Power systems Laboratory
Experiment 3a

Topic :- Verification of Directional relay characteristics

Name- Modi Omkar
Roll No. - 19EE30018

3) For two dataset, the directional overcurrent ~~et~~ relay characteristics were plotted.
Case1:- $\beta = 150^\circ$, $\gamma = -30^\circ$, fault current = 2.67A = 0.534 (in PU), $I_{nom} = 5A$, $I_s = 0.3 I_{nom}$

Trip region is observed between region -27° to 149°, and block region from 149° to 333°.
The observed plot is agrees with the theoretical parameters.

Case 2:- $\beta = 70^\circ$, $\gamma = -110^\circ$, fault current = 2.67A = 0.534 (in pu), $I_{nom} = 5A$, $I_s = 0.3 I_{nom}$

Trip region is observed between 78° to 243°, and block region from -117° to 78°
The experimental error is very less.

Taking smaller intervals for data observation can improve accuracy and reduce error by varying the phase angle between voltage and current in small intervals.

Modi Omkar
19EE30018

Case 1

Fault current = 2.67 A = 0.534 pu

F. Inom = 5A, pickup setting = 0.3 Inom

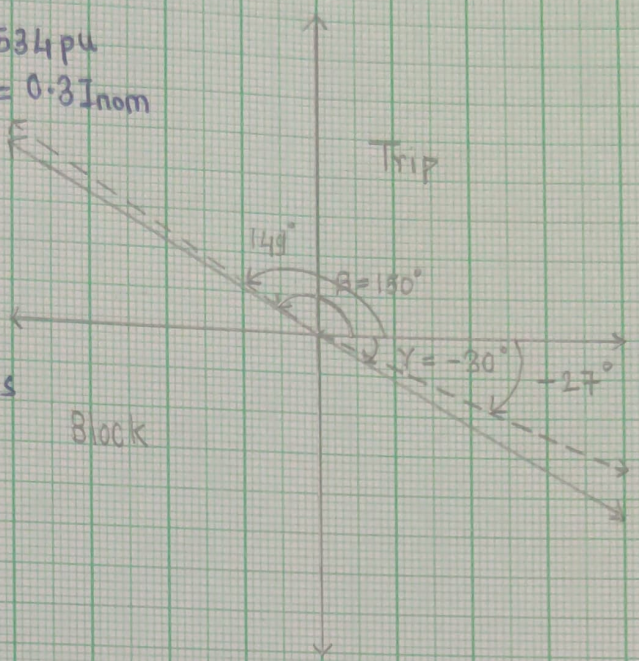
IEEE M Inverse

$\beta = 150^\circ$, $\gamma = -30^\circ$

minimum trip time = 0.2s

--- Observed characteristics

— set characteristics



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19EE30018

Case 2

Fault current = 2.67A, = 0.534pu

I_{nom} = 5A, I_s = 0.3 I_{nom}

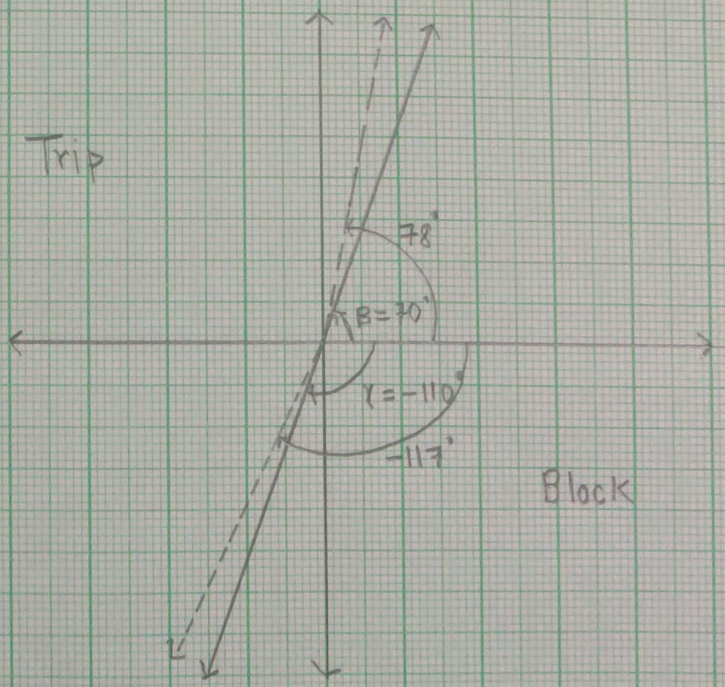
IEEE M inverse

$\beta = 70^\circ$, $\gamma = -110^\circ$

minimum trip time = 0.2s

--- Observed characteristic

— set characteristic



Date

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4) The performance can be improved by using positive sequence component operating them with in the block region with a sufficient safety and use quadrature voltages to determine if relay should trip when fault is close to relay.

Testing can be improved by taking a more observation points at smaller intervals ~~between~~ angle between voltage and current phasors.

5) setting $\beta = 160°$, $\gamma = -20°$ pickup setting = 0.3 kA

case 1.

$I_a = 0.08 \angle -87.91°$ kA , $V_a = 104.77 \angle 78.43°$ kV

wrt I_a

$\angle V_a = 78.43° - (-87.91) = 166.34° > \beta$ ⇒ Block region

$I_b = 0.72 \angle 96.16°$ kA, $V_b = 53.84 \angle -85.74°$ kV

wrt I_b

$\angle V_b = 10.42° < \beta$ ⇒ Trip region

$I_c = 0.79 \angle 84.70°$ kA

$V_c = 54.96 \angle -117.07°$ kV

wrt I_c

$\angle V_c = -201.77° = 158°.23 < \beta$ ⇒ trip region.

So directional relay trip in this case.

Teacher's Signature

Case 2 $I_{pickup} = 0.3\,kA$, $\beta = 160°$, $\gamma = -20°$

$I_a = 0.63 \angle -164.74°$ kA

$V_a = 22.52 \angle 96.26°$ kV

wrt I_a

$\angle V_a = 263° \equiv -97° < \gamma$ ⇒ block region.

$I_b = 0.64 \angle 53.15°$ kA

$V_b = 22.94 \angle -19.90°$ kV

wrt I_b

$\angle V_b = -73.05° < \gamma$ ⇒ block region.

$I_c = 0.61 \angle 45.39°$ kA

$V_c = 22.10 \angle -139.94°$ kV

wrt I_c

$\angle V_c = -94.58° < \gamma$ ⇒ block region.

So directional relay will not operate in this case.

6) 19EE30018

Fault position	Fault resistance	Voltage	Current	Decision (Trip/No trip)
F_1	8 Ω			
F_2	8 Ω			