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Determination of equivalent circuit parameters of 3 phase 3 winding Transformers.

Results: Open Circuit Test:-

primary winding → 1° (Supply)
Secondary winding → 2° {open circuit}
tertiary winding → 3°

Values wrt primary side.

$V_{oc} = 132.8\ V$ (Single phase)
$P_{oc} = 134.8\ W$ (3 phase)
$I_{oc} = 0.539\ A$ (Single phase)

Calculations:

(i) Equivalent admittance of shunt branch

$$Y = \frac{|I_{oc}|}{|V_{oc}|} = \frac{0.539}{132.8} = 4.0587 \times 10^{-3}\ \Omega^{-1}$$

$$Y = G_i + jB_m$$

$$G_i = \frac{P_{oc}\ (\text{per phase})}{V_{oc}^2} = \frac{134.8/3}{132.8^2}$$

$$= 2.548 \times 10^{-3}\ \Omega^{-1}$$

$$B_m = \sqrt{Y^2 - G_i^2}$$

$$= 3.159 \times 10^{-3}\ \Omega^{-1}$$

Coreloss Resistance,

$R_i = \frac{1}{G_i} = 392.465\ \Omega$

magnetizing Resistance,

$X_m = \frac{1}{B_m} = 316.556\ \Omega$

magnetizing inductance $= \frac{X_m}{2\pi f}$

$= 1.051\ H$

Results:- Short Circuit Test :-

Test 1 { Short circuit secondary
Open circuit tertiary
Voltage supply primary.

$I_{sec} = 14.80\ A$.

$I_{sc_1} = 7.36\ A$
$V_{sc_1} = 2.19\ V$
$P_{sc_1} = 11.07\ W$

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Test 2 { Short circuit tertiary
Open circuit Secondary
Voltage supply primary

$I_{ter} = 14.78\ A$

$I_{sc_2} = 7.42\ A$
$V_{sc_2} = 2.48\ V$
$P_{sc_2} = 13.06\ W$

Test 3 { Short circuit tertiary
Open circuit ~~Secondo~~ primary
voltage Supply Secondary

$I_{~~ter~~} = 14.48\ A$

$I_{sc_3} = 14.65\ A$
$V_{sc_3} = 1.06\ V$
$P_{sc_3} = 10.63\ W$

Calculations:-

(ii) $Z_{12} = \frac{V_{sc_1}}{I_{sc_1}} = \frac{2.19}{7.36} = 0.2976\ \Omega$

$$Z_{13} = \frac{V_{SC13}}{I_{SC13}} = \frac{2.48}{7.42} = 0.3342\ \Omega$$

$$Z_{23} = \frac{V_{SC23}}{I_{SC23}} = \frac{1.06}{14.65} = 0.0724\ \Omega$$

Leakage impedances :-

(iii) $Z_1 = \frac{1}{2}(Z_{12} + Z_{13} - Z_{23})$

$= 0.5(0.2976 + 0.3342 - 0.0724)$

$= 0.5(0.5594) = 0.2797\ \Omega$

$Z_2 = \frac{1}{2}(Z_{12} + Z_{23} - Z_{13})$

$= 0.5(0.2976 + 0.0724 - 0.3342)$

$= 0.5(0.0358) = 0.0179\ \Omega$

$Z_3 = \frac{1}{2}(Z_{13} + Z_{23} - Z_{12})$

$= 0.5(0.0724 + 0.3342 - 0.2976)$

$= 0.5(0.109) = 0.0545\ \Omega$