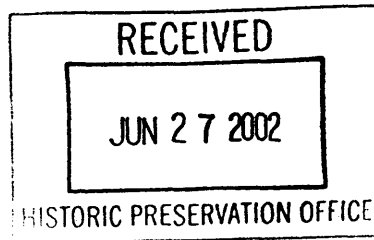


United States Department of the Interior
National Park Service

19



DEC

National Register of Historic Places Registration Form

This form is for use in nominating or requesting determinations for individual properties and districts. See instructions in *How to Complete the National Register of Historic Places Registration Form* (National Register Bulletin 16A). Complete each item by marking "x" in the appropriate box or by entering the information requested. If an item does not apply to the property being documented, enter "N/A" for "not applicable." For functions, architectural classification, materials, and areas of significance, enter only categories and subcategories from the instructions. Place additional entries and narrative items on continuation sheets (NPS Form 10-900a). Use a typewriter, word processor, or computer, to complete all items.

1. Name of Property

historic name TBM-3E "Avenger" Torpedo Bomber Warplane

other names/site number _____

2. Location

street & number 500 Forrestal Road, Cape May Airport not for publication

city or town Lower Township vicinity

state New Jersey code NJ county Cape May code 009 zip code 08242

3. State/Federal Agency Certification

As the designated authority under the National Historic Preservation Act, as amended, I hereby certify that this nomination request for determination of eligibility meets the documentation standards for registering properties in the National Register of Historic Places and meets the procedural and professional requirements set forth in 36 CFR Part 60. In my opinion, the property meets does not meet the National Register criteria. I recommend that this property be considered significant nationally statewide locally. (See continuation sheet for additional comments.)

Marc A. Matsil A/C For NAT + Historic Resources 12/19/02
Signature of certifying official/Title Date

Marc A. Matsil, Assistant Commissioner, Natural & Historic Resources/DSRPO
State of Federal agency and bureau

In my opinion, the property meets does not meet the National Register criteria. (See continuation sheet for additional comments.)

Signature of certifying official/Title Date

State or Federal agency and bureau

4. National Park Service Certification

I hereby certify that the property is:

- entered in the National Register. See continuation sheet.
- determined eligible for the National Register. See continuation sheet.
- determined not eligible for the National Register.
- removed from the National Register.
- other, (explain:)

Signature of the Keeper

Date of Action

Patrick Andrews

2/11/2003

TBM-3E "Avenger" Torpedo Bomber Warplane
Name of Property

Cape May County, NJ
County and State

5. Classification

Ownership of Property
(Check as many boxes as apply)

- private
- public-local
- public-State
- public-Federal

Category of Property
(Check only one box)

- building(s)
- district
- site
- structure
- object

Number of Resources within Property
(Do not include previously listed resources in the count.)

Contributing	Noncontributing	
_____	_____	buildings
_____	_____	sites
1	0	structures
_____	_____	objects
1	0	Total

Name of related multiple property listing
(Enter "N/A" if property is not part of a multiple property listing.)

N/A

**Number of contributing resources previously listed
in the National Register**

0

6. Function or Use

Historic Functions
(Enter categories from instructions)

Defense

Current Functions
(Enter categories from instructions)

work in progress

7. Description

Architectural Classification
(Enter categories from instructions)

N/A

Materials
(Enter categories from instructions)

foundation _____

walls _____

roof _____

other _____

Narrative Description

(Describe the historic and current condition of the property on one or more continuation sheets.)

see attached continuation sheets

TBM-3E "Avenger" Torpedo Bomber Warplane

Name of Property

Cape May County, NJ

County and State

8. Statement of Significance

Applicable National Register Criteria

(Mark "x" in one or more boxes for the criteria qualifying the property for National Register listing.)

- A** Property is associated with events that have made a significant contribution to the broad patterns of our history.
- B** Property is associated with the lives of persons significant in our past.
- C** Property embodies the distinctive characteristics of a type, period, or method of construction or represents the work of a master, or possesses high artistic values, or represents a significant and distinguishable entity whose components lack individual distinction.
- D** Property has yielded, or is likely to yield, information important in prehistory or history.

Criteria Considerations

(Mark "x" in all the boxes that apply.)

Property is:

- A** owned by a religious institution or used for religious purposes.
- B** removed from its original location.
- C** a birthplace or grave.
- D** a cemetery.
- E** a reconstructed building, object, or structure.
- F** a commemorative property.
- G** less than 50 years of age or achieved significance within the past 50 years.

Areas of Significance

(Enter categories from instructions)

A: Military

C: Military

Period of Significance

1945

Significant Dates

1945

Significant Person

(Complete if Criterion B is marked above)

Cultural Affiliation

Architect/Builder

General Motors/Eastern Aircraft Division

Narrative Statement of Significance

(Explain the significance of the property on one or more continuation sheets.)

9. Major Bibliographical References

Bibliography

(Cite the books, articles, and other sources used in preparing this form on one or more continuation sheets.)

Previous documentation on file (NPS):

- preliminary determination of individual listing (36 CFR 67) has been requested
- previously listed in the National Register
- previously determined eligible by the National Register
- designated a National Historic Landmark
- recorded by Historic American Buildings Survey # _____
- recorded by Historic American Engineering Record # _____

Primary location of additional data:

- State Historic Preservation Office
- Other State agency
- Federal agency
- Local government
- University
- Other

Name of repository: _____

TBM-3E "Avenger" Torpedo Bomber Warplane

Cape May County, NJ

Name of Property

County and State

10. Geographical Data

Acreage of Property n/a

UTM References

(Place additional UTM references on a continuation sheet.)

1 18 507792 4317096
Zone Easting Northing

3
Zone Easting Northing
4
Zone Easting Northing

See continuation sheet

Verbal Boundary Description

(Describe the boundaries of the property on a continuation sheet.)

see attached continuation sheets

Boundary Justification

(Explain why the boundaries were selected on a continuation sheet.)

11. Form Prepared By

name/title Joan Berkey, Historic Preservation Consultant

organization date June 17, 2002

street & number 1003 Bartlett Avenue telephone 609-927-7950

city or town Linwood state NJ zip code 08221

Additional Documentation

Submit the following items with the completed form:

Continuation Sheets

Maps

A USGS map (7.5 or 15 minute series) indicating the property's location.

A Sketch map for historic districts and properties having large acreage or numerous resources.

Photographs

Representative black and white photographs of the property.

Additional Items

(Check with the SHPO or FPO for any additional items)

Property Owner

(Complete this item at the request of SHPO or FPO.)

name Naval Air Station Wildwood Aviation Museum

street & number 500 Forrestal Road, Cape May Airport telephone (609) 886-8787

city or town Rio Grande state NJ zip code 08242

Paperwork Reduction Act Statement: This information is being collected for applications to the National Register of Historic Places to nominate properties for listing or determine eligibility for listing, to list properties, and to amend existing listings. Response to this request is required to obtain a benefit in accordance with the National Historic Preservation Act, as amended (16 U.S.C. 470 et seq.).

Estimated Burden Statement: Public reporting burden for this form is estimated to average 18.1 hours per response including time for reviewing instructions, gathering and maintaining data, and completing and reviewing the form. Direct comments regarding this burden estimate or any aspect of this form to the Chief, Administrative Services Division, National Park Service, P.O. Box 37127, Washington, DC 20013-7127; and the Office of Management and Budget, Paperwork Reductions Projects (1024-0018), Washington, DC 20503.

United States Department of the Interior
National Park Service

National Register of Historic Places
Continuation Sheet
Section number 7 Page 1

TBM-3E Avenger Torpedo Bomber/Naval Air Station Wildwood Aviation Museum
Cape May County, NJ

Narrative Description

Current Appearance

The TBM-3E Avenger owned by the Naval Air Station Wildwood Aviation Museum (NASW) is a single-engine torpedo bomber built in March 1945 in Eastern Aircraft's Trenton-Ternstedt plant outside of Trenton, NJ.

The bomber is 40' 4 23/32" long and stands 16' 5" high. [photos 2, 3, 4, and 5] With its wings [photo #8] fully extended in flying position, the airplane measures 54'2" wide, and with the wings folded it measures 19' wide. The body and wings of the airplane are made of aluminum, and the parts of the plane that control its movement—rudder, ailerons, horizontal stabilizer, and vertical stabilizer—consist of an aluminum frame covered with fabric. All are original. The canopy over the top of the airplane, also original, is made of aluminum with Plexiglass windows; it has been removed for restoration.

The engine is a Wright Cyclone engine, R-2600, with a 2,600 cubic inch displacement. Because engines were frequently replaced, it is not known if the current engine is original to this Avenger, and it probably is not. However, it is the same kind of engine that was used on Avengers, and was manufactured during World War II. This Avenger appears to have been equipped with only one gun, that in the turret, which was likely removed upon decommissioning in 1960 from the Royal Canadian Navy.

It is not known if this TBM-3E Avenger was equipped with radar, since there is no evidence on the body that it was ever so equipped. Not found on this Avenger, but built as part of the standard body was a gunner's turret aft of the canopy, and bomb bay doors, both of which have been removed previously.

It is currently painted with a white body, has a circle of red around the engine, and has gray wings.

Because the bomber is undergoing restoration, many of its major components have been disassembled and are being stored on site. Parts that have been removed for restoration include:

- Folding wings (original) [photo #8]
- Instrument panel (original) [fig. #11]
- Cockpit seat (original)

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National Register of Historic Places
Continuation Sheet
Section number 7 Page 2

TBM-3E Avenger Torpedo Bomber/Naval Air Station Wildwood Aviation Museum
Cape May County, NJ
(Section 7 continued)

- Engine (probably not original)
- Propellers (3, each 6' long, probably not original)
- Canopy over pilot (original)
- Flight controls (original) [photo #5]
- Propeller hub (original) [fig. #13]

Original Appearance

The TBM-3E was the last Avenger model put into production during the war; the -3 series had a fuselage lengthened by 11.5 inches and many -3E models carried an AN-APS-4 search radar in a radome beneath the starboard wing. By paying attention to details and deleting some equipment (notably wing and tail de-icing gear), Eastern Aircraft managed to reduce empty weight by nearly 300 pounds in spite of the addition of the APS-4 radar and other systems. These changes were introduced on the production line in December 1944.

There were many variations within the model: for example, later on, additional weight reduction was made possible by dispensing with the ventral tunnel gun and replacing the aft armor plate with a flak suit and flak curtains. Later production aircraft could carry twin 0.50 inch gun packages beneath the wings and some had two ultraviolet fluorescent spotlights installed in the pilot's cockpit to ease night operations. Similarly, those TBM-3Es built for anti-submarine patrols were given a longer canopy to accommodate two aft crew members, thus eliminating the power turret.¹

Specifications for the TBM-3E called for a Wright R-2600 Cyclone engine, with 1900 horsepower, and a Hamilton 3-blade propeller.

At the time of its manufacture for use in war, this Avenger would have been painted light blue on its undercarriage and dark blue on top. A white star on a circular blue ground flanked by two white bars would have been painted on both sides of the rear body and on one or both wings. Its number would also have been painted on the body and possibly on the upright tail as well.² [see figure #8] It should be noted that TBMs were often painted in different colors, depending on the colors used by the carrier on which they were based, or on their function. Some appear with

¹ Rene Francillon, Grumman Aircraft Since 1929, Annapolis, MD: Naval Institute Press, 1989, p. 177.

² Jackson and Doll, p. 36.

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National Park Service

National Register of Historic Places
Continuation Sheet
Section number 7 Page 3

TBM-3E Avenger Torpedo Bomber/Naval Air Station Wildwood Aviation Museum
Cape May County, NJ
(Section 7 continued)

camouflage colors, while others were painted an all-over dark blue (as seen in figure 8), or light gray with a white undercarriage.³

Subsequent Alterations

This Avenger was decommissioned from the US Navy in 1950 and was then transferred to the Canadian Armed Forces where it was used for anti-submarine patrols. In this capacity, it was modified by the removal of the ball turret and the extension to the rear of the glass canopy [former location of ball turret visible in photo #6]. It was also repainted in the official Royal Canadian Navy color scheme of dark gray over light gray.

The bomber was decommissioned from the Canadian Royal Navy in 1960, and after that date was used as an aerial tanker for firefighting and agricultural spraying until 1994-1995. In that use, its bomb bay doors were removed [photo #7], a six hundred gallon tank was installed, along with the necessary spraying equipment and hoses, and the plane was repainted.

Restoration Program

In preparation for restoration, the tank and spraying equipment installed when the plane was used as an aerial tanker were removed by NASW. As part of the restoration program that will bring the Avenger back to its World War II appearance, the following parts that were original to Avengers, but had been removed from this one, have been purchased or reproduced:

- Turret (reproduction using many original parts from other Avengers; ordered, with expected delivery date of fall 2002)
- Bomb bay doors (reproduction made according to original specifications; currently in the hangar and awaiting installation)
- Pull-down seat for rear gunner (reproduction)
- Seat for turret gunner (seeking an original)
- Radio (original from another Avenger, in working condition, awaiting installation)
- Turret gun (non-functioning reproduction, ordered)

³ Barrett Tillman, *TBF/TBM Avenger Units of World War 2*, Oxford, Great Britain: Osprey Publishing Co. (1999), p. 49-60.

United States Department of the Interior
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National Register of Historic Places
Continuation Sheet
Section number 7 Page 4

TBM-3E Avenger Torpedo Bomber/Naval Air Station Wildwood Aviation Museum
Cape May County, NJ
(Section 7 continued)

Once restored, the airplane will be on display at NASW Aviation Museum in their headquarters, Hangar #1 at the Cape May Airport. [photo #1—the TBM is seen inside this massive hanger, to the center left of the photograph].

Integrity

This Avenger maintains a high degree of integrity, largely because it was made near the end of World War II and, as such, was never engaged in direct enemy combat and never sustained any war-related damage.

However, since it was flown for 50+ years after its manufacture, many of its system parts (seals, wiring, hoses, pumps, etc.) have been periodically replaced based on time in operation and condition. Because the aircraft retains the majority of its original structural members (ribs, frame, etc.), it can be considered an “authentic” aircraft as defined by the National Park Service’s *Aviation Bulletin*.⁴ It also retains its original canopy, wings, body, rudder, ailerons, horizontal stabilizer, vertical stabilizer, instrument panel, and flight controls. Two major parts—the gunner’s turret and the bomb bay doors—are missing, but will be replaced as part of the restoration program.

This Avenger also contains an engine which is appropriate to the World War II period of significance for which it is being nominated. This is crucial in terms of the *Aviation Bulletin*.⁵

⁴ National Park Service, *Aviation Bulletin*, p. 41.

⁵ See National Park Service, *Aviation Bulletin*, p. 42.

United States Department of the Interior
National Park Service

National Register of Historic Places
Continuation Sheet
Section number 8 Page 1

TBM-3E Avenger Torpedo Bomber/Naval Air Station Wildwood Aviation Museum
Cape May County, New Jersey

Statement of Significance

Summary Statement of Significance

The TBM-3E "Avenger" owned by the Naval Air Station Wildwood Aviation Museum and located in Hangar #1 at the former Naval Air Station Wildwood Airport (now the Cape May Airport) is nationally significant under criterion A in the area of military as a carrier-based aircraft that was the US Navy's leading torpedo bomber. Because of its ruggedness, dependability, and versatility, the Avenger became one of the most respected aircraft of the Second World War. It represents one of the three most numerous carrier aircraft of all time, and was one of the three most produced attack types during World War II. Throughout that war, the Avenger fought with the US Navy, the US Marines, and the Royal Navies of the Allies in every theatre of the conflict, successfully carrying out reconnaissance, bombing raids, and anti-submarine patrols and contributing significantly to the eventual Allied victory.

Through Rose Bonavita, a woman who worked at the General Motors/Eastern Aircraft Division plant in Tarrytown, NY, driving a record number of rivets into the wing of an Avenger, the TBM-3E also has ties to the famed "Rosie the Riveter" character of World War II. First popularized in a 1943 song, and then later that year illustrated by Norman Rockwell on a cover of *The Saturday Evening Post*, Rosie the Riveter came to symbolize the significant contributions made by women in the workforce during the war.

This TBM-3E is also of statewide significance under criterion A in the area of military because it illustrates the massive military manufacturing effort that New Jersey made during World War II. It is one of 7,546 Avengers built at General Motors' Eastern Aircraft Trenton (NJ)-Ternstedt plant. Formerly used to manufacture and assemble General Motors automobiles, the plant was converted in 1942 to assemble TBM Avengers and built them from 1942 until the end of hostilities in 1945. In recognition of its great effort to produce war materials, the Trenton-Ternstedt plant was awarded the coveted Navy "E for Excellence Award" for superior war production on January 2, 1945.

Under criterion C, this Avenger is of national significance in the "military" category as a rare survivor of a type of warplane that was produced in great numbers during World War II, but of which few have survived. Of the 9, 839 that were manufactured by Grumman Aircraft and General Motors, it is estimated that only 75 to 100 remain. Avengers are located in at least 24 other American air museums, and are also found in museums in Canada, England, and Israel; of these, only two are airworthy. None, as of this date, are listed in the National Register of Historic Places.

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National Register of Historic Places
Continuation Sheet
Section number 8 Page 2

TBM-3E Avenger Torpedo Bomber/Naval Air Station Wildwood Aviation Museum
Cape May County, New Jersey
(criterion B continued)

Historical Background

The use of aerial torpedoes began several years before the start of World War I, when US Navy Admiral Bradley Fisk (1854-1942) patented the first one in 1912. A man of vision, he had progressive ideas about the use of aircraft from a naval standpoint, and despite the technical problems that existed in carrying and launching the weapon, his invention paved the way for its eventual use from an aircraft in the early years of aviation.¹

With the advent of World War I, the British Naval Air Service began experimenting with the use of torpedoes launched from a variety of different aircraft stationed on seaplane carriers; their first success came on August 11, 1915 when a Turkish merchant ship carrying supplies for the Turkish army was bombed with a 14" torpedo. Two days later, another enemy supply ship was sunk by torpedo, and the weapon was accepted into the arsenal of British warplanes. By the end of the war, both the British and the Russians had successfully used aerial torpedoes, leading to the demise of the seaplane carrier and the introduction of aircraft carriers. With them came a new type of aircraft that could operate not only from land, but from the deck of these flat-topped ships, which were designed specifically for the launching and landing of war planes.²

In America, the development of aircraft carriers was concurrent with those in Europe, and as they developed, so did a new breed of aircraft—the torpedo bomber. Initial torpedo dropping tests were carried out successfully in 1919 by aircraft converted for use as torpedo bombers, but it soon became apparent that purpose-built bombers, which could operate from the decks of ships with sufficient range and power to carry out attacks far out to sea, were needed.³

The US Navy's first torpedo aircraft were twin-engined converted Martin TM-1s, former Army bombers modified to carry a 1,618 lb. torpedo. Although relatively successful, major problems were foreseen in converting them for operating off ships, so they were given to the Marines. Through the 1920s, other bombers were introduced, but most were slow, lumbering aircraft. In 1934, the Navy Bureau of Aeronautics published new guidelines for the production of torpedo bombers and Douglas Aircraft Company introduced first the TBD Devastator, and a few years later the Douglas SBD, a dive bomber. The TBD became the Navy's leading torpedo bomber

¹ Terry Treadwell, Grumman TBF/TBM Avenger, Charleston, SC: Arcadia Publishing, 2001, p. 7.

² Treadwell, p. 8

³ Treadwell, p. 11.

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National Park Service

National Register of Historic Places
Continuation Sheet
Section number 8 Page 3

TBM-3E Avenger Torpedo Bomber/Naval Air Station Wildwood Aviation Museum
Cape May County, New Jersey
(criterion B continued)

until Grumman Aircraft Company, which had been established in 1929 in an abandoned garage in Long Island, NY, entered the field in the late 1930s.⁴

In early November 1939, the US Navy approached a number of aircraft manufacturers with regard to designing and building a replacement torpedo bomber for the ageing Douglas TBD-1 Devastator. The Navy sought a new aircraft that had to be as easy to use from a shore base as from an aircraft carrier; they also wanted a more potent torpedo bomber—one with a greater range, larger payload, faster speed, and tougher resistance to battle damage. The Navy invited six manufacturers to submit designs that met their minimum requirements of a maximum speed of 300 mph, a range of at least 1,000 miles while carrying a torpedo, a ceiling of at least 30,000 feet, and a provision for carrying bombs internally.⁵

The Navy received thirteen design proposals, and focused on two of them: one from Vought Aircraft Company using a Pratt & Whitney engine, and another from Grumman using a Wright engine. Because the Navy's specifications were so precise, the two aircraft were very similar in appearance, and both were designed to carry a three-man crew comprised of a pilot, gunner, and bomber. The major difference between the two, however, was that Grumman's bomber was lighter, faster, and had a greater range. Not willing to commit solely to either, the Navy signed contracts with both companies in April 1940 for two experimental aircraft from each.⁶

Within four months, Grumman built its first prototype, known as XTBF-1; although not aesthetically pleasing to some, its barrel-shaped fuselage gave the impression of ruggedness and reliability, and it bore more than a passing likeness to the company's F4F Wildcat, a fighter plane already in production since February 1939.⁷ The prototype was a mid-wing aircraft powered initially by a Wright 1,700 hp engine. Armored plate was installed around the power turret's motor and ammunition, and the plane was given self-sealing fuel lines and self-sealing tanks as for added reliability and safety.⁸ It was also designed with folding wings (crucial for use on an aircraft carrier) and had three armaments: a .50 caliber Browning machine gun that was fired by the pilot through the propeller, another .50 caliber Browning that fired through a small

⁴ Treadwell, p. 14-15. General Motors and L.C. Goad, A History of Eastern Aircraft Division, General Motors Corporation, _____: William E. Rudge's Sons, 1944, p. 19; Renee Francillon, Grumman Aircraft Since 1929, Annapolis, MD: Naval Institute Press, 1989, p. 1.

⁵ Francillon, p. 161.

⁶ Ibid.

⁷ Treadwell, p. 15-16; Francillon, p. 114.

⁸ Treadwell, p. 16.

United States Department of the Interior
National Park Service

National Register of Historic Places
Continuation Sheet
Section number 8 Page 4

TBM-3E Avenger Torpedo Bomber/Naval Air Station Wildwood Aviation Museum
Cape May County, New Jersey
(criterion B continued)

turret at the aft end of the canopy, and a flexible .30 caliber machine gun that fired rearwards from behind the weapons bay. This weaponry was increased in later variants.⁹

Although both Vought and Grumman's prototypes had responded favorably to rigorous testing under intense Navy scrutiny, Grumman was awarded the contract, and on December 30, 1940 received its first order for 286 of the torpedo bombers.¹⁰

The awarding of the contract was propitious for a number of reasons. Although the air arm of the Navy had long been considered as an "unwanted stepchild," it was coming to be acknowledged as a major factor in preparations to counteract further aggression by Japan, which that country had begun in 1937 with its invasion of China. Similarly, the Navy's air force was already playing a vital role in the Atlantic, sweeping the seas in search of German submarines, and bombing planes and surface raiders. However, the Navy was continually in a tug-of-war with the Army over priority in airplane deliveries, and during the first six months of 1941, had received 20% fewer airplanes than scheduled (1,997 ordered vs. 1,547 delivered).¹¹

Rear Admiral John H. Towers, chief of the Navy's Bureau of Aeronautics, testified before the House Naval Affairs Committee in August 1941 and demanded that a "better balance" be established between Army and Navy priority ratings for airplane deliveries.¹² The production of the Avenger would soon bolster the Navy's depleted aviation inventory.

Production of the Grumman Avenger

The Grumman Avenger began life as the TBF (Torpedo Bomber F), the F being the Navy's designated letter for the Grumman factory. When General Motors began production of the Avenger, the letter F was changed to M, resulting in the TBM, with M being the Navy's designated letter for the General Motors factory.

The first production TBF-1 was completed on January 3, 1942. [note that the "-1" stands for the variation number; there would eventually be many variations during the years of production] It had a span of just over 54' (17' with the wings closed) and a length of 40'. It weighed 10,080 pounds empty, 13,667 pounds loaded, and had a 15,905 pound maximum. Powered by a 1,700

⁹ Francillon, p. 162.

¹⁰ Treadwell, p. 38.

¹¹ *The United States News*, August 8, 1941, p. 14.

¹² *Ibid.*

United States Department of the Interior
National Park Service

National Register of Historic Places
Continuation Sheet
Section number 8 Page 5

TBM-3E Avenger Torpedo Bomber/Naval Air Station Wildwood Aviation Museum
Cape May County, New Jersey
(criterion B continued)

hp Wright Cyclone two-speed, 14-cylinder R-2600-8 engine that reached a maximum speed of 271 mph at 12,000 feet, the TBF cruised at a "leisurely" 145 mph with a range of 1,215 miles.¹³

A large landing hook, operated electrically from the cockpit, assisted landing on aircraft carriers. Other parts of the aircraft that operated hydraulically were the automatic pilot, the bomb bay doors, the cowl flaps, the oil cooler flaps, the wing gun charges, and the landing gear.¹⁴

One of the unique features of the TBF/TBM was the independently operated, electrically powered dorsal ball turret located in the top of the fuselage, just aft of the hooked enclosure of the second compartment. It was moved by two synchronized amplidyne motors, which gave elevation, train, and slewing capabilities to the gunner. The use of the motors was the brainchild of Oscar Olsen, an electrical engineer who remembered using a bigger version of the motor on drawbridges and turntable bridges from his days with General Electric. He asked General Electric to design a smaller version of their amplidyne motor, which they did, and the resulting design greatly improved the speed and accuracy with which a gunner could track enemy targets.¹⁵

The gun had a number of limit switches and safety stops built into it, and perhaps the most important was a stop that prevented the gun, which had a 360° radius, from shooting off the tail of its own airplane. Because of the complexities of the electrically-operated turret gun, a "turret school" was established at Kaneohe Naval Air Station, Hawaii, to teach navy men how to use it.¹⁶

The pilot had a .50 caliber machine-gun mounted on the right hand side of the engine cowling. In the early models, this gun fired through the propeller; in later models, two guns were placed on the wings, instead. The gun's charging handle was mounted on the right hand side of the pilot's instrument panel, and the trigger was conveniently mounted on the pilot's control stick. A gun camera, mounted on the starboard side of the aircraft, was activated by the trigger on the pilot's control stick and was synchronized with the .50 caliber gun.

In addition to the pilot and the ball turret gunner, the radio operator/tunnel gunner was another key crewmember whose area within the bomber was given special attention. This gunner had a rear firing .30 caliber machine-gun mounted at the rear of the aircraft just in front of the rear tail-

¹³ Treadwell, p. 41.

¹⁴ Treadwell, p. 42.

¹⁵ Treadwell, p. 43.

¹⁶ Treadwell, p. 46.

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National Park ServiceNational Register of Historic Places
Continuation Sheet
Section number 8 Page 6

TBM-3E Avenger Torpedo Bomber/Naval Air Station Wildwood Aviation Museum
Cape May County, New Jersey
(criterion B continued)

wheel. The tunnel gun was manually charged and fired, and had a 500 round ammunition container installed between the two brackets on the starboard side of the fuselage. The ammunition belt was fed downwards to the gun over a roller, through a slot in the bottom of the container, and then through a belt guide mounted on the side of the gun. This innovation allowed the cartridges to be fed into the magazine regardless of the angle of fire.¹⁷

The Avenger was also the first US Navy aircraft to be equipped with rocket launching rails (called "Hayrakes" by the pilots) slung under each wing. This was a very useful addition to the aircraft's armament, especially when carrying out torpedo attacks, because the Avenger could lay down a devastating barrage of rocket fire which enabled it to reach its target with the minimum of resistance from the enemy's anti-aircraft guns. Later TBFs and TBMs were adapted to carry a variety of torpedoes, bombs, mines and in the later British models, depth charges.¹⁸

The Avenger Enters World War II

Ironically, on December 7, 1941, the second prototype XTBF-1 was made ready for a static display at the annual Grumman Open House. The plane was fully exposed except for its gun-turret, which was hidden under a canvas cover because it was still on the secret list. Grumman was preparing to serve an elaborate dinner to some 15,000 guests at the Open House when word of the Pearl Harbor attack was quietly circulated. The dinner was cancelled, the factory complex was later declared secure, and was to remain that way through the duration of the war.¹⁹ It is said that the name *Avenger* was given to the TBF because of the attack on Pearl Harbor, but there has been no verification of this attribution to date.²⁰

The first TBFs, manufactured by Grumman, came off the production line of its Bethpage, Long Island, New York facility on January 3, 1942, a little less than one month after the bombing of Pearl Harbor. After successfully passing pre-delivery testing, the first TBF-1 Avenger was delivered to the US Navy on January 30th. By August 1942, a total of 145 Avengers had been delivered to the US Navy, a pace that would be dwarfed in the next three years.²¹

¹⁷ Treadwell, p. 46

¹⁸ Treadwell, p. 49.

¹⁹ Treadwell, p. 39.

²⁰ Treadwell, p. 39.

²¹ Treadwell, p. 63.

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The first squadron to be equipped with them was VT-8 aboard the aircraft carrier USS *Hornet* stationed in Pearl Harbor. The planes' first combat action was the critical Battle of Midway on June 4, 1942 when six TBFs entered front-line, combat service. However, only one of the six returned from the mission, and it was so badly damaged it was scrapped.²² Other sources, also unsubstantiated, claim that after this battle, the TBF was christened, "Avenger."

It was later determined that the lack of extensive fire cover by the Allies, combined with the inexperience of the pilots and the overwhelming forces of the Japanese fighters had contributed to the disappointing performance of the Avengers in their first battle. The aircraft had, indeed, absorbed more punishment from the Japanese fighters than any other comparable aircraft, but the other factors weighed heavily against them in their first conflict.²³

General Motors Starts Building Avengers

In August of 1941, the *United States News and World Report* predicted complete stoppage of automobile production for private use sometime early in 1942.²⁴ Already a great number of raw and processed materials were on the critical list, and cars were coming off the assembly line minus their traditional "bright finish." Four days after the bombing of Pearl Harbor, the prediction came true when the federal Office of Production Management issued a curtailment order on automobile manufacturing.²⁵

In response, General Motors—who had long enjoyed profits from their models of Buicks, Pontiacs, and Oldsmobiles—almost immediately stopped production at several of their plants. The day after the order, its parts production plant in West Trenton, New Jersey (known as the Trenton-Ternstedt division) ceased production of its automobile hardware items; the plant had been making as many as 750,000 pieces per day. [see fig. #4] Forty-two miles away, General Motor's super-assembly plant in Linden, New Jersey, which had manufactured 343,000 cars between 1937 and December 1941, stopped production twelve days after the curtailment order was issued. Three remaining plants, in Tarrytown, NY, Baltimore, MD (both of which produced Fisher bodies), and the Delco-Remy battery plant in Bloomfield, NJ, had enough work to remain open, at least temporarily.²⁶

²² Treadwell, p. 73-76.

²³ Treadwell, p. 80.

²⁴ *United States News*, August 8, 1941, p. 15.

²⁵ General Motors and L.C. Goad, A History of Eastern Aircraft Division, General Motors Corporation., ____ : William E. Rudge's Sons, 1944, p. 17.

²⁶ General Motors and Goad, p. 18.

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As early as 1940, the Trenton-Ternstedt plant had forecasted and anticipated work stoppage. With 3,000 employees depending on the plant for income, management began soliciting new contracts to keep them employed once automobile hardware production would taper off. At first, small contracts, which brought work but little or no profit, were obtained. Hopeful of landing a major contract, bids were submitted from November 1940 until May 1941 for the manufacturing of such wartime goods as 20 mm. cartridge cases, mine and depth charges, magazine feeds for machine guns, bombs, and parachute flares. Of these, only the bid for parachute flares would be accepted in January of 1942, but it was not enough to keep all four plants functioning.²⁷

Desperate to stave off the inevitable, the general manager of the Linden, NJ Division went to Detroit where he appealed to the home-office for help. It was decided that Linden would try for a job subcontracting aircraft wings: this type of work seemed closest to Linden's capabilities, complimenting its metalworking experience and plant layout. Although various government agencies and aircraft producers were solicited, only one (Republic Aviation Corp.), which was about to build the top-secret P-47 Thunderbolt, expressed any interest. With no firm contract in hand, though, GM sent a representative to Washington to meet with the Office of Production Management during Christmas week of 1941.

Expecting to be making only a courtesy call, the representative was, instead, greeted with a barrage of questions about the Linden plant's capabilities. Just hours earlier, the Navy had decided to move forward with large-scale production of Grumman's TBF Avenger and the Office of Production Management was at that moment strategizing how best to build the great number of torpedo bombers planned.²⁸

At first, General Motors executives were hesitant to pursue the lead. They were still negotiating a subcontract on the Thunderbolt and felt the potential government contract was a gamble. Nor were they familiar with Grumman Aircraft: even though Grumman had expanded its organization as the war in Europe gathered force in the late 1930s and created a demand for its F4F Wildcat fighter, the size of its firm was hardly comparable to that of General Motors.

Grumman had similar misgivings. Their production capabilities were already overextended, and they had agreed to transfer some of their production of the TBFs to any firm the Navy Department recommended; however, they had difficulty envisioning the transformation of a

²⁷ General Motors and Goad, p. 18.

²⁸ General Motors and Goad, p. 19.

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plant geared to produce one automobile every sixty seconds into one that could build complex bombers.²⁹

Both had good reasons to be wary because there was a vast difference between the automotive and aircraft industries at this time. The larger of the two, the auto industry, had just finished a decade of unprecedented production. Conversely, the aircraft industry was on the cusp of becoming an industry giant in its own right, propelled by the impetus of war and the demand for military airplanes. In 1940, the total production of planes in the United States was only 5,600, a number that paled to the 5.5 million cars that had been produced that same year.³⁰

In terms of assembly procedures, both were also radically different: automobiles were built using specialized mass production techniques, while airplanes were assembled on an almost-custom basis because of a constant flow of engineering changes in the original specifications that affected almost every section of the plane.

Technical specifications were vastly different between the two end products as well. While a car's weight was not an overwhelming consideration in its performance, an airplane's weight was so crucial to its function that it was of the highest concern. Where the car's shape was primarily driven by appearance and comfort, the reverse was true for airplanes whose shape was dictated by the streamlining needed for greater speed and maneuverability. Furthermore, while the body, hood, and fenders of a car serve mostly as protection against weather, the covering or "skin" of an airplane serves a definite structural purpose.

Despite misgivings on both sides about the feasibility of converting automobile plants into airplane manufacturing facilities, General Motors agreed to produce the combat planes in quantity, and in a hurry. They also agreed to build another Grumman plane—the F4F Wildcat—at the same time, and on March 23, 1942, entered into a contract with the federal government for 1,200 Avengers.³¹

With time of the essence, plans for the conversion proceeded at a hectic pace. The Linden general manager quickly realized that his facility had no tool room and decided that the Delco-Remy battery plant in Bloomfield, NJ would be ideal for that part of the production. It also became apparent that the Bloomfield plant did not have sufficient resources to handle the expected workload, so General Motors decided to organize a new division, one that would draw

²⁹ General Motors and Goad, p. 20-22.

³⁰ General Motors and Goad, p. 22; *U.S. News & World Report*, August 8, 1941, p. 2.

³¹ General Motors and Goad, p. 21; Francillon, p. 164.

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on the other divisions' pool of experience to create an entirely new manufacturing organization—in essence, they started a new company. On January 21, 1942, Eastern Aircraft was born, comprised of General Motors plants in Linden, Trenton, and Bloomfield (all in New Jersey), Baltimore (Maryland), and Tarrytown, (New York).³²

GM's first efforts were spent in marshalling the necessary employees to take over and administer the many newly planned departments hitherto unknown to automobile men. This proved to be no easy task, as Admiral DeWitt C. Ramsey, speaking as Chief of the Navy's Bureau of Aeronautics, observed two years later:

A further handicap imposed upon Eastern Aircraft by the demands of the situation was the agreement that no trained personnel was to be begged, borrowed or stolen from established aircraft plants. All that was not done just to make the job more difficult. The reason was obvious. We did not want to rob Peter to pay Paul.³³

Consequently, Eastern Aircraft looked within the General Motors Company and pulled the talent it needed from across the country. Preparations for plant change-overs were made at the same time; it was still undecided which plants would be manufacturing which parts, but it had been determined that the Linden plant would build the Wildcat fighter and the Trenton facility the Avenger torpedo bomber. The Avengers being produced at Trenton were designated by the Navy as TBM-1s, with the "M" being the Navy's symbol for General Motors.³⁴

Regardless of involvement, each of the five plants in the Eastern Division would have to be emptied of its automobile equipment, and the subsequent dismantling program progressed at varying speeds. At Linden, the plant was stripped of all equipment; some was stored for possible later use, while the rest—mostly 250 tons of structural members—was sold as scrap. Demolition there was completed by the end of April 1942. At the Trenton plant, the dismantling began February 27 and continued through mid-July. Millions of pounds of equipment were removed and stored in a hastily-erected 182,000 square foot storage building across the highway. In contrast to Linden, which had practically no machinery that could be adapted to aircraft use, Trenton salvaged 243 out of its total 1,104 peacetime machines. At both plants, runways were constructed for airports to be used in testing the Avengers and Wildcats.³⁵

³² General Motors and Goad, p. 21.

³³ General Motors and Goad, p. 24.

³⁴ General Motors and Goad, p. 25.

³⁵ General Motors and Goad, p. 25-27.

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At all five plants, a great deal of ingenuity went into their physical conversions. Baltimore, for example, used the welding and railroad pits in the plant as storage areas, filling them with unusable automobile equipment then covering them over with portable flooring that allowed for easy access should they be needed later. At Trenton, the framework of its overhead ovens was used to form a balcony and thus gain badly needed floor space. One of the larger projects at Trenton involved breaking through a brick wall at the northwest corner of the building, and then installing an 8 ton, 25' x 70' door to allow finished planes to exit.³⁶

During the process, each of the plant's staffs traveled to the Grumman facility on Long Island to determine just which parts of the two planes they would build. The final decisions were made in February: Tarrytown was chosen to build the wings, center section, trailing edges, the motor mount, the cabin, windshield, and upholstery; Baltimore was to build the rear fuselage, the tail assembly, and all control surfaces; and Bloomfield was selected to build the electrical controls. Manufacturing of forward and center fuselage sections, final assembly, and acceptance trials for the Avenger would take place at the Trenton plant.³⁷

Concurrent with the conversions, plans and specifications for the planes were obtained from Grumman, but not without great difficulty. Grumman had never compiled engineering and tooling information on its planes, largely because they'd never needed them. Grumman had no time studies, parts lists, detailed drawings, or routing sheets, all of which were standard in the auto industry. Eastern Aircraft decided the best way to proceed was to put some of its own men into Grumman's plants to develop the necessary information. This involved putting GM men on the production floor or in an office so tiny they had to sit on the floor to examine the prints that were given to them. A GM photographer took hundreds of pictures of the various parts, tools, and fixtures, while sketch artists drew Grumman's tooling set-up in the absence of existing prints. To handle the work, Eastern Aircraft erected a large shack adjacent to the Grumman plant that became known as the General Motors Bethpage Office and was called "the fastest built, least ostentatious office in GM's history."³⁸

In spite of the detailed engineering data Eastern Aircraft was compiling, the information was not as complete as was needed to make faithful copies of the Grumman planes. To solve the problem, the idea of "PK" aircraft was developed. PK stood for Parker-Kalon fasteners, a method of temporarily connecting parts that allowed for easy disassembly and reassembly. Thus, Avengers and Wildcats put together with these fasteners could be disassembled, measured,

³⁶ General Motors and Goad, p. 26-27.

³⁷ Francillon, p. 164.

³⁸ General Motors and Goad, p. 31.

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and reassembled. Trenton received its first PK samples on February 27th and its first fuselage on April 4th; Linden received its PK fighter on March 21st.³⁹

The solution was wildly successful, but not without a few minor pitfalls. In handling, parts often got mixed up or damaged; in one plant, a small part was inadvertently run over by a truck unbeknownst to the technician measuring it, and the part was machined in its new, concave form. Needless to say, it did not assemble correctly.⁴⁰

Once the problems of converting the plants and developing specifications had been tackled, the next area focused on training the new and original employees. The nucleus of autoworkers, which had dwindled to 5, 379 by October 31, 1942, had auto production skills, but none that could apply to aircraft work. Therefore, new workers would also have to learn from the ground up, along with his or her supervisors. A phased program of training was instituted, with hundreds of men and women receiving early training not only at Grumman, but at the factories that provided the propellers, engines, and instruments.⁴¹

At the Trenton plant, more than 2,500 men and women were trained at the New Jersey State Training School, the Delehanty Institute (in New York City), and other local vocational facilities. Nearly 3,000 went through similar training at the Linden plant. Later in 1942, the training program was climaxed when Eastern Aircraft sent 25 college-educated women to Rutgers University, on General Motors pay, to learn to become junior engineers in a concentrated three-month course. The women formed the first of a number of similar groups to take this training, and at a later date, several other aircraft companies followed suit.⁴²

The rapid expansion, conversion, and staffing-up were undertaken at a break-neck pace. More than 2,000 machines, presses, and tools were ordered less than two months after the formation of Eastern Aircraft. Great difficulty was experienced in finding parts suppliers and subcontractors because every aircraft supplier in the country was already busy. Sources were eventually found for those parts GM decided to purchase rather than make, and the suppliers ranged from alley shops to the country's largest corporations, Woolworth's and Sears Roebuck among them. Some 23 states from coast to coast and Canada were tapped for sources, as were nearly 200 cities, of which 60% were small cities under 50,000 in population. Before the end of 1942, Eastern

³⁹ General Motors and Goad, p. 36-37.

⁴⁰ General Motors and Goad, p. 37.

⁴¹ General Motors and Goad, p. 34.

⁴² General Motors and Goad, p. 34.

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Aircraft had placed orders with more than 3,000 outside firms, which contributed to the making of the more than 10,000 different aircraft parts needed for the Avengers and Wildcats.⁴³

Eastern Aircraft's extensive use of subcontracting enabled the company to get into production faster, while relieving its own stringent manpower and equipment constraints. It was no longer a case of five plants working toward one goal, but a case of hundreds of plants pushing toward the same goal of rapidly making much needed Avengers and Wildcats.

Two initial flights dates had been stipulated by the Navy—October for the Wildcat and November for the TBM torpedo bomber. To meet these production dates, Eastern Aircraft realized that it would first have to proceed with hand fabrication and then develop the necessary tooling program to have standardized parts in the quantities necessary.⁴⁴

A major problem arose, however, in producing the parts. Lacking one uniform set of specifications, assembly jigs had been made using measurements taken from PK parts, or Grumman prints, or GM's corrected prints. The result was that the components produced from these three different sources did not fit because each of Grumman's tailor-made planes was built slightly different from the other.⁴⁵

Complicating this crisis were the numerous engineering and design changes constantly coming through on both planes. The Wildcat, already seeing battlefront experience as part of Great Britain's air force, was receiving many changes, particularly to the number of guns it carried, and that reconfiguration alone produced some 4,000+ engineering orders.⁴⁶

Eastern Aircraft quickly realized there was only one way to solve the problem: they would "loft" both warplanes. At the time, lofting a complete airplane was still an innovation in the aircraft industry. It involved laying out in full scale the external lines of the plane, a practice taken from a somewhat similar procedure in shipbuilding. Once these external lines of the planes were established—in actual and full-size curves—then, following GM's automotive design practice, the exact measurements of every single one of the 10,000 to 15,000 detailed parts could be established.⁴⁷

⁴³ General Motors and Goad, p. 39.

⁴⁴ General Motors and Goad, p. 41.

⁴⁵ General Motors and Goad, p. 42.

⁴⁶ General Motors and Goad, p. 42.

⁴⁷ General Motors and Goad, p. 42.

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Recognizing it would take precious months to loft each plane, Eastern Aircraft continued building the Avenger and Wildcat by hand. From April of 1942 until the end of the year, engineers worked feverishly to produce the two models, and in the process developed a policy at wide variance with automotive practice, which had relied heavily on the "one-machine-one-part" philosophy: by purchasing only general purpose machine tools which were adaptable to many different types of jobs rather than one, they achieved a flexibility in tooling that would allow them to adapt to the numerous design changes that would inevitably result as war progressed.⁴⁸

Not all automotive assembly practices were discarded, however, and in many significant ways they contributed to a faster manufacturing process. In the paint and anodizing departments, for example, techniques had for years been completely mechanized, and the streamlined process was used for the aircraft, as well. Both Linden and Trenton installed elaborate conveyor belts, monorail systems, electric pre-heating and drying systems, as well as dipping tanks to speed production. Other innovations, particularly in final assembly procedures, significantly cut man-hours and resulted in a more reliable aircraft.⁴⁹

In August 1942, Linden tested its first Eastern Aircraft-built Wildcat, and the warplane passed all tests. The debut of Trenton's first Avenger [see fig. #5], on November 11th during an unofficial test-run, was marred by only one not-so-small technicality. The pilot, miles from the newly constructed Trenton airport, switched to a reserve tank of fuel, but no gas flowed. Forced to land on a glide, the aircraft was thoroughly inspected; it was discovered that a valve had been installed exactly 180° wrong. The error was corrected and Trenton's first TBM-1 Avenger bomber passed its initial flying test the next day amid much fanfare.⁵⁰

Eastern Aircraft met its contract with the Navy for 1942, delivering three Avengers before the end of the year. At the time, employment throughout the company had gone up to 22,848 which was twice the total peak peace-time employment of the five plants.⁵¹

Into the war for one year, and desperately needing more airpower, the Navy increased the bomber schedule for both the Wildcat and the Avenger for 1943. As Americans became impatient with a perceived lack of progress, attributed by *Time Magazine* to a "lack of air supremacy,"⁵² the Navy placed greater demands on both Linden and Trenton for increased

⁴⁸ General Motors and Goad, p. 43-44.

⁴⁹ General Motors and Goad, p. 46.

⁵⁰ General Motors and Goad, p. 47.

⁵¹ General Motors and Goad, p. 48.

⁵² Time Magazine, "How Goes the Battle?," December, 1942, as cited in General Motors and Goad, p. 49.

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production. Thirty-one Avengers were built in Trenton during the first three months of 1943, after which production grew in astonishing leaps. TBM deliveries accelerated to a plateau of 100 in July of 1943, outpacing Grumman's production of the Avenger.⁵³

In Trenton, increased production was not as easy as it sounded, however. Set-backs in tooling combined with irregular parts deliveries from the sending plants of Baltimore, Tarrytown, and Bloomfield contributed to uneven production. Superimposed on these difficulties were the changes being constantly made to the airplane. Reports from the combat areas indicated that the Avenger could be much more lethal with the addition of guns to its wings, and much safer for the pilot. As a consequence, Tarrytown—where the wings were made—was forced to radically redesign them, which took time and resulted in a lack of wings at the Trenton assembly plant.

Early during the war, Navy pilots pushed the TBFs to its limits, and often beyond, taking the air speed past the red line of 315 knots to over 425 knots. This proved to be a problem as a number of the bombers had their wings torn off during steep dives. After two crashed off Fort Lauderdale, Florida, the crash remains were tested and it was discovered that the rivet pattern had been changed from the original specifications, causing the wing to lose some of its original strength. Eastern immediately changed the pattern on its production line and the problem never appeared again.⁵⁴

Another early problem involved the use of the standard Navy aerial torpedo, the Mk13. Extremely slow (which made it easily avoided by warships) and unreliable, the Mk13 had to be dropped from a height of under 100' at an air speed of less than 100 knots. This made the Avenger an almost perfect target for anti-aircraft guns aboard enemy ships. Several successful modifications were made to the Mk13, and the resulting Mk13A enabled Avenger pilots to drop the torpedo from heights of 800' at speeds of 280 knots, significantly improving the survivability of the crews.⁵⁵

To meet the ever-increasing demand for more planes, both Trenton and Linden continued to institute new practices that streamlined manufacturing. Better jigs and fixtures were developed, assemblies were continually broken into subassemblies to save time, and all plants instituted a

⁵³ Barrett Tillman, *TBF/TBM Avenger Units of World War 2*, Oxford, Great Britain: Osprey Publishing Co. (1999), p. 9.

⁵⁴ Treadwell, p. 49.

⁵⁵ Treadwell, p. 50.

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“Suggestion Plan,” which offered savings bonds or cash to employees who found new and better ways of accelerating production.⁵⁶ By the end of 1943, almost \$30,000 had been paid out.⁵⁷

In October of 1943, both Linden and Trenton missed their quotas, but with increased determination by employees and management, both plants delivered to the Navy more planes than the schedule called for in December.⁵⁸ Where Trenton had fabricated only 3 TBMs in 1942, by the end of 1943, it had built 1,109.⁵⁹ In December 1943, Grumman ceased production of the Avenger, and the full responsibility of building the torpedo bomber fell to Eastern Aircraft. Throughout 1944, Eastern built an average of nearly ten TBMs per day, and the 1,000th Avenger was delivered to the Navy on December 15, 1943,⁶⁰ with monthly production reaching a record high of 400 in March 1945.⁶¹ For the year 1944, Eastern Aviation tripled its production over the previous year, building 3,481 Avengers; the following year it built 2,953.⁶²

In all, Grumman built a total of 2,293 Avengers, including TBF-1s to TBF-1Cs, and GM's Eastern Aircraft Division built a total of 7,546 TBM-1s, TBM-3s and TBM-3Es, a number which represents over 70% of the total Avenger production. There were twenty-six variations of the TBF and the TBM, ranging from the TBM-3P, a special photographic reconnaissance plane with a trimetrogen camera, to the TBM-1D, -1E, -3C and -3E, which were special radar versions. The TBM-1L and -3L had a searchlight mounted in the bomb bay, the -3N was equipped for night operations, the -3Q for radar countermeasures, and the -3W was another special radar version. Some of these later versions did not appear until after the war.⁶³

It should be noted that GM converted 100% of its production facilities to the war effort. During World War II, GM delivered more than \$12,300,000,000 worth of war material to lead the Allied war effort, including airplane engines, airplanes and parts, trucks, tanks, marine diesels, guns, shells and miscellaneous products. Among those products manufactured for the war effort were the 6X6 army truck (a two-and-a-half ton vehicle that carried both troops and supplies) and the DUKW (nicknamed "the duck"), designed to carry up to 50 men on either land or water.⁶⁴

⁵⁶ General Motors and Goad, p. 55.

⁵⁷ General Motors and Goad, p. 56.

⁵⁸ General Motors and Goad, p. 58.

⁵⁹ Tillman, p. 9.

⁶⁰ *New York Times*, "Navy Accepts 1000th Avenger," December 15, 1943, p. 18.

⁶¹ Tillman, p. 9; Francillon, p. 164.

⁶² Tillman, p. 9.

⁶³ Treadwell, p. 85; Francillon, p. 164.

⁶⁴ General Motors website: http://www.gm.com/company/corp_info/history/gmhis1940.html

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In recognition of its great effort to produce war materials, Eastern Aircraft's Trenton-Ternstedt plant was awarded the Navy "E for Excellence Award" for superior war production on January 2, 1945.⁶⁵ The Bloomfield and Linden plants had received their "E" awards on November 8, 1944.⁶⁶

The first Navy Excellence Award was established by the Navy in 1906 for excellence in gunnery. Later, excellence in engineering and in communications was similarly rewarded. In May 1941, the Navy had decided to extend this award to civilian companies and government plants that met certain criteria in the production of material necessary for the limited emergency declared by President Roosevelt. The first awards were presented sometime in July or August 1941, and were given to individual plants, rather than to entire companies.⁶⁷

The criteria the recommended plant had to meet to receive this award consisted of the following determining factors: 1. excellence in quality and quantity, 2. overcoming production obstacles, 3. low rate of absenteeism, 4. avoidance of work stoppages, 5. maintenance of fair labor standards, 6. training of additional labor forces, 7. effective management, 8. record on accidents, health, sanitation and plant protection, 9. utilization of sub-contracting facilities, 10. cooperation between management and labor as it affected production, and 11. conservation of critical and strategic materials.⁶⁸

The Avenger's Role in World War II

As previously mentioned, the first TBFs were delivered to the Navy in January 1942, just three weeks after coming off Grumman's production line. Torpedo Squadron 8 at Norfolk, Virginia, took delivery of the first fleet of Avengers in April 1942. By the end of May, the Navy had 84 TBF-1s, including 32 assigned to San Diego and 21 assigned to Hawaii.⁶⁹ Despite a less than spectacular performance in the Battle of Midway on June 4, 1942, the Avenger distinguished

⁶⁵ Eastern Aircraft "E" Award Ceremony program, 2-2-1945.

⁶⁶ Eastern Aircraft "E" Award Ceremony program, 12-13-1944.

⁶⁷ <http://pweb.jps.net/~edusmc/>; the author of the website, Ed Sims (edusmc@jps.net) cites Circular No. 228, 1942 Army-Navy Production Award, and Memorandum, *Recruit Training Command U.S. Naval Training Center, Great Lakes, IL* by Lt. (jg) J.J. Matthews dated June 1944, as his sources for this information. According to an e-mail from Sims to this researcher, Matthews worked in the Bureau of Ordnance and the memorandum was his recollection of the sequence of events that created the Army-Navy Production Award.

⁶⁸ Ibid.

⁶⁹ Tillman, p. 9.

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itself as a capable dive bomber, and its similarity to the Grumman Wildcat often confused the enemy. As Japan's leading fighter ace, Saburo Sakai, noted:

I was in a trap! The enemy planes were not fighters, but bombers, the new Avenger torpedo planes, types I had never seen before. From their rear they looked exactly like Wildcats, but now their extra size was visible, as were the top turret with its single gun and the belly turret with another .50 caliber gun.⁷⁰

The Avenger next saw active duty in the Guadalcanal campaign, which officially lasted from August 1942 until February 1943. During this campaign, as in others, Avengers were used by both the US Navy and the Marines. This protracted operation involved Avengers in combat both afloat and ashore as they participated in the Battle of the Eastern Solomons, successfully sinking the Japanese light carrier *Ryujo* on August 24, 1942, but suffering losses in October 1942 at the Battle of Santa Cruz, which went badly for the US Navy as it lost two important aircraft carriers during the conflict. The climax of the Guadalcanal campaign came on November 13, 1942, when three Avenger squadrons flew 26 sorties and sunk the *Hiei*, the first enemy battleship to be sunk by US torpedo bombers. One day later, three Grumman-built Avengers helped to sink the 9000-ton *Kinugasa*.⁷¹

By March 1943, the first American anti-submarine hunter/killer unit became fully operational, and was charged with patrolling the 500- to 1,200- mile stretch along the North Atlantic convoy routes. In this area, German U-boats (submarines, from the German "unterseeboot") preyed off Allied convoys without fear of an air attack, because the area had previously been beyond the capabilities of long-range patrol aircraft based in Newfoundland, Iceland, and the British Isles. The Avenger's range, endurance, and payload made it ideally suited to search and strike roles in anti-submarine activities, and the bomber was quickly pressed into service.⁷²

In the North Atlantic, Avengers destroyed, or shared in the destruction of thirty U-boats, one Japanese sub, and a Vichy French submarine.⁷³ Because of Avenger patrols, Allied shipping losses were trimmed significantly: in the last quarter of 1943, only 89 ships or less than 500,000 tons were lost, compared to a rate the year previous, which saw nearly that many lost in one month.⁷⁴

⁷⁰ Martin Caidin, *Samurai!* (Ballantine Books, January 2001), as quoted in Treadwell, p. 83.

⁷¹ Tillman, p. 15-24.

⁷² Tillman, p. 65-66.

⁷³ Francillon, p. 180.

⁷⁴ Tillman, p. 65-69.

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Avengers operating in the Atlantic normally carried four depth charges and made low angle approaches toward the target. In mid-1943, air groups began combining the F4F Hellcat and the Avenger into hunter/killer teams with great success. The Wildcat would force the enemy submarine to dive, then the Avenger would drop a "Fido," a newly-developed homing torpedo that would either sink or severely damage the submarine. By 1944, Nazi submarines began surfacing only at night to refuel, thinking they were safe from attack. The Americans, however, began outfitting Avengers as night flying planes, removing their bombs and turret guns and replacing them with additional fuel tanks that enabled them to fly up to fourteen hours straight. Despite initial problems in learning how to take off and land from a short flight deck in the dark, night operations eventually became standard on all Atlantic-based anti-submarine carriers.⁷⁵

With Eastern Aircraft's increased production of Avengers, more and more TBMs arrived in fleet units from late 1943 on. By this time, the Avenger's operational versatility had been recognized and exploited, particularly for nighttime sorties when its radar equipment was used to guide conventional Hellcats into night intercepts of enemy aircraft. In November of 1943 during operations in the Gilbert Islands, an Avenger led a team of Hellcats in the gathering dark as they attacked several Japanese G4M "Bettys;" the attack was successful and proved the concept of carrier-based night fights.⁷⁶

Two of the greatest naval battles of World War II were fought in 1944 in the wide expanse of the Western Pacific called the Philippine Sea. They occurred four months apart and involved hundreds of war ships and thousands of aircraft, many Avengers among them.⁷⁷

The First Battle of the Philippine Sea—known in aviation circles as the "Great Marianas Turkey Shoot"—was sparked by the American invasion of Saipan in 1944. Fearful of losing Saipan's valuable position, the Japanese Imperial Navy dispatched nine carriers and numerous escorts to reclaim the position in June 1944. Poised to defend the American position were fifteen flattops loaded with 900 aircraft, including 194 Avengers. During the first few days of the campaign, these Avengers participated in routine bombing, ground support, anti-submarine patrols, and reconnaissance. On June 20th, an Avenger crew spotted the Japanese fleet and commenced one of the fiercest battles in the Pacific. Almost 220 American aircraft took part in the battle, 57 of which were Avengers, and they successfully sank one Japanese aircraft carrier (the *Hiyo*) and a

⁷⁵ Jackson and Doll, p. 45-48.

⁷⁶ Tillman, p. 25.

⁷⁷ Tillman, p. 27

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number of other Japanese cruisers and destroyers, and seriously damaged the 64,000 ton battleship *Musashi*.⁷⁸

The Second Battle of the Philippine Sea, better known as the Battle of Leyte Gulf, is considered an epic naval-air clash. Of the 34 US squadrons participating, 27 were equipped wholly with TBMs, largely the result of General Motors/Eastern Aircrafts' increased production.⁷⁹ Of these, 236 Avengers were embarked aboard the fast carriers of Task Force 38, and 199 Avengers were aboard the fast carriers of Task Group 77.⁸⁰

The three-day battle began on October 24, 1944 as Japan sent five battleships, thirteen cruisers, and fifteen destroyers to defend American landings on the east coast of Leyte, one of the Philippine Islands. An American strike force consisting of 24 dive bombers, 12 fighter escorts, and 10 TBMs with ring-tail torpedoes, first sighted the Japanese fleet. By the end of the battle, six US air groups, assisted by Avengers, managed to sink the *Musashi*, four carriers, and 26 other warships, and heavily-damaged the heavy cruiser *Myoko*.⁸¹

Undaunted by the losses, the Japanese continued to head to Leyte. In four major air strikes on the following day—October 25th—Avenger squadrons helped to destroy the remaining Japanese ships, sinking four carriers and a destroyer. During the two-day battle, more than 50 Avengers were lost, either shot down, crashed, or sunk with their ships.⁸²

In 1945, US Navy Avengers continued to take part in pre-invasion strikes and provided air support during amphibious operations at Iwo Jima and Okinawa. They hunted Japanese ships, flew their first mission against the Japanese mainland on February 19th, and began their first radio countermeasure sorties during the night of February 16th.⁸³

On April 7, 1945, the Japanese Navy launched its last seaborne offensive of the war, sending the huge battleship *Yamamoto*, escorted by a light cruiser and a squadron of destroyers, to Okinawa where the fleet expected to inflict substantial damage to the US invasion fleet. Once spotted by the Americans, however, the Japanese fleet was doomed; with Avengers contributing heavily to the torpedo bombings, a total of 19 torpedo hits managed to sink the *Yamamoto*, and all but three Japanese destroyers were hit and sunk. A total of three Avengers were lost during the battle, and

⁷⁸ Treadwell, p. 103-105; Tillman, 28-35; Francillon, p. 178.

⁷⁹ Tillman, p. 36.

⁸⁰ Francillon, p. 178.

⁸¹ Tillman, p. 38-41.

⁸² Tillman, p. 42; Jackson and Doll, p. 39.

⁸³ Francillon, p. 178.

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five more had to be jettisoned because of extensive damage.⁸⁴ This date marked the Avengers' last major success of World War II.

As the Pacific war came closer to the Japanese home islands, the intensity of air-sea combat increased in tempo and ferocity. For Avenger squadrons, now equipped almost entirely with TBMs, overland strikes and anti-submarine patrols kept them fully occupied. Attrition remained high, with 100 or more Avengers lost or stricken each month. With the Japanese fleet lying in home ports, the need for torpedoes diminished, and as a consequence, most Avenger missions in the final weeks of the war were flown with bombs or mines. During the last two weeks of hostilities, Avengers were active over both Japanese soil and in adjoining waters, and more than fifty were lost at this time.⁸⁵

In addition to serving as part of the US Naval air fleet, Avengers were also used with great success by the US Marine Corps during World War II. The first of 23 marine Torpedo Bomber Squadrons to be equipped with Avengers took place in September 1942. With the Marine Corps, Avengers were primarily used against land targets with bombs and rockets or on anti-submarine patrols with depth charges and rockets. Major operations included the landing at Torokina, Bougainville in November 1943, the Rabaul offensive in early 1944, the battle of the Marianas in July 1944, and the Peleliu landing on September 1944. During the battle for Okinawa, the last major amphibious operation of the war conducted in March 1945, Avengers flew both air support sorties and anti-submarine patrols for Marine squadrons.⁸⁶

Throughout the war, the Avenger was also a leading player in the arsenal of aircraft used by the Allied forces. Britain received almost 1,000 Avengers—402 TBF-1Bs, 334 TBM-1Cs and 222 TBM-3s. Seventeen British squadrons flew Avengers during the war, with twenty other providing training or logistics support at home and abroad. Additionally, two Royal New Zealand Air Force squadrons flew Avengers in the Southwest Pacific. The British used the Avengers to hunt and sink U-boats, and to fly numerous missions against the German forces, significantly offering support for the D-Day landings by Royal Navy squadrons based in southeastern England. Avengers were also used in more than 30 attacks against facilities and shipping in Norway, where German battleships often moored, and successfully launched a bombing raid against the Sumatran oil fields in 1945, cutting the production of aviation fuel by 2/3 at a time when Japan could least afford it.⁸⁷

⁸⁴ Tillman, p. 48.

⁸⁵ Tillman, p. 61.

⁸⁶ Francillon, p. 181-183.

⁸⁷ Tillman, p. 80.

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As a torpedo bomber, the Avenger had come to be respected as a rugged, trustworthy warplane capable of flying in adverse conditions and even when heavily damaged. One British Royal Navy pilot commented:

JZ300 [the Avenger's designation] got her tail singed in a glide bombing attack on enemy shipping in St. Male, France. From 12,000 feet, six Avengers went in at 45 degrees to release their load from 1,000 feet. JZ300 was caught under the tail by shore ack-ack and went on her nose, heading for the water. The pilot, hit in the back, phoned, "stand by to ditch." The observer did not answer. He was dead. Somehow the plane, half the tail gone, cockpit shattered, aerals blown off, managed to right herself. Five miles from the coast, in filthy weather, ceiling 200 feet, visibility 1½ miles, the pilot put down the flaps at 120 knots, but there was no feeling in the stick. He still didn't realize he was flying with only half a tail. They crept in around the coast at 150 feet until at last they saw the base. The plane wouldn't drop properly so they floated three quarters of the way down the runway in the darkness. Only when they climbed out did they begin to wonder how they ever got back; port tail and elevator missing, hole of about 5 inches in the remainder of the tail plane, cockpit enclosure shattered, pilot's headrest hit, bulkhead behind the pilot's cockpit shattered by 36 holes.⁸⁸

By war's end, the Avenger had become one of the three most numerous carrier aircraft of all time. With 2,293 TBFs and 7,546 TBMs, the total production of 9,839 Avengers was exceeded only by 12,570 Corsairs (a naval attack fighter) and 12,275 Hellcats (another fighter used for anti-submarine work, to provide air cover for invasion forces, and to provide close air support for ground troops).⁸⁹ The Avenger had participated in every major air-sea battle of World War II between June 1942 and August 1945, had played a significant role in search-and-destroy missions hunting German submarines, and had proven its worth in both night and daytime assignments.

During 38 months of active duty, Avenger squadrons were found in the sweltering heat of the Solomons as well as the frigid arctic temperatures of the Scandinavian coast. Aviators of four services flew them in combat, including the United States Navy and Marine Corps, the Royal Navy of Great Britain, and the Royal New Zealand Air Force. Avengers employed weapons as diverse as bombs, torpedoes, rockets, and mines to sink Japanese battleships and carriers,

⁸⁸ Jackson and Doll, p. 55-56.

⁸⁹ Tillman, p. 81.

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German submarines, and Axis-controlled Norwegian freighters.⁹⁰ As a warplane, the Avenger had earned a well-deserved reputation for being rugged, dependable, and versatile.

By January 1946, six models of the Grumman TBF Avenger had been built, as had twenty models of Eastern Aircraft's TBM Avenger. Grumman's Avenger models were: XTBF-1, XTBF-2, XTBF-3, TBF-1, TBF-1C and TBF-1D. Eastern Aircraft, which built them until the end of the war in 1945, produced: XTBM-3, XTBM-4 (revised wing folding system and strengthened center section, only three built), TBM-1, TBM-1C (added wing mounted .50 caliber machine guns), TBM-1CP (photographic version), TBM-1D (radar), TBM-1E (improved radar), TBM-3 (first Avenger built by Eastern Aircraft and modeled after Grumman's XTBF-3), TBM-3C (radar), TBM-3D (improved radar), TBM-3E (radar), TBM-1L and -3L (searchlight mounted in the bomb bay), TBM-3N (night version), TBM-3P (photographic version for use in high altitudes), TBM-3Q (radar countermeasures), TBM-3S, TBM-3W (radar search version, turret removed and an additional crew member installed), TBM-4 and the TRM-3 (VIP transport).⁹¹

Of the 7,546 Avengers built by General Motors Eastern Aircraft, 4,664 of them (62%) were of the TBM-3 series.⁹²

The Avenger and "Rosie the Riveter"

During the first six months following America's entry into the war, huge numbers of men were drafted into or enlisted in the armed forces. As these men entered the service, their jobs were filled by men who were exempt from military service for a variety of reasons. Concurrent with the increased demand for men in the military was the large number of new jobs created as American industry geared up to supply the armed forces with armaments, airplanes, and other military materials needed to fight the war. As a result, employers began actively recruiting women workers to meet the increased demand, and both the US government and industry started wooing American women to work in the war effort on the home front.

By January of 1942, the Women's Bureau of the US Department of Labor estimated that at least 30,000 women were employed in shell-loading, small-arms ammunition, and fuse plants.⁹³ During the war, the number of women workers in the United States (in all occupations) grew

⁹⁰ Tillman, p. 81.

⁹¹ Treadwell, p. 159-160

⁹² Jackson and Doll, p. 65.

⁹³ *Newsweek*. January 5, 1942, p. 36.

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from 14 million to 19 million, and by war's end, women made up about 35 percent of the civilian labor force.⁹⁴

As a symbol representing women in the workplace during the war, the character of "Rosie the Riveter" was first introduced to the American public in February 1943 through a song of that title written by Redd Evans and John Jacob Loeb in 1942. According to Loeb's widow, Janet, the title was not based on a real person, but was chosen because of its alliteration.⁹⁵

Originally sung by the "Four Vagabonds," a group of male singers, the song began with these lyrics:

*While other girls attend a favorite cocktail bar,
Sipping dry martinis, munching caviar;
There's a girl who's really putting them to shame—
Rosie is her name.*

*All the day long, whether rain or shine,
She's part of the assembly line,
She's making history working for victory,
Rosie, Rosie, Rosie, Rosie, Rosie, Rosie the riveter.*⁹⁶

The song was featured in two movies: *Follow the Band* (1943) and *Rosie the Riveter* (1944). As a symbolic character, Rosie the Riveter became nationally known when illustrator Norman Rockwell's (1894-1978) image of a woman war worker appeared on the cover of the *Saturday Evening Post* on May 29, 1943. The woman was portrayed with a muscular body and a cute face; her rivet gun rested across her lap, as did her lunchbox with the name "Rosie" painted on it. Symbolically, her feet were resting on a copy of Hitler's Mein Kampf.⁹⁷ [see fig. 3]

Less than ten days after Rockwell's cover appeared, Rose Bonavita and Jennie Fiorito drove a record 3,345 rivets into the wing of an Avenger while working the midnight to 6 a.m. shift at Eastern Aircraft's plant in Tarrytown, NY. The Tarrytown plant had been cited six months

⁹⁴ <http://memory.loc.gov/ammem/ndlpedu/features/timeline/depwwii/wwarii/defense.html>; *Fortune*, "The Margin Now is Womanpower," February 1943, p. 99-102

⁹⁵ Penny Colman, Rosie the Riveter: Women Working on the Home Front in World War II, New York: Crown Publishers, 1995, p. 15.

⁹⁶ Colman, p. 15-16.

⁹⁷ Colman, p. 15.

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earlier as estimating that 70% of its workers would be women.⁹⁸ The paper in Bonavita's hometown, Peekskill, New York, dubbed her "Peekskill's Rosie," while other writers quickly (and erroneously) claimed that Rosie the Riveter had been based on her. Nevertheless, the American public was eager to have a real hero to embrace and was apparently happy to ignore the fact that the song had been released five months before Bonavita set the record.⁹⁹

The Avenger and Former President George H. W. Bush

The most famous American to fly an Avenger was George H. W. Bush (1924 -), later 41st president of the United States. He joined the Navy in 1942 and became the youngest naval aviator ever, at the age of 20, in June 1943. Flying Avengers with VT-51 off the *USS San Jacinto*, he was shot down over Chichi Jima on September 2, 1944. Although Bush parachuted safely and was rescued, neither of his crewmen survived, and Bush later received a Distinguished Flying Cross for delivering his bomb load while his Avenger was under attack.¹⁰⁰ A restored Avenger is now on display at Bush's Presidential Library in College Station, Texas.

New Roles for the Avenger after World War II

With the coming of peace in 1945, the US Navy began demobilizing its men and aircraft. Many of the latest aircraft in its inventory, some of which had never fired a shot during wartime, were mothballed and shipped out to a holding area in Arizona, while others were routed to scrap yards. [see fig. 10] To be prepared for any future conflicts, the US Navy established a Naval Air Reserve Training Command in July 1946 and TBM-3Es were included in many of the Command's torpedo squadrons. These Avengers were not used by the Americans in the Korean War of 1950, however, because newer aircraft (specifically jet fighters) were available. They continued to be used for Reserve training purposes, however, until 1956.¹⁰¹

In Great Britain, the Avenger squadrons were disbanded after the war, but reappeared in 1950 when they were used during the Korean War. These aircraft were under the Mutual Defense Assistance Program, and were the TBM-3E and -3C types. A number of other countries were

⁹⁸ *New York Times*, August 22, 1942, p. 17.

⁹⁹ Colman, p. 21.

¹⁰⁰ Timothy J. Christman, *Naval Aviation News*, Vol. 67 (March-April 1985), p. 12-15; Joe Mizrahi, "Winged Avenger," *Wings*, Vol. 22, No. 3 (June 1992), p. 47.

¹⁰¹ Jackson and Doll, p. 49-54.

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supplied with the TBM Avenger, including Canada in 1949, the Netherlands in 1953, Japan in 1955, and the French in the early 1950s.¹⁰²

After being retired by the US Navy in the 1950s, many remaining Avengers were sold for scrap. [see fig. #10] Several enterprising businessmen in the United States and Canada, however, had developed new uses for the Avenger—crop dusting, forest spraying, aerial firefighting, and re-seeding burned out forests—and began to purchase them as war surplus material from both the United States and Canadian governments.¹⁰³ The United States Forestry Service also acquired eight Avengers for use as firefighting water bombers.¹⁰⁴

For their new use, the Avengers were modified: typically, the bomb bay doors and gunner's turret were removed, and 600 gallon tanks were installed in the bomb bay. Maintenance of the aging Avengers proved to be formidable, as parts became increasingly harder to come by. In British Columbia, one private aerial firefighting company (Art Seller's Skyways) purchased the entire Canadian Royal Navy inventory of Avengers and at one time had 80 Avengers as part of his fleet.¹⁰⁵ By 1969, nearly half (66) of all firefighting tanks in the western United States and British Columbia were Avengers.¹⁰⁶

The History of the TBM-3E Avenger Being Nominated

In 2001, Naval Air Station Wildwood Aviation Museum (NASW) acquired a TBM-3E Avenger (serial # 86180) from Canadian Aerial Firefighting where it was known as Tanker #12 registered as CF-Mud.

#86180 was manufactured at the General Motors Trenton-Ternstedt Plant, which was located at the site of the current Trenton-Mercer Airport. The plane was accepted by the US Navy on 4-6-1945, and was delivered in May of 1945 to VT-26 (a torpedo squadron) based at San Diego, California.¹⁰⁷ VT-26 had been assigned to the jeep carrier *USS Santee* and saw action during the battle of Leyte Gulf in 1944. At the time of #86180's delivery, the squadron was refitting at San

¹⁰² Treadwell, p. 136-137; Jackson and Doll, p. 55-58.

¹⁰³ Jackson and Doll, p. 59.

¹⁰⁴ Treadwell, p. 137; Francillon, p. 189-190.

¹⁰⁵ Jackson and Doll, p. 60; Treadwell, p. 137.

¹⁰⁶ Jackson and Doll, p. 60.

¹⁰⁷ Aircraft History Card, Serial N. 86180.

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Diego. One month later, in June, #86180 was transferred to VT-18, which was also based at San Diego. This Avenger remained with VT-18 for the rest of its World War II military career.¹⁰⁸

Earlier, VT-18 had been on board the *USS Intrepid* during the period August 16, 1944 to December 1944. The squadron participated in the battle of Leyte Gulf on October 24th of that year, when its planes (TBMs among them) flew sorties against powerful Japanese surface forces in the Sibuyan Sea. They contributed to the sinking of the *Musashi*, one of the two largest battleships in the world at the time. They participated in the Battle of Cape Engano and the Battle off Samar, both in October 1944. During this period, VT-18 lost 23 aircraft due to enemy action. *Intrepid* was torpedoed once and hit by suicide Kamikaze aircraft four separate times. Each event caused the *Intrepid* to be withdrawn for repair. The last "hit" was so severe that it had to be pulled back to the West Coast for repairs at San Diego. It was at this time that VT-18 left *Intrepid* for a temporary shore assignment while the squadron conducted training in preparation for combat deployment.¹⁰⁹

After leaving the *Intrepid*, VT-18 spent the remaining few months of the war based at NAS San Diego and also NAS Astoria (Oregon). It was during this time that #86180 joined VT-18 while the squadron was re-equipping. After the end of hostilities, on November 14, 1945, VT-18 was assigned to NAS Quonset Point (Rhode Island) where it was re-designated VA-8. It was embarked on the *USS Leyte* from September to December 1946 while the *Leyte* was on a goodwill cruise to South America for the inauguration of Chile's president.¹¹⁰

Upon return, # 86180 was transferred to VA-5 based at NAS Norfolk (Virginia), where it was used in anti-sub operations and training, flying off the *USS Bennington*. It finished its US Navy career at NAS Jacksonville (Florida).¹¹¹ In 1950, #86180 was transferred to the Canadian Armed Forces where it continued in the same anti-submarine role, flying from the aircraft carrier *HMCS Magnificent* as an AS-3.¹¹²

In 1960, the bomber was decommissioned, and the rest of its active career was spent as a Canadian aerial tanker for firefighting and agricultural spraying. It was known as Tanker 12, registration CF-MUD. In June 1971, it crash-landed in Lake Nigault (Quebec, Canada) while

¹⁰⁸ Letter, Dan Hagedorn, Archives Reference Team Leader, Smithsonian National Air and Space Museum, to Mr. Walt Adams, Middlesex, NJ, 6-5-2001; Individual Aircraft History Card, Serial #86180.

¹⁰⁹ Jackson and Doll, p. 79; Torpedo Squadron Eighteen VT-18, history as found at <http://users.twave.nte/intrepid/torpsquad.htm>

¹¹⁰ Torpedo Squadron Eighteen VT-18, history as found at <http://users.twave.nte/intrepid/torpsquad.htm>

¹¹¹ Letter, Hagedorn to Adams; Individual Aircraft History Card.

¹¹² Royal Canadian Navy Aircraft Record Card

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spraying, and was repaired and placed back into service. In 1977, it was bought by Forest Protection, Ltd. of New Brunswick, Canada where it operated as Tanker 12 and continued in its role of firefighting and agricultural spraying.¹¹³ It was withdrawn from use during 1994-1995 and lay idle until its acquisition by NASW in 2001.¹¹⁴ [see fig. 1 and fig. 2]

Restoration Plans for this Avenger

An anonymous private donation of \$66,000 allowed NASW Aviation Museum to purchase the TBM-3E. Shortly afterwards, the Museum received a \$60,000 New Jersey special legislative grant to restore its Avenger. Restoration, currently underway, includes removal of the aircraft's firefighting apparatus, engine inspection, and airframe restoration and repainting. A full-time museum employee and a team of five volunteers are coordinating the acquisition of equipment and materials, and distributing the workload. To date, the firefighting equipment has been removed and various components, including a machine gun turret, have been ordered. The gun turret is being rebuilt from original parts, and replacement bomb bay doors (received and currently awaiting installation) were reconstructed from new parts according to original specifications. An original radio, still in working condition, has also been recently acquired. Completion of the entire project is estimated to take at least another year at a total cost of \$200,000.

After restoration, the TBM-3E will be part of a museum exhibit at NASW Aviation Museum, memorializing the 38 Navy airmen who perished while training at NAS Wildwood during World War II. Avengers were an integral part of the air fleet at NASW during WWII [see fig. 9 and fig. 14], and were also used at the other New Jersey Naval Air Stations at Lakehurst, Cape May, and Atlantic City. Eventually, the TBM-3E will be completely flyable, participating in fly-bys and other aviation demonstrations while operating from its permanent base at NASW Aviation Museum.

The NASW Aviation Museum is located in Hangar #1, which was formerly part of the Naval Air Station Wildwood during World War II and is currently part of Cape May Airport. The Hangar is listed in the State and National Registers of Historic Places.

¹¹³ Canadian Civil Aircraft Register, as found at <http://www.tc.gc.ca/aviation/activepages/ccarcs>

¹¹⁴ Electronic mail correspondence, Pat Barnhouse, Defence R&D Canada, National Defense Headquarters, Ontario, CA (oilman930@yahoo.com) to Michael Stevens, NASW volunteer, 8-27-2001.

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Geographical Data

Verbal Boundary Description

The boundary is comprised of the TBM-3E Avenger torpedo bomber that is 40' 4 23/32" long, 16' 5" high, and 54'2" wide (with wings open). It is located in Hangar #1, which is the headquarters of the Naval Air Station Wildwood Aviation Museum at the Cape May Airport, 500 Forrestal Road, Rio Grande (Middle Township), Cape May County, New Jersey.

Verbal Boundary Justification

N/A

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**National Register of Historic Places
photographs**

**TBM-3E Avenger Torpedo Bomber/Naval Air Station Wildwood Aviation Museum
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Typical Information for All Photographs

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| 1. Name of Structure | TBM-3E Torpedo Bomber |
| 2. County and State | Cape May County, New Jersey |
| 3. Photographer | Joan Berkey |
| 4. Date of Photograph | Spring 2002 |
| 5. Location of Negatives | Joan Berkey
1003 Bartlett Avenue
Linwood, NJ 08221 |

Photo # and Description of View

1. Interior view of NAS Wildwood Aviation Museum Hangar #1 at the Cape May Airport; the TBM-3E is seen to the center left
2. Front and port side of the aircraft
3. Starboard side of the aircraft
4. Aft view of the aircraft; looking forward
5. View of the cockpit; looking forward
6. View of the location of the gunner's turret in the aft of the aircraft; looking toward the rear
7. View of the bomb bay; looking aft
8. View of the TBM-3E's wings which have been removed during restoration (note that the flight controlling components have been removed from the wings and are being recovered with new fabric)

United States Department of the Interior
National Park Service

**National Register of Historic Places
photographs**

**TBM-3E Avenger Torpedo Bomber/Naval Air Station Wildwood Aviation Museum
Cape May County, NJ**

Typical Information for All Photographs

1. Name of Structure	TBM-3E Torpedo Bomber
2. County and State	Cape May County, New Jersey
3. Photographer	Joan Berkey
4. Date of Photograph	Spring 2002
5. Location of Negatives	Joan Berkey 1003 Bartlett Avenue Linwood, NJ 08221

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United States Department of the Interior
National Park Service

**National Register of Historic Places
photographs**

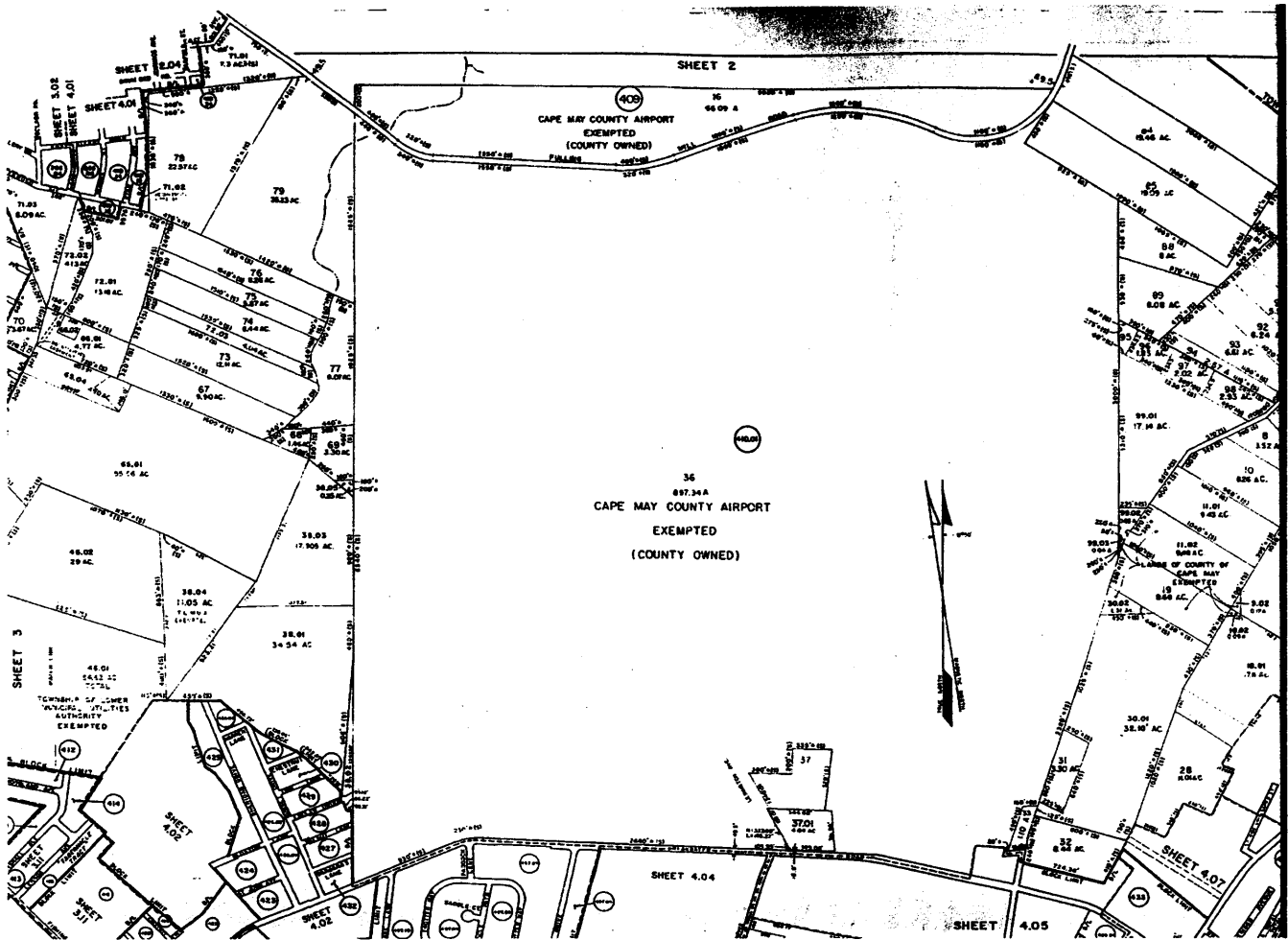
**TBM-3E Avenger Torpedo Bomber/Naval Air Station Wildwood Aviation Museum
Cape May County, NJ**

Typical Information for All Photographs

1. Name of Structure	TBM-3E Torpedo Bomber
2. County and State	Cape May County, New Jersey
3. Photographer	Joan Berkey
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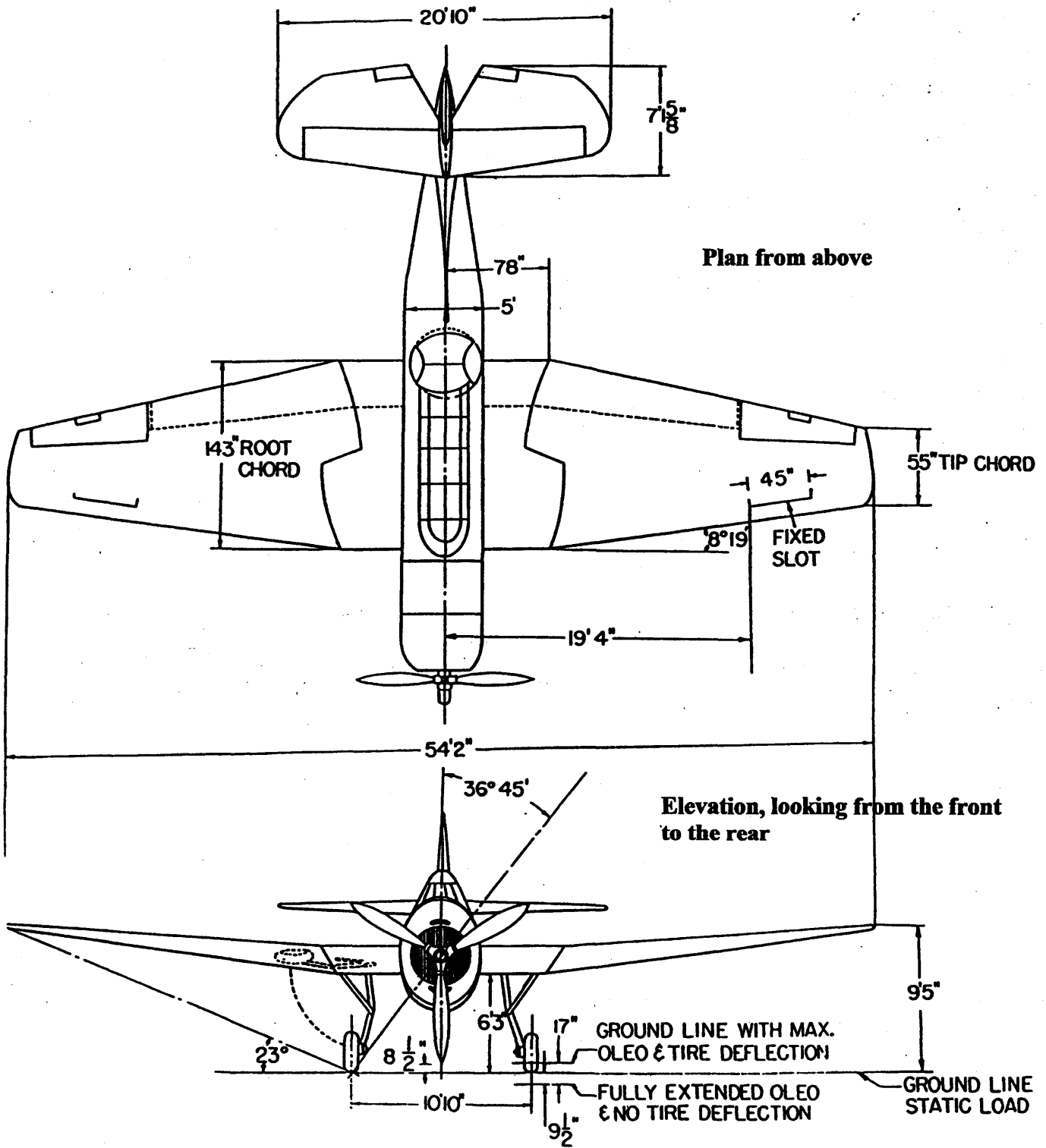
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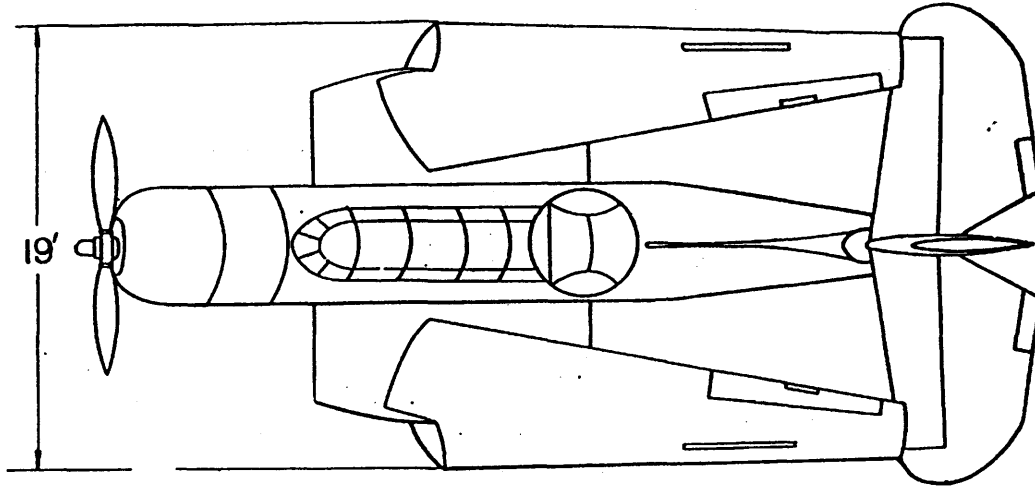
Tax Map, Lower Township, Cape May County, NJ

Showing location of Block 410.01, Lot 36
Cape May County Airport

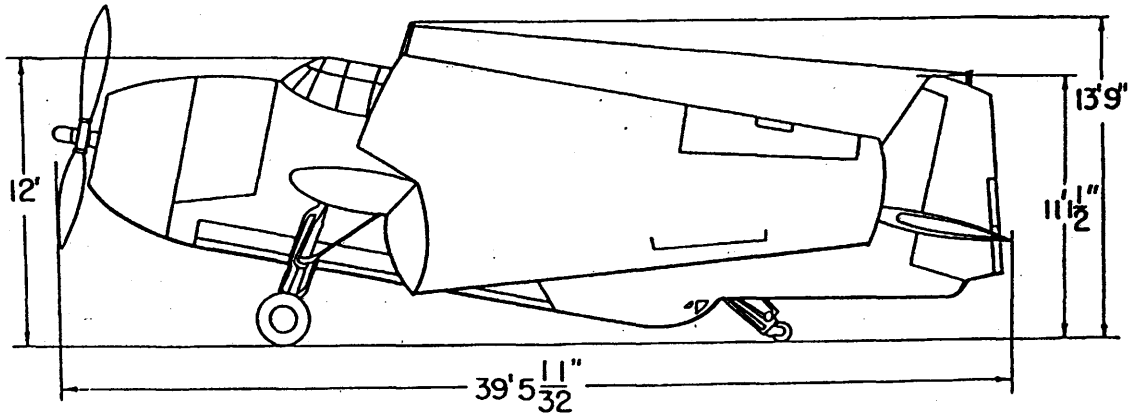
AN 01-190EB-2



AN 01-190EB-2

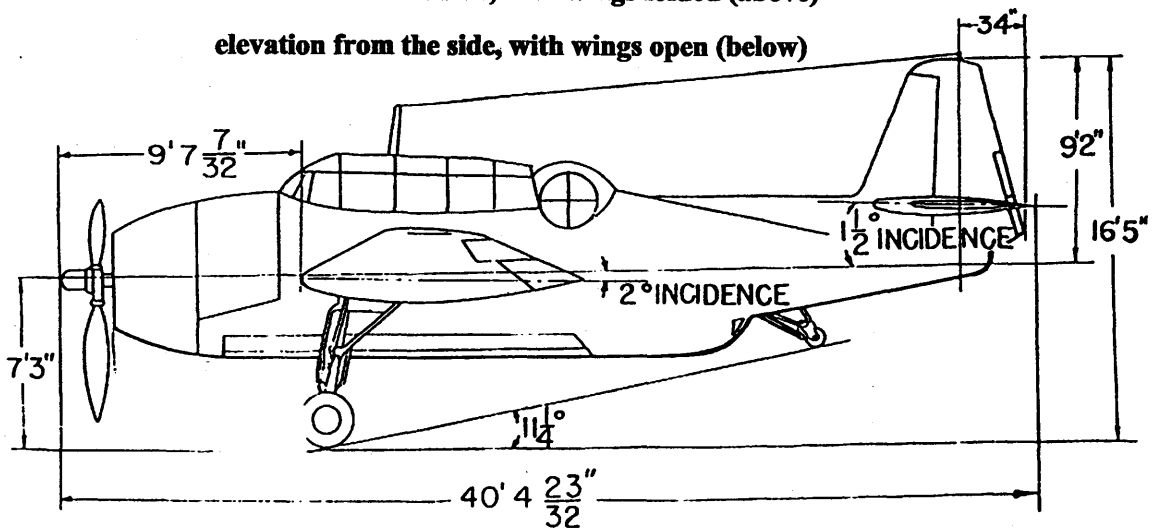


plan from above

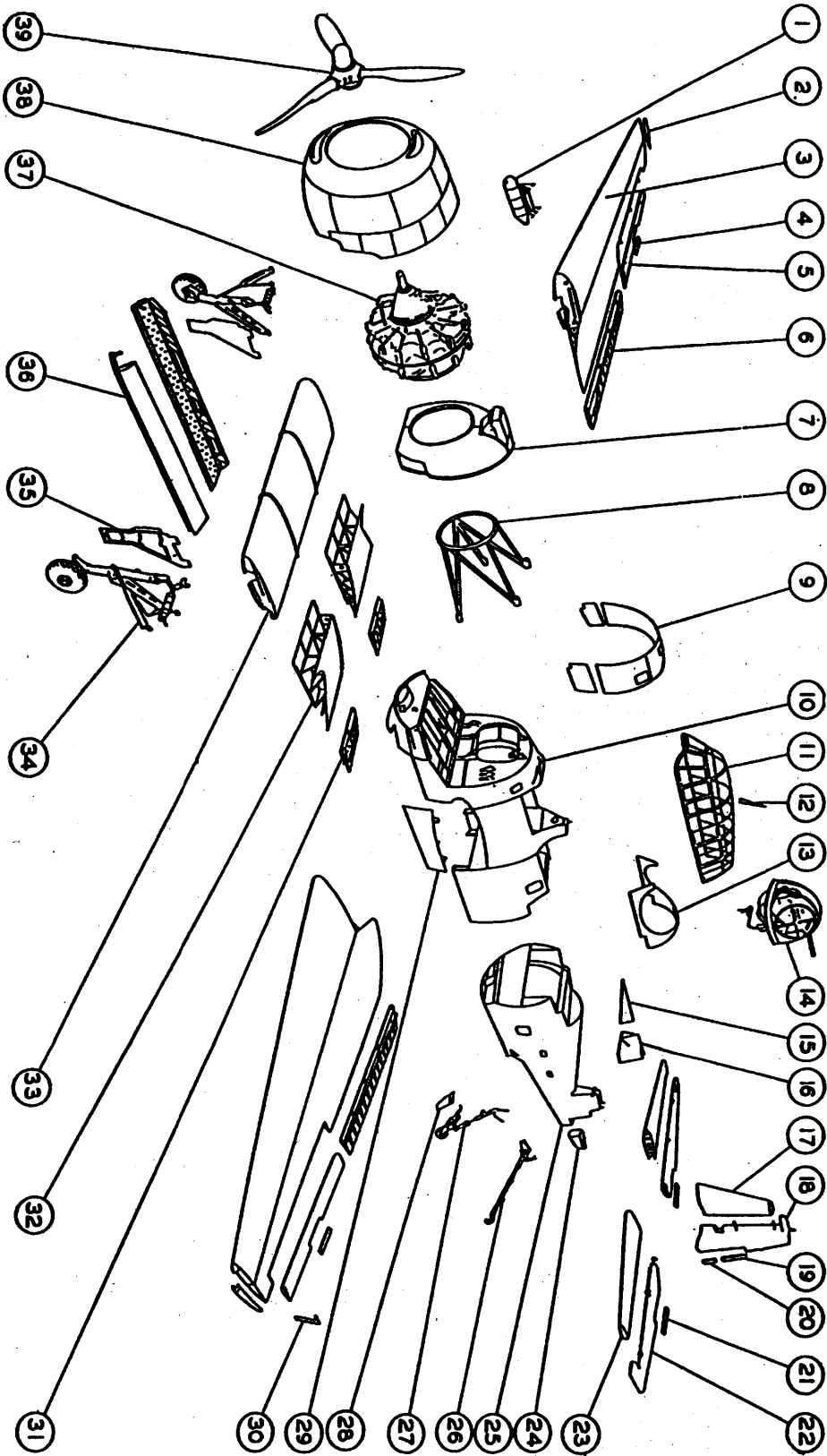


elevation from the side, with wings folded (above)

elevation from the side, with wings open (below)



Plan and Elevations for the TBM Avenger

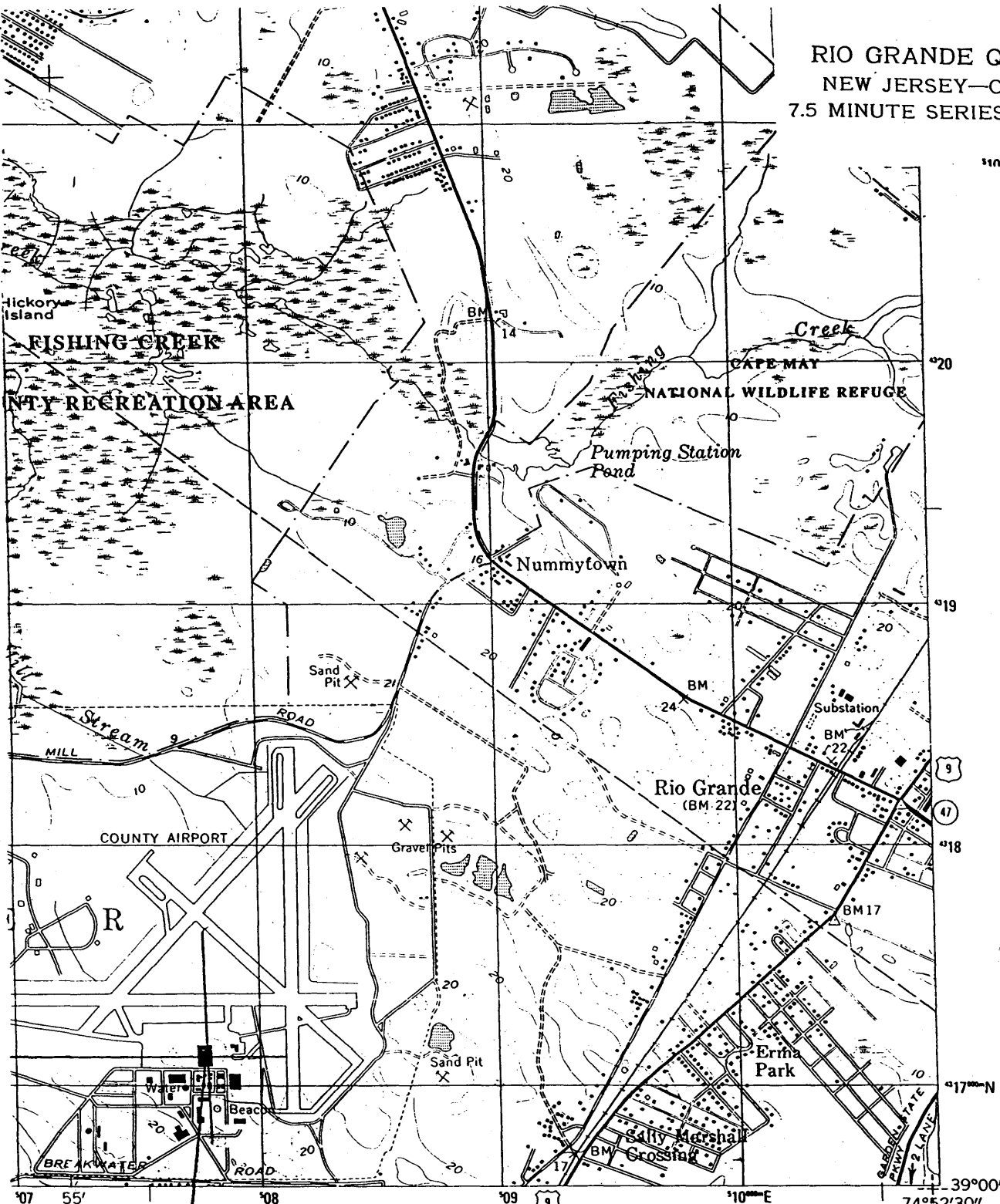


AN 01-190EB-2

Exploded View of the Avenger

RIO GRANDE QUADRANGLE
 NEW JERSEY—CAPE MAY CO.
 7.5 MINUTE SERIES (TOPOGRAPHIC)

1:250,000 74°55'



INTERIOR—GEOLOGICAL SURVEY, RESTON, VIRGINIA—2000

ROAD CLASSIFICATION

- | | |
|------------------------------------|--|
| Primary highway,
hard surface | Light-duty road, hard or
improved surface |
| Secondary highway,
hard surface | Unimproved road |
| ○ Interstate Route | ○ U. S. Route |
| | ○ State Route |

RIO GRANDE, N. J. -

1 MILE

*TBM-3E Average
 Torpedo Bomber
 NASW Aviation Museum
 Rio Grande, Cape May Co., NJ*

QUADRANGLE LOCATION

Zone 18

1994

Easting

Northing

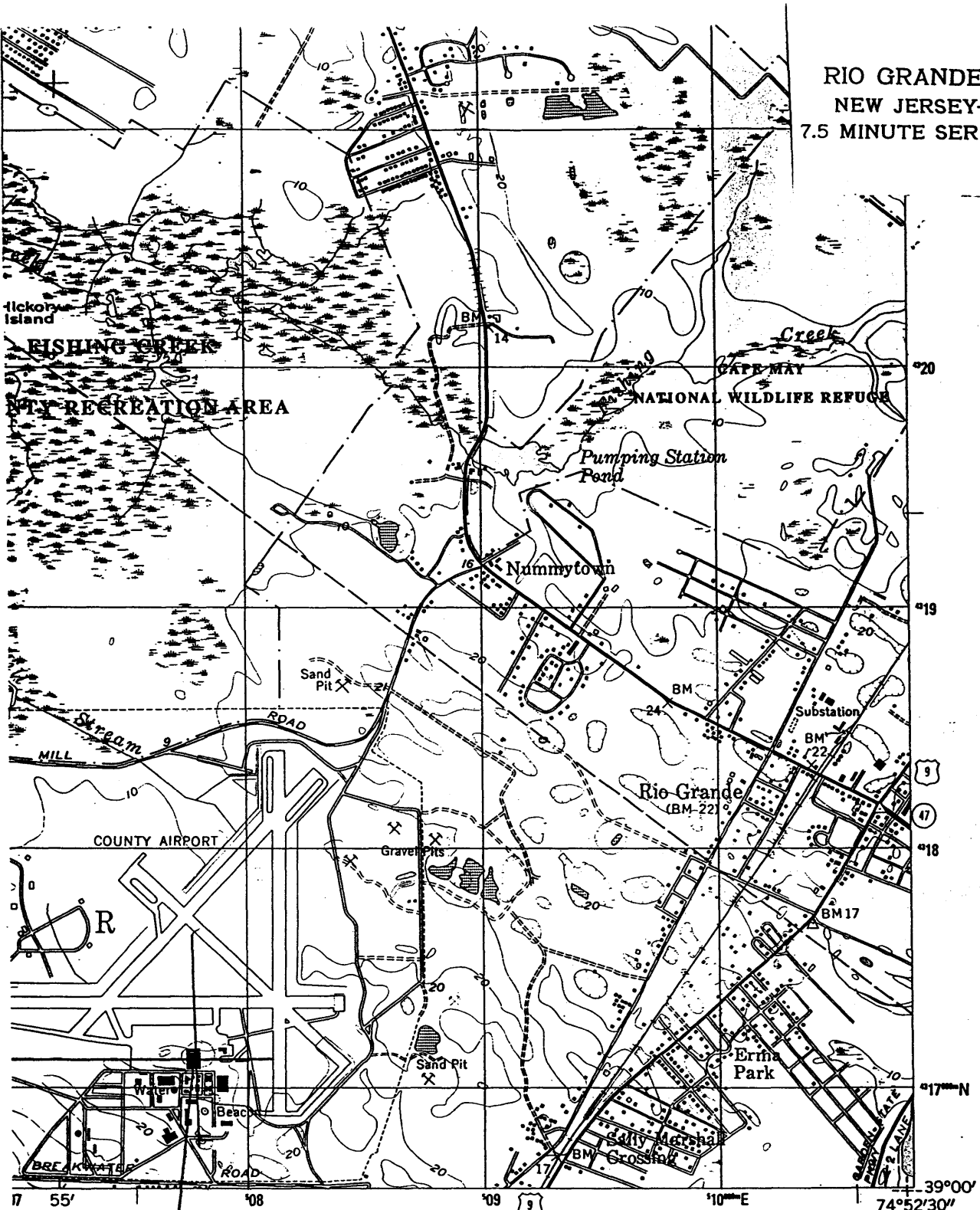
NIMA 6062 III SW—SERIES V822

(WILDWOOD)
 606 IV NE



RIO GRANDE QUADRANGLE
 NEW JERSEY—CAPE MAY CO.
 7.5 MINUTE SERIES (TOPOGRAPHIC)

1:10 1 940 000 FEET 74°52'



INTERIOR - GEOLOGICAL SURVEY, RESTON, VIRGINIA - 2000

ROAD CLASSIFICATION

- | | |
|---------------------------------|---|
| Primary highway, hard surface | Light-duty road, hard or improved surface |
| Secondary highway, hard surface | Unimproved road |
- Interstate Route
 U. S. Route
 State Route

RIO GRANDE, N. J.

*TBM-3E Avenue
 Torpedo Bomber
 NASW Aviation Museum
 Rio Grande, Cape May Co., NJ*

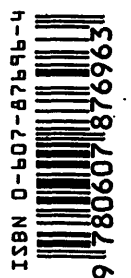
QUADRANGLE LOCATION

Zone 18
Easting 507792 Northing 4317096

1994

NIMA 6062 III SW-SERIES V822

(WILLOWOOD)
 6062 III NE



Supplemental Images

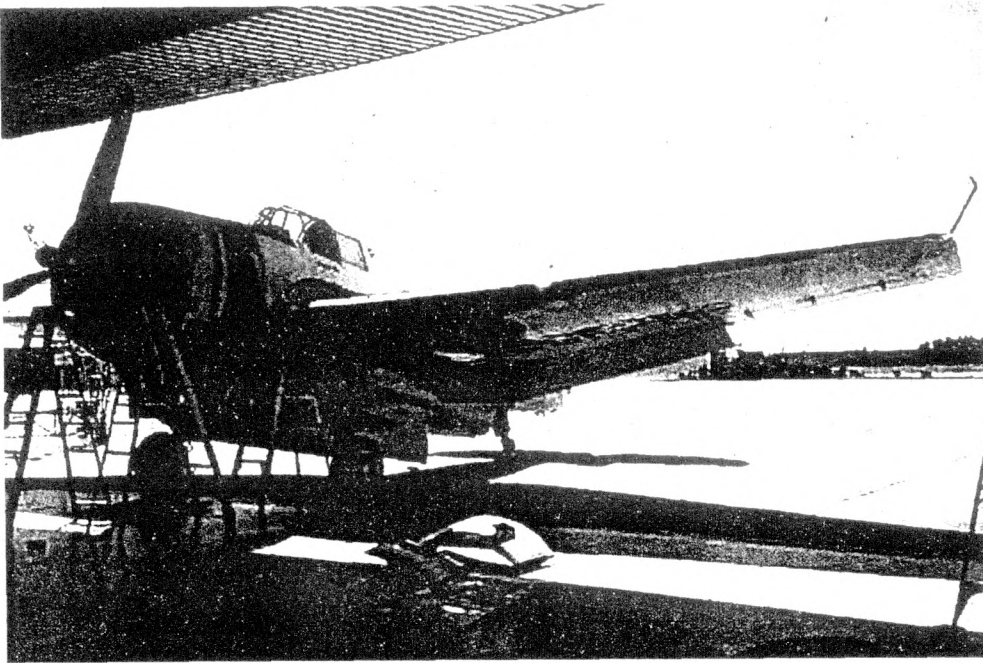


Figure 1: Naval Air Station Wildwood Aviation Museum's TBM-3E torpedo bomber as it appeared in Canada before being shipped to the museum.

[photo from NASW]

Figure 2: NASW's TBM after delivery to the museum in 2001. The building in the background is Hangar #1, headquarters of the Naval Air Station Wildwood Aviation Museum and listed in the State and National Register of Historic Places.

[photo from NASW]



Figure 3: “Rosie the Riveter” cover from the Saturday Evening Post, May 29, 1943

[as found at <http://www.goordnance.apg.army.mil/rosie.htm>]

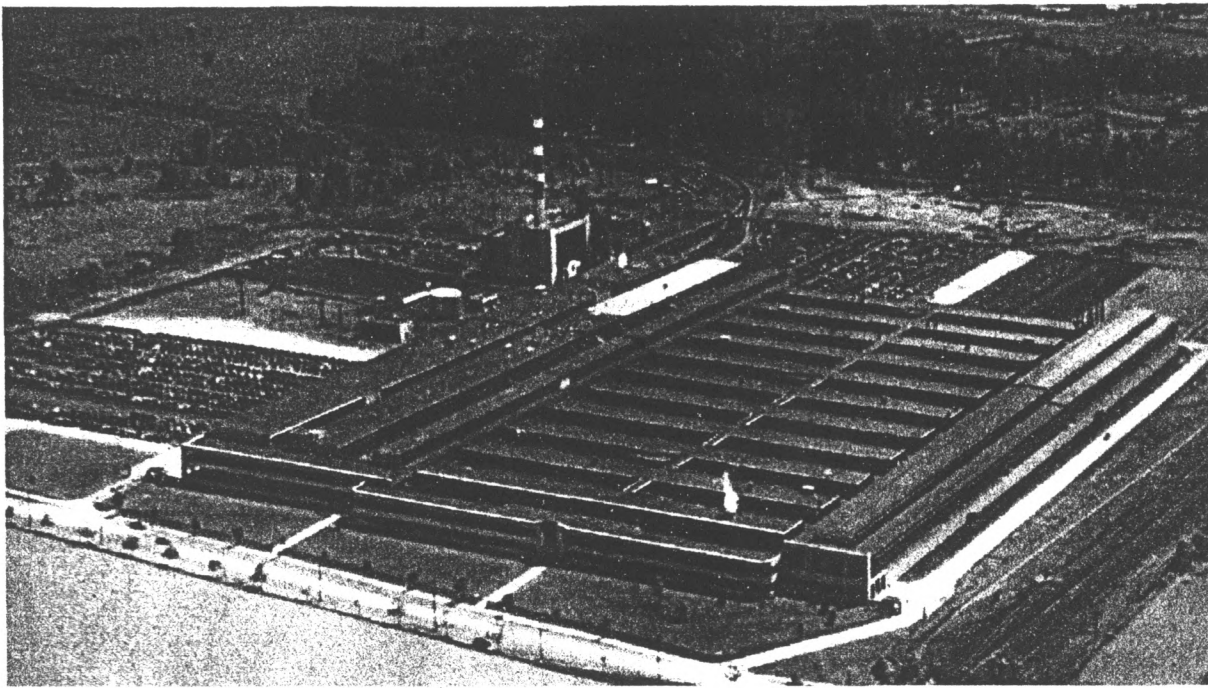


Figure 4: The Trenton-Ternstedt plant, located near West Trenton (Ewing Township), as it appeared ca. 1942 before conversion to aircraft production.

[from A History of Eastern Aircraft Division, p. 66]

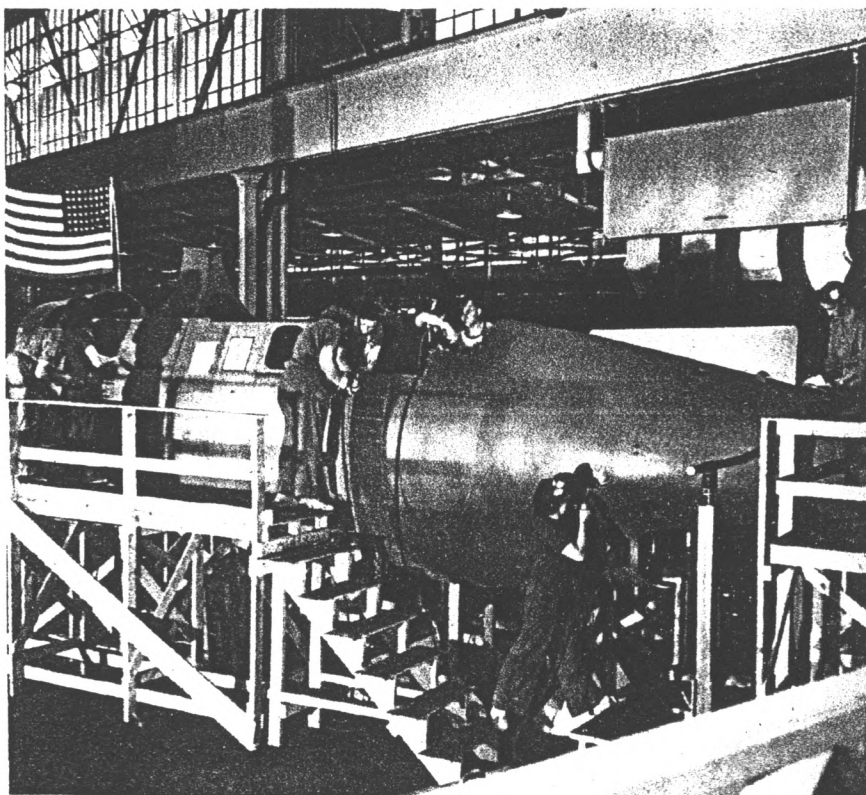
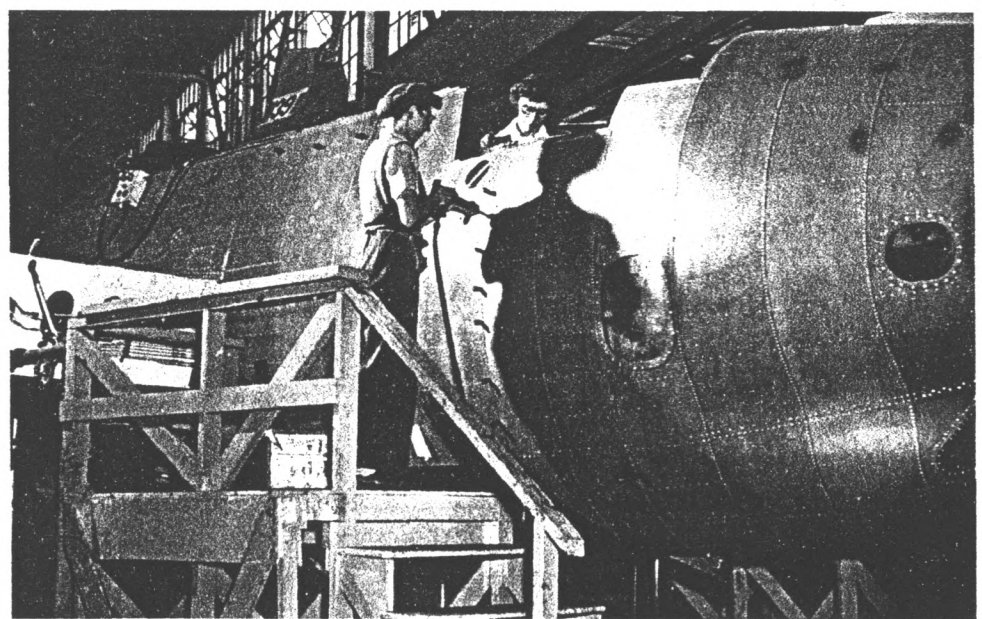


Figure 5: Production of the first Avenger at the Trenton-Ternstedt plant.

[from A History of Eastern Aircraft Division, p. 81]

Figure 6: Two women riveters at the Trenton-Ternstedt plant join the tail assembly and forward section, both of which had been made in the Baltimore plant.

[from A History of Eastern Aircraft Division, p. 134]



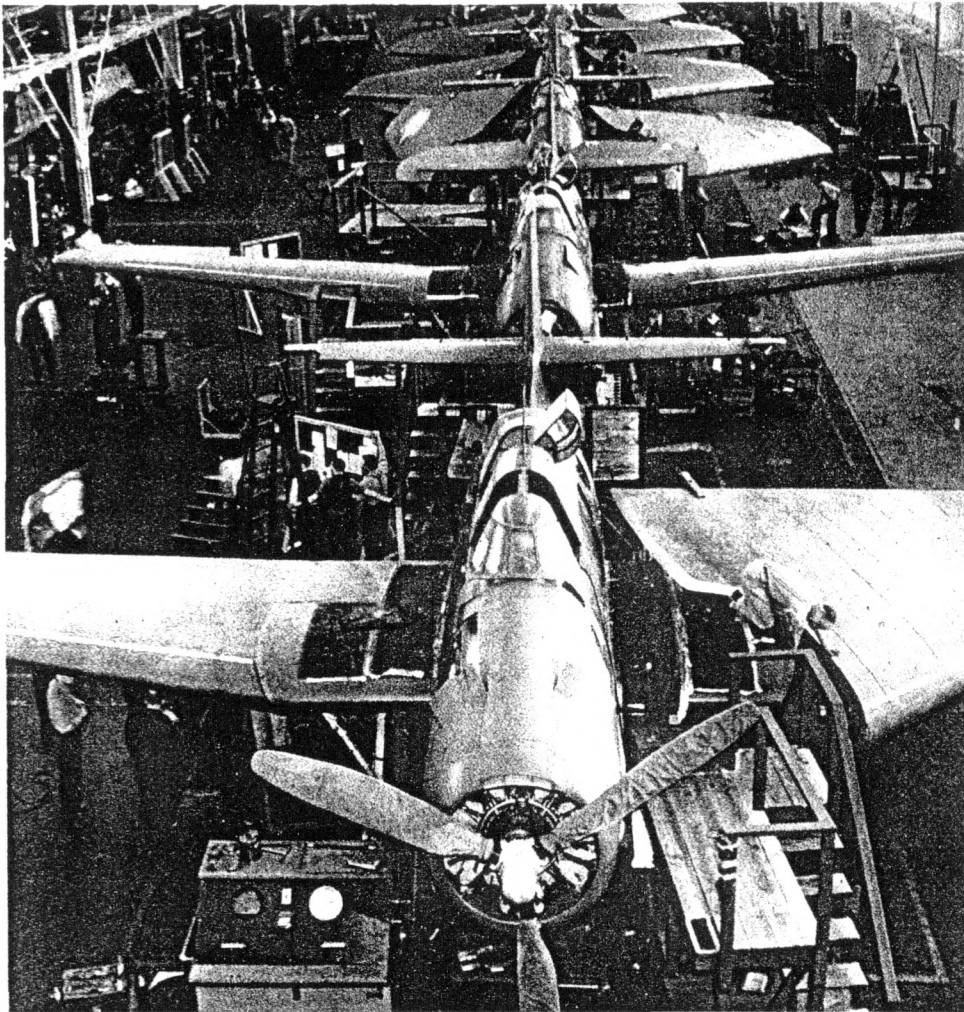


Figure 7: Nearly completed bombers come down the final bay in the Trenton-Ternstedt plant to receive paint, propellers, and radio equipment, and to have their folding wings tested.

[from A History of Eastern Aircraft Division, p. 139]

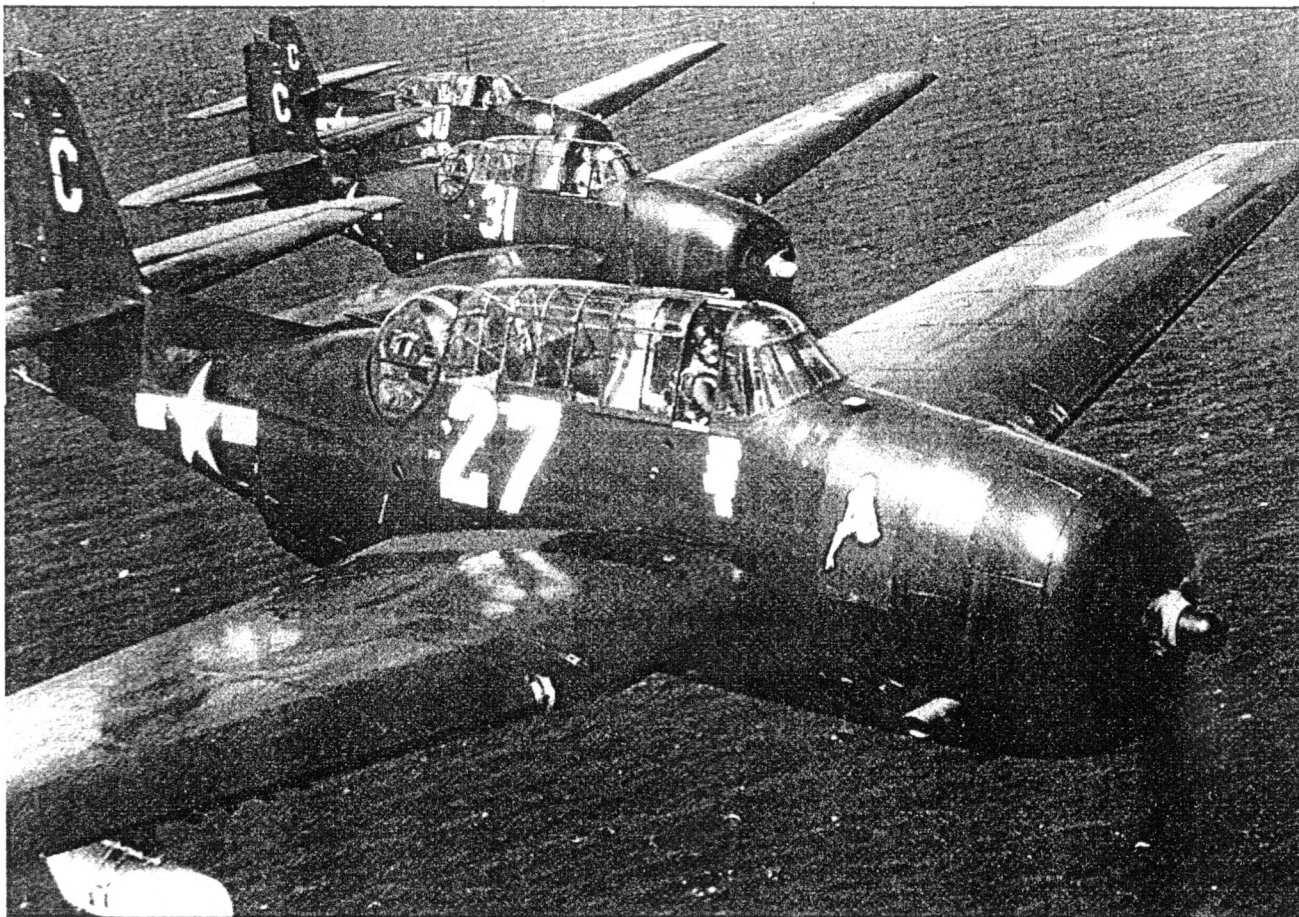


Figure 8: TBM-3E Avengers flying in formation on patrol, based on the light aircraft carrier *USS Monterey*

[from Treadwell's Grumman TBF/TBM Avenger, p. 108]

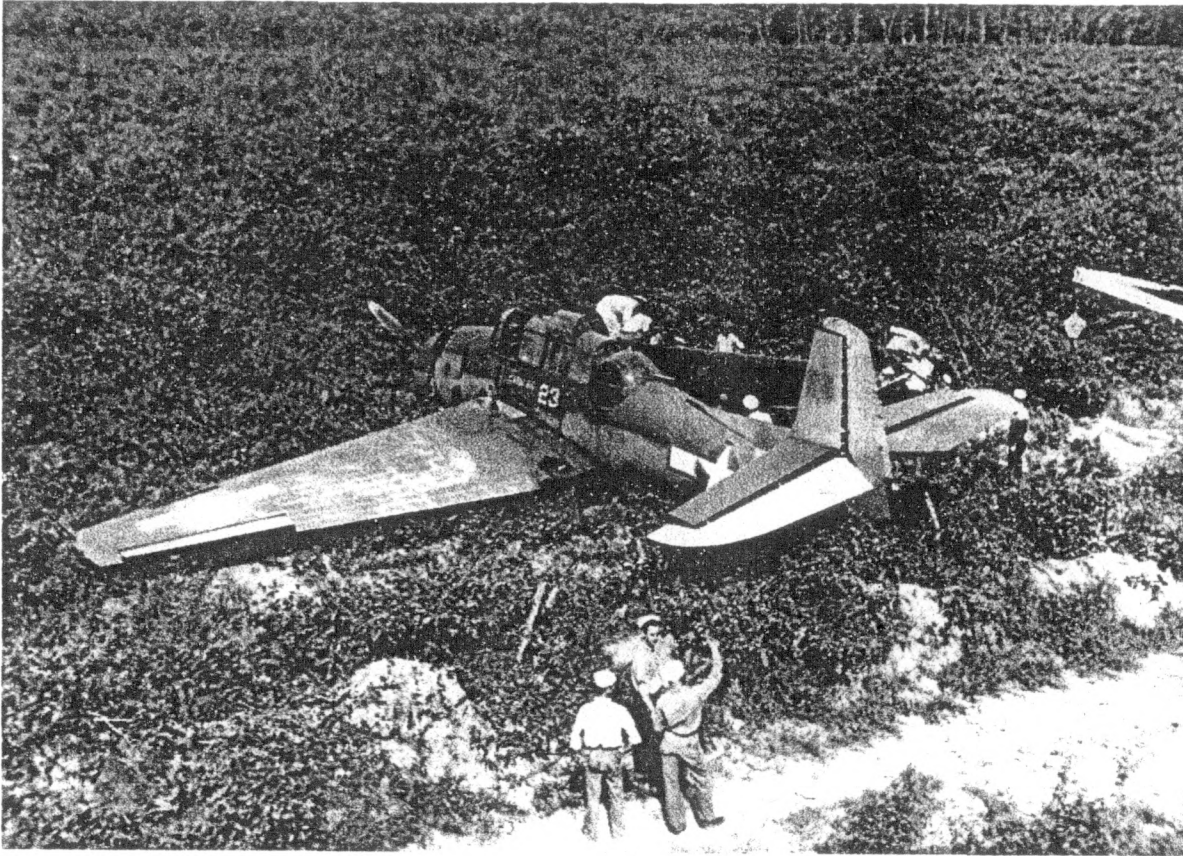


Figure 9: Crash of a TBM at the Naval Air Station Wildwood during World War II

[photo from NASW files]

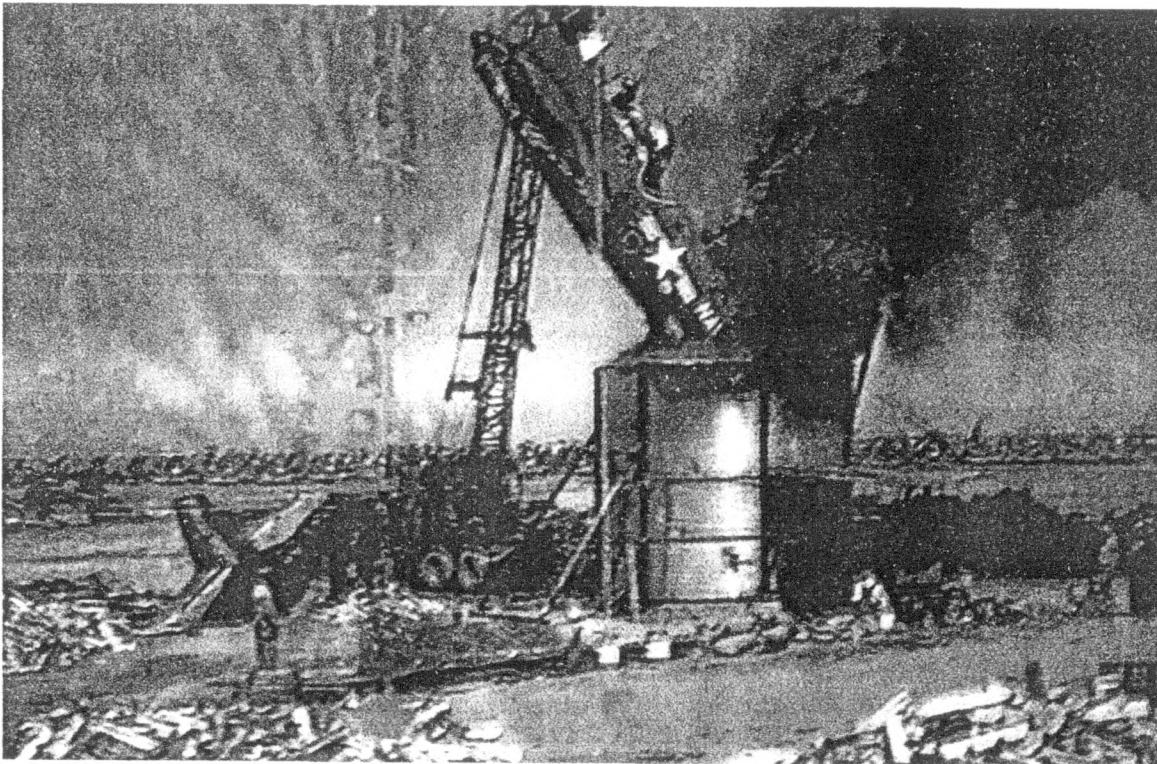


Figure 10: Photograph of an Avenger being melted down after the end of World War II

[photo from NASW files]

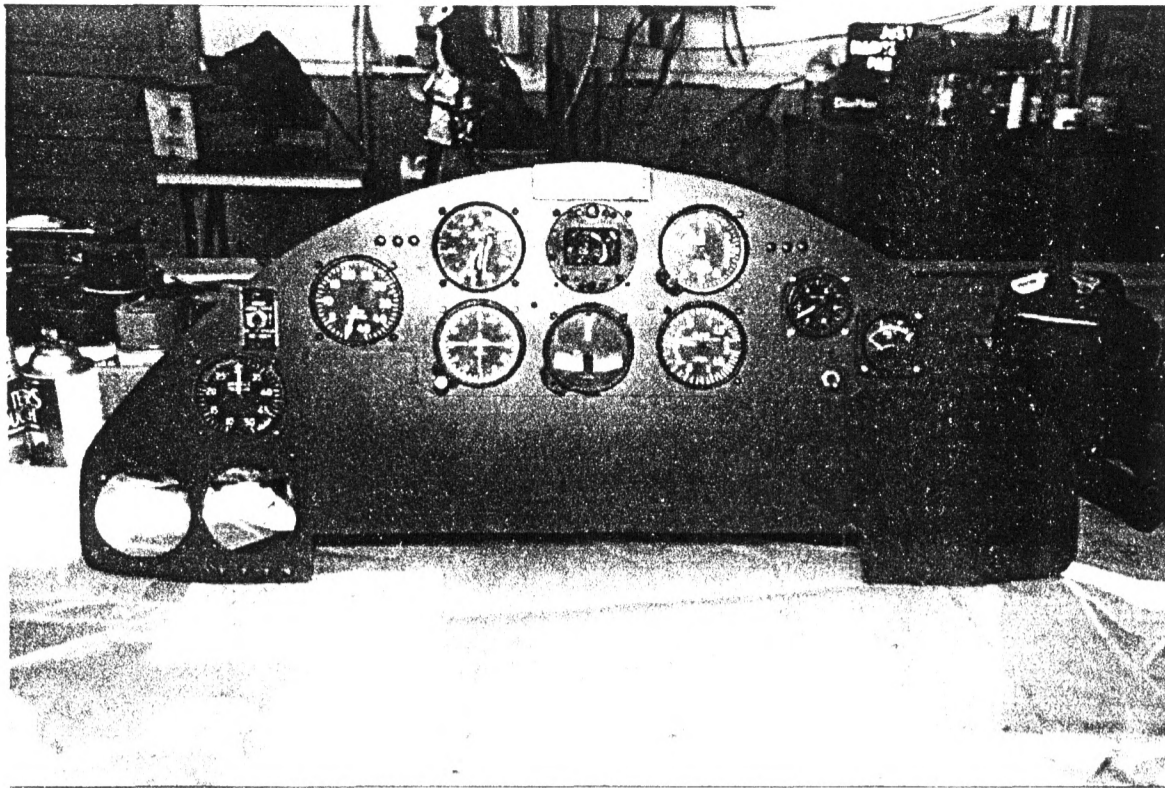


Figure 11: Instrument panel (original) for the TBM-3E owned by NASW Aviation Museum. It is currently being restored.

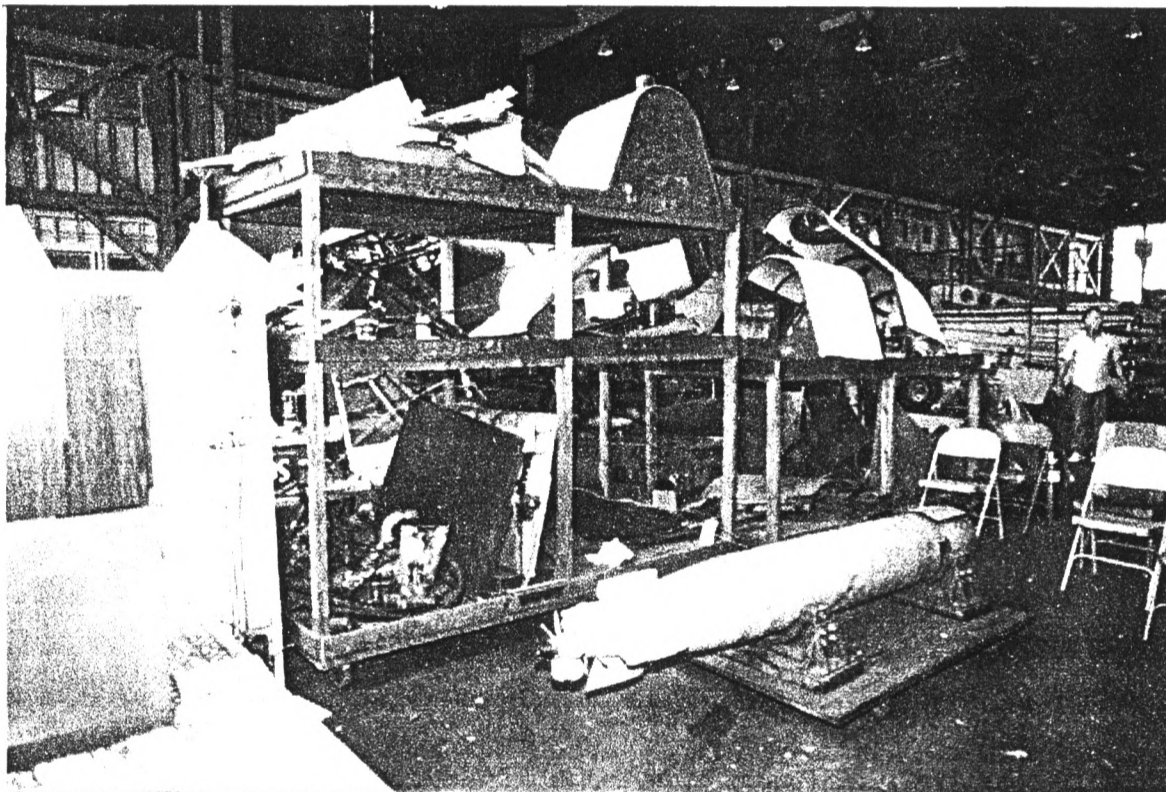


Figure 12: Parts for the TBM-3E that have been removed as part of the restoration program are stored on these large shelves near the plane. In the foreground is an un-armed torpedo of the kind that were used on TBMs during World War II.

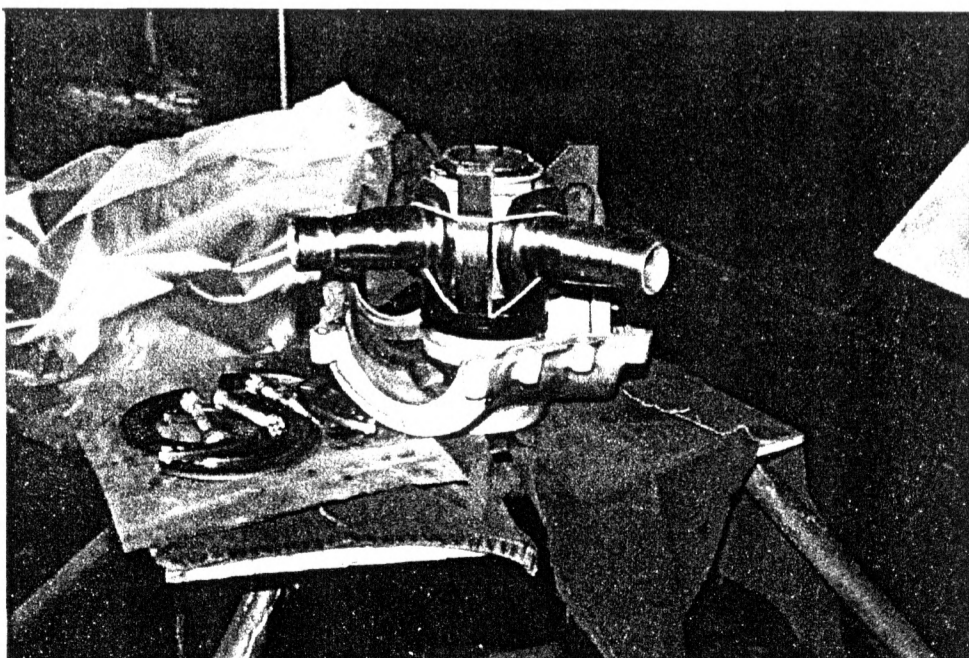


Figure 13: The propeller hub, awaiting restoration.



Figure 14: An Avenger as it appeared at Naval Air Station Wildwood in 1945.

[photo from NASW Aviation Museum files]