REDUCING OPERATIONAL LOSSES BY ORGANIZING LOCOMOTIVE ADMISSION TO TECHNICAL SERVICE-2 BASED ON DISTANCE TRAVELLED AND SERVICE TIME

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Abstract. The paper considers the reduction of operational losses arising during locomotive operation. Particular attention is paid to organizing locomotive admission to technical service-2 not solely according to calendar periodicity, but by jointly considering the distance travelled since the previous maintenance and the elapsed service time. This approach is aimed at reducing unnecessary operations caused by premature technical service-2 as well as technical and operational losses associated with delayed maintenance.

Keywords: service time, operational losses, waiting time, unnecessary movement, locomotive fleet.

Introduction

Efficient utilization of the locomotive fleet in railway transport directly affects the stability and economic efficiency of the transportation process. Time during which a locomotive is not engaged in productive work, waiting for maintenance, unnecessary movements, repeated operations, and excessive reserves prolong locomotive turnaround. Therefore, it is important to organize maintenance in accordance with the actual operational work performed by a locomotive. The aim of the study is to reduce operational losses by jointly considering the distance travelled and service time when admitting locomotives to technical service-2 (TS-2) [1, 2, 4].

Operational losses arising during locomotive utilization are divided into five main groups: waiting time; unnecessary reprocessing and excessive operations; unnecessary movements; defects and their elimination; and excessive reserves. These losses manifest themselves differently within centralized dispatching, traction, and locomotive repair services.

Methodology

Losses directly related to the (TS-2) process include waiting for maintenance, unnecessary movement to a maintenance facility, premature withdrawal of a locomotive from productive operation, repetition of maintenance operations, and the need to maintain an excessive reserve locomotive fleet.

In the proposed approach, the condition for admitting a locomotive to (TS-2) maintenance is monitored using two principal parameters: the distance travelled since the previous (TS-2) maintenance and the elapsed service time since that maintenance [3].

Conceptually, the decision to admit a locomotive to (TS-2) is formed when the following condition is satisfied.

$$L_i \geq L_{TS\text{-}2} \ \text{ or } \ \mathrm{T_i} \geq \mathrm{T_{TS\text{-}2}}$$

where L_i is the total distance travelled by locomotive i since the previous TS-2 maintenance;

T_i - the elapsed service time since the previous TS-2 maintenance, while $T_{TS\text{-}2}$, i denotes the time at which the previous TS-2 maintenance was performed.

Thus, the actual operational workload of the locomotive is coordinated with the periodicity of maintenance.

Integrated monitoring of distance travelled and service time links the decision on TS-2 admission to the actual workload of the locomotive. As a result, unjustified early dispatch of a locomotive for maintenance, unnecessary movement to a TS-2 facility, maintenance waiting time, and excessive withdrawal from productive operation can be reduced. At the same time, monitoring the achievement of the distance or service-time limit helps prevent excessive postponement of TS-2 and contributes to maintaining locomotive technical readiness. Particularly important area is the organization of TS-2. If a locomotive is sent for maintenance without sufficient coordination with its actual operating work, additional waiting and unnecessary movements may arise. Conversely, excessive postponement of maintenance can adversely affect operational losses.

Operational losses are divided into five groups: waiting time, unnecessary reprocessing and excessive operations, unnecessary movements, defects and their elimination and excessive reserves [5-7]. These groups are observed differently in dispatching, traction and locomotive repair activities.

Table-1

Technical service-2 related losses and the proposed approach

Loss category	**Centralized dispatching**	**Traction service**	**Locomotive repair service**
Waiting time	Train locomotives waiting for station operations; shunting locomotives standing idle; dispatch personnel waiting for operations.	Waiting for a locomotive crew; shunting locomotive waiting for a crew; crews waiting to start work.	Waiting for repair; shunting locomotive waiting for repair; repair personnel waiting for operations.

Unnecessary reprocessing and excessive operations	Repetition of control operations; operations with wagons that could be cancelled without affecting the result.	Repetition of control operations; operations with locomotives or crews that can be eliminated without worsening the result.	Repetition of control operations; locomotive operations that can be eliminated without affecting maintenance and repair results.
Unnecessary movements	Unnecessary movement of personnel; irrational wagon movements; excessive movement of shunting and train locomotives; inefficient placement of work equipment.	Crews travelling as passengers; irrational movement of rolling stock, including unnecessary transfers of locomotives and crews to maintenance and repair facilities.	Unnecessary personnel movements; excessive movement of components under repair; inefficient placement of spare parts.
Defects and elimination	Disruption of the train formation plan.	Unnecessary trips without TS.	Defects resulting from poor-quality repair.
Excessive reserves	Excessive material reserves.	Excessive spare parts/materials and excess production capacity, including locomotives not used in operation.	Excessive spare parts/materials and excessive repair equipment.

Conclusion

Joint consideration of distance travelled and service time when admitting locomotives to TS-2 maintenance makes it possible to align the operational process with the actual workload of the locomotive. The approach is aimed at systematically reducing losses associated with waiting time, unnecessary movements, unnecessary reprocessing, and excessive reserves. As a result, a methodological basis is created for coordinating the TS-2 process with train operations and improving the efficiency of locomotive fleet utilization.

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