IMPROVEMENT OF TRAIN CONTROL SYSTEM IN ZIEMELBLAZMA-SKULTE SECTION, LATVIA

In the article the updating of the section Ziemelblazma - Skulte by the dispatching system is discussed.

INTRODUCTION

Remote regulation at the Latvian railway has been introduced since 1960. Its basis is the system of centralized dispatching control.

In 1960 – 1961 dispatching control was introduced at Riga – Tukums and Riga – Elgava sections where new equipment was installed. In 1966 Elgava – Krustpils section was connected to this system. Before 1972 dispatching control was introduced at all stations and signal boxes of Daugavpils railway junction, as well as Daugavpils – Rezekne and Daugavpils – Indra section.

At all these sections the same polar-frequency system of centralized dispatching control PFDC was installed. Over the years many sections were updated when the old system was changed to a more progressive cyclic type NEVA as well as to electronic analog MINSK. Also the system NEVA was reinstalled at Riga – Valga and Rezekne – Pitalova section (Figure 1).

Before 2007 at Latvian railway for centralized dispatching control were used NEVA, MINSK and PFDC systems.

Today these systems are changed to DIALOG, Ebilock and ESTWL (Figure 2).

Centralization microprocessor system EBILOCK 950 functions at many stations in Sweden, Poland, Russia and Lithuania. This system is installed at Riga Passenger station (145 switches). At the moment 20 stations of Daugavpils railway junction and Krustpils – Daugavpils and Krustpils – Rezeknes direction are equipped with this system.

1. CHARACTERISTICS OF ZEMITANI - SKULTE SECTION

Railway line Zemitani — Skulte is an electrified railway line in Latvia that runs 56km. Trip by electric train takes 1 hour and 8 minutes. At first the line was electrified to the station Mangali (opened in 1957), in 1971 electrification was extended to Zveiniekciems and in 1991 it was prolonged to Skulte.

Ziemelblazma station is at 13.7 kilometer post. There are two directions at the station. One direction is Mangali station and JSC "Riga Shipyard" connecting track, the other direction is Vecaki station and “Alfa Port” LLC connecting tracks.

From Mangali station there is single-track section with bridge and then double-track section stretches to Vecaki station.

There is a single-track line from JSC “Riga Shipyard” and double-track line from “Alfa Port” LLC.

Vecaki station is at 18.3 kilometer post. The station has two directions. One direction is Ziemelblazma station, the other is Carnikava station. There are double-track lines in both directions.

Carnikava station is at 30.1 kilometer post. The station has two directions. One direction is Vecaki station, the other direction is Lilaste station. There is a double-track line from Vecaki station. Single-track line goes in the direction of Lilaste station to the bridge across river Gauya and then double-track line starts.

Lilaste station is at 37.2 kilometer post. The station has two directions. One direction is Carnikava station, the other is Saulkrasti station. There is a double-track line from Carnikava station and a single-track line to Saulkrasti station.

Saulkrasti station is at 48.7 kilometer post. The station has two directions. One direction is Lilaste station, the other is Skulte station.
tion. In the Lilaste direction there is a single-track line to 42.1 kilometer post, then double-track line starts in the Skulte direction to 49.2 kilometer post, after which single-track line goes to Skulte station.

Skulte station is at 56.2 kilometer post. The station has one direction. There is a single-track line from Saulkrasti station.

Total mileage of Ziemelblazma — Skulte railway section is 42 km and 619 m. The section is equipped with automatic block system. Total number of intermediate block signals is 15 in each direction.

Ziemelblazma — Vecaki railway section is a double-track section, equipped with two intermediate block signals in each direction (Figure 3).

Fig. 3. Ziemelblazma — Vecaki section

Vecaki — Carnikava railway section is a double-track section with 5 intermediate block signals in each direction (Figure 4).

Fig. 4. Vecaki — Carnikava section

Carnikava — Lilaste railway section is a double-track section with 2 intermediate block signals in each direction (Figure 5).

Fig. 5. Carnikava — Lilaste section

Lilaste — Saulkrasti railway section is a single-track section to the signal box Inchupe with 2 intermediate block signals in each direction. After the signal box Inchupe starts double-track section upto Saulkrasti with 2 intermediate block signals in each direction (Figures 6 and 7).

Fig. 6. Lilaste — signal box Inchupe section

2. DISPATCHER WOKLOAD AT SECTION

The system consists of a centralized train dispatcher’s office that controls railroad interlockings and traffic flows in portions of the rail system designated as CTC territory. One hallmark of CTC is a control panel with a graphical depiction of the railroad. On this panel the dispatcher can keep track of trains’ locations across the section that the dispatcher controls. Larger railroads may have multiple dispatcher offices and even multiple dispatchers for each operating division. These offices are usually located near the busiest yards or stations, and their operational qualities can be compared to air traffic towers.

Traffic regulation by train dispatcher without assistant station masters accelerates train traffic at the section and reduces the number of traffic workers at the stations. Dispatcher usually controls the section 100—150 km long with 10-15 stations.

Ziemelblazma — Skulte section is 43 km. At this section there are trains with the following directions: Riga — Carnikava — Riga, Riga — Saulkrasti — Riga and Riga — Skulte. The following formula is used to calculate train dispatcher workload:

\[ T_1 = 1.15 \times T \times (K \times S + 0.1 \times (S - 1) + 0.3 \times G + 0.17 \times S_a) + 170 \]  

where:
- 170 — time that it takes for a dispatcher to complete all papers after its inspection once at shift handover (that’s why this time is added once in formula 2 as load differs at different sections);
- K — workload coefficient (for single-track sections with double-track segments);
- T — number of trains in both directions per shift;
- S — number of stations with centralized dispatching that are under independent and dispatching control;
- Sa — number of stations with independent control;
- G — total number of stations with dispatching control.

Dispatcher section length with actual dispatcher workload \( \alpha \) and operations of dispatcher for train traffic per shift which is expressed by \( T_1 \). \( T \) is duration of 12-hour shift

\[ \alpha = (T_1 / T) \times 100 \leq \alpha_{add} \]
2.1. Cost of introducing of centralized dispatching system DIALOG at Ziemelblazma – Skulte section

Cost of introducing of centralized dispatching system DIALOG at Ziemelblazma section is €689427.97 EUR (Table 2).

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2.2. Cost of introducing of centralized dispatching system EBILOCK 950-R4 at Ziemelblazma – Skulte section

Cost of introducing of centralized dispatching system EBILOCK 950-R4 at Ziemelblazma section is €6899611.93 EUR (Table 3).

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2.3. The best possible scenario for Ziemelblazma – Skulte section

Cost of introducing of centralized dispatching system DIALOG at Ziemelblazma – Skulte section is €689427.97 (Table 2).

Therefore total expenditure is €157 165.63 annually.

Difference between present expenditure of SJSC Latvian Railway to cover salary for workers and after the introducing of the best possible scenario at Ziemelblazma – Skulte direction is 301372.67 – 157 165.63 = 144 207.00 (€/year).

Hence the centralized dispatching system DIALOG at Ziemelblazma – Skulte section will be repaid in less than 6 years.

2.4. Maximum scenario at Ziemelblazma – Skulte section

Cost of introducing of centralized dispatching system DIALOG at Ziemelblazma – Skulte section is €689427.97 (Table 2).

Therefore total expenditure is €160 707.38 annually.

Difference between present expenses of SJSC Latvian Railway to cover salary for workers and after the introducing of the maximum
scenario at Ziemelblazma – Skulte direction is 301 372.67 – 106 707.38 = 194 665.30 (€).

Hence the centralized dispatching system DIALOG at Ziemelblazma – Skulte section will be repaid in less than 5 years.

CONCLUSION

The best possible scenario is to introduce centralized dispatching system DIALOG and to keep at each station two assistant station masters out of which one will fulfil the duties of station manager with additional payment of 5% and there will be one more back-up assistant station master.

Introduction of the best possible scenario at Ziemelblazma – Skulte direction will cost for SJSC Latvian Railway € 144 207.00.

The centralized dispatching system DIALOG at Ziemelblazma – Skulte section will be repaid in less than 6 years.

The maximum scenario will be to introduce centralized dispatching system DIALOG and at all five stations to keep four assistant station masters, one back-up assistant station master and one station manager (who can also work at all five stations, the same as one back-up assistant station master).

Introduction of the maximum scenario at Ziemelblazma – Skulte direction will cost for SJSC Latvian Railway € 194 665.30.

Hence the centralized dispatching system DIALOG at Ziemelblazma – Skulte section will be repaid in less than 5 years.

After introduction of centralized dispatching system at this section one dispatcher can cope with the workload in one shift.

At this section will be needed six workers, out of which one is a back-up assistant station master, one is a station manager and four are assistant station masters.

Taking into account that planned maintenance at this section is carried out simultaneously at two stations out of five, and then only two assistant station masters will be sufficient. Two more assistant station masters will be necessary for the other shift and a back-up assistant station master in case of emergency. Therefore the expenses will comprise 35% of the present ones.

Assistant station masters will work in stand-by mode and will be sent for in advance or will work in shifts in case of emergency.

Having been introduced the centralized dispatching system DIALOG will be repaid in less than 5 years and it will work for profit not loss.

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