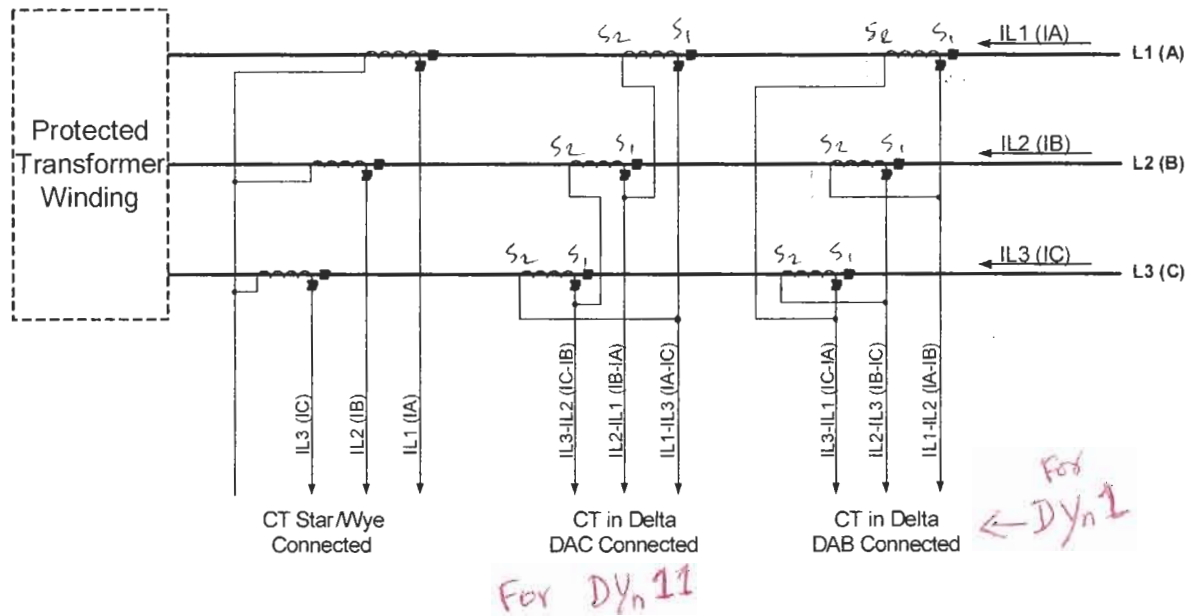


## 2.1 Typical main CT connections for transformer differential protection

Three most typical main CT connections used for transformer differential protection are shown in Figure 1. It is assumed that the primary phase sequence is L1-L2-L3 (i.e. ANSI ABC).



**Figure 1:** Commonly used main CT connections for Transformer Differential Protection

For star/wye connected main CTs, secondary currents fed to the differential relay:

- are directly proportional to the measured primary currents
- are in phase with the measured primary currents
- contain all sequence components including zero sequence current component

For star/wye connected main CTs, the main CT ratio shall be set in RET 670 as it is in actual application. The "StarPoint" parameter, for the particular star/wye connection shown in Figure 1, shall be set "ToObject". If star/wye connected main CTs have their star point away from the protected transformer this parameter should be set "FromObject".

For delta DAC connected main CTs, secondary currents fed to the differential relay:

- are increased  $\sqrt{3}$  times (i.e. 1.732 times) in comparison with star/wye connected CTs
- lag for  $30^\circ$  the primary winding currents (i.e. this CT connection rotates currents for  $30^\circ$  in clockwise direction)
- do not contain zero sequence current component

For DAC delta connected main CT ratio shall be set for  $\sqrt{3}$  times smaller in RET 670 than the actual ratio of individual phase CTs. The "StarPoint" parameter, for this particular connection shall be set "ToObject". It shall be noted that delta DAC connected main CTs must be connected exactly as shown in Figure 1.

→ For delta DAB connected main CTs, secondary currents fed to the differential relay:

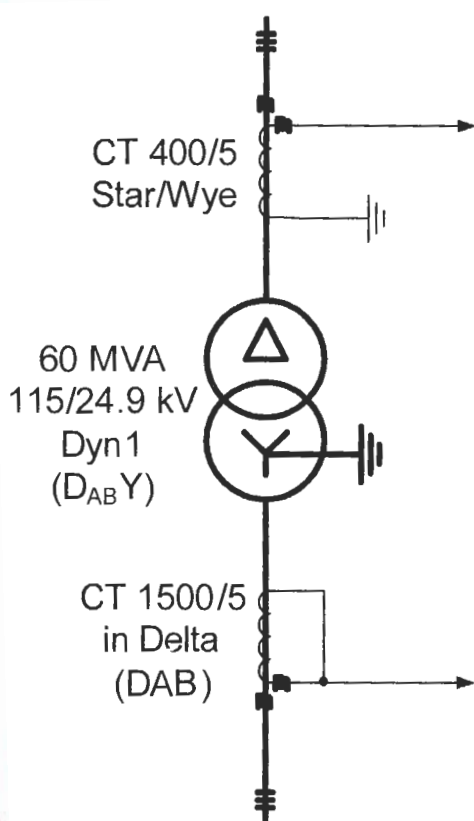
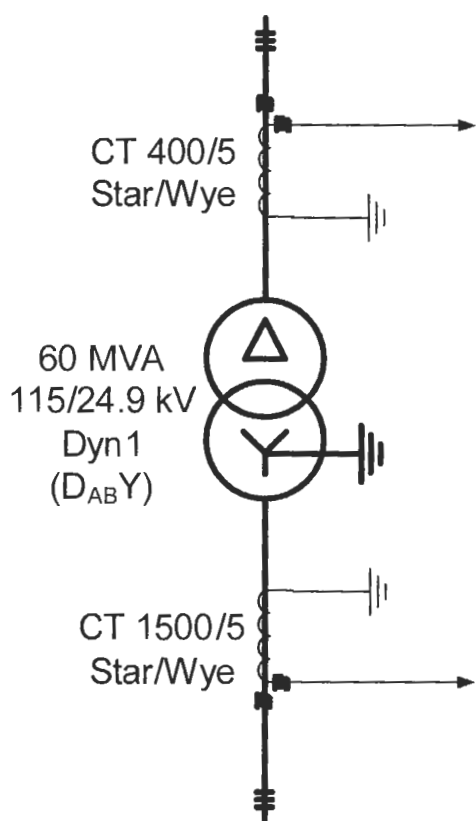
- are increased  $\sqrt{3}$  times (i.e. 1.732 times) in comparison with star/wye connected CTs
- lead for  $30^\circ$  the primary winding currents (i.e. this CT connection rotates currents for  $30^\circ$  in anticlockwise direction)
- do not contain zero sequence current component

For DAB delta connected main CT ratio shall be set for  $\sqrt{3}$  times smaller in RET 670 than the actual ratio of individual phase CTs. The "StarPoint" parameter, for this particular connection shall be set "ToObject". It shall be noted that delta DAB connected main CTs must be connected exactly as shown in Figure 1.

For more detailed info regarding CT data settings please refer to the three application examples presented in Section 3.

## 3.2 Delta-star/wye connected power transformer without tap changer

Single line diagrams for two possible solutions for such type of power transformer with all relevant application data are given in Figure 3.



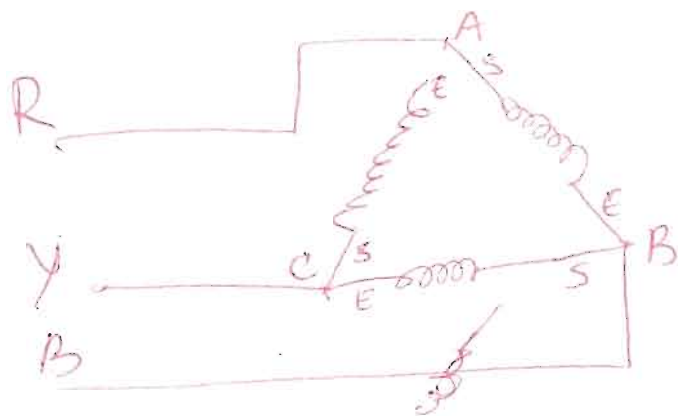
**Figure 3:** Two differential protection solutions for delta-star/wye connected power transformer

For this particular power transformer the 115kV side phase-to-ground no-load voltages lead for  $30^\circ$  the 24.9kV side phase-to-ground no-load voltages. Thus when external phase angle shift compensation is done by connecting main 24.9kV CTs in delta, as shown in the right-hand side in Figure 3, it must be ensured that the 24.9kV currents are rotated by  $30^\circ$  in anticlockwise direction. Thus, the DAB CT delta connection (see Figure 1) must be used for 24.9kV CTs in order to put 115kV & 24.9kV currents in phase.

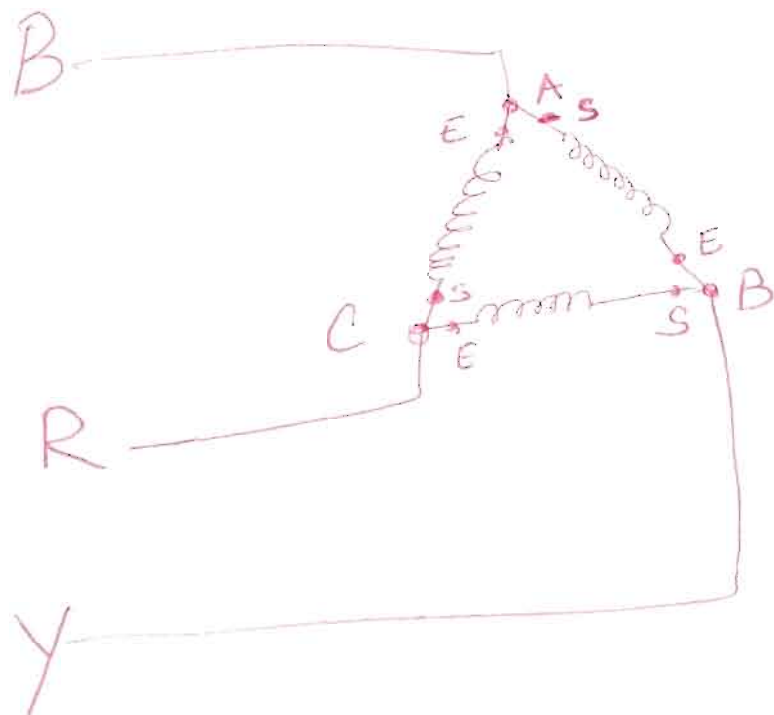
To ensure proper application of RET 670 for this power transformer it is necessary to do the following:

1. Check that HV & LV CTs are connected to 5A CT inputs in RET 670
2. For second solution make sure that LV delta connected CTs are DAB connected
3. For star/wye connected CTs make sure how they are started (i.e. grounded) To/From protected transformer





Dyn 1



Dyn 1