and Marine Corps usage, denotes the type of machine, the second its primary function (mission). The third letter identifies the manufacturer. A number inserted between the function and manufacturer's letter indicates the model number of the designer's aircraft in the same class—the first model or design number "1" is always omitted. The number following the dash indicates the number of modifications to the basic model, i.e., the HR2S-1 is defined as a (H) helicopter, (R) transport, (2) second model, (S) Sikorsky, and (-1) first modification.

Type letter	*Manufacturer*
H—Helicopter	B—Boeing
HO—Observation	K—Kaman
HR—Transport	L—Bell
HS—Antisubmarine	P—Piasecki (after 1952)
HT—Trainer	P—Pitcairn (before 1937)
HU—Utility	S—Sikorsky
	U—Vought-Sikorsky

* The letter "X" or "Y" may precede the entire designation. In this case the letter "X" is used for denoting experimental aircraft. The letter "Y" is used for the more advanced experimental types and also to denote aircraft procured in limited quantities to develop the potentialities of the design.

APPENDIX C

CHRONOLOGY

1932

May — Marine Corps received Pitcairn OP–1 autogyro at Quantico, Virginia.

28 Jun — Evaluation of OP–1 began in Nicaragua.

1939

14 Sep — Igor I. Sikorsky test flew the VS–300, the first practical helicopter in the Western Hemisphere.

1946

18 Jun — CMC established Marine Corps helicopter program.

8 Aug — Major Armand H. DeLalio became first Marine to be designated as a helicopter pilot.

21 Aug — General Geiger, after viewing A Bomb tests, expressed concern to CMC of nuclear weapons effect on future amphibious operations.

13 Sep — CMC tasks Special Board to find solution to amphibious warfare in an atomic environment.

16 Dec — Special Board recommended development of a helicopter program as one solution for conducting amphibious operations in an atomic environment.

19 Dec — CMC directed implementation of a helicopter program and outlined concept of future amphibious operations.

1947

1 Dec — HMX–1 Commissioned.

1948

9 Feb — HMX–1 received first helicopter, Sikorsky HO3S–1 (S–51).

23 May — HMX–1 executes first vertical assault in Operation PACKARD II.

9 Aug — HMX–1 received first Bell HTL–2 (H–13).

19 Aug — HMX–1 received the HRP–1 (PU–3).

Nov — MCS publishes PHIB–31 (Amphibious Operations—Employment of Helicopters (Tentative)).

1949

3 Jun — Marine Corps Board recommended the activation of the first two 12-plane transport helicopter squadrons to commence in 1953.

6 Oct — CMC requested Kaman 190 helicopter for evaluation as an observation helicopter.

1950

12 Jan — CMC requested 13–15 man assault helicopters.

28 Mar — Informal Helicopter Conference drew up specifications for a 20-man assault transport helicopter which subsequently became Operation Requirement No. AO–17501 for the Sikorsky HR2S–1 (S–56).

22 May — Joint Helicopter Conference recommended a two-phase helicopter program: Long-range solution was AO–1750 (HR2S) and short-range the procurement of an interim helicopter to satisfy immediate requirements.

14 Jul — VMO–6 departed San Diego for Korea with four HO3S–1 helicopters.

21 Jul — CMC requested the Sikorsky HRS–1(S–55) as an interim assault helicopter.

1951

5 Jan — Tactics and Techniques Board published its study, Employment of Assault Transport Helicopters.

15 Jan — Marine Corps commissioned HMR–161, the first Marine transport helicopter squadron.

28 Feb — Tactics and Techniques Board published its study, Marine Helicopter Transport Program.

20 Mar — Sikorsky awarded the contract to build the HR2S–1.

5 Apr — HMR–261 commissioned.

14 Jun — Marine aircraft wing reorganized. Helicopter squadrons placed under a parent aircraft group headquarters.

30 Jun — HMR–162 commissioned.

1 Jul — HMR–161 deployed to Korea.

17 Jul — CMC published concept of future amphibious operations urging CNO to provide a shipbuilding program to parallel the availability of the HR2S–1.

13 Aug — CNO approved CMC concept of future amphibious operations of landing the assault elements of one Marine division by helicopter.

1 Sep — HMR–262 commissioned.

15 Nov — HMR–163 commissioned.

1952

11 Jan — CMC published Marine Aviation Plan 1–52 which allowed for the expansion of Marine aviation with the commissioning of MAG (HR)–16, MAG(HR)–26, and MAG(HR)–36.

25 Feb — HMR–361 commissioned.

1 Mar — MAG(HR)–16 commissioned.

29 Mar — MajGen Harris submitted report on HELEX I and II outlining the suitability and requirement for CVE and CVL class carriers as modified LPHs.

28 Apr — CMC requested four converted CVE–55s be modified for helicopter assault operations.

30 Apr — HMR–362 commissioned.

2 Jun HMR–363 commissioned.
2 Jun MAG(HR)–36 commissioned.
16 Jun HMR–263 commissioned.
16 Jun MAG(HR)–26 commissioned.
5 Dec CNO instructed BuAer to develop the HUS–1 (S–58) for the Marine Corps.

1953

5 Feb CMC revised Marine Corps assault helicopter aircraft requirements to a total of 16 LPHs; four converted CVE–105s and 12 CVE–55s.

1954

27 Apr CMC approved the Advanced Research Groups Project I thereby establishing the concept contained therein as the long-range goal of the Marine Corps.
1 Jul Marine Corps Test Unit One activated.
22 Jul CMC approved Advanced Research Group Project IV, Marine Corps Transport Helicopter Requirements for the Immediate Future.
23 Oct CMC requested CNO authorize an increase in the number of HR2S–1 helicopters from 135 to 180, *i.e.*, nine squadrons of 20 aircraft each vice 15 each.

1955

24 May CMC announced decision on Smith Board which resulted in two medium utility helicopter squadrons being added to each aircraft wing organization.
24 May CMC established a goal of helicopter lifting the assault elements of one and one half divisions by helicopter.
16 Jun CNO approved Marine Corps helicopter program of 180 HR2S–1s and 45 HUS–1s.
13 Dec Landing Force Bulletin Number 17 approved which officially promulgated the Marine Corps concept of future amphibious operations.

1956

8 May G–3 Study Number 3 completed recommending an increase from nine to 15 transport helicopter squadrons; 245 light and 45 medium aircraft.
22 May CMC agreed to a five-year shipbuilding program producing five new construction LPHs and five converted from the CVE–105 class. One of each type per year from 1958 to 1962.
4 Jun Hogaboom Board appointed to study the organization and composition and equipment of the FMF.
5 Jul Marine Corps Aviation Five-Year Program submitted to CNO. Plan called for nine light helicopter squadrons of 20 aircraft each and six medium squadrons of 15 Aircraft each, plus three VMOs of 18 aircraft each, all by 1962.
20 Jul *Thetis Bay* (CVS–90) commissioned as CVHA–1.
31 Dec HMR squadrons began changing designation to HMR(L).

1957

7 Jan Hogaboom Board report published, outlining three phase objective, 1957 to 1965, for the helicopter program.
12 Jan HMR(M)–461 commissioned.
13 Feb Marine Corps received first HUS in a tactical squadron.
3 Nov HMR(M)–462 commissioned.

1958

9 Jan CMC requested replacement for the HUS–1.
2 May CMC informed CNO that Marine Corps considered the CVS as an acceptable interim LPH.
1 Jun Helicopter groups reorganize under "M" series T/O as recommended by Hogaboom Board. Two HMR(L)s and one HMR(C) in each group.
1 Sep HMR(M)–463 commissioned.

1959

30 Jan USS *Boxer* (CVS–21) reclassified as the LPH–4.
2 Mar USS *Princeton* reclassified as the LPH–5.
16 Mar MAG(HR) designation changed to MAG.
30 Jun HMR(L)–264 commissioned.

1960

1 Feb Helicopter groups revert to "L" series T/O structure. Three HMR(L)s vice two HMR(L)s and one HMR(C).
7 Mar CNO published Developmental Characteristic Number AO–17501–1 for the CH–46A.
9 Aug CNO issued Developmental Characteristic Number AO–17503–3 for the ASH.

1961

20 Feb BuWeps announced that Boeing–Vertrol would build the replacement for the HUS–1, the CH–46A(BU–107II).
27 Mar CNO issued Developmental Characteristic Number AO–17501–3 for the CH–53A(S–65).
1 Jul USS *Valley Forge* reclassified as the LPH–8.
1 Sep HMR–364 commissioned.

1962

1 Feb HMR(L)s began changing designation to HMM and HMR(M)s to HMH.
2 Mar BuWeps announced that Bell Aircraft Company would build the Marine Corps ASH, the HU–1E (BELL–204).
24 Aug BuWeps announced Siorsky's CH–53A would replace the HR2S–1.

APPENDIX D

HELICOPTER SPECIFICATIONS

	HRP–1	*HRP–2*	*HO3S–1*	*HRS–1*	*HRS–2*	*HRS–3*	*HO5S–1*	*HOK– 1*	*HUS–1*	*HR2S–1*	*HTL–1*	*HUP–2*
Normal Gross Weight	6,900	6,979	4,985	7,000	7,125	7,750	2,695	5,798	13,300	28,023	2,350	5,750
Empty Weight	5,193	5,205	3,788	4,697	4,832	5,193	2,100	4,160	7,435	20,075	1,570	4,120
Useful Load	1,707	1,774	1,197	2,303	2,293	2,557	595	1,638	5,865	7,948	780	1,630
Zero Range Payload	1,307	1,373	947	1,543	1,533	1,797	303	1,224	4,900	6,435	516	1,015
Maximum Fuel Load (Pounds)	580	580	580	1,050	1,050	1,050	342	619	1,578	2,400	174	950
Cruising Speed (KTS)	83 *	87 *	65	60	60	60	70	70	90	100	60	80
Power Plant	R–1340	R–1340	R–985–AN5	R–1340	R–1340	R–1300	0–425–1	R–1340–48	R–1820–84	R–2800	0–335–5	R–975–42
Total Horsepower (Take off)	600	600	450	600	600	700	245	525	1,525	4.200	200	550
Rotor Diameter (feet)	41	41	45	53	53	53	33	50.5	56	72	35	53½
Maximum Height	15′	15′	12′6″	14′	14′	14′	8′8″	16′8″	15′8″	22′	9′2″	12′6″
Maximum Length	83′4″	83′4″	57½′	62′6″	62′6″	62′6″	39′1″	47′	65′7″	88′	41′5″	75′
Number of Pay Seats (Permanently Installed)	8	8	3	10	10	10	3	3	12	23	2	5
Litter Capacity	6	6	0	3	3	3	2	2	8	16	2	2
Crew Required	2	2	1	2	2	2	1	2	2	3	1	2

* Maximum Airspeed

APPENDIX E

U.S. MARINE CORPS HELICOPTERS ON HAND 1947–1962

	1947	*1948*	*1949*	*1950*	*1951*	*1952*	*1953*	*1954*	*1955*	*1956*	*1957*	*1958*	*1959*	*1960*	*1961*	*1962*
HRP–1		5	6	5												
HRP–2				2	3	3	1									
HO3S–1		5	8	5	4	3	1	2	2							
HTL–1				2	2	1										
HTL–2		1	1	1	1											
HTL–3				2	2	1										
HTL–4				8	11	12		5								
HTL–5								1	5							
HRS–1					47	35	36	27	25	27	8	2				
HRS–2						71	60	52	11	2						
HRS–3							45	51	77	113	123	113	50	35	17	13
HO4S–1					6	3	2	2	2	1						
HO5S–1						33	57	37	26	6						
HTK						4						1				
HUP1&2								11	13		3		2			
H–13D									6							
HR2S–1										2	14	37	36	29	29	28
HOK–1										28	41	45	39	37	35	30
HUS–1											49	124	159	199	255	309
HUS–1Z														4	4	4
HUSS–2															3	5
TOTAL HELO *	0	11	15	25	76	166	202	188	167	179	238	322	286	304	343	389
OY/OE	22	24	14	17	24	43	45	41	53	41	42	37	39	34	22	25

* Figures include all aircraft on hand in Marine Corps inventory (FMF, HMX, and shore activities) as of 31 Dec for each calendar year.

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