

EG:300-L1
Unit Main Title

ENOLA GAY: THE B-29 AND THE ATOMIC MISSIONS

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EG:300-L2
Unit Main Label

August 6, 1945, 2:00 a.m., Tinian Island, the Central Pacific. Bathed in floodlights, the B-29 Enola Gay awaits the start of its historic mission: to drop the first atomic bomb on Japan. Gen. Leslie Groves, the head of the Manhattan Project, had warned the Enola Gay's commander, Col. Paul Tibbets, to expect "a little publicity," but Tibbets and his crew are stunned by the scene on the tarmac. Movie cameramen, photographers, and reporters surround the crew. Groves is determined that this moment in history will not go unrecorded. Soon, at 2:45 a.m., the aircraft takes off.

The beginning of the Enola Gay's mission was the culmination of over a year's work. The U.S. Army Air Forces had modified its most advanced bomber, the B-29, and had created a new, special military unit for delivering atomic bombs. This unit's mission was so secret that, with few exceptions, the nature of its weapons was concealed even from its members.

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EG:300-L2a-P2a

(Crew picture to be used as cut-out in front of EG's nose.)

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EG:310-L1
Main Title

THE B-29: A \$3 BILLION GAMBLE

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EG:310-L2
Main Text

The Boeing B-29 Superfortress was conceived, designed, and rushed into production as a very-long-range conventional bomber. Of the more than 3,700 B-29s built during the war, only 15 were sent to the Pacific as potential atomic bombers. The rest formed the backbone of the most powerful and destructive bomber force of World War II.

The B-29 was the most technologically complex mass-production aircraft of World War II. This complexity represented a significant gamble: unforeseen technical problems during flight testing could have endangered the entire B-29 development and production program, which eventually cost over \$3 billion--\$1 billion more than the Manhattan Project. It was the largest commitment of resources to a single military aircraft up to that time.

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EG:310-L2a-P2a
background photograph of
B-29s in formation
NASM photograph
3A 38442

(no label needed)

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EG:310-L3

DESIGNING A SUPERBOMBER

In the wake of Nazi Germany's quick victory over Poland in 1939, Maj. Gen. Henry H. "Hap" Arnold, Commander of the Army Air Corps, asked the War Department for authority to define requirements for a very-long-range heavy bomber. After drafting performance requirements for the new bomber, the Air Corps in January 1940 requested design proposals from Boeing, Lockheed, Douglas, and Consolidated. In September 1940, Boeing received a \$3.6 million contract to build a full-size wooden mockup and two prototypes. The new bomber received the designation XB-29.

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EG:310-L3a-P3a
photograph

Boeing conceptual drawing of 1938, which became the basis for the company's 1940 bomber proposal.

Courtesy of the Boeing Company Archives

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EG:310-L3b-S3b
model (if available)

B-29 wind tunnel model.

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EG:310-L4

STRETCHING TECHNOLOGICAL LIMITS

To meet the Air Corps' performance requirements for the new bomber while working under a strict schedule, Boeing engineers stretched existing aircraft technology to the limit. An aerodynamically efficient wing, flush-riveted skin, and tight-fitting engine cowlings reduced drag (air resistance), allowing the B-29 to carry a larger bomb load higher, faster, and farther than earlier bombers. For the first time on a heavy bomber, defensive machine guns were installed in remotely controlled turrets. Over 125 electric motors powered the aircraft's internal equipment.

The B-29's complexity was both a major technological achievement and a gamble for Boeing and the Army Air Corps. As Boeing began building the first prototype B-29, the program began to suffer numerous delays. Over 900 changes were to be made to the initial design.

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EG:310-L4a-P4a

The prototype XB-29 traveling under guard from the Boeing factory in Seattle to the test field before its first flight, July 1942.

Courtesy of the Boeing Company Archives

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EG:310-L4b-P4b

The XB-29 takes to the air for the first time, September 21, 1942.

Courtesy of the Boeing Company Archives

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EG:310-L5

PRESSURIZED CREW COMPARTMENTS

For the first time on a combat aircraft, heated, pressurized compartments allowed crewmen to fly at high altitudes without bulky clothing and oxygen masks. A pressurized tunnel ran through the aircraft's two bomb bays and connected two of the compartments. Bunks in the rear compartment allowed crewmen to sleep on long flights. The tail gunner's pressurized position remained isolated from the other compartments.

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EG:310-L5a-P5a
graphic from Time-Life

B-29 internal systems and crew stations.

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EG:310-L5b-S5b,c

Typical crewman's flight equipment for the unpressurized B-17 (left) and the pressurized B-29 (right).

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EG:310-L6

ENGINE PROBLEMS

The B-29's complex Wright Cyclone R-3350 engines caused problems from the beginning of flight testing. After several near-accidents, an engine fire caused the second prototype to crash, killing Boeing's chief test pilot, 10 others on board, and 20 on the ground. The crash precipitated a crisis for the B-29 program, prompting a Senate investigation and tighter Army Air Forces control of the project's engineering and flight testing.

Improved quality control, a redesigned engine cowling, improved lubrication, and better cooling helped to reduce the R-3350's tendency to catch fire. The fire problem persisted well into the B-29's service life, but by 1945 the R-3350 had become a very reliable engine.

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EG:310-L6a-P6a
photograph (could
possibly substitute a
photo of one of the Enola
Gay's engines here)

Installation diagram for the Wright Cyclone
R-3350 18-cylinder radial engine.

Courtesy of the Boeing Company Archives

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EG:310-L6b-S6b

One of the Enola Gay's four 5-meter (16-foot,
8-inch) diameter Curtiss Electric propellers.

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EG:310-L7

SUPERFACTORIES FOR A SUPERBOMBER

The U.S. Army Air Forces ordered over 1,600 B-29s even before the first aircraft had flown. This order far exceeded the capacity of the massive B-29 factory Boeing was building at Wichita, Kansas. To meet the demand, fabrication of some components and assembly of airframes was contracted out.

Chrysler Corporation produced the bomber's engines at a huge plant in Chicago. General Motors' Fisher Division manufactured forgings, castings, stampings, and various B-29 subassemblies. Bell Aircraft Company built bomb bays, fuselages, and eventually entire aircraft in Marietta, Georgia. Boeing later established another B-29 plant in Renton, Washington, and the Martin Company erected one in Omaha, Nebraska.

The first production B-29s rolled off the assembly lines during July 1943. By war's end, about 3,700 aircraft and 30,000 engines had been produced.

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EG:310-L7a-P7a
map

Sites of principal B-29 and R-3350 engine subcontractors.

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EG:310-L7b-P7b

A B-29 rolls out of Boeing's Wichita, Kansas, plant, one of four massive factories devoted to production of the Superfortress, 1944.

Courtesy of the Boeing Company Archives

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EG:310-L7c-P7c

Workers install control cables in a bomb bay at Boeing's Renton, Washington, factory, 1944.

Courtesy of the Boeing Company Archives

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EG:310-L7d-P7d
(additional photographs from the various production facilities may be added here.

Production of the R-3350 engine at Chrysler's Dodge factory in Chicago, 1943.

Courtesy of Chrysler Corporation

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EG:311-L1

CREATING A NEW AIR FORCE

Under pressure from President Roosevelt to begin bombing Japan, General Arnold activated the first B-29 combat command, the XX Bomber Command, in November 1943, and its parent organization, the Twentieth Air Force in April 1944. Arnold selected Brig. Gen. Kenneth Wolfe to head the XX Bomber Command, which was expected to conduct missions against Japan from bases in China. Unlike all the other Army Air Forces, the Twentieth Air Force would be directly under the command of the Joint Chiefs of Staff with Arnold as their executive agent.

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EG:311-L1a-Pla
photograph

Brig. Gen. Kenneth B. Wolfe, first commander
XX Bomber Command, 1943.

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EG:311-L2

THE BATTLE OF KANSAS

Because of production delays, few B-29s were available when training began in late 1943. Many crews had to train in older heavy bombers instead. By the end of the year, the average crew had less than 30 hours of flight time in the airplane.

To ease the B-29 shortage, General Arnold ordered workers to be diverted from Boeing's assembly lines in Washington to Kansas, where they accelerated B-29 production. During the hectic month that followed, which became known as the "Battle of Kansas," the workers completed just enough B-29s to equip the first combat units. Although the vanguard squadrons of the XX Bomber Command departed at nearly full strength, the crews left for the war with much still to learn about their complex, temperamental bombers.

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EG:311-L2a-P2a
photograph

Crewmen train in a high-altitude chamber, Smoky Hill Army Air Field, Kansas, 1943.
Courtesy of the Boeing Company Archives

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EG:311-L2b-P2b
photograph

B-29s undergoing modification at Wichita during the "Battle of Kansas," March 1944.

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EG:320-L1
Main Title

BOMBING JAPAN

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EG:320-L2

A DIFFICULT BEGINNING

Early bombing raids against targets in Japanese-held China and Southeast Asia were conducted by the XX Bomber Command from air bases in India and China. The first attack on Japan since the early 1942 Doolittle Raid was staged from Chengtu, China, on June 15, 1944. The targets were coke furnaces and steel plants in the city of Yawata.

The B-29 crews operating from China faced enormous obstacles. Japanese forces blocked overland routes to China, so all food, fuel, bombs, and ammunition had to be flown to the base over the Himalaya Mountains from India. Bomber crews taking off from Chinese bases had to fly 5,000-kilometer (3,200-mile) round-trips to reach those few targets in western Japan within their range. The strain of these long flights at high altitude, along with mechanical failures and poor bombing results, hampered operations.

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EG:320-L2a-P2a
photograph

Thousands of laborers constructed the XX Bomber Command's airfield at Chengtu, China, in 1944 without the aid of machinery.

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EG:320-L2b-P2b
photograph

A B-29 takes off from the airfield at Chengtu, China, passing the wreck of a B-29 that crashed on takeoff during an earlier mission, 1944.

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EG:320-L3

BULLDOZERS BEFORE BOMBERS:

CREATING BASES IN THE CENTRAL PACIFIC

The "Air Plan for the Defeat of Japan," drawn up in 1943, called for most of the strategic bombing campaign to be conducted by the newly formed the XXI Bomber Command from bases in the central Pacific. After the Marianas Islands were captured in the summer of 1944, Army engineers and Navy Seabees moved in and began constructing the five largest air bases ever built up to that time: one on Saipan and two each on Tinian and Guam. Each was capable of handling several hundred B-29s.

The airfields were finished--and the three islands totally transformed--by the spring of 1945. This monumental accomplishment set the stage for the last great air campaign of World War II.

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EG:320-L3a-P3a

Brig. Gen. Haywood S. Hansell Jr., first commander of the XXI Bomber Command, 1944.

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EG:320-L3b-P3b
map

B-29 bases in the Marianas.

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EG:320-L3c-P3c
(other photos of base construction, etc., may be added)

Airfield construction, North Field, Guam, 1944.

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EG:320-L4

INTO ACTION FROM THE MARIANAS

Operations from Saipan began in November 1944, reducing the length of a round-trip flight to Tokyo to 4,800 kilometers (3,000 miles) and bringing most significant Japanese targets within range.

Still, problems remained. Brigadier General Hansell, commander of the XXI Bomber Command, wanted to continue the high-altitude, precision-bombing techniques first tried in Europe. But crews attacking targets in Japan from 9,000 meters (30,000 feet) encountered powerful and previously unknown winds of over 320 kilometers (200 miles) per hour--the jet stream. These winds either pushed bombers along at ground speeds approaching 800 kilometers (500 miles) per hour or slowed them nearly to a standstill, making accurate bombing almost impossible. Even at lower altitudes, unpredictable weather often obscured targets. By the end of 1944, after seven raids on Japanese aircraft factories and steel plants, only about 1 bomb in 50 had fallen within 300 meters (1,000 feet) of its target.

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EG:320-L4a-P4a
photograph

The Kawasaki aircraft factory near Kobe under
attack on January 15, 1945. XXI Bomber
Command B-29s rarely attained this degree of
accuracy during daylight attacks.

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EG:321-L1

CITIZEN AIRMEN

As the U.S. Army Air Forces expanded dramatically during World War II, it drew men from every geographical region. Almost all air crew were volunteers, motivated by patriotism and a sense of wartime duty. Flight pay, the prospect of rapid promotion, and the glamour of aviation attracted others. As one of the Army Air Forces' highest priority units, the Twentieth Air Force received the best flyers among those still training in the United States.

Although many senior officers came from combat units, most B-29 crewmen had not yet been overseas when they arrived at the great airfields in the Marianas. These citizen airmen faced an enormous responsibility: to take a complex, often unpredictable aircraft into combat halfway around the world and deliver what they hoped would be the knockout blow against Japan.

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EG:321-L1a-Pla
photograph

Portrait of a typical B-29 crew: Homer's Roamers, the crew of Aircraft No. 3, 873rd Squadron, 1945. They survived the war.

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EG:321-L1b-P1b
photograph

Quonset hut crew quarters on Saipan.
Eighteen enlisted crewmen were housed in each
hut.

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EG:321-L1c-P1c

B-29 crewmen try to relax between missions by
playing baseball, 1945.

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EG:321-L1d-P1d

Post-mission debriefing, 1945.

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EG:321-L1e-S1e,f,g...

(airmen's paraphernalia with I.D. captions)

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EG:322-L1

A HAZARDOUS BUSINESS

Although loss rates for American crews bombing Japan rarely approached those suffered over Germany, crews faced many dangers, especially during the early stages of the Marianas campaign. Engines sometimes failed on bombers taking off laden with fuel and bombs, leading to fiery crashes. Japanese antiaircraft fire and fighters sometimes posed a serious threat over the target. Nor was abandoning a wounded B-29 over Japan a good idea, since capture could mean execution, frequently by beheading.

Many bombers succumbed to battle damage, lack of fuel, or errors made by fatigued pilots during the 2,400-kilometer (1,500-mile) return flight. Although patrol aircraft and submarines rescued many downed crews, others disappeared into the Pacific without a trace. By war's end, 417 B-29s had been lost in combat and accidents in Asia and the Pacific, with 3,015 crewmen listed as killed, wounded, or missing.

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EG:322-L1a-P1a
photograph 3A-38954

Capt. Walter "Waddy" Young and his crew in front of Waddy's Wagon. All were lost on a January 9, 1945, mission to Musashino.

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EG:322-L1b-P1b
photograph

A B-29 pilot shows the strain of combat as his aircraft approaches the target.

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EG:322-L1c

"On the long trip to the target, I found it hard to believe that such a serene and tranquil sky could, at any moment, become filled with so much violence and destruction. And in the face of that beauty, the thing that bound us all together...was that we were scared to death."

George S. Gray, B-29 gunner, 500th Bomb Group

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EG:322-L1d-P1d
NASM photograph
3A-03326

A Japanese Ki-45 "Nick" fighter passes just beneath the propellers of its target, 1945.

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EG:322-L1e-P1e
NASM photograph
3A-03327

A B-29 disintegrates over Japan after suffering a direct hit by antiaircraft fire during a mission in early 1945.

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EG:322-L1f-S1f

B-29 crewman's flak jacket and helmet.

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EG:322-L1g

"Just after we had opened the bomb bay doors and were on the bomb run, one of the twin-engine fighters came out of the 12 o'clock high...and sliced off McKillip's wing right between engines one and two.... Mac's plane turned over on its back and slowly spiraled down from 18,000 feet [5,600 meters]. Our tail gunner...saw it hit the ground and explode. No parachutes were observed...[and] the entire crew was instantly killed. Many nights on Tinian, I actually fell off my cot dreaming I was going down with Mac's crew!"

Willis C. Lundahl, B-29 pilot, 504th Bomb Group

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EG:322-L1h

"Oh, I get that lonesome feeling
When I hear those engines whine,
Those 29's are breaking up
That old gang of mine.

There goes Jack, there goes Bill
Down over Tokyo.

We all hope it's home we go
How soon we do not know.

A goddamned Zeke* rammed old Pete,
We wept to see him go,
Heavy flak riddled Jack,
He couldn't make Iwo.

Oh they say it's thirty missions
But it's more like twenty-nine,
Those 29's are breaking up
That old gang of mine."

*Allied code name for the Mitsubishi A6M Zero
fighter

Song by an anonymous B-29 crewman, sung to
the tune of "Those Wedding Bells Are Breaking
Up That Old Gang of Mine"

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EG:322-L2

A POLICY OF EXECUTION

The Japanese government announced publicly in 1945 that it would execute any Allied flyers captured over Japan. After Iwo Jima, the Japanese ordered that any airmen picked up at sea were to be killed. Commandants of Japanese prisoner-of-war camps were instructed to kill their prisoners if American forces approached, but the rush to surrender prevented the Japanese from carrying this out.

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EG:322-L2a-P2a

For aircrew, capture meant imprisonment in horrible conditions and even execution. Like this Australian intelligence officer, Allied flyers were sometimes beheaded.

Courtesy of Time-Life, Inc.

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EG:322-L2b

"GENERAL HEADQUARTERS
SUPREME COMMANDER FOR THE ALLIED POWERS
LEGAL SECTION

Tokyo, Japan

APO 5000

26 March 1948

File No. 014.13

Legal Section Informational Summary No. 249

SUBJECT: US vs. Toshio TASHIRO etal

Charged with the responsibility for the murder of 62 captured American fliers who were either slashed, stabbed or burned to death when Tokyo Military Prison was destroyed by fire following a heavy US air raid [May 25-26, 1945], five Japanese war criminals are presently on trial before a Yokohama Eighth Army Military Commission....

The guards, KAMBE, OKUBO, and KAMIMOTO are charged with the outright acts of murder in that they willfully and unlawfully killed 17 prisoners by piercing and cutting them with swords during the time of the fire. TASHIRO, as prison warden, is charged with ordering his subordinates to kill any Americans that might escape from their cells during the air raid.... He specifically ordered his subordinates not to release the Americans, thereby causing the deaths of 45 American prisoners by burning."

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EG:322-L3

REDUCING LOSSES

By the spring of 1945, Japanese air defenses had deteriorated so much that B-29 losses had dropped to very low levels on most missions. Still, some bombers continued to be lost during the long return flights.

Emergency airfields constructed on Iwo Jima, roughly halfway between the Marianas and Japan, provided a much needed haven for aircraft unable to limp home. Bases capable of handling B-29s were built on Okinawa after its capture in June 1945, providing another escape option for crippled aircraft.

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EG:322-L3a-P3a
photograph

A flight engineer and pilot monitor dwindling fuel reserves during a mission's return flight.

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EG:322-L3b-P3b
photograph

Exhausted from the tension of combat, a crewman naps during the six-hour return trip in the tunnel connecting the forward and aft crew compartments.

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EG:322-L3c-P3c
photograph

Lt. Gordon Savage of the 19th Bomb Group crash-landed his flak-riddled B-29 on Iwo Jima after the great Tokyo raid of March 9-10, 1945. All the crew survived.

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EG:322-L3d-P3d
photograph

Lt. Holly Anderson inspects the fuselage of his flak-damaged B-29 after landing on Iwo Jima, May 3, 1945.

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EG:322-L3e-P3e

Returning from a bombing mission, this crippled Boeing B-29 did not quite make the runway at Saipan. With two engines failed, it nosed into the sea, trapping three crewmen in the wreckage, who died as a result of the crash.

Courtesy of the U.S. Air Force

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EG:322-L3f-P3f

This Boeing B-29 ran out of fuel and crash-landed at Isley Field, Saipan, while returning from a night bombing mission over Tokyo. Although it hit an antiaircraft gun position and crashed into a fuel truck before it slid to a stop, the crew escaped with only minor injuries.

Courtesy of the U.S. Air Force

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