ELECTRIC TRACTION SUBSTATIONS STUDY OF RAILWAY

Valentin IEREMIE
Ştefan cel Mare University of Suceava

Radu-Dumitru PENTUC
Ştefan cel Mare University of Suceava

Cezar-Dumitru POPA
Ştefan cel Mare University of Suceava

Florin BERNEA
Carpath Cement Holding

1. INTRODUCTION

Fixed installations for electric traction (IFTE) Romanian Railways have been built during 1965-1991. 78 traction substations and over 10,500 miles of wire contacts held currently define the size of these facilities.

In our country, the design and the construction of fixed installations for the electric traction had been created in a very unfavorable time period, characterized by a general policy of austerity-oriented savings becoming more severe and more reduced execution times. Exploitation, misuse of the 80s (too intense and marked by frequent interruptions in electricity supply traction substations) contributed to the physical and moral wear of primary and secondary apparatus, which was passed anyway because it had been built on technology from the 70s. All these shortcomings have led to their operation and minimal technical conditions financial efforts.

In Romania, the Railways, to supply electricity to the catenary a single-phase traction 25kV-50Hz system was adopted, supplied from the local grid of 110 kV.
2. TRANSFORMATION STATIONS

The energy system includes all facilities for producing energy in a usable form, convert it into electricity and sometimes combined heat and power, transport, processing, distribution and use of electricity or heat. All the elements of the energy system are characterized by a coordinated process of generation, transmission, distribution and consumption of electricity or heat.

The power system is a set of plants, substations, transformer substations and power receivers, connected by a grid lines. Electric power system is the energy system and includes facilities for producing electricity (generators), processing plants, to a voltage to another (and transformer stations), transmission facilities and distribution of electricity (network high, medium and low voltage) and use its facilities.

The electricity produced by power plants suffer more changes in blood to be transported with low losses as large as distances and then used by consumers. Transmission of electricity from large and very large distances (ie tens to hundreds of kilometers) have been so high on power lines and very high voltage (110, 220, 400, 750 kV). Transmission of electricity at relatively small distances (of the order of kilometers or at most a few tens of kilometers), is made with medium voltage lines (6, 10, 20 kV) and at very short distances (hundreds of meters), the low voltage lines (0.4 kV). The higher voltage is much lower current and therefore losses (own consumption, CPT) for transmission of electricity, much lower because they are proportional to the square of current.

Conversion voltage levels (the transportation of electricity as low loss with power lines), taking place in the stations and substations, which are nodes of the power system and power lines are connected.

3. ELECTRIC TRACTION SUBSTATIONS

In the past 20 years have seen an extraordinary development in the field of electric traction. This was accompanied and determined by the pace of development of power electronics and microprocessors, which led to fundamental changes in design, construction and operation of electric traction. Due to the rapidity with which these changes have been made, there is currently co-existence of many different types of traction systems.

Electric vehicles powered by the contact line (autonomous vehicles, which energy source is not a vehicle) requires a series of plants along with them, form a system of electric traction. In Fig. 1. presents the main equipment of an electric traction system.

The production, transport and distribution of electricity installations are made up of: electric power (hydro, thermal, nuclear, wind), substations, power lifting SRT and high voltage overhead power lines LIT (110 kV, 220 kV, 440 kV) for long distance transmission of electricity. Note that these facilities are not specific to electric traction.

The traction substations creates the connection to the national power or high voltage power system's own track, and power adjustment parameters (voltage, current, frequency) on standardized values necessary to the contact line LC.

LC line of contact - network overhead is mounted above the tread and the vehicle takes power through a current collector or collector. Note that some vehicles are powered by a rail contact, located at ground level.

CR rolling path - is metallic raceway (the rail) for railway vehicles, trams and subways, and taking her current role back to the traction substation. For some vehicles path can be concrete or asphalt (buses) or can be mixed (for some metro). Power cables are overhead lines, which bars a link between low voltage (the positive bars BP) of traction substations and line contact.

ZN neutral zone - is a zone of separation of portions of the contact line fed from different phases of the power system.

PS sectioning stations - allow connections or longitudinal sectioning of the contact line between two substations, traction, thereby limiting the area that a fault can occur. Longitudinal sectioning may be additional and PSS subsections stations located between substations and sectioning posts. In addition, if double taxiways, PS and PSS and binding done in parallel lines on the two-way contact, which improves by decreasing the tension in catenary’s voltages. If there are no jobs

Fig. 1. The traction system schema
PSS is by linking parallel channels in parallel PLP binding.

CI cables - back the closing of the electrical circuit. They make the connection between the return current path (track) and the low voltage traction substation (the negative bars BN).

V - electric vehicle takes power from the line of contact through the sensor, which converts energy into mechanical energy to the rim driving wheels, which provides a vehicle to move.

Traction system c.c. is the contact line system powered by DC. The system is used both in urban and electric traction railway electric traction. The schematic diagram is shown in Figure 2.

Traction substations are supplied from the power lines of three phase power system of 110 kV or 220 kV and 50 Hz. In sub-phase voltage reduction takes place through a step-down transformer to convert current values and the phase alternating current. For the greater power in substations are generally two groups of force, one in operation and the other is reserve.

Introduction recuperative braking vehicles was an important step towards increased energy efficiency of transportation systems.

To eliminate this case, the traction substation may be equipped with inverters (Fig. 3). Thus the contact line is fed from a rectifier, and when the vehicle exceeds the power recovered along the route, the inverter is automatically activated and the system transfer energy high voltage. Of course, this system requires a significant additional investment, which requires a careful economic study. VEM party structure with the mechanical grip unguided path (road) is shown in Figure 4.

On the front axle steering is installed (including steering wheel, gear drives, roller and articulated lever system) which is achieved by transferring the front wheels, thus guiding the CR VEM.

The main transmission drive axle is installed (including gear reducers, mechanical differential and planetary axes), allowing different speeds of the left-right wheel drive axle, to prevent excessive tire wear and power consumption.

The frame, representing a welded construction, made of rolled steel and sections, which supports body VEM and the two bridges connecting the elastic suspension with leaf springs.

The articulated trolleybus, the second axle is the driven normally. With the development of this type of trolley was possible involvement of the third with three axles or motors, either through a purely mechanical solution, in which both motors are axle shafts driven through by a single engine. Diode Block 2 consists of two groups of diodes connected in series, each group containing two parallel diodes used for two operating modes of the vehicle (driving, braking respectively).

Traction motor is a DC motor with series excitation in insulation class F, drive vehicles intended for urban traction TN 76. The motor is...
directly supply the contact line, the voltage is equal to its nominal rated motor voltage.

Romanian electric locomotive 060-EA-LE has been designed for single-phase AC power, 50 Hz and 27 kV, with a power of 5100 kW distributed over the six electric motors of 850 kW each.

Rolling machine, which is based on CR, is composed of 12 six-axle tractors and engines, distributed evenly over the two bogies.

The two bogies are connected by a flexible coupling, so that their rotation can be horizontal to the box, for easy inclusion curve. Given the principle of constructive mechanical part of the electrical engine axle formula for this is C'0 - C'0, which means that the running of the locomotive apparatus comprises two bogies, each with three individually driven axles.

Main circuit-breaker (circuit breaker) is an instrument which carries the general disruption of the locomotive electrical circuits, providing protection from overloads and short circuits.

The arrester is provided with variable resistance in the electrical equipment of locomotive air surge protection (which can reach hundreds of kV with duration of the order microseconds) and voltage switching (to lower values but longer). Circuit is mounted in parallel between power and ground.

Rectifier diodes that allow the recovery schemes using both alternations. Practical schemes are those with mid-point or single-phase diode bridge.

Traction motors are DC motors series, number 6.

AC electric locomotive speed control phase, 50 Hz, 25 kV. AC locomotives phase speed control is obtained only by varying widely voltage from a minimum value to its nominal value and to broaden the scope of regulation, the last step voltage, and a few steps longer apply reduced field.

Schematic diagram of the circuit under braking rheostat generator with separate excitation is shown in Figure 7. Changing the excitation current is achieved by gradually. Lockouts separator’s handling SSB1T if not open-3T cells related breaker 27.5 kV transformer 1T.
Fig. 8. Suceava electric traction substation plan.
4. Suceava Traction Substation

Suceava traction substation is located on the left side of the railway line Burdujeni Suceava - Suceava Nord km. 448 300 (ax path processors) being designed to supply the normal operation of the contact line Suceava Nord station and distances:
- STE-Suceava Suceava Vest - Stroiești PS;
- STE-STE Dolhasca Suceava;
- STE Suceava - Dărmănești - PS Todiștei.

In terms of the primary circuit scheme is being fueled by double-phase type with a pipe branch of 110/20 kV double circuit Ițici Main parts:
- Primary circuit - were designed to make the transfer of power between the 110 kV high voltage line and the line of contact.
- Secondary circuits - Includes circuits for controlling, blocking signaling, measuring, protection and automation.
- Equipment associated with secondary circuits are arranged in panels placed in the control room.
- Own Services - are only meant to ensure continuous supply of alternating current and secondary circuits.

Forming an outer ring located 1.5 m contour of the fence. On the outer ring road contour vertical electrodes are disposed at a distance of 6 m apart.

All connections between devices and the earth electrode are twofold.
Also at the substation earth electrode and the link connecting the copper plate feeder back from the three transformers. Protection apparatus mounted outside the control room to support the construction of the control unit against direct lightning strikes lightning rods is achieved by frame mounted on poles.

Secondary circuits are: control circuits as follows: control switches in cell IO 110 kV substation; secondary electrical circuits MOP-1 mechanism; switch control cells IUP 27.5 kV substation; control switches in cell feeder nF; order separators feeders; transfer of command separators feeders STF3 STF1-2-4; order separators SLFn feeders; 27.5 kV command connecting separators; 27.5 kV semiconductor command separators, and SSB2T SSB1T-3T-1T; control of cell separators 27.5 kV substation; control of air separators blade (SLA); 110 kV command separator; order knives grounding semi connecting 27.5 kV; earthing knives command of the bay feeder nF; tap changer control, circuits of blocking.

5. Conclusions

In conclusion I want to highlight the importance of the power factor in a fixed electric traction installation. For example, if electric traction substation of Suceava there are three power transformers, of which only one is operating, the other two being in reserve. When less electric vehicles are operating, the traction power transformer will operate at a reduced load, or even empty. For this it is desirable to have reactive power compensation equipment required by the transformer. The most popular method of improving power factor at a low voltage distribution system is the use of power capacitors. Capacitor's size and location has to be determined and corrected by calculations. In general these have to be connected as close as possible to the load.

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