

继电保护作业 5

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1.

(1) 取 $K_{rel} = 0.85$, 则有:

$$\begin{aligned}Z_{AB} &= Z_1 \cdot Z_{AB} = 18 \angle 75^\circ \Omega \\Z_{act,AB}^I &= K_{rel} * Z_{AB} = 15.3 \angle 75^\circ \Omega \\Z_{act,J}^I &= Z_{act,AB}^I * \frac{n_{TA}}{n_{TV}} = 15.3 * \frac{300/5}{110/0.1} = 0.834 \Omega \\&>> Z_{set,AB}^I = 0.834 \Omega\end{aligned}$$

(2) 取 BC 线路 I 段保护可靠系数 0.85,

$$\begin{aligned}Z_{BC} &= Z_1 * L_{BC} = 22.5 \angle 75^\circ \Omega \\Z_{act,BC}^I &= K_{rel} * Z_{BC} = 19.125 \angle 75^\circ \Omega \\K_{bra} &= \frac{Z_{s,1} + Z_{AB} + Z_{s,2}}{Z_{s,2}} = 1.919 \angle -4.64^\circ\end{aligned}$$

BC 末端短路时有:

$$Z_{act,AB}^{II} = K_{rel} * (Z_{AB} + K_{bra} * Z_{act,BC}^I) = 43.729 \angle 71.89^\circ \Omega$$

变压器末端短路时有:

$$Z_{act,AB}^{II} = K_{rel} * (Z_{AB} + K_{bra} * 0.5 Z_T) = 68.85 \angle 83.47^\circ \Omega$$

则有取动作阻抗和整定阻抗为:

$$\begin{aligned}Z_{act,AB}^{II} &= 43.729 \angle 71.89^\circ \Omega \\Z_{set,AB}^{II} &= Z_{act,AB}^{II} * \frac{300/5}{110/0.1} = 2.385 \Omega\end{aligned}$$

动作时限和灵敏度:

$$\begin{aligned}K_{sen} &= \frac{Z_{act,AB}^{II}}{Z_{AB}} = 2.429 \\t_{AB}^{II} &= 0.1 + 0.5 = 0.6s\end{aligned}$$

(3)

$$\begin{aligned}\cos \varphi &= 0.85 >> \varphi = 31.79^\circ \\Z_{L,min} &= \frac{0.9 U_{min}}{I_N} = \frac{0.9 * 110 * 1000 / \sqrt{3}}{200 \angle -31.79^\circ} = 285.788 \angle 31.79^\circ \Omega\end{aligned}$$

取 $K_{rel} = 1.1$

$$Z_{set,AB}^{III} = \frac{1}{K_{rel} * K_{ss} * K_{rel}} * Z_{L,min} = 144.337 \angle 31.79^\circ \Omega$$

$$Z_{act,AB}^{III} = Z_{set,AB}^{III} * \frac{n_{TA}}{n_{TV}} = 7.873 \Omega$$

灵敏度和动作时限:

近后备:

$$K_{sen} = \frac{Z_{AB}^{III}}{Z_{AB}} = 8.019$$

远后备:

对于 BC 线路:

$$K_{sen} = \frac{Z_{set,AB}^{III}}{Z_{AB} + K_{bra} * Z_{BC}} = 2.361$$

对于变压器线路:

$$K_{sen} = \frac{Z_{set,AB}^{III}}{Z_{AB} + K_{bra} * 0.5 Z_T} = 1.467$$

动作时限:

$$t_{AB}^{II} = \max(2, 2.5) + 0.5 = 3s$$

2.

(1)

$$Z_{act,AB}^I = K_{rel} * Z_{AB} = 15.3 \angle 75^\circ \Omega$$

$$Z_{act,J}^I = Z_{act,AB}^I * \frac{n_{TA}}{n_{TV}} = 0.835 \Omega$$

$$Z_{set,AB}^I = \frac{Z_{act,AB}^I}{\cos(\phi_k - \phi_{sen})} = \frac{0.835}{\cos(75^\circ - 70^\circ)} = 0.838 \Omega$$

(2) 取 $K_{rel}^{II} = 0.8$,

$$Z_{act,AB}^{II} = 43.729 \angle 71.89^\circ$$

$$>> Z_{act,J}^{II} = Z_{act,AB}^{II} * \frac{n_{TA}}{n_{TV}} = 2.385 \Omega$$

$$Z_{set,AB}^{II} = \frac{Z_{act,J}^{II}}{\cos(\phi_k - \phi_{sen})} = \frac{2.385}{\cos(71.89^\circ - 70^\circ)} = 2.386 \Omega$$

灵敏度和动作时限:

$$K_{sen} = \frac{43.729 / \cos(71.89^\circ - 70^\circ)}{18 / \cos(75^\circ - 70^\circ)} = 2.421$$

$$t_{AB}^{II} = 0.1 + 0.5 = 0.6s$$

(3)

$$Z_{act,AB}^{III} = 144.337 \angle 31.79^\circ$$

$$>> Z_{act,J}^{III} = Z_{act,AB}^{III} * \frac{n_{TA}}{n_{TV}} = 7.873 \Omega$$

$$>> Z_{set,AB}^{III} = \frac{Z_{act,J}^{III}}{\cos(31.79^\circ - 70^\circ)} = 10.020 \Omega$$

近后备:

$$K_{sen} = \frac{144.37 / \cos(31.79^\circ - 70^\circ)}{18 / \cos(75^\circ - 70^\circ)} = 10.166\Omega$$

远后备:

对于 BC 线路:

$$Z_\Sigma = Z_{AB} + K_{bra} * Z_{BC} = 61.136 \angle 71.72^\circ \Omega$$

$$K_{sen} = \frac{10.020 / \cos(31.79^\circ - 70^\circ)}{Z_\Sigma / \cos(71.72^\circ - 70^\circ)} = 3.003$$

对于变压器:

$$Z'_\Sigma = Z_{AB} + K_{bra} * 0.5Z_T = 98.358 \angle 83.47^\circ \Omega$$

$$K_{sen} = \frac{144.337 / \cos(31.79^\circ - 70^\circ)}{98.358 / \cos(83.47^\circ - 70^\circ)} = 1.816$$

动作时限:

$$t_{AB}^{III} = \max(2, 2.5) + 0.5 = 3s$$

3.

(1)

$$K_{bra,max} = \frac{X_{F,max} + X_{FA} + X_{AB}}{(X_{E,min} + X_{EB}) || (X_{D,min} + X_{DB})} + 1$$

$$= 1 + \frac{X_{F,max} + X_{FA} + X_{AB}}{X_{E,min} + X_{EB}} + \frac{X_{F,max} + X_{FA} + X_{AB}}{X_{D,min} + X_{DB}}$$

(2)

$$K_{bra,min} = \frac{X_{F,min} + X_{FA} + X_{AB}}{(X_{E,max} + X_{EB}) || (X_{D,max} + X_{DB})} + 1$$

$$= 1 + \frac{X_{F,min} + X_{FA} + X_{AB}}{X_{E,max} + X_{EB}} + \frac{X_{F,min} + X_{FA} + X_{AB}}{X_{D,max} + X_{DB}}$$

4.

(1) 在临界情形时有:

$$Z_{m.M} = (\frac{1}{2}Z_\Sigma - Z_m) - j * \frac{1}{2}Z_\Sigma \cot \frac{1}{2}\delta \quad (1)$$

$$|Z_{m,M} - \frac{1}{2}Z_{set}| = |\frac{1}{2}Z_{set}| \quad (2)$$

可以解得:

$$\delta = 136.40^\circ$$

$$\delta' = 223.60^\circ$$

则 δ 在 $136.40^\circ - 223.60^\circ$ 范围内会使该继电器误动

(2)

$$t = T * \frac{\delta' - \delta}{360^\circ} = 2 * \frac{223.60^\circ - 136.40^\circ}{360^\circ} = 0.484s$$