SYSTEM SEPARATION SECTIONS

TRANSITION BETWEEN TRACTION POWER SUPPLY SYSTEMS WITH LOW INTERACTIONS

English

System separation sections are core elements that securely separate different traction power supply systems. Design, function and arrangement are dependent on operational and local constraints. The existing concept for system separation sections in the Netherlands can be modified to minimise environmental impact and interaction with the feeding grid. The new concept has been implemented in the pilot installation at Zevenaar and was successfully tested in the summer of 2016.

System separation sections are the technical facility to separate different traction power supply systems. Their main task is to prevent damage caused

- to the infrastructure by direct interconnection of different power supply systems and
- to the traction units by connecting a non-compatible traction circuit to the energised catenary system.

The technical specifications for interoperability, TSI ENE and TSI LOC & PAS, as well as the European standards, EN 50367 and EN 50388, only provide very general requirements regarding the structure of system separation sections. In contrast, the OVS00054-3 “Ontwerpvoorschrift Generieke spanningssluis” design guide provides detailed requirements for the design of system separation sections in the Netherlands.

The arrangement of system separation sections in the Betuweroute project follows variant 3 (Figuur 4.7.2-3) of the OVS00054-3 design guide. Train rides with raised pantographs are not permitted. They are detected by the short-circuit current created when reaching the short-circuiting zone with the consequence of instantaneous de-energisation of the two traction power supply systems (AC 25 kV 50 Hz and DC 1500 V).

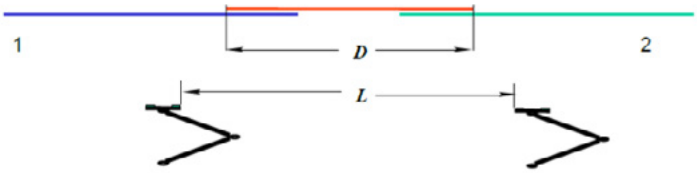

Fig. 1: Principle arrangement of a neutral section
(source: Fig. A.1 of EN 50367)
1 Phase/system 1
2 Phase/system 2
D Overall length of neutral section as the distance between adjacent systems/phases including overlapping parts
L Inner distance between two adjacent pantographs

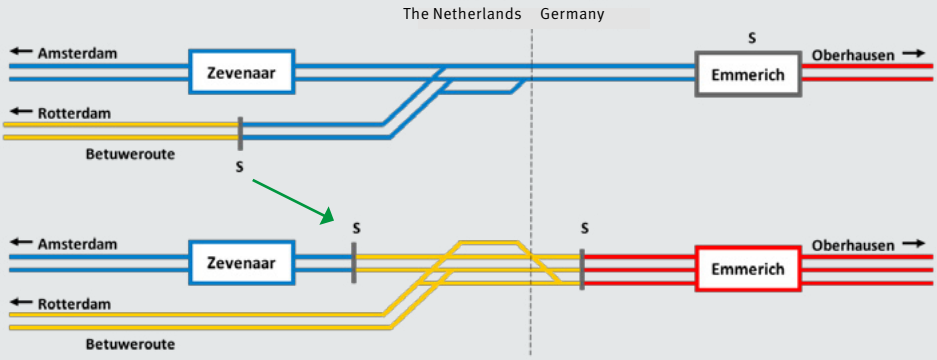

Fig. 2:
Basic route map between Zevenaar/NL and Emmerich/DE route system (source: RPS)
Top: situation until summer 2016
Bottom: target state
— DC 1 500 V
— AC 25 kV 50 Hz
— AC 15 kV 16,7 Hz
S System separation section

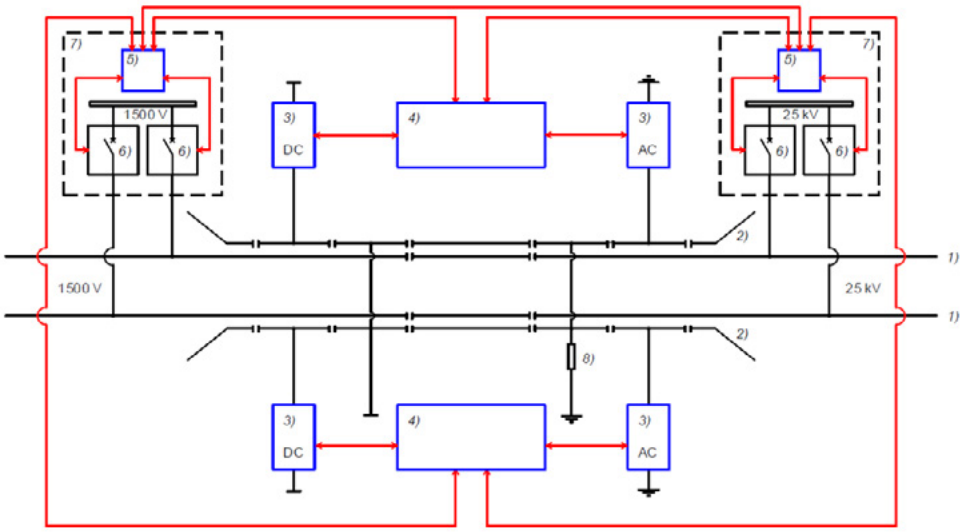

Fig. 3:
Arrangement of the system separation section (source: RPS).

— Primary circuit
— Control system
— Communication links
1: Main contact line
2: Detection wire
3: Voltage detection circuit
4: Central control cabinet
5: Interface to substation equipment
6: Circuit breaker
7: Substation
8: Short-circuit limiter

The original system separation section at Zevenaar was located at the beginning of the Betuweroute and close to the OS Zevenaar Oost a.c. traction substation. Coming from the a.c. fed area and passing the system separation section with the pantograph raised leads to high short-circuit currents and subsequently to a large voltage drop in the 3AC 150 kV feeding grid.

The traction power supply was reinforced in 2015/2016 to strengthen rail traffic, especially on the Betuweroute. This was implemented by switching the power supply from DC 1 500 V to the more powerful AC 25 kV on the section from Zevenaar to the German border. This made it necessary to move the system separation section from the Betuweroute to the passenger line (green arrow, Fig. 2). The detection concept for inadmissible train passages was modified at the same time.

The new arrangement of the system separation section is very similar to variant 3; the difference is that an additional zone 10 m in length has been added at each end. This voltage detection zone enables voltage transfer by means of a raised pantograph from the open route onto the detection wire; thus, de-energisation of the power supply is achieved before reaching the short-circuiting zone.

The length of the neutral zone has been reduced to around 20 m so as not to increase the total length of the system separation section of 65 m.

Rail Power Systems GmbH has provided the control system concept and delivered the control system including voltage detection and trip signal transmission. Starting in August 2015, careful system analysis and detailed calculations to ensure system response were carried out. And finally system performance was successfully proved during train rides in July 2016. The chosen concept and the selected equipment are in use at a transition between DC 1 500 V and AC 25 kV with an operational speed of 130 km/h. After almost one year of operation and based on the experience during commissioning, the following can be concluded: detection and signal processing enable operational speeds of up to 160 km/h. Moreover, the system can be easily adapted to AC 15 kV 16,7 Hz and DC 3000 V traction power supply systems. In case of higher operational speeds, the catenary design may require adoption.

Fig. 4: Train ride in the system separation section, approaching from Emmerich (source: ProRail)

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