Carolina Conductor

Volume 8 Number 8 **Monthly Newsletter of the Carolina Railroad Heritage Association, Inc.** © August 2021

Preserving the Past
Active in the Present
Planning for the Future

Web Site: hubcityrrmuseum.org

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Meeting Site:
Woodmen of the World Building
721 East Poinsett Street
Greer, SC 29651-6404
Third Friday of the Month at 7:00 p.m.

Hub City Railroad Museum and SOU Rwy Caboose #X3115:
Spartanburg Amtrak Station
298 Magnolia Street
Spartanburg, SC 29301-2330
Wednesday 10-2 & Saturday 10-2

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EMD History

Harold L. Hamilton and Paul Turner founded the Electro-Motive Engineering Corporation in Cleveland, Ohio, in 1922, soon renaming it to Electro-Motive Company (EMC). The company developed and marketed self-propelled railcars using General Electric's newly developed internal combustion-electric propulsion and control systems. Hamilton started his railroading career as a fireman, then locomotive engineer, on the Southern Pacific Railroad, then became a manager with the Florida East Coast Railway before he left railroading for a marketing position with the White Motor Company, an early manufacturer of trucks and buses, in Denver. Training and service agreements were part of White's marketing package that Hamilton would carry over to EMC. Aware of the needs of branch line services of railroads and the opportunities provided with GE's new internal combustion-electric propulsion and control technology, he quit his position with White and set up shop in a Chicago hotel with his partner and a designer to develop and market a new generation of self- propelled railcars.

In 1923 EMC sold two gasoline-powered rail motor cars, one to the Chicago Great Western and the other to the Northern Pacific. EMC subcontracted the body construction to St. Louis Car Company, electrical components to General Electric, and the prime mover to the Winton Engine Company of Cleveland, Ohio. The motorcars were delivered in 1924 and worked well, fortunate for the fledgling company, because the sales were conditional on satisfactory performance. In 1925 EMC entered full-scale production, selling 27 railcars.


EMC Northern Pacific Motorcar #B-5.

In 1930 General Motors (GM) was seeking to enter production of diesel engines and broaden their range of applications. They purchased the Winton Engine Company, who had in their product line a variety of stationary and marine diesel engines and spark-ignition engines for heavy vehicles. GM saw EMC's role in developing and marketing Winton-engined heavy vehi-

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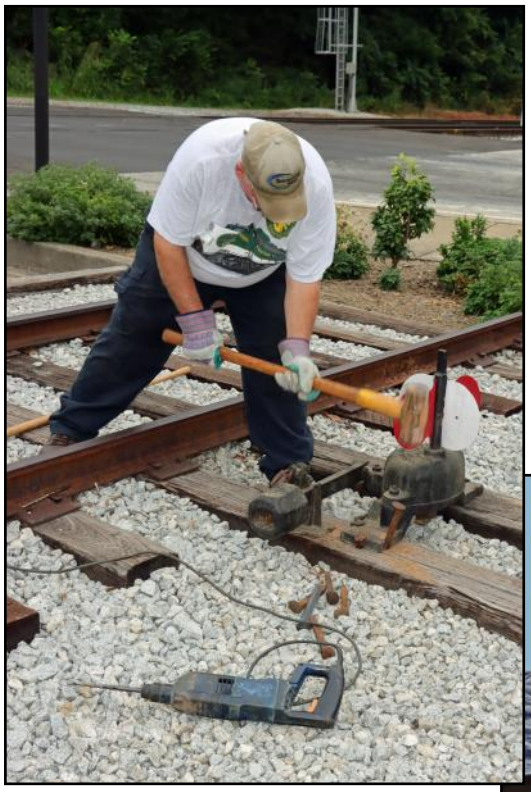
Museum Happenings



↑ Bob Klempner gives his best imitation of a Gandy Dancer driving spikes in the newly installed low level switch stand at the caboose.

↑ Virtual Railfan cameras being installed by Michael Tippins of Texas at the museum. Anyone in the world can now watch trains as they pass our museum. You too can watch by going to the Hub City Railroad Museum web site: hubcityrrmuseum.org. You can scroll through the past 10 hours of video to find recent train activity. Also, there are cameras all over to explore as a subscriber. Hopefully we get enough support to remain a free site.

↑ David Winans gives visitor tours at the busy museum.

Wanted—Articles for the Carolina Conductor

Submit an article of 200 words or more with some photos and captions and see them in print. Every one of us has some unique railroad experience that would make interesting reading for our membership. Your editor always needs more contributions of local railway history and news.

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cles as fitting their objectives and purchased the company shortly after the Winton acquisition, renaming it Electro-Motive Corporation (EMC). Supported by the GM Research Division headed by Charles F. Kettering, GM's Winton Engine Corporation focused on developing diesel engines with improved power-to-weight ratios and output flexibility suitable for mobile use. Eugene W. Kettering, son of Charles Kettering, led Winton's side of the development project.

In 1933 EMC designed the power setups for the *Zephyr* and *M-10000* streamliners, a breakthrough in the power and speed available with their propulsion systems. The *Zephyr* used the first major product of the new GM-Winton venture, a 600 hp, eight cylinder version of the Winton 201A Roots blown, uniflow scavenged, unit injected, 2-stroke diesel engine. As the Budd and Pullman Standard companies entered contracts to build more diesel-powered streamliners, they became major customers for EMC. Diesel power had been shown suitable for small, lightweight, high speed trains, in addition to its more established role in yard service.

Pioneer Zephyr at the Museum of Science & Industry in Chicago.

Seeing opportunities to broaden the role of diesel in railroading, EMC invested in a new locomotive factory and started development work on the locomotives that it would produce. The factory headquarters on 55th Street in McCook, Illinois, west of Chicago, remains the corporate headquarters. The 1935 EMC 1800 hp B-B development design locomotives featured the multiple-unit control systems that became the basis of cab/booster locomotive sets, and the twin engine format that would be adopted for the newest *Zephyr* power units in 1936 and EMC's E series streamlined passenger locomotives that their new factory began producing in 1937. Prior to their introduction of the E units EMC was in production of switch engines, which remained the mainstay of their production until dieselization of freight and passenger service hit full stride in the mid-1940s.

The GM-Winton research and development effort continued through the mid-1930s, building on experience with the Winton 201A, to develop diesel engines to better meet the specific needs of locomotive use. The fruit of that effort was GM's new 567 engine, introduced by their renamed Cleveland Diesel Engine Division in 1938. The new engine upgraded the horsepower of EMC's E series locomotives to 2000 per locomotive unit and increased reliability substantially. Also in 1938, EMC increased its reach up the chain of locomotive production by transitioning from General Electric equipment to in-house produced generators and traction motors. With Eugene Kettering moving to EMC that year, EMC moved into a leading role in further development of GM's locomotive engines.

GM-Winton-EMC's long development efforts put the company in an advantageous position relative to other developers of diesel-electric locomotion. Their nearest competitor was the American Locomotive Company (ALCO), who had produced diesel-electric switch engines since the mid-1920s, provided motive power for the *Rebel* streamliner trainsets in 1935, and started production of development design locomotives to compete with the E-units in 1939. EMC's other main competitor, the Baldwin Locomotive Works, had their development work with diesel delayed by their belief through the 1930s that the future of mainline service remained with steam, and by financial difficulties that effectively froze their diesel development while EMC and ALCO continued theirs. Baldwin started producing diesel-electric switch engines in 1939.


Newly restored B&O early E-unit.

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Passenger trains made little money for the railroads, but replacement of steam engines with reliable diesel units could provide railroads with a crucial difference for profitability. With standardized production of locomotives, EMC simplified the processes for ordering, manufacturing, and servicing locomotives and introduced economies of scale that would lower unit costs. EMC offered support services including financing, training, and field maintenance that would ease the transition from steam to diesel and boost their market in the last years before US entry into World War II. The performance of the new 567 engine in passenger locomotives also built confidence in the viability of diesel power for freight service.

In 1939 the company built a four-unit freight locomotive demonstrator, the FT, and began a tour of the continent's railroads. The tour was a success. Western railroads in particular saw that the diesels could free them from dependence on scarce water supplies for steam locomotives. In 1940, after incorporating dynamic braking at the suggestion of customers, they were receiving their first orders for the new freight locomotive.

FT demonstrator unit.

1940-1960

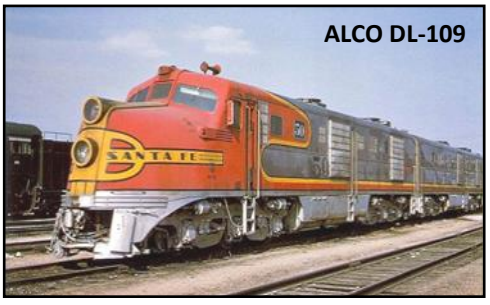
General Motors moved production of locomotive engines under the authority of EMC to create the GM Electro-Motive Division (EMD) on January 1, 1941. With that move, EMD became a fully self-contained development, production, marketing, and service entity. Non-locomotive products (large marine and stationary diesel engines) continued under GM's Cleveland Diesel Engine Division for another twenty years.

In January 1941 EMD delivered the first FT unit to the Atchison, Topeka & Santa Fe Railway, numbered Unit 100, and through that year they were in full-stride production of road and switch locomotives. World War II temporarily slowed EMD's locomotive production; United States Navy ships gained priority for diesel power and the petroleum crisis of 1942-43 made coal-fired steam a more attractive option. The War Production Board stopped production of new passenger equipment between September 1942 and December 1944. Later in the war, diesel locomotive production for freight service was picking up as more locomotives were needed to haul wartime supplies. By the time the FT model was replaced in 1945, 555 cab units and 541 booster units had been produced.

EMD emerged from the war years with major advantages for over competitors in diesel locomotive production, having entered them with fully developed lines of mainline road diesel locomotives while war production allocations restricted their competitors, principally the American Locomotive Company (ALCO) and the Baldwin Locomotive Works, to selling mainly diesel switchers and steam locomotives of pre-existing designs. That gave an advantage to EMD's state of technical development with higher powered diesels in the critical postwar years. New model passenger locomotives were delivered starting in February 1945. New models of their freight locomotive followed later in 1945 and 1946.

By the late 1940s most American railroads had decided to dieselize their locomotive fleets. Passenger services facing increasing competition from air and automotive travel rapidly replaced steam for image and cost reasons, but the biggest growth market was for freight locomotives. To meet post-war demands, EMD opened another locomotive production facility in Cleveland, Ohio, in 1948.

ALCO-GE was EMD's strongest competitor during the dieselization era, having produced the first road-switcher diesel locomotives in 1941 and gained about a 26% market share of diesel locomotives, mostly for switching and short-haul applications, as of 1946.[11] ALCO's higher-powered locomotives for mainline service were less successful, as they were plagued by reliability problems. In 1948 the ALCO-GE partnership developed a prototype gas-turbine-elec-



ALCO DL-109

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tric locomotive; series production began in 1952. Latecomers to the diesel locomotive business Baldwin, Fairbanks-Morse, and Lima-Hamilton struggled in the market as their products failed to gain a solid reputation. By 1950 it was clear that EMD's competitors could not crack their position in mainline road diesels and in 1949 their new EMD GP7 road switcher locomotive invaded the market niche previously held by ALCO and Baldwin.

In 1950, EMD's new plant in London, Ontario, Canada, began production. The plant was operated by the Canadian subsidiary General Motors Diesel (GMD), producing existing EMD as well as unique GMD designs for the Canadian domestic and export markets. GMD were, as a Canadian concern, able to sell products to other British Commonwealth nations without the tariffs encumbering trade with non-Commonwealth nations, gaining the same market access as ALCO and Baldwin through their subsidiaries Montreal Locomotive Works and Canadian Locomotive Company.

EMD GMD-1

EMD's road-switcher locomotives with power and reliability sufficient for mainline use overturned the market for freight locomotives, soon displacing their competitors' road-switchers, then later their own F-series carbody locomotives. The GP9 became the most-produced EMD model ever, with 4,112 A units and 165 B units sold between 1954 and 1963. Owing to their ease of maintenance and versatility, most locomotives sold in North America since the introduction of the GP9 have been road-switcher, or *hood*, units. Flush-sided locomotives based on a road-switcher chassis, or *cowl* units, would later be produced for passenger service.

EMD GP-9

During the mid-1950s, more difficult market conditions followed the peak demand of the dieselization era. The 1950s saw collapse in the positions of all EMD's established competitors and the strong emergence of a new one, the General Electric Company. Lima-Hamilton failed first, in 1951 merging with Baldwin to form Baldwin-Lima-Hamilton. Baldwin's own position was precarious, with their market share dwindling until they left the locomotive business in 1956. Fairbanks-Morse, after struggling to maintain a foothold in the industry with their opposed piston marine powerplant, left the locomotive field in 1963. General Electric dissolved the ALCO-GE partnership in the wake of ALCO's lackluster efforts at developing reliable higher-powered engines, and took over the ALCO-GE gas-turbine-electric venture in 1953. In 1956 GE was marketing its own Universal Series Cooper-Bessemer powered diesel-electrics as export locomotives. ALCO's belated introduction of improved locomotive power in 1956 provided the company little benefit; they no longer had the marketing, financing, or service support of GE and the GP9 was a formidable competitor in the saturated domestic market. In 1960 the U25B was the first of GE's road locomotives powered by their FDL-16 diesel engine, which would rapidly displace ALCO's position and eventually displace EMD's position in the domestic market. Competition from the two giants with large capital resources overwhelmed ALCO until they went out of business in 1969.

ALCO U-25B demonstrator.

The 567 engine was continuously improved and upgraded. The original six-cylinder 567 produced 600 hp, the V-12 1,000 hp, and the V-16 1,350 hp. EMD began turbocharging the 567 around 1958; the final version, the 567D3A (built from October, 1963, to about January, 1966) produced 2,500 hp in its V-16 form.

1960 to 1985

As the 1960s opened EMD was compelled to re-

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spond to the challenge offered by GE's U25B, upgrading the features of their GP (General Purpose) and SD (Special Duty/Standard Duty) series locomotives, boosting the power of their 567 engines, then developing the more powerful 645 engines. Those endeavors as well as the feature upgrades introduced with the SD40-2 were sufficient to maintain EMD's competitive advantage over GE until the mid-1980s.

In 1962 GM moved their remaining production of large non-locomotive diesel engines from Cleveland to the EMD facility in McCook, ending the existence of the Cleveland Diesel Engine Division.

In late 1965, EMD introduced the enlarged 645 engine. Power ratings were 1,500 hp V-12 non-turbocharged, 1,500 hp V-8 turbocharged, 2,300 hp V-12 turbocharged, 2,000 hp V-16 non-turbocharged,

EMD SD-45

and 3,000 hp V-16 turbocharged. In late 1965 EMD built their first twenty-cylinder engine, a turbocharged 3,600 hp V20 for the EMD SD45. The final variant of the sixteen cylinder 645 produced 3,500 hp.

In 1972, EMD introduced modular control systems with the *Dash-2* line; the EMD SD40-2 became one of the most successful diesel locomotive designs in history, both in terms of sales and service longevity. A total of 3,945 SD40-2 units were built.

EMD GP40-2

EMD introduced their new 710 engine in 1984 with the 60 Series locomotives (EMD SD60 and EMD GP60), the EMD 645 engine continued to be offered in certain models (such as the 50 Series) until 1988. The 710 is produced as an eight-, twelve-, sixteen-, and twenty-cylinder engine for locomotive, marine and stationary applications. Concurrently with the introduction of the 710, EMD's control systems on locomotives changed to microprocessors, with computer-controlled wheel slip prevention, among other systems.

1985 to 2000

EMD's North American market share dropped below that of its main competitor General Electric in 1987. After the Canada-United States Free Trade Agreement came into effect in 1989, EMD decided to consolidate all locomotive production at the Diesel Division of General Motors of Canada (formerly GMD) plant in London, Ontario, a development which ended locomotive production at the La Grange, Illinois plant in 1991, although the Illinois facility continued to produce engines and generators.

In the late 1980s and 1990s EMD introduced AC induction motor drive in EMD locomotives using Siemens technology. In the early 1990s, EMD introduced the radial steering truck, which reduced wheel and track wear. In 1995 EMD replaced mechanical unit injectors with electronically controlled unit injectors on its 710 engines.

In 1998 EMD introduced the four-stroke sixteen cylinder 265H-Engine, used as the prime mover in

EMD SD90MAC

the EMD SD90MAC-H locomotive. Instead of completely replacing the 710 series engine, the H-engine was concurrently produced alongside EMD's two stroke engines, although mainly for export. Acceptance of the 265H was limited over reliability issues. The 265H, at 6,300 hp, was the most powerful engine ever

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produced by EMD and the first four-stroke engine offered to the market by EMD or its ancestral companies since the Winton 201A introduced their breakthrough in two-stroke diesel power in 1934.

In 1999, Union Pacific placed the largest single order for diesel locomotives in North American railroad history when they ordered 1,000 units of the EMD SD70M. Union Pacific's fleet of SD70Ms has since been expanded by more than 450 additional units. In addition, Union Pacific also owns nearly 500 EMD SD70ACe locomotives, six of which have been painted in "Fallen Flags" (acquired/merged railroads) commemorative liveries. All these locomotives are 710G-powered.

2000 to Present

EMD SD70ACe

The year 2004 saw CSX Transportation take delivery of the first SD70ACe units, which were advertised by EMD as more reliable, fuel efficient, and easier to maintain than predecessor model SD70MAC. The model meets the EPA Tier 2 emission requirements using the two-stroke 710 diesel engine.

The following year Norfolk Southern became the first carrier to receive the new SD70M-2 - successor to the SD70M. Like its sister road switcher, the SD70ACe, the SD70M-2 meets EPA Tier 2 requirements using the same engine. And like the "ACe", the "M-2" is certified to be in conformance with ISO 9001:2000 and ISO 14001:2004.

In June 2004, *The Wall Street Journal* published an article indicating EMD was being put up for sale. On January 11, 2005, Reuters published a story indicating a sale to "two private U.S. equity groups" was likely to be announced "this week". Confirmation came the following day, with a press release issued by General Motors, stating it had agreed to sell EMD to a partnership led by Greenbriar Equity Group and Berkshire Partners. The newly spun-off company was called Electro-Motive Diesel, Inc., thus retaining the famous "EMD" initials. The sale closed on April 4, 2005.

On June 1, 2010, Caterpillar announced it had agreed to buy Electro-Motive Diesel from Greenbriar, Berkshire *et al.* for $820 million. Caterpillar's wholly owned subsidiary, Progress Rail, completed the transaction on August 2, 2010.[3] Although Caterpillar announced that John S. Hamilton would continue in his roles of president and CEO of EMD after the close of the transaction, Mr. Hamilton left EMD for unspecified reasons in late August 2010.

The U.S. Environmental Protection Agency's Tier-4 locomotive emissions regulations on new locomotives went into effect on January 1, 2015. As of that date EMD's 710-engined locomotives (e.g. SD70ACe's) could be built only for use outside the contiguous United States (i.e. Canada, Alaska, Mexico, and overseas). EMD had originally thought the 710 engine could be modified or "tuned-up" to meet Tier-4 standards, but it was not able to meet those requirements while maintaining optimum performance and reliability during rigorous "real world conditions" tests. Development of a Tier-4-compliant locomotive shifted from its original focus on the two-stroke 710 to the four-stroke 1010J engine, derived from the 265H engine.

Progress Rail SD70ACe

The first (pre-production) locomotive using the 1010J engine, the SD70ACe-T4, using a 4,600 horsepower (4,400 traction hp) 12-cylinder engine was unveiled in late 2015. Testing of the new locomotives began in the Spring of 2016. The first two units of a 65-unit order for the new locomotive were delivered to

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Union Pacific in December 2016.

EMD continues to offer 710-powered locomotives for export as well as "ECO" upgrade packages for modernizing of older locomotives, which sustained their business during the hiatus of locomotive production for the domestic market.

Progress Rail SD70ACS

Genset Locos

Progress Rail Genset loco.

Progress Rail Genset PR30C

A locomotive builder may make a range of locomotives of different power, with the lowest power switcher with, say, one genset engine, and the highest power main line freight locomotive with several genset engines. The excess engines are turned off when the extra power is not needed.

Progress Rail PR43C locomotive.

The Progress Rail PR43C was a 4,300 hp C-C genset diesel-electric locomotive built by Progress Rail Services Corporation. It was the result of a conversion of existing EMD SD50 locomotives. This involved replacing the original EMD 645 prime mover with a pair of Caterpillar engines, a 3,600 hp 12 cylinder C175 engine and a 700 hp C18 engine. The locomotive was jointly designed by Progress Rail and Norfolk Southern Railway. Development began in 2008.

Three locomotives were built; they were manufactured at Progress Rail's Mayfield, Kentucky factory. As a result of repeated failures, the locomotives were retired in 2017, and all were cut up for scrap in 2018.

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