Remaining Service Life Diagnostic Technology of Insulators for Power Distribution Equipment

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Abstract

For power distribution equipment supplying electrical energy to factories or buildings, it is essential to ensure the reliable and stable power supply for a long period. Once any trouble occurs due to deterioration of insulators in high-voltage electrical equipment, then the adverse effects against factories or buildings, such as manufacturing losses or damages of equipment will be substantial. In order to prevent such a critical loss by unexpected power loss due to sudden accident in the power distribution equipment, we have developed a new technology for diagnosis of remaining service life of insulators, which is one of dominant factors in determining the remaining service life of power distribution equipment.

In the past, diagnosis techniques for insulators by electrical evaluation techniques such as insulation resistance measurement or partial discharge measurement have been mainly studied. However those electrical evaluation techniques are greatly influenced by humidity or electro-magnetic noise, therefore the results greatly fluctuate depending on the measured season, time or environmental conditions.

In this paper, we introduce a newly developed remaining service life diagnosis technology for insulators, which is based on chemical evaluation technique independent from humidity or electro-magnetic noise. We defined the end of life of insulators as when the surface resistance of insulators dropped and partial discharge started, which will lead to rapid acceleration of the deterioration.

In application of this technology, at first chemical characteristics of insulators such as ion concentration and coloration will be measured at site. Then the collected data will be analyzed by the Mahalanobis-Taguchi (MT) method, which is well-known as an effective pattern information analyzing technique. Next, the master curve of service life for each kind of insulator in our database will be adjusted with a formula based on the correlative relationship between the surface resistance of insulators and the output gained by MT method analysis. Finally, expected remaining time until the surface resistance drops to allow partial discharge on each measured point will be obtained, assuming under the same environmental condition.

This technology will help users to make effective and optimal plan to carry out preventive maintenance, parts replacement or equipment renewal, before sudden failure of equipment to bring critical loss to the plant actually happens.

Monitoring results of actual aged sample equipment and some simulation test results in laboratory also match well with diagnosis results obtained beforehand, which supports to prove effectiveness of this technology.