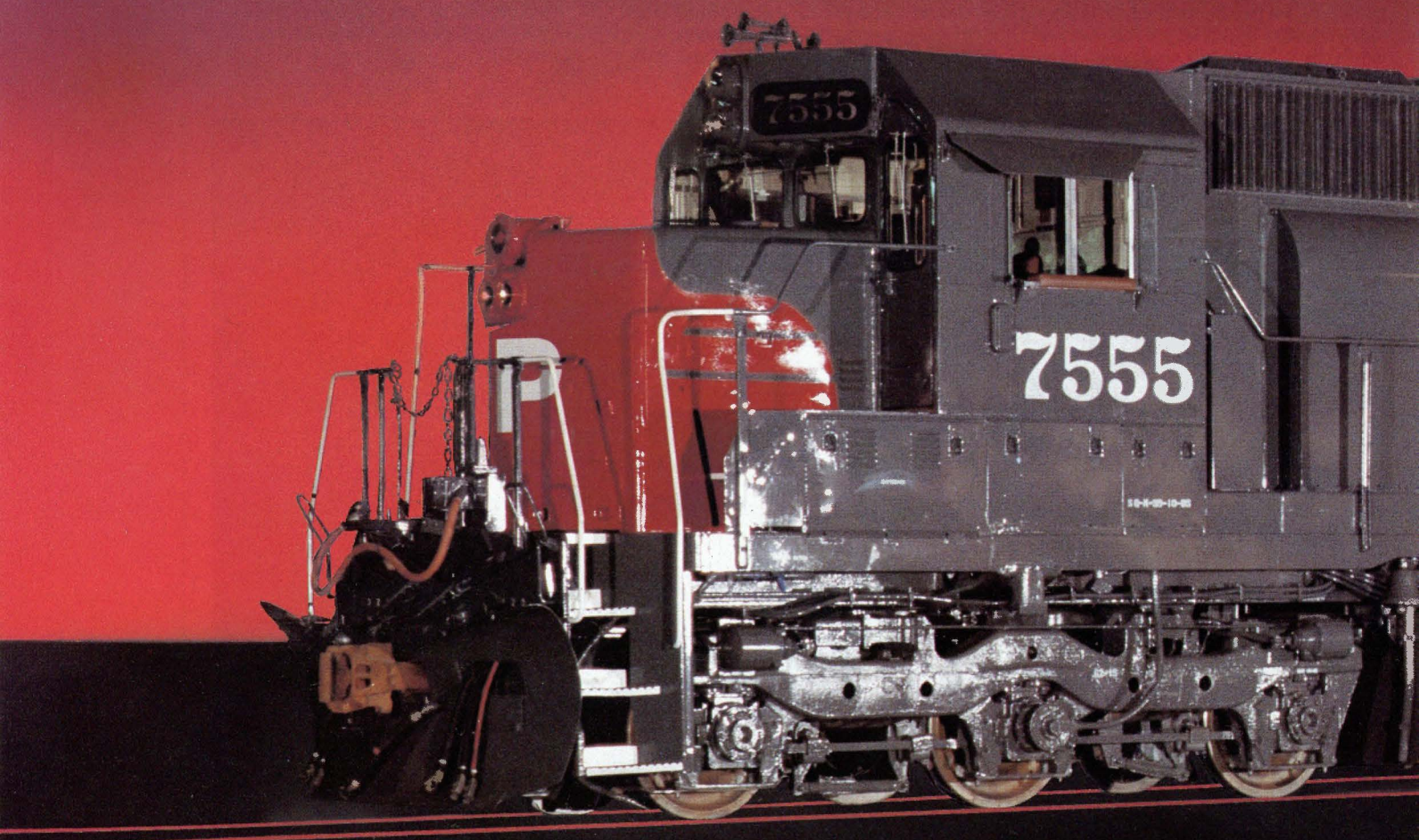
Nestled behind Sacramento's Amtrak station and below the bridges of Interstate 5, almost out of sight from the townsfolk and Interstate motorist, lies the heartbeat of the Southern Pacific Railroad, the Sacramento Shops. Renamed the Sacramento Locomotive Works in 1981 to reflect the changes that have occurred over the years, the shops were once the largest employer in California's capitol city when over 5,000 workers maintained all of the system's locomotives, freight and passenger cars, and manufactured new cars and spare parts for them.

♦ Article by Don Bain — Photography by Dick Dorn ♦



S♦A♦C♦R♦A
Q U A

Today's Southern Pacific traces its roots back to the Central Pacific Railroad, a name recognizable to everyone, railfan or not, from their childhood history lessons as the railroad that began building east from California to connect with the Union Pacific Railroad, then building west from the Missouri River. Meeting at Promentory Point, Utah, they formed the transcontinental railroad and opened up the west for expansion and development.

Since the transcontinental railroad was not completed until 1869, how was the Central Pacific able to equip itself with locomotives and rolling stock without being connected to any other railroad to allow delivery from the manufacturers in the east?

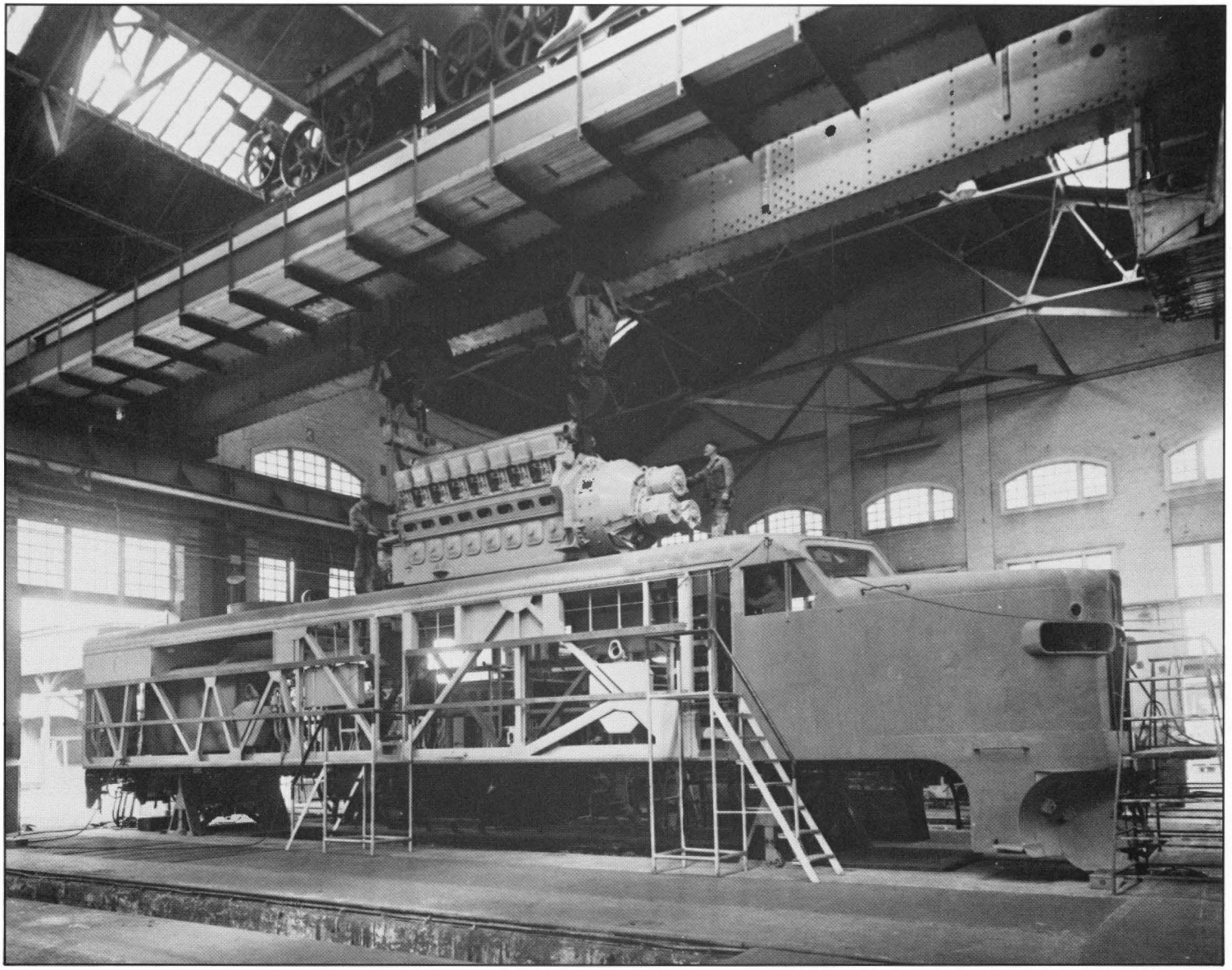
The first steam engines were brought around Cape Horn on sailing ships. Arriving in Sacramento in a disassembled state, they were assembled on the banks of the Sacramento River. The first locomotive to arrive in such a fashion for the CP was Central Pacific number 1, the *Governor Stanford*, arriving on the river schooner *Artful Dodger* on October 5, 1863. The freight cars, and later passenger cars, were all constructed in Sacramento from scratch by workers of the rapidly expanding Central Pacific.

EARLY SHOPS HISTORY

A pair of small wooden buildings on the Sacramento River levee near "M" Street served as the first car shops of the Central Pacific, and it was here that the first pieces of rolling stock used for construction purposes were built. As the railroad pushed east through Roseville, Newcastle, and Auburn, the first passenger trains were added and the first passenger cars also had their beginnings here.

As the railroad continued to push farther east, more and more freight and passenger cars were required, and the small wooden buildings near the river levee where the present Old Sacramento State Park is located were soon outgrown. The present Locomotive Works complex dates back to 1863 when the City of Sacramento granted the Central Pacific the river levee from "M" Street to First and Broad Streets, and a 30 acre slough in the American District on the north edge of the city. The State of California also deeded an adjacent body of water called Lake Sutter, later known as China slough, to the CP. Both were turned over to the CP on the condition that the CP build their tracks, shops, and grounds up to the same height of the river levees, which were then being raised to keep the Sacramento and American rivers out of the city after disastrous floods in December, 1862, and January, 1863.

Shortly after the land was donated, the CP began erecting a 20 by 150 foot wooden building along the edge of Lake Sutter near Sixth and "I" Streets. This was followed shortly by another building measuring 30 by 130 feet. These first two buildings were used to build freight and passenger cars, and were the seeds for the shops complex yet to come.



Alco PA-1 number 6006 was stripped and undergoing a Class A overhaul at the Sacramento Shops in September 1953 after 1,250,000 miles of service. This was the first PA to have a general overhaul on the SP. *Southern Pacific*

CAR SHOPS

In 1870, work was started to lengthen the car shop from 46 feet to 307 feet, with the width remaining at 90 feet. A lack of funds held up completion until 1872 though. By 1880, it was becoming evident that the building was becoming too small once again to handle the work at hand, and the building was again lengthened, this time to its present length of 495 feet.

In 1873, a new car paint shop was completed, measuring 228 feet long by 70 feet wide, with five wings of 23 by 70 feet. Over the northernmost wing, a second story was included which provided new offices for the shops. Eventually, the five wings were closed in, and in 1892, the building was widened to 180 feet and the walls of the wings were removed. In 1894, the paint shop was extended by 85 feet to its present length of 313 feet.

The car paint shop was also known as car shop #3, and also produced freight cars besides passenger cars up until about the turn of the century when the last of the slough was filled in and new freight car shops (car shop #5) were added north of the locomotive shops. Car shop #9 was established about 1915, taking over an area that had been leased by Fruit Growers Express. Car shop #5 was abandoned about 1920, with its work being consolidated with car shop #9.

In 1888, a new two-story, 75 by 189 foot building of similar design and construction to existing buildings was erected north of the old wooden car shop buildings. This building housed machinery for boring car wheels, turning axles, mounting wheels, and drilling and fitting iron parts for both freight and passenger cars.

In the early morning hours of November 7, 1898, the car machine shop caught fire. The Sacramento Fire Department had trouble responding to the alarm as they were blocked by a cut of cars between the shops and the depot. Once into the shops complex, they had trouble locating the hydrant in the darkness, then the threads of the hydrant and hose did not match. When this was remedied and the hydrant opened, a stream of mud came out of the nozzle! By this time the fire had destroyed the car machine shop and the adjacent car shop building. A 12,000 gallon water tank on top of the car shop building was full but of no use as its wooden legs were soon eaten through by the flames and the tank fell away from the building, dousing the firefighters and not the fire!

Rebuilding started at once as the entire system was dependent on the Sacramento Shops for wheels, iron parts, and passenger car work. A second fire occurred in August, 1917, destroying the wooden car shop building between the two two-story brick buildings, also consuming a number of passenger cars in for repairs. Again, the building was quickly rebuilt and widened in the process.

LOCOMOTIVE SHOPS

Machine Shop

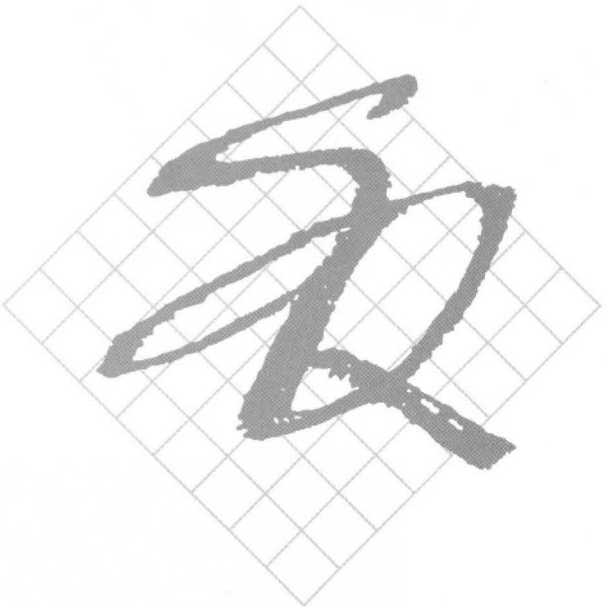
As the first two car shop buildings were being erected in 1863, plans were also being drawn for a locomotive boiler repair shop to replace the small building then being used on Front Street. Much of the locomotive work in the first year or two of the CP was performed by the Goss and

Lambard Machine and Foundry Works of Sacramento. They repaired the locomotive boilers as required and made other needed repairs to the growing locomotive fleet. In 1868, the CP purchased the entire operation of Goss and Lambard including all machinery, tools, the foundry, and the blacksmith shop. Construction of a new machine shop for the CP began shortly thereafter once the construction that began in 1867 of a new car shop and planmill was completed.

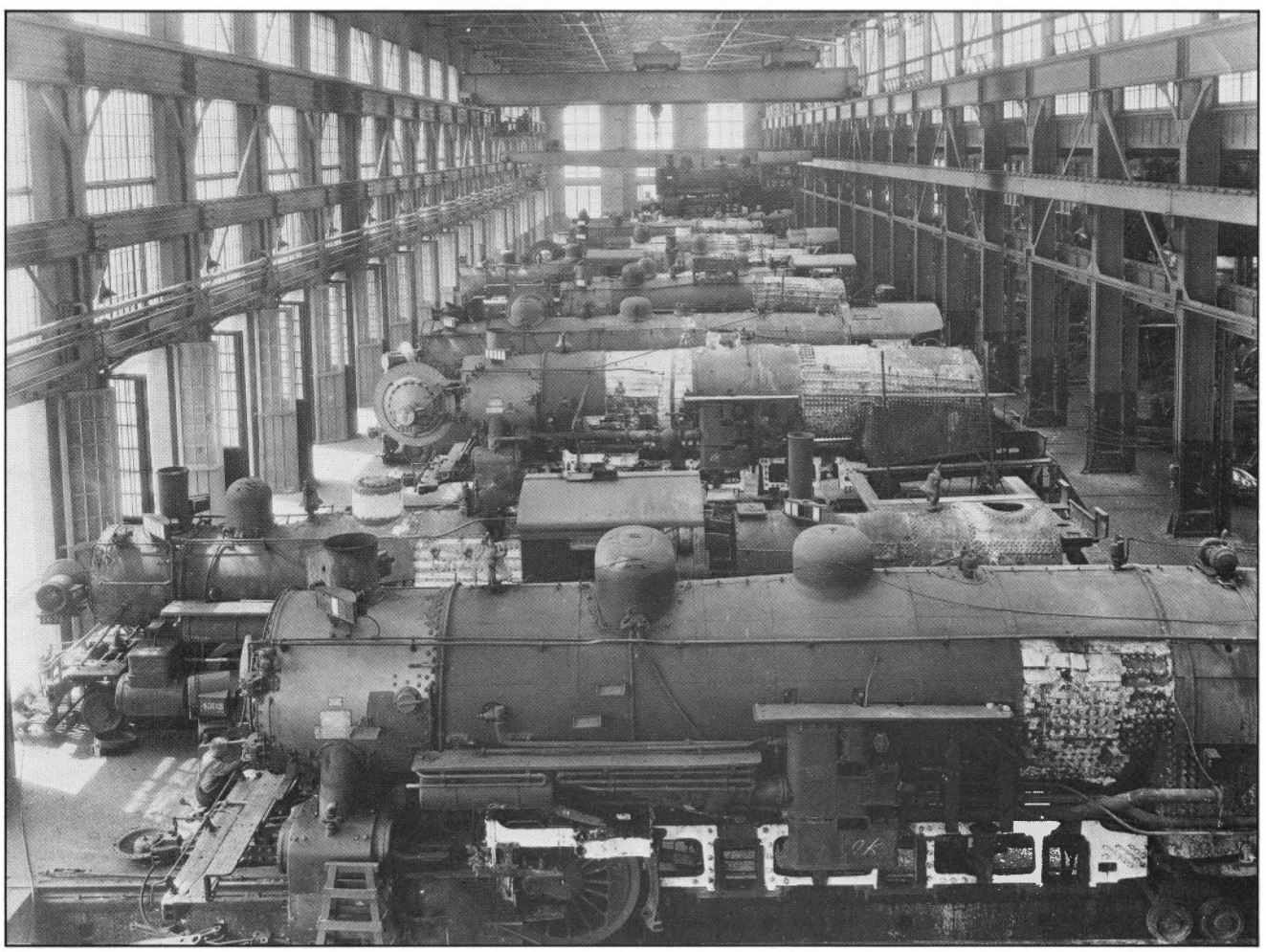
As previously mentioned, all of the buildings had to be built on a level equal to that of the river levees to prevent floodThe new machine shop was built in the same style as the new car shop, in which some 1,500 12 by 12 inch square cedar piles 30 feet in length were driven down to bed rock. The piling tops were even with the tops of the river levees and on top of this, 6,000 square yards of granite from the quarries at Rocklin and Penryn were placed in slabs two feet thick, on ing. top of which the brickwork for the walls was placed. Similar construction techniques were used in all of the later shop buildings built, with corrugated sheet metal used for the roofs. It is interesting to note that as built, the shop buildings had earthen floors, and the old paint shop just phased out in 1984 still had a dirt floor.

Following the machine shop in 1868, the shops were quickly added onto and expanded as the CP blossomed in size once the transcontinental link-up was completed. The boiler room for powering the huge Corliss steam engine that provided the power for the machinery through a system of drive shafts and leather belts came later in 1868. During 1868-1869, a 29-stall roundhouse with a diameter of 378 feet was constructed on the north side of the machine shop. The original turntable for the roundhouse was made of wood and lasted only a short while until a new cast iron one could be delivered from the east.

The first section of the machine shop opened early in 1869 and measured 100 by 204 feet, and was 30 feet high. Plans provided for an overhead crane and a transfer table, but the crane was not installed until 1870 and the transfer table did not come until 1888. The overhead crane was designed and built in the shops, as was a new and larger one in 1888. (The design and fabrication of



During the days of steam, the Sacramento Shops were a much busier place than what they are today. In this undated photo from Southern Pacific's files, every stall of today's Fabrication Shop was full and 0-6-0 number 1226 was being lifted by the overhead crane. *Southern Pacific*



parts, tools, and machinery is a unique feature of the shops that continues to this day. If a part or piece of machinery is not readily available from outside suppliers, the shop employs its own draftsmen to design the needed item. It is then fabricated within the shop by shop employees.)

As built, there were eleven pits in the west side of the machine shop, with all machinery located in the east side of the building. There were eleven tracks entering the building from the yard, and the last pit on the north end of the shop had a drop pit. This was removed in 1887 or 1888 when a drop pit was installed in the roundhouse. As the shop load increased, the shop was enlarged in 1875 to 400 feet in length.

This vantage point from the overhead crane shows an overview of the Erecting Shop in July 1985. The long hood of SD45R 7552 (with new radiators) is in the foreground, the rest of the 7552 is taking shape two stalls away, SD45R 7551 is nearing completion, SD45T-2 9171 is receiving a new main generator, a spreader is having a bent ram replaced, and SD40T-2 8303 is receiving a new prime mover.

In building this new addition to the machine shop, a foundation was not included. Evidently those in power figured that it did not need as massive a foundation as was first used. Instead, the west wall pits were dug down five feet, 12 by 12 inch redwood timbers were laid lengthwise 18 feet wide. On top of these were placed more 12 by 12 inch square timbers crosswise, then brick piers were built for roof truss supports. Piles were driven down the center of the shop and bricks were laid on top of them for the center roof support beams that would also hold the interior mounts for the overhead crane. Exterior brick walls following the same design pattern as the old walls were then added. The south wall was made of wood to allow for future expansion.

For some reason, the transfer table was not built until 1888. Plans from 1869 show that one was projected to be built at that time. The first table was 40 feet long and traveled a distance of 395 feet. A small two cylinder steam engine provided the power to move the six pairs of wheels that moved the table through a series of gears and clutches. In 1896, shortly after electricity arrived at the shops, a 25 horseelectric motor replaced the steam engine powering the transfer table.

As locomotives grew larger, the transfer table was lengthened several times to accommodate them. In 1905, a completely new table measuring 44 feet 6 inches was installed, along with a 40 HP electric motor. In 1929 or 1930, a 50 HP alternating current motor working off of three overhead trolley wires replaced the smaller motor as locomotive size and weights continued to grow. Some locomotives were now weighing 442,300 pounds with a wheelbase of 45 feet 10 inches and were becoming increasingly difficult to move into the shops. A 4100 class Mallet could be placed in either of the first two bays by running them directly across the turntable. In the case of a Golden State type locomotive, the engine truck was jacked up and chained to the front bumper. Even then, the overhang on both ends necessitated much machinery having to be moved out of the way to allow travel down the pit. In July 1942, the present 70 foot transfer table was placed in operation, and cab-forward 4194 became the first locomotive to be moved by it. During the later years of the 1940's, the operator's control booth on the table was painted in Daylight colors.

Besides an increasing workload of repairs to its locomotive fleet during the latter stages of the 19th century, the railroad also had a growing fleet of ferry and steamboats also requiring needed boiler and engine repairs, and the new machine shop included space for this. The machine shop was increased to its present length of 524 feet in 1888, following closely the same design and construction techniques used in the 1875 addition.

Erecting Shop

Around 1901, the shops were again becoming too small, and construction finally started in 1905 on a new erecting

shop west of the machine shop. The plans for this building were destroyed in San Francisco in the famous 1906 earthquake and fire that destroyed much of that city. However, there are photographs of the construction of the erecting shop showing a pile driver at work and a concrete foundation being laid on top of the piles. The old wooden west walls of the machine shop came down, and new brick walls matching the rest of the architecture were put up in their place.

In 1906, a new 120 ton capacity traveling crane was installed, and locomotive 2698, a 2-8-0, one of the largest locomotives then in service was suspended from the crane for six days to test the brake slippage and deflection of the crane under load.

Boiler Shop

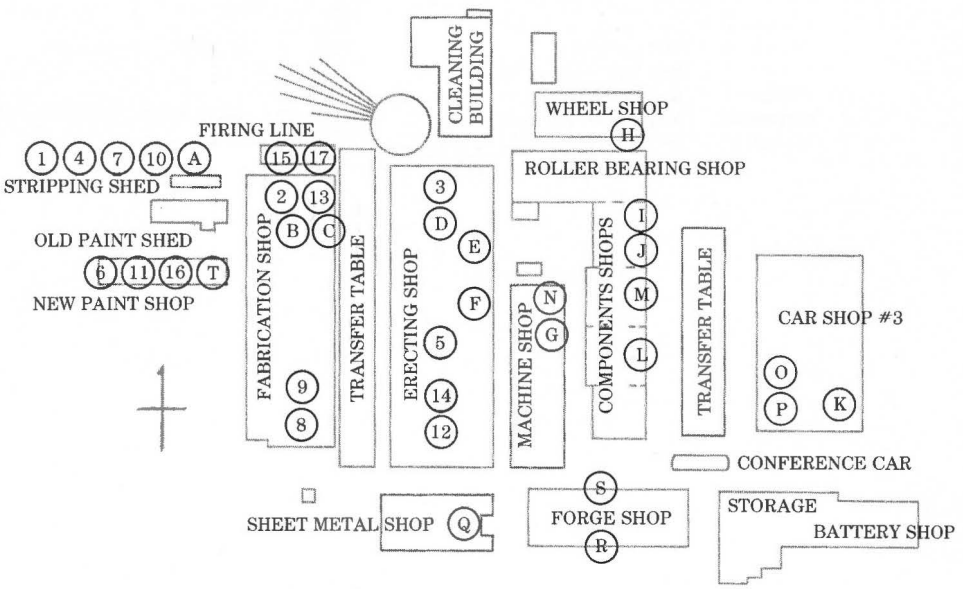
In 1872, the Sacramento Shops were given approval to construct ten American-type eight-wheel (4-4-0) locomotives. Number 173, a small 1864 product of Norris originally built for the original Western Pacific Railroad was in the shops for repairs at that time, but its 40-inch boiler and small cylinders made it obsolete and it was scrapped, with its number being assigned to the first locomotive built by the Sacramento Shops.

The new 173 had a 48-inch boiler, 17 x 24 inch cylinders, 56 inch diameter drivers, and weighed in at 70,070 pounds with 130 pounds of pressure, five pounds more than any other engine on the Central Pacific at that time. Equipped to burn coal, the engine had the diamond shaped smokestack common to that era, but was able to burn either coal or wood with a change of grates.

The boilers for these locomotives were fabricated in the machine shop, along with the new boilers for the river steamers and ferry boats the CP had acquired from the California Pacific Railroad and others it had assumed control of. This made the construction of a separate boiler shop a must, and one was started at once (1872-1873). Measuring 60 by 232 feet, the wooden building was built near the location of the present transfer table. All of the machinery in the boiler shop was powered by belts driven by a shaft running along the east wall which was powered by a three-cylinder upright steam-driven engine designed and built at the shops.

At the north end of the boiler shop, a small wooden, wedge-shaped building was erected for repairing and building new tenders and tanks, and also for work on smokestacks. When a new larger, transfer table was built in 1888, it was necessary to move the boiler shop slightly to the west. About the same time, a new, larger boiler shop was built. Measuring 90 by 230 feet and of wooden construction, a 90 by 110 foot extension on the north side housed a new tank shop. Projected, but not built at this time was a 50 by 90 foot extension for a locomotive cab shop. This was later built, and a 1902 plot plan of the shops shows this as the locomotive paint shop.

Locomotive Flow Chart Thru GRIP Program And Shop Building Layout



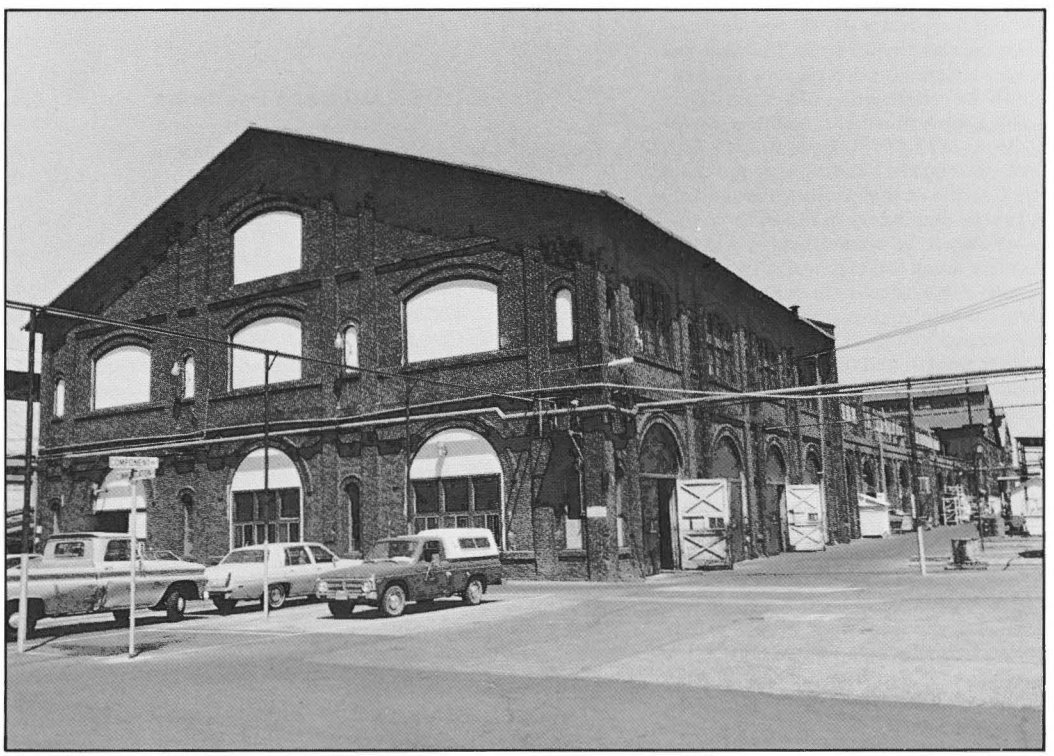
GRIP Location and Operation

1. Stripping Shed —Pre-Clean
2. Drop Pit — Detruck
3. Erecting Shop —Pre-Strip
4. Cleaning Track —Wash
5. Erecting Shop — Final Strip
6. Grit Blast Facility —Grit Blast Exterior
7. Cleaning Track —Wash
8. Fabrication Shop —Pre-Fab Frame
9. Fabrication Shop —Pre-Fab Hood
10. Cleaning Track —Wash
11. Paint Facility —Primer
12. Erecting Shop —Rebuild
13. Drop Pit — Retruck
14. Erecting Shop — Finish Rebuild
15. Firing Line — Test
16. Paint Facility — Final Paint
17. Firing Line — Final Test and Release

Shop Building Layout Legend

A. Stripping Shed
B. Drop Pit
C. Truck Shop
D. Engine Rebuild
E. Power Assembly Area
F. Engine Components Rebuild
G. Electric Shop
H. Locomotive Wheel Shop
I. Injector And Governor Shop
J. Second Floor —
   Upholstering Shop
   Panel Wiring Area
K. Traction Motor Shop
L. Air Room
M. Rotating Shop
N. Repair Gang
O. Main Electric Cabinet Line
P. Wiring Harness Assembly
Q. Radiator Repair
R. Pipe Shop
S. Coupler and Draft Gear Rebuild
T. Grit Blast and Paint Facility

Most of the structures that make up the Sacramento Locomotive Works are rich in history. Above, this is the old Car Shop #3 building now housing the Traction Motor Shop and Locomotive Works administrative offices. Portions of this building date back to 1873 with the newest parts being added in 1894. Below, portions of today's Components Shop date back to the beginning of the Sacramento Shops in 1867 but the two story end of the building visible in the foreground only dates back to 1888.



This is a general overview of the prime mover rebuilding area located in the Erecting Shop. In the foreground, valve camshafts, next are two 20-cylinder 645 engine blocks and in the background are crankshafts.

Upon completion of the new boiler shop, the old boiler shop was moved to a new location west of the new shop, and divided into three sections housing the brass foundry, spring shop, and the sheet iron works. A new small adjoining building was constructed next to these for work on smoke stacks. During the 1905 expansion of the machine shop, the boiler shop was widened to its present width.

Drawing Room

In every well organized shop, factory, or manufacturing plant, a well-equipped drafting room is a necessity, and so it is with the Sacramento Shops. Draftsmen are needed to make working drawings of ideas and plans for machinists to produce parts, and to design new items. The first shop draftsman was George A. Stoddard, having been hired in the infancy of the Central Pacific. His first drawing, Sacramento Drawing Room No. 1, was for a brake shoe for the locomotive *Nevada*. The ten American-type locomotives built by the shops in 1872 were designed from the ground up by Mr. Stoddard.

Some of the other items later designed by Stoddard and his assistants in the early years of the shops were boilers for the ferry boat *Solano*, and engines for other ferry boats and steamers. They also designed all of the equipment for the rolling mill, blacksmith shop, and several large punches, shears and other equipment for the foundry and machine shops. All of the early freight and passenger cars, snowplows (both bucker and the newer cyclone types), and most of the locomotives produced at Sacramento were the results of the shop draftsmen. Even some of San Francisco's famed cable cars were designed and built by the Sacramento Shops.

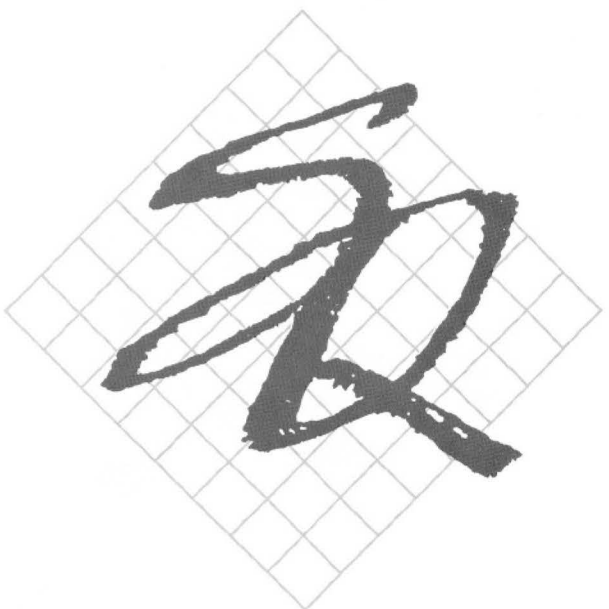
Although the drafting room has been looked on as an extravagance over the years by many in management, and has even been closed down a number of times, it continues to survive and is responsible for hundreds, perhaps thousands of designs and improvements, and was one of the earliest contributors to the Sacramento Quality legacy.

Blacksmith Shop and Rolling Mill

The blacksmith shop and rolling mill were considered for many years to be a single unit. In 1868 when the first shop buildings were going up, a 60 by 145 foot square brick building was built on redwood pilings for the blacksmith shop. In 1873, a 90 by 72 foot addition was added with a large furnace installed in the middle of it for forge work. The forge was used for making new, and reworking old locomotive frames. A new 2,000 pound drop-forge hammer replaced three belt-driven dead-stroke hammers used in the original blacksmith shop.

Iron was supplied from mills in the east and San Francisco until George Stoddard was asked if he could design a rolling mill. Mr. Stoddard, who had never seen a rolling mill, replied immediately "Yes I can" and then went to work to design a small one.

The machinery for the entire rolling mill was built in the shops and installed at the south end of the blacksmith shop. A furnace heated scrap iron that was bundled and tied together with wire until it was red-hot, then the bundles were placed in the drop-hammer where they were squared up, re-heated, then passed through the rollers. Coal imported from Australia was used in the furnaces of both the rolling mill and the foundry. The small rolling mill was a success and operated night and day from 1876 to 1930, and was expanded in size several times. For many years, the shops made all of the rail joiners, tie plates, rail bolts, and spikes used on the system. The great depression of 1929 put an end to both the foundry and rolling mill.



LOCOMOTIVE CONSTRUCTION AND REHABILITATION

As touched upon earlier, steam locomotives were constructed at the Sacramento Shops, almost entirely from parts made on the premises. Construction of steam engines ended in April, 1937 when 0-8-0 number 1314 was turned out, the 195th engine constructed at the shops. Locomotive construction spanned two periods, 1873-1889, and 1917 to 1937.

A total of 74 locomotives were built in the first period for the Central Pacific, Southern Pacific, Oregon and California, and others. The largest group of locomotives built were 49 4-8-2's constructed between September, 1925 and March, 1930. The second period of locomotive construction saw 121 more Sacramento Quality products emerge from the shops.

Sacramento has always been the main locomotive shop for both the Central Pacific and Southern Pacific systems. Other shops were built around the system, but most were capable of handling only running or light repairs. Sacramento has always been assigned the toughest jobs such as boiler replacements, frame straightenings, and now, rebuildings.

With the phase-out of steam and the dawning of the diesel era, the nature of the shops mission followed suit and changed to that of maintaining the diesel engine and its associated electrical transmission and propulsion systems. The first diesel engines arrived on the system in 1939, but total dieselization would not occur for another decade-plus, allowing for a gradual transition into a totally new world for the shops.

During the 1950's and 1960's, wreck repairs, rewirings, and engine changes kept the shops humming with activity and allowing expertise to be built up regarding diesel locomotive maintenance. As locomotive technology increased in the 1960's, the SP fleet of diesel locomotives that had darkened the fires of steam was growing older and less reliable.

The present day GRIP (General Rehabilitation and Improvement Program) developed slowly over the years, taking around 20 years to evolve into today's present form. During the 1950's and 1960's, certain units were in the shops for one form of heavy repair or another and sometimes there were delays in their rehabilitation due to parts shortages that left the engine sitting idle without any work being done to it. To maximize manpower that also might be sitting around temporarily between projects, it was decided to join the two and put idle manpower to work on idle engines. Thus, a unit in for electrical rewiring might also get its engine rebuilt in the process, although that was not the reason why it was sent to the shops. Or, a unit in for wreck repairs could have also been rewired. A few units eventually received the "works," rewiring, rebuilt engine, rebuilt traction motors, and replacement of some worn out electrical parts.

As can be expected, the reliability for these units far exceeded other units of the same class who may have received one or more similar, but not as extensive, repairs about the same time. As the 1970's approached and the anticipated lifespan of the first generation road power was nearing its end, the SP began looking around at what was then available from the locomotive suppliers and began sampling the market with mostly small orders for late first- and early-second generation power. Units such as the GP20, GP35, U25B, U28B, C415, C628 and C630's all eventually wound up on the roster, but the GP18, SD24, U23B, C424 and C425, and others did not.

The SP was satisfied with the job performed by its sizeable GP9 and SD9 fleets, particularly the SD9 whose light axle loadings allowed it to be used on the NWP and many Oregon branchlines where weight restrictions on many older bridges precluded the use of the newer and heavier power then coming on to the market. In late 1969, GP9 3434 entered the Sacramento Shops to become the first locomotive to go through the shops and be totally stripped down and have all of

During the rebuilding process SD45R 7553 was receiving a new pilot windsheet in the Fabrication Shop. As is always the case, quality is stressed and any damaged parts are repaired or replaced resulting in a new locomotive at the end of the rebuilding process.

its electrical components rebuilt or replaced as needed, as well as have its prime mover rebuilt with new or rebuilt component parts and emerge with a new number. It was decided not to chop the nose of any of the high-hood units or raise the horsepower ratings of the units as many other roads were doing at that time. In February, 1970 the 3434 emerged with a new number, 3300, as well as a new designation, GP9E ('E' for electrically upgraded), and was re-classed as an EF418E-1. Thus was born the locomotive rebuilding program that is now about to enter its eighteenth year, and has seen 740 locomotives from ten different models go through the doors at Sacramento and get the Sacramento Quality treatment.

SACRAMENTO SHOPS TODAY

Over the years, the SP Mechanical Department has kept pace with all of the improvements and new technology developed by itself and others regarding locomotive power plants and electrical systems, and has incorporated many of these into its rebuilding program. The SP feels that today's SD45 rebuild is as advanced as anything comparable on the market, and in many respects, is superior.

The Sacramento Shops were renamed in 1981 as the Sacramento Locomotive Works to better reflect its mission. The car repair shops had been moved to Roseville two years earlier when the much more modern Pacific Fruit Express car shops became available after the SP/UP split up their combined refrigerated car operation and SPFE opted to go with only one repair facility at Tucson.

The major work of the Sacramento Locomotive Works in 1984 and 1985 has been the rebuilding of SD45's. Other locomotive work is always going on at the shops, including accident repairs and engine changes. The shops also maintains other types of equipment such as Jordan Spreaders, snowplows, cranes of all types and sizes, and numerous other pieces of rail equipment. There are also other jobs being performed in the shops which we will speak of later, but the GRIP program is the one associated by most with the shop, and the one whose work is most visible to us.

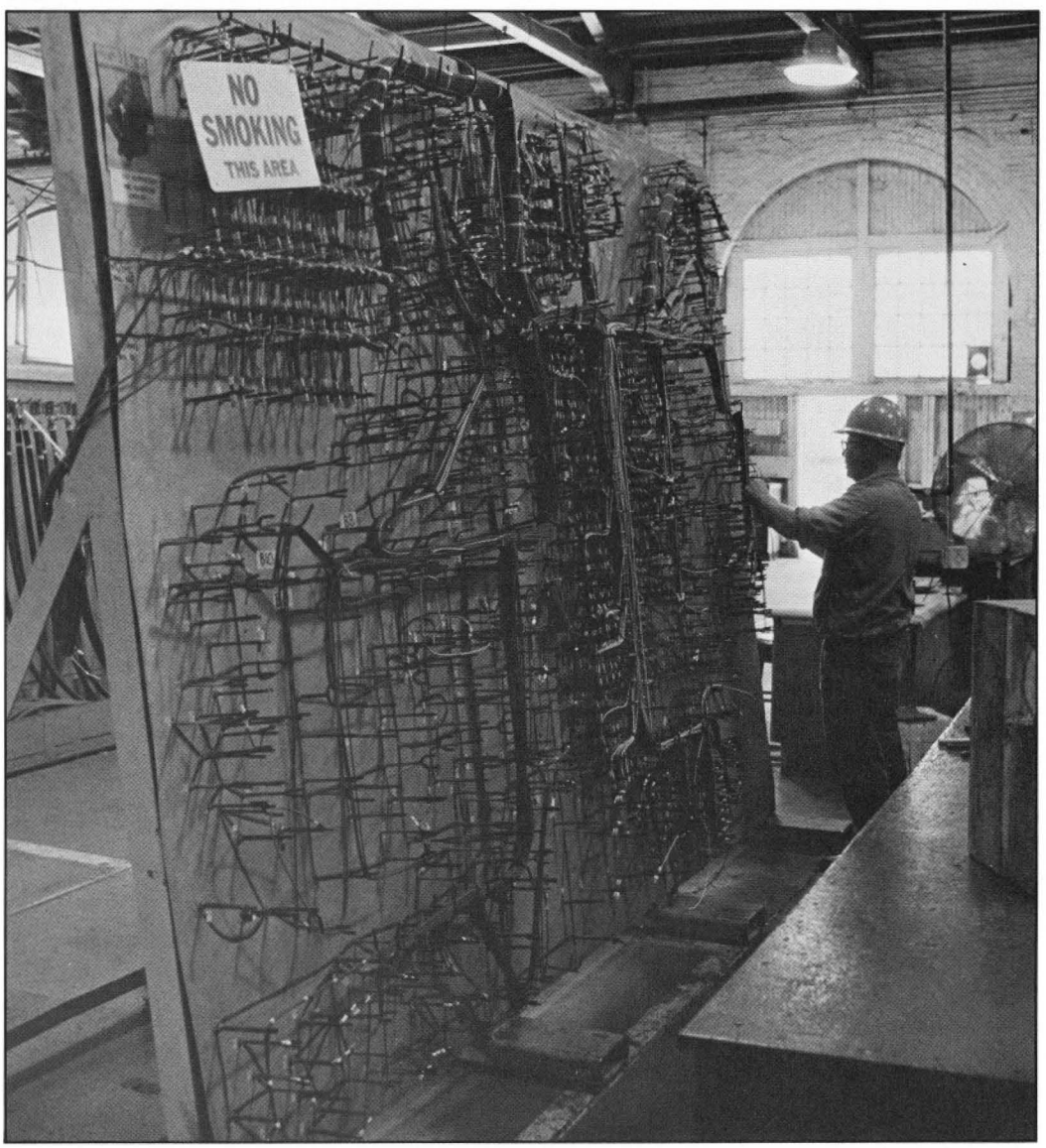
GRIP PROGRAM

The mechanical department in San Francisco is responsible for determining when a unit has reached the end of its useful life and is worthy of the General Rehabilitation and Improvement Program (GRIP). When a unit is down for major repairs at one of the shops around the system, it is evaluated for other defects, and this information is sent to San Fran-

SACRAMENTO LOCOMOTIVE WORKS REBUILT LOCOMOTIVE PRODUCTION

YEAR	GP9E	SD9E	GP20E	U25BE	SD35E	GP35R[1]	SD7R	SD40R	SD45R
1970	26	25							
1971	20	27							
1972	41	12							
1973	36	14							
1974	32	21	7						
1975	20	12	6	1					
1976	35	10	7	1	1				
1977	27	14	13		5	1			
1978	5	5	4		3				
1979	5	3	6			5	12	1	1
1980							32	43	
1981[2]								42[3]	21
1982[4]									43
1983									24
1984									48
1985[5]									23
							Grand Total:		740

Notes:
[1]Includes five de-turboed GP35R's built in 1979.
[2]Does not include nine Tractive-Effort Booster Units built in 1981.
[3]Includes unit 7399, an SD45 carbody with a 16-645 engine classified as an EF630 R2 (SD44).
[4]Does not include four Tractive-Effort Booster Units built in 1982.
[5]Figures through October 31, 1985.



The electrical wiring harness for an SD45R resembles electronic spaghetti while it is being assembled on a specially built jig. It takes two men seven working days to complete the wiring harness before it is installed in the electrical cabinet.

cisco for a decision on whether a unit is deemed to be cost-effective to rebuild. Not all units make it into the GRIP program, some are repaired, and others are too far gone from accidents or fire damage to be economically repaired.

Once a unit is selected for the GRIP program, it is forwarded to Sacramento where it is held pending scheduling into the program. Depending on the backlog of units on hand, a unit may sit around the shop yard for a couple of years or more waiting for its date for rehabilitation. The average wait is around 12 to 15 months though. Besides being out-of-service on arrival, almost all units are pretty well stripped of usable parts by the shops where they were stored while they were waiting for their GRIP program decisions to be made. It is rare for the shops to receive a unit with good traction motors, power assemblies, and most other easily changeable parts still intact.

When a unit finally enters the GRIP program, the rebuilding process is scheduled to take 46 working days for completion, requiring over 5,400 man-hours of labor being expended on it. An average of $700,000 is spent per unit upgrading it unless there is more than average body work needed due to an accident or fire.

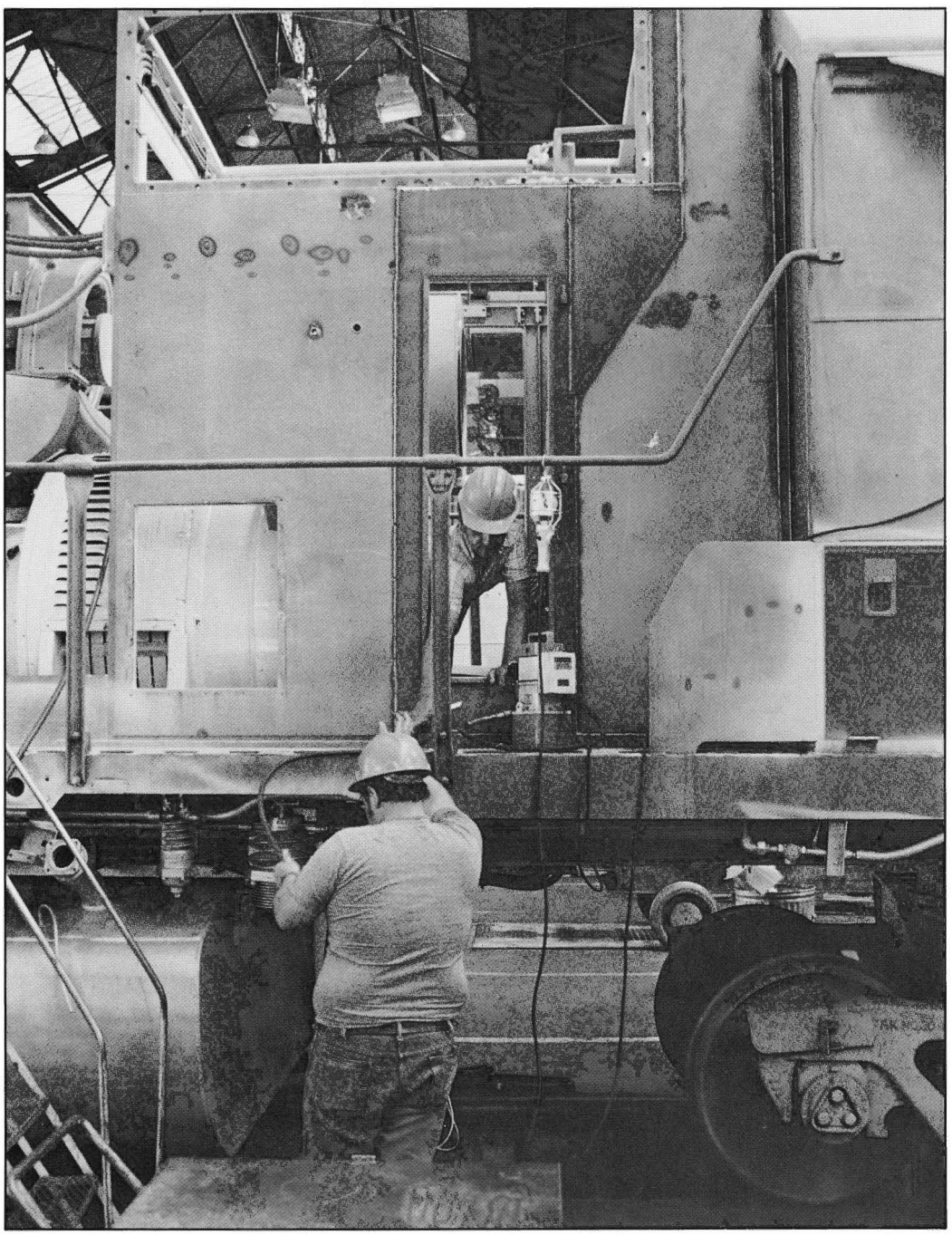
GRIP Process

The first step taken once the unit physically starts its flow through the shops is to spot the unit at the stripping shed where any remaining fuel, water, oil, and sand are drained from the unit, and all of the filters removed. The unit is then moved to the cleaning track where it is given an exterior wash and the engine room is given a preliminary wash. A thorough engine room cleaning is not done at this time as the traction motors and all electrical gear are still in the unit.

After being washed, the unit is then moved into the north end of the truck shop and placed on the drop pit where the trucks are removed and the unit is placed on shop trucks. The locomotive trucks are disassembled, cleaned, and visually inspected and repaired as needed. The roller bearings are removed from the axles, and the wheels, axles, and pinion gears are inspected for cracks. The tread depth and profile of the wheels are checked, and if there is sufficient tread left on the wheel, it may be resurfaced (trued) as required, then placed in the replacement parts pool. If any defects are found on any of the components, they are replaced or repaired. Rebuilt GRIP units receive all new wheels. New rebuilt traction motors are installed throughout each truck.

The unit then moves via the transfer table to the north end of the erecting shop where it is stripped down to the bare frame and the cab is reduced to a skeleton. All that is left on the frame at this time is the cab and fuel tank. What remains of the unit is then taken back to the cleaning track for a thorough cleaning, removing any remaining oil and grease.

Next, the frame and cab are placed in the south end of the truck shop for any body modifications. (The long hood is also in the shop, but is not mounted to the frame at this time). Some of the modifications made at the present include replacing the one-piece L-shaped engineers windshield with a two-piece one, removing the front and rear classification lights, replacing the front Mars light with the



SD45R 7552 was near the mid point in the rebuilding process when photographed in July 1985. The prime mover and main generator were in place as was the new electrical cabinet and workers were in the process of installing the electrical system wiring.

Final assembly takes place in the Erecting Shop where SD45R 7552 was being fitted with electrical components in July 1985. Behind the 7552 is the 7551 which would later become the first SP unit to wear the post merger red and yellow paint.

new Oscitrol light system found on the recently delivered GP40-2's and B36-7's, adding a full rear warning light package, removing the inboard wheel sanders, and applying the telemetry equipment antenna (for caboose less operation). The fuel tank gets new fuel gauges and two filling spouts on each side, one of standard SP design, the other one compatible with Santa Fe fueling nozzles.

After all body modifications have been made, the long hood is replaced and the unit is moved to the grit blast facility for sandblasting. While the term sandblasting is more familiar to us, what is used now is actually a very fine steel shot. The grit blasting is done indoors and the grit is recovered through a series of grates the track rests on, and is then separated from the paint particles and re-used.

The grit blast and paint shop facility are the newest buildings on the shop grounds, opened early last year. Their cost was over $2 million and feature the very latest in technology and environmental protections.

After receiving a coat of silver epoxy primer paint, the unit is then moved to the erecting shop where it will spend the majority of its time in the GRIP program. A new Dash-2 electrical cabinet is installed first. This cabinet is wider than the standard SD45 electrical cabinet, and the walls of the new cabinet actually become the outside walls of the long hood immediately behind the locomotive cab. This is easily noticeable upon examination of one of the rebuilt units.

A rebuilt alternator comes next, followed by a rebuilt 20-645E3B engine rated at 3,600 HP (3,200 HP on the 7400-7536). A reworked "clean cab" control stand meeting the latest FRA requirements along with repositioned speedometer and brake valve is installed in the locomotive cab. Also installed in the cab is the telemetry equipment to allow lead unit operation on caboose-less trains.

All new wiring and piping is installed throughout the unit. Of special note is the wiring harness for the electrical cabinet. This takes two men seven working days to cut the several hundred wires to the proper length, fasten connecters to the ends of the wires, then tie them together into bundles before installing them in the cabinet.

Once the locomotive is physically completed, it is then retrucked and taken to the firing line. The firing line is an open air shed on the west side of the shop, and is where a unit is fired up for the first time and everything is physically inspected and then monitored for leaks and proper operation. This is a recent departure from past practice where a unit would be painted first before going to the firing line. It was found that often there were needed repairs or additions to be made that would damage the paint, and the unit would have to return to the paint shop for touch-up work. Now, once a unit is found to operate satisfactorily, it is moved to the paint shop for final painting.

The new environmentally-clean paint shop is unlike anything most of us have ever seen, somewhat resembling a scene out of a science-fiction space movie. The painters are encased in white, paper jump suits and wear protective helmets and masks that are connected to an outside air supply. Actual painting is made from a hydraulically operated platform on either side of the locomotive, each individually controlled by the painter.

Painting requires three days for an SD45R unit. The cab and engine room interiors are painted a beige color, a more harmonious and appealing color than the former apple green. On the exterior, the red paint on the rear of the long hood and on the nose are painted first. This is done as it requires far less masking than if the grey areas were painted first. Next comes a coat of dark grey, followed by lettering and numbering, including stenciling of miscellaneous information on com-

Sacramento does more than rebuild locomotives. They also do a variety of major repairs as was the case when SD40T-2 8303 paid a visit in July 1985 for a new prime mover. This type of heavy repair work is performed in the Erecting Shop.

partment doors. Painting an SD45 requires the use of 25 gallons of primer, 25 gallons of grey, five gallons of red, and 15 gallons of beige paint.

The unit returns to the firing line for a final check-up, and then is released to the system. All shop releases are moved dead to Roseville via the Woodland turn. The GRIP units are forwarded dead-in-consist to Eugene for set-up and inspection by the leasing company. All of the SD40 and SD45 rebuilds are sold by the SP to leasing companies and then leased back to the SP to take advantage of numerous tax advantages available by doing so. The units are moved dead to Eugene to avoid a rather hefty California tax that would be placed on them if they were set up within the state for operation.

Just like most new products, a unit released from the GRIP program comes with a warranty covering its operation. On some rare occasions, a recently released unit may be seen back at the shops for repair work covered under the warranty. Virtually all of these repairs are for mechanical component failures, items beyond the control of the Sacramento Quality that goes into them.

OTHER SHOP FUNCTIONS

Besides rebuilding and repairing locomotives, the Sacramento Locomotive Works provides a number of other functions for the system. A partial listing of components the shops rebuilds or repairs for distribution and installation by the other shops around the system are: traction motors; wheels and axles; power assemblies (pistons and cylinder liners); cylinder heads; diesel injectors; engine governors; brake valves; crankshafts; and complete engine blocks.

The injectors and engine governors are repaired in a dust-free "clean room" similar to those in use in the electronics industry. Individual complete power assemblies consisting of pistons, cylinder liners, and heads are also rebuilt for system distribution to other shops. Both EMD and GE assemblies are rebuilt in the shop. Besides rebuilding individual power assemblies, entire engines are rebuilt at Sacramento for distribution and installation by the other system shops. During 1984, 20 such engines were rebuilt at the shops.

Work on locomotive wheels and bull gears is performed within the shop complex in the old car shop mill building. Wheels needing resurfacing or reprofiling are turned in a wheel lathe that peels both wheels at once while they are still mounted on the axle.

Perhaps one of the more interesting tasks the shop performs to the outside observer is in inspecting the engine blocks before rebuilding. The 20-cylinder block is exceptionally long, and after several hundreds of thousands of miles of use, it may develop a slight sag which allows for uneven wear within the engine or a broken crankshaft. When inspecting the the engine blocks, they are set on end-grain oak blocks on the largest granite surface plate west of the Mississippi River and are measured for trueness, the plate being optically flat to within 5/10,000th of an inch. If an engine block is found to be outside of allowable tolerances, the block is line-bored back to specifications.

Wheel Shop

The wheel shop has been around almost since the beginning of the Central Pacific Railroad. In the 1960's, the wheel shop was relocated to the northwest corner of the property when a new, automated shop was built. This was the second fully automated wheel shop in the west, being only superseded by the Missouri Pacific's shop in North Little Rock.

The wheel shop supplies the system with half of its new and resurfaced freight car wheels, new axles as required, and new or rebuilt roller bearing assemblies. The old or damaged wheels arrive at the shop on SPMW flatcars or PMT truck trailers, and then are sorted according to wheel size, axle weights, and type of wheel. Work is performed in group lots filling orders for the car shops around the system. It is much easier and faster to work on 100 70-ton wheelsets than to

have to vary the equipment for individual sizes as they pass through the shop.

The wheels are inspected on arrival to AAR standards for the nature of the defect. Most wheelsets require new wheels to be pressed on the usually reusable axle, but others require only turning to remove flat spots or return the surface of the wheel face to the proper profile. Some of the defects found in the wheels themselves are cracks, thin flanges or tread, or loss of temper due to overheating. New wheels are pressed onto the axles using a fully automated press that removes the old wheels and mounts the new ones in one continuous operation. In 1984, 4,776 wheels were turned in the shop, 12,389 new wheels were pressed onto axles, and 520 new axles were used.

Traction Motor Shop

The newest repair shop at the Sacramento Locomotive Works is the traction motor repair shop which opened in 1983. Using the old passenger car shop building (Car Shop #3), the shop produces 90% of the rebuilt traction motors used on the system today. The other 10%, and all previous rebuilt traction motors, come through purchase from outside vendors. This shop is now running near capacity, turning out eight rebuilt motors per day.

Incoming motors are first placed in a pressure washer where dirt and lubricating materials are externally removed. Often, one trip through is not enough to rid the motors of the tar-like lubricating substance and a second trip through is needed. The gear case covers and pinion gears are pulled off next. The motors are then placed on a stripping machine.

This machine engages the motor and moves it back and forth until the bearings break loose. The armature, now being free of the motor, is removed and the case is returned. After inspection, all salvageable parts are placed on racks for chemical cleaning. The gear case is chemically cleaned and vacuum dried. A portion of the armature is blasted free to clean off carbon from the commutator, and the armature is washed.

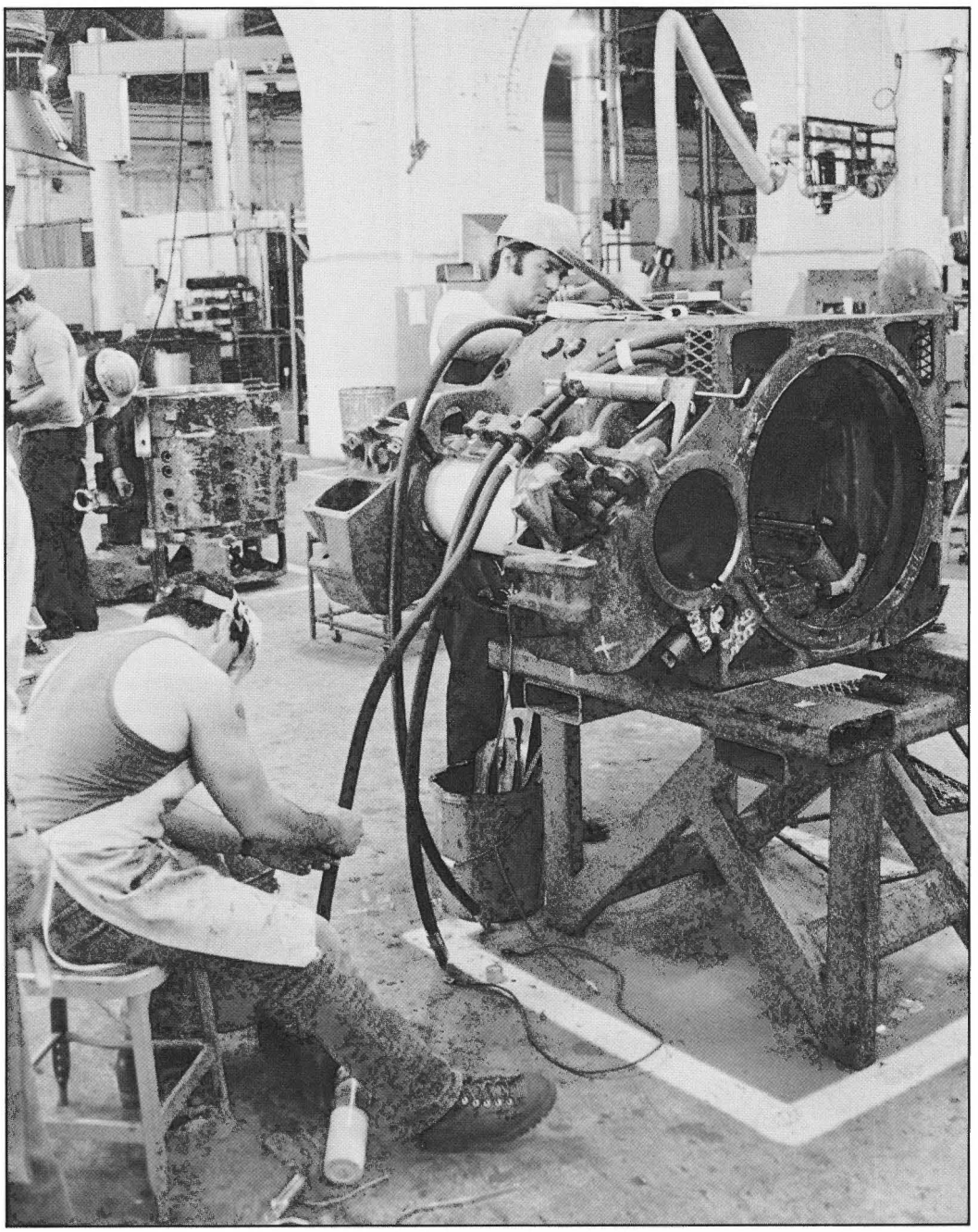
The frames are qualified (inspected), and any heavy frame welding for defects found is made. Any light electrical repairs are made, such as to the stator. Next, any other repairs to the major electrical frame are made (heavy field coils, interpols).

The armatures are further dried, then impregnated with varnish and baked dry. The armature commutators are undercut (turned), and then balanced. New bearings are installed and the armature is replaced into the frame. New brushes are installed, followed by replacing the gear case covers and pinion gears.

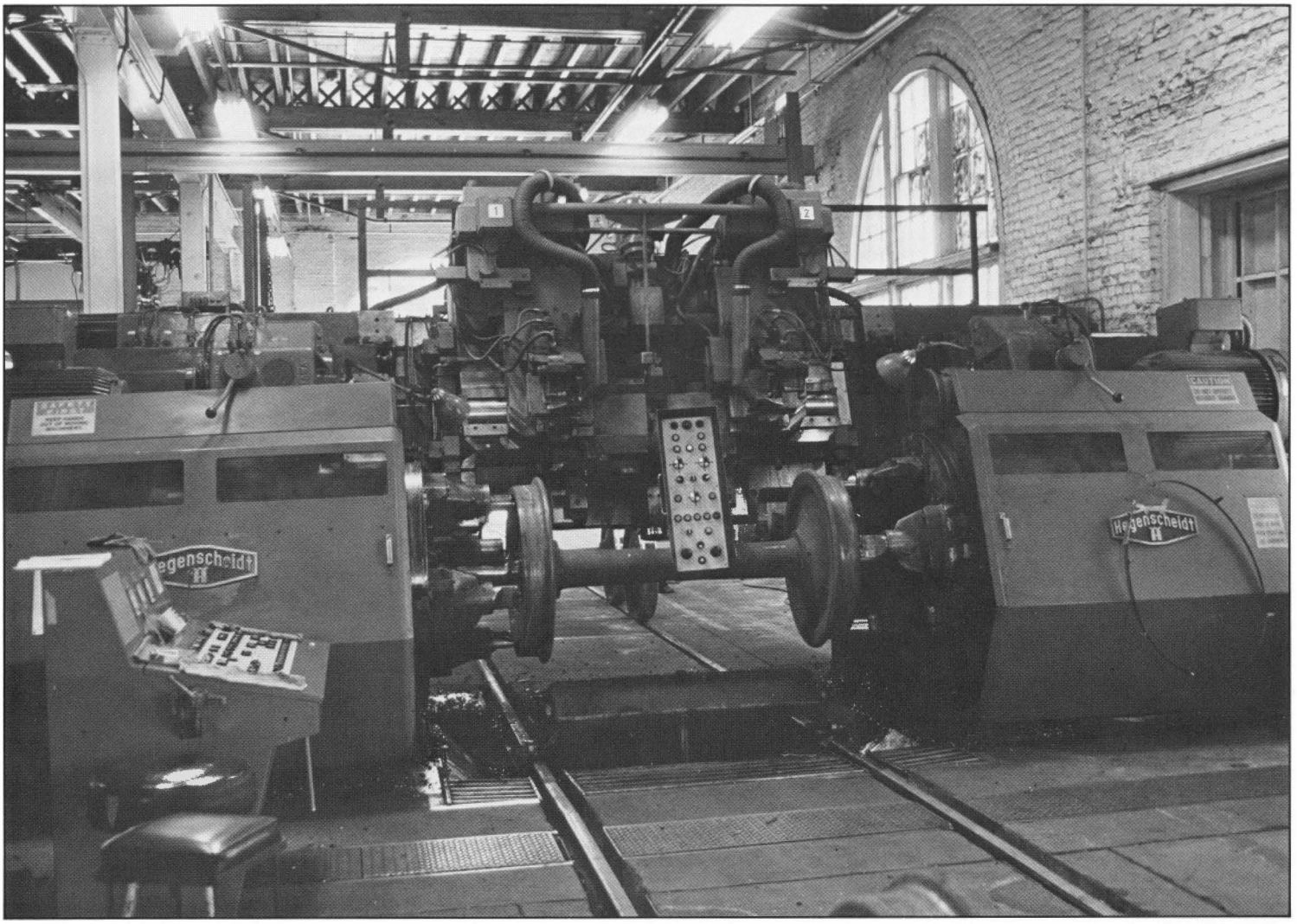
Finally, the gear cases are masked and given a coat of red paint allowing for easy identification as a Sacramento rebuilt motor. The motor cases are color coded, blue cases signify a Motor Coil or Chandyson Brothers rebuild, and black are from EMD. The SP estimates it will save upwards of $7.5 million in 1985 by rebuilding traction motors itself instead of sending them out. Maximum daily output is nine traction motors, with eight currently being produced. A total of 2,005 traction motors were rebuilt in the shop in 1984.

THE FUTURE

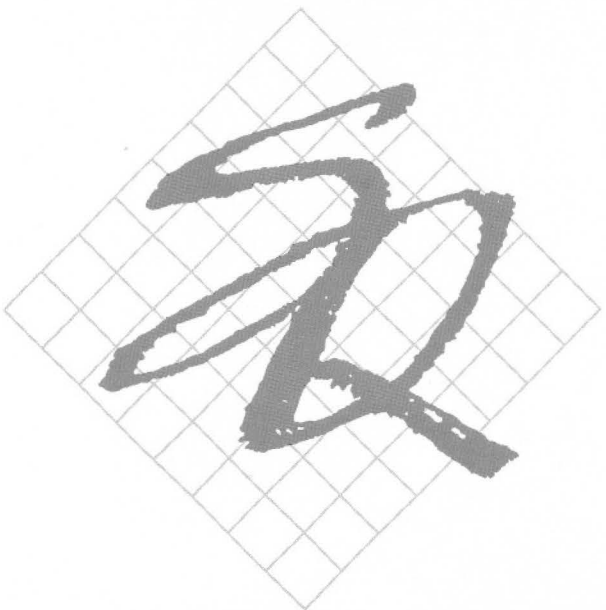
The mission of the shops has changed considerably since 1868, with much of it happening in the last 30 years. From over



The Traction Motor Shop provides the SP system with 90% of the motors used by the SP and it performs all of the rebuilding work done by the SP in-house. In this scene, a rebuilt motor is in the process of being reassembled and rewired in the Traction Motor Shop.



The wheel shop is equipped with a Hegenscheidt wheel lathe which peels both wheels of a wheel set simultaneously without having to be removed from the axle. Both locomotive and freight car wheels are turned here.



5,000 employees back in its heyday, it has gradually wound down and their are about 550 workers now. The pending merger of the Southern Pacific and the Santa Fe and its effects on the shop are unknown at this time. Whether they will continue on as-is at the current level, be expanded, or abolished entirely are the three possibilities.

The buildings may be old, but the Sacramento Quality work that goes on inside of them and the resulting products are certainly as modern as anything being produced by America's locomotive manufacturers with the exception of the Super-Series units just now being introduced. It has been said that any of the new facilities and equipment now at the shops can be uprooted and moved to another or new facility if the SPSF should decide to close down the works. What cannot be transferred is the 117 years of history, tradition, pride, and excellence, that has gone into the work of the Sacramento Shops, now the Sacramento Locomotive Works. All of these ingredients have made Sacramento products what they are today, Sacramento Quality.

Acknowledgments: We would like to thank the following people from the Sacramento Locomotive Works for their time, help, and expertise in making this article possible: Mr. Henry Chidgey, Works Manager; Mrs. Linda Mayhew, Assistant to the Works Manager; Mr. Ross Gill, Manager, Production Engineering; Mr. Ken Fleming, Assistant Chief Draftsman; Mr. William Graham, Quality Conrol Inspector, and each of the hundreds of Sacramento Locomotive Works employees.

The historical information was largely based on a narrative historical account of the shops prepared in 1948 by Mr. Don Joslyn, a 46 year employee of the shops who went to work there in 1902 at the age of 16, and was the photographer for the shops between 1921 and 1948. Also supplying historical information and verifying dates and details was Mr. Joe Strapac, President of the Southern Pacific Historical and Technical Society.

Sacramento paints their locomotives in an environmentally controlled paint shop using the newest in painting technology. Painters are fully enclosed in disposable paper "space suits" complete with an outside source of air and work from special hydraulically controlled platforms which move each painter along the sides of the locomotive. From these platforms painters can spray an entire locomotive without having to walk a step. SD45R 7550 has already received its red nose and has been masked off for the coat of traditional SP grey.

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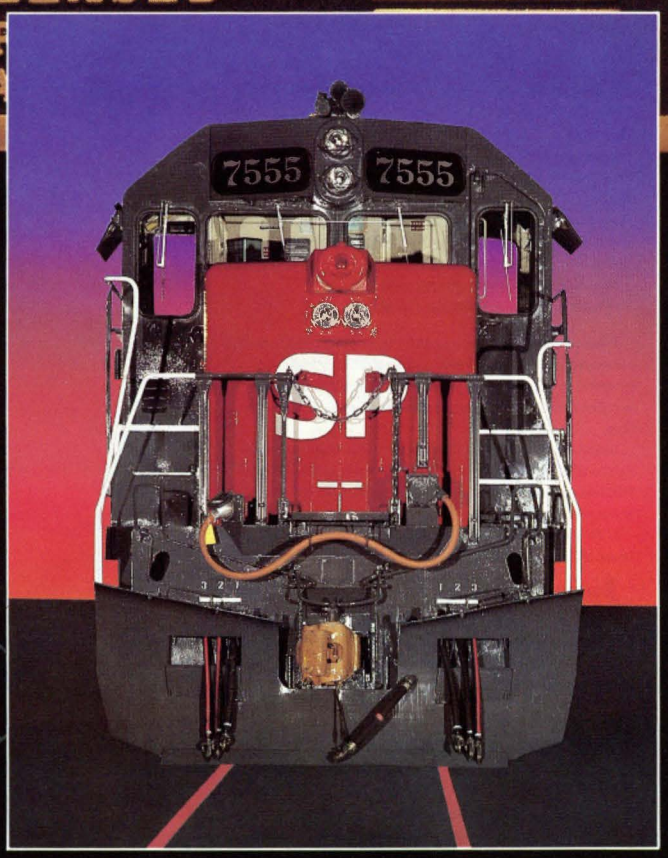

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