

# **Goodyear N-Class blimps**

Peter Lobner, updated 12 February 2022

## **1. The Navy's post-WWII blimps**

At the time of the Japanese attack on Pearl Harbor on 7 December 1941, the US Navy had a small lighter-than-air (LTA) program operating 10 non-rigid airships. From 1942 to 1945, Goodyear Aircraft Company in Akron, Ohio built 155 airships in four classes for the U.S. Navy for patrol duty in the Atlantic, Pacific and Mediterranean theaters of WW II.

- 134 K-class blimps
- 10 L-class blimps
- 7 G-class blimps
- 4 M-class blimps

After WW II, the Navy's blimps were rapidly retired from service. The Naval Airship Association reports: "From more than 125 airships in 15 squadrons patrolling roughly 3 million square miles off the coasts of 4 continents, by the end of 1946 there were only 2 squadrons remaining. Airship Squadron 31 (ZP-31) based at NAS Santa Ana, CA was designated ZP-1 and maintained a small detachment at NAS Moffett Field. Subsequently, by August 1947, squadron ZP-1 was transferred to NAF Weeksville, NC, thus ending all LTA operations on the west coast."

WW II-era K-class (ZPN-K) blimps were upgraded and operated after WW II as ZP2K blimps (and later as ZSG-2), which were equipped for long endurance patrol flights with in-flight refueling equipment and attachments for picking up sea water for ballast. Thirty of these were re-designated ZP3K (and later ZSG-3) after being further updated for anti-submarine warfare (ASW) operations and for carrier-based operation.

By 1948 the Navy showed renewed interest in the unique and long range capabilities of airships. The ZP4K (later designated ZSG-4) became the first post-WW II new-construction blimp. These were a

modernized ASW variant of the basic WW II K-class design and were ordered from Goodyear in 1951. The first of 15 units was delivered in June 1954.

The next new-construction blimps were the ZP5K (later designated ZSG-5), which were ordered from Goodyear in 1952. The first of these ASW blimps was delivered in May 1955. A unique feature was the inverted "Y" tail. The Navy received a total of 12 ZP5Ks.

Next came the N-class blimps, which were much larger than their WW II-era predecessors. Originally conceived by the Bureau of Aeronautics as an ASW airship, a 1947 competition between Goodyear Aircraft Company and Douglas Aircraft Company led to the selection of the Douglas design, which the Navy purchased. However, responsibility for manufacturing the large blimps was assigned to Goodyear, which built the blimps in their giant Airdock in Akron, Ohio. A total of 22 N-Class blimps were delivered to the Navy between 1952 to 1960. Most had very short operational lives.

On 21 June 1961, the Secretary of the Navy announced the termination of the Navy's lighter-than-air (LTA) program. Patrol Squadrons ZP-1 and ZP-3 were disestablished by the end of October 1961. Two N-class blimps that had been kept at Lakehurst for research were retired on 31 August 1962 after making a final ceremonial flight. It was the end of an era in naval aviation.



*Airship ZPG-2 (Serial #141559) made the last flight for a U.S. Navy airship on August 31, 1962, thus ending a continuous 45-year period of naval LTA service that began with the DN-1, the Navy's first airship. Source: U.S. Naval Institute*

## 2. Nuclear weapons and blimps

In the post WW II-era, the Navy introduced a variety of nuclear weapons to the fleet, including the following nuclear depth charges.

- Mk 90 Betty, with a 32 kT Mk 7 nuclear warhead, entered the stockpile in the early 1950s and was withdrawn from service in 1960.
- Mk 101 Lulu, with an 11 kT boosted-fission W34 nuclear warhead, entered the stockpile in 1958.

With many blimps in service as armed ASW platforms, the Navy needed to know if a nuclear depth charge could be used during wartime without endangering the airship and crew that launched it. This issue was addressed in a 1960 Bureau of Weapons report by D.A. Gilstad, et al., in which the authors reported:

“Four Model ZSG-3 airships, U. S. Navy Bureau of Aeronautics Nos. 40, 46, 77, and 92, participated during Operation Plumbbob to determine the response characteristics of the Model ZSG-3 airship when subjected to a nuclear detonation in order to establish criteria for safe escape distances for airship delivery of antisubmarine warfare special weapons. Restrained response data for 0.40-psi overpressure input were obtained during Shot Franklin with the ZSG-3 No. 77 moored tail to the blast. Unrestrained response data for 0.75-psi overpressure input were obtained during Shot Stokes with the ZSG-3 No. 40 free ballooned, tail to the blast, 300 feet aboveground. The first airship exposed to overpressure experienced a structural failure of the nose cone when it was rammed into the mooring mast, together with a tear of the forward ballonnet which necessitated deflation of the envelope. The second airship broke in half and crashed following a circumferential failure of the envelope originating at the bottom of the envelope, forward of the car.”

This publicly available information doesn't really answer the question of whether an ASW blimp could escape safely after launching a nuclear depth charge that would detonate underwater. However, even at the top speed of a N-Class ZPG-2 ASW blimp (70 knots), a blimp-launched nuclear weapon doesn't seem to be a good idea.

### 3. The N-Class blimps

The N-Class production run consisted of the following 22 airships:

- 1 ZPG-1
- 12 ZPG-2 ASW blimps
- 5 ZPG-2W airborne early warning (AEW) blimps
- 4 ZPG-3W AEW blimps

Visual cues for identifying these N-class variants are:

- The ZPG-1 and -2 airships do not have the height-finding radar radome on the top of the envelope. The ZPG-1 is smaller.
- The ZPG-2 and -2W have a large radome under the gondola and small propeller nacelles on outriggers. The engines are in the gondola. The -2W has a radome on top of the envelope.
- The ZPG-3W has large nacelles housing the engines on outriggers, no radome under the gondola and a radome on top of the envelope.



*A ZPG-3W airship in the foreground, with a ZPG-2W above and a K-type blimp in the background, circa 1960. Source: US Navy photo*

## The ZPG-1

Originally designated ZPN-1, the ZPG-1 was the smallest of the N-Class blimps, with an envelope measuring 324 ft (98.8 m) long, 71 ft (21.6 m) in diameter, with a volume of 875,000 ft<sup>3</sup> (24,777 m<sup>3</sup>) and an overall height of 95 ft (30.0 m). The ZPG-1 was designed for ASW missions and carried a search radar in a radome under the gondola. Two Wright R-1300 Cyclone 7 air-cooled radial engines on outriggers provided propulsion. Either engine could drive both propellers via the transmission system. It was re-designated SZ-1A in 1962.



*ZPN-1 leaving the Goodyear Airdock in Akron, OH in 1951.*

*Source: Goodyear via The Noon Balloon, Winter 2021.*



*ZPN-1 at Lakehurst, NJ. Source: Naval Aviation News, Sep 1952, via The Noon Balloon, Winter 2021.*

## The ZPG-2

Originally designated ZPN-2N, the ZPG-2 was designed for antisubmarine warfare (ASW) patrols of 2-3 days duration. It was equipped with sonobuoys and could be armed with “lethal stores” (bombs, torpedoes, depth charges) loaded on launchers mounted externally, near the aft end of the gondola. The ZPG-2 was equipped with a Hazeltine / General Electric AN/APS-20 S-band search radar. The 33 ft wide by 8 ft tall (10 x 2.4 m) rotating antenna was installed in a large radome beneath the gondola. The ZPG-2 made its first flight in March 1953.



*ZPG-2 blimp. Source: US Navy via Wikipedia*

One ZPG-2 was built or modified with external engines to test the configuration planned for the ZPG-3W, and is sometimes referred to as a ZPG-2 1/2.

Since 1957, the ZPG-2 named *Snow Bird* has held the world records for airship unrefueled distance and time of flight. GlobalSecurity describes the record flight as follows:

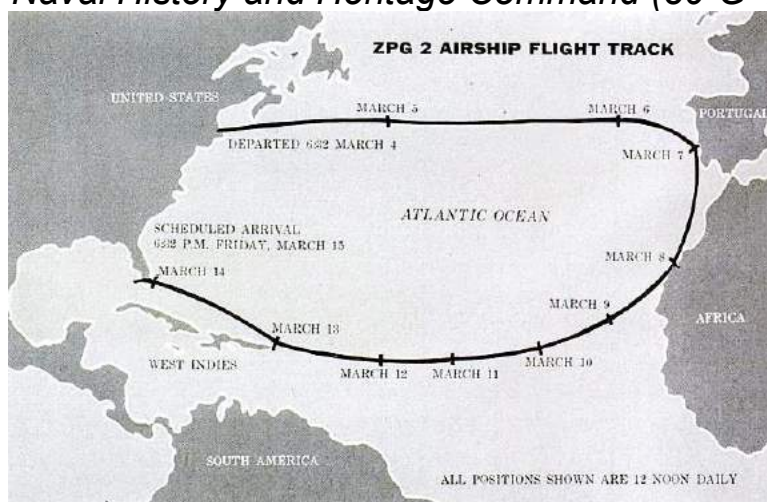
“On Monday, March 4, 1957, at 1832 (EST) *Snow Bird* lifted off from Naval Air Station, South Weymouth for her epic-making flight. The record for continuous non-refueled flight was 200 hours and 12 minutes aloft. *Snow Bird* officially eclipsed this record at 0245 (EST) on March 13, and broke a second record later that day. The distance record established by the German



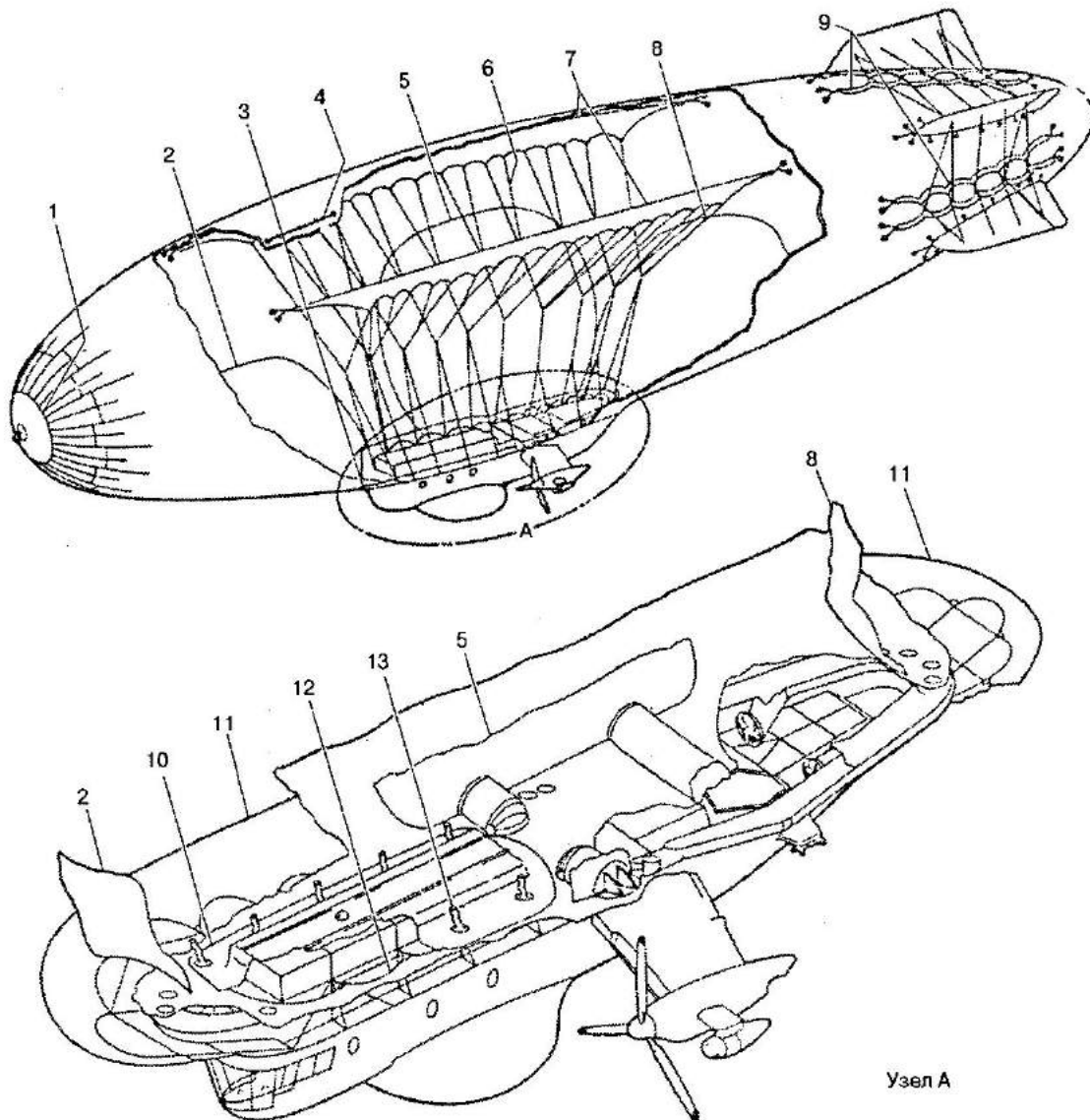
airship Graf Zeppelin in August 1929 fell when Snow Bird passed the 6,980-mile mark in her tricontinental journey. Snow Bird continued her flight, having established two new world records. On March 15, 1957, at 1844, Snow Bird landed at NAS Key West. The voyage took 264.2 hours and covered a distance of 9,448 miles. No airship of any type had ever flown that far or remained aloft that long without refueling. For his contributions as commander and pilot of Snow Bird's record flight, Cdr. Hunt was awarded the Harmon International Trophy on November 12, 1958. The award was presented to him by President Eisenhower."



*Snow Bird departs NAS South Weymouth, MA, 4 March 1957.  
Source: Naval History and Heritage Command (80-G-1009746)*



*Snow Bird route map, 4 – 15 March 1957.  
Source: Flying magazine via This Day in Aviation*

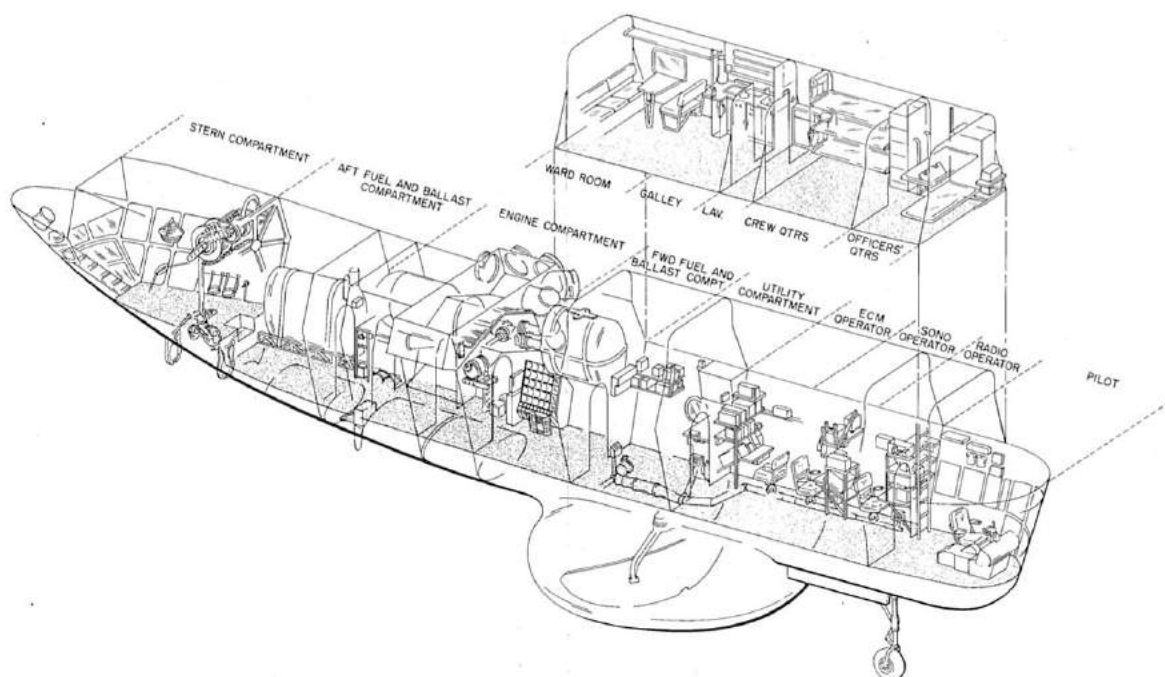


*Legend:*

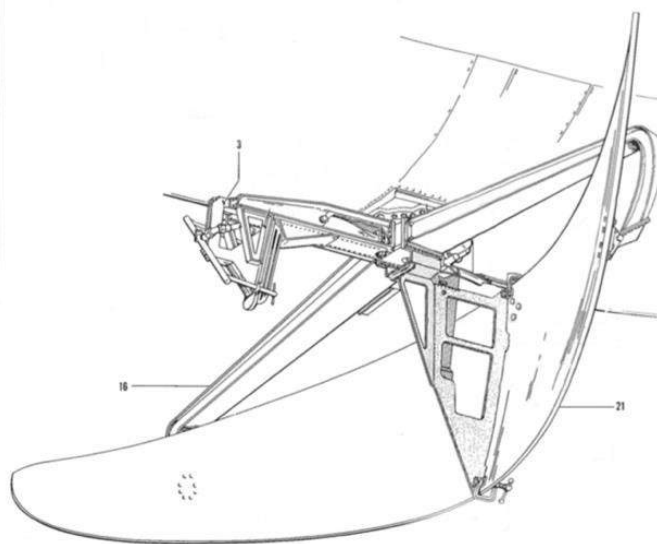
1 - nose stiffeners; 2 – nose ballonet; 3 – reinforced cloth belt;  
 4 - bursting panel; 5 - two central ballonets (port & starboard);  
 6 - suspension cable; 7 - internal catenary belts; 8 - aft ballonet;  
 9 – tail lateral support cables; 10 - gondola cover; 11 - gondola  
 fairing; 12 - external catenary belts; 13 - covers for internal  
 suspension cables

*Internal layout of the ZPG-2 airship. Source: Boyko (2001)*





*Above: ZPG-2 gondola layout for an ASW mission with a crew of 21. The AN/APS-20 search radar is in the bulbous radome under the gondola.*



*Right: Details of the AN/APS-20 radar antenna.*

*Source, both diagrams: NAVWEPS 01-195PBA-2 (1958)*

## The ZPG-2W

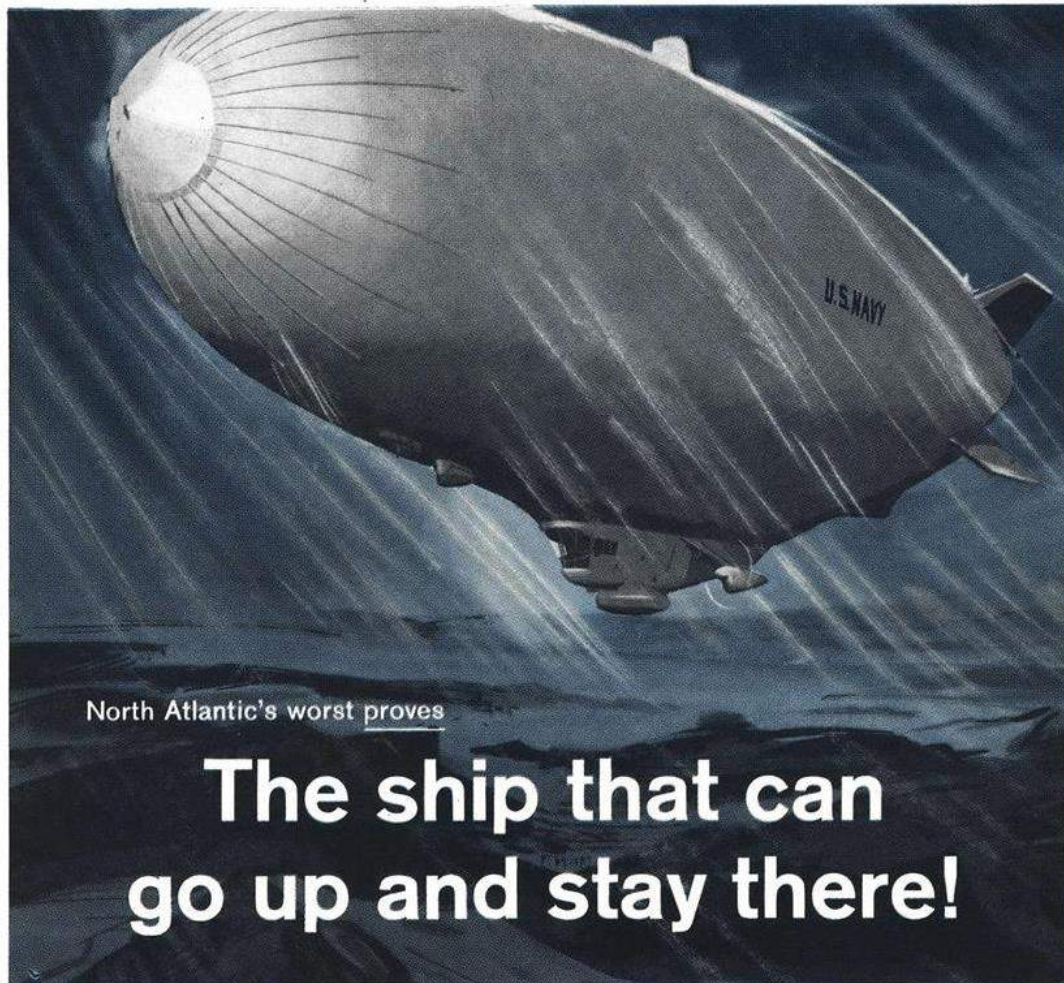
The ZPG-2W introduced in 1956 had a more comprehensive radar suite that was tailored for all-weather airborne warning (AEW) missions. The ZPG-2W carried the AN/APS-20 search radar under the gondola and an AN/APS-69 height-finding radar in a prominent radome on top of the envelope.



*ZPG-2W profile view clearly shows the AN/APS-69 radome on top of the envelope. Source: US Navy*



*ZPG-2W gondola showing the large radome for the AN/APS-20 search radar. Source: NAA Noon Balloon #111 (2016)*



North Atlantic's worst proves

# The ship that can go up and stay there!

## Navy reveals amazing details of airship all-weather endurance flight test

On January 14th, the Naval Air Development Unit at South Weymouth, Massachusetts, working closely with Airship A.E.W. Squadron No. 1 of Lakehurst, N. J., assigned four Goodyear-built ZPG-type blimps to 10 continuous days and nights of radar sentinel duty over the storm-tossed North Atlantic.

On January 25th, the last airship reported back to its air dock — the group having established a weather endurance record unparalleled in the history of flight:

For ten days, working as a team, these latest airships maintained unin-

terrupted radar patrol of the sea approaches to the nation's northeast coast — flying the assigned area in spite of weather which included a 37-hour blizzard, severe icing conditions, and long spells of "zero-zero" visibility, over seas whipped by 60-knot winter gales.

It is convincing proof of the increasing importance of the role the airship is destined to play — in defending the nation which has sole control of the nonflammable helium that makes the modern lighter-than-air craft possible.

Armed with the latest homing type

weapons and the largest airborne radar, the blimp looms as the most dependable and practical aerial sentinel yet posted at the Free World's rim.

*They're doing big things at*  
**GOODYEAR**  
**AIRCRAFT**

*Plants in Akron, Ohio, and  
Litchfield Park, Arizona  
Rewarding Careers for Engineers*

*Goodyear ZPG-2W blimp advertisement, circa late-1950s.  
Source: AW&ST magazine*

## General characteristics of the Goodyear ZPG-2W & ZPG-3W

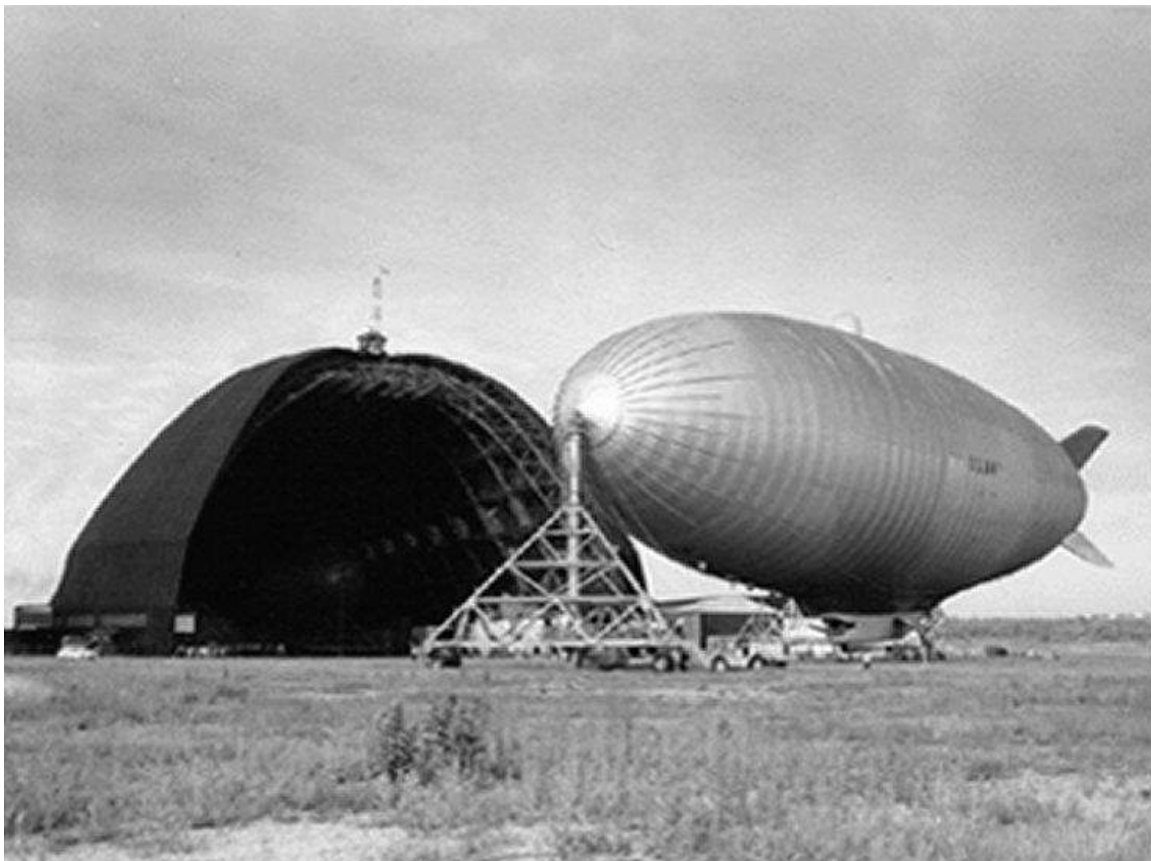
Parameter	ZPG-2W	ZPG-3W
Length	342.6 ft (104.4 m)	403 ft (123 m)
Diameter, max	75.4 ft (23.0 m)	85 ft (25.9 m)
Height, overall	107.2 ft (32.7 m)	117 ft (35.7 m)
Envelope volume	1,011,000 ft <sup>3</sup> (28,628 m <sup>3</sup> )	1,465,000 ft <sup>3</sup> (41,484 m <sup>3</sup> )
Ballonets	247,300 ft <sup>3</sup> (7,003 m <sup>3</sup> )	
Primary radar	<ul style="list-style-type: none"> <li>• AN/APS-20E search radar, power 1.75 MW, installed under the gondola.</li> <li>• AN/APS-62 height finder radar on top of the envelope.</li> </ul>	<ul style="list-style-type: none"> <li>• AN/APS-70 search radar, power 2 MW, installed inside the helium envelope.</li> <li>• AN/APS-62 height finder radar on top of the envelope.</li> </ul>
Powerplants	<ul style="list-style-type: none"> <li>• Two Wright R-1300-3A Cyclone 7 air-cooled, 7-cylinder supercharged engines @ 700 hp (522 kW) continuous, each</li> <li>• Engines installed inside the double-deck control car, driving outboard propellers in external nacelles attached by outriggers to the gondola</li> <li>• Engines accessible for maintenance in flight.</li> </ul>	<ul style="list-style-type: none"> <li>• Two Wright R-1820-88 Cyclone 9 air-cooled, 9-cylinder, radial engines @ 1,275 hp (951 kW) continuous, each.</li> <li>• Engines installed in external nacelles attached by outriggers to the gondola</li> </ul>
Speed, cruise	35 knots	35 knots
Speed, max	70 knots	82 knots
Empty weight	47,700 lb (21,622 kg)	71,080 lb (32,241 kg)
Takeoff weight	66,800 lb (30,300 kg)	93,100 lb (42,229 kg)
Static heaviness	6,000 lb (2,722 kg)	10,500 lb (4,763 kg)
Takeoff run	1,850 ft (564 m) over a 50 ft (15.2 m) obstacle	2,350 ft (716 m) over a 50 ft (15.2 m) obstacle
Crew	21	21
Operational ceiling	3,000 ft (914 m)	5,000 ft (1524 m)
Range	Demonstrated: 9,448 miles (15,205 km) unrefueled ( <i>Snow Bird</i> )	Normal mission: about 3,000 n miles (5,556 km)
Endurance	Demonstrated: 11 days (264.2 hours, <i>Snow Bird</i> )	Normal mission: 80 hours @ 35 knots @ 5,000 ft

*Source: NAVAER Characteristics Summary and other sources*

## **The ZPG-3W, Vigilance-class blimps**

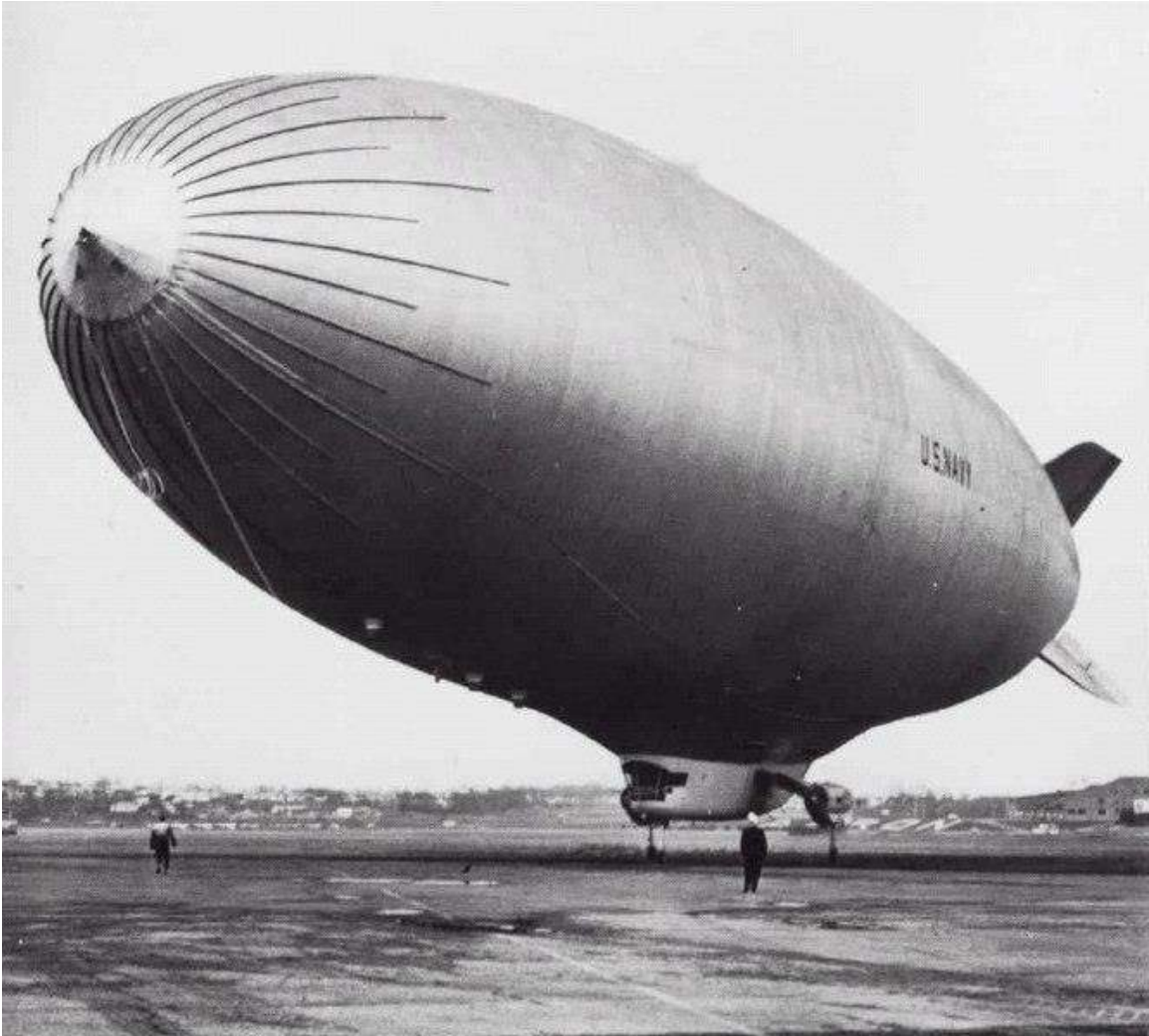
The ZPG-2W was followed by the larger ZPG-3W blimps designed for the AEW mission and carrying a more powerful search radar. The ZPG-2W and ZPG-3W were equipped with a radar platform at the top of the envelope, which supported the AN/APS-62 height-finding radar in a radome extending above the envelope. On the ZPG-3W, the large, low frequency General Electric AN/APS-70 search radar was installed inside the helium envelope, supported from the bottom of this radar platform.

The AN/APS-70 search radar had a rotating antenna measuring 40 feet wide by 6 feet high (12.2 x 1.8 m). It was capable of detecting distant flying objects through multiple layers of cloud clutter. An IFF (interrogation friend or foe) antenna was attached at the bottom of the AN/APS-70 antenna.

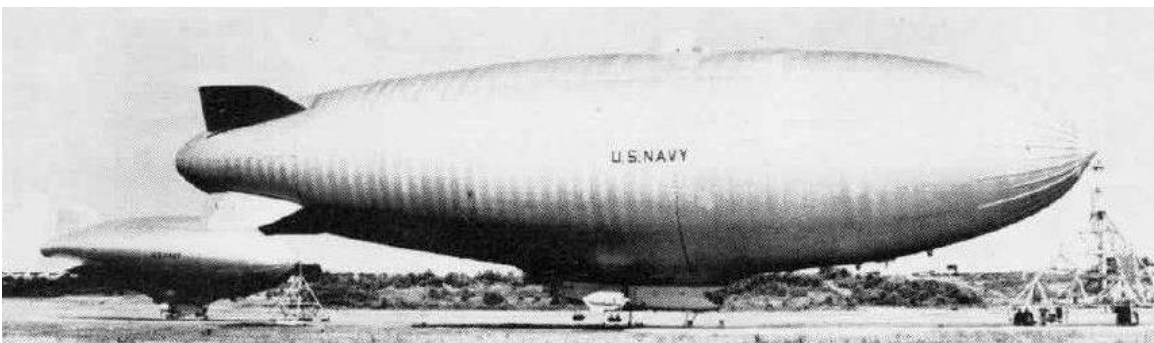


*ZPG-3W moored. Source: US Navy via GlobalSecurity*





*Navy N-class ZPG-3W early warning blimp of airship airborne early warning squadron ZW-1 at Naval Air Station Lakehurst, New Jersey (USA), circa 1960. Source: US Navy photo via Wikimedia Commons*



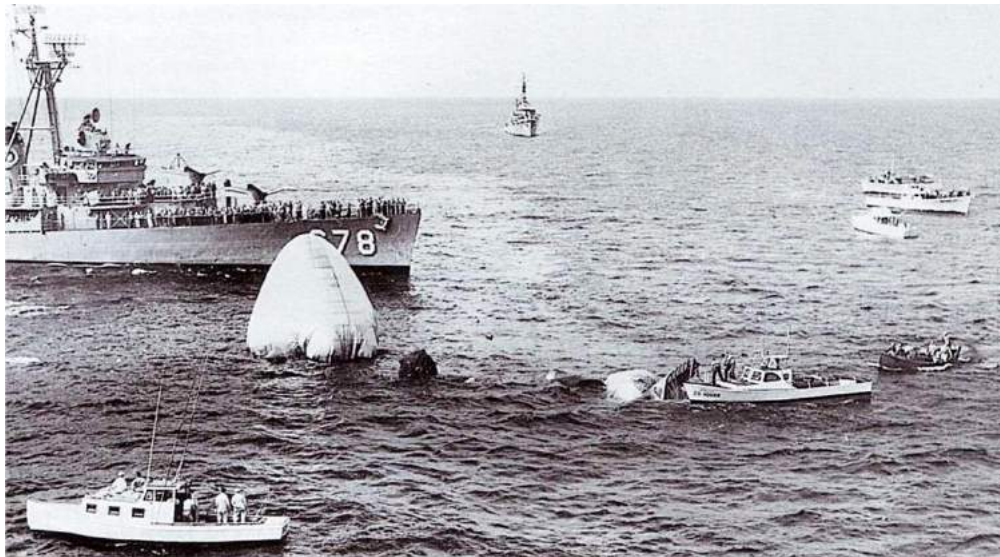
*The Navy's largest blimp, the ZPG-3W, before its maiden flight alongside the smallest blimp in service, the ZS2-G1.*

*Source: AW&ST magazine, Oct. 1958*

The ZPG-3W mockup was completed at the end of 1955, followed by the Navy's order for four airships. The maiden flight occurred in July 1958 and the four airships were delivered to the Navy between December 1958 and April 1960.

Squadron ZW-1, based at NAF Lakehurst, NJ, was the only squadron operating the ZPG-3W. They began conducting ZPG-3W AEW radar barrier patrols over the North Atlantic on 20 February 1960. The on-station endurance capabilities of the four ZPG-3Ws compared favorably to the coverage provided by five USAF EC-121 Super Constellations operating in rotation. While on station, the ZPG-3W crew could refuel by retrieving a floating fuel bag that had been left for them by a surface ship. Squadron ZW-1 was re-designated airship patrol squadron ZP-1 on 3 February 1961.

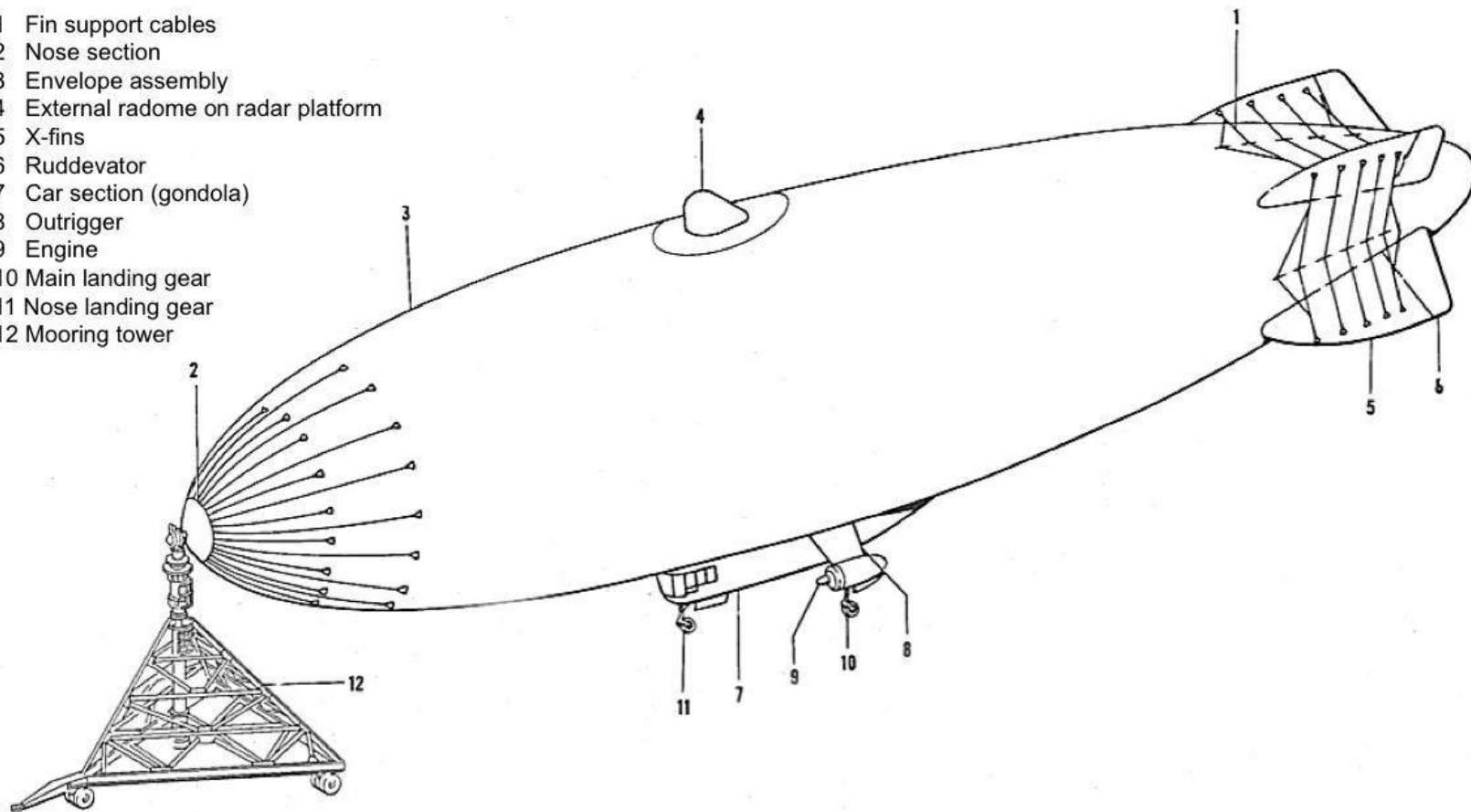
On 6 July 1960, ZPG-3W registration #144242 was at 300 feet (91 m) altitude when an explosion occurred on board. The aircraft fell into the sea 15 miles (24 km) off Long Beach Island, New Jersey and sank in 60 feet (18 m) of water. There were 21 crew members on board at the time, 18 of them died in the crash. The airship was searching for two yachts that were reported missing during a race from Newport, RI to Bermuda.



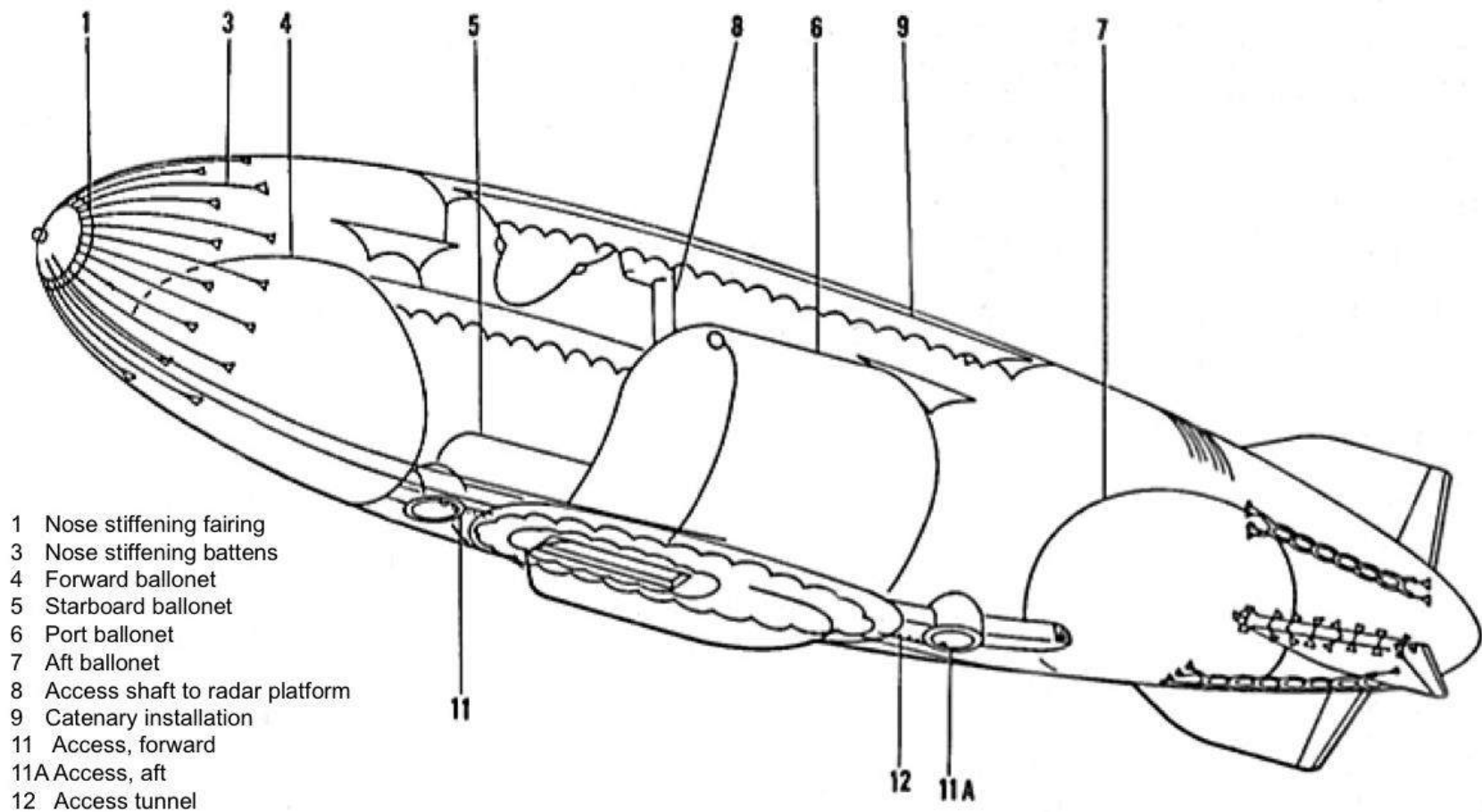
*ZPG-3W crash site. Source: Yumpu.com*

On 31 October 1961, ZP-1 Squadron was decommissioned, ending ZPG-3W operations after only 20 months.

- 1 Fin support cables
- 2 Nose section
- 3 Envelope assembly
- 4 External radome on radar platform
- 5 X-fins
- 6 Ruddevator
- 7 Car section (gondola)
- 8 Outrigger
- 9 Engine
- 10 Main landing gear
- 11 Nose landing gear
- 12 Mooring tower

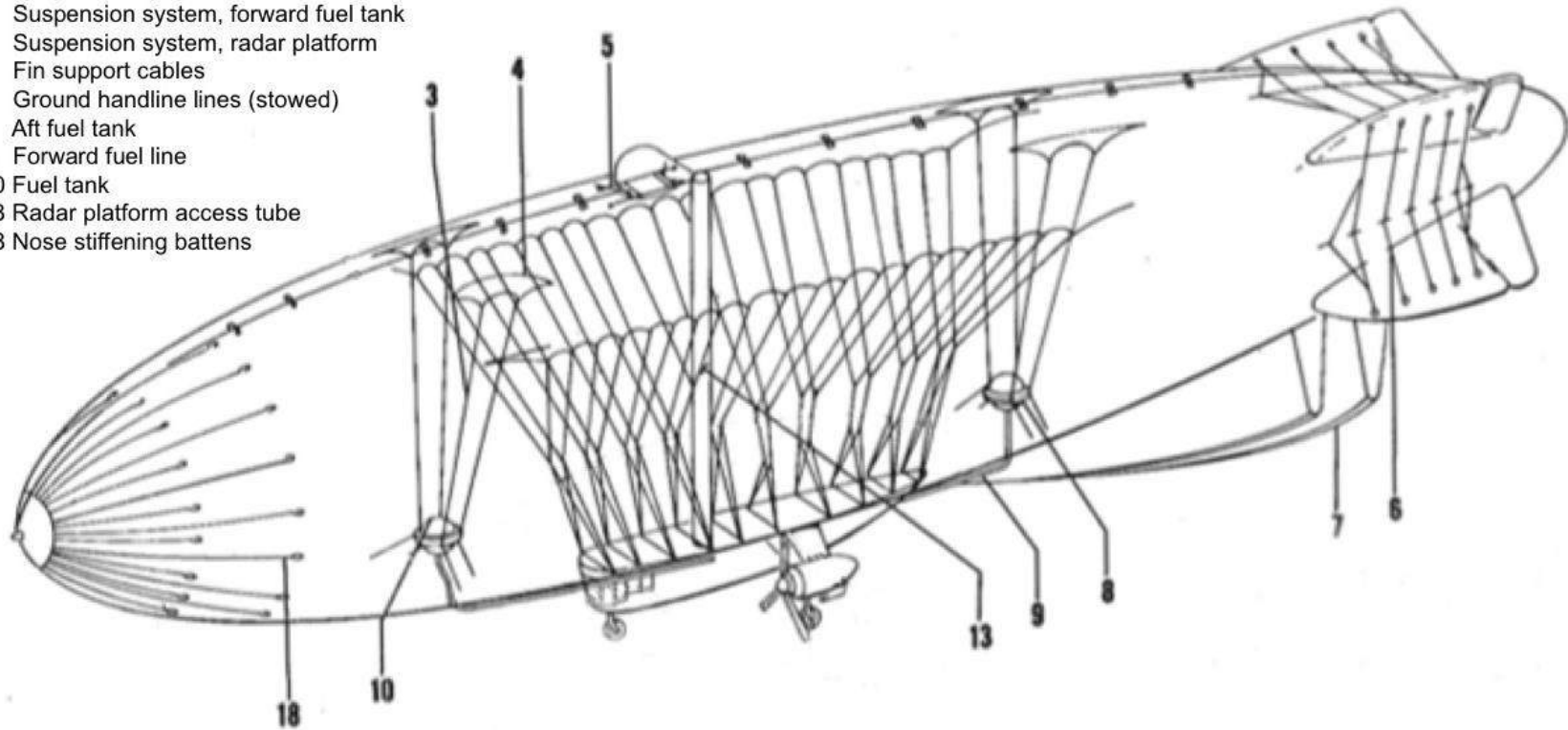


*ZPG-3W external arrangement. Source: adapted from NAVAER 01-195PDA-504 (1959)*



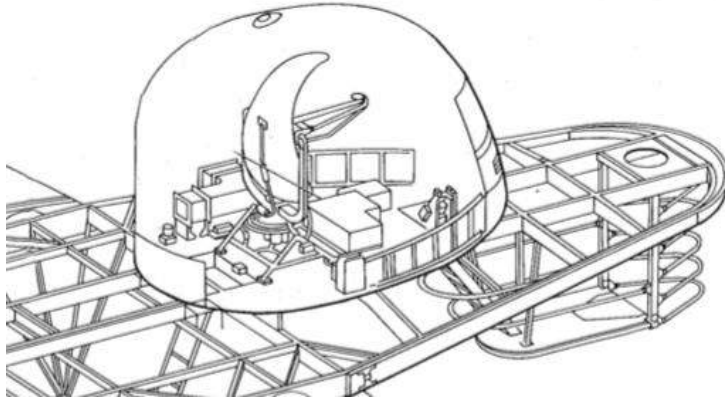
*ZPG-3W envelope & ballonets. Source: adapted from NAVAER 01-195PDA-504 (1959)*

- 3 Suspension system, forward fuel tank
- 4 Suspension system, forward fuel tank
- 5 Suspension system, radar platform
- 6 Fin support cables
- 7 Ground handline lines (stowed)
- 8 Aft fuel tank
- 9 Forward fuel line
- 10 Fuel tank
- 13 Radar platform access tube
- 18 Nose stiffening battens



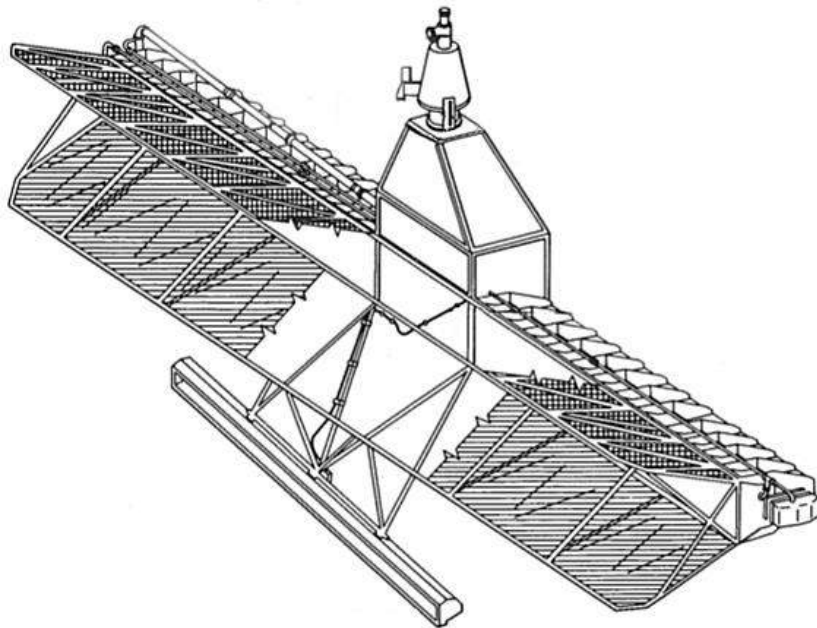
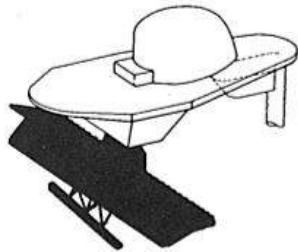
*ZPG-3W catenary system. Note the separate suspension systems for the fore and aft fuel tanks.  
Source: adapted from NAVAER 01-195PDA-504 (1959)*





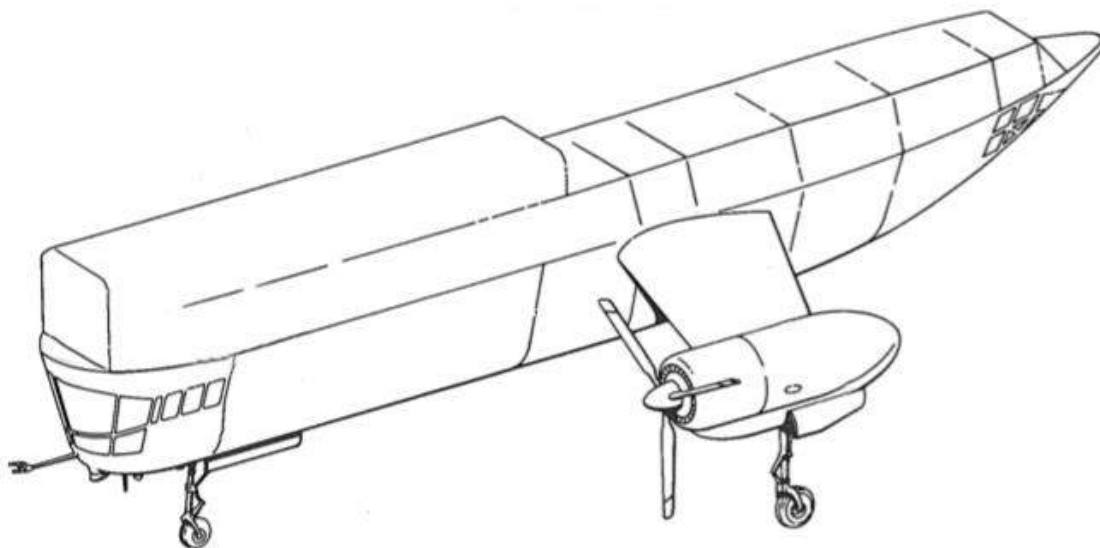
*Radar platform showing the AN/APS-62 height-finder radar installation in the external radome.*

*Source: adapted from NAVAER 01-195PDA-504 (1959)*

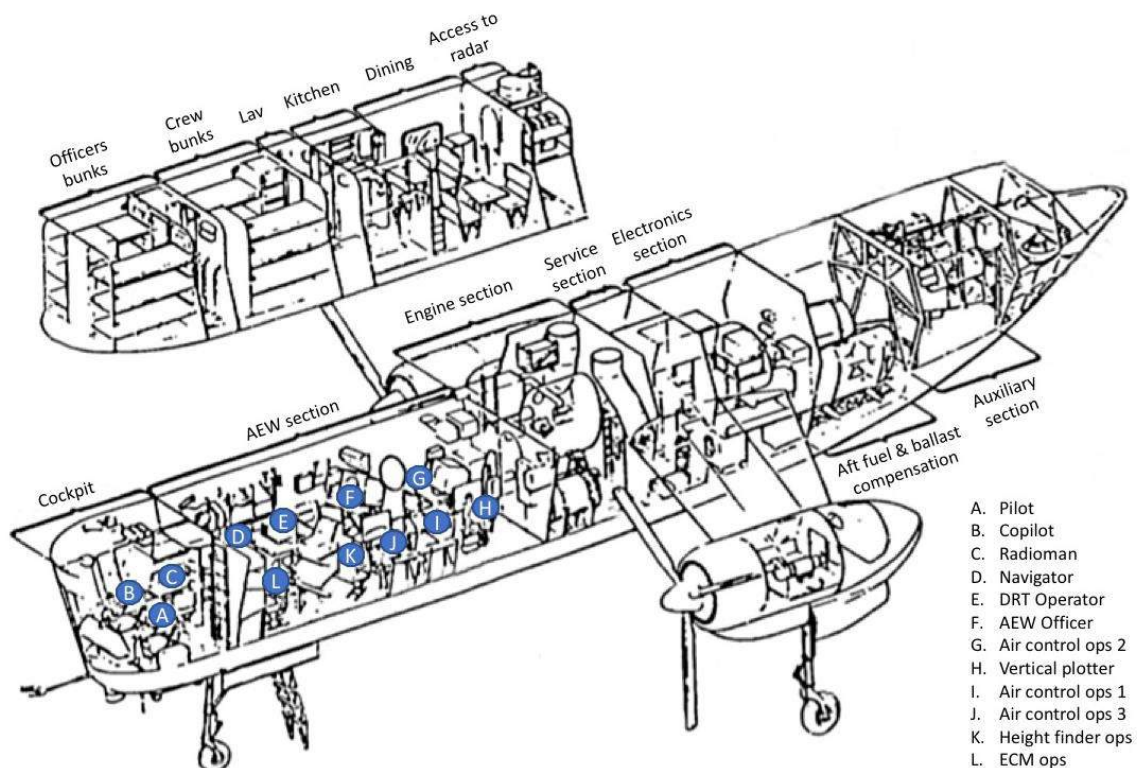


*AN/APS-70 search radar and IFF (bar antenna) installation supported from the bottom of the AN/APS-62 radar platform, as shown in inset, inside the envelope.*

*Source: adapted from NAVAER 01-195PDA-504 (1959)*



*ZPG-3W gondola exterior view.*  
*Source: adapted from NAVAER 01-195PDA-504 (1959)*



*ZPG-3W gondola interior arrangement and crew deployment.*  
*Source: adapted from NADC-80149-60 (1980)*



*ZPG-3W at Lakehurst in 1960. Source: Major Edward Martin Helm, USAF via U.S. Naval History and Heritage Command*



*ZPG-3W at the Davis-Monthan "boneyard." Source: Yumpu.com*

You can watch a 2012 tour of this ZPG-3W gondola at the following link: <https://www.youtube.com/watch?v=o0so94Bl6zM>

#### **4. After the N-class retired**

After they had been retired from service in 1961, the ZPG-2W and ZPG-3W were “posthumously” re-designated in 1962 as the EZ-1B and EZ-1C, respectively. The anti-submarine ZPG-1 became the SZ-1A and the ZPG-2 became the SZ-1B.

Thirteen years later, in 1975, the National Aeronautics and Space Administration (NASA) initiated a study called “Feasibility of Modern Airships – Phase I.” The Navy joined Phase II of that study in 1976, and continued studying naval airship applications for three decades without developing an operational naval airship. These Navy studies were:

- Feasibility of Modern Airships – Phase II (1976 – 77)
- Advanced Navy Vehicle Concepts Evaluation (ANVCE, 1976 – 1977)
- Assessment of Selected LTA Vehicles for Mission Tasks of the US Coast Guard (1975 – 1978)
- Maritime Patrol Airship (MPA) Program (1980)
- Naval Airship Program (NAP) (1982 – 1989), with DARPA taking over the program as part of Project WALRUS thru 1995
- Navy Hybrid Ultra Large Airship (HULA) program (2001 – 2003), and continued support since 2006 (after Project WALRUS was terminated) from Naval Air Systems Command (NAVAIR) Advanced Development Program Office (ADPO) – Airship Concepts

You’ll find more information in my separate articles on ANVCE, MPA, Sentinel 1000 & 5000 (NAP), HULA, and WALRUS.

After all of the above studies, the Navy finally received its first new airship in 44 years, the MZ-3A blimp manufactured by the American Blimp Corporation. The MZ-3A, delivered in June 2006, is a variant of the production model A-170 commercial blimp. It was operated and intermittently stored thru 2017. More information on the MZ-3A is in my separate article on American Blimp Corporation.

Since 1957, the ZPG-2 named *Snow Bird* has held the world records for airship unrefueled distance and time of flight. Since their last flight in 1962, the ZPG-3W blimps remain the largest non-rigid airships ever to fly. They also were the last airships to be built in the massive Goodyear Airdock in Akron, OH, which, in 1980, was designated a Historic Civil Engineering Landmark by the American Society of Civil Engineers.

## 5. For more information

### Post WW II US naval airship overview

- “U.S. Navy Lighter-Than-Air (LTA) - The Post War and Cold War Era,” Naval Airship Association, Inc.: <https://www.naval-airships.org/post-war-cold-war>
- “XV. Airship Types in the Postwar Period,” <https://www.history.navy.mil/content/dam/nhhc/research/historics/naval-aviation/navys-lighter-than-air-experience-monograph/pdfs/lta-10.pdf>
- “USN LTA: Cold War History,” Airship History: <https://airshiphistory.com/wp/1-page-postwar-era/>
- Captain Joseph Bouchard, “Guarding the Cold War Ramparts – The U.S. Navy’s Role in Continental Air Defense,” Naval War College Review, Summer 1999: <https://fas.org/nuke/guide/usa/airdef/art5-su9.htm>
- “Airship Early Warning Squadron 1 (ZW-1),” The Lighter-Than-Air Society: <https://www.blimpinfo.com/history-2/this-mo-in-hist/this-mo-in-hist-jan/aew-squadron-zw-1/>
- D.A. Gilstad, C.G. Weeber, A. Kviljord & GW Woods, “Structural response and gas dynamics of an airship exposed to a nuclear detonation. Final report,” Report AD-360874, Bureau of Weapons, 25 April 1960, Abstract only: <https://www.osti.gov/biblio/6293873-structural-response-gas-dynamics-airship-exposed-nuclear-detonation-final-report>
- Brett Holman, “Airship vs. A-bomb,” Airminded, 6 May 2007: <https://airminded.org/2007/05/06/airship-vs-a-bomb/>



## **ZPG-1**

- “Latest LTA Sub-Hunter Being Tested,” Naval Aviation News, September 1952, reprinted in The Naval Airship Association’s magazine, The Noon Balloon, Winter 2021.

## **ZPG-2 & -2W**

- “Handbook Maintenance Instructions Navy Model ZPG-2 Airship,” NAVWEPS 01-195PBA-2, 1 February 1958: <https://utd-ir.tdl.org/handle/10735.1/1880?show=full>
- “3324 ZPG-2W Characteristics Summary – 21 February 1956,” US Navy via Avialogs: <https://www.avialogs.com/aircraft-g/goodyear/item/4206-3324zpg-2wcharacteristicssummary-21february1956>
- “3325 ZPG-2W Standard Aircraft Characteristics - 1 July 1954,” US Navy via Avialog: <https://www.avialogs.com/aircraft-g/goodyear/item/4207-3325zpg-2wstandardaircraftcharacteristics-1july1954>
- “ZPG-2 / ZPG-2W “N” Series,” Global Security: <https://www.globalsecurity.org/wmd/systems/zpg-2.htm>
- “The ZPG-2 Airship ‘Snow Bird’ sets Unrefueled Flight Time and Distance Records,” The Lighter-Than-Air-Society, 1957: <https://www.blimpinfo.com/history-2/this-mo-in-hist/this-mo-in-hist-mar-2/zpg-2-snowbird-records/>
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## **ZPG-3W**

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## **Other Modern Airships articles**

- *Modern Airships - Part 1:* <https://lynceans.org/all-posts/modern-airships-part-1/>
  - Airship Industries (Sentinel 1000 & 5000 airships)
  - Goodyear - civilian blimps
  - US Navy - ANVCE program airships (1976 – 1979, Goodyear ZPG-X & SABV & Martin Marietta 836 airships)
  - US Navy - Maritime Patrol Airship (MPA) study airships (1980, Goodyear ZP3G and Bell MPA airships)
  - US Navy - YEZ-2A program (Sentinel 1000 & 5000 airships)
- *Modern Airships - Part 2:* <https://lynceans.org/all-posts/modern-airships-part-2/>
- *Modern Airships - Part 3:* <https://lynceans.org/all-posts/modern-airships-part-3/>