

Comprehensive modernization of shunting locomotive TEM2 (No. 8907)

The purpose of this modernization is to gradually replace the currently operating, physically and morally outdated fleet of locomotives that perform shunting operations on station tracks of Ukrainian railways and industrial enterprises.

Diesel locomotives that have reached the end of their service life or are within the limits of their service life are submitted for modernization. The comprehensive modernization of the TEM2 diesel locomotive has fully enabled the company to implement modern trends in locomotive construction.

Organizations involved in the modernization of the TEM2 diesel locomotive	
SPE UKRTRANSMASH	units БРЧЕП-2
«Nikolaev Locomotive Repair Plant» Ltd	the enterprise where the modernization was carried out
JSC “Ukrainian Energy Machines”	traction unit А735, excitation control unit БУБ-250, measuring converter ПИИТ-6, controller КМФ2001, protection unit БЗ-03, relay and contactor equipment (train contactors, reverser, etc.)
Anglo Belgian Corporation	Cummins QST30 diesel engine with electronic regulator
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.

A special feature of the power circuit modernization is the change in the connection of traction motors. In comparison to the original scheme of two parallel circuits with three electric motors connected in line, the scheme of three parallel circuits with two motors connected in line has been applied. This scheme allows to increase the

anti-slip properties of the locomotive and to realize the coupling weight more efficiently. Reducing the number of motors in the chain made it possible to increase the maximum voltage for each traction motor. This made it possible to realize the speed characteristics of the locomotive using only one shunt stage.

The installation of a modern Cummins QST30 diesel engine with an electronic regulator has significantly increased fuel and oil economy and reduced emissions.

A modern traction unit (A735) 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 (БVB-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 (БРУП). 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 main unit of the modernized power transmission scheme is a modern microprocessor-based unit БРУП - a power transmission regulation and control unit.

The power transmission regulation and control unit (БРУП-2) 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 (БРУП) 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 ПНТ-6 sensor (a more modern ТНН-1000В can be used).

The locomotive is controlled by a non-positioning digital driver's controller (data is transmitted via a digital CAN channel) and additional controls from the driver's

console. The driver's controller has its own electronic display to show the position number. The controller also has the necessary mechanical locks to ensure safe operation of the locomotive. The signals from the controls are transmitted to the power transmission control and management unit (БРУЕТ).

The power transmission regulation and control unit (БРУЕТ) is capable of transmitting power transmission parameters to the common locomotive local area network for further display on operating monitors or display boards. This eliminates a large number of signal and information cables.

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 TEM2 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.