

F2H-1 Banshee (BuNo 122450) at the National Advisory Committee for Aeronautics, Langley, Virginia (USA), 9 March 1951. The F2H-1 would probably have had a longer NACA Langley career, however, it was written off in a landing accident on 12 July 1951 (NASA)

## Air Wars 13

# Banjo

### A Detailed Look at McDonnell's F2H Banshee

by Bert Kinzey, illustrations by Rock Roszak

This article covers the prototypes through the F2H-2 variants and sub-variants of the aircraft. The F2H-3 and F2H-4 versions will be covered at a later date.

he end of World War II brought with it massive cutbacks and outright cancellations of contracts for military equipment of all types. There was a fight for survival, and even large, well-established defence contractors found themselves involved in mergers or even going out of business. McDonnell Aircraft Corporation, which had been a sub-contractor during the war, would seem to be one of many companies that had a bleak future when the war ended, but a seed had been planted that would ensure McDonnell Aircraft would not only survive in the postwar era, but would make its mark in military aviation history.

In January 1943, the US Navy had asked McDonnell to design a jet powered fighter capable of operating from aircraft carriers. This led to the design of the XFD-1 (later XFH-1) which would make its first flight on January 26, 1945, while the war still raged in Europe and in the Pacific. Two months later, McDonnell had a contract to produce the FH-1 Phantom. This aircraft became the US Navy's first fighter powered only by turbojet engines, and it was the first all-jet aircraft to launch from and recover aboard an aircraft carrier. It also became the first jet fighter to become operational in squadrons with the US Navy and Marine Corps, but the Navy

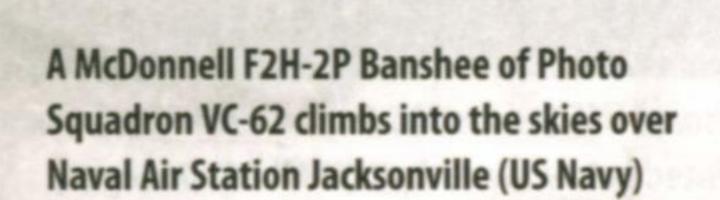


Navy McDonnell F2H Banshee fighters over Korea on 5 January 1953. The aircraft in front is a F2H-2P reconnaissance aircraft from photographic squadron VC-61. The other is an F2H-2 fighter from fighter squadron VF-11 Red Rippers. Both squadrons were assigned to Carrier Air Group 14 (CVG-14) aboard the aircraft carrier USS Kearsarge during the deployment to Korea from 11 Aug 1952 to 17 Mar 1953 (US Navy)





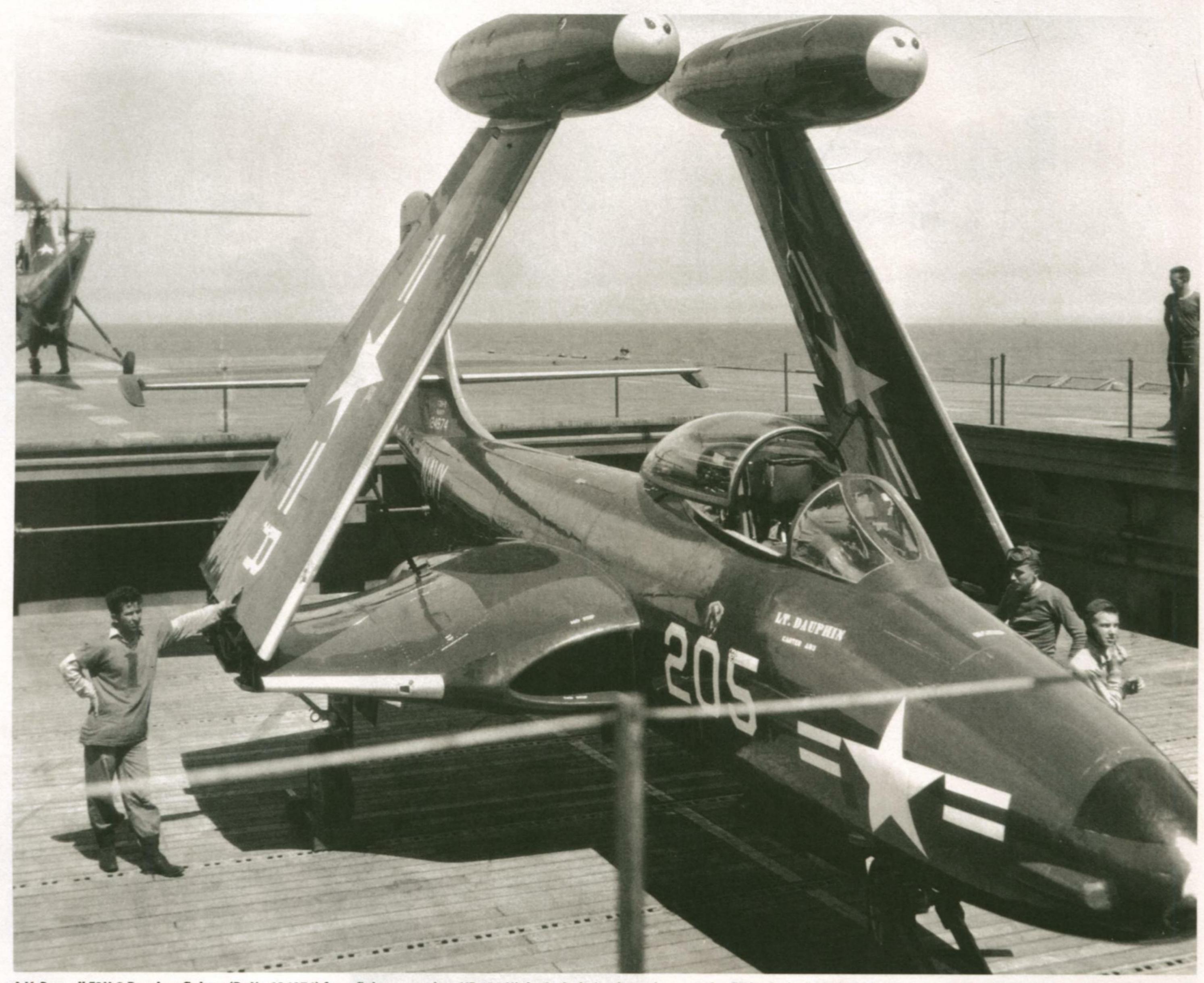
A F2H-2 Banshee (BuNo. 125663) of fighter squadron VF-11 Red Rippers over Wonsan (Korea) on 20 October 1952. VF-11 was assigned to Carrier Air Group 101 (CVG-101) aboard the aircraft carrier USS Kearsarge during the deployment to Korea from 11 Aug 1952 to 17 Mar 1953





Two F2H-2s of fighter squadron VF-172 Blue Bolts returning to the aircraft carrier USS Essex during a deployment from 26 Jun 1951 to 25 Mar 1952 to the Western Pacific and the War in Korea. VF-172 was assigned to Carrier Air Group Five (CVG-5). All other aircraft of CVG-5 had the tail code S during that deployment, but VF-172's tail code was R



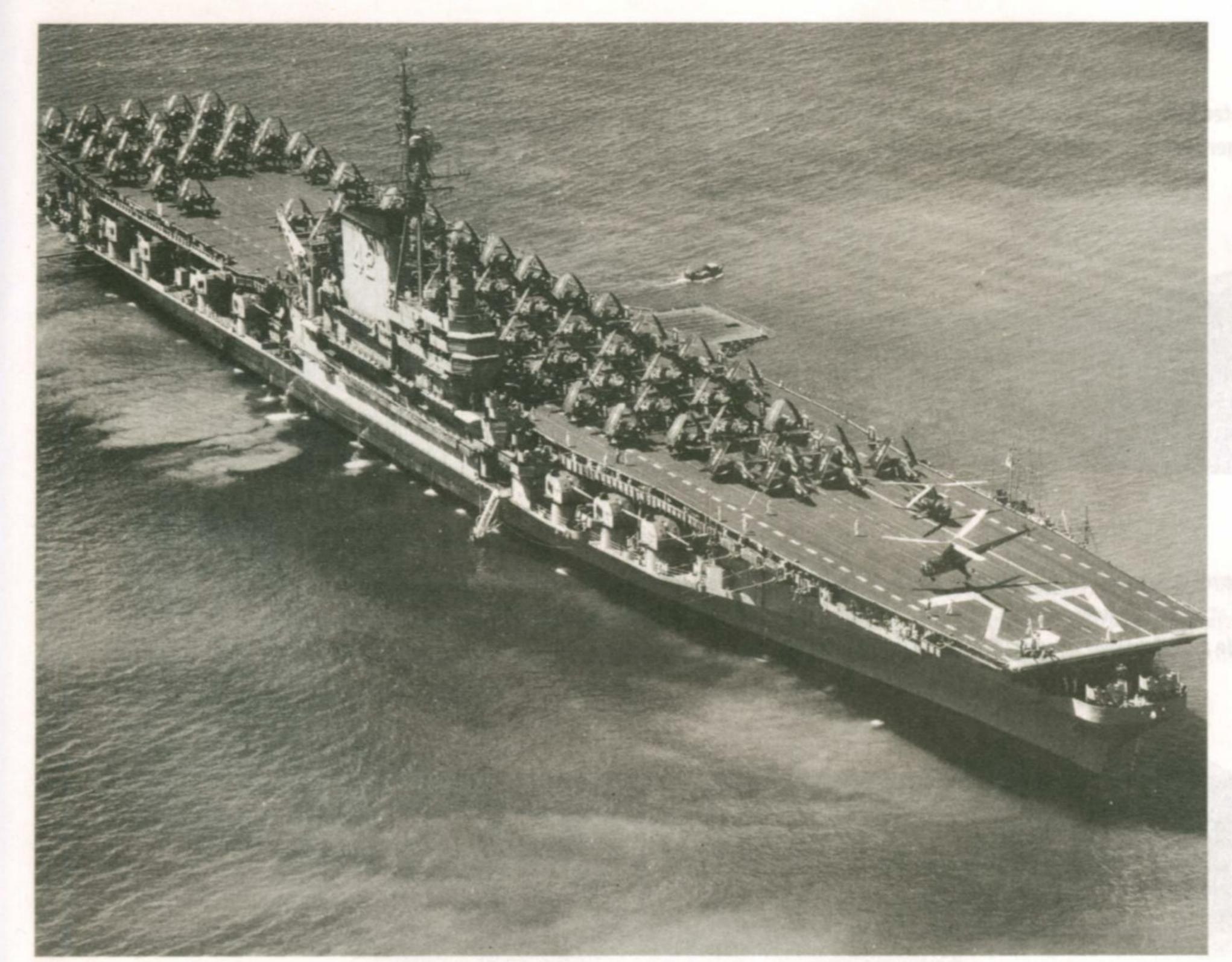


A McDonnell F2H-2 Banshee fighter (BuNo 124974) from fighter squadron VF-172 Night Owls, being brought up to the flight deck aboard USS Essex on 25 August 1951. The Essex was deployed to Korea from 26 June 1951 to 25 March 1952. Note the names of the plane's pilot (Lt. Dauphin) and the plane captain (Carter AO3) painted below the cockpit (AFAN T.G. Donegan)



US Marine Corps McDonnell F2H-2P Banshee photographic aircraft (BuNo 128881) used by Marine photographic squadron VMJ-1, 1st Marine Aircraft Wing, after photographing enemy installations around the Yalu River in Korea on 15 May 1953 (National Archives)





USS Franklin D. Roosevelt pictured at anchor in Guantanamo Bay, Cuba, 22 March 1950. On deck are various aircraft of Carrier Air Group 17 (CVG-17), including McDonnell F2H-2 Banshee and Vought F4U-5 Corsair fighters, Douglas AD-4 Skyraiders and two Sikorsky H03S helicopters (National Museum of Naval Aviation)

realized that the Phantom was only a first step, and would at best be an interim aircraft leading to a jet fighter that was truly capable of combat operations. Just over a month after the XFD-1 made its maiden flight, McDonnell received another contract to develop three prototypes of a larger and more powerful version of the Phantom originally designated the XF2D-1. This was later changed to XF2H-1 when the Navy reas-

signed its letter designators for aircraft manufacturers.

Under the direction of Herman D. Barkley and Al Utsch, design moved ahead quickly on the new fighter, but it was apparent that simply enlarging the Phantom's airframe was not going to be sufficient. While the layout of the aircraft remained basically the same, the wings, fuselage, and tail were all redesigned as they were



A F2H-2P Banshee of photo reconnaissance squadron VFP-62 in 1957. The detachment was stationed as part of Carrier Air Group Seventeen (CVG-17) aboard the aircraft carrier USS Franklin D. Roosevelt during that carrier's deployment to the Mediterranean Sea between 11 Jul 1957 and 05 Mar 1958 (Dave Olson, USN)

F2H-2 Banshee Data	THE PARTY OF THE P
Maximum Speed	575 mph at sea level
Max Speed at Altitude	532 mph at 35,000 feet
Cruising Speed	501 mph
Service Ceiling	48,800 feet
Range	1,200 miles
Combat Radius	620 miles
Fuel Capacity	1,277 gallons w/ tip tanks
Span	44 ft 10in
Length	40 ft 2 in
Height	14 ft 2 in
Empty Weight	11,146 pounds
Gross Weight	17,200 pounds
-	

enlarged. The two Westinghouse J34-WE-22 powerplants, each capable of producing 3,000 pounds of thrust, were almost twice as powerful as the J30-WE-20s used in the Phantom, which could deliver only 1,600 pounds of thrust. The Phantom's four .50-calibre machine guns were replaced by four M3 20-mm cannon, each supplied with 150 rounds of ammunition.

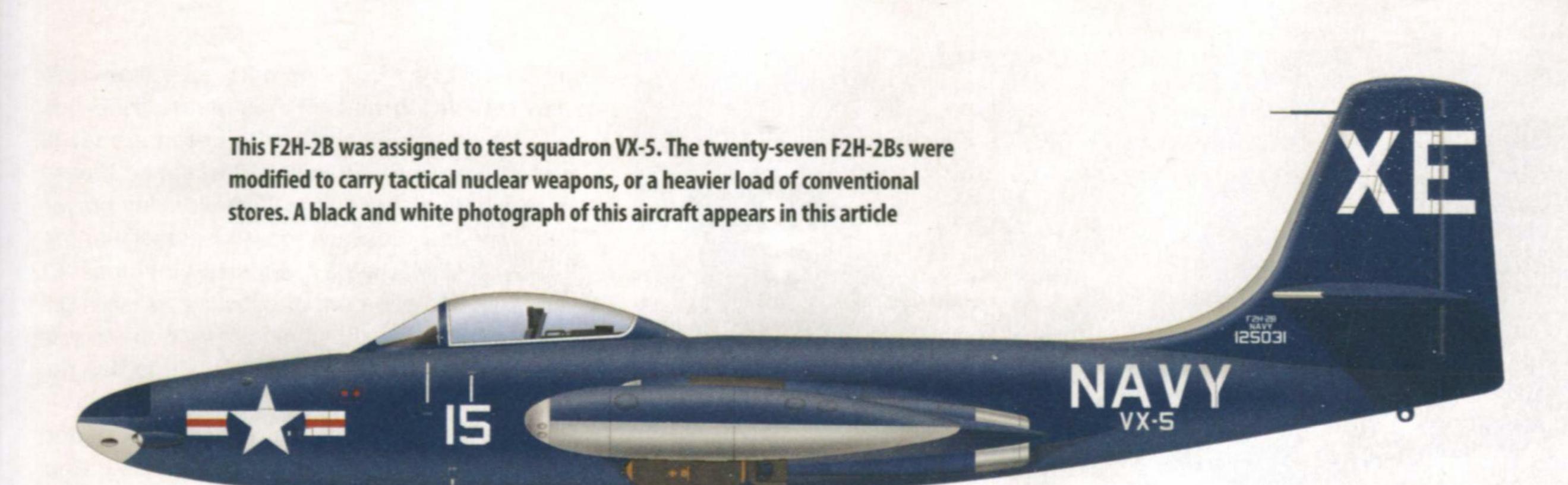
Other design features included a kneeling

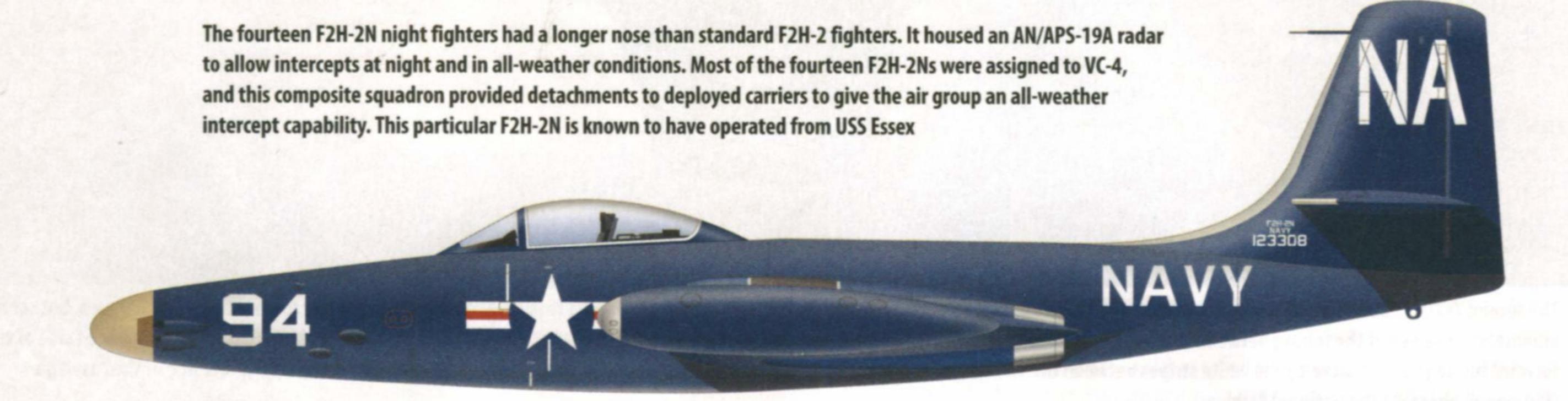


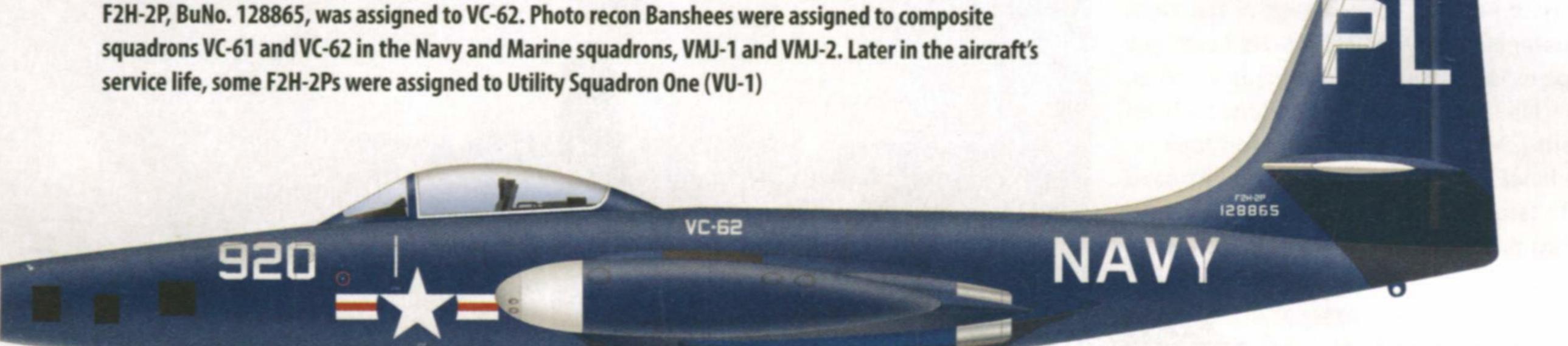
Two of the prototypes show how the Banshee was originally designed to have the nose of the aircraft tuck under the tail of another to save room on aircraft carrier flight decks and in hangar bays. This idea was also tried on Vought's XF6U-1 Pirate and North American's FJ-1 Fury. This feature was later eliminated from Banshee production when it proved to be impractical. Also note that the aircraft in the background has the original tail design with the dihedral for the horizontal tail, while the aircraft in front has the later design without the dihedral, yet they both have the larger fairing between the vertical tail and the spine. (McDonnell photo via the National Archives)









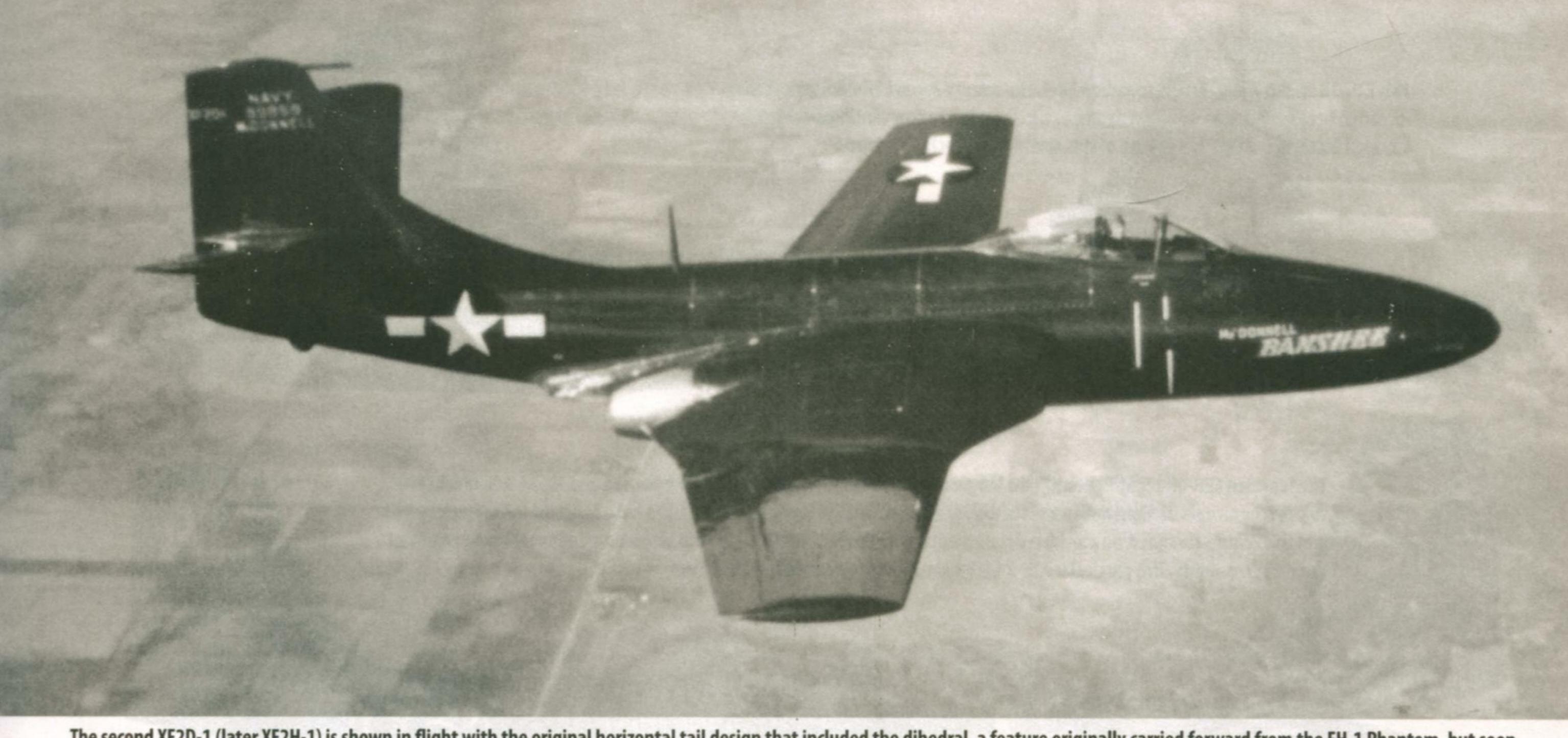






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The second XF2D-1 (later XF2H-1) is shown in flight with the original horizontal tail design that included the dihedral, a feature originally carried forward from the FH-1 Phantom, but soon eliminated. The size of the fairing between the vertical tail and the spine of the fuselage would later be decreased. Also note that the prototypes had boarding steps on the right side of the forward fuselage as indicated by the white stripes between the spring-loaded doors covering the steps. Production aircraft had the boarding steps only on the left side of the fuselage (McDonnell photo via the National Archives)





The first production F2H-1 was evaluated at Naval Air Test Center at Patuxent River, Maryland. Note the lack of silver on the leading edges of the wings and tail. This would become standard on the F2H-2, as well as other US Navy fighters of that era. (National Museum of Naval Aviation)

McDonnell's FH-1 Phantom was the first all-jet powered aircraft to launch and recover aboard an aircraft carrier, and the first to enter operational service with the US Navy and Marine Corps. However, relatively few were produced, and the Phantom was only used in front line service for less than two years. The F2H Banshee was a larger and more powerful aircraft, but it was a direct development of the FH-1 and shared many of its design features. (National Museum of Naval Aviation)

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nose gear, also used on Vought's XF6U-1 Pirate and North American's FJ-1 Fury. The idea was to lower the nose of the plane so that it could be tucked beneath the tail of another aircraft, thus saving valuable deck space on an aircraft carrier, but this feature did not work out well and was subsequently deleted. A small AN/APG-30 ranging radar was placed in the nose, ahead of the four cannon, with a small black radome in the top half of the nose cone.

On January 11, 1947, McDonnell's test pilot Robert M. Edholm took off from Lambert Field in St. Louis for the XF2D-1's first flight. The aircraft climbed effortlessly at a rate of 9,000 feet per minute, twice that of its contemporaries. Pleased with what they saw, the Navy quickly ordered the aircraft into production with a contract for fifty-six F2H-1s. The testing that fol-



The first production version of the Banshee was the F2H-1. These aircraft could not be fitted with tip tanks, and they had a shorter fuselage than subsequent variants of the Banshee. Only fifty-six F2H-1s were produced, and most were used by Naval Reserve units as proficiency trainers like the one shown in this photograph (National Museum of Naval Aviation)



The first version of the Banshee to be produced in large numbers was the F2H-2, and these saw extensive service operating from aircraft carriers during the Korean War. Both the F2H-2 fighter variant and the F2H-2P photographic reconnaissance version performed valuable service during the conflict. Here an F2H-2 is about to launch from Cat 1 aboard USS Lake Champlain. During the war, the new jets served alongside propeller-driven aircraft like the A-1 Skyraider, seen on deck in this photograph, and also the F4U Corsair (National Museum of Naval Aviation)

produced 3,150 pounds of static thrust. The engines were supplied with 700 gallons of fuel, all of which was carried inside the fuselage - the capability to carry tip tanks on the wings did not begin until production of the F2H-2. A McDonnell-designed ejection seat was installed to allow the pilot a safe egress from the aircraft in the event of an airborne emergency, and in August 1949, an F2H-1 set an altitude record for combat aircraft of more than 52,000 feet.

VF-171 and VF-172 would remain the only active duty Navy squadrons to fly the F2H-1. This first version of the Banshee was quickly replaced in fleet service by the much more capable F2H-2. F2H-1s were relegated to serving as proficiency trainers with reserve squadrons for the remainder of their useful life.

First flown on August 18, 1949, the F2H-2 became the first version of the Banshee to be produced in large numbers. A total of 406 would be produced, making it the most numerous of all Banshee sub-types. Several important improvements were made to the new variant, including a fuselage lengthened by fourteen inches to increase the internal fuel capacity by 177 gallons, and a two-hundred gallon fuel tank could be fitted to each wing tip. While these external tanks were usually present, they could be removed and the aircraft flown without them

lowed showed only a small control problem that was easily corrected by eliminating the dihedral of the horizontal tail and reducing the size of the fairing that blended the leading edge of the vertical tail into the spine of the fuselage.

In keeping with the Phantom name used for McDonnell's first jet fighter, the new aircraft was nicknamed Banshee, the second in a line of spooks for the company. Demons, Goblins, Voodoos, and another Phantom would follow later.

The F2H-1 began rolling off the production line in August 1948, with the first aircraft assigned to VX-3 at NAS Atlantic City, New Jersey, to be used for testing. Banshees were soon being assigned to VF-172 and then VF-171, which were part of Air Group 17 at NAS Cecil Field, Florida. The two squadrons took their new jet fighters aboard USS Franklin D. Roosevelt to begin carrier operations.

The F2H-1 had a maximum speed of 587 mph at sea level, a 2,000 mile ferry range, and a combat radius of 600 miles. It was powered initially by two J34-WE-22 engines, but these were later upgraded to J34-WE-30s, each of which



A high view provides a good look at the planform of the first Banshee production variant. This F2H-1 was used for test and evaluation at the Naval Air Test Center. (National Museum of Naval Aviation)





Deck crewmen scramble around an F2H-2 from VF-12 as it is prepared for launch from USS Midway. Note the large ports for the four 20mm cannon on the nose of the aircraft (National Museum of Naval Aviation)



F2H-2s from VF-22 are spotted with wings folded on the flight deck of USS Lake Champlain, during that carrier's Korean War cruise in 1953. Note the two pylons under the folding outer wing section (National Museum of Naval Aviation)

in place. To carry these tanks, internal strengthening had to be added to the wings.

The stronger wings also had eight hardpoints for external stores. There has been considerable incorrect information published about
the ordnance carrying capability of the F2H-2,
with most sources stating that it carried two
500-pound bombs or up to six five-inch rockets.
Official US Navy technical manuals from
NAVAER state that the external load limit for the
F2H-2 was 1,540 pounds, and these manuals
also provide information on typical load-outs,
including the two 500-pound bombs carried on
two of the stations beneath the engine fairings.
Alternatively, four 250-pound bombs could be
carried on these same stations. Four 100-pound
bombs could be loaded on the inboard stations,

but these lighter weapons could also be carried on the outboard wing stations, meaning that as many as eight 100-pound bombs could be loaded. Likewise, up to eight 5-inch rockets could be mounted on zero-length launchers on any of the eight external pylons. Various mixes of the smaller bombs on the inboard hardpoints and rockets on the four stations under the outer wing panels could also be carried. A common weapons load used in Korea included four 250-pound bombs on the inboard four pylons and four 5-inch rockets on the stations under the outer stations. This particular combination of bombs and rockets reflected the maximum load capacity of the aircraft.

The stronger wings and longer fuselage increased the F2H-2's empty weight to 11,146

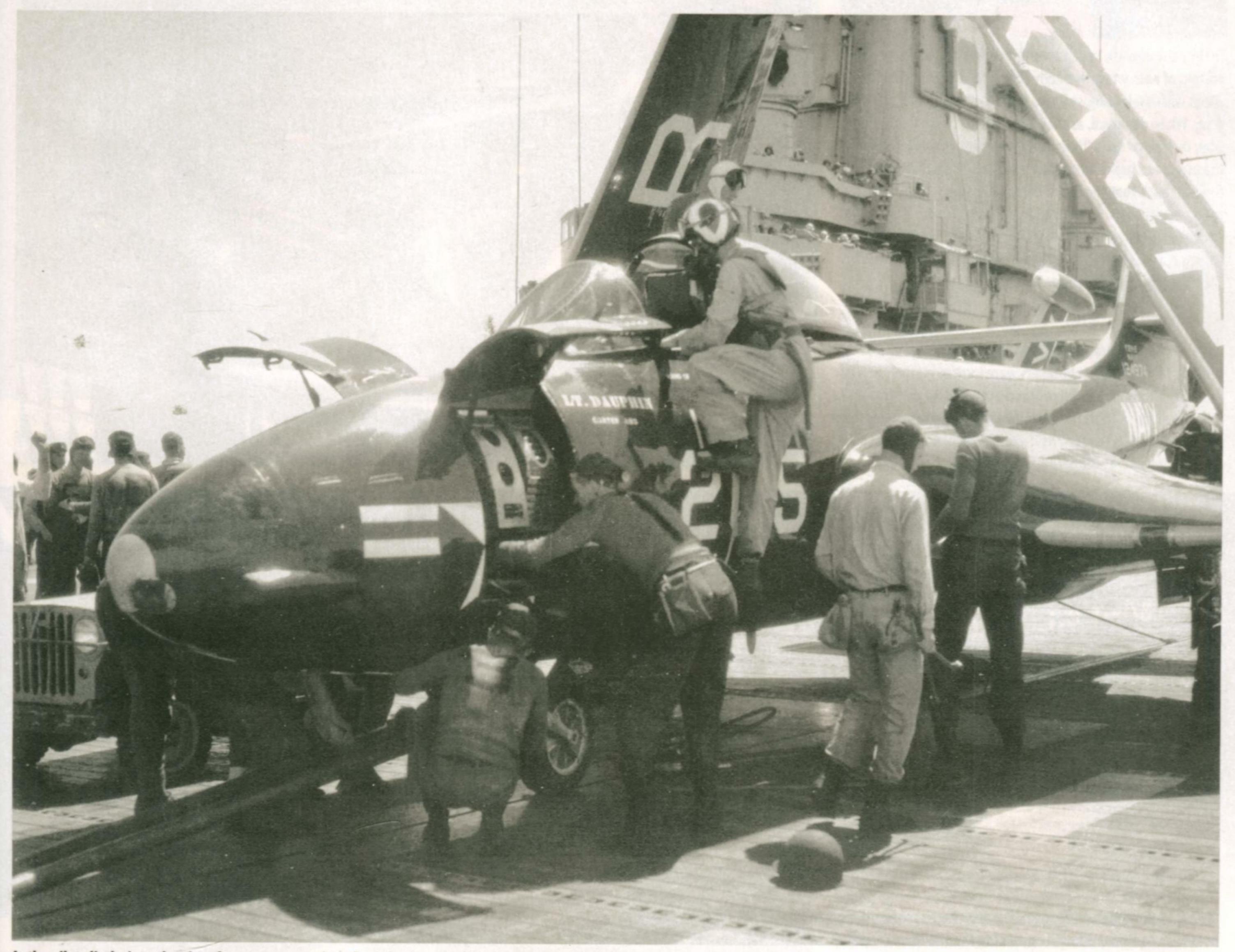
pounds as compared to 9,794 pounds for the F2H-1. This weight increase was offset by the use of more powerful J34-WE-34 engines, each of which produced 3,250 pounds of thrust.

During production, twenty-five F2H-2s were modified to carry Mark 7 and Mark 8 tactical nuclear weapons. The internal structure of the aircraft was strengthened to carry the heavy weapons under the left wing root, and increased loads of conventional stores, up to 3,000 pounds, could also be borne. These twenty-five aircraft were given the designation F2H-2B and were assigned to test and composite squadrons. During their service life, they were used to develop delivery techniques for tactical nuclear weapons and ways to extend the range of the aircraft.





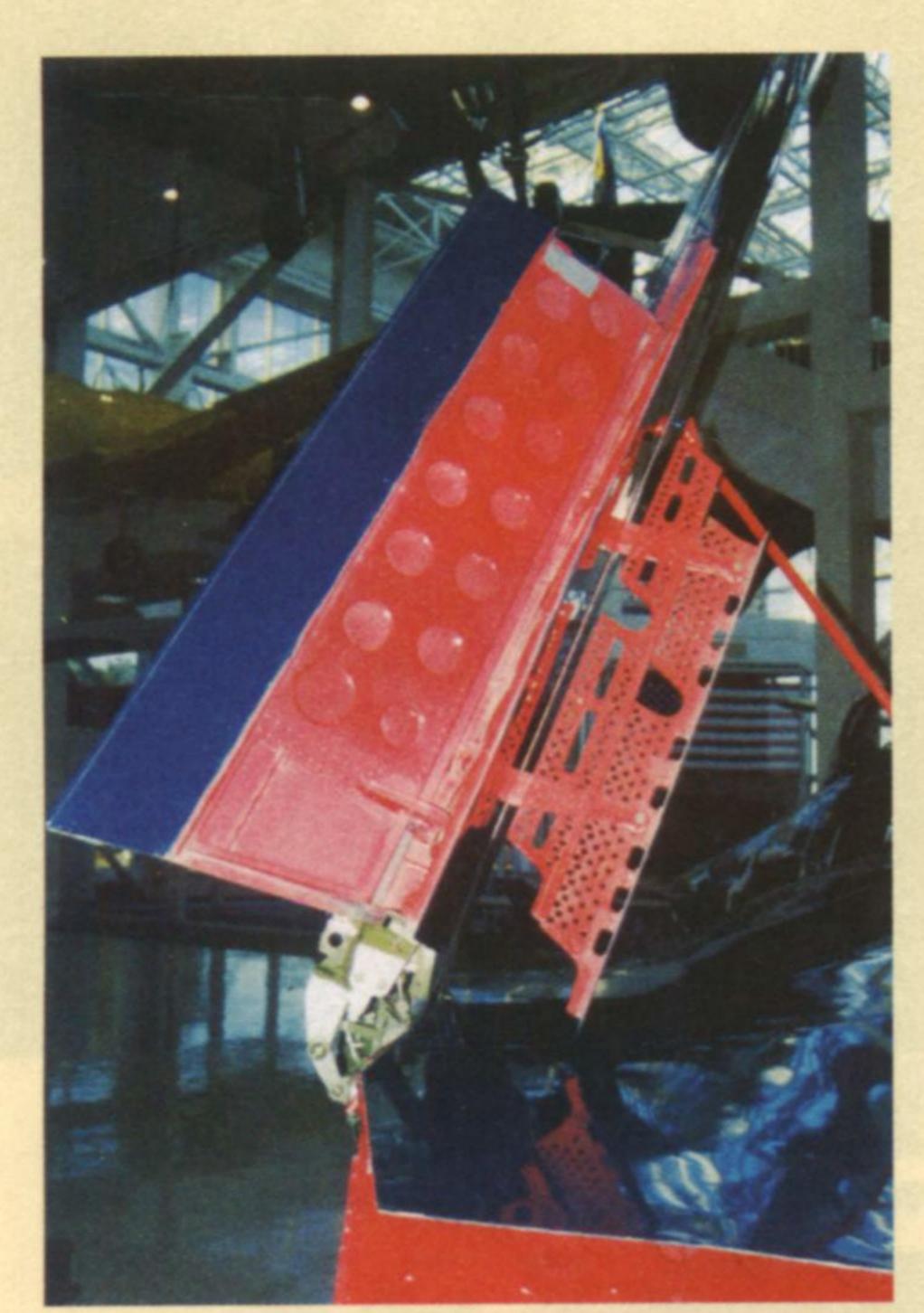
Twenty-five F2H-2Bs were built with internal strengthening to allow them to carry heavier weapons under the left wing. To distinguish these aircraft from standard F2H-2 fighter variants, they were designated F2H-2Bs. This modification was primarily intended to provide these Banshees with the capability to deliver Mk 7 or Mk 8 tactical nuclear weapons, but it also increased the maximum load of conventional stores from 1,540 o 3,000 pounds. These two F2H-2Bs were assigned to Test Squadron VX-5 (US Navy photo via Jim Mesko)



As the pilot climbs into the aircraft, armourers make a final check on the four 20-mm cannon in a Banshee aboard USS Essex. Each cannon was supplied with 150 rounds of ammunition. The four 20-mm cannon remained the standard internal armament for all fighter versions of the Banshee (US Navy photo via Jim Mesko)



## F2H Banshee Walkaround



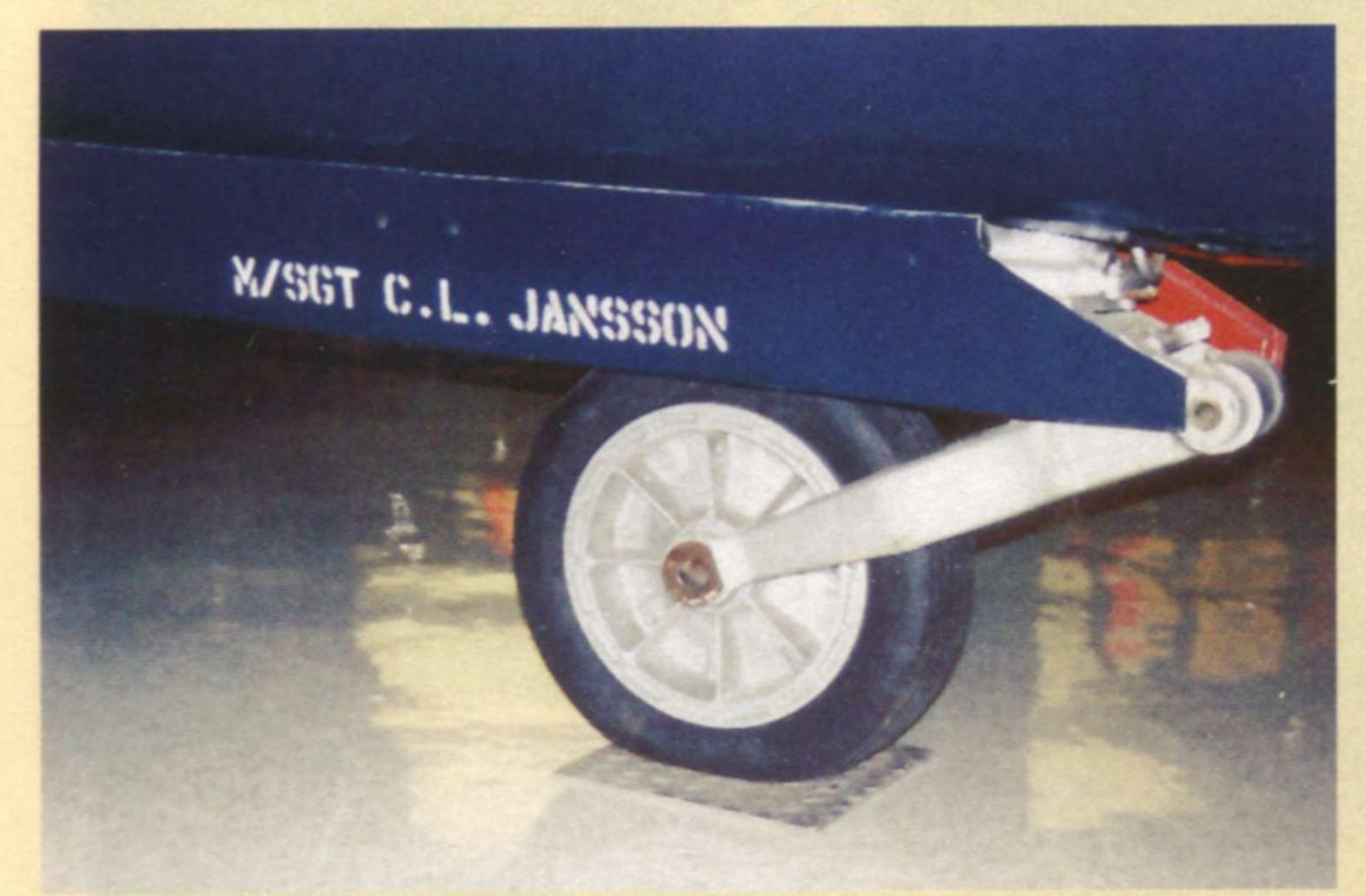
To slow the aircraft, speed brakes were located in the top and bottom of each wing. Normally they were stored inside the wings with their outer surfaces flush with the skin of the wing. When deployed, as shown here, they popped out of the wing to provide drag. Their inner surfaces were painted red. The top speed brake on the left wing can be seen here from the rear. Note that the speed brakes were perforated with various sized holes. Speed brakes and flaps, which slowed the aircraft in flight, were often painted red to serve as a warning to other planes in trail that the aircraft was slowing down (Detail & Scale photo by Bert Kinzey)

right: The left console included the throttle quadrant as its primary feature. Circuit breakers were located on the forward side of the console. The olive green oxygen hose is visible on the seat along with the harness. Note the rail that guides the forward end of the canopy as it slides fore and aft (Detail & Scale photo by Bert Kinzey)

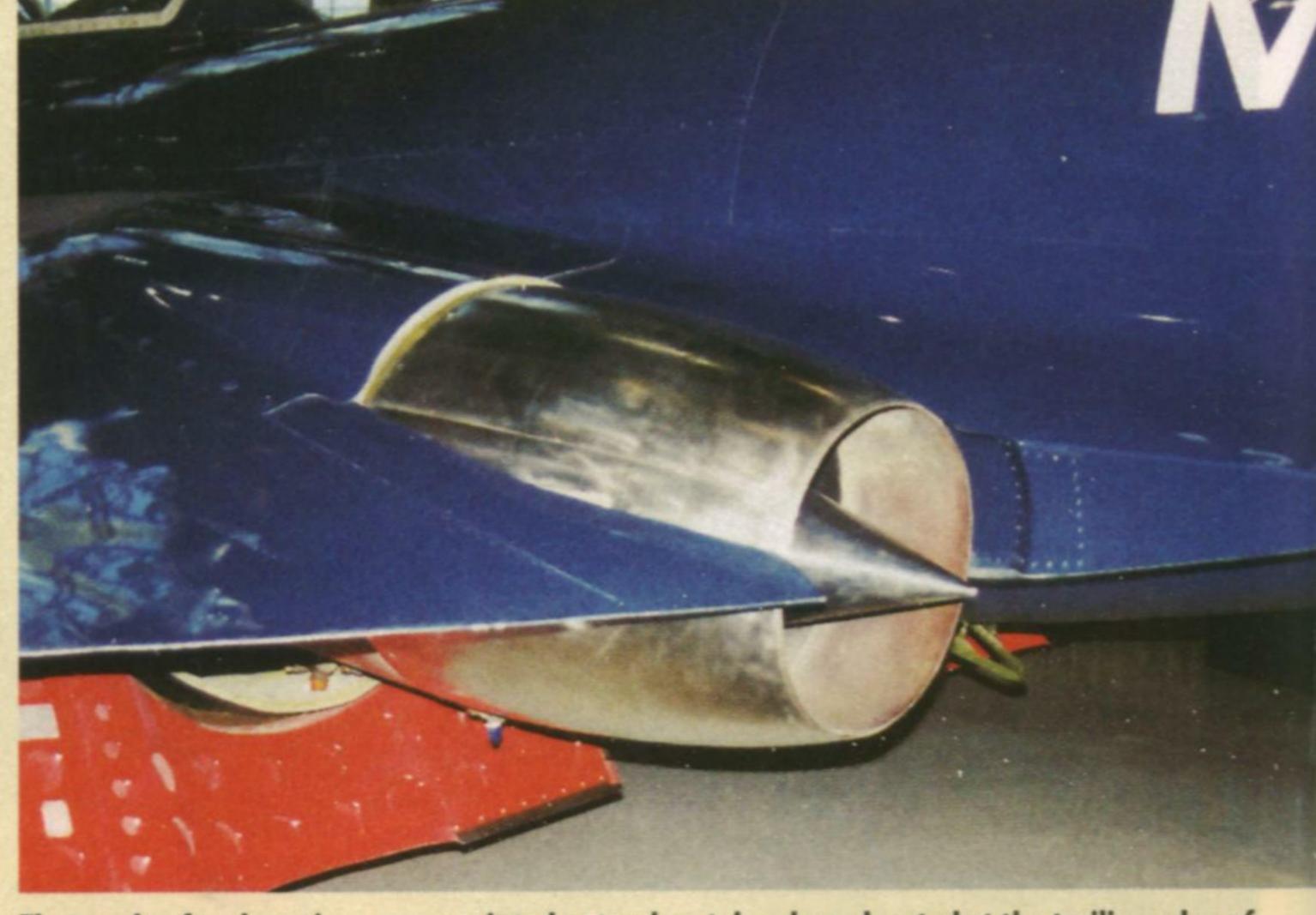


The instrument panel in the F2H-2P photographic reconnaissance version did not have a gun sight, but there was a small scope at the top center of the panel. It should be noted that US Navy fighters of this time frame that were painted in the overall blue scheme had flat black cockpit interiors. When the exterior scheme was changed to Light Gull Gray over white, the cockpit interiors were painted gray (Detail & Scale photo by Bert Kinzey)



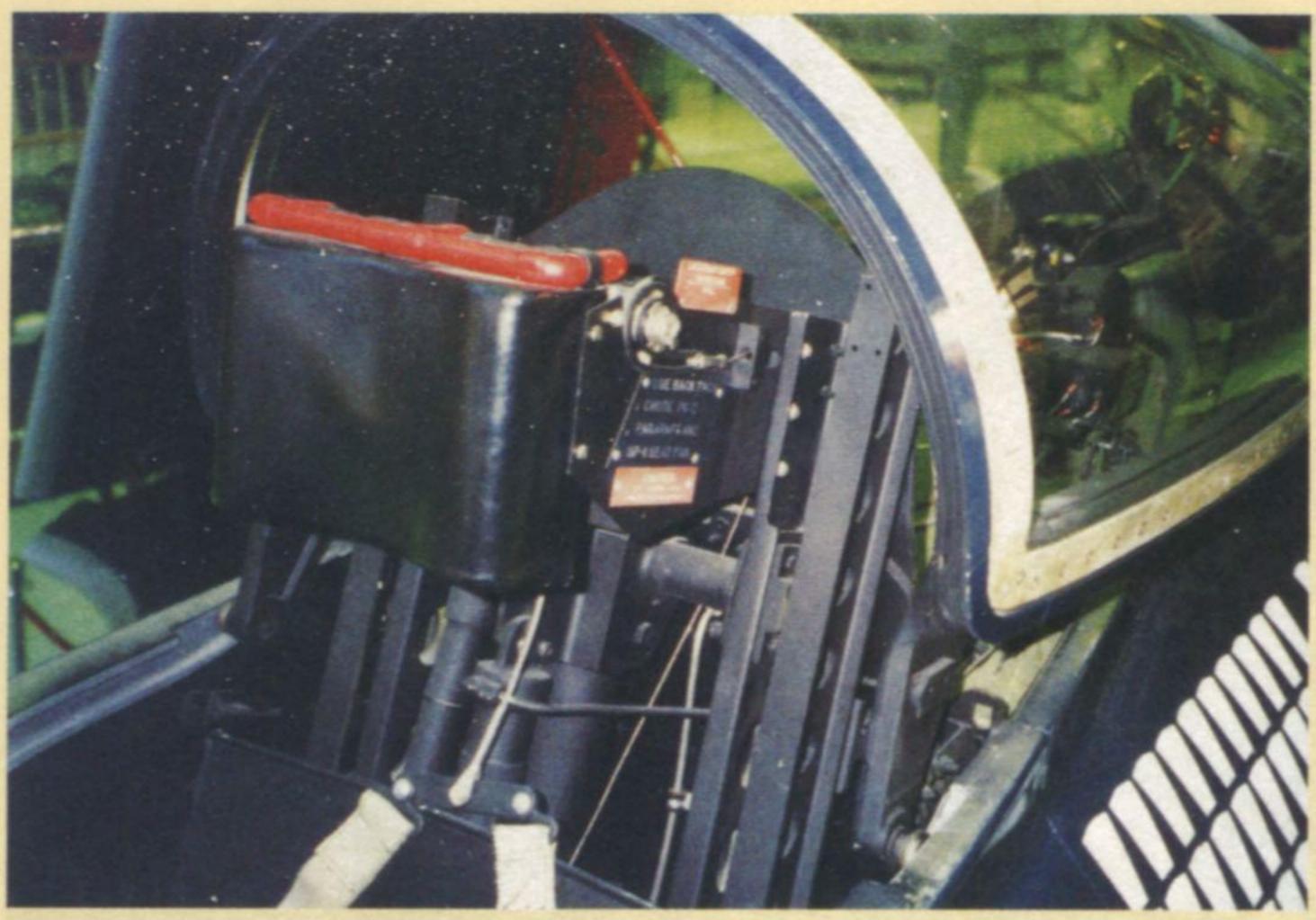


Details of the nose landing gear. It was a simple scissors design and lacked the launch bar and hold back equipment found on all of today's US Navy carrier aircraft. The Banshee and its contemporaries used bridles to hook up to the catapults, and the hold-back bars were attached under the fuselage (Detail & Scale photos by Bert Kinzey)



The nozzle of each engine was unpainted natural metal and was located at the trailing edge of the wing root. There was a conical shaped shock cone inside the exhaust pipe. These jet engines were not equipped with afterburners (Detail & Scale photo by Bert Kinzey)





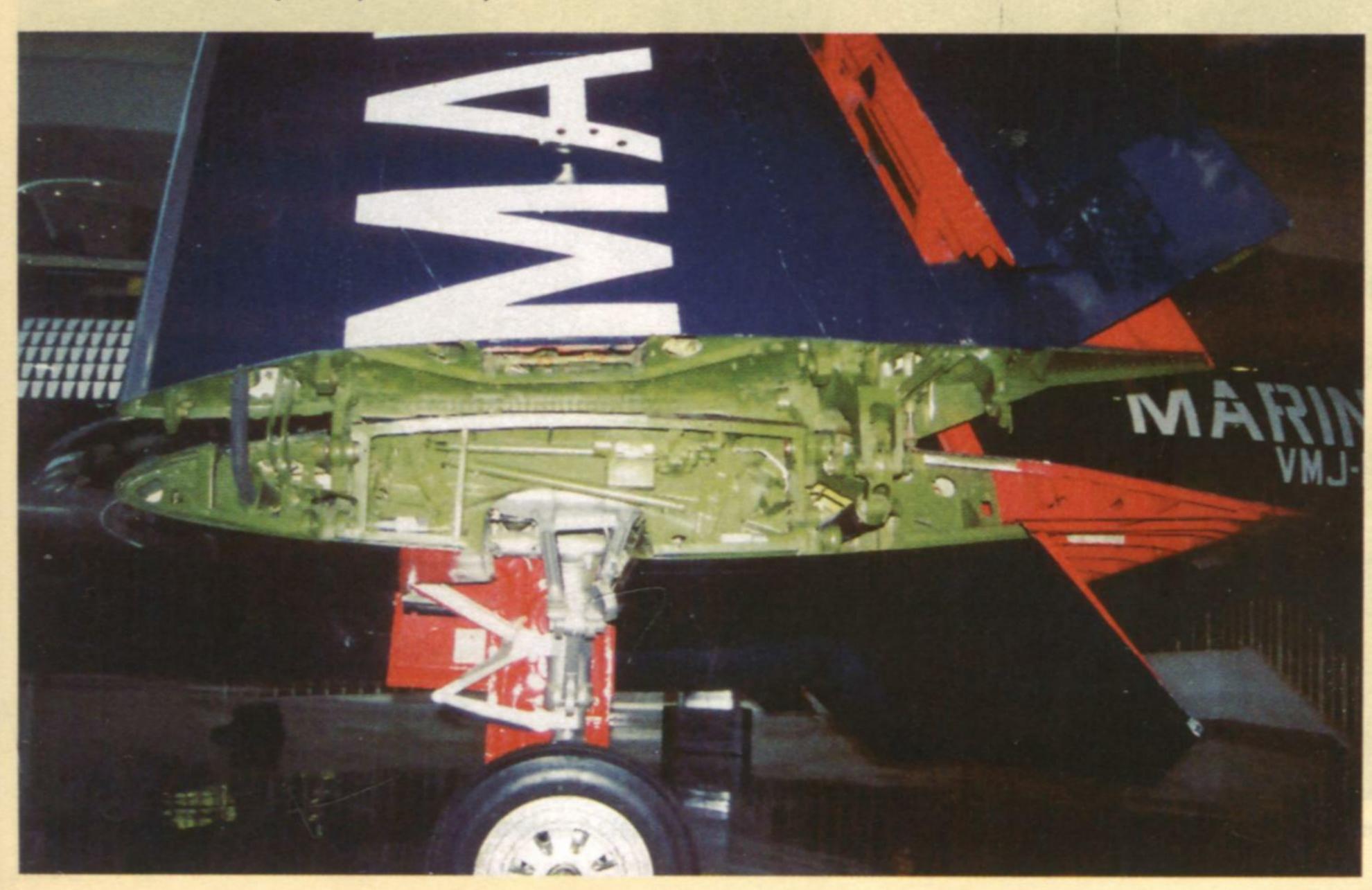
Details at the top of the ejection seat are shown here. The writing near the top of the seat instructs the pilot to use a 'BACK PACK CHUTE PK-2 PARARAFT and a SP-1 SEAT PAN'. The parachute was not packed into the seat as they have been in most fighters since the 1960s. Instead, it was worn on the pilot's back as it had been long before the invention of ejection seats (Detail & Scale photo by Bert Kinzey)

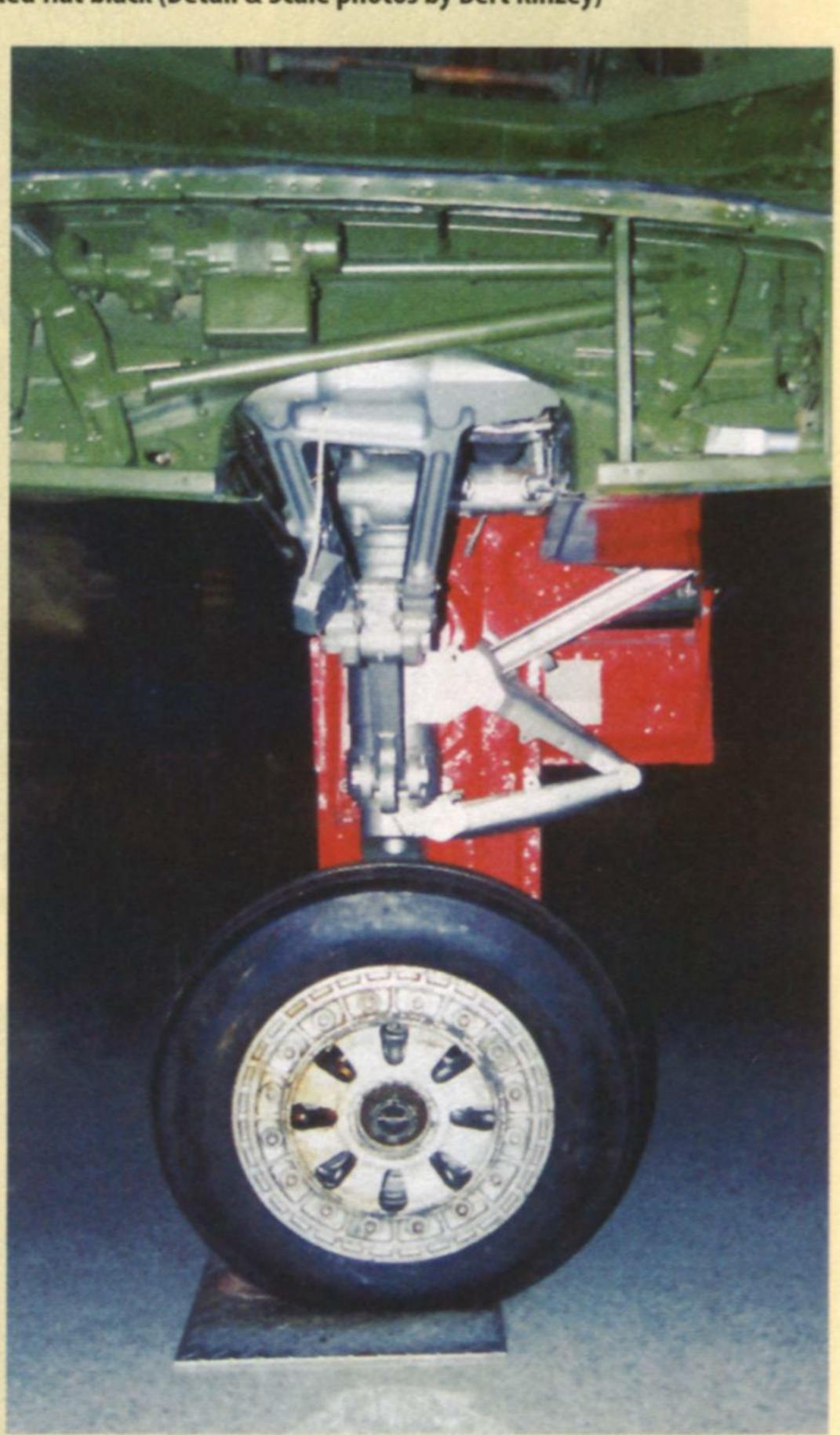


Details behind the ejection seat are visible through the open canopy. Note that the inside framing of the canopy was painted flat black (Detail & Scale photos by Bert Kinzey)



Additional circuit breakers were located on the forward side of the right console. Radio controls were on top of the console as were other electrical switches. The joystick controls the autopilot. Again, the natural metal rail guide for the canopy is visible in this view (Detail & Scale photo by Bert Kinzey)

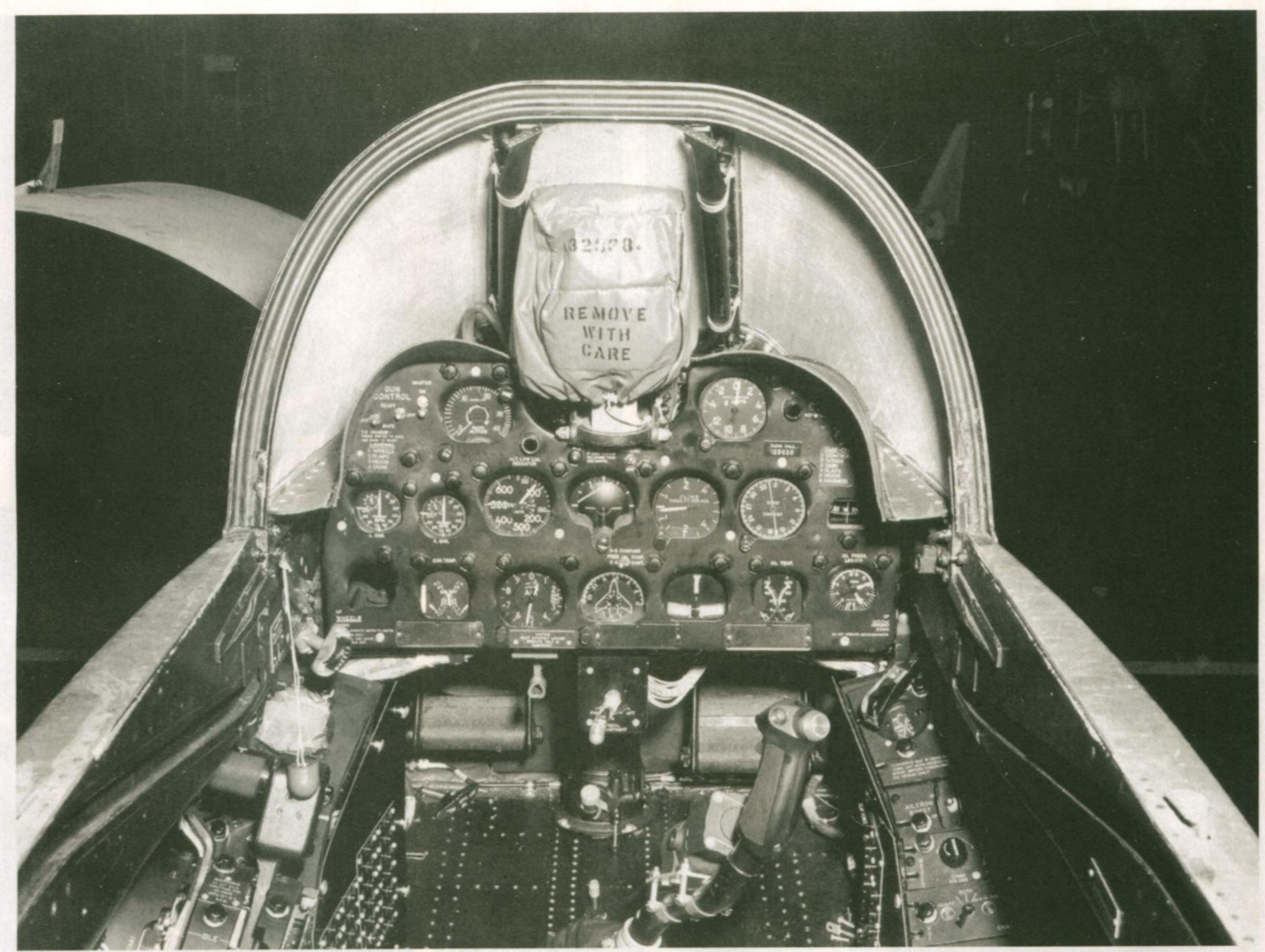




The torque link and the retraction strut are visible in this side view of the landing gear. Most photographs of operational Banshees show that the struts and wheels were painted silver as seen here, but in a few cases, they were painted the same blue as the exterior of the aircraft. It should be noted that the landing gear on this restored Banshee has no hydraulic fluid in it. This results in the gear being depressed more than it would be on an operational aircraft. The gear was short and sturdy, and proved up to the challenge of carrier operations. An unusual design feature of the Banshee was that the main landing gear retracted outward. The main gear on almost all other jet fighter aircraft retracted inward (Detail & Scale photo by Bert Kinzey)

left: Electrical, fuel, and hydraulic fittings, plumbing, and wiring all passed through the wing fold joint. Although this restored Banshee has the interior of the wing fold painted in primer green, photographs of operational aircraft seem to indicate that most were painted the same blue as the exterior of the aircraft (Detail & Scale photo by Bert Kinzey)



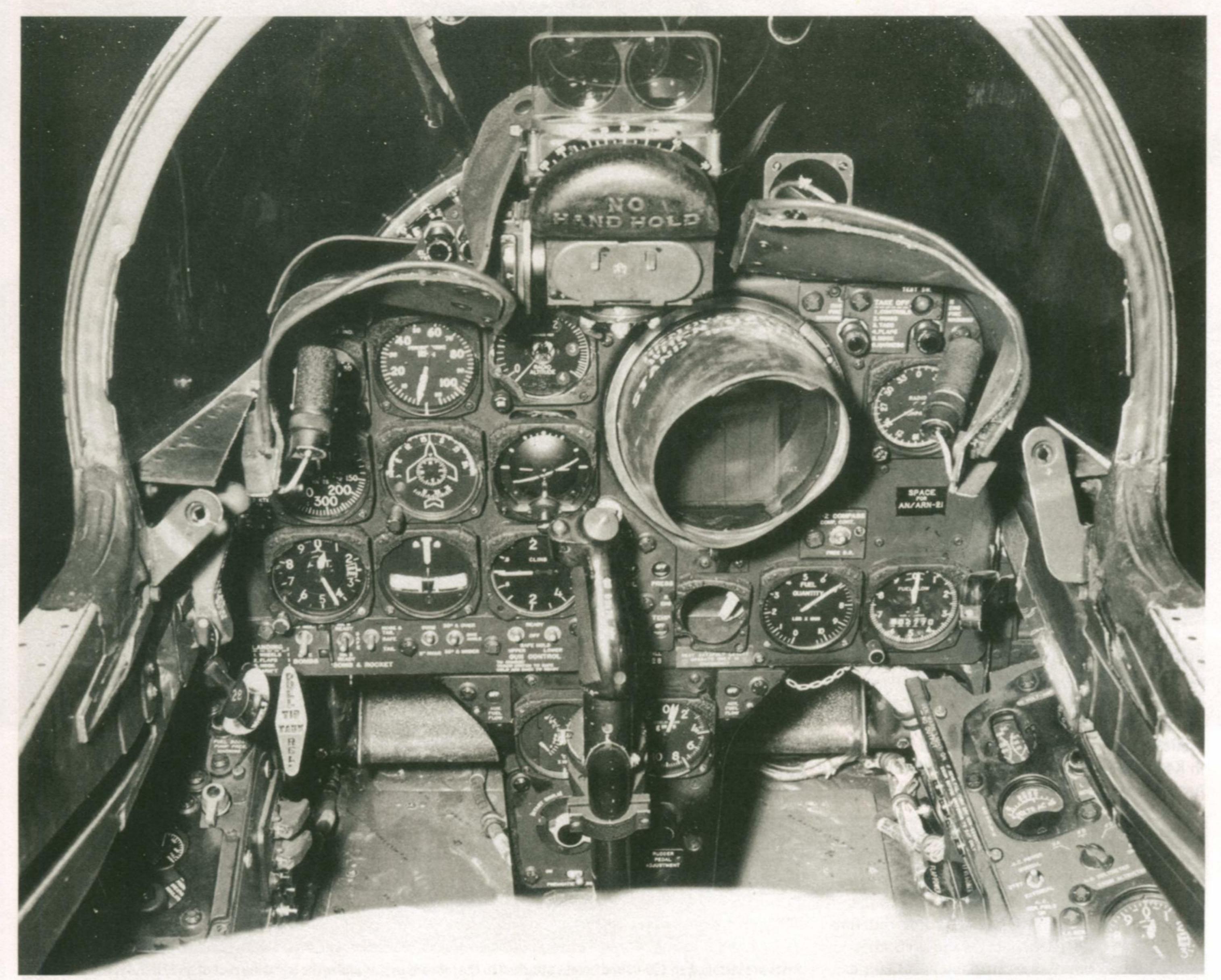


The instrument panel used in the standard F2H-2 fighter and the F2H-2B is shown here with the gun sight mounted at the top center of the panel. It has a protective cover in place. The instruments were straightforward and very much like those that had been used in propeller-driven fighters (McDonnell photo via Jim Mesko)



Some F2H-2Ps remained in service long enough to be repainted in the Light Gull Gray over white paint scheme in the late 1950s. This photo Banshee was assigned to VC-61 (National Museum of Naval Aviation)





The radar scope in the F2H-2N night fighter version required the instruments to be rearranged to a considerable degree, but the illuminated gun sight remained in place, and in this photograph it is uncovered (McDonnell photo via Jim Mesko)

Fourteen F2H-2N night fighters were also produced, BuNos 123300 through 123313. To mount the air intercept radar, the nose was extended by 33.6 inches, and the four 20-mm cannon were repositioned. The forward part of the elongated nose was a radome to provide good forward coverage for the AN/APS-19A radar set, and the aircraft was also equipped with a Mk. 20, Mod. 0 illuminated gun sight. Of the fourteen F2H-2Ns produced, one was lost on an early test flight, and one was utilized for test and evaluation purposes. Most of the remaining twelve were assigned to Composite Squadron Four (VC-4). This squadron provided detachments to deployed aircraft carriers in order to give their air groups an all-weather intercept capability.

It has been reported that the F2H-2Ns did not have the ability to carry stores under their wings, but there is ample photographic evidence that these aircraft at least retained the eight hardpoints and pylons like standard F2H-2 fighters. It is doubtful, however, that these were used operationally very often, if at all.

The F2H-2N became the US Navy's first carrier based, all-weather jet interceptor. It was also the forerunner of the F2H-3 and F2H-4 all-weather fighters that would follow it into production. F2H-2N, BuNo, 123311, would be used as the XF2H-3 prototype.

By far the most important and numerous F2H-2 sub-variant was the F2H-2P photo-reconnaissance version, eighty-nine of which were produced. The first F2H-2P made its initial flight on October 12, 1950.

To accommodate up to six cameras, the nose section was lengthened by twenty-seven inches and all cannon armament was deleted. One K-18 and up to five K-17 cameras were normally carried, but a S7S strip camera and a series 30 scanner could be used when required. The pilot could rotate cameras between the vertical and oblique positions in flight. The F2H-2P also retained the AN-6A gun camera as standard equipment. Three windows were located on each side of the nose section, while three more were on the bottom. A heating unit kept the windows free from frost and moisture at high altitudes. For night photography, flash cartridges could be carried in pods under the outer wing panels to illuminate targets.

F2H-2Ps were assigned to composite squadrons VC-61 at NAS Miramar, California, and VC-62 at NAS Jacksonville, Florida. These two units provided detachments of the photo recon aircraft to carriers of the Pacific and

Atlantic Fleets respectively. Marine squadrons VMJ-1 and VMJ-2 also flew the F2H-2P as tactical reconnaissance assets for the Marine Corps. Late in their service life, a few F2H-2Ps were assigned to Utility Squadron ONE (VU-1).

The F2H-2P would become the longest-serving Banshee variant, remaining operational until the late 1950s when it was finally retired from service.

#### Korea

Both F2H-2 fighters and F2H-2P reconnaissance aircraft flew important missions and provided valuable service during the Korean conflict.

Although the war began on June 25, 1950, no Banshees participated until over a year later when USS Essex arrived on station off the coast of Korea in August 1951. VF-172, known as the Blue Bolts, was the first Banshee fighter squadron to see action, flying from USS Essex, in August 1951. This also marked the first time an aircraft built by McDonnell entered combat. During the war USS Kearsarge embarked VF-11, and USS Lake Champlain took VF-22 and VF-62 into combat against the North Koreans. This latter was the only carrier to operate two Banshee fighter squadrons at the same time in Korean waters. No Marine Banshee fighter squadrons

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saw action in Korea.

For the most part, F2H-2s flew fighterbomber missions against targets of opportunity and interdicted supply lines. Using their 20-mm cannon, 5-inch rockets, and 100, 250, and 500pound bombs, the Banshee proved to be a reasonably capable and very reliable fighter. At no time in the war did they ever have the chance to engage enemy aircraft in aerial combat, so no air-to-air kills were scored, nor were any Banshees lost to enemy aircraft.

It was the F2H-2P that provided the Allies with the most valuable service during the Korean War. It quickly proved to be the finest photoreconnaissance asset in the theatre. VC-61 at NAS Miramar, California, charged with providing reconnaissance assets to carriers operating in the Pacific, provided detachments of F2H-2Ps to the carriers Essex, Boxer, Bon Homme Richard, Kearsarge, Oriskany, and Valley Forge. Philippine Sea, which provided reconnaissance aircraft to the Atlantic Fleet carriers, did provide F2H-2Ps on one occasion during the conflict when it sent Detachment 44 to serve aboard USS Lake Champlain. These aircraft were marked with a PL tail code, while those from VC-61 carried the letters PP.

Meanwhile, VMJ-1 flew from Pohang Airfield in South Korea as part of Marine Air Group Thirty Three (MAG-33) where it was under direction of the Fifth Air Force. The twelve Marine F2H-2Ps provided as much as forty percent of the tactical reconnaissance for the Allied air forces in Korea in spite of the fact that they were much further from the targets than Air Force reconnaissance assets.

By the time the Korean War ended, the newer and larger F2H-3 and F2H-4 Banshees were coming off the production lines. These would add a new all-weather capability to the Navy and Marine air groups and would redefine the mission of the Banshee. As they did, the F2H-2 moved on to serve in Navy and Marine Reserve units, but the F2H-2P would remain in front line service until the end of the decade. MAM



Fuses are installed on 100-pound bombs attached to the inboard pylons under the left wing root of an F2H-2. Typical loads for these pylons were 100, 250, and 500-pound bombs, but 5-inch rockets could also be carried on these stations. Both 100-pound bombs and 5-inch rockets could also be carried on the pylons under the outer wing sections (US Navy photo via McDonnell and Jim Mesko)



Another sub-variant of the F2H-2 was the F2H-2N night fighter version, but only fourteen were built. These Banshees had a longer nose to house an AN/APS-19A radar that provided the aircraft with the capability to make intercepts at night or in bad weather. This F2H-2N is shown at Point Mugu where it was used for testing. Note that the aircraft retains its hardpoints and pylons under the wings for carrying external stores (National Archives)

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The primary sub-variant of the F2H-2 series was the F2H-2P photographic reconnaissance version. F2H-2Ps had a longer nose section than the F2H-2 fighters, and all four cannon were deleted. Cameras were installed in vertical and side-looking installations. Three large windows for cameras were dominant features on each side of the elongated nose section, and three more were under the nose section for vertical cameras. These F2H-2Ps are from VFP-62 and are shown aboard USS Kearsarge, in 1956 (National Museum of Naval Aviation)



It was fairly unusual for any of the F2H-2 Banshees to be seen operationally without their tip tanks, but this F2H-2P from VC-61 is an exception as it taxies forward aboard USS Valley Forge, in 1951 (National Museum of Naval Aviation)