

NATIONAL HISTORIC LANDMARK NOMINATION

NPS Form 10-900

USDI/NPS NRHP Registration Form (Rev. 8-86)

OMB No. 1024-0018

1956 GRAND CANYON TWA-UNITED AIRLINES AVIATION ACCIDENT SITE

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United States Department of the Interior, National Park Service

National Register of Historic Places Registration Form

1. NAME OF PROPERTY

Historic Name: 1956 Grand Canyon TWA-United Airlines Aviation Accident Site

Other Name/Site Number: Grand Canyon National Park Archaeological Site AZ:C:13:0755

2. LOCATION

Street & Number: Not for publication: X

City/Town: Grand Canyon National Park Vicinity: _____

State: Arizona County: Coconino Code: 005 Zip Code: 86023

3. CLASSIFICATION

Ownership of Property
Private: ___
Public-Local: ___
Public-State: ___
Public-Federal: X

Category of Property
Building(s): ___
District: ___
Site: X
Structure: ___
Object: ___

Number of Resources within Property
Contributing

3

3

Noncontributing
___ buildings
___ sites
___ structures
___ objects
___ Total

Number of Contributing Resources Previously Listed in the National Register: 0

Name of Related Multiple Property Listing: N/A

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4. STATE/FEDERAL AGENCY CERTIFICATION

As the designated authority under the National Historic Preservation Act of 1966, 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.

Signature of Certifying Official

Date

State or Federal Agency and Bureau

In my opinion, the property ____ meets ____ does not meet the National Register criteria.

Signature of Commenting or Other Official

Date

State or Federal Agency and Bureau

5. NATIONAL PARK SERVICE CERTIFICATION

I hereby certify that this property is:

- ____ Entered in the National Register
- ____ Determined eligible for the National Register
- ____ Determined not eligible for the National Register
- ____ Removed from the National Register
- ____ Other (explain):

Signature of Keeper

Date of Action

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6. FUNCTION OR USE

Historic: Transportation

Sub: Air-related

Current: Recreation & Culture

Sub: Outdoor Recreation



7. DESCRIPTION

Architectural Classification: N/A

Materials:

Foundation:

Walls:

Roof:

Other:

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Summary Statement of Significance

The 1956 Grand Canyon United-TWA Aviation Accident Site meets National Historic Landmark Criterion 1 for its association with the modernization of America's aviation airways. On June 30, 1956, a Trans World Airlines Super Constellation L-1049 and a United Air Lines DC-7 collided in uncongested airspace 21,000 feet over the Grand Canyon in Arizona, killing all 128 people onboard the two flights. Regarded as an important watershed in aviation history, the accident dramatically accelerated movements to address an airway crisis created by improved aircraft technology, the advent of the jet age, increasing traffic in the airspace system, and the fact that little had been done to expand the capacity of the air traffic control system. As a result, in August 1957 President Eisenhower signed the Airways Modernization Act, a prelude to establishing the Federal Aviation Agency.

Describe Present and Historic Physical Appearance

The 1956 Grand Canyon aviation accident site is located within [REDACTED] Grand Canyon National Park [REDACTED]

[REDACTED] The TWA Super Constellation crashed at an elevation of 3,200 feet [REDACTED]

The United DC-7 crashed 1¼ miles north of the TWA aircraft at an elevation of 4,000 feet [REDACTED]

[REDACTED] Debris from the mid-air collision was scattered over 1.5 square miles east and west of the Colorado River. The site is difficult to access, requiring multiple transit days via hiking trails or the Colorado River.

On the evening of June 30, and again on the morning of July 1, 1956, a local scenic airline pilot spotted intense fires burning at both impact areas.³ After the rescue and recovery operation began, U.S. Army helicopter pilots described two burned accident sites with fragmented aircraft debris. A medic who accompanied the helicopter pilots to both crash sites reported that no one had survived the crashes.⁴ In its Accident Investigation Report released on April 17, 1957, the Civil Aeronautics Board (CAB) concluded that the force of the impact disintegrated the largest components of both aircraft. The severely damaged major components remaining, with the exception of the DC-7's wing tip and the Constellation's rear tail, led investigators to determine how the airplanes had collided above and slightly west of the TWA impact area.⁵ The appearance of the sites has been

¹ Civil Aeronautics Board, *Accident Investigation Report: Trans World Airlines, Inc., Lockheed 1049A, N 6902C, and United Air Lines, Inc., Douglas DC-7, N 6324C, Grand Canyon, Arizona, June 30, 1956*, released April 17, 1957, http://ntl1.specialcollection.net/scripts/ws.dll?file&fn=8&name=S%3A%5CDOT_56GB%5CAirplane%20accidents%5Cwebsearch%5C063056.pdf1 (accessed February 25, 2011), 4.

² National Park Service, Grand Canyon National Park, Division of Science and Resource Management, 2007, archeological site record, Grand Canyon National Park Museum Collection, Grand Canyon, AZ.

³ John S. McLaughlin, Superintendent, Grand Canyon National Park to Regional Director, Region Three, "Trans-World Airlines and United Air Lines Crashes, June 30," August 1956 (date stamp), Grand Canyon National Park Museum Collection, Grand Canyon, AZ.

⁴ Civil Aeronautics Board, *Accident Investigation Report*, 3. Synthetic fabrics, wooden cabinets, trim, luggage and other cargo in the aircraft bodies allowed these fires to burn or smolder for days. AP wire photos, July 2 and July 5, 1956, Grand Canyon National Park Museum Collection, Grand Canyon, AZ. The accident sites were described in 2000 as "mere blackened scars on an otherwise buff-colored terrain of the canyon walls." Colonel Edgar A. Haine, *Disaster in the Air* (New York: Cornwall Books, 2000), 191.

⁵ Civil Aeronautics Board, *Accident Investigation Report*, 16.

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impacted by the recovery effort in the immediate aftermath of the accident and the clean-up operations conducted in 1957 and 1976.

TWA Accident Site, 1956

The geographical location of the TWA accident site is a sloping plateau covered with boulders, flat ridges and a drainage channel. The condition and distribution of aircraft parts led the CAB to conclude that the L-1049 Constellation had hit the ground at a deep angle in an inverted position.⁶ The impact produced an extensive mound of burned debris and widely scattered and twisted pieces of aircraft. Hundreds of square feet of blackened ground surface around the impact area,⁷ caused by burning aircraft fuel, was seen from the air. Heavily disturbed soil, rocks, and vegetation appear in 1956 photographs. The largest pieces of aircraft debris were perhaps 25 to 30 feet long, but the majority of debris was much smaller, perhaps one to two feet in maximum dimensions.⁸ CAB officials determined that with few exceptions, "all of the aircraft was at the main wreckage area."⁹ A map created by the CAB showed the distribution of identifiable pieces of wreckage.¹⁰ From this wreckage, helicopters removed seven large pieces for delivery to Washington, D.C. These pieces included a wing spar, wing flap, a piece of lower wing skin, two sections of right fuselage, a section of rear fuselage, and a piece of upper right side fuselage.¹¹ Recovery personnel also removed the remains of all 70 accident victims, and all but three were interred in a mass grave in Flagstaff, Arizona.¹²

United Accident Site, 1956

The United accident site is located on a bedrock ledge at the top of an 800-foot-high Redwall limestone cliff. The aircraft had impacted the ground with its nose and right wing down, but in a forward position sending multiple fragments west, north, and east into a "deep, narrow canyon" or crevasse.¹³ Otherwise, the United site exhibited the same physical characteristics as the TWA site with hundreds of square feet of blackened ground surface, an extensive mound of burned debris, widely scattered and twisted pieces of aircraft,¹⁴ and heavily disturbed soils, rocks and vegetation. Helicopters removed four pieces of the aircraft wreckage including two sections of engine cowling, a small section of wing skin, and a small section of baggage compartment flooring. Color photographs from July 1956 show a five-man team from the Colorado Mountain Club ascending the cliffs on rappel lines to access the cliff ledge and the large crevasse below the wreckage. Recovery personnel removed the remains of the victims. Twenty-nine of the victims were identified and sent to families for burial. The remaining twenty-nine victims were buried in a mass grave marked by a large stone memorial at the Grand Canyon Pioneer cemetery.

⁶ Ibid.

⁷ AP wire photos, 1, 3 July 1956, Grand Canyon National Park Museum Collection, Grand Canyon, AZ.

⁸ Estimated dimension is based on photographs with people standing next to the wreckage on the ground. Catalog number 464773, Grand Canyon National Park Museum Collection, Grand Canyon, AZ.

⁹ Civil Aeronautics Board, Bureau of Safety Investigation, *Structural Investigation Report: Aircraft Accident Involving Trans World Airlines L-1049A, N 6902C and United Airlines DC-7, N 5324C at Grand Canyon, Arizona on June 30, 1956* (July 24, 1956), 3.

¹⁰ Ibid. This map is identified in the report as the Wreckage Distribution Chart and is housed in the Grand Canyon National Park Museum Collection. Several dozen individual aircraft pieces, some of which were removed, are depicted in this hand-drafted chart.

¹¹ Ibid.

¹² Haine, *Disaster in the Air*, 197.

¹³ Ibid., 193. No CAB hand-drawn map, as prepared for the TWA site, was made for the United crash site due to its inaccessibility and time constraints. Ian Hough, Grand Canyon National Park, by telephone to Susan Salvatore, National Historic Landmarks Program, March 15, 2011.

¹⁴ AP wire photos, 1, 3 July 1956.

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Camp Sites, 1956

Ground operations for the recovery effort were centered at camp sites near each wreckage area and were used by CAB investigators, airline representatives, Grand Canyon National Park officials, recovery personnel, media personnel (reporters and cameramen), and congressional members. These sites served as gear and equipment staging areas, logistics and meeting centers, and eating and sleeping areas for overnight stays. The TWA camp was set up at the edge of the TWA wreckage site. Photographs show this camp as a flat ridge area cleared of boulders to accommodate helicopter landings and equipment. A nearby group of large boulders sheltered the camp from the wind and sun. The United camp was set up in an open area near the edge of a six-foot drop-off. The drop-off and ledge below sheltered the camp from the wind and sun. This camp was also used to prepare victims for recovery with embalming fluids and body bags.

1957 Clean-Up Operation

In the summer of 1957, Phoenix resident Robert Billingsley, supposedly unaware that the crash areas were closed, conducted a trip down the Colorado River during which he examined wreckage from the accident.¹⁵ Upon his return, Billingsley spoke with a local radio station in Phoenix and claimed he had found enough human remains at the sites to “fill a dozen gunny sacks.” He also claimed to have found blackened coins, jewelry, and a TWA spoon.¹⁶ Billingsley repeated his claims to park officials who then coordinated a follow-up investigation and clean-up operation at both accident sites on September 17, 1957.¹⁷ At the TWA site, a clean-up crew collected personal items, buried 15 to 20 pounds of human body fragments at an undisclosed location near the impact area, and turned over three rings to TWA. The tail section, located 1,650 feet from the impact area on the side of a steep ravine, was pushed into the ravine to conceal it from view.¹⁸ At the United site, the crew cut up the DC-7 horizontal stabilizer into four sections and concealed it behind large boulders. Below the impact area, the crew removed 100 feet of climbing rope used in the 1956 recovery operation. Additionally, “numerous other large pieces of wreckage [REDACTED] were concealed.”¹⁹ No human remains were found at the United site.²⁰ Following the clean-up operation, the National Park Service reopened the section of the canyon where the sites are located; however, the crash sites themselves remained closed to hikers.²¹

Although some pieces of both aircraft were removed or relocated in 1956 and 1957, the vast majority of the wreckage including large pieces, such as the TWA tail section, remained at the sites after 1957. A 1960 aerial photo shows a significant amount of wreckage present at the United site.²² Park officials were aware that the

¹⁵ Lynn Coffin, “Meeting with Robert Billingsley,” 15 August 1957, Grand Canyon National Park Museum Collection, Grand Canyon, AZ.

¹⁶ “Statements by Mr. Close on KOY Radio Station,” Phoenix, 7:15 A.M. Broadcast, 7 August 1957, Grand Canyon National Park Museum Collection, Grand Canyon, AZ. Billingsley removed two rings from the site.

¹⁷ Coffin, “Meeting with Robert Billingsley.”

¹⁸ Lynn Coffin to the Superintendent, “Clean-up of UAL-TWA Crash Sites, September 17-18,” 17-18 September 1956, Grand Canyon National Park Museum Collection, Grand Canyon, AZ.

¹⁹ Ibid.

²⁰ Lynn Coffin to Edgar Howbert, Dickinson, Wright, Davis, Mckean & Cudlip Counsellors at Law, 18 October 1957, Grand Canyon National Park Museum Collection, Grand Canyon, AZ.

²¹ John McLaughlin, “Superintendent’s Order No. 2-57,” 20 September 1957; Merle Stitt, Superintendent, Grand Canyon National Park to Ellsworth Perry, Regional Vice President, United Airlines, 21 May 1976, Grand Canyon National Park Museum Collection, Grand Canyon, AZ.

²² P. T. Reily, United Airlines crash site aerial photo, 1960.

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aircraft wreckage attracted attention and noted that “many persons” visited the sites annually despite the restrictions on the area and potentially removed or disturbed artifacts despite restrictions on the area.²³

1976 Clean-Up Operation

By the twentieth anniversary of the aviation accident, growing use of the park and a national anti-litter campaign pushed officials to further clean up both accident sites.²⁴ According to then Assistant Superintendent Bruce Shaw, the wreckage had become “an attractive nuisance” that drew “sensation-seekers” hoping to find “all kinds of morbid things.”²⁵ In the mid-1970s, park officials began negotiating with TWA and United Airlines to remove aircraft debris.²⁶ In October 1976, the National Park Service contracted with a salvage firm to remove the remaining large pieces of aircraft wreckage. According to Superintendent Shaw, the operation involved “removing the few large hunks of metal by helicopter, then raking the other debris into containers and flying it to trucks at the canyon rim.”²⁷ Helicopters made over 70 trips to remove approximately 20,000 to 30,000 pounds of aluminum²⁸ including most of the larger pieces of the Constellation wreckage.²⁹

At the United site, “four engines, one landing gear, one wing rib, several other large pieces of wing sections, numerous pieces (small pieces up to the size of a desk) on the north and east side of the impact area” were removed as well as “several large pieces on top of the back slope.”³⁰ Climbers evidently helped to remove wreckage, using cables to hook pieces in inaccessible locations for retrieval and kicking large pieces over the edge where they could be reached for removal.³¹ A vertical stabilizer or aileron lying between the crash sites was also removed. “Very little in the way of personal property” was found at the United site and “only a small quantity of human bone,” was recovered and turned over to the Coconino County Coroner.³² According to an administrative report, by the end of October the salvage operation was complete.³³

Current TWA Accident Site

The TWA site includes the impact area and the immediately surrounding debris field. Contained within this site is the recovery operations camp located adjacent to the impact area. The blackened ground surface caused by

²³ Stitt to Perry, 21 May 1976.

²⁴ Lyle McDowell, Acting Regional Director, Western Region to Associate Director, Park System Management, National Park Service, “TWA and United Airlines Aircraft Wreckage from 1956 Crash,” 9 July 1976, Grand Canyon National Park Museum Collection, Grand Canyon, AZ; Merle Stitt to Regional Director, Western Region, “TWA and United Airlines Aircraft Wreckage from 1956 Crash,” 30 June 1976, Grand Canyon National Park Museum Collection, Grand Canyon, AZ.

²⁵ Stitt to Regional Director, Western Region, “TWA and United Airlines Aircraft Wreckage from 1956 Crash,” 8 July 1976, Grand Canyon National Park Museum Collection, Grand Canyon, AZ. In Shaw’s opinion, this situation put the fragile desert plants and soils at risk.

²⁶ Merle Stitt to Richard Street, Assistant General Counsel, United Airlines, 12 August 1976, Grand Canyon National Park Museum Collection, Grand Canyon, AZ; Alexander Moody, Attorney for United Airlines to Merle Stitt, 17 September 1976, Grand Canyon National Park Museum Collection, Grand Canyon, AZ.

²⁷ *The Denver Post*, 8 August 1976.

²⁸ *Arizona Republic*, 13 October 1976.

²⁹ Assistant Superintendent’s Files, “TWA and United Crash Clean-Up,” 6-7 October 1976, Grand Canyon National Park Museum Collection, Grand Canyon, AZ.

³⁰ *Ibid.*

³¹ *Arizona Republic*, 13 October 1976.

³² Merle Stitt to Alexander Moody, Attorney for United Airlines, 28 October 1976, Grand Canyon National Park Museum Collection, Grand Canyon, AZ; Merle Stitt to Dale Medland, Vice President, United Airlines, 28 October 1976, Grand Canyon National Park Museum Collection, Grand Canyon, AZ.

³³ “Daily Report,” Grand Canyon National Park, 29 October 1976, Grand Canyon National Park Museum Collection, Grand Canyon, AZ.

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the crash is no longer visible. The impact area contains a two-foot deep crater (.10 acres) and heavily disturbed ground area

Intensely burned main cabin debris is located mostly in the bottom of a small drainage within the impact area.

The TWA recovery operations camp used in 1956 and 1957 contains a cluster of boulders at the southwest edge of a flat ridge immediately east of the TWA debris field.

Current United Accident Site

The United impact area is similar to the TWA impact area in terms of a recognizable impact crater, heavily disturbed ground surface, The majority of the wreckage, located in the burned impact area and the ridge directly above it. The impact area contains a one- to three-foot deep crater characterized by blackened soil, rock, melted aluminum puddles,

³⁴ Ibid.

³⁵ Kimberly Spurr, "In-Field Inventory of Human Remains at AZ C:13:755," Past Peoples Consulting, 6 October 2006, 3.

³⁶ Grand Canyon National Park, Division of Science and Resource Management, 2007, archeological site record, Grand Canyon National Park Museum Collection, Grand Canyon, AZ.

³⁷ Ian Hough, archeological site documentation field notes, 15-16 November 2008, Division of Science and Resource Management, Grand Canyon National Park Museum Collection, Grand Canyon, AZ.

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[REDACTED]

The United debris field covers [REDACTED]

[REDACTED]

[REDACTED]

[REDACTED] were blown clear of the impact explosion and likely remain today where they landed in 1956 based on their proximity to the impact crater and the fact that they are twisted and torn, but not burned.

[REDACTED]

[REDACTED]

The United recovery operations camp contains three and possibly four discrete areas immediately west of the impact site. [REDACTED]

[REDACTED]

Aspects of Integrity

The 1956 Grand Canyon Aviation Accident Site is nationally significant for its direct association with the modernization of American aviation safety regulations. This association is demonstrated by the landscape, [REDACTED] that portray a traumatic accident. Therefore, the aspects of location, setting, materials, feeling, and association are the essential elements needed to convey the site's significance.

Location. The area of the Grand Canyon [REDACTED] is the exact location of the 1956 mid-air aviation accident. The site is a remote section of the canyon's vast landscape that conveys a sense of the accident's improbability, the challenges associated with recovering accident victims, and the accident investigation.

Setting. The physical environment of the accident site, characterized by the surrounding canyon landscape, has not changed. The site is located within [REDACTED] Grand Canyon National Park [REDACTED]

[REDACTED]

The United impact site and debris field [REDACTED]

[REDACTED] The setting of both wreckage sites conveys a strong sense of remoteness and isolation.

³⁸ Ibid.

³⁹ Ibid. The bottle caps with the word "Dodge" have not been positively identified as such, but Dodge Company has been a major manufacturer of embalming fluid since the 1930s.

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Materials. Materials located at the two aircraft impact sites [REDACTED]

Feeling. The overwhelming feeling of an aviation accident exists at this site, especially at the impact areas. The burned and twisted wreckage [REDACTED] extremely rugged terrain and isolated location strongly convey the sense that the accident produced a tragic loss of life in a seemingly vast, open and safe airway.

Association. The 1956 aviation accident can be directly related to the two impact areas, debris fields and recovery camps. This is supported by material remains dated to 1956, photographs of the accident sites that show the airlines wreckage, and eyewitness accounts of the sites. [REDACTED]

Contributing Resources

1. TWA Impact Area. This resource includes the site of impact where large sections of the Constellation were deposited upon impact, the immediately surrounding debris field where material fell to the ground after the mid-air collision, and the adjacent recovery camp.
2. United Impact Area. This resource includes the site of impact where large sections of the DC-7 were deposited upon impact, the immediately surrounding debris field where material fell to the ground after the mid-air collision, the adjacent recovery camp, and rappel lines.
3. Greater Debris Area. This resource includes the greater area surrounding the TWA and United impact areas with known distribution of wreckage and other items that came to rest away from the impact areas and the immediately surrounding debris field.

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8. STATEMENT OF SIGNIFICANCE

Certifying official has considered the significance of this property in relation to other properties:

Nationally: __ Statewide: __ Locally: __

Applicable National

Register Criteria: A x B __ C __ D

Criteria Considerations

(Exceptions): A __ B __ C __ D __ E __ F __ G

NHL Criteria: 1

NHL Theme(s): V. Developing the American Economy: transportation and communication

Areas of Significance: Transportation, Politics/Government

Period(s) of Significance: June 30, 1956 – July 12, 1956 (the accident date through the immediate recovery effort and accident investigation)

Significant Dates: June 30, 1956 (accident date)

Significant Person(s): NA

Cultural Affiliation: NA

Architect/Builder: NA

Historic Contexts: American Aviation Heritage National Historic Landmarks Theme Study (2011)

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State Significance of Property, and Justify Criteria, Criteria Considerations, and Areas and Periods of Significance Noted Above.

The 1956 Grand Canyon United-TWA Aviation Accident Site meets National Historic Landmark Criterion 1 for its association with the modernization of America's aviation airways. On June 30, 1956, a Trans World Airlines Super Constellation L-1049 and a United Air Lines DC-7 collided in uncongested airspace 21,000 feet over the Grand Canyon in Arizona, killing all 128 people onboard the two flights. Regarded as an important watershed in aviation history, the accident dramatically accelerated movements to address an airway crisis created by improved aircraft technology, the advent of the jet age, increasing traffic in the airspace system, and the fact that little had been done to expand the capacity of the air traffic control system. As a result, in August 1957 President Eisenhower signed the Airways Modernization Act; a prelude to establishing the Federal Aviation Agency (renamed the Federal Aviation Administration in 1967).

The Grand Canyon aviation accident site portrays a unique and powerful cultural landscape. Its two impact sites, and the artifacts strewn over 1,000 acres, project a compelling sense of intense tragedy. These features define the watershed accident and give meaning to the postwar airway crisis and the need for immediate reform.

In the decade after World War II, congested airspace and inadequate aviation facilities caused an "airways crisis." In this situation, civilian and military aircraft operated under separate air traffic control systems, and pilots in uncontrolled airspace flew under the "see and be seen" principle with little or no external traffic control assistance. Under the latter situation, the TWA Constellation and the United DC-7 collided in midair over the Grand Canyon, becoming the worst aviation disaster to date. The accident highlighted the ineffectiveness of the Civil Aeronautics Agency's (CAA) handling of aviation safety and partly led to the passage of the Federal Aviation Act of 1958, which created the independent Federal Aviation Agency.⁴⁰ Public reaction to the tragedy spurred increased congressional funding in an unprecedented effort to modernize America's postwar airways with nationwide radar coverage, a common military/civilian navigation system, and new flight rules placing all aircraft above 15,000 feet under control of ground personnel.⁴¹ In addition, technologies such as collision avoidance systems and flight data recorders rapidly developed.⁴²

Historic Context

Pioneering Aerial Navigation

Limited federal oversight of air travel in the United States has its origins in mail delivery. After the First World War, the Post Office Department turned its wartime experiments into an Air Mail Service staffed with former military pilots and surplus war planes. Without an air traffic control system in 1918, pilots used magnetic compasses and followed landmarks, railroads, and roadways to reach their destinations.⁴³ In 1921, ten radar stations between New York and San Francisco served as a pilot's first navigation tools. In 1923, the Post

⁴⁰ Roger E. Bilstein, *Flight in America: From the Wrights to the Astronauts* (London: The John Hopkins University Press, 2001), 232; Michael McComb, "Collision Over the Canyon: Half a Century Onward," *Airways* 13 (August 2006): 53. The FAA changed its name to the Federal Aviation Administration in 1967.

⁴¹ Stuart I. Rochester, *Takeoff at Mid-Century: Federal Civil Aviation Policy in the Eisenhower Years, 1953-1961* (Washington, DC: U.S. Department of Transportation, Federal Aviation Administration, 1976), 130; Gordon Murphy, "The Grand Canyon Midair Collision: A Stimulus for Change," *The American Journal of Forensic Medicine and Pathology* 11, 2 (1990): 102.

⁴² Michael McComb, "Desert Disaster: TWA-United Mid-Air Collision over the Grand Canyon," *America's Flyways* (June 2006), 25.

⁴³ Carl Solberg, *Conquest of the Skies: A History of Commercial Aviation in America* (Boston: Brown and Company, 1979), 20.

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Office Department began installing a system of beacons placed on towers every ten miles along the transcontinental airway.⁴⁴

During the 1920s, airmail operations helped create the U.S. commercial aviation industry. The Air Mail Act of 1925 awarded lucrative federal mail contracts to commercial operators and spawned such long-standing companies as American, United, and Eastern Airlines.⁴⁵ As air travel increased, aviation leaders pressed for federal oversight to improve and maintain safety standards. The ensuing 1926 Air Commerce Act made the Secretary of Commerce responsible for fostering air commerce, operating and maintaining aids to air navigation, and investigating accidents. Under this act, the newly established Aeronautics Branch in the Commerce Department assumed the Post Office Department's responsibility for maintaining and completing the transcontinental lighted airway, charting airways, establishing air traffic rules, and licensing pilots and their aircraft.⁴⁶

Charles Lindbergh's historic flight over the Atlantic in 1927 touched off an aviation craze and ushered in a new era of air travel. Money poured into both airline stocks and technological innovations such as air-cooled engines, aluminum skin, and monoplane design.⁴⁷ Between 1926 and 1930, passenger air travel increased from 5,800 passengers per year to 417,000.⁴⁸ The March 1931 high profile crash of a Transcontinental and Western Air (TWA) wooden tri-motor airplane that killed nine, including famed Notre Dame football coach Knute Rockne, spelled the end of wooden aircraft. The Aeronautics Branch discovered that moisture inside the wing had deteriorated the glue and weakened the wing. Thereafter, Boeing and Douglas produced revolutionary aircraft that were 50 percent faster than their predecessors, initiating the era of the modern airliner.⁴⁹

Using a new generation of airplanes and prodded by a sharp reduction in mail contracts, airlines in the 1930s began to shift from hauling mail to carrying passengers for increased revenues.⁵⁰ Introduction of the DC-3 and its lower operating costs significantly reduced air fares and proved especially attractive to business travelers.⁵¹ In 1938 a little over one million Americans chose to fly while 15 million traveled by Pullman train cars.⁵² Two years later passenger air traffic tripled as over three million people took to the skies.⁵³

This dramatic increase in passenger travel, coupled with the 1935 crash of a TWA DC-2 that killed five, including Senator Bronson Cutting of New Mexico, led Congress to reorganize civil aviation. A Senate

⁴⁴ Theresa L. Kraus, *The Federal Aviation Administration: A Historical Perspective, 1903-2008* (Washington, DC: U.S. Department of Transportation, Federal Aviation Administration, 2008), 1.

⁴⁵ Roger E. Bilstein, "Air Travel and the Traveling Public: The American Experience, 1920-1970," in *From Airships to Airbus: The History of Civil and Commercial Aviation*, ed. William Trimble, vol. 2, *Pioneers and Operations* (Washington, DC: Smithsonian Institution Press, 1995), 92.

⁴⁶ Nick A. Komons, *Bonfires to Beacons: Federal Civil Aviation Policy Under the Air Commerce Act, 1926-1938* (Washington, DC: U.S. Department of Transportation, Federal Aviation Administration, 1978), 84-88, 91-93, 144 for commentary. By 1933 the Airways Division of the Department of Commerce had completed 18,000 miles of lighted airways, installed 1,550 light beacons, and constructed over 250 airfields.

⁴⁷ Heppenheimer, *Turbulent Skies*, 44-45; Solberg, *Conquest of the Skies*, 72.

⁴⁸ Heppenheimer, *Turbulent Skies*, 14; Solberg, *Conquest of the Skies*, 22.

⁴⁹ Susan Cianci Salvatore, John D. Anderson Jr., Janet Daly Bednarek, Roger Bilstein, Caridad de la Vega, Marie Lanser Beck, and Laura Shick, *American Aviation Heritage: Identifying and Evaluating Nationally Significant Properties in U.S. Aviation History* (Washington, DC: U.S. Department of the Interior, National Park Service, 2011), 100-01.

⁵⁰ Heppenheimer, *Turbulent Skies*, 64, commentary on 45. The 1930 McNary-Watres Act cut mail-pay rates, the main source of revenue for the airlines. A 1934 scandal over mail route contracts resulted in a second Air Mail Act that further reduced mail rates, slashing postal revenue for the airlines by half.

⁵¹ *Ibid.*, 72.

⁵² Bilstein, "Air Travel and the Traveling Public," 97.

⁵³ Heppenheimer, *Turbulent Skies*, 72.

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investigation into the accident placed some blame on the Aeronautics Branch, citing problems “with the bureau’s procedures and navigation aids.”⁵⁴ As a result, in 1938, President Franklin Roosevelt signed the Civil Aeronautics Act vesting responsibility for the nation’s airways in an independent Civil Aeronautics Authority (CAA). Although the new authority addressed safety concerns and eliminated the inefficiencies of the old airmail contract system, it was a cumbersome tripartite organization that ultimately proved unable to meet the aeronautic challenges of the postwar era.⁵⁵ In 1940 President Roosevelt addressed aviation regulation further and divided the CAA into two agencies, the Civil Aeronautics Administration and the Civil Aeronautics Board (CAB). “The CAA returned to the Department of Commerce and was tasked with overseeing ATC [air traffic control], pilot and aircraft certification, safety enforcement, and airway development. The CAB became responsible for accident investigations, safety rulemaking, and economic regulation of the airlines.”⁵⁶

The Airways Crisis

While World War II dramatized the airplane’s potential, an unprecedented surge in postwar air travel caught both the airlines and government unprepared. Dramatic wartime technological advances and increased production had provided airlines with aircraft possessing higher cruising speeds than pre-war aircraft. Airports became more congested and the increasing popularity of private flying further saturated air space.⁵⁷ Without radar and the ability to directly communicate with pilots, the skies above major airports became dangerously crowded⁵⁸ and by the late 1940s, air traffic volume outstripped the capacity of the existing navigation and traffic control systems.⁵⁹ The “airways crisis,” caused by the phenomenal growth of private, military, and commercial aviation “began to strain the thin network of navigation and traffic control facilities that guided planes on the Federal airways.”⁶⁰

The year 1947 then became the “worst single year in air transport history.” Of thirty-six domestic accidents, five proved fatal. That summer, after 143 people died during a two-week period, President Truman took action, appointing leaders of all the main aviation agencies to a Special Board of Inquiry on Air Safety. On December 29, 1947, the group delivered its inconclusive final report. No common cause could be identified for all the crashes. Rather the causes included malfunctioning aircraft systems, pilot error, faulty meteorological reporting, and bad airway control.⁶¹

Efforts to address the airways crisis continued when, in 1948, the House Commerce Committee tasked the Radio Technical Commission for Aeronautics, a quasi-governmental advisory group, to map an airways facilities plan. The agency’s report, known as SC-31 (Special Committee 31) “cited a critical need for additional navigation aids, improved air-to-ground communications, modernized traffic control procedures, and above all, a single, integrated ‘common’ system to serve and regulate both civil and military users.”⁶² The outbreak of the Korean War in 1950 hampered the progress of SC-31. Ignoring the need for a common system,

⁵⁴ Salvatore, et al, *American Aviation Heritage*, 119; Komons, *Bonfires to Beacons*, 277-78.

⁵⁵ Komons, *Bonfires to Beacons*, 347, 378-79.

⁵⁶ Federal Aviation Administration, “The History of the FAA,” http://www.faa.gov/about/history/brief_history/ (accessed February 28, 2011); also see Kraus, *Federal Aviation Administration*, 4-5.

⁵⁷ R. E. G. Davies, *Airlines of the United States Since 1914* (Washington, DC: Smithsonian Institution Press, 1972), 354. During the war, 1.5 million Americans had learned to fly and a million more military personnel flew as passengers. By 1948 reduced prices on coach air service made flying affordable to middle-class Americans. Solberg, *Conquest of the Skies*, 323.

⁵⁸ Solberg, *Conquest of the Skies*, 336-37.

⁵⁹ Rochester, *Takeoff at Mid-Century*, 57. A 1948 Commerce Department report found the air traffic control and navigation system to be overloaded and incapable of handling any more than 42 percent of the current traffic. Heppenheimer, *Turbulent Skies*, 136.

⁶⁰ Rochester, *Takeoff at Mid-Century*, 57.

⁶¹ Davies, *Airlines of the United States*, 330-31.

⁶² Rochester, *Takeoff at Mid-Century*, 57-58.

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military planners began to construct their own parallel air traffic control system, Tactical Air Navigation System, also known as TACAN. Meanwhile the CAA continued to develop its air traffic control system, VOR/Distance Measuring Equipment (DME), although it was incompatible with TACAN equipment. The parallel development of these two incompatible systems, and the ensuing debate over which technology was best suited for a common system, prevented badly needed reforms. The 1953 election of Dwight Eisenhower simply compounded these problems. The new president fulfilled his promise to cut government spending. In 1954, Eisenhower reduced CAA appropriations to \$71 million below 1951 levels. During the same period, spending on the SC-31 recommendations declined from \$37 million to \$5 million.⁶³

From 1938 to 1953, as the number of annual airline passenger miles increased 1,800 percent, plans like SC-31 failed to adequately modernize the air traffic control system as the airline industry experienced phenomenal growth. In 1952, airlines hauled 25 million Americans, nearly one-sixth of the population.⁶⁴ New larger airplanes from Douglas and Lockheed moved more passengers at speeds exceeding 300 mph. Domestic airlines finally surpassed Pullman service in 1955 and in 1956 more Americans traveled by plane than by train.⁶⁵ In that year, the “Big Four” airlines (American, Eastern, United, and TWA) were each bigger than the entire industry had been only a decade before.⁶⁶

Although most people remained unaware of the true magnitude of the crisis gripping America’s airways, this transportation revolution alarmed industry experts and government officials who understood the air traffic control system was outdated. As 1955 passed without a single passenger fatality in scheduled domestic operations, a sense of false security developed. Yet, repeated warnings of air disasters did appear. Between 1950 and 1955, 65 mid-air collisions involving light planes occurred in the United States but these accidents, typically involving around 50 fatalities, failed to illicit immediate reform.⁶⁷

Early Reform Efforts

The perception that the air traffic control system was increasingly inadequate caused some government officials and industry experts to call for reform. President Eisenhower, as he later related, “received reports that the increasing speed of aircraft, the rapid growth in the volume of daily flights, and the introduction into common use of jet and vertical lift aircraft were causing serious congestion in the airspace.” He also learned that aviation facilities would quickly become outdated for efficient air traffic management.⁶⁸ In May 1955, at the president’s request, the Director of the Bureau of the Budget authorized the formation of the Aviation Facilities Study Group to assess the need for new federal oversight of airspace and future aviation facilities.⁶⁹ The group’s findings, known as the Harding Report after William Barclay Harding who headed the group, were issued to the bureau’s director on December 31, 1955. According to the report, overcrowded airspace already existed and the development of airports, navigation aids, and the air traffic control system lagged far behind aeronautical developments.⁷⁰ “The risks of mid-air collisions,” the report warned, “have already reached

⁶³ Heppenheimer, *Turbulent Skies*, 174-75.

⁶⁴ Rochester, *Takeoff at Mid-Century*, 3-4.

⁶⁵ Solberg, *Conquest of the Skies*, 346.

⁶⁶ Heppenheimer, *Turbulent Skies*, 170.

⁶⁷ Edmund Preston, ed., *FAA Historical Chronology: Civil Aviation and the Federal Government, 1926-1996* (Washington, DC: Department of Transportation, Federal Aviation Administration, August 1998), 54; Rochester, *Takeoff at Mid-Century*, 61, 63.

⁶⁸ “Dwight D. Eisenhower: Special Message to the Congress Recommending the Establishment of a Federal Aviation Agency,” June 13, 1958, in John T. Woolley and Gerhard Peters, *The American Presidency Project*, Santa Barbara, CA, <http://www.presidency.ucsb.edu/ws/index.php?pid=11091> (accessed March 15, 2011).

⁶⁹ Preston, *FAA Historical Chronology*, xiii.

⁷⁰ “Dwight D. Eisenhower: Special Message to the Congress.” Harding was a Wall Street broker and experienced aviator.

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critical proportions,” and airline operations are “flagrantly defying the law of averages.”⁷¹

Implementing the Harding Report’s recommendations fell to Edward P. Curtis who President Eisenhower had appointed in February 1956 to serve as his special assistant for aviation facilities planning.⁷² Curtis was tasked with preparing “legislative, organization, administrative and budgetary recommendations to implement the comprehensive plan.” No stranger to aviation, Curtis had served in the Air Corps in World War I and in World War II risen to the rank of major general. “In time, the Harding report would prove to be a cornerstone and Edward Curtis a skilled architect in the remodeling of Federal aviation policy and the creation of a new aeronautics agency.” Until then, a chorus of pilots echoed the Harding Report’s warning, including Leo Kriloff who, in April 1956, lamented, “The dread specter of a mid-air collision...is not only a possibility—it’s an absolute certainty under present rules. The only question is where and when.”⁷³

The 1956 Grand Canyon Mid-Air Collision

As Curtis prepared his plan, the nation was shocked by a costly civil air disaster. On Saturday morning, June 30, 1956, two airliners took off from Los Angeles International Airport about three minutes apart. At 9:01 a.m. (PST), Trans World Airlines Flight 2, a Super Constellation bound for Kansas City, Missouri, departed with sixty-four passengers and six crew members. At 9:04 a.m., United Air Lines Flight 718, a DC-7 carrying fifty-three passengers and five crew members, departed for Chicago, Illinois. Both four-engine transports traveled on somewhat parallel flying routes,⁷⁴ the TWA flight at 19,000 feet and the United flight at 21,000 feet.⁷⁵ Trans World Airlines Captain Jack Gandy had flown this particular route about 177 times and was well qualified with nearly 15,000 flying hours. United Airlines Captain Robert F. Shirley had flown the route on a regular basis since October 1, 1955, and was also well qualified with nearly 17,000 flying hours.⁷⁶

At 9:21 a.m., over the Mojave Desert near the California-Arizona border, the TWA flight requested permission from the Los Angeles Air Traffic Control center to ascend from 19,000 feet to 21,000 feet to avoid bad weather. Ground control advised the TWA pilot of United’s presence at that level. The TWA flight then asked and received approval to ascend 1,000 feet on top (above the general cloud layer) for better weather. At 10:13 a.m., both pilots relayed their positions at an elevation of 21,000 feet to the Salt Lake City controller, and estimated arrival at the Painted Desert point of reference near Winslow, Arizona, at 10:31.⁷⁷

About the time they crossed the California border, the two aircraft had passed from controlled instrument flight rules (IFR) along prescribed airways, to visual flight rules (VFR) whereby pilots became responsible for avoiding other aircraft. The Super Constellation was traveling at about 310 mph, and the DC-7 at approximately 330 mph.⁷⁸ The last radio message at 10:31, unidentifiable at the time, was later interpreted as, “Salt Lake, United 718...ah...we’re going in.”⁷⁹

⁷¹ Rochester, *Takeoff at Mid-Century*, 121.

⁷² “Dwight D. Eisenhower: Special Message to the Congress Agency.”

⁷³ Rochester, *Takeoff at Mid-Century*, 123, 125.

⁷⁴ Haine, *Disaster in the Air*, 190; David Gero, *Aviation Disasters: The World’s Major Civil Airliner Crashes since 1950* (Great Britain: Patrick Stephens Limited, 2006), 23.

⁷⁵ Rochester, *Takeoff at Mid-Century*, 126. “Preparations for Flight 2 were routine except that departure was delayed a few minutes by minor maintenance on the aircraft.” CAB, *Accident Investigation Report*, 1.

⁷⁶ CAB, *Accident Investigation Report*, 7.

⁷⁷ Gero, *Aviation Disasters*, 23, 24 for commentary; Haine, *Disaster in the Air*, 190. The Painted Desert was “an imaginary line demarcated by two navigation aids that stretched north-westwards from Winslow, Arizona, into southern Utah.”

⁷⁸ Gero, *Aviation Disasters*, 23-24; Rochester, *Takeoff at Mid-Century*, 127.

⁷⁹ Civil Aeronautics Board, *Accident Investigation Report 3*.

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A search for the two airliners commenced after the pilots failed to report passing the Painted Desert line of position. Following a radio search by communications stations along the route, the CAA and TWA and United communication centers issued a missing aircraft alert at 11:51 a.m. and a search and rescue operation began from Nellis Air Force Base in North Las Vegas, Nevada.⁸⁰ Aircraft from California and Arizona airfields started scouring the Grand Canyon area for any sign of the missing aircraft.⁸¹ That evening Palen Hugdins, a pilot for Grand Canyon Airlines, a sight-seeing service, identified the TWA Constellation empennage (the tail assembly), and on the next day he located the United crash site approximately one mile away.⁸² Park rangers relayed Hugdins' findings to Nellis and on July 1, air search and rescue units shifted their base of operations to Grand Canyon Airport.⁸³

Military units from across the south and southwest participated in the recovery and investigation operations. At least two army H-19 helicopters from Douglas Airbase, one air force H-21 helicopter from Nellis, two H-21s from Luke Air Force Base, Arizona, and one helicopter from March Airfield, California, joined the operation.⁸⁴ Army crews from the 14th Fixed Wing Tactical Transport Company and the 93rd Cargo Helicopter Squadron at Ft. Huachuca, Arizona,⁸⁵ were later joined by a helicopter detachment from Fort Benning, Georgia. Representatives from the airlines, the CAB, the CAA, the Federal Bureau of Investigation and the Post Office Department joined military personnel on the canyon's South Rim.

On July 1 an air force helicopter briefly landed under hazardous conditions near the TWA wreckage.⁸⁶ High winds prevented landing at the United wreckage [REDACTED].⁸⁷ The rescue team quickly determined that no one had survived the disaster. On July 2, an eleven-person recovery party (including the county coroner, CAB, CAA, and airline officials) flew by helicopter [REDACTED] and landed on a small ledge 150 feet from the TWA crash site.⁸⁸ They collected bodies in rubber sacks and transported five victims to Grand Canyon Airport. From the airport, a DC-3 flew the bodies to a temporary morgue at the Flagstaff fair grounds.⁸⁹ The recovery crew remained in the canyon overnight after high winds made their return too dangerous.⁹⁰

On July 3, the recovery party retrieved another 21 bags of human remains from the TWA crash site.⁹¹ This dangerous work concluded body recovery at TWA, but crews continued to collect personal items and plane

⁸⁰ Ibid.

⁸¹ *Arizona Republic*, 1 July 1956.

⁸² Civil Aeronautics Board, *Accident Investigation Report*, 3.

⁸³ During the night of June 30-July 1, search and rescue was based in Winslow, Arizona. It appears that operations shifted to Grand Canyon Airport after Hugdins' second flight on the morning of July 1 when he identified the United plane [REDACTED] Merle Stitt to Regional Director, Region Three, Grand Canyon National Park, July 18, 1956.

⁸⁴ Phil Iverson, Grand Canyon National Park Telephone and Radio Notes, [handwritten notes, no title], 30 June-1 July 1956, Grand Canyon National Park Museum Collection, Grand Canyon, AZ; Civil Aeronautics Board, *Accident Investigation Report*, 4.

⁸⁵ *Arizona Republic*, 3 August 1956.

⁸⁶ Civil Aeronautics Board, *Accident Investigation Report*, 4.

⁸⁷ *Arizona Daily Sun*, 2 July 1956; Phil Iverson, Grand Canyon National Park Telephone and Radio Notes, "KB7724-10:05 a.m. - Davis," 1 July 1956, Grand Canyon National Park Museum Collection, Grand Canyon, AZ.

⁸⁸ Larry Wren, "Gory Crash Scene Detailed by Larry Wren," *Arizona Daily Sun*, 4 July 1956, 1; Phil Iverson, Grand Canyon National Park Telephone and Radio Notes, "Telephone-11:20-from Cravey H.T.," 2 July 1956, Grand Canyon National Park Museum Collection, Grand Canyon, AZ.

⁸⁹ Phil Iverson, Grand Canyon National Park Telephone and Radio Notes, [handwritten notes, no title], 3 July 1956, Grand Canyon National Park Museum Collection, Grand Canyon, AZ.

⁹⁰ *Arizona Daily Sun*, 2 July 1956.

⁹¹ Phil Iverson, Grand Canyon National Park Telephone and Radio Notes, "KOC 7724- Airport from Carl-7:55a.m.," 3 July 1956, Grand Canyon National Park Museum Collection, Grand Canyon, AZ; *Arizona Daily Sun*, 3 July 1956.

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pieces for the CAB investigation until July 7.⁹² The remains of only three people were ever identified from the TWA site. The unidentified remains of the 67 other passengers and crew were buried in a mass grave, designated the Grand Canyon Memorial Cemetery, at Flagstaff on July 9.⁹³

On July 3, another recovery party also collected two bags of human remains [REDACTED] below the United impact site.⁹⁴ At this point few victims from the United flight had been recovered and it was unclear whether the impact area atop a sheer cliff face could be reached.⁹⁵ United Airlines hired a Swiss mountain team, sharing expenses with Swissair, to help recover victims.⁹⁶ Meanwhile a five-man team of Colorado Mountain Club mountaineers, also hired by United, began scaling the cliff. The ascent was extremely hazardous according to one team member: "the rock was quite rotten...I sure hope I never see anything like that again."⁹⁷ By July 4, three victims had been recovered from the base of the cliff, but neither the climbers nor the helicopter crews had reached the impact area. Following another abortive attempt to land near the wreckage, officials began to discuss the possibility of cancelling further recovery efforts because of the hazardous flying conditions.⁹⁸

On July 5, after driving hundreds of expansion bolts into the soft rock, the climbing team neared the United impact area. Army helicopter pilots Capt. Walter Spriggs and Chief Warrant Officer Howard Proctor also made a treacherous landing, about 150 feet from the wreckage. Spriggs directed the landing of a second helicopter carrying two Colorado mountain climbers. Five more men arrived the following day. On July 6, the Swiss Mountain team arrived with specialized gear. By July 10, the recovery crew had removed 43 bags of remains. The next day, Park Superintendent John McLaughlin terminated recovery efforts.⁹⁹ Eventually 29 of the 58 crash victims were identified and sent to relatives for private burial. On July 12, the remains of the 29 unidentified passengers from the United flight were buried in four coffins at the Grand Canyon Cemetery on the South Rim.¹⁰⁰

Treacherous terrain, high winds, and extreme temperatures created such dangerous flying and working conditions that some experts had deemed the recovery operation impossible.¹⁰¹ Superheated air created 60 mph winds below the rim, tossing the fragile helicopters perilously close to the canyon walls.¹⁰² Temperatures on the canyon floor of 120 degrees challenged man and machine and limited helicopter landings to the early morning hours when the air was cool enough to provide the rotors with lift. One of the Colorado Mountaineers recalled that: "sometimes we only had a few seconds to unload supplies and load on bodies."¹⁰³ The rushing Colorado River provided the only possible emergency landing spot once the helicopters descended below the rim. As Captain Spriggs explained to reporters: "If you misjudge the distance [at United] by 10 or 15 feet, you would drop maybe 1,000 feet into the canyon."¹⁰⁴ Not a single life or aircraft perished during the 76 flights to

⁹² *Arizona Daily Sun*, 3 July 1956; *Arizona Republic*, 7 July 1956.

⁹³ *Los Angeles Examiner*, 10 July 1956; Haine, *Disaster in the Air*, 196.

⁹⁴ Iverson, "KOC 7724-Airport from Carl-7:55a.m."; *Arizona Daily Sun*, 3 July 1956.

⁹⁵ Phil Iverson, Grand Canyon National Park Telephone and Radio Notes, "KB7724-Airport from Carl-9:30 a.m.," 3 July 1956, Grand Canyon National Park Museum Collection, Grand Canyon, AZ.

⁹⁶ *Arizona Daily Sun*, 3 July, 1956; Haine, *Disaster in the Air*, 196.

⁹⁷ *Rocky Mountain News*, 6 July 1956.

⁹⁸ *Arizona Daily Sun*, 4, 5 July 1956

⁹⁹ *Ibid.*, 5, 6, 10, 11 July 1956; *Arizona Republic*, 6 July 1956; Haine, *Disaster in the Air*, 197.

¹⁰⁰ John S. McLaughlin, Superintendent, Grand Canyon National Park to Regional Director, Region Three, 18 July 1956, 5.

¹⁰¹ *Arizona Republic*, 30 July 1956.

¹⁰² "After Commercial Aviation's Worst Disaster: A Perilous Searching Operation," *Life*, 16 July 1956.

¹⁰³ *Rocky Mountain News*, 6 July 1956.

¹⁰⁴ *Arizona Republic*, 6 July 1956.

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and from the crash sites.¹⁰⁵ The extraordinary airmanship and daring of the helicopter crews was recognized as “without precedent in army history” and resulted in numerous commendations and medals.¹⁰⁶

Structural Investigation

The results of the structural investigation led the CAB to conclude that an inflight collision had occurred. “Smears” and paint or “paint smudges” from the Constellation L-1049 appeared on the DC-7’s left outer wing panel, wing tip assembly, and a buckled aileron. A section of the DC-7s lower wing skin found in the TWA impact area revealed a piece of the L-1049’s headlining used in the cabin. The L-1049 aft fuselage bore three propeller cuts. One of these cuts contained red and blue paint marks that matched the paint scheme on the DC-7’s propeller.¹⁰⁷

Wreckage location, combined with physical damage, also provided clues to an inflight collision. Severe damage on the L-1049 main empennage, found 550 yards north of the aircraft’s impact area, revealed that it had separated from the aft fuselage in flight after colliding with the DC-7. Two pieces from the Constellation empennage were located far enough from the main empennage to indicate separation prior to ground impact. “Heavier pieces of the L-1049 aft fuselage structure and aft interior equipment were found west of the main TWA wreckage site. Light interior materials from the aft fuselage [REDACTED] [REDACTED] indicating that they were torn or spilled out at a sufficient altitude to drift this distance.”

Based on a thorough analysis of physical damage and the location of aircraft wreckage, the CAB formulated its inflight collision sequence:

[I]t appears that first contact involved the center fin leading edge of the L-1049 and the left aileron tip of the DC-7. Instantly thereafter the lower surface of the DC-7 left wing struck the upper aft fuselage of the Constellation with disintegrating force. Without question this force caused complete destruction of the aft fuselage and destroyed the structural integrity of the left wing outer panel. As this occurred the aircraft continued to pass laterally, the left fin leading edge of the Constellation and the left wing tip of the DC-7 made contact, tearing off pieces of both components. During this same time the DC-7 No. 1 propeller inflicted a series of cuts in the area of the aft baggage compartment of the L-1049. This entire sequence took less than one-half second.¹⁰⁹

The Flight Investigation

¹⁰⁵ McComb, “Collision Over the Canyon,” 53.

¹⁰⁶ *Arizona Republic*, 30 July 1956. At Ft. Huachuca, forty-one members of the 93rd Transportation Company, 14th Army Aviation Company and 9470th Technical Unit received commendations. At a White House ceremony on August 2, President Eisenhower decorated thirty army and air force pilots for “skill and daring seldom matched in time of peace.” *Arizona Republic*, 3 August 1956. Two air force pilots accidentally left off the list of White House honorees were later decorated. *Arizona Republic*, 2 August 1956. The airmen from Ft. Huachuca and Luke Air Force Base in Phoenix received recognition for risking their lives to recover victims and collecting crucial evidence. Nine army pilots received the Soldier’s Medal, another fifteen received commendation ribbons, and two pilots received both. Furthermore, two air force pilots received the Distinguished Flying Cross and four received the Air Force Medal. *Phoenix Gazette*, 2 August 1956. Seven of the nine Soldier’s Medal recipients (all from the 93rd Transportation Company) would also received the Distinguished Flying Cross. *Arizona Republic*, 3 November 1956. Six were later commissioned as colonels for their actions. *Arizona Daily Sun*, 3 September 1956. The Flight Safety Foundation honored two army pilots and an air force captain. *Arizona Republic*, 9 August 1956. Seven of the nine Soldier’s Medal recipients (all from the 93rd Transportation Company) would also receive the Distinguished Flying Cross. *Arizona Republic*, 3 November 1956.

¹⁰⁷ CAB, *Accident Investigation Report*, 4-6.

¹⁰⁸ *Ibid.*, 5-6.

¹⁰⁹ *Ibid.*, 15-16.

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As part of its investigation, the CAB also analyzed the flight itself. Both planes were in uncontrolled airspace, where sufficient facilities and the means for such control did not exist. Here pilots operate under visual flight rules, also known as the “see and be seen” principle that depends on the flight crews’ ability to visually provide separation between aircraft. Both planes had also diverted northward over Grand Canyon National Park from their proposed flight tracks, a practice allowed in uncontrolled airspace to take advantage of weather factors.¹¹⁰

Limitations faced by air traffic controllers in an insufficient navigation system, which directly impacted the fate of the two airliners, came forth during the public hearing CAB held in the Department of Commerce Auditorium in Washington, D.C., between August 1 and 4, 1956. The CAB questioned the Salt Lake controller regarding whether traffic advisory information should have been issued to the flights. The controller knew that both aircraft were flying at the same altitude and that both had estimated duplicate arrival times at the Painted Desert line of position. The controller replied that because flights in uncontrolled areas are not required to take a specific track, he did not know what track either flight would take to the line of position. Furthermore, the Painted Desert line of position is nearly 175 miles long. “The estimates from the flights, therefore, did not mean they could converge there but merely that both would pass the line eastbound at that time.” Providing advisory information to flights within uncontrolled airspace was not required and also not possible without control of flights, more definitive position descriptions, and additional facilities and staff.¹¹¹

In its analysis, the CAB cited “the probable cause” for the collision “was that the pilots did not see each other in time to avoid the collision.” Why the pilots had not seen each other in time was inconclusive and could be attributed to a number of variables that had been explored and summarized by the CAB:

[T]he evidence suggests that it [the midair collision] resulted from any one or a combination of the following factors: Intervening clouds reducing time for visual separation, visual limitations due to cockpit visibility, and preoccupation with normal cockpit duties, preoccupation with matters unrelated to cockpit duties such as attempting to provide the passengers with a more scenic view of the Grand Canyon area, physiological limits to human vision reducing the time opportunity to see and avoid the other aircraft, or insufficiency of en route air traffic advisory information due to inadequacy of facilities and lack of personnel in air traffic control.¹¹²

The Aftermath

The Grand Canyon disaster “rocked the aviation world,” as the deadliest in American commercial aviation history at the time.¹¹³ The two giant airliners’ collision over the emptiness of the Grand Canyon in relatively clear weather in broad daylight was especially troublesome. Aviation experts had been warning of a catastrophic mid-air collision over a congested metropolitan area, not the vast expanses of the Southwest. It was, in the words of one CAA official, the “impossible” accident.¹¹⁴ By illustrating the razor thin margin of error that existed in the crowded airspaces above major cities, the collision highlighted the airways crisis.¹¹⁵ As

¹¹⁰ Ibid., 16-17.

¹¹¹ Ibid., 10. Also, this advisory information was only a discretionary duty in the controlled area. The CAA Director of Air Traffic Control confirmed these facts, testifying “that advisory service for traffic in uncontrolled areas would be tantamount to positive control of all traffic which would require personnel, facilities, and equipment not presently available.” CAB, *Accident Investigation Report*, 11.

¹¹² Ibid., 24-25.

¹¹³ Cadwalader, “Air Mystery is Solved,” 151.

¹¹⁴ Rochester, *Takeoff at Mid-Century*, 127.

¹¹⁵ “U.S. Skies Getting Overcrowded, Near Collisions More and More Frequent,” *U.S. News & World Report*, 13 July 1956: 34.

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one commentator stated: “The Arizona accident, tragic as it was, served one good purpose. It focused the attention of the American people on their government and the horse-and-buggy conditions prevailing on our airways.”¹¹⁶

The Eisenhower administration was familiar with the problems plaguing the nation’s airways, however, some lawmakers were largely unaware of the crisis. “In Washington, Congressmen who had never taken an interest in aviation matters went to the library” and began questioning CAA officials. Many congressmen, shocked to discover how primitive the air traffic control system was, listened in disbelief as CAA officials described how aircraft operated under visual flight rules without any ground control.¹¹⁷

In the wake of the disaster, it became obvious that the CAA lacked the resources to implement any meaningful change.¹¹⁸ Only two weeks before the Grand Canyon collision, Congress had reduced funding for CAA’s five-year modernization plan to install radar for positive control above 24,000 feet. Just two weeks after the crash, CAA officials went before the Senate Appropriations Committee with a supplemental request for \$68 million dollars to immediately purchase and install over one hundred new radar units. This approval reduced CAA’s original timeframe for the plan from five to three years. Henry Rothschild, director of the Commerce Department, admitted to a senator: “we would be less than fair with you if we did not tell you that this crash, this recent crash, moved us along at a faster pace, too.”¹¹⁹

Four months after the disaster, funding for aeronautics-related projects skyrocketed. In 1957, James Pyle, director of CAA, asked for and received \$810 million for a new airways plan. Allocations for new airway facilities increased from \$16 million in 1956 to \$125 million in 1958. CAA employment rose sharply with thousands of new hires from 1957 to 1958. Congressional legislators realized “we had a fantastic catching up to do.”¹²⁰ On December 1, 1957, officials also lowered the control floor for positive control from 21,000 to 15,000 feet, and announced plans for twelve “superskyways” that would provide for direct, controlled high-altitude routes for transcontinental commercial flights, decisions no doubt influenced by the 21,000-foot altitude of the Grand Canyon collision. On November 20, 1956, CAA announced that it had awarded a \$9 million dollar contract for 23 long-range radars, the agency’s largest single purchase of electronic equipment to that date. The new radars were to be used primarily for en route air traffic control purposes.¹²¹

The crash also produced a new urgency to break the deadlock over the conflicting civil (VOR) and military (TACAN) air navigation systems. Two months prior to the Grand Canyon collision, one industry expert had predicted that this dispute would continue indefinitely. On August 30, 1956, the Air Coordinating Committee approved a study panel’s recommendation that VOR and TACAN be combined. VORTAC (an acronym used to describe a short-range navigation system, using the VOR directional component and the distance component of TACAN) would become a key element of the civil-military common system of air navigation and air traffic control.¹²²

Although some work had been completed on a Collision Avoidance System (CAS) for aircraft before the summer of 1956, the first concerted attempts to produce a viable device came after the Grand Canyon

¹¹⁶ Ernest Conine, “Russian Roulette on our Airways?” *Harper’s Magazine* 213 (September 1956), 40.

¹¹⁷ Rochester, *Takeoff at Mid-Century*, 128.

¹¹⁸ Michael Nolan, *Fundamentals of Air Traffic Control* (Belmont, CA: Wadsworth Publishing Company, 1994), 24.

¹¹⁹ Rochester, *Takeoff at Mid-Century*, 130.

¹²⁰ Rochester, *Takeoff at Mid-Century*, 130, 146-47.

¹²¹ Terry Kraus to Susan Salvatore, e-mail message to Susan Salvatore, March 30, 2011.

¹²² *Ibid.*; Rochester, *Takeoff at Mid-Century*, 131-35.

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disaster.¹²³ U.S. airlines then began looking for a warning device that could prevent similar collisions. In 1956, the Air Transport Association (ATA), an association of the major U.S. airlines, held a symposium to compare their requirements for a CAS with current technology. ATA also formed a Collision Avoidance Committee that later merged with the Federal Aviation Agency's Collision Prevention Advisory Group.¹²⁴ A number of companies began research and development on collision alarms for aircraft, the most notable being Collins Radio Company in Cedar Rapids, Iowa. United Air Lines and American Airlines began negotiating with famed electronic genius Art Collins to equip their fleets with his collision alarm system. Collins' system would automatically alert the pilot of any aircraft within a two-mile radius, provide the location of the intruder, and adjust the plane's flight path accordingly.¹²⁵ Clearly, the 1956 Grand Canyon collision spurred the development of CAS technology and laid the groundwork for the modern Traffic Alert/Collision Avoidance Systems in use today.¹²⁶

Creation of the Federal Aviation Agency

In February 1957, Edward Curtis, Eisenhower's special assistant for aviation, unveiled his plan before the President's Advisory Committee on Government Organization. He outlined how to address the organizational and technical deficiencies that had led to the inadequacies of the nation's aviation facilities system. He proposed forming a temporary independent agency, the Airways Modernization Board, devoted to research and development to deal with immediate traffic control needs. In the long term, he envisioned an independent Federal Aviation Agency. Four days later the plan was sent to Congress and released to the public.¹²⁷ In August 1957, President Eisenhower signed the Airways Modernization Act. The act established the short-lived Airways Modernization Board, starting "a new era of sensible control of the nation's airspace."¹²⁸ On May 21, 1958, Senator A. S. Mike Monroney of Oklahoma "introduced... a bill to create an independent Federal Aviation Agency to provide for the safe and efficient use of national airspace by both civil and military operations, and to provide for the regulation and promotion of civil aviation in such a manner as best would foster its development and safety."¹²⁹

The 1956 Grand Canyon aviation accident was not the only air disaster to spur the government into action. Two midair collisions between civilian and military aircraft in the spring of 1958, "dramatically pushed these plans along," particularly demonstrating "the need for unified control of civil and military flights."¹³⁰ One collision near Las Vegas, Nevada, between an air force jet fighter and a United DC-7, killed all forty-seven onboard the airliner, and the second collision over Brunswick, Maryland, between a T-33 trainer and a Capital Airlines, killed two military personnel and all eleven passengers onboard the airliner. In President Eisenhower's special message to Congress on June 13, 1958, he recommended the establishment of a new federal aviation agency: "it had been my intention to submit recommendations for a [F]ederal Aviation Agency to the Congress early in the next session. The recent Maryland collision has made it apparent, however, that the

¹²³ U.S. Congress, Office of Technology Assessment, *Safer Skies with TCAS: Traffic Alert and Collision Avoidance System—A Special Report*, OTA-SET-431 (Washington, DC: U.S. Government Printing Office, February 1989), 3.

¹²⁴ In the fervor following the crash, J. S. Morrell of the Bendix Corporation, produced the first accurate study of the physics involved in collision avoidance. U.S. Congress, Committee on Science and Technology, *Aircraft Collision Avoidance* (Washington, DC: U.S. Government Printing Office, 1979), 4.

¹²⁵ "CORPORATIONS: Genius at Work," *Time*, 24 September 1956, <http://www.time.com/time/magazine/article/0,9171,867144,00.html> (accessed February 25, 2011); Mary H. Cadwalader, "Air Mystery is Solved," *Life*, April 1957: 164.

¹²⁶ Rob Lee, "TCAS: How it Works," *Flight Safety Australia* 8 (July-August 2004), 25; U.S. Congress, *Safer Skies With TCAS*, 3.

¹²⁷ Rochester, *Takeoff at Mid-Century*, 193-94.

¹²⁸ Davies, *Airlines of the United States*, 356.

¹²⁹ Rochester, *Takeoff at Mid-Century*, 194.

¹³⁰ *Ibid.*, 204

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need for action is so urgent that the consolidation [of aviation facilities and air traffic management functions] should be undertaken now.”¹³¹ The imminent arrival of commercial jets also played a central role in these decisions. However, the 1956 collision clearly demonstrated that visual flight rules were obsolete in an era of piston aircraft. After the Grand Canyon disaster, “the thought of a fleet of jetliners flying under visual flight rules was suddenly a thing of horror.”¹³² Thus the crash provided a sense of urgency and a measure of how far air traffic control lagged behind aircraft technology.

¹³¹ “Dwight D. Eisenhower: Special Message to the Congress.”

¹³² Heppenheimer, *Turbulent Skies*, 179.

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Conclusion

The sense of urgency and public demand the 1956 Grand Canyon aviation disaster created were fundamental to the passage of the Airways Modernization Act in 1957 and the creation of the temporary Airways Modernization Board, which one historian extolled as “a new era of sensible control of the nation’s airspace.”¹³³ Federal funds for aviation facilities, which had lagged before the crash, significantly increased afterwards. In addition, civil and military interests resolved their dispute over a common airplane navigation system. This crash, along with the 1958 midair collisions, advanced the passage of the Federal Aviation Act in 1958, which created the Federal Aviation Agency. Reflecting on its rapid passage, Elwood Quesada, the agency’s first administrator, stated, “undoubtedly, the best troubleshooter we had was public demand for change.” The creation of the Federal Aviation Agency marked a significant turning point in the “campaign for a rational, efficient system of aviation planning and policymaking.”¹³⁴

Before the Grand Canyon collision, people in government had been working for months on improving the airways program. Thus, the accident was not a catalyst, but more an elucidator, one that dramatically hastened plans already in motion. “Surely the accident, occurring at a climactic point in the airways crisis,” states historian Stuart I. Rochester, “had a momentous impact. It focused public attention on the air issue, stirred Congress from its ostrichism, and jolted even those insiders who were already cognizant of the collision hazard.” Stuart concludes, “If it was not *the* pivotal event in the campaign for sounder civil air regulation, it was, undeniably, an important watershed.”¹³⁵

¹³³ Davies, *Airlines of the United States*, 356.

¹³⁴ Rochester, *Takeoff at Mid-Century*, 215, 219.

¹³⁵ *Ibid.*, 125-26, 147.

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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--Arizona
- Other State Agency
- Federal Agency—Department of Interior, National Park Service, Grand Canyon National Park.
- Local Government
- University (Northern Arizona University, Special Collection, Cline Library)
- Other (Specify Repository):

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10. GEOGRAPHICAL DATA**Acreage of Property:** 1,332**UTM References:** REDACTED**Verbal Boundary Description:** REDACTED**Boundary Justification:** REDACTED

The location of this property is restricted information under law:
National Historic Preservation Act of 1966, as amended, section 304, 16 U.S.C. 470w-3(a)

Section 304

[16 U.S.C. 470w-3(a) – Confidentiality of the location of sensitive historic resources]

(a) The head of a Federal agency or other public official receiving grant assistance pursuant to this Act, after consultation with the Secretary, shall withhold from disclosure to the public, information about the location, character, or ownership of a historic resource if the Secretary and the agency determine that disclosure may –

- (1) cause a significant invasion of privacy;
- (2) risk harm to the historic resources; or
- (3) impede the use of a traditional religious site by practitioners.

[16 U.S.C. 470w-3(b) – Access Determination]

(b) When the head of a Federal agency or other public official has determined that information should be withheld from the public pursuant to subsection (a) of this section, the Secretary, in consultation with such Federal agency head or official, shall determine who may have access to the information for the purpose of carrying out this Act.

The location of this property is restricted information under law:
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Section 304

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NATIONAL HISTORIC LANDMARKS SURVEY
June 11, 2014