

POWER FREQUENCY MAGNETIC FIELD TEST AND ANALYSE OF HV CABLES IN TUNNEL

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ABSTRACT

The measurement and calculation of power frequency magnetic field was conducted for double-circuit underground power cable lines at 110kV and 220kV, and the magnetic field level of cable lines was given. The power frequency magnetic field under rated current was given for those underground power cable lines inside and outside tunnels by calculation. How to evaluate power frequency magnetic field was also investigated.

KEYWORDS:

power cable; power frequency magnetic field.

1 INTRODUCTION

Underground power cables in operation produces power frequency magnetic field (PFMF). Confined to limited tunnel space, the cable lines are usually close to the passage of workers. Therefore, the PFMF of cables to workers is typically stronger than that of under overhead lines. With urban economic development, the transmission capacity of underground power cables has been increasing and the PFMF in tunnel is further increased. The impact to surrounding magnetic field level caused by PFMF of 110kV and 220kV underground power cables has become an important issue needed to be investigated.

It is of great importance to execute on-the-spot measurement of PFMF around power cables. It is because that, on one hand, the level of PFMF in tunnel with operational current can be investigated through measurement; on the other hand, in order to obtain the level of magnetic field under rated current, much computational programming is required, and the correctness of results need to be verified by comparison between the measured and the computed values.

In this article, we measured and analyzed the PFMF of a double-circuit underground power cable line at 110kV and a double-circuit underground power cable line at 220kV respectively, and calculated the PFMF of these two cable lines under rated current both in tunnel and above ground. Finally the level of PFMF under each scenario based on measuring and calculating results is evaluated.

2 MEASUREMENT OF PFMF OF UNDERGROUND POWER CABLE

2.1 Measurement and Calculation Method

The magnetic field measuring system of PMM8053A made in Italy is used in measuring the PFMF of underground power cable.

The measuring point is selected at representative points on transect of the cable lines. To get its horizontal distribution characteristics of the PFMF, vertical direction measuring is conducted at regulated measuring height,

which is often determined by installation position of cables and terrain condition of tunnels. It is either taken at the installation height or 1.5m above the bottom of tunnels.

The three-phase cables are typically evenly transposed, so the induced current on the shield is relatively small, which is negligible. Therefore, the magnetic field produced by single-phase cable is calculated by Formula (2-1):

$$B = \frac{\mu I}{2\pi r} \quad 2-1$$

Where B is magnetic flux density, μ is magnetic permeability, and r is distance between the measured point and cable.

As to three-phase cable, when calculating horizontal and vertical components of magnetic field intensity formed by phase difference, the phase angles of current must be calculated respectively, which is formed by phase vectors. Specific method as follows: first for a given calculation point, assume a spatial direction; then, according to the real and imaginary current of the wire, calculate the vector sum of horizontal component and vertical component of this point in the assumed spatial direction; finally let the derivative of the vector sum to its direction angle equal to zero, and thus obtain the maximum and minimum value, as well as their directions, of the magnetic field at the point.

2.2 Measurement and Calculation of 110kV Underground Double-circuit Cable

The 110kV double-circuit cables measured is placed as an equilateral triangle. The type of cable is YJLW02-110-1 × 400mm² with designed carrying capacity of 737A. Load during measuring is low, the current of which is 20.92A and 14.24A respectively. The width of tunnel is about 2m, the installation height of cable is about 0.4 ~ 0.6m, the double-circuit cables are placed close to the sideway walls, the distance between each phase cable is about 1.3m. In the middle of the tunnel, there is a cement walk channel with the width of 0.5m.