

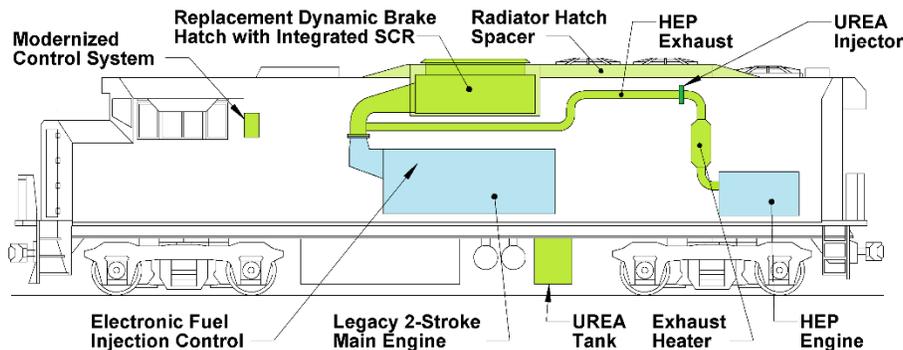


Rail Propulsion Systems

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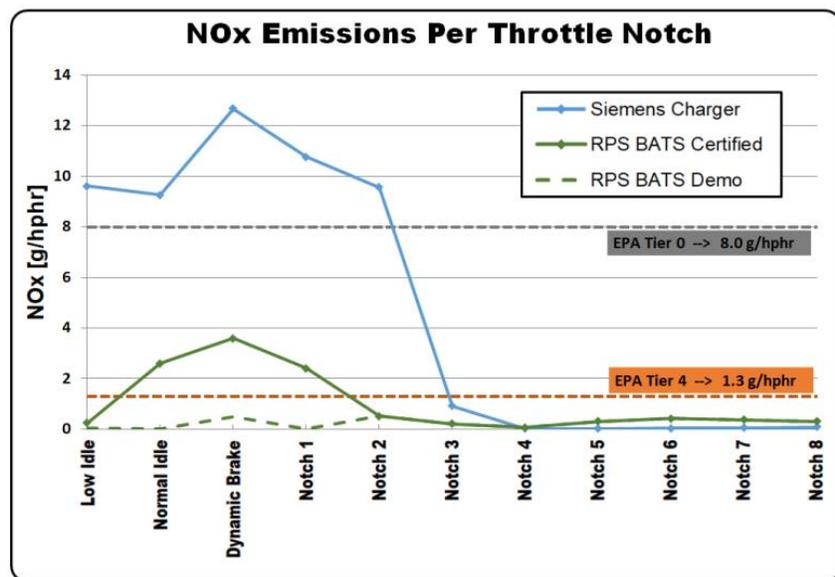
Proven, Cost Effective Emissions Solution for Diesel Passenger Locomotives

A Southern California technology company has demonstrated the first diesel passenger locomotive in the United States with combined in-use emissions lower than the current EPA Tier 4 standard. With help from North Carolina Dept. of Transportation, the NC Clean Energy Technology Center and the Federal Highway Administration, Rail Propulsion Systems LLC (“RPS”) of Fullerton, CA has demonstrated a working F59PH locomotive that has lower emissions, lower fuel consumption and is less expensive than new Tier 4 diesel locomotives. As an added advantage, the F59PH retains the separate Head End Power (“HEP”) engine for lighting and temperature control of the passenger cars, preserving comfort and safety for passengers in the event of a failure of the main engine.



The patented technology that offers these impressive results is the Blended After-Treatment System (“BATS”). Legacy passenger locomotives typically have two diesel engines, a large 3000HP diesel engine for propulsion and a smaller 800HP diesel HEP engine for supplying power to the passenger cars. The patented BATS retrofit pictured above works by blending the exhaust from both engines into a single emissions system allowing effective emissions reductions from idle to full power.

The figure at the right contrasts the tested emissions levels of the BATS in green with the publicly available emissions data of the Siemens Charger locomotive in blue. While both locomotives





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have NOx emissions well below Tier 4 at the higher throttle notches, at lower throttle notches their NOx emissions are higher than Tier 4.

The solid green line displays the advantage of BATS: much lower NOx emissions at lower notches. The Siemens Charger NOx levels are dramatically higher at lower notches, exceeding Tier 0 until the locomotive is operating at Notch 3.

While the low emissions of the locomotive recently delivered to North Carolina are certainly newsworthy, a prototype system has been tested that produces continuous in-use NOx emissions at below Tier 4 levels. The dashed green Demo line is the emissions demonstrated with the prototype hardware. RPS is confident its production systems will meet the Tier 4 NOx standard at all notches all the time.

In addition, because the NOx would be substantially lower than Tier 4, regulators would be justified in creating a Tier 4-Equivalent designation, based on mathematically combining the NOx and PM emissions. Using a PM multiplier of 13 times that is being considered as equivalence for NOx by California regulators, BATS would qualify for such a designation. On a Tier 4-Equivalent basis, the production BATS retrofit system would produce less than half the combined in-use emissions of the Siemens Charger locomotive. Critical to the widespread adoption of low-emission technologies, BATS expects to have a Total Cost of Ownership less than half that of a new passenger locomotive. Both the initial capital cost and the mandatory engine rebuild frequency would be reduced by half.

“Given the long-term move away from diesel power, passenger rail agencies should focus on interim solutions to squeeze the remaining value from their legacy diesel fleets,” said Dave Cook, Chief Technical Officer of RPS. “One good solution is to retrofit their remaining legacy locomotives with BATS. This buys time for passenger agencies while they investigate and demonstrate options for new zero emissions electric or hybrid passenger locomotives”.

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