NPS Form 10-900
(Oct.1990)

OMB No. 1024-0018

United States Department of the Interior
National Park Service

National Register Of Historic Places Registration Form

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NAT. REGISTER OF HISTORIC PLACES
NATIONAL PARK SERVICE

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OHP

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

1. Name of Property

historic name Atchison, Topeka and Santa Fe Railway Steam Locomotive No. 3751

other names/site number AT&SF 3751

2. Location

street & number 2435 East Washington Boulevard ☐ not for publication

city or town Los Angeles ☐ vicinity

state California code CA county Los Angeles code 037 zip code 90021-2921

3. State/Federal Agency Certification

As the designated authority under the National Historic Preservation Act of 1986, as amended, I hereby certify that this ☒ nomination ☐ request for determination of eligibility meets the documentation standards for registering properties in the National Register of Historic Places and meets the procedural and professional requirements set forth in 36 CFR Part 60. In my opinion, the property ☒ meets ☐ does not meet the National Register Criteria. I recommend that this property be considered significant ☒ nationally ☐ statewide ☐ locally. (☐ See continuation sheet for additional comments.)

Signature of certifying official/Title — Date 8/31/00

California Office of Historic Preservation

State or Federal agency and bureau

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

Signature of commenting or other official — Date

State or Federal agency and bureau

4. National Park Service Certification

I hereby certify that this property is:

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

Signature of the Keeper — Date of Action

Carol R. Shull — 10/4/00

AT&SF 3751
Name of Property

Los Angeles, California
County and State

5. Classification

Ownership of Property
(Check as many boxes as apply)

- ☒ private
- ☐ public-local
- ☐ public-State
- ☐ public-Federal

Category of Property
(Check only one box)

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

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

Contributing	Noncontributing	
		buildings
		sites
1	0	structures
		objects
1	0	Total

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

N/A

Number of contributing resources previously listed in the National Register

6. Function or Use

Historic Functions
(Enter categories from instructions)

TRANSPORTATION/rail-related

Current Functions
(Enter categories from instructions)

TRANSPORTATION/rail-related

7. Description

Architectural Classification
(Enter categories from instructions)

Other: steam locomotive

Materials
(Enter categories from instructions)

foundation

roof

walls

other steel, wood, glass, brass

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

8. Statement of Significance

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

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

Criteria Considerations
(Mark "X" in all the boxes that apply.)

Property is:

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

Areas of Significance
(Enter categories from instructions)

TRANSPORTATION
ENGINEERING

Period of Significance

1927-1953

Significant Dates

1927
1941
1953

Significant Person
(Complete if Criterion B is marked above)

N/A

Cultural Affiliation

N/A

Architect/Builder

Atchison, Topeka and Santa Fe Railway (designer)
Baldwin Locomotive Works (builder)

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

9. Major Bibliographical References

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

Previous documentation on file (NPS):

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

Primary Location of Additional Data

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

Name of repository:

_____

AT&SF 3751
Name of Property

Los Angeles, California
County and State

10. Geographical Data

Acreage of Property Less than one acre

UTM References
(Place additional UTM references on a continuation sheet)

	Zone	Easting	Northing		Zone	Easting	Northing
1	11	386860	3764740	3			
2				4			

☐ See continuation sheet.

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

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

11. Form Prepared By

name/title Philip C. Merkley, Administrative Manager, assisted by William R. Plunkett, Archivist; Additional material provided by Walter P. Gray, III, Chief, Archives & Museum Div., Calif. Secretary of State

organization San Bernardino Railroad Historical Society date February 28, 2000

street & number PO Box 2878 telephone 909-862-5015

city or town San Bernardino state CA zip code 92406-2878

Additional Documentation

Submit the following items with the completed form:

Continuation Sheets

Maps

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

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

Photographs

Representative **black and white photographs** of the property.

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

Property Owner

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

name San Bernardino Railroad Historical Society

street & number PO Box 2878 telephone 909-882-4599

city or town San Bernardino state CA zip code 92406-2878

Narrative Description

Atchison, Topeka and Santa Fe Railway locomotive No. 3751 is an oil-burning steam locomotive built in May 1927 by the Baldwin Locomotive Works in Philadelphia, Pennsylvania. Santa Fe and Baldwin jointly developed the design in 1926. Known as a "New Mountain" type on the Santa Fe Railway, the locomotive was the first of its type purchased by the Santa Fe and the first of this type built by Baldwin. Over its long history of service on the Santa Fe, the locomotive underwent several changes. Originally built to burn coal, the locomotive was converted to an oil-burner in December of 1936, at the Santa Fe shops in San Bernardino, California. In 1938, the Santa Fe motive power department decided to undertake a major rebuild of the AT&SF 3751 class locomotives, and the AT&SF 3751 was the last engine in the class to be rebuilt in early 1941. The description below reflects its current condition resulting from the 1941 modernization.

Type:	4-8-4 3751 Class; 14 engines, numbered 3751-3764
Builder:	Baldwin Locomotive Works, Philadelphia, PA
Construction Number:	60004
Service:	Passenger and Freight
Track gage:	4 feet, 8 ½ inches
Driving Wheel Diameter:	80" 1941-Present
Cylinders:	30" bore 30" stroke
Boiler Pressure:	230 lb./sq. in 1941
Boiler Diameter:	88"
Grate Area:	108 sq. ft
Wheel Base:	Total 94' 10 ½"
Engine Wheel Base:	46' 9"
Length:	Engine and Tender 108' 7"
Weight in Working Order:	Engine 478,100 lb.
	Tender 396,246 lb.
	Total 874,346 lb.
Heating Surface:	5634 sq. ft. Total
Tractive Force:	66,000 lb.
Horsepower:	Boiler - 5000, Cylinder - 3900, Drawbar - 3600
Fuel:	Oil 7101 gallons
Water:	20,000 gallons
Pulling Power-Passenger:	26 cars, 1820 tons, level grade, 65 m.p.h.
	15 cars, 1050 tons, 2% grade, 20 m.p.h.
Pulling Power-Freight:	105 cars, 5949 tons, level grade, 45 m.p.h.
Speed:	90 m.p.h.; 103 m.p.h. Highest Recorded Speed.

Alterations

When locomotive construction number 60004 rolled out of the shops of Baldwin Locomotive Works in 1927, she was the 13th 4-8-4 type locomotive built in America. The first twelve 4-8-4s were built by American Locomotive Company for the Northern Pacific and have all been scrapped, leaving AT&SF 3751 as the oldest 4-8-4 in existence. Destined for the Santa Fe, this locomotive was a new design experience for both the builder and operator. Assigned number 3751, she was the first of four classes of Santa Fe 4-8-4s, which included 3751, 3765, 3776, and 2900 classes. Costing $99,712.77 when delivered, she had been designed jointly by Santa Fe mechanical engineer H. H. Lanning and staff personnel from Baldwin. The appearance of the locomotive when built is shown in the attached builder's photograph taken in 1927, photograph number 1.

As originally built, AT&SF 3751 was an innovation in design, with its 4-wheel trailing truck to support the 108 sq. ft. grate of the boiler's firebox. Included was a cast-steel engine bed and separate cast cylinders, with cross-counter balanced 73" driving wheels. The boiler pressure was a standard Santa Fe practice – 210 psi. The total engine weight was 432,240 lbs. Total engine-tender weight tipped the scales a 724,000 lbs. Starting tractive effort was 66,000 lbs. with a maximum drawbar horsepower of 3,200 at 40 m.p.h.

In December of 1936 the AT&SF 3751 was converted to an oil burner at the San Bernardino shops. A Santa Fe patent Batz lead truck was applied, while the valve gear travel was shortened to allow operation in the 77 m.p.h. range. Following this conversion, AT&SF 3751 soon received a new roller-bearing equipped tender with a 7,107 gallon oil and 20,000 gallon water capacity. The larger tender allowed the ATSF 3751 to serve as protection power for the then new diesel-electric powered streamlined Super Chief passenger train.

With the arrival of the eleven new 3765 Class 4-8-4s in 1938, the Santa Fe motive power department decided to undertake a major rebuild of the 3751 Class. The purpose was to upgrade these locomotives to equal the 3765 Class if possible. This project began in October of that year and converted all fourteen locomotives of this class, culminating with the AT&SF 3751 herself early in 1941. These improvements included a new one-piece cast engine bed, new Wagner bypass valve equipped 30" x 30" cylinders, 80" drivers and Timken roller bearings on all engine axles. With additional internal bracing, the boiler pressure was increased to 230 psi, although due to larger drivers the original tractive effort of 66,000 lbs. remained the same. The conversion did, however, allow for 90 m.p.h. speeds and raised the horsepower rating to 3,600 in the 50 m.p.h. range with an indicated horsepower of over 3,900. The appearance of the locomotive after this modernization is shown in the attached photograph number 2 taken during World War II.

This major rebuilding was a success in producing a much more powerful and efficient locomotive. Other lesser improvements and modifications were also made during the 1940s. Pictures in SBRHS files indicate that the AT&SF 3751 received the standard Santa Fe extension stack by 1943. This stack lifted the smoke and provided the engine crew with better visibility of signals. In 1947, the Interstate Commerce Commission ordered automatic train stop to be used on locomotives exceeding 79 m.p.h. No. 3751 received Union Switch & Signal intermittent inductive automatic train stop equipment mounted on the right side trailer truck frame, which permitted her timetable maximum speed of 90 m.p.h. By 1949 the "deflector" type stack was in place for use in the numerous tunnels over the Tehachapi grade. Up to the time her fires were finally dropped on August 23, 1953, she had not received any further changes to her basic design.

Specific Features

There are several features that mark a modernized Santa Fe steam locomotive. These features, found on the AT&SF 3751, include the following:

- Number board attached to the handrail
- Jacketing covers the smoke box at the front of the locomotive, creating a massive appearance
- Uncluttered appearance due to most piping being hidden under the jacket
- Wagner by-pass valve integral to the cylinder casting
- Large locomotive number painted on the tender

Restoration

In 1957 the AT&SF 3751 was officially retired from Santa Fe and donated to the City of San Bernardino. In 1958 the AT&SF 3751 was placed in Viaduct Park, San Bernardino, California, for display. In 1981, the San Bernardino Railroad Historical Society (SBRHS) was formed for restoring AT&SF 3751 to operation. In 1985, the AT&SF 3751 was sold by the City of San Bernardino to the SBRHS. In 1986, with the help of SBRHS volunteers, AT&SF 3751 was moved to California Steel Industries, in Fontana, California where the SBRHS housed the locomotive and completed the restoration. In 1991, the restoration was completed and AT&SF 3751 returned to steam operation on August 15. An excursion called the California Limited was run December 27-30 to commemorate one of the famous all first-class Santa Fe name trains that this locomotive once pulled.

The restoration work began while the locomotive was still located in Viaduct Park. When it became evident that heavy work would be needed to restore the locomotive to an operating condition, a suitable site was found at California Steel Industries in Fontana, California.

Temporary track was laid to move the locomotive out of Viaduct Park, and the AT&SF 3751 was towed to the CSI site. There the locomotive was carefully disassembled. Extensive photographs were taken during disassembly, so that the original configuration would be duplicated during re-assembly. In addition to these photographs, the SBRHS had obtained a copy of the original folios the Santa Fe had used to document the details of their locomotives. These folios include details on material characteristics and appliances, such as air pumps, power reverse, and feedwater heater, used on the AT&SF 3751. Such details were crucial to an accurate restoration. All components of the AT&SF 3751 were removed and repaired or replaced during the restoration. To minimize possible damage to bearings from sand blasting, carbon dioxide pellets were used to clean the frame. A portion of the firebox was replaced, and new flues were installed. To replicate the locomotive's appearance, the old sheet metal jacket was used to create patterns for the new jacketing. The dark green color of the cab interior was researched and duplicated.

The intent of the restoration was to create an operating Santa Fe 3751 steam locomotive as she appeared when taken out of service in 1953. However, the intermittent inductive automatic train stop equipment was not refurbished and installed during the restoration. The appearance of AT&SF 3751 after this restoration is shown in the attached photograph number 3, taken in January 1999 during a break-in run to her new home at the Redondo Junction Roundhouse in Los Angeles, California.

Narrative Statement of Significance

Summary

In the area of engineering, Locomotive No. 3751 is significant at a national level because: 1.) It is the oldest surviving example of this type (the first order of 4-8-4s was built for the Northern Pacific by the American Locomotive Company, but all were scrapped), 2.) It is the first 4-8-4 produced by the company that was the largest steam locomotive manufacturer in the world (The Baldwin Locomotive Works--equivalent to Boeing today), and, 3.) It is the first 4-8-4 purchased by what was then--and until recent years remained--one of the principal railroads in the United States (The Atchison, Topeka and Santa Fe Railway). In the area of transportation, No. 3751 is significant at a national level because: 1.) It brought to the Santa Fe Railway the technological ability to innovate in train speed and comfort, 2.) As a social artifact it was a factor in shaping the public's expectations regarding long-distance transportation, and, 3.) It helped implement the Santa Fe's response to the Great Depression and the rise of the automobile through the establishment of what we would consider "modern" train services and amenities.

The AT&SF 3751 locomotive is historically significant in both transportation and engineering terms. In the transportation aspect, the locomotive reflects the evolution of steam-powered transportation in the United States, and as the oldest locomotive of its type is singularly historically significant. With regard to engineering, the locomotive's history reflects the engineering work conducted to understand and characterize its as-delivered performance and the technology needed for its subsequent modernization.

Transportation Significance[1]

Railroads were the pioneers of the American West, paving the way for settlement and growth. The Atchison, Topeka and Santa Fe Railway pioneered in the southwest quadrant of the Nation. The great southwest is in large measure the natural result of the spectacular developments in western transportation. The story of the Santa Fe became the story of the southwest.

Begun in 1868, the Santa Fe Railway reached California by 1883. The history of the Santa Fe Railway is a complex one involving construction, several purchases and reorganizations, including the appointment of receivers in 1893. Despite periodic ups and downs, the general

[1] Most of the material in this section is excerpted from *History of the Atchison, Topeka and Santa Fe Railway* by Keith L. Bryant, Jr.

trend for the Santa Fe was one of growth in traffic. This history provides the context for increasing size and power of its locomotives.

In the early years, locomotives were small and the railroad cars relatively light. In the late 1870s the locomotives were of the 4-4-0 wheel arrangement[2]. As the number and weight of cars increased, the need for larger locomotives arose. Thus by the mid 1880s, the Santa Fe was buying 2-6-0, 2-8-0, and 4-6-0 locomotives. In 1896 the railroad owned 962 locomotives, many of which were lightweight, worn out and in poor or non-operating condition. During the next twenty years, however, the roster grew to 2,084 engines, most of which were newer and heavier, with greater tractive effort. The advent of modern steam on the Santa Fe occurred around 1898, when the Santa Fe reclassified and renumbered its locomotives, and designated many for retirement. The arrival of a large group of 2-8-0s between 1897 and 1902 marked the transition to modern power.

By 1900, the mechanical department began to make the major decisions on locomotive design changes, and within fifteen years the department drafted the blueprints and wrote the specifications for all orders. Teams of inspectors went from Topeka to the builder's shop to observe all phases of the construction process to guarantee quality.

J. W. Kendrick became third vice president of the Santa Fe in June 1901. As an operations expert with a vast knowledge of locomotives, he initiated a series of motive power improvements. Kendrick pushed the builders hard to develop wide fireboxes supported by trailing wheels. Working in close consultation with Baldwin engineers, he designed locomotives with many interchangeable parts. Kendrick also established a system of large folios for locomotive plans and drawings.

Kendrick also decided to purchase larger power, and in 1902 the Santa Fe received the first order of fifteen 2-8-2s (Mikado). The Mikado replaced the 2-8-0 in freight service because their trailing wheels supported a larger firebox, which in turn helped develop grater tractive effort. The design was conservative and utilitarian, and with minor variations the Santa Fe bought 59 more in 1913 and 1916.

Around 1905 the Santa Fe began looking for an alternative fuel. Despite every effort to make coal more efficient, including screening and washing, the transportation costs alone forced the company to look for a substitute. The solution came from a California oil company, an answer to the operating department's prayers. This company operated a refinery at Santa Paula on the

[2] Steam locomotives are classified into types by the number and location of the wheels. Fredric Whyte devised a system, which bears his name, for classification that uses numerical symbols for wheels. In the Whyte system, the first numeral represents the total number of lead wheels, the second numeral the driving wheels, and the third the trailing wheels. Thus, a 4-4-0 has four lead wheels, four drivers, and no trailing wheels.

Southern Pacific, and asked the SP if it would loan them a locomotive to use in conducting experiments with oil as a substitute for coal. The SP refused, and so the company approached the Southern California Railway, a Santa Fe subsidiary. The Southern California sent 4-4-0 Number 10 to Santa Paula, and some of its mechanics went along. The oil company worked on the locomotive, but when they fired her up, she could not move her own weight. The mechanics brought Number 10 back, but the oil company continued to experiment with new burner systems. The Santa Fe's San Bernardino shops cooperated in the experiments, and together they developed a flat nozzle that sprayed oil over a wide area of the firebox. With the new nozzle system in place, Number 10 moved over Cajon Pass, and the conversion of Santa Fe locomotives to oil burners began. It was this burner design that was later used in the ATSF 3751 when it was converted to oil in 1936.

Needs for larger power in passenger service caused the Santa Fe to turn to the 4-6-2 Pacific. The Pacific type represented an improvement and enlargement of the 4-6-0 Tenwheeler, for the addition of a pair of trailing wheels allowed for a larger firebox and boiler, which gave the engine more weight for better adhesion. In 1903 Baldwin delivered 41 Class 1200 Pacifics, the first of four classes delivered by 1914. The Pacific and Mikado improved operating efficiency, but the Santa Fe had to resort to helpers over the tough grades at Raton, Glorieta, Abo, and Cajon, so Kendrick sought a more powerful locomotive for this purpose.

In answer to this need, Santa Fe and Baldwin worked together to produce the 2-10-2. These were compound engines and worked quite well. Baldwin built 86 in 1903-04, 74 more in 1905-06, and 32 more in 1912-13. The success of these compound locomotives led the Santa Fe to try compound Mallets of various wheel arrangements, including 4-4-6-2, 2-8-8-2, and 2-6-6-2 between 1909 and 1911. These locomotives were intended for helper service over the steep grades. However, these engines were generally not successful and many were rebuilt into smaller engines. The experience with the 4-4-6-4 illustrates some of the problems the Santa Fe had with these engines: They slipped easily, and the unbalanced sets of drivers just did not work. After six years of service they were cut up into two Pacifics in 1915. The 2-10-10-2s were rebuilt into conventional 2-10-2s in 1915-1918. Between construction of the "Cyrus K. Holliday" of 1869 and the 2-10-10-2s of 1911, fantastic progress had been achieved in locomotive size, power, and efficiency. After World War I, even greater strides were accomplished. The period of experimentation led to more conservative types and not even a world war and federalization would deter the course of the Santa Fe management in developing its own standards and designs.

Following the end of World War I and control by the U.S. Railroad Administration, the Santa Fe entered into another era in its continuing development of the steam locomotive. The "mania" for Mallets and compounding ended, and the company began to stress speed and efficiency rather than size. For the next thirty years the motive power department developed its own designs for

new steam locomotives and constantly upgraded older power with devices that raised their level of performance. The building of the ATSF 3751 in 1927 and subsequent upgrade in 1941 are today's evidence of this activity.

The immediate predecessors to the 3751 class were the 4-8-2 Mountains. These locomotives were first purchased in 1918 as the 3700 class. A total of 51 of this type were purchased and numbered 3700-3750, with the last delivered in 1924. The Santa Fe Mountains had large cylinders and boilers and could generate a substantial tractive effort as they conquered the system's long, continuous grades. Extra steaming power was essential because of the substantial number of mail and baggage cars being pulled on Santa Fe passenger trains, and the need for steam in the diners and lounges.

The twenties were a time of major changes on the Santa Fe. Under the leadership of William Benson Strong, Santa Fe President 1920-1933, major reconstruction programs relayed rail, straightened curves, reduced grades and built new bridges. These improvements allowed for longer trains and higher speeds. The shops at San Bernardino were expanded. The economy of the Southwest changed materially. Agriculture expanded, though not as rapidly as manufacturing, while timber, stone, and mineral products declined. The discoveries of oil in California, Texas, and Oklahoma created a new demand for tank cars. Burgeoning citrus and produce farms in the Southwest demanded more efficient refrigerator cars and faster movement to markets. In 1923, a new Central Manufacturing District was opened in Los Angeles.

Of far greater importance in the evolution of modern steam power on the Santa Fe was the arrival of the first 4-8-4 Northern[3] in 1927. During the previous year, Santa Fe engineers worked on a design for a 4-8-4, and No. 3751, built from ATSF specifications, arrived from Baldwin to enter a strenuous testing program. For almost a year AT&SF 3751 ran between Albuquerque and La Junta over Raton Pass. In comparison with the Mountains then in use, AT&SF 3751 could pull a one-third heavier load with almost 20 percent less fuel. It could start a train of 26 passenger cars and pull 9 of them over Raton without a helper. The nine remaining locomotives of the 3751 class were delivered by 1928. By the early 1930s they were covering two or three divisions in a run. Some traveled from La Junta to Los Angeles, a run of 1,234 miles, with nine crew changes.

The engineering department improved the 4-8-4 design in 1936 and the Santa Fe ordered eleven more 4-8-4s, largely for passenger service. The locomotives in this order were known as the

[3] Although "Northern" is a commonly used name for the 4-8-4 wheel arrangement, this was not universally used by the railroads themselves. For example, the New York Central referred to their Northerns as "Niagaras" and the Richmond Fredericksburg & Potomac Railroad called them "Potomacs." Copies of Santa Fe correspondence in SBRHS files show that the Santa Fe referred to them as "New Mountains" when they were purchased in 1927.

3765 class, and the improvements these locomotives carried included higher boiler pressure and larger drive wheels. These locomotives were capable of attaining 90 miles per hour, and pulled the Chief from La Junta to the West Coast, using a helper over Raton Pass.

With the success of the 3765 class 4-8-4s, the Santa Fe decided to modernize the 3751 class to create a comparable engine. This modernization was began in 1938 and culminated with the modernization of the AT&SF 3751 herself in 1941. Improvements to the 3751 class included larger drivers, higher boiler pressure, and roller bearings on all axles. The result was a modern locomotive fully comparable to the 3765 class.

The Santa Fe had started experimenting with diesel locomotives in 1934, and by 1936 diesel locomotives began to power the Super Chief. The enormous traffic demands placed on the Santa Fe during World War II strained the locomotive roster. Orders for additional diesels and steam locomotives were placed in December 1941 and February 1942, but wartime restrictions precluded the power that was so acutely needed. From 1939 to 1942 only 117 new locomotives were acquired, while 78 were scrapped. Of the 117 units, 86 were diesels, and this was a godsend. The diesels were assigned to the Argentine-Belen and Winslow-San Bernardino runs, and they quickly earned their costs many times over.

The war experience with diesels convinced Fred G. Gurley, ATSF President from 1944-1957, if he needed convincing, to convert totally to diesels. Thus a definite phasing out of steam began shortly after 1945. For example, in the fall of 1945 the Santa Fe owned 1,567 steam engines, 103 road diesels, and 144 diesel switchers. Within five years the figures changed to 1,199 steam engines and 627 road diesels. During this steam phase-out, the older and small steamers were scrapped as new diesels were acquired, but the 2-10-4s, 4-8-4s, and 4-6-4s were in constant use. In 1951 the entire system west of Albuquerque was dieselized, except for No. 3751, Nos. 3757-3760, and No. 2929, which were assigned to fill in as needed on the Los Angeles Division. No. 3751 and No. 2929 would sometimes run as extras to San Diego and handle the Del Mar Race Track Special. On August 23, 1953, the last fire was dropped in AT&SF 3751 and she was stored at the Redondo Junction Roundhouse in Los Angeles. By 1956, only 96 steam engines remained on the Santa Fe roster, and on August 27, 1957, the age of steam ended on the Santa Fe. Following its retirement from Santa Fe's roster on May 15, 1958, AT&SF 3751 was placed in Viaduct Park within sight of the shops that harbored its 1936 conversion from coal to oil.

Feeling

Many observers have commented on the special feeling evoked by an operating steam locomotive. Three are included here to show the feelings evoked by these magnificent machines.

Doyle McCormack is the engineer and Chief Mechanical Officer for the former Southern Pacific Daylight No. 4449. The 4449 was restored to pull the American Freedom Train in the mid 1970s, and the locomotive continues in occasional operation. In the video *Daylight Express*, he was talking about building up steam and getting the 4449 ready for a trip. He said, "When you bring her from a cold piece of iron to a living creature, that is the closest man has come to creating life."

Ed King is a retired railroader who regularly writes a column for *Trains* magazine. In the January 2000 issue, he said, "I have also hand-fired and run steam locomotives. And, simply put, the difference between all those other machines and the steam locomotive is that the steam locomotive is alive. This is why I'm so badly hooked–so much more than with all those nice machines combined. ...But take a hunk of iron and put water in its boiler and a fire in its firebox, and life begins, something like the late astronomer Carl Sagan's lightening bolt striking the primordial ooze."

On the 3751's return trip from Sacramento in June 1999 to attend Railfair '99, the AT&SF 3751 stopped in Tehachapi, California to take on water. Gene Vickery, a Tehachapi resident, observed the arrival, and described it with these words:

> That soulful moan echoed off the mountains of the Tehachapi Pass at 9:15 PM this evening....the undeniable sound of 3751's steam whistle in the cool mountain air. She paused here for thirty minutes as she took on 14,000 gallons of water to slake her thirst from the climb. The flood lights reflected off her beautifully contoured and riveted sides as she sat and patiently "chuffed" while the local fire engine replenished the water in her tender. The full moon slowly silouetted her stack, and outlined the long-out-of-service water tower beside the track. I don't know who the talented engineer was, but as she started to move to the east, he seemed to be playing "She'll Be Comin' 'Round the Mountain..." almost like a muffled trombone. The train started to move. The gleaming orange and yellow diesel followed, then the mechanical car followed by the incongruously grafitti-decorated hopper cars. It was a nightime spectacle of natural and artificial light, of aromas of hot oil, and most especially of the memory-recalling sounds....of steam escaping the cylinders as the train started it's labored moving....the wail of the whistle....and the echos of the wail as they bounced off the surrounding peaks. A moment to be savored and remembered.

Engineering Significance

This section of the narrative addresses the engineering aspects of the original construction of AT&SF 3751 in 1927 and its subsequent modernization in 1941.

As noted in the above transportation narrative, the historical trend in American locomotive design was ever-increasing power (tractive effort). This drove such physical characteristics as

overall size and weight, and firebox size. Other design parameters that evolved included efficiency, locomotive serving frequency and complexity, and wear on the rails. These parameters became major design drivers in the specifications the Santa Fe wrote for the 3751 class locomotives.

1927 Construction

The Santa Fe took delivery of AT&SF 3751 on June 15,1927. Shortly afterward, AT&SF 3751 went to Topeka for setup, weighing, and a break-in period, as was common practice. The locomotive then underwent a series of tests on the Santa Fe line between La Junta, Colorado, and Winslow, Arizona. Since the design was a new for the Santa Fe, they conducted extensive tests of the locomotive before placing the order for the remainder of the first ten engines of this class.

According to an unpublished Santa Fe test report[4], "The object of this test was to determine the power performance of Locomotive 3751 which was designed and built to obtain greater power and speed for mountain type passenger service." As a part of the test program, two changes were made to the locomotive during selected test runs to assess their impact on performance: (1) the grate area was reduced from the specified 108 sq. ft. to 80 sq. ft. to determine if the 108 sq. ft. was beyond the economical area, and (2) the diameter of the Layden exhaust nozzle was varied to determine its proper size. The locomotive was instrumented for these tests and a dynamometer car was used to record the performance characteristics. A great deal of data was collected during these tests, e.g., running time, number of cars, water and coal used, ash produced, foot-pounds of work at the drawbar, ambient temperature, wind direction and speed, barometric pressure, and general weather conditions. The test indicated that a 3 ¾ inch Layden exhaust nozzle was most efficient. Regarding the grate area, the report concluded as follows:

> As a general conclusion the data reflect that the larger grate area is preferable:
> (a) Because the locomotive can be forced to greater capacity without running the combustion per square foot of grate area above the economical rate;
> (b) Because the locomotive can sustain a greater output of power for longer periods of time;
> (c) Because longer runs can be made without cleaning the fire and dumping the ash pan; a desirable feature on long engine runs.

As a result of these successful tests, the Santa Fe placed the order for the remaining engines that were delivered in 1928. A subsequent order for four more AT&SF 3751 class locomotives was placed, and these were delivered in 1929, making a total of 14 engines in this class.

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[4] *Report of Test 87212, Locomotive 3751 in Passenger Service between La Junta and Winslow*

In addition to these characterization tests, the Santa Fe also conducted comparative performance tests between La Junta, Colorado and Albuquerque, New Mexico with 4-8-2 Mountain locomotive No. 3714 and No. 3751. The test results, reported in the July 1928 *Railway Mechanical Engineer*, are shown in Table I and are the averages of the performance figures for five round trips.

Table I—Comparative test of locomotives 3714 and 3751 between La Junta and Albuquerque—Average of five round trips burning mine-run coal

	Loco. 3714	Loco. 3751	Percentage in favor of Loco. 3751
Total time, hr.	11.47	11.65	—
Dead time, hr.	1.32	1.72	—
Running time, hr.	10.15	9.93	—
Speed, m.p.h.	34.25	35.0	2.2
No. stops	12	13	– 7.70
No. cars	10.5	14.5	38.1
Train tonnage	782	1,037	33.30
1,000 ton-miles	263.9	350.4	32.50
Cool used, lb.	59,640	48,060	19.40
Water used, gal.	33,520	35,370	– 5.50
Million foot lb. work	13,380	18,537	38.60
Coal per 1,000 ton-miles, lb.	226.2	138.6	38.7
Water per 1,000 ton-miles, lb.	1,058	930	12.1
Coal per million ft.-lb., lb.	4.46	2.55	42.8
Water per million ft.-lb., lb.	20.7	17.4	15.95
Lb. water per lb. coal	4.70	6.74	43.40

Note: Values marked thus (–) are in favor of Locomotive 3714 which, for an accurate comparison, should be credited with about 10 per cent better showing in all fuel factors because of not being equipped with a feedwater heater.

Another topic covered in the article was limiting track stresses. The article addressed this factor as follows:

> As a result of studies made on the Santa Fe during the past few years with a view to determining the wheel loading, distribution of weights and method of counter-balancing which will keep track stress within safe limits, a loading of trucks and driving axles of locomotive No. 3751 was adopted as shown in Table II. For purposes of comparison, the wheel loads of locomotive No. 3710, a previous Santa Fe Mountain type locomotive, are also given in this table.

Table II—Comparative driving axle and truck loads in pounds

	Locomotive 3751	Locomotive 3710
Engine truck	63,500	58,180
No. I wheel,	66,300	61,350
Main wheels	70,600	60,850
No. 3 wheels	66,500	60,550
No. 4 wheels	66,000	60,350
Trailer truck.	92,600	66,500

> The effectiveness of this design, together with accurate cross counterbalancing and a division of the trailer-truck load between two axles, has been such as to permit increasing driving-axle loads almost 10,000 lb. in locomotive No. 3751 as compared with locomotive No. 3710 and at the same time to develop lower peak track stresses.

1941 Modernization

In 1938 the Santa Fe embarked on its 3751 class modernization program, with ten of the fourteen engines being modernized over the next year. *Railway Mechanical Engineer* magazine[5] reported on the conversion in part as follows:

> The Atchison, Topeka & Santa Fe has converted ten heavy 4-8-4 type steam locomotives, known as the 3751 class, at its Albuquerque, N. M., locomotive shops. These locomotives were purchased from Baldwin in 1928. They were originally stoker-fired, but a few years ago were changed to oil and this fuel continues in use. They will run through between La Junta, Colo., and Los Angeles, Cal., 1,235 miles. The conversion was completed in July.

The article continues to outline the changes made during the conversion. These improvements included the following items:

- Commonwealth locomotive bed type frames replace original frame;
- Timken roller bearings applied to all wheels;
- 80-inch Boxpok drivers replace original 73-inch drivers;
- new and longer smoke box applied;
- dome closed by inside cap, riveted in place;
- feedwater heater raised to smokebox location;
- reciprocating feedwater pump located under left side of cab;
- boiler pressure raised to 230 lb.;
- two extra backhead braces and two extra flue sheet braces applied;
- size of radial stays around syphons increased;
- reinforcing pads riveted to barrel and smoke box,
- all rods new including tandem main rods, and new valve motion.

The introduction of roller bearings brought new challenges for precision work to the Santa Fe's Albuquerque shops. *Railway Mechanical Engineer* described the challenge this way:

> The application of roller bearings in the shop is new on the Santa Fe and is an important addition and betterment. New tenders were applied to the 3751 class locomotives at the time of change to oil and these had roller bearings as supplied by the builders. The present conversion includes roller bearings for engine trucks, trailers, and drivers. Doing this work in the railroad shop requires the introduction of new standards of accuracy. Plus or minus .0015 in. is a common

[5] *Santa Fe Rebuilds Ten Locomotives, Railway Mechanical Engineer*, September 1939

> notation on the new axle blueprints, and such close tolerances on the location of the cone-backing shoulders on axles require the use of special gages. These are the template type, made by Brown & Sharpe. One of these gages has its length stenciled 37.953125 in. A full set of inside and outside micrometers up to ¼ in. is used at the axle lathe. The axles are of Timken design with liberal-radius fillets, and the wheel fit is smooth turned and polished for an inch or more inside the hub where experience and the Timken tests show that fatigue cracks develop. The fits for the bearing cones on the journal portion of the axle are ground on a Landis grinder.

The modernization of AT&SF 3751 herself did not occur until 1941. At that time the above changes were made. In addition, the AT&SF 3751 received a new cylinder casting that included a Wagner by-pass valve. The Wagner by-pass valve was designed to reduce cylinder wear on long downgrades by keeping exhaust smoke and soot from being drawn into the cylinders. It also saved fuel by conserving steam, because it allowed the steam in the cylinders to circulate back and forth. Farrington[6] describes the valve as follows:

> The 4-8-4 type locomotives were also fitted with a bypass valve that was a modification of the Wagner design of valve, which had been introduced many years before in Germany. Placed above the steam chest was a cylindrical bushing, 9 ¼ inches in diameter, with a piston fitted in each end. Openings through the bushing communicate with the steam passages leading to the cylinder. The pistons had suitable ports cut in them, and were separated by a coiled spring. They could be moved closer together by steam pressure acting on their outer ends. When the throttle valve was open, steam acted against the pistons, moving them closer together and holding them in such a position that there was no communication through the bushing between the two ends of the cylinder. When the throttle was closed and the steam pressure was relieved, the spring forced the pistons apart, so the ports registered with the steam passages leading to the cylinder and there was free communication from one end of the cylinder to the other through the bushing.

The following additional contextual material was provided by Walter P. Gray, III, Chief, Archives & Museum Division, Office of the California Secretary of State. Mr. Gray was formerly Museum Director, California State Railroad Museum, and is a recognized authority on railroad history:

1. Engineering Significance

The earliest successful steam locomotives, developed in the 1820s, had four wheels. This wheel arrangement is the simplest one possible. Locomotives increased in size and power in response to improved materials, the ability to manufacture larger mechanical structures, and increasing demand for railroad transportation. Larger boilers (to make more steam) and more wheels (to improve stability at higher speeds and to transmit more power to the rails) were early

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[6] Farrington, S. Kip, Jr., *The Santa Fe's Big Three*

innovations. The fact that newer locomotives had to operate on existing railroads where the clearances around the tracks had become fixed meant that more powerful engines could not be any wider or much taller than their predecessors. The only alternative was to make them longer, and to add wheels to support the additional weight.

The wheel arrangements of U.S. steam locomotives are commonly described using what is called the Whyte system of nomenclature. The Whyte system allows every locomotive type to be classified numerically based on the number of pilot truck wheels, driving wheels, and trailing wheels. Wheels under the tender (the part of the locomotive carrying the fuel and water commonly coupled behind the engine) are not counted. A four wheel locomotive where all the wheels are powered is called a 0-4-0, indicating that there are no pilot wheels ("0"), four driving wheels ("4") and no trailing wheels ("0"). A common style of locomotive developed in the late 1830s added a four wheel pilot truck to the earlier four-coupled locomotive. The pilot wheels supported the front of the engine and guided the locomotive through switches and around curves. This style is known as the 4-4-0 (four pilot wheels, four driving wheels, and no trailing wheels).

Each wheel arrangement also has a name by which it is commonly known. Some of the names are literal or descriptive (the 4-4-0 is an "eight wheeler," and the 2-10-0 is a "Decapod"), other names are evocative (the first 2-8-2s were built for a railroad in Japan, and are called "Mikados") or based on the first railroad to purchase a specific wheel arrangement (the first 2-10-4 freight engines were bought by the Texas & Pacific Railroad and thereafter all were known as the "Texas" type. The evolution of U.S. steam locomotive design, and by crude extension the history of railroads in America during the period 1830-1950, is reflected in the Whyte table of organization.

As a generalization, locomotives without pilot wheels were used for switching or slow-speed operation, two-wheel pilot trucks were applied to freight locomotives and four-wheel pilot trucks were used on locomotives intended primarily for passenger service. Freight engines customarily had more and smaller driving wheels, while passenger locomotives had fewer and larger driving wheels. The 4-4-0 was the ubiquitous passenger locomotive for most of the 19th century, and the 2-8-0 wheel arrangement was made in greater numbers than any other for freight service.

Around 1900, locomotive designs had gotten long enough to require trailing trucks to support overhanging fireboxes at the rear of the boiler. The 4-4-0 evolved into the 4-4-2 design, while the 2-8-0 with a larger firebox (for greater steaming capacity) became the 2-8-2. Two-wheel trailing trucks were universal on larger engines until the development of the four-wheel trailing truck as the key innovation of the 2-8-4 design of 1925. These engines, called "Berkshires" for the mountain range in Western Massachusetts through which the first examples ran, had much

increased steaming ability because of the larger firebox, but lacked the capability for speed to be successful in fast passenger train service.

The next--and many would argue, ultimate--development in United States steam locomotive design was to combine the eight large drivers necessary to pull fast passenger and expedited freight trains, the four-wheel pilot truck required for stability at high speed, and a large firebox supported by a four-wheel trailing truck. The resulting 4-8-4 design was first constructed in late 1926 for the Northern Pacific Railway and delivered in January 1927. The type became known as the "Northern Pacific," soon shortened to "Northern."

A total of 1,126 Northern type locomotives were constructed for use in North America (including Mexico and Canada), and the design was operated on 36 railroads. The effects of the Great Depression on railroad transportation meant that comparatively few locomotives of any kind, including 4-8-4s, were produced during the 1930s, and innovation in locomotive design stagnated. In consequence, the 4-8-4 represents the best and--as events would prove--final development in North American steam locomotive technology.

Railroads and engine manufacturers had begun to experiment with internal combustion power for locomotives after World War I, and streamlined, diesel-electric locomotives were ready for market by 1940. World War II delayed the adoption of this technology, but the post-war industrial boom included the replacement of more than 50,000 steam locomotives with approximately 30,000 diesel locomotives between 1945 and 1960. The rise of the diesel meant there was never a market for "improved" steam locomotives beyond the 4-8-4: they represent the final and highest development of steam locomotive design in this country.

While numerically representing only 2.5% of the approximately 47,000 steam locomotives in service on United States railroads in 1950, the 4-8-4s were of significant importance out of proportion to their numbers. Northerns pulled the majority of fast, long-distance passenger and freight trains during the late steam era, and produced more ton-miles than any other locomotive classification. Northerns were customarily the last steam locomotives to be replaced by diesels, and were commonly the type of engines that made the "last run of steam" as American railroads replaced their steam locomotives with diesel-electric engines during the period 1940-1960.

A crude modern analogy is the ratio of wide body commercial jetliners to conventional commercial aircraft: they are all jets, and nearly all provide the same type of service (that is, they carry passengers). But widebody jets carry a disproportionate number of passengers because they are large (so each aircraft can hold as much as two or three smaller planes), fast, and are used on trips over longer distances. To push the analogy a bit, a case could be made that because of their technical characteristics (high capacity, range, speed) widebody jets are a significant

development in commercial aviation, with important impacts on the history of the United States. It would follow, then, that specific examples of these aircraft could be singled out for special recognition as first or most representative specimens. The first Boeing 747, for example, might fall into this category.

Of 1,126 4-8-4 locomotives built for use in North America (George Drury in his book Guide to North American Steam Locomotives cites 1,115), 56 survive today. Thirty seven are in the United States, ten are in Mexico, and nine are in Canada. Most are in parks or some other state of outdoor exhibition, and the majority are in poor to very poor condition. Of the 56 survivors, only nine--all but one in the U.S.--are able to operate. One specimen, Union Pacific No. 844, has the distinction of being the only steam locomotive in the United States that has never been retired from service. The rest have been removed from display in parks or outdoor museums and restored to operation.

No. 3751 is emblematic of this latter course: left neglected and essentially forgotten in an obscure park in San Bernardino, this locomotive was literally saved from inevitable deterioration and loss, and restored to an appearance and operating condition that fully reflects its status as a 1927 locomotive that had undergone a series of modifications and improvements characteristic of the Santa Fe's efforts to keep its locomotive fleet in modern condition in order to provide the type of service they desired to provide, and had survived to the end of the steam era.

2. Transportation Significance

A distinguishing characteristic of the Santa Fe's route between Chicago and Los Angeles was--and is--the remarkable isolation of much of the territory through which the railroad ran. The Santa Fe was an innovator in developing ways to make travel through the Great Plains and the desert Southwest tolerable, if not pleasant. The company established comparatively clean, comfortable and reliable eating establishments along the line (the famous Harvey Houses), established a high standard of comfort aboard trains, and was energetic in seeking ways to make the trip faster. Buying large, fast locomotives was only part of the answer. The typical locomotive of the 1920s could only travel 100 miles or so before it required maintenance and inspection, and the Chicago-Los Angeles journey could require fifteen engine changes. These were time-consuming and detracted from the railroad's desired image of fast and efficient. Locomotives that had the capacity and durability of design to go many hundreds, even

thousands, of miles with only fuel, water and lubrication were required, and the 4-8-4 type brought this ability to the Santa Fe.

No. 3751 was larger and more powerful than any other locomotive on the Santa Fe, and demonstrated that single locomotives could haul passenger trains of unprecedented weight at high speeds for sustained periods of time. It was the technological embodiment of a new railroad operational concept that shortened the time necessary for long-distance train travel and established a public demand for speed which has never been satisfied. If this concept had been flawed from either a technological or commercial perspective, No. 3751 would have been the one and only of its kind--a dead end. In the event, it was merely the first of 65 locomotives that represent Santa Fe's substantial economic investment in the idea of transportation efficiency and speed. Ultimately, No. 3751 was among several 4-8-4 locomotives assigned to the world's longest unassisted steam locomotive assignment: the Santa Fe's 1,789 mile Kansas City-Los Angeles Grand Canyon Limited/Scout service. This represents a form of social significance that pertains to No. 3751 within the context of the Santa Fe, and which also applies to the place of No. 3751 in the context of it being the earliest extant specimen of the whole class of 4-8-4 locomotives that represent the link between antique ("horse and buggy") conceptions of speed and service, and our modern notions of public transportation.

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Verbal Boundary Description

The resource boundary consists of the locomotive and tender itself.

Boundary Justification

The nomination reflects that the resource boundary is the structure, which is functional and is moved from time to time. The structure is located on the tracks in stalls 18 and 19 in the Redondo Junction Roundhouse, Los Angeles, California.

Photographs

1. Name of Property: AT&SF 3751.
2. County and State: Los Angeles, California
3. Photographer: Baldwin Locomotive Works (builder's photo).
4. Date of photograph: May 1927.
5. Original negative location: Copy negative in the collection of Stan Kistler, Grass Valley , California.
6. Description of view: Left (fireman's side) of the locomotive.
7. Photograph number: 1.

1. Name of Property: AT&SF 3751.
2. County and State: Los Angeles, California.
3. Photographer: Frank O. Kelley.
4. Date of photograph: About 1943.
5. Original negative location: Original negative in the collection of Stan Kistler, Grass Valley , California.
6. Description of view: Left (fireman's side) of the locomotive.
7. Photograph number: 2.

1. Name of Property: AT&SF 3751.
2. County and State: Los Angeles, California
3. Photographer: William F. Ramsey.
4. Date of photograph: June 1999.
5. Original negative location: Original negative in the collection of the photographer, William F. Ramsey, Fullerton, California.
6. Description of view: Right (engineer's side) of the locomotive while ascending Cajon Pass, San Bernardino County, California.
7. Photograph number: 3.