



VEBKO ONLINE HELP

“Leakage Reactance” Tab

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Section	Transformer Module
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This tab is used to calculate the transformer leakage reactance value. In fact, the short circuit voltage is the voltage applied to the primary coil while the secondary coil is short-circuited. In the short circuit voltage, the nominal current is established on both sides of the transformer. The active power absorbed in the short circuit voltage is the same as the transformer losses. The purpose of obtaining the value of the short circuit voltage is to calculate the transformer losses. As the load current increases, the short circuit voltage increases linearly. The short circuit voltage is obtained using the following equation.

$$U_{cc} = U_{ccm} * \frac{I_r}{I_m}$$

Figure 1

In this formula, U_{cc} , U_{ccm} , I_r and I_m are the values of the short circuit voltage in the I_r nominal current, the value of the short circuit voltage in the I_m measuring current, the nominal current and the measured current, respectively. Now, to calculate UK%, the short circuit voltage calculated in the above formula is used in the following equations.

$$U_{cc} = \sqrt{U_X^2 + U_R^2} \rightarrow \epsilon_{ccm} = \frac{U_{cc}}{U_r} * 100$$

Figure 2

In the above equation, U_r is the transformer nominal voltage while ϵ_{ccm} =UK%.

It is necessary to observe some points in this test. To short circuit the secondary side, the cable size is calculated. Cable size or short circuit busbar on the secondary side are obtained using an example. Suppose There is a transformer with 7.5 MVA of nominal power, 33 to 11 KV conversion ratio with Dyn11 vector group and a %10 short-circuit voltage. The primary and secondary nominal current equal

131 Amp and 393 Amp, respectively. The CT turns ratio equals 800 to 5 amp on the secondary side and 150 to 50 amp on the primary side. Considering the conversion ratio on the primary side, the UK% value of the transformer equals 10 percent. Therefore, the short-circuit voltage is obtained to be 3300 volts which means that if 3300 volts are applied to the primary of the transformer, while the secondary is short-circuited, the nominal currents pass through the primary and secondary of the transformer. Assuming a 400 volts of voltage being applied to the primary of the passing currents, the primary and secondary are obtained using the following equation.

$$I_{1cc} = 131 * \frac{400}{3300} = 15.87^A$$

$$I_{2cc} = 393 * \frac{400}{3300} = 47.63^A$$

Figure 3

Taking into account the current value obtained in the secondary side, the cable cross section is selected in accordance with the passing of this current.

If CT is present in the transformer, to avoid CT excitation, the secondary terminals are short-circuited. Also, this test is performed in the nominal tap and then the highest and lowest taps. It should be noted that to avoid sudden increase of the current during the test, the voltage is increased gradually. To do so, first, a "Continuous Ramp" state is created to avoid inrush current in the transformer. The measurement current must not be smaller than the nominal current but if this is not feasible, according to the IEEE Std C57.152™-2013 (Revision of IEEE Std 62TM-1995), as much as 50 percent of the nominal current can be used instead.

It should only be noted that if the secondary winding of a transformer is yn, the secondary neutral should not be connected to the other phases.

In "State Settings", the test voltage value and the test time are specified.

If the transformer has several taps, "Insert Mode" you can specify in which taps and in what order to add them to the test table.

In "All Tap", you can specify how the taps are arranged, from top to bottom or from bottom to top. In

"Specific Tap", you can select a specific tap; And in "In Range", you can specify from one tap to a specific tap.

"Insert Position" also specifies where the newly added test row should be above the selected row, below it, or after the last row.

After performing the wiring shown in the figure, by clicking on "Insert Rows" for each phase, a new row is added, in front of each of which, the name of the phase and U_k and the nominal power of the transformer are written. These values come from the "Test Object" tab in "Power Ratings" section by default, but they can also be changed from inside the table.

After performing the test, by clicking on the row of each phase, either in "Result (Selected)" section or inside the same row, the test results are displayed.

In the fields "Iact", "V meas" and "V phase" the amount of current drawn from the specified voltage phases, the actual value of the injected voltage and the injection voltage phase is specified, respectively.

The short-circuit voltage and its deviation from the specified value which are displayed on the transformer plate are also specified in "Uk calc" and "Uk dev" fields.

To execute this test, a transformer with Dyn11 vector group and a $U_k\%=3.3\%$ is used. First, the values are entered in Test Object and after configuring the wiring, by right-clicking on the table and clicking on Apply Test the test is executed and the test results for each phase can be viewed. Also, the waveform of the voltage injection and the current drawn from the transformer is displayed in Signal View.

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