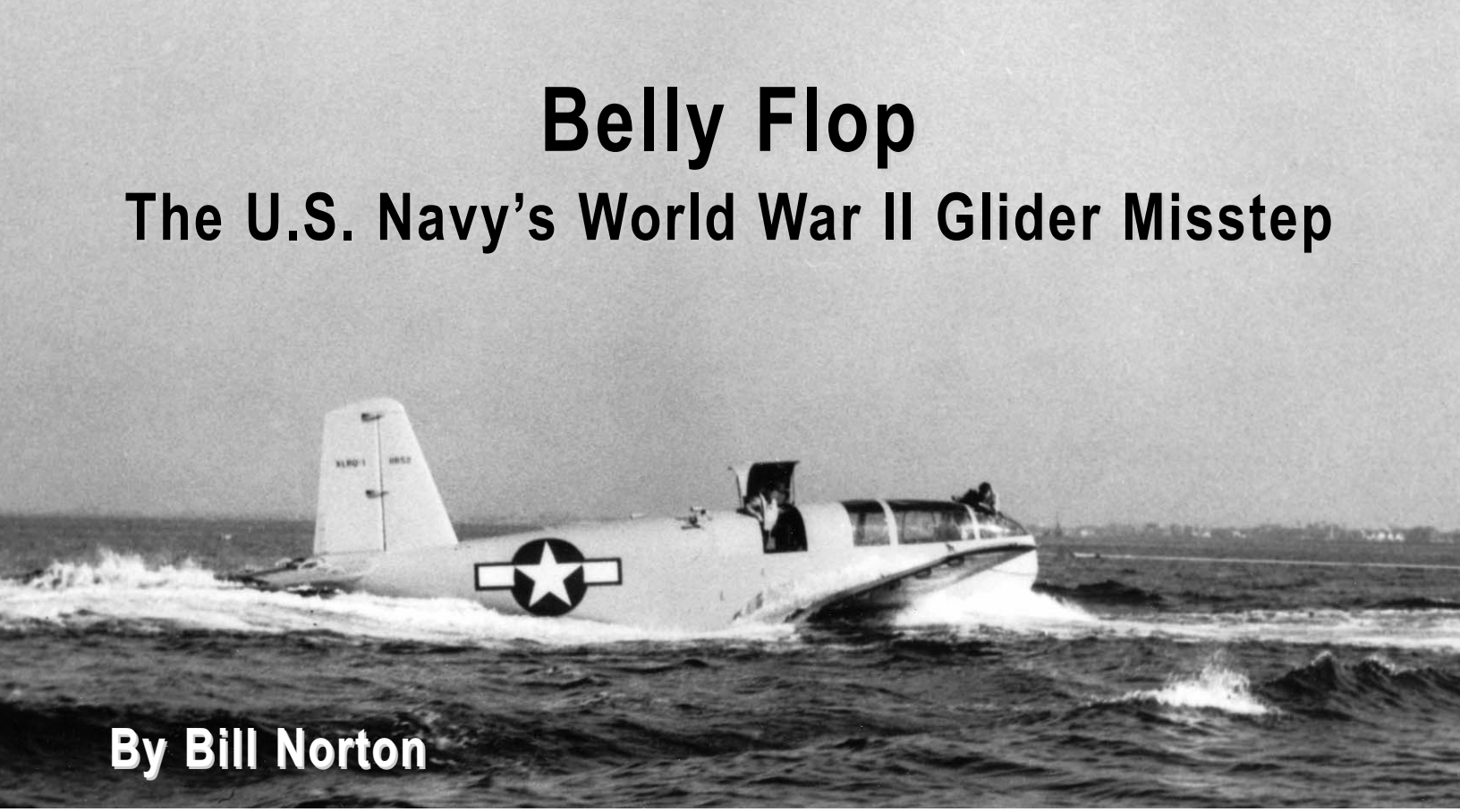
Belly Flop

The U.S. Navy's World War II Glider Misstep



By Bill Norton

The second XLRQ-1 prototype is underway on the Delaware River, apparently towed by airplane or surface vessel. The glider also possessed a retractable outboard motor to propel it for beaching after landing in a bay, lagoon, or surf. (Air Force Flight Test Center)

The German success with assault gliders during the opening moves of their western campaign in spring 1940, and the apparent success during the Crete invasion a year later, were a wakeup call for other militaries forming airborne forces. By the end of 1940, Great Britain had begun creating its own glider force and the U.S. Army initiated a large program in February 1941. The U.S. Navy, at the urging of Secretary of the Navy Frank Knox and Congress, started looking at gliders in April 1941 for Marine landings. This suggested amphibious gliders; an entirely new concept. It began a major undertaking that ran for two years before being abruptly abandoned.

Gliders appeared the only practical means for aircraft to complement Marine seaborne assaults via landing craft and amphibious vehicles. It would require gliders to be towed aloft from the sea or hard surface fields, and then glide free to a landing in the water. This was a bold innovation, envisioning swarms of gliders towed into range of the objective, setting down in the shallows, and beaching to deposit squads of Marines ashore instead of the long and vulnerable motoring to the beach of landing craft from ships offshore. It appears that inland landings were considered impractical.

Commandant of the Marine Corps, Maj. Gen. Thomas Holcomb, decided in October 1940 to train one Marine battalion of each regiment as 'air troops.' One company would be paratroopers while the rest would be lifted in by aircraft to 'airland' into the combat zone. With Knox's subsequent direction, the Navy began exploring the potential of gliders as one means of lifting the Marine air troops. While the entire notion of United States Marine Corps amphibious gliders was not carefully studied before program initiation, and caused many a furrowed brow, it was certainly worth exploring considering the new tactics and shattering victories of Germany and Japan.

The Navy was to develop and procure the gliders while the Corps trained their own pilots and airborne troops. The Commandant wrote the Chief of the Bureau of Aeronautics (BuAer) on May 31, 1941, stating the USMC's desires. The assistant chief, Capt. Marc A. Mitscher, had already initiated glider development when the effort was announced in April - although he made no secret of his skepticism. One of his officers, Comdr. Delmar S. Fahrney, had previously begun a bomb glider, or 'Glomb,' program as an adjunct to a long-standing unmanned drone effort, and this would run coincident with the Marine transport glider work. On April 30, Fahrney directed the Naval Air Factory (NAF), in Philadelphia, to perform a transport glider design study. Fahrney and the BuAer team would continue managing contracts and guiding the overall program.

The NAF assigned Lt. Comdr. (soon Comdr., then Capt.) Ralph S. Barnaby to supervise the design project. Among his team, participating in the eventual flight testing, were Marine pilots Maj. Richard E. Figley, Lt. (later Capt.) Robert V. Reilly,

Capt. Ralph Barnaby stands beside a LNE-1 training glider. Barnaby was the leading glider authority in the Navy's aircraft development and test organization, and so became a principal figure in the wartime project to develop combat gliders. (National Soaring Museum)

and Lt. R. Ryan. Maj. John Wehle, USMC, was soon assigned Glider Project Officer in the Marine Corps Division of Aviation. In the first half of 1942, Wehle spent five months in Great Britain, completing the Royal Air Force Glider Flight Training course and participating in Army glider activities. He came home convinced the Corps needed these capabilities. By June 1941, towed sailplane experiments were being conducted to acquaint Navy personnel with glider operations.

Barnaby was assistant chief engineer at NAF, later chief engineer. He was a noted naval aviator and engineer in addition to being a long-time sport sailplane pilot and president of the Soaring Society of America. The charismatic officer had flown the Navy's first glider experiment, dropped in a sailplane from the dirigible *USS Los Angeles*. The notion was for the glider to provide a safer means than a parachute for delivering a landing officer to the ground in the event an emergency landing and mooring of the airship was necessary. The trials at Lakehurst, N.J., saw Lt. Barnaby in a German *Prüffling* (Graduate) open cockpit, single-seat training glider (BuNo A8546). The first flight, detaching from beneath the *Los Angeles*, occurred on

The Navy had acquired glider operational experience 10 years before when it employed a small number of these Franklin PS-2s to instruct pilot cadets in power-off landing techniques. The training, led by Barnaby, was dropped as a budget-cutting measure. (National Soaring Museum)

The prototype Pratt, Read XLNE-1 training glider (PRG-1 to the builders) is seen in flight, probably in spring 1942. The side-by-side seating was very unusual for the period. (National Soaring Museum)

Although the Navy planned to acquire hundreds of LNE-1s for Marine Corps training, output was below expectations and it was soon learned sailplanes were not an optimal platform for training men who would fly much larger, low-performing gliders. Only 75 examples were ultimately purchased and most never flew during the war. (National Soaring Museum)

The Schweizer SGS 2-8 commercial sailplane provided the basis for the LNS-1 trainer for the Marine Corps, as it did for the Army TG-2A. The Navy procured 13 of these gliders as a rapid means of acquiring training aircraft. (National Soaring Museum)

January 31, 1930. Although successful, the later in-flight mating and separation of powered aircraft and dirigibles meant the glider option need not be pursued.

At the irrepressible Barnaby's urging, six Franklin PS-2 gliders (9401-9402, 9614-0617) were incorporated into naval primary pilot training to instill the skills for off-field deadstick landings in the event of engine failure. Barnaby ran this month-long portion of the program at Pensacola, Fla., from summer 1933 through 1935. However, it was not considered essential and was dropped in 1936 as a Depression-era cost-cutting measure. Barnaby continued his vocal promotion of gliders as a military asset and so was the *de facto* Navy expert on the subject.

In September 1941, the USMC restructured its plans, discarding the original intentions of air troops in each regiment for dedicated Air Infantry Battalions landing, with equipment, to augment the parachute battalion within a division. Static line paratroop jumps from the gliders were contemplated in addition to mounting a defensive machine gun and being capable of delivering 37-mm anti-tank guns, small vehicles, and even light tanks. One 900-man battalion would be established on the west coast of the U.S. with 24-place gliders and another on the east coast with 12-place aircraft. A total of about 75 gliders would require 150 USMC glider pilots. It was envisioned that lifting one battalion would require a minimum 60 12-place gliders on triple-tow behind 20 Consolidated PBY-5 *Catalina* twin-engine flying boats - although several successive missions might be required to haul in other equipment.

Intentions continued to coalesce as plans to moving two battalions, equating to a requirement for 100 (including 25 spares) of the 12-place and 48 (12 spares) of the 24-place gliders. By 1942, this had evolved again to 200 12-place and 300 24-place machines, then raised to 600 12-place and 400 24-place gliders with 1,600 pilots. After U.S. entry into the war and expansion of the USMC from two to four divisions in spring 1942, the Corps contemplated enlarging the glider program to carry from 4 to 12 battalions, lifting 10,800 troops in more than 1,271 gliders flown by 3,436 pilots. This broke down to 675 12-place (with 90 for training and 135 spares), 296 24-place (12 training, 59 spares) and 300 cargo gliders (60 spares).

The Commandant kept ambitions in check, with expenditures to be limited at $15 million until gliders and operational training experience were in hand, and essential battlefield needs were clarified as the war progressed. Glider development and pilot training moved ahead to meet the ambitious goals.

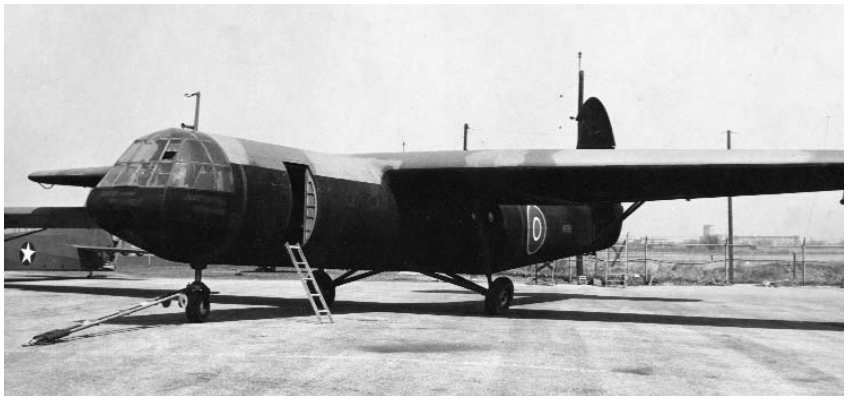
The Trainers

The most expedient means of gaining knowledge of gliders and establishing a cadre of experienced glider pilots while the combat aircraft were in development was by beginning immediate training on sport sailplanes. To supply training gliders, the USN sought contractors not already engaged in priority powered airplane production. The aircraft were to incorporate wood to the greatest extent possible,

Like the U.S. Army, the Marines found sport sailplanes to be a poor training tool for pilots bound for lumbering combat gliders. Three Piper LNP-1s were acquired as an answer to this, the three-place glider developed by the Army as the TG-8 from the L-4 liaison airplane. (National Soaring Museum)

The Aeronca LNR-1 was another three-place trainer from the Army where it was known as the TG-5 and developed from the L-3 light plane. Three of these were evaluated in late 1942 to fill the Marine training role. (National Soaring Museum)

The third three-place trainer was bought in slightly larger numbers, but ended up being used mostly as bomb glider testbeds. The Taylorcraft LNT-1 was derived from the L-3 'Grasshopper' liaison aircraft and known to the Army as the TG-5. (National Archives)



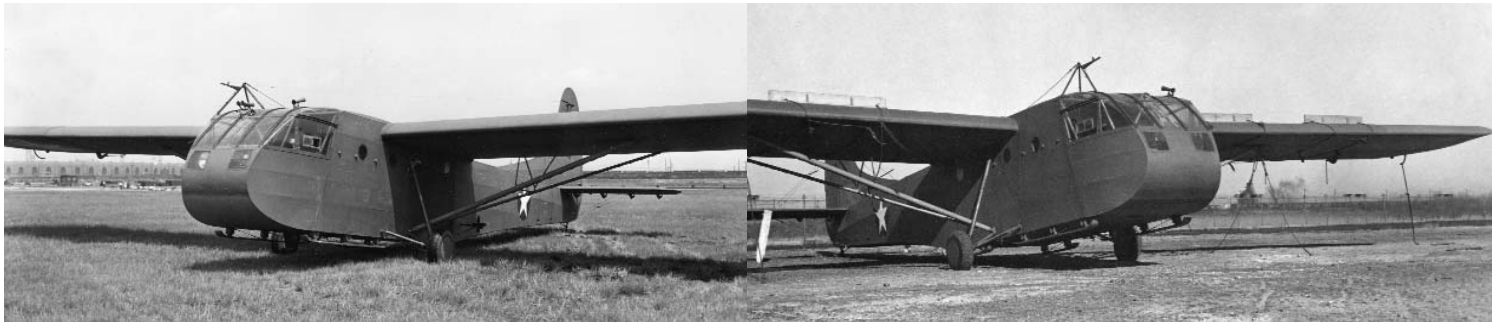
Navy borrowed an Airspeed Horsa *transport glider from Great Britain for evaluation. Insight into wooden construction and operational experience was gained, and at one point building the Horsa in the U.S. was considered. (National Soaring Museum)*

eschewing aluminum and other strategic materials required for higher priority programs. Examples of U.S. Army and British combat gliders were also evaluated to gain additional insight and experience.

Since all established U.S. glider manufacturers were already engaged by the Army and working to the limits of their facilities, the Navy took on a new firm with a novel design. Their first glider development contract went to the Gould Aeronautical Division of Pratt, Read and Company, Inc. (formerly the Pratt, Read Piano Co.) of Deep Water, Conn. The July 1941, $20,000 agreement was for a prototype to be delivered by about December 1, 1941. The company clearly had experience in fine woodworking, but a committee of six glider enthusiasts acted as designers for the glider. Principal among these were Parker Leonard, Jay Buxton, and Bob Stanley. Their product was the PRG-1 which the Navy designated XLNE-1 wherein the X stood for experimental, the L for glider, N for trainer, and E for Pratt, Read. This unusual glider looked like a winged tadpole with its wide, podded fore-body for side-by-side seating narrowing to a tubular aft fuselage with monocoque wood covering. It is odd that the tradition-bound Navy would see value in side-by-side training that was almost unknown at the time.

The civil-registered prototype PRG-1 (NX41802) was late, first flying on March 7, 1942, and accepted by the Navy. The service then ordered another XLNE-1 and six production LNE-1s. This was soon raised to 50 aircraft and then upped again by summer 1942 to a total 100 gliders, at a projected cost of $380,603, before any production examples had been formally delivered. The 1,150-lbs gross weight (GW) glider, 770 lbs empty, spanned 54.5 ft with a wing area of 230 ft² and a glide ratio 26:1.

At one point in 1942, the War Department planned to acquire 575 LNE-1 gliders at a rate of 3-10 per month. Whatever the Pratt, Read delivery schedule, the Navy was dissatisfied with actual output. Consequently, the service turned to a glider already developed for the Army to quickly put gliders in the hands of instructors and student pilots. They gave a $26,000 contract to Schweizer for 13 LNS-1s, the company's SGS 2-8 (Army TG-2A). This glider



The Navy wrestled 13 Waco CG-4A 15-place gliders away from the Army to support USMC training. Labeled LRW-1s, the Marines reportedly never flew them. (National Soaring Museum)

Here is a remarkable picture of a PBY-5 preparing to tow a CG-4A aloft. The Waco is one of three the Navy retained for assessment. (National Soaring Museum)

The NAF's PBY test support aircraft was given the nickname "Tugboat Annie" to reflect its new job. Note the nylon tow line attached to the fuselage at two points as a bridle. (National Soaring Museum)

Another extraordinary image is this showing the NAF's Catalina standing by to take up tow line slack and pull a British Horsa *assault glider into the air. One thing the tow tests of these large gliders made clear is that early notions of pulling three amphibious transport gliders behind twin-engine airplanes was fanciful. (National Soaring Museum)*

had a welded steel tube fuselage and aluminum frame aero surfaces, with fabric over all. The wing spanned 52.0 ft with 214-ft² area, length 23.3 ft, 860-lbs GW or 480-lbs empty, and 23:1 glide ratio.

In late 1942, the Navy also acquired three each of the Army's 3-place gliders, derived from light planes. The engine had been removed, the nose extended for a third seat under a greenhouse canopy, and landing gear reduced in stature to more resemble the stance of the envisioned Army combat gliders. Likewise, glide ratios of about 10:1 were more representative of the coming transport aircraft. These were the XLNR-1 from the Aeronca TG-5, XLNT-1 from the Taylorcraft TG-6, and the XLNP-1 from the Piper TG-8.

The Army passed 13 of its Waco 15-place CG-4As transport gliders to the Navy, who redesignated these LRW-1s (R for cargo transport). The USMC reportedly never flew the 10 handed to them while the Navy performed some evaluations with their three, towed by an NAF-operated *Catalina* the locals fondly dubbed "Tugboat Annie" (08065). The 300-400-ft nylon tow line was attached to the PBY as a bridle; an attachment to both sides of the fuselage beneath the wing aft strut attach fittings (perhaps the existing tiedown rings) and meeting to one line aft of the aircraft. There was some means of reeling the towline into the 'Cat' after glider release.

The PBY did just fine towing a fully loaded Waco, but struggled with engine overheating during single engine-out scenarios, and handling became difficult in turbulent air. Towing on instruments was nearly impossible because any change in glider attitude jerked on the tug and disturbed the required trimming and fine control. Long flights were particularly fatiguing for the glider pilots, requiring hourly change offs, or more frequently if encountering turbulence. Night flight towing the LRW-1 was demonstrated to be impractical, the glider pilots "complained bitterly of vertigo and extreme fatigue" owing to rough air and a particularly dark night with few tug reference lights.

The evaluations included towing two LRW-1 gliders simultaneously; one glider on a 350-ft tow line and the other on 450 ft. Unlike the Army, the Marine pilots preferred to fly with a vertical displacement as well as lateral to reduce pilot workload; one above the tug slipstream and the other below.

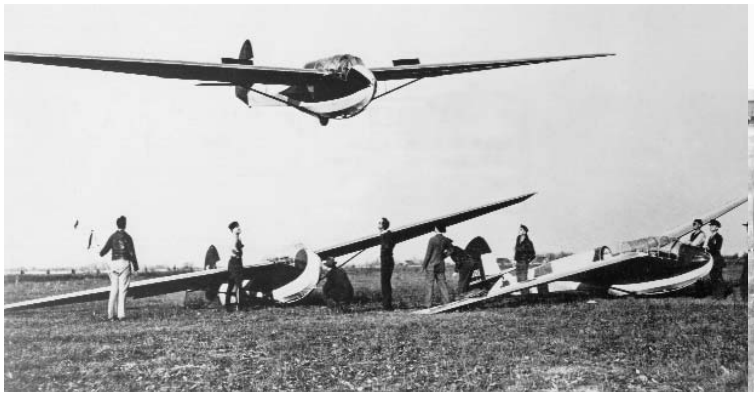
A series of flights with the *Catalina* and Wacos hauling miscellaneous freight among east coast bases during March 1943 was illustrative. There was no efficiency advantage in a transport dragging cargo around in trailing gliders compared with carrying the freight itself or even in two airplanes.

The Navy struggled with the interphone line along the tow cable as did its sister service, judging this unsatisfactory but never arriving at a good solution for communications between the tug and glider. They made minor changes to the LRW-1s to correct perceived deficiencies, such as installing a radio and adding a landing light in the lower starboard forward pilot window. This may account for mention of two LR2W-1s found in the literature.

The Navy borrowed an Airspeed AS.51 *Horsa* transport glider from Britain and six Hotspur Mk II 8-place gliders from the Royal Canadian Air Force for evaluation, experimentation, and training.

The Training

As with the Army, civilian schools were engaged initially to provide introduction to glider flying for a core cadre of personnel serving later in leadership and instructor roles. Lt. Eschol M. Mallory, USMC, was assigned to locate the interim schools. Although Mallory felt only fully trained airplane pilots should fly the Marine's combat gliders, a view shared by Maj. Wehle, it was clear to their superiors that there would not be enough such men to spare for such duty. So, the USMC moved in July 1941 to recruit, within the next year, 50 officers through the grade of Captain for training as glider pilots and 100 noncoms to serve as second pilots.



An assortment of military and civilian personnel conduct glider operations at Marine Base Parris Island, N.C. Lt. Col. Vern Guymon, commander of Marine Glider Group 71, performs the landing in the Schweizer SGS 2-8 glider. (Naval Aviation Archives)

To support efficient glider launch for Marine pilot training, the Navy procured this Gar Wood truck-mounted winch. There was a throttle and speed control to pull a glider up to flying speed and then reel in the cable once released, or cut the line in an emergency. (National Soaring Museum)

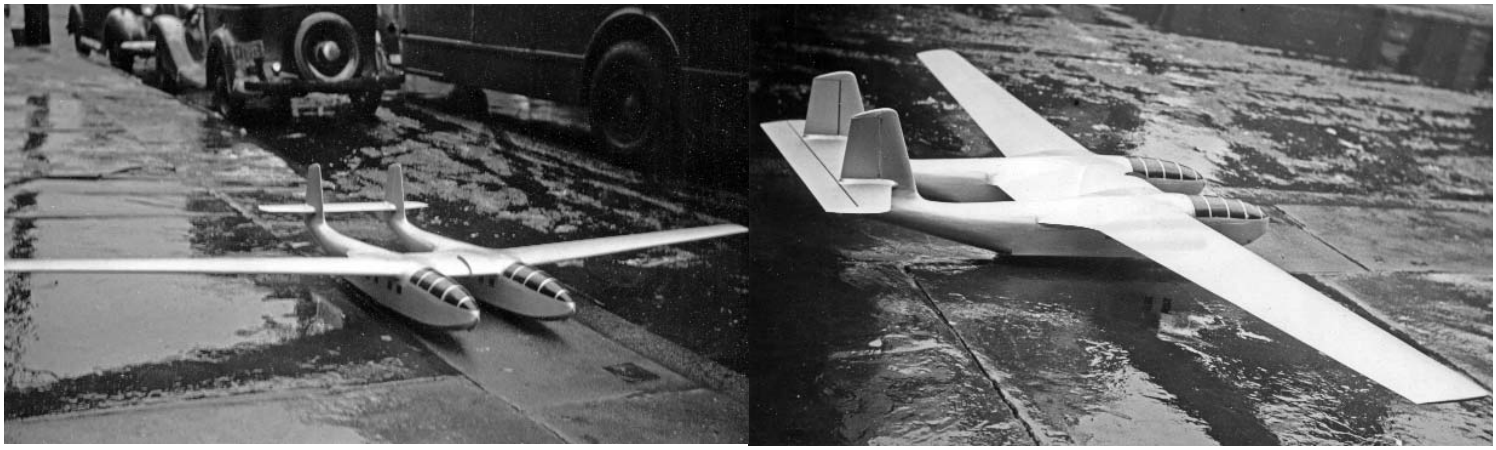
During November 1941, four pilots, including Lt. Col. Vernon M. Guymon, attended the Lewis School of Aeronautics in Lockport, Ill. Run by sailplane designer Stan Corcoran, the instruction principally employed his Cinema IIB glider. Eight other pilots underwent glider indoctrination at the Motorless Flight Institute, Harvey, Ill., under the oversight of Joe Stainhauser with instruction on Schweizer SGS 2-8s and Cinemas. Emphasis was on tow, cross-country flight, and landings in unfamiliar fields. In about four weeks, these men each logged approximately 30 hours on sport gliders with winch, automobile, and aero tows. The schools were eventually equipped with Navy-procured gliders and even a contractor-built Gar Wood truck-mounted winch for ground launch. Other officers followed, but service schools were to eventually assume the entire training responsibility.

Following the basic instruction on sport gliders, personnel transitioned to Marine Base Parris Island, S.C., for advanced training. All assets were to be in place by January 10, 1942. On January 15, the unit was designated simply the Glider Detachment, and comprised 10 officers and 17 men of an authorized 14 and 56, respectively. A formalized structure was established on April 24 as Marine Glider Group 71 (MLG-71), with Guymon as CO and authorizations for 20 or 26 officers and 218 enlisted members. Added on May 1 was the Marine Glider Squadron 711 (VML-711) initially commanded by then Maj. Mallory, but Capt. Barnette Robinson took over from February 8, 1943.

A collection of LNS-1 trainers occupy a hangar at Parris Island during 1942. The embryo of the Marine Glider Group trained at the South Carolina base throughout that year. (Naval Aviation Archives)

As purpose-built military sailplanes became available beginning in mid-March 1942, training and proficiency flying on LNE-1s and LNS-1s began while awaiting the combat gliders. The Marines also flew and employed as tow planes a trio of NAF N3N-3 "Yellow Peril" biplanes, a North American SNJ-2, one Grumman J2F-3 *Duck*, a single Bellanca JE-1 *Pacemaker*, and even the rare NAF XN5N-1.

Guymon began to feel, as the Army did and Maj. Wehle had observed in Britain, that sailplanes were of little training value. The few three-place gliders had more representative flight characteristics, and seven more XLNT-1s were procured in the first half of 1943, the type apparently being considered for USN production. Consequently, LNE-1 production was curtailed at 75 on April 5, 1943. Another factor was that Pratt, Read had spent $908,000 to that time, nearly three times the contract value. Final cost



The large float tank model of the 24-place amphibious glider concept shows the twin-hull 'catamaran' layout, and the XLRH-1 closely followed this design. Like the British Glider Pilot Regiment, the Marine pilots were counted in the troop numbers as they were expected to fight alongside their passengers after landing. (National Soaring Museum)

was $1.4 million, or a steep $18,664 per glider. (New U.S. Army sailplanes averaged $3,500.)

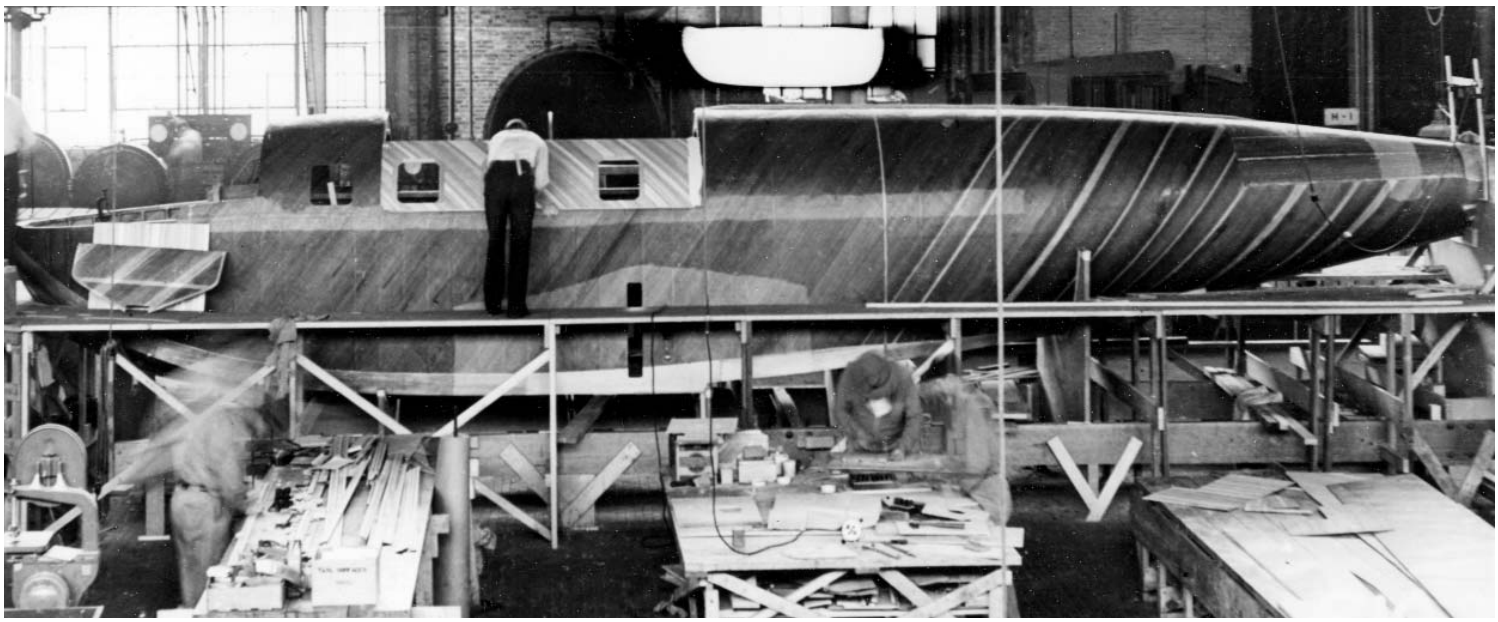
In the meantime, Guymon sought a more suitable and permanent location for his unusual unit. They finally moved to a new base at Eagle Mountain Lake, Fort Worth, Tex., on November 24, 1942. The outfit eventually achieved strength of 36 officers and 246 enlisted personnel operating 21 gliders. (This last number suggests that, while awaiting the full complement of pilots, most of the LNE-1s were stored and never flown.)

On January 1, 1943, 120 Student Naval Aviation Pilots (Glider) were undertaking instruction with the Civilian Pilot Training Program and destined for Glider Group 71. Plans were for 60 students to pass through this program monthly, contributing to a projected total 1,534 glider pilots. They were to be supported by 20,000 enlisted personnel. Two other training sites were contemplated for when the program grew to its full dimensions; Edenton, N.C., and Titusville, Fla., (this last changed later to Shawnee, Okla.).

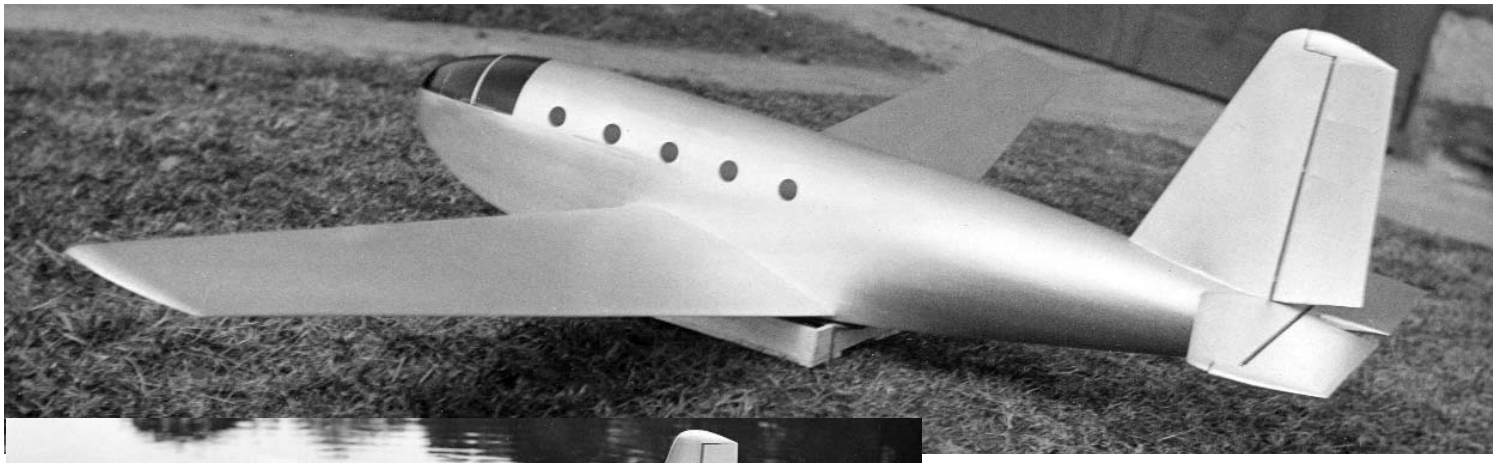
New Concepts

The initial BuAer tasking had discussed 12-place gliders with jettisonable landing gear and possibly a watertight cabin for water landings. On May 28, 1941, the NAF requested permission to pursue a truly amphibious aircraft with retractable undercarriage. This was granted, especially as the USMC concept of operations had already turned in this direction. The gliders were principally intended to carry troops and their gear. However, the Navy also conceived using them to airland aero engines to ailing flying boats, like PBYs. Since these airplanes could land at almost any out-of-the-way island post and then have an engine break, it could be weeks before a suitable ship carrying a replacement engine could reach the site. Having an amphibious glider drop in on the surf with the engine sounded like a neat solution. As the text says, one of the experimental gliders had mounts to carry a large radial engine (R-3350) in the cabin. Presumably, the engine would be loaded and unloaded via a hoist.

The glider could be towed aloft from a runway by a



To reduce the demand on strategic materials required by high-priority programs, the gliders were to be built primarily of wood. The lamination of plasticized wood veneers into compound curves of the outer surface is shown in this photo of the Allied Aviation XLRA-1 under construction during 1943. (Naval Aviation Archives)



ABOVE: Devising a practical concept for an amphibious transport glider was a unique challenge for the engineers at the Naval Aircraft Factory. They finally hit on the "float-wing" by which the aircraft was stabilized on the water by the inboard portions of the low wing with substantial dihedral, while the fuselage had the normal planning hull, as shown here in the form of a float tank model for the 12-place aircraft. (National Soaring Museum)

UPPER LEFT: The float-tank model of the Bristol XLRQ-1 shows how closely the developers of the 12-place 'aquaplanes' followed the NAF concept. The model has a deep root fillet added to accommodate retractable main gear. (National Soaring Museum)

LOWER LEFT: Possibly the first of two prototype XLRQ-1s is pushed into the water at the Philadelphia Navy Yard. Note the outboard motor propeller protruding beneath the fuselage and the deep wing root fillet. (Naval Aviation Archives)

The XLRQ-1 canopy and hatches underwent several changes during the course of the program to allow ready ingress and egress of the 13 personnel. Wing dihedral was intended to keep control surfaces above the water for suitable handling. (Air Force Flight Test Center)

Bristol Aeronautical Corp. XLRQ-1 characteristics:

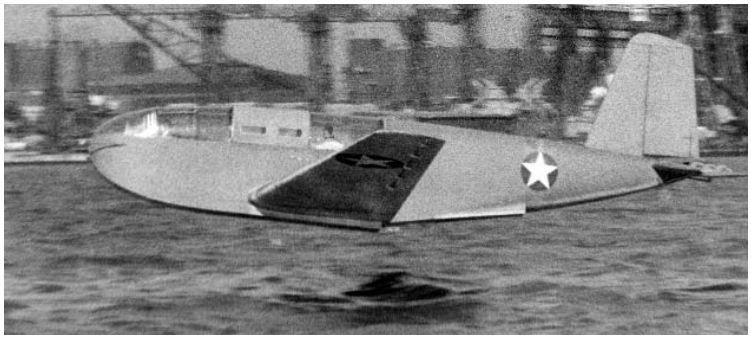
wingspan	71.2 ft	empty weight	5,261 lbs
wing area	500 ft²	gross weight (troops)	8,494 lbs
length	41.8 ft	(equipment)	8,603 lbs
height	13.8 ft	maximum speed	180 mph
		landing speed (stall)	56 mph

fighter or larger aircraft, or towed off the sea by a flying boat or seaplane. At the destination, the glider was expected to land on the water and maneuver in lagoons or bays with a 32-hp outboard motor.

The 12- and 24-place amphibious or 'aquaplane' glider requirements were an opportunity for Barnaby's design teams to be truly innovative. After running through somewhat conventional seaplane and flying boat concepts, the engineers hit on what Barnaby felt to be more practical candidates. Of four proposals, one was a twin-hull 'catamaran' design to carry six troops in each hull, or other military freight. (The two pilots were expected to fight alongside their passengers once disembarked, and so were included in the counting of 12.) The most promising 12-place concept was clearly a 'float-wing' glider that, like the catamaran, did not require outrigger floats.

The concept of the float-wing envisioned an aircraft with low wing merging into a flying boat hull. Much of the flotation and stability would derive from inboard portions of the sealed, hollow wing, making heavy, drag-producing outboard wing floats unnecessary. The inspiration was a few flying boats that had employed large sponsons on the fuselage for water stability without wing-mounted floats. Extending these to become full wings appeared feasible. Dihedral would place control surfaces above the water for unimpeded lateral control during takeoff and landing. The design featured spoilers and a two-step planing hull.

The Bristol XLRQ-1 is seen during water testing in Philadelphia in 1943. At this time, the glider lacked any wing root fairings for main undercarriage retraction. (National Soaring Museum)



The XLRQ-1, without wing fillet, flies above the surface of the Delaware River during 1943 in one of the few test flights. This was the first amphibious glider to fly in the U.S., and little else like it was accomplished in other countries. (National Soaring Museum)

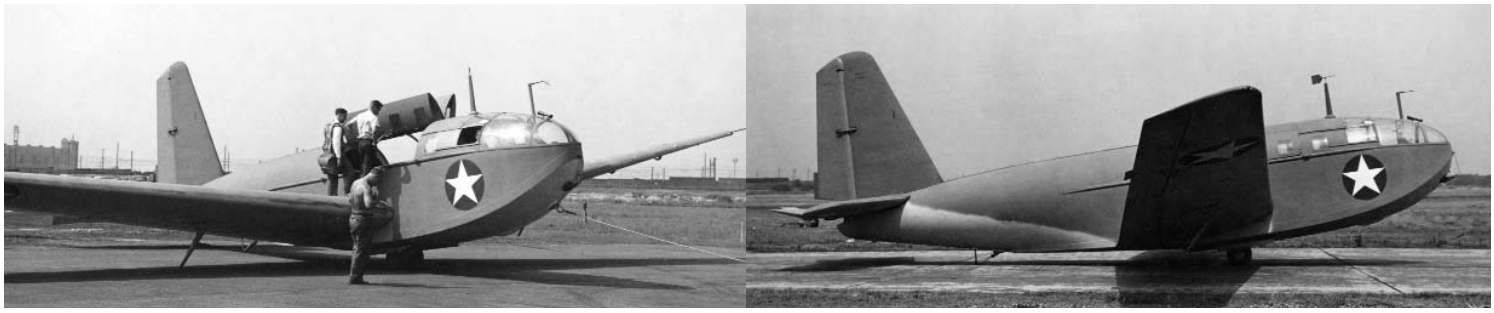
On July 26, 1941, the conceptual designs were submitted to BuAer. There was some disquiet with the unusual results. In addition, the Marines expressed discontent with the low-wing glider because it would not permit rapid exit of parachute troops. The twin-hull design appeared more suitable in this respect and the Corps suggested it be expanded to meet the 24-place requirement. The NAF was asked to collect validating data on the designs. So, scale models of the twin-hull and float-wing aquaplanes were built for wind tunnel and towed float tank tests. These were crafted by Paul Karnow, a youthful local model maker. The float-wing model spanned 4.3 ft and the catamaran perhaps close to 6.0 ft. Testing in the NAF tank, they demonstrated good water handling behavior, rising onto the step with excellent trim.

The exterior covering of the gliders would be laminated Birch sheets impregnated with casein glue such that each layer became plasticized enough for molding under pressure and heat to more readily create compound curves. Large molds would be constructed for the primary components into which were laid the treated wood veneers for curing. The exterior surfaces were then coated with a plywood sealer and painted. The results were both watertight and insect-proof.

With a sense of urgency, BuAer did not wait for the test results before pressing ahead. During August 1941, the 12- and 24-place preliminary designs were ready to be passed on to prospective manufacturers. Emphasis remained on firms not already committed to priority powered aircraft projects and with the gliders constructed mostly of wood. Consequently, all competitors were newly founded and with shallow experience base. The Navy was not extravagant in their funding and, with firms never before having undertaken aircraft development, the contractors were stretched fiscally. All of them suffered delays because of their fragile financial condition, inefficient management, comparatively low program priority leading to material shortages, difficulties with a relatively new construction method, vendor delays, difficulty hiring experienced engineers and craftsmen, and design changes requested by the Navy or found prudent during the course of development. There was also a misconception at the beginning, on the part of all involved, that gliders would be basic and simple aircraft, easy to design and build. In fact, these were motorless transports lacking only flight propulsion systems.

Economy Size

Four firms responded within the required 30 days to the Navy requirements for the 12-place aquaplane; Aeromold Corp. (soon renamed Greenport Aeronautical Corp.), Allied Aviation Corp. of Dundalk, Md., Bristol Aircraft Corp. of Bristol, Va., and Timm Aircraft Corp. of Los Angeles, Calif. The award went Allied, the firm with the lowest bid cost and



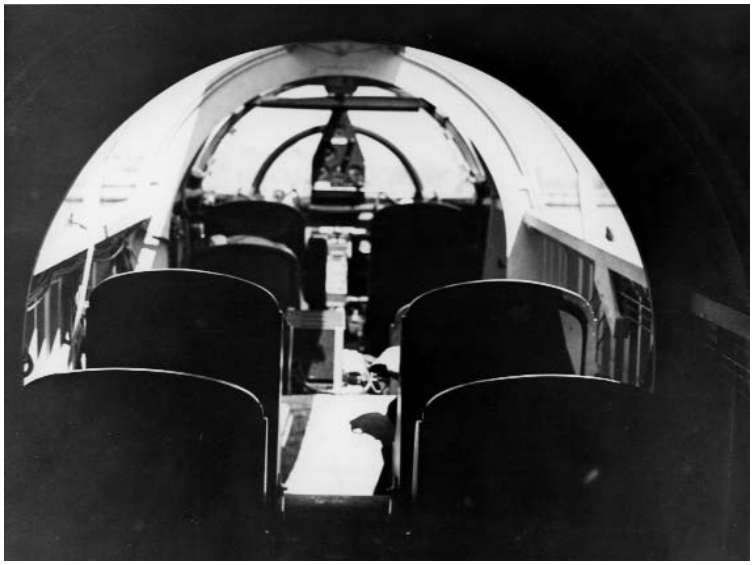
The Allied XLRA-1 was externally almost indistinguishable from the XLRQ-1. A clearly unique feature of the first prototype was the centerline strut with tail skid and wing outrigger skids. (National Soaring Museum)

empty weight ($273,346 and 3,059 lbs, respectively). Because of the uncertainty engendered in hiring such an inexperienced firm, an additional contract was soon let to the next lowest bidder, Bristol ($369,050 and 3,169 lbs), in the hope that at least one of the efforts would yield useful results. The contracts called for delivery of a structural static test article in just three months and the first of two flying prototypes in six months. Although the Navy admitted these dates were simply "something to aim at," the mere fact that a company would agree to such terms for an experimental design suggested they did not understand what they were getting into.

When the December 15, 1941, contract was issued to Bristol, the firm had changed its name to Bristol Aeronautical Corp. after acquiring Greenport and moving to New Haven, Conn. President and chief engineer of this firm, George Warren, partnered with A.L. Patterson, had been a naval aviator and retained close ties with personnel in the service, as well as having worked as an engineer at Curtiss. Warren wisely hired experienced engineers and designers. However, their working capital was meager and they were escutcheoned in a small lumber mill then incapable of producing large structures. Additional work space was soon obtained. Their design, the XLRQ-1, could accommodate an additional Marine as a 13-place glider.

Closely following the NAF conceptual design, the low-wing wooden glider had flaps and spoilers, a shallow boat hull possessing two steps, and a vast 'greenhouse' canopy over the forward half - perhaps the largest Plexiglass canopy introduced to that time. Control surfaces were fabric covered. The outboard motor could be extended through doors under the aft fuselage just forward of the aft step. A battery-powered SCR-585-A radio was also featured. Bristol initially designed their aircraft with a single center landing gear, like sailplanes. The Navy judged this impractical, insisting on a retractable tricycle undercarriage. However, their decision came as the static test airframe was being finished and added to delays in the flight airframes.

Bristol delivered their static article to the NAF on October 16, 1942. This required additional work, delaying ground trials that were limited by lack of undercarriage or outboard motor bay. The ground tests consisted of applying loads to the structure on the ground to demonstrate suitable strength. After completion of the tests, a decision was made to perform all necessary work, including installation of the outboard, to permit the airframe to serve as the initial flight and sea trials aircraft.



Interior of the XLRA-1 shows the troop seating and forward pilot stations. The aircraft seated 12, including pilots, with entrance and exit across the wing through overhead hatches. (Naval Aviation Archives)

The spartan instrument panel of the XLRA-1 Invader *is arranged in a vertical fashion and affords excellent vision forward. The dual control wheels are provided for the aircraft commander and second pilot. (Naval Aviation Archives)*

The first XLRA-1 prototype motors along at slow speed with its outboard motor during testing in 1943. Tufts are attached to the surface of the aircraft to enable visualization of airflow. (Naval Aviation Archives)

The XLRA-1 approaches the seaplane ramp at the Philadelphia Navy Yard following a test run on the water. The hatches on both sides appear to offer ready access to the interior. (Naval Aviation Archives)

The preliminary tests were performed by the NAF on the Delaware River, astride the Philadelphia Navy Yard. Three flights were performed on January 3, 1943, with a Grumman J2F-5 *Duck* tug. While the lightly loaded glider performed well enough, the tug pilot noted lousy visibility and dangerously poor directional control on a takeoff that proved exceptionally long. However, stability of the glider on the water was "splendid." Flight control and handling in flight and on the surface were satisfactory. Two tows behind a PBY-5A on January 15 were much better. Operations progressed with the glider loaded up to 7,000 lbs gross weight. The aircraft may not actually have been towed to height for release but simply off the water. Surface runs using the outboard motor on January 20 noted minor problems with the installation. Loading and unloading trials were also performed with fully equipped Marines egressing across the wing. Following this work, the aircraft was returned for completion of static tests.

The prototype XLRQ-1 (11651) was delivered to the NAF on May 5, 1943. This had wheel controls replacing the twin sticks of the static article. The new hydraulically actuated tricycle landing gear had the mains retracting into the wing root for which wells were created with fairings added in the upper wing-fuselage junctions. Three such fairings were devised, from discrete enclosures to full-length root fillets, with the intention of testing each for the lowest drag. Control system checks and aircraft drop test with the new undercarriage were conducted prior to flight. Pending completion of static tests, flight restrictions were imposed. This included 8,200 lbs maximum weight and a 110 mph speed placard. These made complete testing impossible, but a good shakedown was accomplished.

Allied Aviation Corp. XLRA-1 characteristics:

wingspan	72.0 ft	empty weight	2,800 lbs
wing area	495 ft²	tow speed	150 mph
length	40.0 ft		

Surface and flight trials of the glider in Philadelphia on August 6 through 16, 1943, had on board pilot E. K. Jaquith, observer Harry Sparks, and mechanic George Salo, all presumably Bristol employees. The PBY-5A "Tugboat Annie" was operated by Maj. Figley and Capt. Reilly. Surface trials revealed some minor problems but were otherwise encouraging. First flight was on August 6 and lasted 15 minutes. Tow was at 104 mph to 1,200 ft. This appears to have been the initial 'up-and-away' flight of the XLRQ-1, becoming the first amphibious glider in the U.S. During the second and third flights on August 6, each 30 minutes long with release at 2,000 ft, tail vibrations were experienced that required subsequent control system rework. The fourth and fifth flights on August 10 were each 20-minutes in duration and

The initial example XLRA-1 lifts above the surface of the Delaware River during flight trials in 1943. The stepped hull and tow line attachment are evident. (National Soaring Museum)

At this instance in a test flight, the XLRA-1 has its landing gear extended and is in a low tow position. Pitot probe and sideslip vane are well above the aircraft to avoid water spray impact. (National Soaring Museum)

The second Invader *prototype shows a further evolution in the canopy design. Although a true tricycle undercarriage was called for, a compromise is evident in the wheels added to the tail and wing skids. (National Soaring Museum)*

at heavier weights, with runway takeoff and landing. Overall, handling on the water and in flight was very good. Operations were conducted in up to 4.0-ft swells.

During the water landing on the fifth flight, with 2,213 lbs of ballast, some hull structural damage resulted owing to high suction loads, suggesting the need for strengthening. Consequently, the sixth flight on August 16 was a 1-hour 15-minute ferry from Philadelphia back to the contractor's plant in New Haven. During the mission, the pilot discovered that full spoilers blanked the rudder.

While the PBY and Maj. Figley were in New Haven, the opportunity was taken on August 16 to fly the second XLRQ-1 (11652) to check operation of the hydraulically actuated landing gear on this example. This worked well and was judged mechanically superior to the manual system, in addition to being 200 lbs lighter. The wheel well fairings were also different than on 11651, but experienced more buffeting from flow separation.

Allied's 12-place XLRA-1 glider was unofficially named the *Invader* and developed under an October 8, 1941, contract. Among the principals at Allied was president Richard E. Breed, III, executive vice-president Hugh S. Williamson, general manager Burnham Litchfield, and chief engineer Walter F. Burke.

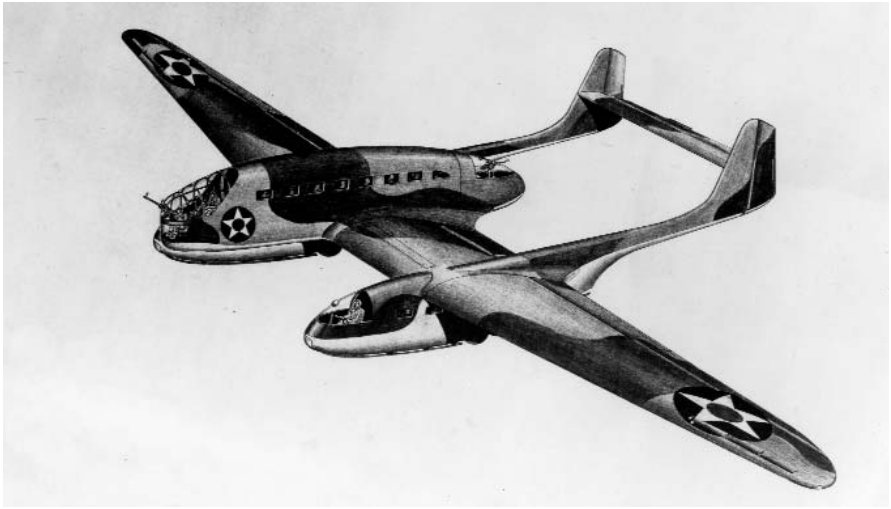
Showing their common heritage, the XLRA-1 looked very similar to the XLRQ-1. The glider featured a dual-wheel retractable truck on the centerline, without brakes, and mid-wing outriggers. On the first aircraft (11647) the outriggers were simple skids while the second (11648) the outriggers were oleo struts with wheels and the aft fuselage featured a roller. Unlike Bristol, Allied was not immediately required to change to a tricycle gear. Fittings were installed to support an R-3350 engine in the cabin.

The static article was delivered on December 16, 1942. However, the aircraft was incomplete and the company sent workman to finish construction. Structural weaknesses were then uncovered during test that required the wing to be rebuilt. After delivery of the first prototype, flight testing commenced at NAF on March 24 and on this first flight the wing was damaged. Although Allied insisted the glider had stuck a floating object, BuAer suspected design flaws, rough seas, or both. The glider was repaired but operated under restrictions because the wing was considered structurally deficient.

Comprehensive Navy testing was carried out between August 18 and September 3, 1943, in Philadelphia. The glider was launched and recovered off a seaplane ramp both on its gear and from the transportation trailer. A 9.7-hp outboard gave 4-5-kts movement on a calm surface with light winds, but even modest winds or wave action slowed the glider to almost no forward motion. A 37-hp motor gave more suitable performance. But, both models suffered inadequate ventilation, with smoke and fumes filling the cabin.

Water and runway takeoff and landings went well. Tows were performed at various times by a Grumman F4F-3 *Wildcat*, J2F-5 *Duck*, and *Catalina*. Some porpoising was experienced at the early portion of the water takeoff in light chop, and the

With uncertainty as to the suitability of the float-wing concept, other ideas were suggested. This high-wing design, possibly the 12-place Allied XLR2A-1, apparently gained stability on water simply from the width of the hull since it lacked outrigger floats. (Jay Miller collection)



The twin-hull, 24-place glider morphed into a design with an 'intermediate' center fuselage as G&A Aircraft developed the concept. The XLGR-1 shared a common basic design with the Army XCG-9 project, both appearing like this drawing. (National Archives)

tow planes were working hard, but once on the step everything smoothed out. The wake of the tug actually smoothed out the trailing surface and quieted the glider's ride to liftoff. During one land takeoff with the original main wheels and wing skids, with the glider not aligned with the tug and the tow line taken up suddenly, the glider swerved so violently that a wing skid snapped. Operations with outboard wheeled struts undercarriage were much better, although criticized for lacking brakes.

Flight handling of the XLRA-1 was generally satisfactory. A few structural issues and undesirable features were identified, but appeared readily correctable.

Allied had a conceptual design for a high-wing 12-place glider. Since there was still doubt as to the suitability of the float-wing design, developing an alternative appeared wise to BuAer. Some seemed to believe Allied had the wherewithal to develop this new glider concurrent with their existing contract. Although a move was made to issue a $289,800 contract for this LR2A-1, Allied did not provide suitable quotations for contract definitization and the matter was dropped.

With the continuing pressure to get aircraft to Marines for operational tests at the earliest date, BuAer decided to issue production contracts for 100 of each 12-place glider models. Although many voices spoke against production until the value of the whole concept had been demonstrated, an order of this magnitude was considered cautionary, ensuring production capacity was in place for immediate large-scale orders if such a decision was made.

Allied was given a letter of intent on April 4, 1942, for 100 units before the XLRA-1 had substantially taken form. The agreement included a peculiar provision by which the second flight test glider under the original contract was to count as the first production glider under the second contract, allowing funds to be advanced to the ailing company. The tricycle undercarriage (modified P-40 fighter components) was to be introduced on the eleventh production machine. This configuration may account for the LRA-2 designation mentioned in the literature, although described as having jettisonable two-wheel main gear assembly, with a contract or two aircraft issued. The Navy anticipated a delivery rate of 10 LRA-1s per month and a plant in Winston-Salem, N.C., was being prepared.

An order for 100 LRQ-1s, at an expected cost of $27,215 per aircraft, was placed with Bristol on August 4, 1942, well before substantive testing. This came after Bristol remarked that if it did not get a Navy production commitment it might be consumed with Army glider work.

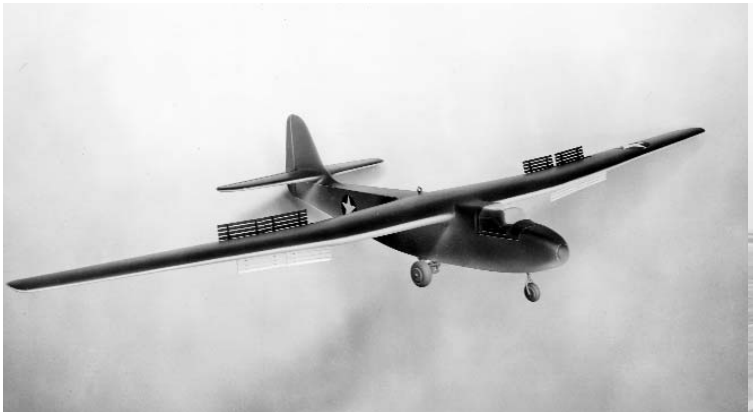
Midsize Models

Following the USMC's recommendation, the NAF's catamaran glider was recast as a 24-place aircraft and prospective manufacturers sought. Five proposals were received by September 24, 1941, these from Bowlus Sailplanes, Inc., Greenport Aeronautical Corp., Pitcairn-Larson Autogiro Co., Snead & Co, and Timm. A contract was issued on October 9, 1941, to the lowest bidder/lowest weight - Snead & Co. with $266,510 and 5,728 lbs. As with the 12-place gliders, a competing project was soon initiated. The December 23 contract went to the next lowest bidder, Pitcairn-Larson Autogiro Co. ($350,942 and 5,728 lbs). This concern was renamed A.G.A. Aviation Corp. (for Autogiros, Gliders and Airplanes) as of October 11.

As with the 12-place contracts, the manufacturers were to deliver a static article and the first of two flight models within six to eight months. Although this schedule was admittedly little more than something on which the Navy could "hang its hat," it was optimistic in the extreme given the immaturity of the firms involved. It does not appear that any of the hard-pressed USN personnel visited the competitors prior to contract award. Each of the firms was newly formed or reorganized with almost no actual design and manufacturing experience. Although A.G.A. supposedly had the resources of the company previously building autogiros for commercial and military customers, virtually no personnel or plant had been carried along. Snead had previously built welded aluminum assemblies under subcontract and steel office furnishings.

Snead & Co. was run from Jersey City, N.J., with construction facilities in Orange, Va. Under consulting engineer Dr. Alexander Klemin, the XLRH-1 closely followed the twin hull design. It was to span 110.0 ft with a guaranteed empty weight of 5,728 lbs. It was discovered that the NAF's choice of wing was unsuitable and considerable additional work had to be performed, albeit with NAF assistance. However, the firm's detailed design was judged poor, at best, by BuAer engineers.

The competing A.G.A., hailing from Willow Grove, Penn., was to create the XLRG-1 that departed markedly from the NAF's concept. The new design was to have a wingspan of



The requirement for a large cargo glider to support Marines ashore and serve as a bomb glider platform yielded the XLRN-1 developed by the NAF and shown here in model form. It was to carry 18,000-lbs of cargo/explosives or 3,000-lbs of fuel. (National Soaring Museum)

Unlike the troop transport gliders, the XLRN-1 showed no evidence of being intended for water operations, although this may have been merely an expedient for an initial design. This view emphasizes the thick wing with a leading edge bulge for a generator, and the cross-beam main undercarriage. (National Soaring Museum)

109.0 ft and an empty weight of 4,800 lbs. An above-wing 'intermediate' center fuselage pod housed the two pilots and a dozen troops while the twin 'floats,' to be provided by Edo and from which the tail booms issued, would carry five Marines each. This brought the glider in line with the very similar 32-place XCG-9 glider A.G.A. was working on for the Army.

A.G.A. decided to demonstrate the suitability of their 'twin float' design with a scaled-down flight model. Their 40 percent scale wooden aircraft was built in just 35 days for $40,000-$45,000, entirely company funded. Capt. Barnaby, along with other pilots, conducted a series of flights with the machine in Philadelphia beginning on November 16, 1941. Although some design changes were suggested, the results were satisfactory. The firm became G&A Aircraft, Inc. in early 1942, a division of Firestone Tire and Rubber Company.

The G&A design was, by June 1942, 1,500 lbs overweight and water tank trials indicated that substantial changes would be required to the boat hulls - likely adding to weight problems. The company estimated it would require twice the negotiated contract value to reach completion. By November the static test article delivery was still sometime after March 1, 1943, well behind schedule. Then, a weight report indicated the aircraft was 2,879 lbs overweight, or more than 50 percent. This bad news was followed by worse when a structural test wing failed at only about 50 percent of design maximum load.

The 24-place aircraft were pursued less vigorously than the 12-place models because of greater uncertainty inherent in the designs. There was residual skepticism about them, especially as they would likely be expensive to build and all conceivable landing gear or jettisonable trolley designs for a runway takeoff appeared cumbersome. However, eager to move ahead, 50-unit production contracts were prepared using the same logic as for the 12-place projects and before either contractor had accomplished much on the development contract. Snead got a letter of intent on April 1, 1942, the contract following in August. It called for production to commence August 15, 1942. If this was not improbable enough, the firm suggested with either remarkable aplomb or extraordinary ignorance that it could build one glider per day. Although G&A was also considered for production, their poor progress on the experimental contract did not seem to warrant this step at the time. All the glider contractors would have had to substantially expand their facilities or find partners to meet the production commitments.

As Snead and G&A thrashed about in their respective quagmires during late summer 1942, Maj. Wehle suggested the USMC examine the possibility of having *Horsa* gliders built in the U.S. to meet the requirement. He had flown the type and reported it was largely acceptable. Built of plywood, it seated 25 troops and two pilots. An order for 100 as the initial portion of a 2,000-aircraft fleet was postulated, at an eventual delivery rate of 100 per month.

The USN acted quickly, dispatching a missive to the British government seeking an example *Horsa* and complete drawings. The reply cautioned that the glider, obviously not amphibious, would likely be unsuitable for the humid conditions of the Pacific theater. Furthermore, it could barely be towed by a Douglas R4C (DC-3) and really needed a four-engine type, so the Navy and Marines might lack suitable tugs. Even if the glider could be redesigned to break down into assemblies transportable by ship, they would consume tremendous cargo volume.

Little consideration was initially given to Army types and avoiding duplicative efforts, other than to recognize that some of that service's glider manufacturers might be free to take on *Horsa* production. The assumption was that Army aircraft would naturally be inferior in meeting naval requirements. However, with the 12-place glider effort progressing discouragingly slowly, thoughts turned to the CG-4 that was transportable by sea, considering as many as 575 LRW-1s.

The Commandant agreed to look into the *Horsa* option while continuing with the Navy development efforts. When the Navy got the example *Horsa* (H6765), it conducted tow tests behind a *Catalina*. However, circumstances would dictate that neither this nor the CG-4 proposal advanced far.

The enormous size of the XLRN-1 is indicated in this team photo. It was the largest American glider of the war and amongst the largest aircraft the nation built of wood. (National Soaring Museum)

Falling to Pieces

Progress on the transport gliders continued to be poor during summer 1942. Some of the projects were clearly going nowhere while even the most promising could offer no reliable delivery dates. A decision in June 1942 to dramatically increase procurement from 150 to 1,000 transport gliders was never acted upon. Adding to production contracts that were essentially dormant was meaningless.

Disagreements over the wisdom of pursuing the glider program had persisted from its inception. In summer 1942, then-Lt. Col. Wehle wrote a widely circulated paper suggesting the entire glider program be reconsidered in light of slow progress being made and the realities of operational problems that were crystallizing. An Informal Glider Board was convened by BuAer on October 9, 1942, to review and clarify the situation. Their report on October 17 admitted that a combat-capable force would not be ready for employment before May 1, 1944. They dismissed the CG-4 as unsuitable, recommended the 24-place projects be cancelled and a single-hull design be pursued. However, they suggested letters of intent for production of 2,200 Bristol or Allied 12-place gliders, or both, should be issued at once.

Many felt the program should not be continued beyond the initial stage until the actual combat requirements were elucidated, representative aircraft available, and operational testing completed. BuAer pointed out that delays in pursuing production until the experimental gliders had been tested and design changes identified could mean combat capability would not be attained until January 1, 1945. This suggested the entire enterprise might contribute nothing to defeating the Axis.

Other reviews and discussion through January 1943 had other perspectives, some casting serious doubt on the utility of amphibious gliders for the envisioned assault mission and the ability of BuAer projects to meet requirements in a timely manner. Commanding USMC generals were queried. The responses were similarly mixed, but those in the South Pacific were uniformly negative. By this point, even the well-informed Wehle had come 180 degrees, stating emphatically that "… military gliders, amphibious or land based, are of no value to the Marine Corps." He judged the weapon unproven and, seeing no real combat capability until July 1944, money being spent on the effort was wasted. He recommended cancellation. Another board of BuAer program officers and NAF pilots participating in the program had to confess that glider operations appeared impractical in forward operating locations and in anything but good weather conditions. They also recommended cancellation.

By this time the Marines were committed to an 'island-hopping' campaign in the vast reaches of the Pacific, with landings expected to commonly be beyond the range of land-based aircraft or those requiring shore-based support. It was difficult to see how gliders could meaningfully contribute to these operations. Tows lasting many hours would be

This group shot before the XLRN-1 includes Capt. Barnaby, the shorter man in the middle. Note the fixed landing gear and the ditching hatches for flight deck crew. (National Soaring Museum)

The great mass of the XLRN-1, at 36,000-lbs fully loaded, meant that only a 4-engine transport was suitable to tow it aloft at anything but nearly empty weight. A Douglas R5D-1 hauls the glider across the NAS Patuxent River backdrop. (National Soaring Museum)

Naval Aircraft Factory XLRN-1 characteristics:

wingspan	110.0 ft	empty weight	18,000 lbs
wing area	1,200 ft²	loaded weight	36,000 lbs
length	67.5 ft	overload weight	40,000 lbs
height	18.4 ft	max. tow speed	180 mph

exceedingly exhausting for the pilots, and gliders at that time had no blind flying capabilities. The question of flight in weather was being addressed by the Army and the Glomb programs through the use of instruments, autotow, and autopilots systems extant or under development. (A truly operational instrument flight capability was never attained.)

It was July 1942 before thoughts turned to the issue of tugs with a proposal from Wehle to immediately acquire 72 Douglas R5D *Skymaster* (DC-4) transports to serve in the near-term for parachute troop operations and later as tugs. While a very worthy idea, the reality was that six dozen of the very costly four-engine transports would be exceedingly difficult to obtain in short order. The earlier notion that a *Catalina* could drag three 12-place gliders simultaneously was clearly misplaced. Perhaps two could be towed. The two-engine R4C would have a radius of action of at most 400 miles and so would be unsuitable for most potential amphibious operations. In any event, this would be a small measure of the number of suitable transports required to haul the hoped-for 1,000 or so operational gliders, even in multiple lifts delivering an effective and self-sustaining mass of troops in the initial assault. The Informal Glider Board had determined that by winter 1943-44 the USN and USMC would have 3,200 airplanes capable of towing at least one 12-place glider, and so judged no additional procurement was required in this respect. This appears to have been optimistic.

While the Navy considered it "more defensible if we waste money than if we failed to do everything possible to get gliders," in the words of one Admiral, some of the glider efforts had reached critical mass. Snead's poor progress was cause to cancel the production contract on August 29, 1942. Although their glider was beginning to come together by September 1942, the firm was facing bankruptcy and the Navy was preparing a 'get well' plan to help it recover its losses. The G&A situation was so bad as to appear irrecoverable. The pain was ended on November 13, 1942, with a Navy stop-work order simultaneously to Snead and G&A, having expended $675,839 on the former and $350,741 on the latter. With both 24-place projects terminated, the idea of developing a single-hull replacement never gelled.

All this speculation and summarizing came just as the float-wing glider was beginning to prove itself in actual test. While grossly behind schedule, the 12-place projects had actually yielded flying aircraft in what was actually a remarkably short time given the complexity of the task and the nature of the organizations involved. However, more work was clearly needed to take these to production, and the firms involved were suffering managerial and fiscal meltdown. The Navy was seeking a way to give Allied advanced payments to help it stave off financial collapse. But, it was all too little and to late.

The director of the Marine Corps Division of Aviation, Gen. Mitchell, forwarded the most concise reports and conclusions to the Commandant on March 13, 1943, with a recommendation to drop the glider program. The Commandant, in turn, endorsed cancellation on April 15, 1943, in a missive to the Chief of Naval Operations (CNO). Everyone in the chain on its way to the Chief concurred with the action. Adm. King then wrote the Secretary on May 18 recommending liquidation, but that gliders on hand to be used for experimental purposes. The termination decision was announced on June 18, effective June 24, 1943.

Just Won't Quit

In dismantling the program, the Navy agreed to transfer most or all of its glider work to the Army for evaluation,

The NAF XLRN-1 had some flight handling difficulties requiring changes during test that were never quite satisfactory. By the time it flew in fall 1944, it was clearly unneeded and so not pursued further. (National Soaring Museum)

including aircraft then under test. Although Army pilots appeared in New Haven on August 10, 1943, to fly a XLRQ-1 to Wright Field, in Dayton, Ohio, the Navy had yet to formally approve the transfer and the officers went home empty handed. The Navy agreed on August 5, 1943, to provide the second XLRA-1 prototype to the Army for evaluation, but this also was not consummated. Only the one glider remained, and the BuAer had other ideas.

Capt. Fahrney suggested that if the USMC did not want 200 12-place gliders, they should be developed for experimental and operational test purposes, or as Navy assets. He suggested they could be used as utility aircraft, such as for the flying boat support mission, towed by seaplanes and flown by any trained naval aviator. However, only the "glider enthusiasts" at BuAer seemed to believe the Navy had a requirement for gliders.

The decision to terminate the 12-place production contracts, except for hulls sufficiently along in assembly, was defined on June 19, 1943, as 15 aircraft each. Six of each would go to the Training Task Force Command and the balance, plus two Hotspurs at Eagle Mountain Lake, to the NAF for testing. It was not to be.

In the case of Bristol, its management was in a shambles, supervisors were fleeing, and creditors were strident. The company was unlikely to meet even these reduced contract terms. Since procurement officials were unwilling to advance the company another nickel, there was discussion of moving the work to the NAF—more precisely having the Naval Air Modification Unit (NAMU), Philadelphia, assume supervision of the activity. Instead, reason prevailed and both Bristol contracts were terminated on September 16, 1943, after expending nearly $4 million.

Things were little better at Allied. Management clashes with the Navy in-plant inspector had BuAer insisting on personnel changes. August 1943 tests revealed the single wheel design appeared acceptable and thought was given to canceling the change to the P-40 gear that was proving troublesome, and perhaps even canceling the last five aircraft that were to receive the gear. The government had already poured $2.4 million into the company and could reasonably expect to spend another million over the next year for the 15 production aircraft - making them exceedingly expensive gliders, indeed. After further consideration the Allied contracts were cancelled on September 18.

The NAF took over the flight-worthy gliders and continued experimental testing. Trials of the LRQ-1 progressed with a flight as late as December 5, 1943, and water operations were conducted with 11652. Barnaby participated in many of the tests after August as pilot, along with Reilly. What was likely the only airworthy XLRA-1 was destroyed on December 11, 1943, when high winds lifted an LRW-1 off the ground and deposited it atop the amphibian.

What there was of the 12-place production aircraft that could possibly be of use was collected, amounting to two LRA-1 and two incomplete LRQ-1 examples. These were moved to the NAF for final preparation and testing. However, this work was given low priority. On November 1, 1944, one LRA-1 and one LRQ-1 were almost ready for flight, the other two being stored. It is unlikely anything came of this. All of the wooden aircraft were eventually broken up.

Sky Yacht

The last Navy glider project was born of the Glomb and cargo glider projects crossing paths in fall 1942. The Marine cargo glider requirement was initially addressed in a BuAer planning document of June 29, 1942, that called for an aircraft that could carry either fuel, freight, or explosives. An explosives-laden glider was to be flown onto a target via remote control as part of Fahrney's Glomb program. As officially enunciated in a September 29 directive, three types were sought. The small glider was to carry 1,000 USgal of fuel or 6,000-8,000 lbs of explosives. This was to be created by conversion of the USMC's 24-place glider, but no contract was ever let for this work given the poor state of the contractors and slow progress on the personnel glider development. The intermediate size cargo glider was to carry 2,000 USgal or a 12,000-14,000-lbs explosive load. The large glider would accommodate 3,000 USgal or 18,000-20,000 lbs of explosives.

To meet the intermediate glider requirement, Bristol was considered in mid-November 1942 for a contract to produce an enlarged version of their XLRQ-1. It was to carry,

alternatively, 24-30 passengers, 2,000 USgal of fuel, or 14,000 lbs of explosives. It was also hoped that the new design challenge would keep disaffected Bristol engineering staff from departing and inject much-need funds into the failing entity. However, it was wisely decided on December 5 to defer this action until the NAF had tested the XLRQ-1. The idea persisted until June 12, 1943, by which time Bristol was a walking corpse and procurement officials refused to contemplate issuing them another contract. Capt. Fahrney then proposed handing the requirement to the NAF.

The large cargo/Glomb gliders had already come to roost at the NAF. On June 29, 1942, the CNO ordered the NAF to undertake the detailed design and construction of a large wooden glider to fulfill one of two requirements proposed by BuAer. The Bureau had already forwarded their drawings and tentative specifications to the NAF on June 22. The first was a requirement for a high-wing glider to carry 18,000 lbs of explosives or 3,000 USgal of fuel. The later intermediate design had evolved to a glider carrying 12,000 lbs of fuel or 10,000 lbs of explosives. The fuel was to be delivered as cargo or transferable in flight to a long-range aircraft serving as tug.

Apparently considering two simultaneous projects too much, the NAF initially undertook only the 18,000 lbs payload requirements as the XLRN-1, setting out to build a static test article and two flight test airframes. This was the Navy's most ambitious gliders project, America's largest glider of the war, and one of the largest aircraft the nation built of wood. Development was undertaken with tight security and apparently employed Allied Aviation resources. Specifications were clarified to include troops or freight like spare engines lifted to forward flying boat bases. An autotow system, an ongoing Glomb project, was to be incorporated for test. The remote operator would be in the tug and a television camera mounted in the glider's nose. Several schemes for in-flight fuel transfer were considered, the hose apparently to issue from a 10-ft long, tapered tube protruding from the nose. After fuel transfer, the unmanned glider would be landed via remote control or cast off to find its own way back to earth.

Work on the XLRN-1 was slowed by inevitable problems, and it was October 1, 1943, before a mockup was ready for inspection. The aircraft were assembled at the NAMU where Capt. Fahrney had become CO. With the schedule stretching out, thought was given to canceling the project. The aircraft was no longer needed as a USMC cargo glider and Glomb production contracts had been issued for much smaller aircraft. It was also discovered that fuel could not be safely transferred in flight with the aircraft under electronic control owing to the explosion hazard. However, the XLRN-1 effort was continued to glean engineering value from the investment, with the pace of construction slowed further. One notable outcome was the realization that aircraft construction in wood on this scale appeared impractical and might not standup well in some theaters of operation.

The impressive glider had a fixed tricycle landing gear, although the main undercarriage was on a beam attached beneath the aircraft such that it could be jettisoned. The high wing was fitted with flaps plus large spoiler panels above and below. Cargo doors or rear loading ramp are not visible in photos or discussed in the literature. However, it seems clear the low fuselage bottom and high wing were intended for ease of loading. Although amphibious operation is not overtly mentioned in available documentation, the lack of boat hull and wing floats may have been an expedient. The cargo missions would have required at least beaching or inland landing, if not setting down in surf. Provisions were made for two types of auxiliary power units, with a gasoline motor in the fuselage and a wind-driven generator in the starboard wing leading edge. These would charge batteries providing 30-minutes of electrical power. Empty weight had crept up during detail design and assembly from about 11,000 lbs, depending on mission configuration, to 18,000 lbs for the flight test aircraft.

Prototype assembly continued into early 1944, with costs exceeding a million dollars. One source of the delay was a reworking of the control system to reduce friction and yoke/pedal forces. Delamination of the black walnut spar was another stumbling block. Flight testing was to be conducted at Naval Air Station (NAS) Patuxent River, Maryland. The glider was delivered there by barge with the outer wing panels removed, and then assembled by October 19, 1944.

Taxi tests behind "Tugboat Annie" on October 24 had Maj. Figley and Capt. Barnaby at the controls. Testing continued with brief liftoffs and short flights with different flap settings, reaching 100 ft altitude after release. After several more 'taxi' runs, the first true flight occurred the following day with Lt. Ryan replacing Barnaby as copilot, then-Maj. Reilly flying the Cat. The XLRN-1 was at 19,400 lbs and the sortie lasted 24 minutes.

Testing proceeded into November with Barnaby again doing much of the flying. At the full-up weight of 36,000 lbs the glider had to be towed by a R5D-1. This four-engine transport, numbers spread thinly across the services, was one of the few aircraft that could tow the fully loaded glider. The PBY-5A could haul the XLRN-1 only at light weight.

The pilots found the glider's longitudinal stability to be poor, with oscillations from over-control owing to poor control harmony in pitch and yaw. Further internal and external control system changes were necessary. A 'false' trailing edge was applied to the elevators and rudder, the elevators rebalanced, and the elevator tabs locked out. The top slat on each upper spoiler was removed to correct an over-balance condition. Considerable progress was made, as seen during the second and third flights, November 7 and 9, at 50-55 minutes each, although rudder pedal forces remained prohibitively high.

The handling deficiencies finally ended the project. All required modifications could not be supported for a mere demonstration effort. It seems doubtful that autotow trials or remote control with the TV camera were performed. The second aircraft was never completed and all materials were eventually broken up.

The intermediate cargo/Glomb requirement was apparently addressed as a 1944 project labeled the LR2N-1. It never progressed far before being cancelled.

US NAVY/MARINE CORPS GLIDERS

Type	Make	Seats / Payload (lbs)	Year Contracted / Delivered	No. Delivered	Bureau Number(s)	Notes
XLNE-1/LNE-1	Pratt, Read	2 / -	1941	2/73	XLNE-1 31505/6, LNE-1 31507/78 Army 42-39509/78, 43-43329/31 (31579/85 and 34115/34 cancelled)	73 transferred to Army Aug. 5,1943 as TG-32
LNS-1	Schweizer	2 / -	1942	13	02979/80, 04380/89 26426	as Army TG-2
XLNP-1	Piper	3 / -	1942	3	36425/27 Army 42-12499/501	as Army TG-8
XLNR-1	Aeronca	3 / -	1942	3	36422/24 Army 42-57452, -57461/2	as Army TG-5
XLNT-1/LNT-1	Taylorcraft	3 / -	1942-43	3+7/25	XLNT-1 36428/30 Army 42-12496/98, 67800/06, LNT-1 87763/87 incl. Army 42-58561	as Army XTG-6
XLRA-1/LRA-1	Allied	12 / -	1943	1/0	11647/8	amphibian, cancelled
XLRA-2	Allied	12 / -	1943	0	31503/4	as XLRA-1 but altered landing gear
LR2A-1	Allied	12 / -	(1942 ?)	0	N/A	high-wing design not formally ordered
XLRQ-1/LRQ-1	Bristol	13 / -	1943	2/0	11651/2	amphibian, cancelled
XLRG-1	G&A	24 / -	1942	0	N/A	amphibian, 40% scale version from AGA flown, cancelled
XLRH-1/LRH-1	Snead and Co.	24 / -	1942	0/0	11649/50	amphibian, poor contractor performance, cancelled
XLRN-1	NAF	80 / 18,000	1944	2	36431/32	cargo/Glomb amphibian, built by Naval Aircraft Factory and 36431 tested, cancelled
XLR2N-1	NAF	24 / 12,000	1944	0	N/A	cargo/Glomb amphibian, cancelled with little progress
LRW-1	Waco	15 / 3,570	1942	13	37639/48, 44319, 69990/1 incl. Army 42-252784 & -252785	as Army CG-4A, 10 returned to Army Aug. 5, 1943
LR2W-1	Waco	?	1942 ?	(2)	85094/5	uncertain reference
Horsa	Airspeed	25	1943 ?	1	British H6765	
Hotspur II	General Aircraft	8	1943	6	Unknown	loan from Canada

Post-Mortem

On August 5, 1943, 73 LNE-1 gliders were transferred to the Army, the two missing LNE-1s presumably lost to attrition. All six original three-place trainers were also eventually returned to the Army. The seven additional XLNT-1s had apparently been shuffled off to the NAF for use in bomb glider tests along with 25 more acquired as LNT-1s. Ten Wacos were also handed back to the Army on August 5. With the one lost in a wind storm, the fate of the other LRW-1s is unknown. By that time, all but the CG-4As were of little value to the Army and so were simply stored.

Glider Group 71 was disbanded after some 372 personnel had been trained on gliders. On December 30, 1943, paratroop units were also ordered disbanded. Considerable construction had been accomplished at the Titusville training base, but little preparation was done in Shawnee.

More than two years of effort had seen more than $20 million spent and the labor of hundreds of people expended. Of 383 gliders on order, 145 had been delivered. Unlike some military programs where at least engineering and training value can be considered an outcome following cancellation, little can be perceived as deriving from the Dept. of the Navy's glider undertaking. The best that can be said is that the misstep did not cost lives or excessive treasure, and did not significantly impact other vital war efforts. It is certainly a fascinating footnote in naval aviation history. Apart from some motorboat tows of a DFS 230 glider on twin floats by the Germans, with an eye towards placing a Kalkert Ka 430 on floats, and 1935 trials with Hanna Reitsch flying the *See Adler* (Sea Eagle) sailplane on a floatation bag, it is not believed anyone else ever undertook any development approaching what the U.S. Navy achieved in amphibious gliders.

Would gliders have actually been useful in Marine combat in the Pacific? It seems doubtful. At the time the cancellation decision was made, the only large-scale combat experience in amphibious warfare had been the Guadalcanal and Tulagi landings. Much worse was to come. The distances were too great, the volume of Japanese defensive fire too lethal, and gliders too vulnerable and cumbersome to unload on the beach. Even inland landings would have exposed isolated groups of infantrymen to determined Japanese assault. By the time gliders had been ready for action, their dubious value would have been made clear by the increasingly costly island campaign.

Bibliography

The American Flying Boat, An Illustrated History, Richard C. Knott, Naval Institute Press, 1988, Annapolis, Md.

Fighting Gliders of World War II, James E. Mrazek, St. Martin's Press, Inc., N.Y., 1977.

The Glider Gang: An Eyewitness History of World War II Glider Combat, Milton Dank, J. B. Lippincott Co., N.Y., 1977.

The Glider War, James E. Mrazek, St. Martin's Press, Inc., N.Y., 1975.

History of Marine Corps Aviation in World War II, Robert Sherrod, Presidio Press, San Rafael, Calif., date unknown.

History of the World's Glider Forces, Alan Wood, Patrick Stephens Limited, England, 1990.

The Navy's Transport Glider Program 1941-1943, Vol. 1, Lt. Comdr. Vance Brown., USNR, DCNO (Air) Monographs in the History of Naval Aviation, U.S. Navy, date no earlier than Nov. 1, 1944.

Silent Wings: The Story of the Glider Pilots of World War II, Gerard M. Devlin, W. H. Allen & Co., London, 1985.

U. S. Marine Corps Special Units of World War II, Charles L. Updegraph, Jr., History and Museums Division, Headquarters, U. S. Marine Corps, Washington, D.C. 1977.

United States Navy Aircraft Since 1911, Gordon Swanborough and Peter M. Bowers, Naval Institute Press, Annapolis, Maryland, 1990.

Sailplanes, 1920-1945, Martin Simons, EQIP Werbung & Verlang GmbH, Germany, 2001.

The Sky My Kingdom, Hanna Reitsch, Greenhill Books, London, 1991.

Soaring Through the 20th Century, Paul A. Schweizer, Schweizer Books, Elmira, New York, 2004.

U.S. Naval Weapons, Norman Friedman, Conway Maritime Press, London, 1983.

Wings for the Navy: A History of the Naval Aircraft Factory, 1917-1956, William F. Trimble, Naval Institute Press, 1990, Annapolis, Maryland.

"Bristol XLRQ-1 Glider Story," Ed Cassagneres, *AAHS Journal*, Summer 2003, pp.123-128.

"Troop-Carrying Glider," no author stated, *Aero Digest*, January 1942, p. unknown.

"The Rise and Fall of the Cargo Glider," Robert M. Goyer, *Air Classics*, September 1991 (Part I), pp.22-29 and 82-83, October 1991 (Part II), pp.43-49.

"Sea-Going Gliders: Experiment in Failure," (no author stated), *Air Classics Special* "Flying Oddballs," Vol. 3, 1992, pp.10-15.

"Transport Gliders: The Rise and Demise of a Weapon System," (no author stated), *Air Enthusiast*, Part I March 1972 pp. 126-134 and 163, Part II April 1972 pp.207-216, Part III May 1972 pp.250-253, Part IV June 1972 pp.318-322.

"Patrick the Porcine Pelican," C. J. Kelleher, *Soaring*, July 1977, pp.32-33.

"The U.S. Navy's WWII Floatwing Assault Gliders," author not stated, periodical unknown, pp.2-6.

"Air Force and Moment for XLRN-1 Glider," Report No. 665, Aerodynamical Laboratory, Department of Aeronautics, Navy Yard, Washington, D.C., April 22, 1943.

"Investigation of Short Glider Tow Lines," Memo Report 2-43, R.E. Figley, Capt., USMCR, Naval Aircraft Factory, Philadelphia, Penn., January 20, 1943.

"Glider Experimental Cargo Line," Memo Report 4-43, R.E. Figley, Capt., USMCR, Naval Aircraft Factory, Philadelphia, Penn., May 22, 1943.

"Salvage of a Disabled Aircraft by Towing as a Glider," Memo Report 5-43, R.V. Reilly, 1st Lt., USMCR, Naval Aircraft Factory, Philadelphia, Penn., May 18, 1943.
"Test of the Gar Wood Training Glider Winch," Memo Report 6-43, R.V. Reilly, Capt., USMCR, Naval Aircraft Factory, Philadelphia, Penn., June 21, 1943.
"Flight Tests of XLRQ-1 Glider," Memo Report 8-43, R.E. Figley, Maj., USMCR, Naval Aircraft Factory, Philadelphia, Penn., August 24, 1943.
"XLRA-1 Glider – Final Demonstration Report," Memo Report 10-43, R.E. Figley, Maj., USMCR, Naval Aircraft Factory, Philadelphia, Penn., October 19, 1943.
"Estimated Performance – Initial Flight – XLRN-1 Towed by PBY-5A," Report No. 52, R. W. McK Seifert, Naval Aircraft Modification Unit, October 15, 1943.
"Revised Estimated Performance – XLRN-1 Towed by PBY-5A," Report No. 100, H. Kaufman, Naval Aircraft Modification Unit, Philadelphia, Penn., July 7, 1944.
"XLRN-1 Gliders," memo, D.S. Fahrney, Capt., USN, Naval Aircraft Modification Unit, Philadelphia Navy Yard, March 24, 1944.
"XLRN-1 Gliders," Memo of Conference, W.M. Seifert, Lt. Comdr., USNR, Naval Aircraft Modification Unit, April 13, 1944.
"XLRN-1 Rudder Control System," memo, W. W. Pearl, Naval Aircraft Material Center, Philadelphia, Naval Aircraft Factory, April 25, 1944.
Untitled memo to Capt. R.S. Barnaby, John T. Lauder, Lt., USNR, Naval Aircraft Material Center, Naval Air Experimental Station, U.S. Navy Yard, Philadelphia, Penn., May 6, 1944.
"Report of Conference held April 27, 1944 at NAMC, Bldg. 75 – XLRN-1 Glider, Surface Coating," memo, T. Morton, Naval Aircraft Material Center, Naval Air Experimental Station, U.S. Navy Yard, Philadelphia, Penn., May 18, 1944.
"Report of Conference August 16, 1944, between Capt. E. Rounds, USNR of NAS, Patuxent River, Lt. R.J. Ryan, NAMU and Mr. W. Pearl, NAMU at NAS, Patuxent River, Md. on first flight of XLRN-1 Glider," memo, William W. Pearl, Naval Aircraft Material Center, Philadelphia, Naval Aircraft Factory, Navy Yard, August 18, 1944.
"XLRN-1 Glider – Report of flight tests at NAS, Patuxent River, Md. October 24 and 25, 1944," memo, W.W. Pearl, Naval Aircraft Material Center, Naval Aircraft Modification Unit, Johnsville, Penn., October 30, 1944.
"XLRN-1 Glider #36431 – Report of Flight Tests at NAS, Patuxent River, Md. November 7, 1944, & November 11, 1944," memo, W.W. Pearl, Naval Aircraft Material Center, Naval Aircraft Modification Unit, Johnsville, Penn., November 14, 1944.
"XLRN-1 Gliders," memo, D, S. Fahrney, Capt., USN, Naval Aircraft Modification Unit, Philadelphia, February 12, 1944.
"Strength Requirements – XLRN-1 Glider," Inter-Office Memo, T. C. Bennett, Navy Yard, Naval Aircraft Factory, Philadelphia, Penn., July 23, 1942.
"XLRN-1 Gliders – Manufacture of – N.A.F. Schedule No. 2666," memo, F. Lloyd Harrison, Comdr., USN, Navy Yard, Naval Aircraft Factory, Philadelphia, Penn., July 14, 1942.
"XLRN-1 Gliders – Drafting Section Conference on Specification for Installation of Auxiliary Power Plant," memo, Karl H. White, Navy Yard, Naval Aircraft Factory, Philadelphia, Penn., February 13, 1943.
"XLRN-1 Airplane," memo, R.H. Kaufman, Naval Aircraft Factory, Philadelphia, Penn., October 1, 1943.
"Glider, Fuel and Explosive Carrier; Construction of," memo, Ralph Davison, Capt., USN, Navy Department, Bureau of Aeronautics, Washington, D.C., June 22, 1942.
"BuAer Project Order 180-43 – Design and Manufacture of One Static Test Article and Two Flight Articles of the Model XLRN-1 Glider – Increase of," memo, J.S. Ramsburgh, Navy Department, Bureau of Aeronautics, Washington, D.C., May 25, 1943.
"Allied Invader Glider Allocated to Army," no author stated, press release, Allied Aviation Corporation, Baltimore, Maryland, September 21, 1943.
"LRQ-1 Aircraft Characteristics," Engineering, Bristol Aeronautical Corporation, undated (after September 17, 1943).
"The Paramarines: Organization and Training of USMC Parachute Troops, 1940-1944," Maj. Merle T. Cole, *AAHS Journal*, Winter 1989, pp.242-249.

Acknowledgements

The author would like to acknowledge the kind assistance of Thomas Culbert, Charles Day, the fine personnel at the Air Force Flight Test Center History Office, National Archives, National Soaring Museum, Naval Aviation Archives, and San Diego Aerospace Museum.

About the Author

William J. Norton is a flight test engineer and *Global Hawk* pilot at the Air Force Flight Test Center, Edwards AFB, California, where he performs development testing of new and modified aircraft. For 20 years, Bill did much the same things during a career as a US Air Force officer where he also served as aircrew on test aircraft. He has contributed to such programs as the RQ-4 *Global Hawk*, MQ-9 *Predator*, F/A-22 *Raptor*, CV-22 *Osprey*, C-17 *Globemaster III*, AGM-129 *Advanced Cruise Missile*, F-15E *Strike Eagle*, C-23 *Sherpa*, and many others. Bill holds a Masters degree in Aeronautical Engineering. He has penned nine aviation books, numerous magazine articles, and many technical papers. Bill holds a number of aeronautical ratings, has restored and operates a DeHavilland DHC-1 *Chipmunk*, and has built a Rutan *Long-EZ*. Bill resides in Southern California.