# LOCOMOTIVE 2018

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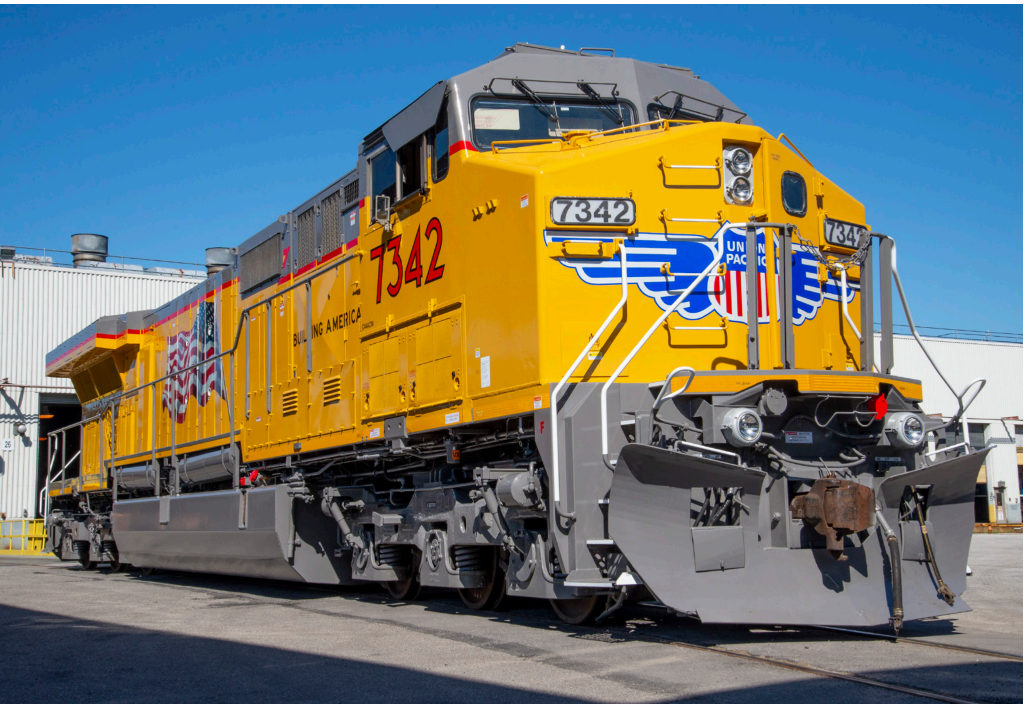
**Wild Wyoming on video**
Join Tom Danneman on a video adventure tracking down elusive BNSF motive power in the Bighorn Basin.

**On the cover**
EMD GP60 demonstrator No. 5, Riverdale, Ill., Sept. 19, 1987. See page 52. Greg McDonnell




controls in the process. Adorned in a brilliant coat of CP red, complete with the reintroduced CP beaver shield, and transformed to an AC4400CWM, CP 8100 made its formal debut at the Erie facility just before Christmas.

Meanwhile, 29 CP AC44s were sent to GE's Fort Worth facility for modernization and emerged as AC4400CWM Nos. 8101-8129. CP has committed at least 80 more AC4400CWs for modernization at the Texas plant in 2018. Included in the mix are 59 locomotives from CP's initial 83-unit


**Born at Erie in summer 1995, CP 9521 is back and better than new as AC4400CWM 8000.** Greg McDonnell

**Prototype for the modernization of a group of Union Pacific AC6000CW "convertibles," UP 7342 poses outside Building 26 at GE's Erie, Pa., plant on July 9, 2018.** GE, Steve Gerbracht

AC4400CW order. Known as CP1s in the railway's parlance, the original AC4400CWs differ slightly from the rest of the fleet, having first-generation GMG196 alternators and smaller fuel tanks. The differences are enough to warrant a separate number series for the rebuilt CP1s and, in keeping with GE practice, an Erie-built prototype. Selected as the first CP1 candidate for modernization, CP 9521 was sent to Relco in Albia, Iowa, for fuel-tank modifications and other pre-upgrade work before moving to Erie for rebuilding as CP 8000. Subsequent CP1 rebuilds are being cycled through Relco Albia for fuel-tank enlargement and other modifications before moving to Fort Worth for modernization as 8000-series AC4400CWMs. All other rebuilds will be numbered in the 8100 series and beyond.

UP has enlisted GE to perform similar work on some of its 106 AC6000CW "convertibles." The UP convertibles were built to AC6000 specs and configuration, but powered with FDL16 engines that could be replaced with 6,000-hp prime movers should the railroad desire at a future date. None were ever converted. Sharing shop space with CP 9521 at Erie, UP 7342 was torn down in 2017, overhauled, and modernized with the latest controls and auxiliary equipment. Unlike the CPs and other rebuilds, the UP locomotive retained its original operator cab. More UP convertibles are scheduled for modernization at GE facilities in 2018.

These programs tap but a fraction of the potential modernization of existing fleets of older A.C. locomotives. BNSF and CSX roster significant numbers of SD70MACs, and BNSF, CP, CSX, and UP AC4400s account for one in every 10 Class I railroad locomotives. The legacy of these two models is already cemented in motive power history.

## ECOs

The current trend toward modernization began, not with high-powered road locomotives, but with utilitarian four-axle EMD Geeps, including some of the oldest power in the North American fleet. Even with changes in operating philosophy, rationalization of routes, and consolidation of secondary fleets, Class I railroads operate some 7,000 EMD GP and SD models. Four- and six-axle EMD road-switchers remain the backbone of secondary fleets throughout the continent.

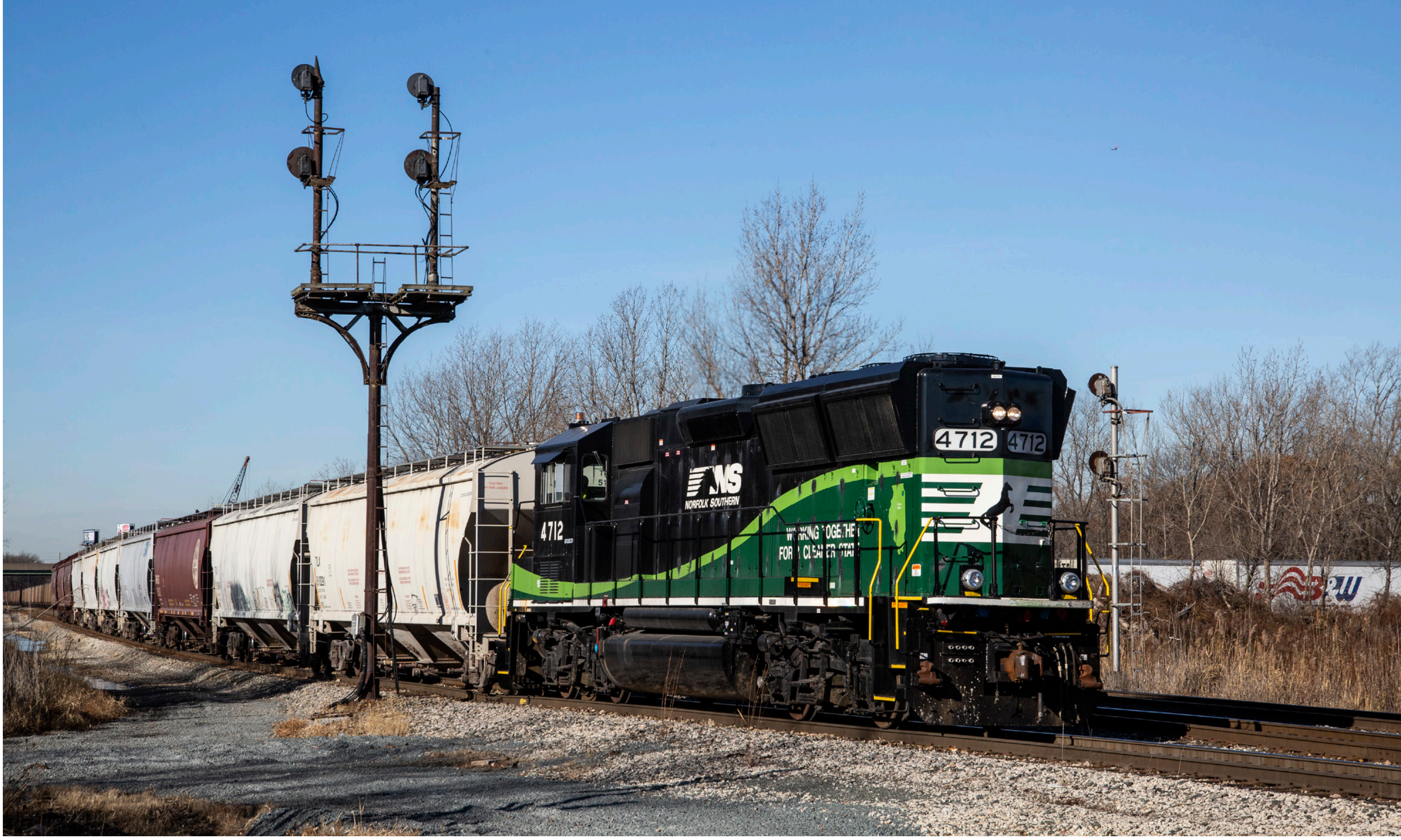
The rise of emissions controls and regulations, particularly in pressured urban "non-attainment" areas where many GPs reside, became the sole apparent threat to this seemingly ageless class of locomotives. Third-party "Tier 0" and "Tier 0+" 645-engine emissions upgrade packages, battery-powered hybrids, and genset-style locomotives from disruptors such as RailPower, NREC, and MotivePower sought to capture this market all but ignored by the big builders. In 2010, EMD re-entered the fray with its 710ECO Repower line.

Designed to modernize older EMD GPs and SDs with new control systems and fuel-efficient, lower-emission 710-series engines, ECO marked a bold entry into a traditionally tough market. The price tag for such extensive secondary-fleet rebuilds has always contributed to the challenge. Both EMD and GE have a history of failed attempts: EMD's BL20 program and GE's Super 7 program, to name two modern examples. However, the climate had changed. The locomotives were older, the need greater, and the external pressures were now stronger than ever.

EMD fielded two GP22ECO demonstrators for the program: EMDX 7101, converted from Kansas City Southern 2836, a GP40 of Penn Central origins; and EMDX 7102, rebuilt from CP GP9 No. 1637. Both demonstrated extensively, striving to prove the benefits of modernized Geep or SD power in a variety of Class I railroad applications. KCS acted first, ordering 18 GP22ECOs and two SD22ECOs created from an eclectic mix of GP40, GP40-2, GP40-2L, SDP40, and SD40-2 cores. Eight of the GP22ECOs emerged from GMD in London, Ont., while the other 12 GPs and



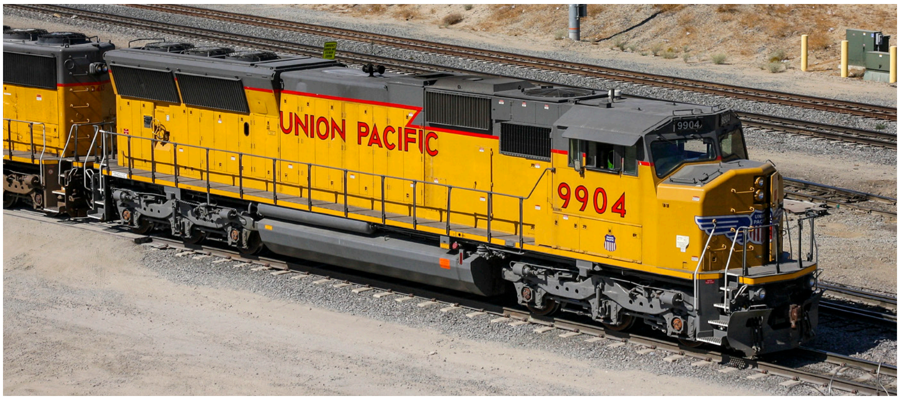
Four- and six-axle EMD road-switchers remain the




**Showing off its flared radiators and special ECO paint scheme, NS GP33ECO 4712 leads the "Bakery Job" past New York Central-era signals on the Indiana Harbor Belt at Ivanhoe Junction in Gary, Ind.** William Beecher Jr.

SDs were rehabilitated with the help of MotivePower in Boise, Idaho. Other roads also sampled ECO conversions, often with minimal change to the visible layout of the locomotive: a pair of NS GP38ACs converted to GP22ECOs with eight-cylinder 710s, three BNSF SD45-2s converted to SD32ECOs, eight Belt Railway of Chicago GP23ECOs built from mixed heritage GP40s, a UP GP59ECO rebuilt from a GP40, a trio of GP22 and GP23ECOs on Tacoma Rail, and even passenger F59s employed by Amtrak and Metrolink in California. Some units had 645-engines replaced with ECO 710s, while others, such as the passenger units, received upgraded 710 prime movers.

Union Pacific supplied 28 SD60Ms for SD59M-2 upgrades by Progress Rail in Mayfield, Ky., and EMD London. Completed between 2010 and 2014, the units traded 16-710 engines for 12-cylinder EPA Tier 2-compliant versions along with a new cooling system and control upgrades. Designated SD59MX by the railroad, the locomotives were assigned to regional service in California. Class unit UP 9900 was further modified with an experimental exhaust-gas recirculation package for NOx reduction, plus an experimental diesel oxidation catalyst+diesel particulate filter package for particulate matter reductions. Funded by a California Air Resources Board and Air Quality Improvement Program grant, this project was aimed as a proof-of-concept for future Tier 4-emissions compliance on installed-based locomotives.




**One of 28 Union Pacific SD60M ECO upgrades (designated SD59M-2 by EMD, and SD59MX by the railroad), UP 9904 leads the Kaiser Hauler at West Colton, Calif.** Charles Freericks

Canadian Pacific took the ECO program to the mainstream. CP had to face hard facts on its 193-unit GP7 and GP9 fleet. Despite significant upgrades in the mid-1980s, this fleet, originally from the 1950s, had reached a major decision point. And given the units represented 11 percent of the railroad's power and operated systemwide, there was no way they could be ignored. Progress Rail stepped in to offer the solution, the GP20C-ECO. Taking the Geeps in trade and salvaging key components to meet EPA rules for content, the GP20C-ECO offered up a new road-switcher design, complete with eight-cylinder 710 engine rated at 2,000 hp. Existing trucks and other components were retained; however, this GP20 model featured new underframes, operator cabs, and hoods. CP initially took 30 units in 2012-2013 but quickly returned for 100 more over the course of two years. In one fell swoop, 130 GP20C-ECOs replaced CP's entire fleet of first-generation Geeps.

CP's ECO aspirations didn't stop there. The railway contracted Progress Rail to rebuild 20 retired SD40-2s as SD30C-ECOs. At the Progress Rail facility in Mayfield, Ky., the locomotives were stripped to the frame and rebuilt with a 12-cylinder 710 engine, new crashworthy cab and

backbone of secondary fleets throughout the continent.

torsional stress problems.

So far as foreign "quick-running" engines went, their higher rpm did not compensate for their smaller bore and stroke, hence the required locomotive horsepower couldn't be produced off a single crankshaft. Electric transmissions favor single-engine units. Moreover, GE felt that the ratings of the overseas engines were optimistic, being based upon European rather than American field conditions; and sturdiness was questioned.

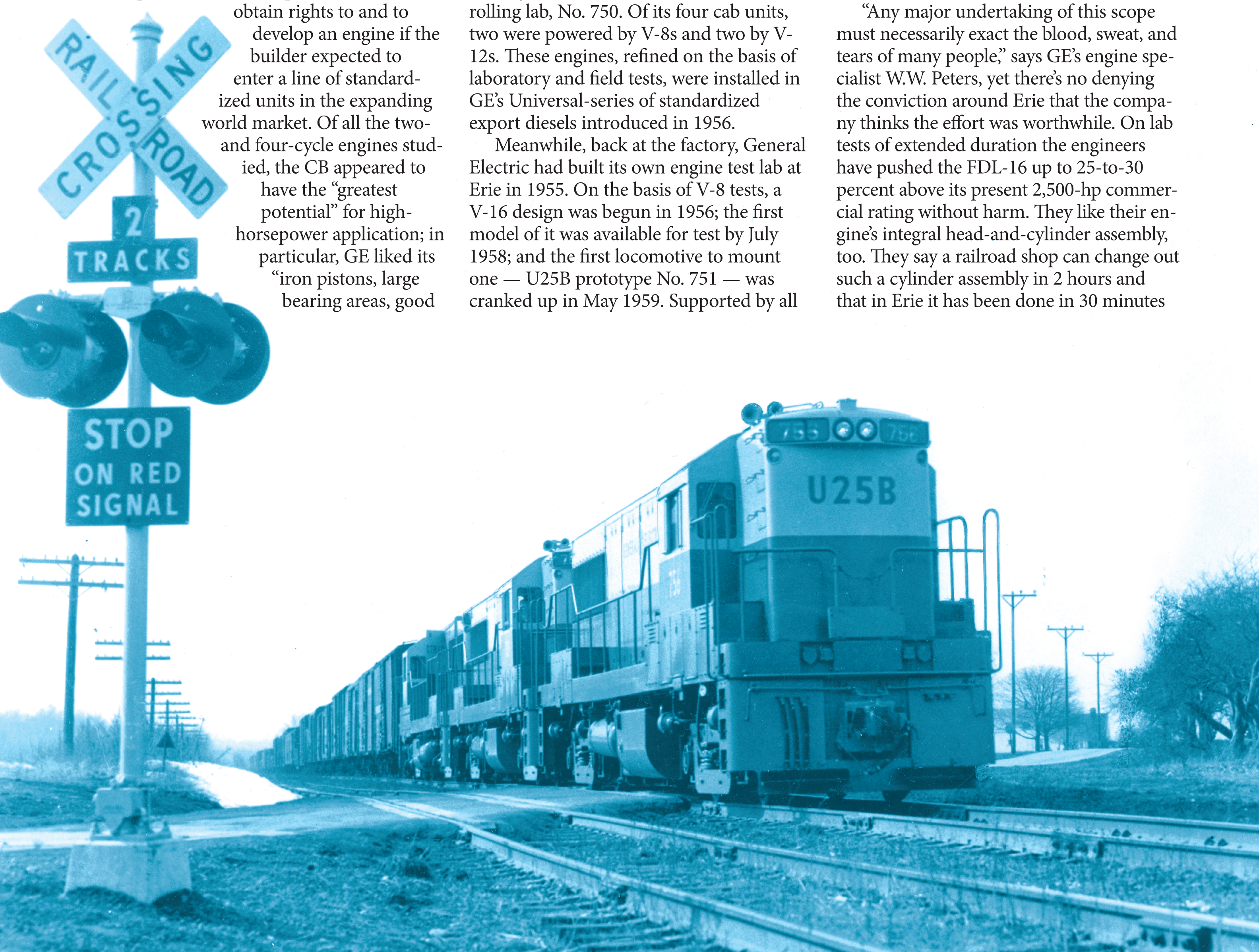
## Calling Cooper-Bessemer

The fundamental concept which sired the FDL-16 was drawn up by Cooper-Bessemer in the early 1940s, and at the end of World War II development had reached the point where a six-cylinder inline version could be placed in a GE export locomotive. The Erie Works people deemed the engine "fairly satisfactory" in operation but too expensive and heavy to be competitive with other makes — and there the matter stood until 1953, when Alco-GE quietly dissolved their hyphenated partnership. At that point it became imperative for GE to obtain rights to and to develop an engine if the builder expected to enter a line of standardized units in the expanding world market. Of all the two- and four-cycle engines studied, the CB appeared to have the "greatest potential" for high-horsepower application; in particular, GE liked its "iron pistons, large bearing areas, good breathing, and general sturdiness" as well as the existence of a V-8 design. So contractual arrangements were concluded and in early 1954 the Erie Works assembled a rolling lab, No. 750. Of its four cab units, two were powered by V-8s and two by V-12s. These engines, refined on the basis of laboratory and field tests, were installed in GE's Universal-series of standardized export diesels introduced in 1956.

**Ready for the road, GE 2501-2504 pose at Erie for the company photographer.**

Meanwhile, back at the factory, General Electric had built its own engine test lab at Erie in 1955. On the basis of V-8 tests, a V-16 design was begun in 1956; the first model of it was available for test by July 1958; and the first locomotive to mount one — U25B prototype No. 751 — was cranked up in May 1959. Supported by all this experimentation, the first production-model V-16 was completed and placed on test in September 1960, then installed in demonstrator No. 753.

"Any major undertaking of this scope must necessarily exact the blood, sweat, and tears of many people," says GE's engine specialist W.W. Peters, yet there's no denying the conviction around Erie that the company thinks the effort was worthwhile. On lab tests of extended duration the engineers have pushed the FDL-16 up to 25-to-30 percent above its present 2,500-hp commercial rating without harm. They like their engine's integral head-and-cylinder assembly, too. They say a railroad shop can change out such a cylinder assembly in 2 hours and that in Erie it has been done in 30 minutes




**An A-B-B-A "rolling laboratory" turned out in 1954 as Erie Railroad 750A-750D set GE's road locomotive project in motion.**

flat from the time the stop button was pushed until cooling water was back in the engine and it was running again. They like the rapid acceleration and freedom from smoke afforded by the eight exhaust pipes to the turbocharger (one pipe for each pair of cylinders); and they say the FDL-16's lube-oil consumption — less than 1 percent of fuel — is "par for the course." As for economy, the engine operates under full-load conditions at less than 0.360 pounds per brake horsepower hour when burning oil of 19,300 btu or higher heating value — another figure which requires no apology to the competition. And she'll burn residual fuel under conditions of acceptable combustion and tolerable smoke if you'll accept some increase in maintenance costs. In short: a big, robust, but efficient diesel which, if the market requires, can be uprated without forcing customers to change out their parts inventory.

## U is for universal

The configuration of the U25B (which stands for Universal 2,500 hp B-B) is

**Making one of their first revenue runs, U25B demos 756, 753, and 754 work a freight on the Pennsylvania Railroad south of Erie, Pa., in February 1961.**

original with GE and appears to have virtually blanked further sales of the once-popular high-horsepower six-motor C-C. The thinking at Erie goes like this: In view of their weight on drivers, diesels of four-axle, two-truck (or B-B) wheel arrangement in the 120-to-130-ton range have been underpowered. Why drag around the useless dead weight of a C-C when a B-B is all that's needed? Obviously the six-motor unit has the advantage in tractive effort in slow drag freight operation, yet it exerts no more tractive effort than a four-motor unit of equal horsepower at any speed over 16 mph. The old question of adhesion (how to use the horsepower of a C-C in a B-B without excessive wheel slip) was resolved by a belief in and action upon what is known as the "slippery spot concept of adhesion." That is, when a driving wheel begins to slip and can't recover normal traction for a prolonged distance, it is not necessarily because the rail is slippery for that length but rather because the spinning wheel is developing only a tiny adhesive value (i.e., it can't slow down). Indeed, it may be picking up a film of oil from rail or wheel rim, which further inhibits its recovery. Answer: Mount a small alternator on each axle, which can detect a practical change in axle rpm corresponding to, say, 4 or 5 mph; that detection, in turn, actuates a "slip-suppressing brake" — an automatic, light, quick (within 3 seconds) application of the regular brakes on the unit on which the slip occurs; meanwhile, the engine continues to deliver full power. Result: The unit recovers its feet and the brake application further serves to clean any film off the rim of the slip-prone wheel.

Having settled on a 130-ton B-B layout for its U25B, General Electric decided to concentrate all its road research on that one size and model rather than to spread its developmental efforts less effectively across a wider catalog. The builder is convinced that the specialization perhaps necessary to eradicate steam power is dead and that the market is now focused upon high-horsepower locomotives, which can effect significant unit reductions in moving heavy trains faster. Which leads to the 2,500-hp U25Bs operating in multiples up to a total multiple-unit output of 10,000 hp or more.

In service, the U25B demonstrators have now been at large long enough to acquire some meaningful statistics. On grades, for example, a four-unit, 10,000-hp team has registered these performances:

— On 1 percent compensated, 3,952 tons moved at 31 mph.

— On 1 percent again, 5,762 tons (109 cars) moved at 22 mph.


— Also on 1 percent, 9,200 tons (144 loads, 12 empties) moved at 14.5 mph.

— On 1.42 percent, 5,258 tons (116 cars) moved at 18 mph.

— Again on 1.42 percent, 5,614 tons (128 cars) moved at 16 mph.

— On 2.2 percent, 3,950 tons (82 cars) moved at 15 mph.

On dry rail in the West, the U25Bs have recorded adhesions of as high as 24-25 percent at speeds from 11.5 to 12 mph. They started a 3,950-ton train on 2.2 percent without any wheel-slip indication and achieved 10 mph within 4 minutes under full throttle.

On demonstration, a single U25B unit started a 2,500-ton train out of a yard on a 1 percent grade, maintaining 30 percent adhesion for 5 minutes with some mechanical sanding.

On a 110-car, 11,900-ton ore train, three U25Bs totaling 7,500 hp held 19 mph on an average grade of 0.45 percent, whereas the train would have required four of the road's 1,750-hp units and speed on the grade would have been 11 mph.

As one would expect of any original piece of engineering, the U25B has experienced its full measure of teething problems, for no lab test can quite duplicate prolonged 50-mph running across a dusty desert at, say, a 120-degree roadbed temperature, or the throttle hand of an impatient engineer moving big tonnage out of a yard on frosty 1 percent. Yet the performance consensus is that the locomotive puts out its advertised 2,500 hp and that not only are its engine and electric transmission unequaled in capacity now but they have a substantial margin for future growth.

There is no use in pretending, to be sure, that General Electric has anything but an upgrade fight to stake out an appreciable share of the market for the U25B.

First, GE is new in the domestic road-diesel field. Although 5,000 power assemblies (cylinder, rod, valves, and so forth) are at work in Universal-model export units overseas from South America to South Africa, the U25B's FDL-16 engine remains fresh to U.S. roads and hence


**Tracing the Colorado River through Glenwood Canyon, GE 2501-2504 and DRG&W dynamometer car No. 10 work an eastbound freight near Shoshone, Colo., in spring 1962. Rio Grande gave the U25B a pass.**

carries with it implication of new parts inventory, maintenance procedures, personnel orientation. Similarly, U.S. roads possess no historic knowledge of the FDL-16's long-term repair cost or fuel consumption. Until the U25B, GE was a supplier of traction motors, generators, and electrical control gear, primarily to Alco, and was a builder only in terms of such specialties as straight electrics, turbines, export motive power, and smaller industrial and shortline diesels. Aware of this image, the Erie design team has kept the design of the U25B as unsophisticated as possible — using, for example, stock railroad storeroom hardware for all expendable parts — but nevertheless first-class salesmanship is mandatory, supported by in-depth field service.

Second, in the midst of a market dominated by trade-in thinking, the U25B is without an ancestor. Yet to remain competitive, GE must offer an allowance on other makes which, aside from trucks equipped with GE motors and certain GE electrical components, offer little but their weight in scrap prices.

All this totals up to the penalty paid by the pioneer. If comparatively few U25Bs have been sold to date when gauged by the success accorded Electro-Motive's GP30, then at least General Electric has signed up a cosmopolitan corps and attained the foot-in-the-door milepost. If and when these original buyers place substantial U25B repeat orders we will have an opportunity to put General Electric's unique design effort in perspective. Bear in mind that upon occasion the men at Erie have waxed eloquent about an "advancing technology [which] may someday produce diesel-electrics of 4,000 or even greater horsepower per four-axle unit." If so, the U25B will be found in their family tree.