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Induction Electric Hazard Prevention and Control Technology in Contact Network Maintenance Construction

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ABSTRACT. *Contact network construction is an important part of electrified railway construction. How to ensure the personal safety of construction workers in the process of contact net construction has become an important consideration for electrified railway construction. Therefore, through the analysis of the induction electricity, this paper explores the safety hazard of the induction electricity to the workers during the construction process of the contact net and the specific protective technical measures, which provides reference for the actual contact network maintenance work.*

KEYWORDS: *Contact network; Maintenance construction; Induction power; Safety protection*

1. Introduction

1.1 Difference between High Voltage Contact and Induction Electric Shock

(1) When the high-voltage equipment such as the contact network, substation, power line, and power distribution station is in operation, a relay protection device capable of quickly cutting off the short-circuit current is provided on the power supply side, and the distance between the human body and the live part is less than safety. When the distance is specified, the air of the human body and the charged body is broken down to form an electric arc to discharge the human body. The protection device on the power supply side acts to drive the circuit breaker (or air switch) to trip, and the power supply is instantaneously cut off. In most cases, the human body can be disconnected from the live device. Therefore, when a high-voltage electric shock occurs, the human body causes more arc burns, and the electric shock directly kills less.

(2) The induced current loop formed by the electrical circuit for power failure maintenance does not have any protection device. As long as the loop is closed or there is a path, the induced current always exists. When the human body touches it and the induction electric shock occurs, the line does not have automatic cut-off

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induction. The ability of electricity, the ability of electric shock personnel to leave the power supply has also been lost, and the surrounding workers are not easy to detect, the induction electricity will pass through the human body for a long time, causing the human muscles to shrink. In most cases, the human body and the charged body cannot be separated, directly causing Therefore, the death of electric shock is more harmful to the human body, and it is more concealed and needs to be highly valued.

1.2 Electromagnetic Induction

The entire electrified railway project is a complex system project, including high-voltage equipment such as contact networks, substations, power lines, and power distribution stations, as well as electrified equipment such as relay protection devices. The above-mentioned live equipment facilities, especially electric lines, are in the process of power failure maintenance or contact network construction. At this time, the relay protection device and the circuit breaker for cutting off the short-circuit current are in an inoperative state, but in the state where the loop is closed, the induced current is It is on the line, which is called induction.

(1) Static induction. When the uncharged conductor B approaches the positively charged conductor A, the portion near A is negatively charged, and the portion far from A is positively charged. This phenomenon is called electrostatic induction. When the voltage Vt is applied to the contact network, an electrostatic induction voltage Vs is generated between the conductor and the ground, and the relationship between the electrostatic induction voltage Vs of the conductor and the contact wire voltage Vt is[1]:

$$Vs = \frac{C_{12}}{C_{22} + C_{12}} Vt \tag{1}$$

(2) Magnetic induction. In general, the normal operating side contact line - the ground loop is the first loop, which is the source of electromagnetic induction. The track-ground loop is the second loop. This loop is mainly the induced current generated by the current in the first loop, and the direction of the induced current is opposite to that of the first loop current. The power-off inspection side contact line is the third loop, which is induced by the influence of the first loop, and is affected by the reverse current of the second loop, so that the induced potential is weakened. The induced electromotive force on the power contact side contact line can be expressed as[2]:

$$E = 2\pi fMIL\lambda_g \tag{2}$$

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2. Induction Elimination Method

2.1 Interval Operation to Eliminate Induction

The alternating electromagnetic field generally exists in the contact net after power failure, and the contact net is insulated from the ground at both ends, or the ground end of one end of the ground is insulated, and an electromagnetic induction voltage of up to 2-3 KV may be generated. Such a high electromagnetic induction voltage can be described as a crisis for the operator. Therefore, in order to eliminate the harm caused by electromagnetic induction to the construction work, the operator can control the grounding line spacing according to international standards, and take a safe working range from grounding at both ends. Under normal circumstances, if the power line is in the process of returning the line, the operator generally takes the two ends of the contact net to ground in the construction process and reserves 1700m (single line) or 1000m (double line), in the presence of two more than 1000m When the grounding distance is set, the grounding wire must be added.

For working environments with relatively low electromagnetic induction effects, such as contact with online operations, work vehicles, and ladder platforms, when the construction personnel are in contact with the wrist arm base[3], the pull wire, and the lower anchor compensation equal to the ground, the contact is in contact with the zero potential metal fitting. The current is transmitted through the body and leaked in the presence of the fitting to injure the constructor. Therefore, in order to prevent the harm of such electric shock to the operator, it is usually selected to increase the temporary grounding wire and directly connect the rail to prevent and protect the safety of the operator.

As a concrete pillar of a railway wire and the like, it can only withstand a voltage of 3000V, and in the case where the wrist arm base, the lower anchor compensator and the cable are not grounded separately, the anti-corrosion lower anchor cable can be regarded as Insulation performance under low pressure. However, it cannot be ignored that due to the presence of alternating electromagnetic fields and induced charges in contact with the power grid, for the lower anchor cable, the compensator and the wrist arm base, the operator must discharge the power before construction, otherwise it is easily susceptible to transient sensing. Voltage damage. The general measure for discharge treatment is to perform grounding treatment.

2.2 Station Operation Eliminates Induction Electricity

Station operations often need to face the situation of power outages and partial power outages. Whether it is a power outage or partial power outage, it is necessary to carefully check the power supply grounding of the power supply line within the scope of operation[4]. It is better to use the sunroof point of the whole site for maintenance and repair, which can reduce the risk of electric shock to the operator. For the case of partial power outages, the operator needs to verify the electrical segmentation performance, especially the soft span, throat zone and switch section,

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to ensure that the operator can keep a safe distance from the live equipment during construction, avoiding A current leakage occurs during a power outage.

After the construction of the operator is completed, the work site must be strictly controlled, cleaned, and the temporary ground wire removed. The distance between the grounded part and the live part is monitored to be within the safe range. Ensure that the operator, the vehicle and the live equipment can maintain a corresponding safety distance from the elevator car, the handling of the material and the operation of the vehicle when the power is restored, so as to avoid the harm of the induced electricity.

3. Safety Measures during Contact Net Construction

3.1 Increase the Equipotential Line and the Electrical Wiring between the Channels

Increasing the equipotential line can effectively eliminate the current path formed during the construction of the contact net due to the inability of the selected structure to be perfectly matched, and the increase of the equipotential line between the soft crosses avoids the occurrence of induced voltage. In addition, current channels are often present during the retrofit of the anchor section joints, and have a cross-sectional area equal to or greater than the cross-sectional area of the strand contact line. Therefore, the installation of the electrical connection between the channels can avoid the occurrence of current channels. For example, during the construction of the station change line, the electrical wiring between the channels can be increased to ensure the smooth transfer of electrical energy between the contact nets.

3.2 Reduce Contact Resistance Consider Copper-Aluminum Transition

Reducing the contact resistance between the electrical connection line and the contact net can ensure that the electrical connection line and the contact grid are closely connected. In the case of the composite grease in the painting shop, the induction power is significantly reduced, thereby ensuring the safety of the operation. When different materials are used in the process of contact nets and electrical connecting lines, in order to avoid the electrical energy encountering a large impedance during the transmission process, high heat is generated to burn the contact wire and the accessories, and copper and aluminum may be considered during the construction process. transition.

4. Conclusion

In order to prevent the harm of induction electricity during the construction of the contact net, attention should be paid to the safety distance between the grounding

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lines. In the case where there is a return line in the working section, the grounding wire should be added. This paper explores the relevant knowledge of induction electricity. From the perspective of eliminating induction electricity, combined with the construction of contact network provides some recommended measures for preventing and eliminating induction electricity.

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