

Cubicle switchgear EZB 3 kV DC

The EZB 3 kV DC cubicle-type switchgear manufactured and supplied by Elektrizace železnic Praha a.s. from its own design, is for traction substations and switching station of a DC system. The switchgear is designed according to EN 50123-1 and is used for DC distribution. The switchgear is a functional unit for distributing (+), (-) the poles of a DC system consisting of individual modules mutually interconnected both mechanically and electrically. All assembly switchgear always consists of two modules. Different arrangements of the assembly switchgears or individual modules give individual functional units, e.g. feeder, main busbar coupler. The EZB-US 3kV cubicle diode 12-pulse rectifier with natural air cooling according to EN 60146-1-1, EN 50328, can be connected to the switchgear to create an integral unit.

The switchgear's feeder consists of the EZB-N module, i.e. a HSCB module and the EZB-P (V) module the basic electric equipment of which includes 3 kV DC main busbars, disconnectors, earthing switches, and current and voltage measuring equipment.

EZB-N Module+trolley

The EZB-N module acts as a contact line feeder and includes a self-contained metal structure 800 mm wide x 1,200 mm deep x 2,000 mm high overall. The bottom part of the EZB-N module accommodates a trolley with a HSCB. The inner cubicle walls are covered with self-extinguishing panels to protect the frame's structure against the electric and thermal effects of an arch produced during HSCB tripping. The cubicle's rear wall (transition to the EZB-P,V module) contains openings for contact heads to connect to the main and lead out busbars system. These holes are closed by a trolley-controlled mechanism; as the trolley is moving out of the cubicle the cubicle is safely separated from the feeder system after the trolley moves out. Trolley movement is partially regulated by a drive, to the end retracted position and from this position back for extraction. The remaining movement of trolley is carried out manually. In an emergency, e.g. loss of control voltage, the trolley with the HSCB can be extracted manually (a crank) after opening the doors in the travel's front panel. The trolley is locked in the retracted position by a gearbox that is part of the drive.

In addition to a HSCB the trolley accommodates current and voltage measuring sensors, instruments for monitoring short circuits on the line (circuit-breaker, resistor, fuse, and current sensor), contact heads to connect to the power circuit, minus pole heads to measure the voltage and heads to connect exposed trolley parts to protective earthing.

The HSCB trolley has three operating modes

- Service mode in which the HSCB is ready for closing or opening.
- Test mode in which 3 kV power circuit is open but the HSCB can still be used for switching operations as the control circuits remain connected.
- Revision mode in which repairs and measurements can be carried out on the circuit-breaker, the control circuits are disconnected and the trolley is moved out of the switchgear assembly.

The upper front section of the module has a compartment for auxiliary circuits and control systems. This compartment is in a separate area outside the main power circuit. The compartment includes a PLC, digital protection, terminals auxiliary circuits. A touch display on the door provides control and visualization of one feeder panel (EZB-N+P). A controlling system is integrated in the switchgear for local control and together with the traction substation's control systems it also allows remote and central control.

Measurements and protection

In addition to the voltage at the output of each HSCB and the current flowing from the feeder to the traction line, the voltage on the main busbar can be measured in the switchgear assembly. These values are then displayed on the touch display and in the remote and central control system. A short-circuit monitoring device for the output to the traction line measures the voltage and current flowing through a circuit consisting of a fuse, circuit breaker and resistor. The system determines if the traction line is short-circuited or correct according to the electrical resistance.

The low-voltage compartment has digital protection that protects the traction line. Digital protection enables protective functions to be used, such as over-current, short-circuit current, di/dt , under- and over-voltage. In addition the EZB 3 kV DC switchgear can be equipped with protection against damaging the insulation of the connecting cables, earthing protection and over-voltage protection.

EZB-P (V, S) module

The EZB-P (V, S) module consists of a self-contained metal structure 800 mm wide x 400 mm deep x 2,000 mm high overall. The module connects to the rear of the EZB-N module by screws. The operator has access to the module's rear part only via doors. The door has safety glass panels for a visual inspection of the position of the disconnectors and earthing switches. The door has a switch that stops the feeder if the door is opened. The module contains the the main busbar and it can also accommodate the following equipments: motor disconnector, manually controlled earthing switch, instruments for monitoring the condition of the connecting cables' sheathing, earthing protection and surge arresters.

Module P is used for the supply (+) from the rectifier, module V is used as an terminal feeder and module S is used for disconnecting of the main busbar.

EZB-US Module

A box-type, 12-pulse diode rectifier with converters on the trolley and marked EZB-US can be connected to the EZB 3 kV DC switchgear assembly. The module's cubicle consists of a self-contained structure of metal profiles 1,800 mm wide x 1,600 mm deep x 2,000 mm high overall. The bottom part of the EZB-US module accommodates a trolley with a diode bridge. The cubicle's rear wall contains holes for contact heads to connect to the AC or DC busbars. These holes are closed by a trolley-controlled mechanism; as the trolley is moving out of the cubicle the cubicle is safely separated from the feeder system after the trolley moves out. Trolley movement is partially regulated by the actuator, to the end retracted position and from this position back for extraction. The remaining movement of the trolley is carried out manually. In an emergency, e.g. loss of control voltage can be trolley extracted manually (a crank) after opening the doors in the travel front panel. The trolley is locked in the retracted position by a gearbox that is part of the drive.

The standard nominal output current of the naturally cooled rectifier is 1,500 A in V. load class according to EN 50328. The rectifier's connection according to standard No. 8 includes two bridges in series with one diode per branch (6kV/3.3 kA diode). The rectifier has standard protection (temperature -elevated, -maximal, AC and DC overvoltage, and commutating) including diagnostics on the module's touch display.

EZB-R Module

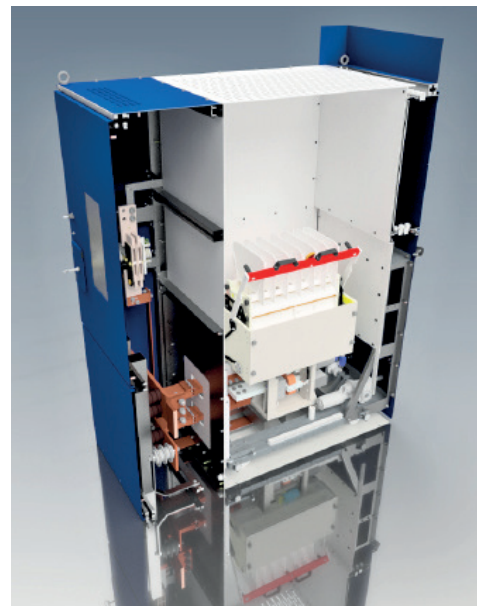
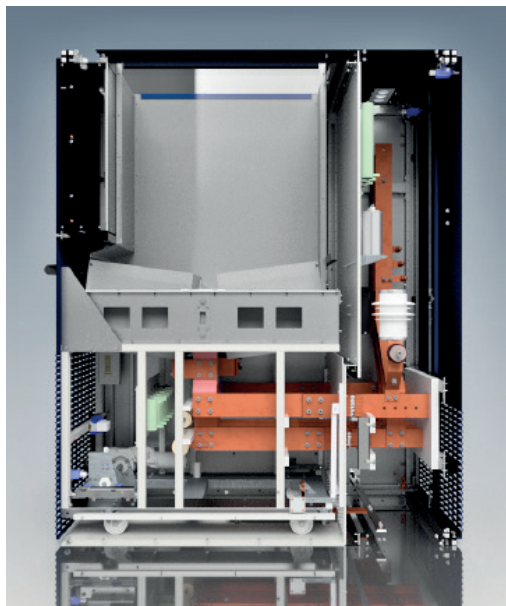
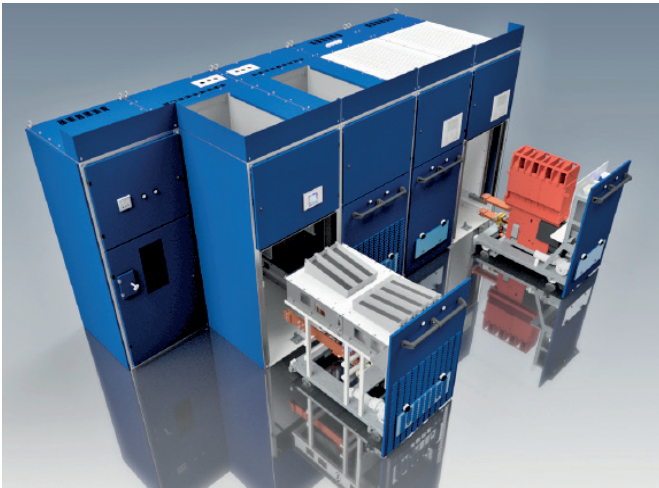
The EZB-R module consists of a self-contained metal structure 800 mm wide x 400 mm deep x 2,000 mm high overall. The module is used to distribute the minus pole (return circuit) or earthing in switching stations. The module can be used to connect return cables and earthing and it can also be fitted with current or voltage earthing protection.

Conclusion

- The modules with their instrumentation have been tested in an authorized test laboratory according to the respective standards.
- EZB 3 kV DC switchgears are operated in traction substations in the Czech Republic, Estonia, and Latvia.
- The switchgear is delivered to the site as a compact unit consisting of individual modules, so that the final connection and installation can be carried out quickly.
- The minimum protection of all modules switchgear is IP 20 according to EN 50123-6 ed.2.
- The provisions of the following standards were followed when designing and producing the EZB 3kV DC cubicle switchgear: EN 50123-6, EN 50 328, EN 50-163, ČSN 34 1500 ed.2, ČSN 33 2000-4-41 ed.3.

Table of the basic parameters of individual modules

Parameters	EZB-N Module	EZB-N Trolley	EZB-P (V, S) Module	EZB-R Module	EZB-US Module
Nominal Voltage [V]	3000 V DC	3000 V DC	3000 V DC	3000 V DC	3000 V DC
Auxiliary Nominal Voltage	48, 110 V DC, 230 V AC	48, 110 V DC, 230 V AC	48, 110 V DC, 230 V AC	48, 110 V DC, 230 V AC	48, 110 V DC, 230 V AC
Main Busbar Nominal Current [A]	up to 5 000	-	up to 5 000	up to 5 000	up to 1500
HSCB Nominal Current [A]	-	up to 4 200	-	-	-
Disconnecter Nominal Current [A]	-	-	up to 4000	up to 4 000	up to 3000
Nominal Short-Time Withstand Current 1s [A]	40 000	40 000	40 000	20 000	16 000
Nominal Ground Fault Current [A]	16 000	16 000	16 000	16 000	16 000
Protection	IP40/00	-	IP40/00	IP40/00	IP20/00
Weight [kg]	400	250	200	200	600
Operating Temperature [oC]	-5 to +40	-5 to +40	-5 to +40	-5 to +40	5 to +40
Dimensions W x D x H [mm]	800x1200x2000	680x1050x1250	800x400x2000	800x400x2000	1800x1600x2000



ELEKTRIZACE ŽELEZNIC PRAHA a. s.

nám. Hrdinů 1693/4a,
140 00 Praha 4 Czech Republic

Phone: +420 296 500 101 - Managing Director Secretariate
+420 296 500 301 - Commercial Dpt.
+420 296 500 311- Export Dpt.
e-mail: info@elzel.cz

www.elzel.cz



Elektrizace železnic Praha a.s.

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