L&T Technology Services

Redefining Railway In-Sleeper Point Machines

Compact, reliable, and safer track switching

CASE STUDY



engineering intelligence

EXECUTIVE SUMMARY

An Indian rail technology company sought to redesign conventional point switching by replacing exposed trackside point machines with an in-sleeper architecture. This would improve network availability, simplify maintenance, and enhance operational safety without changing existing rail infrastructure.

LTTS engineered a fully enclosed in-sleeper electromechanical switching system that combined compact mechanical design, safety-critical engineering, environmental protection, and structural validation within the footprint of a standard PSC sleeper. The design incorporated IP68 protection, SIL4 design alignment, manual fallback operation, safe maintenance isolation, modular construction, and FEA-based verification.

LTTS undertook concept engineering, detailed design, prototype development, and engineering validation based on the customer's Functional Requirements Specification (FRS) and applicable railway guidelines.

Field trials, certification, Indian Railways approval, Safety Case preparation, FMEDA, and physical qualification testing remained within the customer's and RACT's scope.

CLIENT CHALLENGE

Railway point machines are critical for safe and reliable track switching. The customer needed a compact in-sleeper solution that could withstand harsh railway environments while reducing maintenance and downtime. The system had to fit within a hollow metal sleeper, preserve standard PSC sleeper interfaces, and provide IP68 protection, high reliability, and safe operation.

The engagement involved addressing:

01 **Operational limitations,** since conventional point machines required removal during tamping – increasing overall maintenance effort and downtime.

02 **Compact integration,** with the complete electromechanical system being ready for fitting inside a hollow metal sleeper, while maintaining standard sleeper interfaces.

03 **Reliability requirements,** across IP68 protection, modularity, and high operational reliability.

04 **Safety and maintainability,** across safe electrical isolation and manual fallback operation capabilities for maintenance and power-loss scenarios.

ENGINEERING COMPLEXITY ADDRESSED

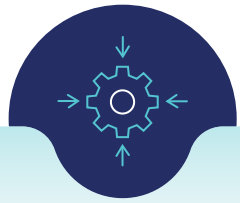
The design needed to resolve several interlocking engineering complexities: packaging motors, gears, shafts, sliding bars, and electrical components within a tightly constrained sleeper envelope, while achieving IP68 sealing against water, dust, and trackside conditions. It also included ensuring SIL4-aligned fail-safe switching with manual actuation and key-operated isolation for safe maintenance and validating structural integrity through FEA under 125 kN wheel loads and vibration up to 19.33 Hz.

OUR SOLUTION

LTTS designed a compact and robust architecture with all key components integrated within a hollow metal sleeper, reducing reliance on trackside installations



IP68-protected design: Protects critical components from water and dust ingress, reducing maintenance exposure



SIL4 design alignment: Developed in alignment with EN 50126, EN 50128, and EN 50129 requirements



Modular architecture: Simplifies installation, maintenance, and integration into existing railway networks



Electromechanical engineering: Designed gears, shafts, sliding bars, rods, fish tail bars, brackets, clamps, and supporting electrical systems



Safe operation and maintenance: Key-operated isolation switch and manual fallback operation mechanism to enable safe servicing and operations, even during power loss



Simulation-led verification: FEA and reliability assessments validated the design against FRS-defined load and vibration requirements



Accelerated development: Leveraged customer input, reusable templates, and proven engineering practices to improve delivery efficiency

BUSINESS OUTCOMES

The LTTS team delivered:

Reduction in Maintenance Effort,
eliminating the need for point machine removal during tamping

Compact, IP68-Protected Design,
minimizing trackside footprint and mitigating water and dust ingress

Enhanced Safety and Availability,
with SIL4-aligned design with safe isolation and manual fallback operations

FEA-Verified Performance,
validated against railway load, vibration, stress, and safety requirements

THE LTTS EDGE

LTTS combined mechanical engineering, electrical system design, safety engineering, structural simulation, and railway domain expertise within a single engineering program. The integrated approach enabled rapid concept development, virtual validation, and prototype delivery while remaining aligned with customer functional requirements and applicable railway standards.



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ENGINEERING THE CHANGE

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