신뢰성이 향상된 배전급 피뢰기 설계 기술의 동향

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Trend in New Distribution Class Arrester Ground Lead Disconnector Design

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Abstract : The paper also introduces a new Distribution Class ground lead disconnector design that not only extends the claimable detonation range well below the 20 amps specified in industry standards, but is very durable when exposed to severe arrester durability tests. Finally, this paper shows how this next generation disconnector interacts with the connected arrester to improve the overvoltage withstand capability of the arrester assembly. The interaction of the disconnector grading capacitor with the series-connected arrester metal oxide disc elements actually improves the arrester assembly temporary overvoltage withstand capability, making the design less vulnerable to TOV failures. Since the vast majority of distribution class arresters are sold domestically with ground lead disconnectors, this design improvement in the disconnector to improve detonation reliability also translates into a significantly improved distribution class arrester design.

Key Words : Arrester, Disconnector, Reliability, Distribution class

1. Introduction

Protection of the dielectric integrity of the transformer is provided by the closely connected arrester. Approximately twenty years ago, the traditional gapped-silicon carbide distribution class arrester design was replaced by the improved gapless arrester, based on metal oxide varistor (MOV) technology. In addition to performance improvements associated with this new MOV technology, the traditional porcelain-housed arresters were replaced during this same time period by polymer-housed arresters.

Conversion from porcelain to polymerhoused distribution class arresters allowed manufacturers to reduce the active element length of their arrester designs. The porcelain designs traditionally had a ground lead disconnector attached to the base end of the arrester and the arrester was supported by a grounded metal "bellyband" bracket, typically attached around the porcelain housing approximately one-third the distance from the bottom end of the arrester housing. The distance from the top edge of the metal bellyband to the arrester top end cap provided the required line to ground insulation clearance as specified for each arrester rating in the C62.11 Standard. The distance from the bottom of the grounded bellyband to the ground lead disconnector provided the necessary clearance to prevent the intact, failed porcelain arrester from locking out the system if the arrester should fail but remain intact. Assuming that the ground lead disconnector reliably detonates during arrester failure. Should the disconnector fail to operate, the base end of the failed arrester will remain connected to system ground and the line will lock out until upstream protection operates and the failed arrester is replaced.

2. Experimentals

For required arrester durability tests defined in the standard, the arrester is expected to withstand the duty without failing and the detonator is expected to withstand the duty without detonating. The thermal design of the disconnector is such that there is not sufficient coulomb content in the sparkgap region to cause the adjacent cartridge to detonate during arrester durability tests. However, if the surge duty is sufficient to cause the arrester to fail, the subsequent flow of system fault current available at the arrester location is intended to provide sufficient heating of the cartridge to cause it to detonate. The design of the disconnector is such that this detonation then causes the ground lead to be separated from the base end of the arrester.

3. Results and Discussion

It should be pointed out that most manufacturers publish only one TOV curve for their distribution arrester designs. This curve is typically based on the TOV capability of the arrester only, since Distribution Class arresters can be installed without insulating brackets and ground lead disconnectors. The actual arrester assembly (including disconnector) TOV capability may exceed that claimed for the arrester alone. Figure 1 shows a typical gapless distribution class arrester temporary overvoltage curve.

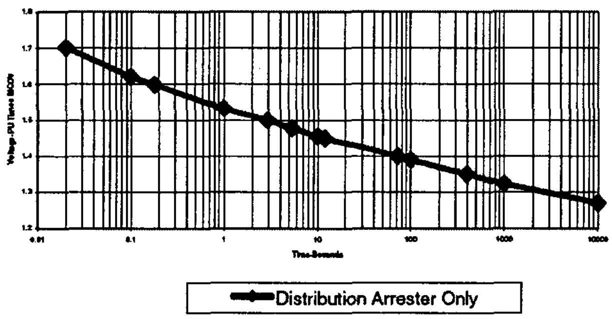

Fig. 1. Typical no prior duty TOV curve for gapless distribution arrester.

As noted previously, the significantly higher impedance of the capacitorgraded disconnector electrically interacts with the capacitive and non-linear resistance characteristic of the metal oxide discs. At system operating voltage levels, the voltage across the capacitively graded disconnector is typically a few hundred volts, compared with tens of volts for the resistively graded disconnector. As applied voltage increases above operating levels, the parallel combination of the disconnector capacitor and its sparkgap assume a higher percentage of total voltage than does the resistively graded disconnector. Because the capacitor does not experience I^2R loss, in contrast to the resistance graded design, the disconnector can withstand overvoltages for extended periods of time, as long as the capacitor voltage does not exceed the bypass gap sparkover level. Unlike an arrester with a resistively graded disconnector, which has a claimed TOV capability that is independent of arrester voltage rating, arresters with capacitively graded disconnectors have a rating-dependent TOV curve.

4. Conclusion

Introduction of a high voltage capacitorgraded arrester ground lead disconnector addresses utility concerns regarding reliable detonation of the Distribution Class arrester disconnector. Test data confirms the detonation integrity of the disconnector is maintained even after the arrester is subjected to high current surge duty prevalent in the distribution system environment. Even under weak source temporary overvoltage conditions, which can damage the resistance-graded design affecting detonation reliability, the capacitor-graded design performs properly.

감사의 글

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참고 문헌

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