



**Modernisation of old interlocking
systems with electric point setting
– cost effective solutions
with PRORIS-H**

**Reconstruction of the Budapest-side („even”) points area
of Szombathely station with PRORIS-H interlocking system**



Szombathely has a so-called serial-layout (like several stations on Hungarian railway network), as it comprises two stations: the passenger station, bordered with the „even” points area; and the freight station, bordered with „odd” points area, and between the two stations, there is a „middle” points area. The station (GySEV has been trusted its operation on the 11th of December, 2011; former times MÁV was the operator) has an old interlocking-mix (Integra/FM system): the signals are light ones, points had got mechanical setting with pull-wires, but the central logics is relay-based. Four relay rooms, three mechanical signal boxes, push-button panel for the main signalman, and, additionally, numerous outside relay cubicles with a lot of auxiliary subsystems: elements and circuits built in the last forty-fifty years. These subsystems are the following: electric point setting, level crossing in station area, block systems connections, ETCS- and Indusi -interfaces and a lot of „others”. Signs of these modifications remained on each signalbox: the numerous different-colour wires mean numerous changes – used for the actual remake in the interlocking circuits. There were a lot of modifications in the four relay rooms (a central one and three local ones for the three signalboxes), but, perhaps the „even” relay room has been changed the most times.

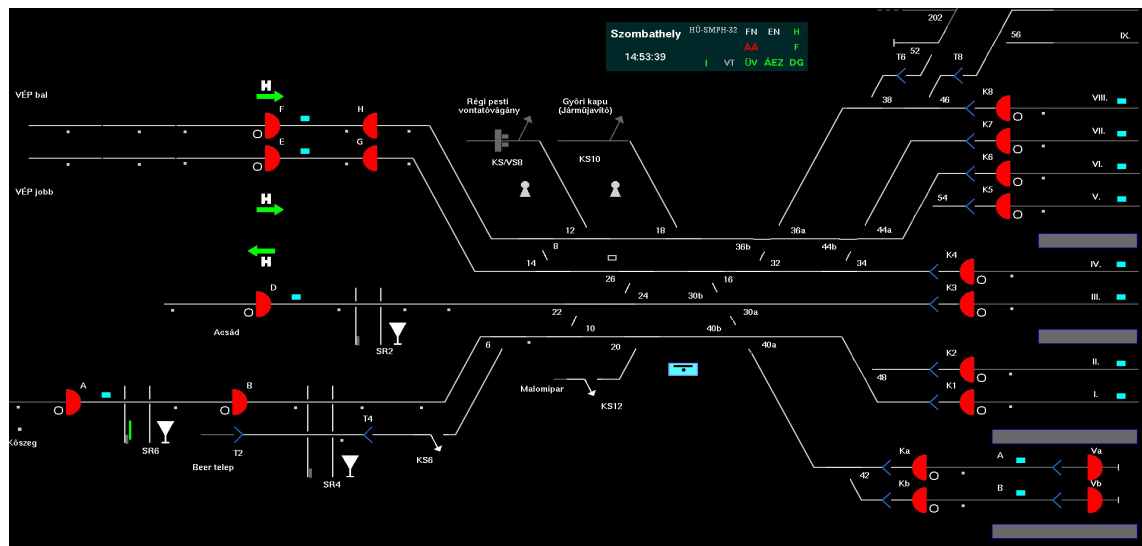
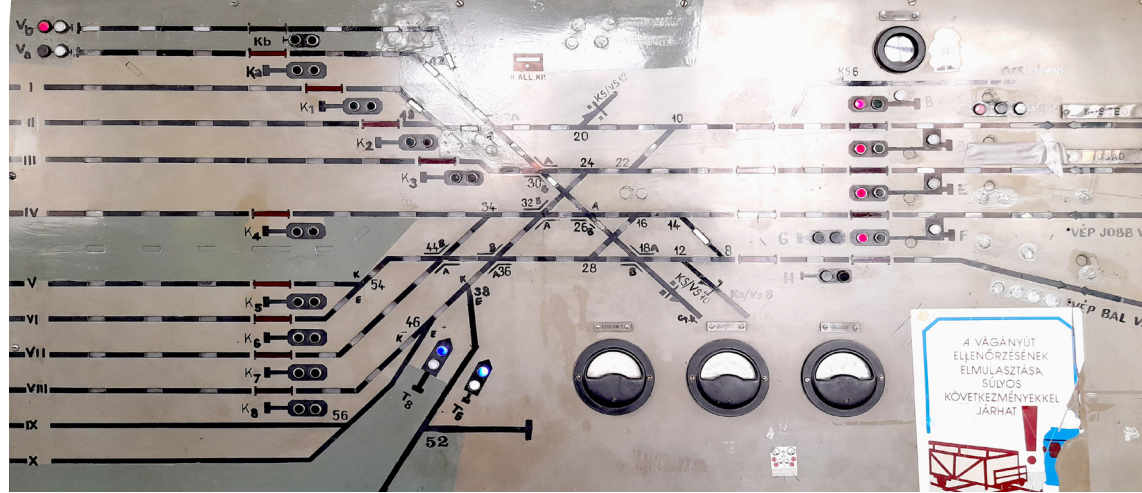
INTRODUCTION

Due to track condition reasons – 5 km/h and 10 km/h speed restrictions in the „even” points area – reconstruction of complete track renovation became inevitable. Traffic technology and timetable of the station made it possible to plan a less complicated track layout and a moderate reduction the number of points. Due to GySEV's decision, point setting and point endposition-checking must be elaborated with electric point machines, therefore the mechanical (pull-wire) point setting had to be abolished.

Earlier, mechanical central point setting was carried out with the aid of levers, pull-wire network and Soulavy point device, as it is usual in these-type mechanical systems (so-called „FM”), but, because of the several reconstruction phases in former times, three small zones in the „even” points areas were retrofitted with electric point machines. However, this fact did not ease the making of circuit plans of the present reconstruction, rather it made much more complicated: when planning the interface between FM and PRORIS-H, we had to deal with not the well-known circuits of FM-systems, but with an extremely unique relay logic.



*“Old” relay frames with their
– several times modified - wiring*



*The old (demolished)
indication panel
and the new one
of the "even" points area*

POSSIBLE SOLUTIONS

UTIBER Kft. (a Hungarian infrastructure planning company) has been trusted to prepare the complete (general) planning of the station; it comprises all type of plans, i.e. track, signalling, telecom, catenary and other (e.g. public utilities) plans. These plans covered the different planning phases: study, licensing, functional and wiring schemes. The first planning phase was to prepare a study plan. Considering the main goal, i.e. each point and derailer shall be equipped with electric point machine, the study plan resulted in three possible versions:

- the so-called lever-substitute device solution, retaining the lever frame, mechanical interlocking box and tumbler relays; i.e. mechanical inter-dependencies remain, but relay contacts of lever-substitute devices control – indirectly – the point machines. Disadvantage of this solution is retaining the complete indoor mechanics, which is very maintenance-demanding and is in extremely obsolete state;
- Domino55 (D55) point control solution: in order to control and check the endposition of points, D55 relay units and free-wired Integra XJ relays are used. Disadvantage of this solution is big space-demand: the GySEV-appointed room was too small for this version, since relay units and free-wired Integra XJ relays would have needed 25-30 standard relay frames at least;
- in order to control and check the endposition of points, PRORIS-H point modules and Prolan relay frames (ILA) are used. The only disadvantage? (or question mark?) was, former times such a „huge” amount of points have not been controlled by PRORIS-H. But a lot of advantages could be predicted:
- During last PRORIS-H projects, Prolan has developed a new, but functionally reduced (simplified) point control module (due to a small-sized marshalling yard (FILK); this solution was detailed in Signal+Draht, 2023/10), which does not contain the route logic of point, therefore comprises three printed boards only (instead of 7 boards). With the aid of this simplified point module, 3 points can be installed in a rack, therefore 12 points can be deployed in a cabinet (size of a cabinet is 600×600 mm);
- o Other solution could not be considered in the available small room, because it was known, interface between the old (FM) and new (PRORIS-H) systems demands significant amount of relays;

- o From space-utilization point of view, Prolan ILA-rack is the most efficient solution, because with it 80 ten-contacts relays can be housed on standard relay frames (on same standard relay frame only 20 Integra XJ relays and 40 Hengstler/Elesta relays in „cradle“ can be mounted);
- o with the aid of PRORIS-H technology, numerous other objects can be integrated, therefore JM18 / ProSigma modules are used to control the following objects:
 - station level crossings (3),
 - keylock objects (2),
 - so-called non-interlocked shunting signals (4),
 - push-out shunting signals (2),
 - call-on aspects on exit main signals (10).
- o considering the level crossings in station-area, their outdoor cubicles can be replaced by an indoor SR-module, therefore, in case of troubleshooting, less people needed (former times 5-6 people was ordered for finding a complicated failure);
- o a lot of safety functions can be solved in PRORIS-H's ProSigma subsystem, therefore the additional elements (e.g. electronic timers) are not needed,
- o electronic MMI of PRORIS-H can be easy-installed and flexibly-adapted with the following additional advantages:
 - the system can be integrated into the complete CTC of GySEV, and all information from CTC can be indicated on MMI of the point operator's workstation (e.g. open line objects: open line level crossings, block system statuses, block section state etc.),
 - status-information from the „even“ points area (e.g. points, level crossings) can be visualized on other workstations, e.g. on monitors of main signalman: therefore, so-called two-person point checking can be solved and only one signalman can be enough in the signalbox; moreover, the non-reliable old route indicator panel can be replaced by an up-to-date one.

In following chapter, special and unique solutions - applied during planning and installation of PRORIS-H and interface circuits - are detailed.

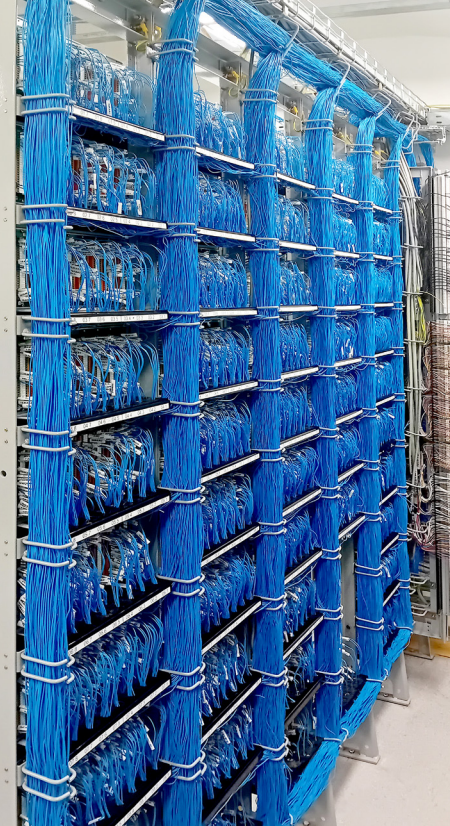
INTERFACE CIRCUITS BETWEEN INTEGRA / FM AND PRORIS-H SYSTEMS

While preparing plans, the main planning principle was the following: in case of adaptation to PRORIS-H, operational scheme and logic of the old Integra relay system must be retained (route setting initialisation from main signalman, execution from point operator signalman). Of course, all changes (due to topology change reasons) in route-tables and point-locking tables must be considered. In order to interface, existing relay circuits had to be modified, these circuits have been supplemented with necessary dependencies, and, moreover, new relay circuits have been planned (e.g. start-target, point and route locking circuits).

After the reconstruction of the „even” points area, the push-button route panel in the main signalman's office remained; some route-appointing push-buttons on the control panel have been changed according to the modified topology. The main signalman appoints the desired route on his control panel with the aid of two push-buttons (one for direction and one for the station track) in his office. Route-appointing relay circuits had to be modified due to demolition of mechanical lever frame in the „even” signalbox: tumbler relays had to be substituted with so-called route-appointing relays (each route must have a route-appointing relay). Route appointing relays are able to be active, when route-plan dependencies (e.g. there is no other route-setting or locking to the same track) are fulfilled. Route-appointing is proper, when two (one for a particular direction and one for a particular track) appointing relays are in „up” position at the same time. In this case, the point operator signalman gets a route indication on PRORIS-H electronic MMI (so-called EMU2).

If the main signalman appointed a train route, point operator signalman gets the right to set the appointed route via PRORIS-H EMU2; in this case the particular start-target relay circuit is activated. There are two, independent start-target circuits:

- in case of entry train route, start relay assigned to the particular open line direction (Kőszeg, Acsád, Vép up and down), target relay assigned to the station track;
- in case of exit train route, start relay assigned to the station track, target relay assigned to the particular open line direction.



*Back side of relay frames,
with huge amount of individual wiring*

*Relay frames with adaptation relays,
PRORIS-H in background*



In start-target circuit the following dependencies are checked:

- operation of route appointing relays,
- position of in-route and flank protecting points (according to the point locking table): in order to achieve this, free-wired right and left endposition repeating Elesta-type relays are mounted on relay frames; these relays are operated from PRORIS-H point module,
- if necessary, appointment of diverging route,
- basic state of some other elements (shunting signals, call-on aspects etc.).

When start-target relay circuit is active, the next step is route locking: each route (from/to every direction and every station track) has a route locking relay. Of course, for this function magnetic latching relays are used (i.e. this relay is able to store the locking information when energy is not available. Mechanic latching relays are not available in Hengstler and Elesta sortiments). Locking is activated (magnetic latching relays are deexcitated), when start-target relays and route appointing relays has been operated. In case of exit route, block dependencies are examined, too.

If route locking has been activated, setting of in-route points and flank protection points must be excluded, therefore – using contacts of route locking relays and their repeating relays, based on points locking plan –, a second locking circuit, the point locking relay's circuit has been designed.

Train detection in the points area has been installed, in order to exclude the point setting when a vehicle is coming to a facing point in dangerous distance or a vehicle is between two trailing points. Former times 400 Hz track circuits were installed for the above-mentioned purposes, but these ones have been demolished. According to GySEV prescriptions, Thales AzLM axle counters were built for each point, therefore no „non-detected” section remained in the „even” points area inside the entry signals. Therefore, some individual (not point-assigned) axle counter sections have been installed. For each axle-counter section, default-active train detection relays (free-wired) have been installed, operated from axle counter racks directly. PRORIS-H system reads both working and basic contacts of these train detection relays.

After the route setting, the route-checking relay circuits supervise all dependencies prescribed in point locking table (this is the second checking phase: the first one is the start-target circuit). In this circuit the non-occupied (free) state of axle counter sections of the train route is checked, too. However, this checking is not full from safety point of view, because „regular occupied” state cannot be supervised (the regular occupied state is supervisable only in route-release relay

circuits, but they have not been modified). Therefore, regular occupied state must be checked manually in every year by the maintenance personnel. After operation of route-checking relay circuits, the process returns to the „old” interlocking, where the „old” signal control relays set the signal to proceed aspect. When the train is coming, and the first axle counter section becomes occupied, signal goes to Stop aspect immediately, in spite of „old” working method, where the short route-release track circuits switched the signal into Stop aspect. Therefore, operation of signal control relay, control and checking of proceed aspect is the same as it was in former times: this function remained in the FM/Integra system.

Train-initiated route release is carried out partly with „old” route-release relays operated in FM/integra system, and partly with „new” route release relays in the new relay room – the latter replaces the former tumbler relays in the demolished mechanical signal box. Mechanism of route release is the same as it was in former times: when the route release relay becomes active, the route locking magnetic latching relay is excited again. Moreover, the route release relay deactivates the circuit of route-appointing relays, therefore start-target circuit becomes inactive, too.

There are three station level crossing in „even” points area (SR2, SR4 and SR6); control and supervision of these level crossing installed in PRORIS-H system, too. Level crossings can be operated (both opening and closing, and, both individual and route-related operations) from the point operator signalman’s EMU2 workstation only. Route-initiated locking and releasing in case of SR2 and SR4 are carried out with the aid of new axle counter sections and their occupation-storing relays. In case of SR6, which is further from the station, existing track circuits initiate the release of locking. All level crossings have so-called rigid-dependency, i.e. signals can be set to proceed aspect only if level crossings have been closed.

Line level crossings towards the „even” side of the station are autonomous ones; they (except two LXs) are not initiated from the station, only their status indication has been installed on PRORIS-H EMU2 workstation. This status information is gained from GySEV CTC. Two open line level crossings: AS931 in Szombathely – Acsád open line section, AS155 in Szombathely – Kőszeg open line section initiated from the station area. Strike-in sections of AS931 are axle-counter ones, due to ETCS: when the train reaches ETCS TSR-balise of AS931, the „closed” status information must be already available. (From Szombathely to Sopron ETCS L2 is in operation, where each object, therefore open line level crossings must be covered by Eurobalises.)

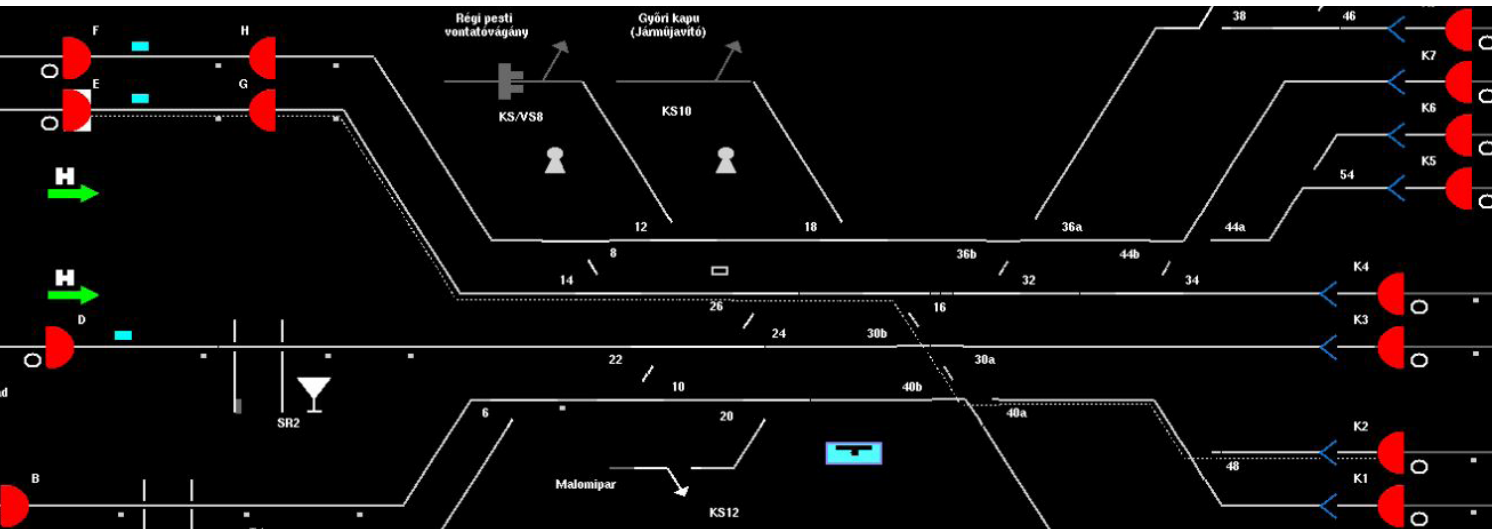
CHANGES IN SIGNALMAN'S MMI IN MAIN SIGNALMAN'S OFFICE

There is a domino (Integra) control panel in the main signalman's office, where all open line objects (block system, open line level crossings), ATPs (ETCS and Indusi) indication and manoeuvre can be found. It has been integrated to this control panel all „other“ indications and manoeuvres –(former times separated in a “cupboard”); „approval“ push-buttons and counters for entry and exit call-on aspects have been installed. Control and checking of entry call-on aspects remained responsibility of „old“ FM/Integra interlocking system (an „Approval“ command comes from domino control panel, thereafter command of call-on aspect itself can be initiated from EMU2), however control and checking of exit call-on aspects are full PRORIS-H (ProSigma-B) function. Therefore, flashing white aspect (call-on aspect) on exit signals controlled by PRORIS, but normal white aspect (apply for shunting moves, but in the same signal lamp) checked by FM/Integra (of course, commands are coming from EMU2 in both cases).

PRORIS-H

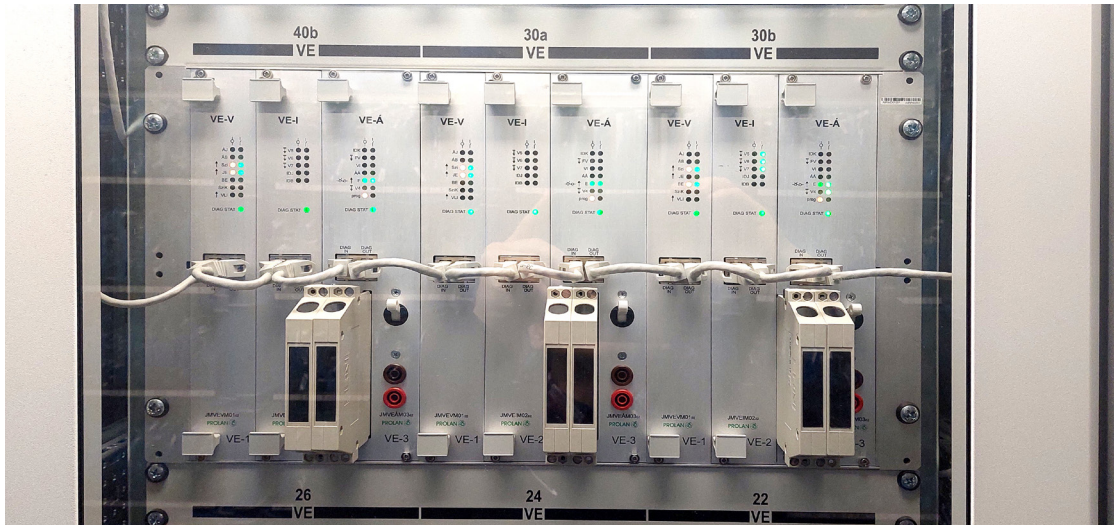
There was no such route-appointing function in PRORIS-H (main signalman only appoints the route to a point operator signalman, thereby ordering them to set the required route), therefore this function had to be developed specifically for Szombathely station. Statuses of route appointing relays dedicated to the directions (Kőszeg, Acsád, Vép up and Vép down) and dedicated to station tracks, are read-in via C-RTU data-collector module with the aid of these relay's contacts (since it is a non-safety critical function, one contact is enough). C-RTU device has been developed by Prolan and it is used in other, numerous applications. Data processing is carried out by a SILO sw-module and, gained from track and direction information, the appointed route is visualized on EMU2. Therefore – in good cooperation with GySEV – a new symbol had to be defined, in order to show the route appointment. The so-called „call-on approval function” has also not been used in former times; it had to be developed, too. To accomplish this function, C-RTU modules and SILO sw-module are used

*Lupe view
with a route appointment*



likewise. Statuses of approval relay are read-in with one of their contacts and indicated on EMU2 with visible and acoustic signals with a new symbol. C-RTUs are connected directly with EMU2 subsystem in both cases, since these functions are non-safety critical ones, they serve only indication purposes. The safety functionality, behind these new functions, remained in the „old” (FM/Integra) interlocking system with its fail-safe relay circuits.

As it was written above, in Szombathely PRORIS-H system the so-called simplified point indoor modules have been used. Detailed information about this module can be found in paper Signal und Draht 2023/10., as we used the module in project of Fényeslitke Intermodal Logistic Centre. Now we only mention the further development of this simplified point module (VE). Since the route-related and flank protection locking of points have been accomplished in the „old” interlocking, a new point locking repeating relay had to be added to the earlier version of VE module. With the aid of this point locking relay – operated from spur-plan point locking circuit – point setting can be excluded in case of route-related and flank protection locking (forbidding the following: change of point control, switch-on of point setting high-voltage). Moreover,



Simplified point control module in standard rack

locking of a point is visualized on EMU2 with the aid of its contact-reading-in. Up to now, the difference of route-related and flank protection locking is not indicated (the same symbol is used for both locking types), because of the circuit-construction of the „old“ system and in order to avoid the significant modification these old circuits. However, two different locking types can be distinguished for traffic staff (signalmen), if route appointment indication and locking indication are evaluated together.

In order to indicate all interlocking objects on PRORIS-H MMI (EMU2), suitable status indications had to be created; these status indications must fit to the PRORIS-H system requirements. Since the indication (lamp and relay) circuits operates with different voltage levels and types, moreover, they are in different interlocking rooms; several thin, non-safety relays had been installed into specialised clamp-terminals (due to small space-demand and galvanic disconnecting).

The signal aspect indication has been accomplished with reading-in the contacts of lamp-checking relays:

- in case of entry signals, indication of main filament checking is executed with the aid of contacts of red and auxiliary red lamp checking relays (due to the lack of independent main filament checking relays);
- in case of exit signals, combination of following contacts
 - o red lamp checking relay,
 - o white lamp checking relay,
 - o shunting signal control relay.

(In case of exit signals, when shunting proceed aspect (white lamp) controlled, red lamp must be switched off, therefore red lamp failure shall be avoided):

In case of non-safety critical commands (e.g. „prohibiting of signal setting to proceed“) thin relays are used too; these relays are operated from ProSigma-B subsystem's outputs. Their contacts had to be built in the adequate FM/Integra relay circuits (e.g. in case of command „prohibiting of signal setting to proceed“ the contacts are signal control relay's circuit).

EMU2 MMI of PRORIS-H uses well-proven indications of Prolan CTC-systems (Elpult, AKF), only the above-mentioned symbols are new ones. Manoeuvres are standard ones of PRORIS-H system, but the interlocking – in the „background“ is different.

SUMMARY



The reconstructed „even” points area of Szombathely station put into operation at the end of march, 2024 has more importance than it seems at first. Beyond that GySEV got an up-to-date, comfortable point control solution integrated into the company's CTC, this technical solution is applicable for renovation even at large stations, when financial resources are insufficient for complete interlocking renewal, but points must be transformed to electrical setting.





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