

Comprehensive modernization of the 2TE10M mainline diesel locomotive
(No. 3589)

Today, the condition of diesel rolling stock has reached a critical level in terms of service life. In the current environment, the most realistic measure to ensure sustainable, uninterrupted and safe operation is to make fuller and more efficient use of rolling stock overhaul opportunities, i.e. modernization with the introduction of new approaches to improving the technical level of locomotives.

The comprehensive modernization of the 2TE10M diesel locomotive has fully enabled the company to implement modern trends in locomotive construction.

Organizations involved in the modernization of the 2TE10M diesel locomotive	
SPE UKRTRANSMASH	units БРЧЕП-1, МСДО (data acquisition unit, display);
«Nikolaev Locomotive Repair Plant» Ltd	the enterprise where the modernization was carried out
JSC “Ukrainian Energy Machines”	traction unit А723, excitation control unit БУВ-250, measuring converter ПИИТ-6, controller КМФ1203, protection unit БЗ-01, relay and contactor equipment (train contactors, reverser, etc.)
Anglo Belgian Corporation	diesel engine 8DZC-1000-188 with electronic regulator HEINZMANN
KEP LLC	traction rectifier ТВД-6,3к-1000, power supply unit for motor-compressor СТ61Т-450/110, power supply unit for on-board network СТ61-150/110, power supply unit for battery СТ62Т-100/24

The power transmission structure was changed to a more modern AC-DC power transmission. This type of power transmission made it possible to retain the ЕД-118 DC electric motors, which underwent a major overhaul.

The installation of a modern 8DZC-1000-188 diesel engine with a HEINZMANN electronic regulator has significantly increased fuel and oil economy and reduced emissions.

A modern traction unit (A723) with a modern excitation system consisting of an auxiliary and traction alternators was used. The use of a three-phase auxiliary alternator made it possible to realize the power supply of own needs electrically, i.e. to abandon mechanical drives. A modern traction generator with improved electrical characteristics makes it possible to fully realize the traction characteristics of the modernized power transmission system.

The excitation control unit (БУВ-250) regulates the excitation currents of the traction and auxiliary generators that are part of the traction unit, and provides their protection by current, voltage, and other parameters. The excitation of the traction generator is regulated by a signal from the power transmission control and management unit (БРУЕП). The excitation control of the auxiliary generator is performed by an automatic unit that maintains the generator output voltage according to the U/f law, which allows connecting loads for own needs both through converters and directly to the three-phase alternating network (asynchronous drive for cooling traction motors, cooling diesel engine, generator, traction rectifier).

The power transmission scheme was significantly modernized. The main units of which are modern microprocessor-based units БРУЕП - the locomotive power transmission regulation and control unit and the microprocessor-based control and diagnostic system МСУД

The power transmission regulation and control unit (БРУЕП-1) makes it possible to exclude old analog control units and the relay control circuit of the power transmission. The unit does not require complicated debugging of old analog units, allows implementing more advanced control and protection algorithms, and increases the reliability of the power transmission scheme. It also implements modern slip protection, which, thanks to the dynamic regulation of the traction generator voltage, allows to realize the maximum coupling weight of the locomotive.

The power transmission regulation and control unit (БРУЕП) implements algorithms for regulating and controlling power transmission by regulating the excitation of the traction generator, controlling relay and contactor devices (train contactors, reverser, etc.), receiving feedback signals (traction motor currents, generator voltage, relay and contactor signals, etc.) from the scheme, including from the ПИИТ-6 sensor (a more modern ТИИ-1000В can be used).

The locomotive is controlled by a modern digital driver's controller (data is transmitted via a digital CAN channel) and additional controls from the driver's console. The signals from the controls are transmitted to the power transmission control and management unit (БРУЕП).

The diagnostic and information display system (МСДО) is designed to monitor and display information on the driver's display about the state of the power transmission, main and auxiliary electrical equipment of the locomotive, the state of

discrete signals from the actuators of the electrical circuit to generate alarm and warning messages. The system provides data that can be used by service staff during locomotive maintenance.

The diagnostic and information display system (MCDO) controls the auxiliary relay and contactor devices, auxiliary power supplies and compressor operation via the motor-compressor power supply.

The locomotive is equipped with a motor-compressor power supply unit (CT61T-450/110), which controls the modern compressor based on signals from the diagnostic and display system and protects it. The on-board power supply unit (CT61-150/110) provides power to the on-board network consumers. Both devices are connected to an auxiliary generator.

All units involved in power transmission and auxiliary power supply are connected in a digital network based on the CAN protocol. This eliminates a large number of control cables, improves reliability, and provides access to all locomotive parameters.

The introduction of a microprocessor-based control and regulating unit, diagnostic and display system made it possible to implement a project for the deep modernization of the 2TE10M diesel locomotive using modern electrical equipment. The comprehensive modernization with the use of a microprocessor-based control and regulation unit allows for the application of the latest control and regulation algorithms, increases the protection of electrical equipment and simplifies the operation of the locomotive. The use of a diagnostic and display system improves the safety and comfort of the locomotive crew and simplifies scheduled maintenance.

Main parameters of the modernized diesel locomotive 2TE10M	
Power, kW (hp)	2x2000 (2x2717)
Service weight, t	2x138±3%;
Static load from the wheel set on the axle, not more than, kN	230±3%;
Full power usage speed, up to km/h	40
Type of traction transmission	AC-DC current
Brake type	pad
The voltage of control circuits, V	110
Power unit	8DZC-1000-188
Electronic diesel regulator	HEINZMANN