

Unbalance in MV/HV shunt capacitor banks can cause capacitor failures accompanied by fire and explosion

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July 20, 2022

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- July 20, 2022

*In this article, **Baldev Raj Narang** investigates into the issue of unbalance protection for medium and high voltage shunt capacitor banks.*

Why is unbalance capacitor protection for MV capacitor banks critical?

It is important to understand the criticality of unbalance protection for medium and high voltage Shunt Capacitor Banks. The instances of fire and accidents are not uncommon in these capacitor installations. The absence or faulty operation of this protection can cause major accidents accompanied by explosion and fire, putting installation and human safety at risk. Thus, medium, and high voltage shunt capacitor banks are provided with unbalance protection. There are two common ways of configuring this protection. RVT (Residual Voltage Transformer) with Neutral Displacement Relay (NDR) with an open delta winding to sense unbalance or Double Star connected Capacitor banks with NCT (Neutral Current Transformer) connected between neutrals of two star connected capacitor banks. Unbalance current is sensed by NCT.

Unbalance leads to cascading overvoltage phenomena

The internal construction of an APP type MV capacitor unit having series- parallel configuration of internal capacitor elements is shown in figure 1. If any element fails, a short circuit gets created across failed element and the voltage across remaining healthy elements rises. The unbalance condition starts when an internally connected individual capacitor element fails for any reason like manufacturing defect or while handling inrush current, or harmonic current, or towards end of the service life of capacitor. The onset of unbalance is a dangerous occurrence. APP capacitors have short circuit mode of failure which is unsafe. The full terminal voltage now gets applied across fewer healthy elements. This leads to failure of more capacitor elements. This is a cascading process and the healthy capacitor elements progressively experience higher and higher voltage across lesser and lesser capacitor elements. If the unbalance is not arrested the voltage rise can lead to an accident like explosion and possibly a fire.(See Figure 1)

protected with self-healing and overpressure interrupter mechanism and do not depend on any external protection. Though MPP capacitors for MV/HV application have been developed but these are still not commercially viable for widespread use.

Unbalance protection not needed for LV applications

The internal configuration of capacitor elements for low voltage APP capacitors is different and safer than that for MV/HV Capacitors. The internal elements of a star or delta connected Low Voltage APP capacitor unit have one element only in each parallel arm of each phase, there are no series elements as shown in Figure 3. Failure of any one or more elements does not cause voltage rise across remaining healthy elements, thus unbalance condition is not unsafe in Low Voltage APP capacitor installations and unbalance protection is not needed. MPP shunt capacitor banks, LV/ MV/HV being self-protected and having open circuit failure mode don't need unbalance protection or for that matter any external protection. (See Figure 3)

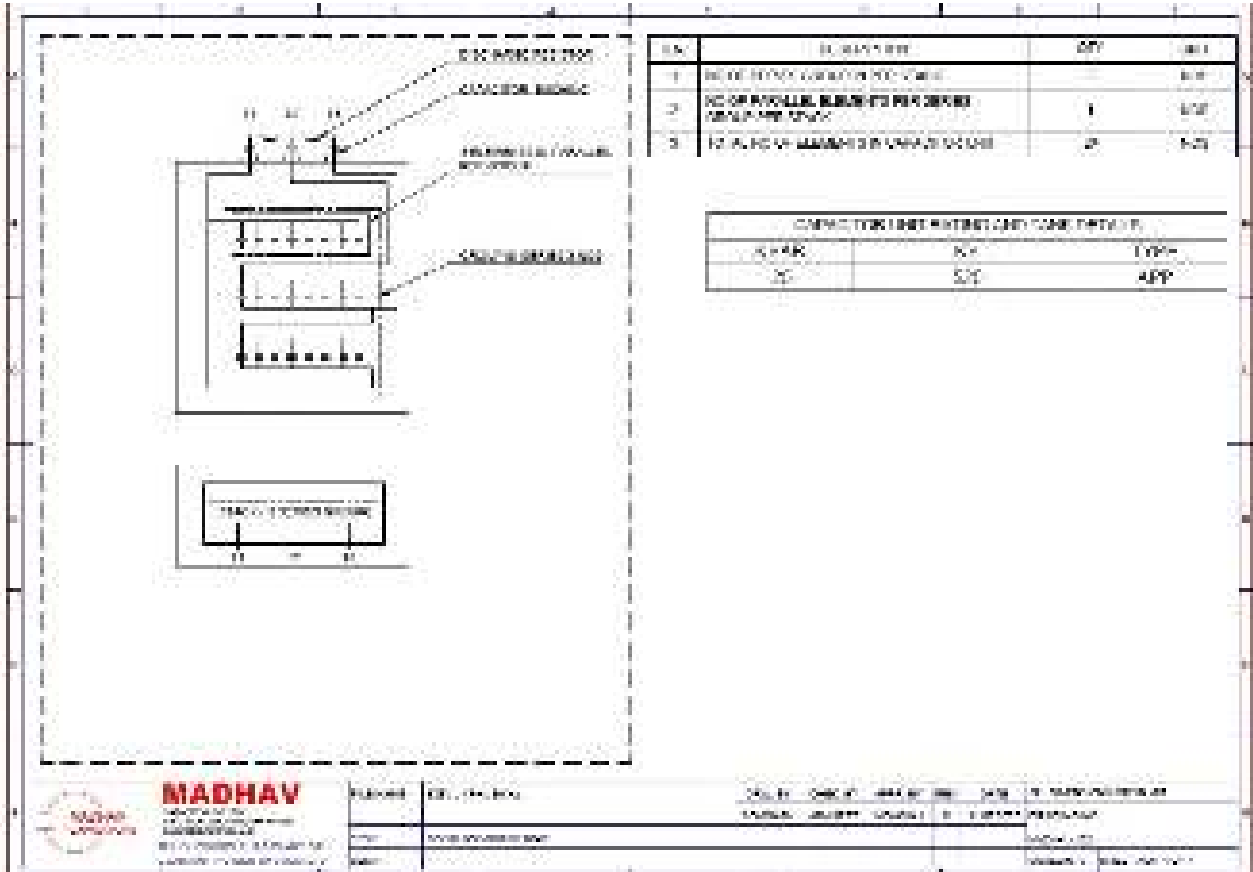


Figure 3: Typical Construction of a low voltage APP Capacitor Unit

About the author

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