STUDI ALIRAN DAYA SISTEM TENAGA 3 BUS

$V_1 = 1.02\angle0^o$ **1**   j(1/30)   **2** 400 MW

Slack

j(0.0250)   j(0.05)

320 Mvar

3

300 MW   270 Mvar

200 MW

V= |1.01|
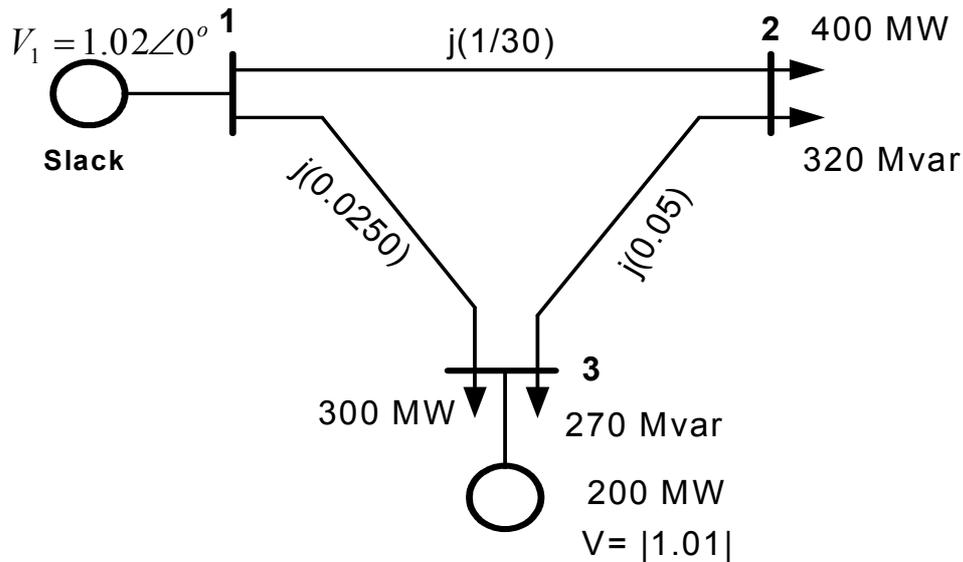
Data Impedansi Saluran

$$Z12 := \left(\frac{1}{30}\right)i \qquad Z13 := 0 + 0.025i \qquad Z23 := 0 + 0.05i$$

DATA ADMITANSI SALURAN KE TANAH

$$y12 := 0 + 0.0i \qquad y13 := 0 + 0.0i \qquad y23 := 0 + 0.0i$$

$$y1 := y12 + y13 \qquad y2 := y12 + y23 \qquad y3 := y13 + y23$$

Data Pembangkitan

$$MVAdasar := 100$$

$$V1it0 := 1.05 + 0i \qquad V2it0 := 1 + 0i \qquad V3it0 := 1.01 + 0i \qquad P3schb := 300$$

$$P2sch := \frac{-400}{MVAdasar} \qquad Q2sch := \frac{-320}{MVAdasar} \qquad P3sch := \frac{200 - P3schb}{MVAdasar} \qquad Q3schb := 270$$

KONVERSI IMPEDANSI KE DALAM ADMITANSI

$$Y12k := \frac{1}{Z12} \qquad Y23k := \frac{1}{Z23} \qquad Y13k := \frac{1}{Z13}$$

$$Y21k := Y12k \qquad Y32k := Y23k \qquad Y31k := Y13k$$

$$Y11 := Y12k + Y13k + y1 \qquad Y22 := Y21k + Y23k + y2 \qquad Y33 := Y31k + Y32k + y3$$

KONVERSI TEGANGAN DAN ADMITANSI BESARAN KE DALAM BENTUK POLAR

$|Y11| = 70$ $\arg(Y11) = -1.570796$ $|Y32| = 20$ $\arg(Y32) = 1.570796$

$|Y21| = 30$ $\arg(Y21) = 1.570796$ $|Y13| = 40$ $\arg(Y13) = 1.570796$

$|Y31| = 40$ $\arg(Y31) = 1.570796$ $|Y23| = 20$ $\arg(Y23) = 1.570796$

$|Y12| = 30$ $\arg(Y12) = 1.570796$ $|Y33| = 60$ $\arg(Y33) = -1.570796$

$|Y22| = 50$ $\arg(Y22) = -1.570796$

ITERASI PERTAMA

$|V1it0| = 1.05$ $\arg(V1it0) = 0$ $|V2it0| = 1$ $\arg(V2it0) = 0$

$|V3it0| = 1.01$ $\arg(V3it0) = 0$

BENTUK MATRIKS ADMITANSI

$$\text{Ybus} := \begin{pmatrix} Y11 & Y12 & Y13 \\ Y21 & Y22 & Y23 \\ Y31 & Y32 & Y33 \end{pmatrix} \qquad \text{Ybus} = \begin{pmatrix} -70i & 30i & 40i \\ 30i & -50i & 20i \\ 40i & 20i & -60i \end{pmatrix}$$

PENYELESAIAN PERSAMAAN DAYA

METODE PERTAMA (BENTUK POLAR)

$\text{P2it1a} := |V2it0| \cdot |V1it0| \cdot |Y21| \cdot \cos(\arg(Y21) - \arg(V2it0) + \arg(V1it0))$

$\text{P2it1b} := |V2it0| \cdot |V2it0| \cdot |Y22| \cdot \cos(\arg(Y22) - \arg(V2it0) + \arg(V2it0))$

$\text{P2it1c} := |V2it0| \cdot |V3it0| \cdot |Y23| \cdot \cos(\arg(Y23) - \arg(V2it0) + \arg(V3it0))$

$\text{P2it1} := \text{P2it1a} + \text{P2it1b} + \text{P2it1c}$ $\text{P2it1} = 6.227123 \times 10^{-15}$

$\text{P3it1a} := |V3it0| \cdot |V1it0| \cdot |Y31| \cdot \cos(\arg(Y31) - \arg(V3it0) + \arg(V1it0))$

$\text{P3it1b} := |V3it0| \cdot |V2it0| \cdot |Y32| \cdot \cos(\arg(Y32) - \arg(V3it0) + \arg(V2it0))$

$\text{P3it1c} := |V3it0| \cdot |V3it0| \cdot |Y33| \cdot \cos(\arg(Y33) - \arg(V3it0) + \arg(V3it0))$

$\text{P3it1} := \text{P3it1a} + \text{P3it1b} + \text{P3it1c}$ $\text{P3it1} = 7.581905 \times 10^{-15}$

$$Q2it1a := -|V2it0| \cdot |V1it0| \cdot |Y21| \cdot \sin(\arg(Y21) - \arg(V2it0) + \arg(V1it0))$$

$$Q2it1b := -|V2it0| \cdot |V2it0| \cdot |Y22| \cdot \sin(\arg(Y22) - \arg(V2it0) + \arg(V2it0))$$

$$Q2it1c := -|V2it0| \cdot |V3it0| \cdot |Y23| \cdot \sin(\arg(Y23) - \arg(V2it0) + \arg(V3it0))$$

$$Q2it1 := Q2it1a + Q2it1b + Q2it1c$$

$$Q2it1 = -1.7$$

SELISIH ANTARA DAYA PERHITUNGAN DENGAN DATA PEMBEBANAN

$$\Delta P2it1 := P2sch - P2it1 \qquad \Delta P3it1 := P3sch - P3it1 \qquad \Delta Q2it1 := Q2sch - Q2it1$$

$$\Delta P2it1 = -4 \qquad\qquad \Delta P3it1 = -1 \qquad\qquad \Delta Q2it1 = -1.5$$

PENYUSUNAN ELEMEN MATRIKS JACOBIAN

$$J11a := |V2it0| \cdot |V1it0| \cdot |Y21| \cdot \sin(\arg(Y21) - \arg(V2it0) + \arg(V1it0))$$

$$J11b := |V2it0| \cdot |V3it0| \cdot |Y23| \cdot \sin(\arg(Y23) - \arg(V2it0) + \arg(V3it0))$$

$$J11 := J11a + J11b$$

$$J12 := -|V2it0| \cdot |V3it0| \cdot |Y23| \cdot \sin(\arg(Y23) - \arg(V2it0) + \arg(V3it0))$$

$$J13a := |V1it0| \cdot |Y21| \cdot \cos(\arg(Y21) - \arg(V2it0) + \arg(V1it0))$$

$$J13b := 2 \cdot |V2it0| \cdot |Y22| \cdot \cos(\arg(Y22) - \arg(V2it0) + \arg(V2it0))$$

$$J13c := |V3it0| \cdot |Y23| \cdot \cos(\arg(Y23) - \arg(V2it0) + \arg(V3it0))$$

$$J13 := J13a + J13b + J13c$$

$$J21 := -|V3it0| \cdot |V2it0| \cdot |Y32| \cdot \sin(\arg(Y32) - \arg(V3it0) + \arg(V2it0))$$

$$J22a := |V3it0| \cdot |V1it0| \cdot |Y31| \cdot \sin(\arg(Y31) - \arg(V3it0) + \arg(V1it0))$$

$$J22b := |V3it0| \cdot |V2it0| \cdot |Y32| \cdot \sin(\arg(Y32) - \arg(V3it0) + \arg(V2it0))$$

$$J22 := J22a + J22b$$

$$J23 := |V3it0| \cdot |Y32| \cdot \cos(\arg(Y32) - \arg(V3it0) + \arg(V2it0))$$

$$J31a := |V2it0| \cdot |V1it0| \cdot |Y21| \cdot \cos(\arg(Y21) - \arg(V2it0) + \arg(V1it0))$$

$$J31b := |V2it0| \cdot |V3it0| \cdot |Y23| \cdot \cos(\arg(Y23) - \arg(V2it0) + \arg(V3it0))$$

$J31 := J31a + J31b$

$J32 := -|V2it0| \cdot |V3it0| \cdot |Y23| \cdot \cos(\arg(Y23) - \arg(V2it0) + \arg(V3it0))$

$J33a := -|V1it0| \cdot |Y21| \cdot \sin(\arg(Y21) - \arg(V2it0) + \arg(V1it0))$

$J33b := -2 \cdot |V2it0| \cdot |Y22| \cdot \sin(\arg(Y22) - \arg(V2it0) + \arg(V2it0))$

$J33c := -|V3it0| \cdot |Y23| \cdot \sin(\arg(Y23) - \arg(V2it0) + \arg(V3it0))$

$J33 := J33a + J33b + J33c$

$$Jac1 := \begin{pmatrix} J11 & J12 & J13 \\ J21 & J22 & J23 \\ J31 & J32 & J33 \end{pmatrix} \qquad Jac1 = \begin{pmatrix} 51.7 & -20.2 & 9.288639 \times 10^{-15} \\ -20.2 & 62.62 & 1.236852 \times 10^{-15} \\ 3.165607 \times 10^{-15} & -1.236852 \times 10^{-15} & 48.3 \end{pmatrix}$$

$$\Delta Pit1 := \begin{pmatrix} \Delta P2it1 \\ \Delta P3it1 \\ \Delta Q2it1 \end{pmatrix} \qquad \Delta\delta1 := Jac1^{-1} \cdot \Delta Pit1 \qquad \Delta\delta1 = \begin{pmatrix} -0.095666 \\ -0.046829 \\ -0.031056 \end{pmatrix}$$

HASIL PEROLEHAN TEGANGAN DAN BEDA FASA ITERASI PERTAMA

$V1it1 := V1it0 \qquad\qquad V2it1 := |V2it0| + \Delta\delta1_{2,0} \qquad\qquad V3it1 := V3it0$

$sdtV1it1 := \arg(V1it0) \qquad sdtV2it1 := \arg(V2it0) + \Delta\delta1_{0,0} \qquad sdtV3it1 := \arg(V3it0) + \Delta\delta1_{1,0}$

MASUK ITERASI KEDUA

KONVERSI TEGANGAN KE DALAM BENTUK KOMPLEKS

$V11 := V1it1 \angle 0 \quad V21 := V2it1 \angle sdtV2it1 \quad V31 := V3it1 \angle sdtV3it1$

$|V11| = 1.05 \quad |V21| = 0.968944 \qquad |V31| = 1.01$

PENYELESAIAN PERSAMAAN DAYA

$P2it2a := |V21| \cdot |V11| \cdot |Y21| \cdot \cos(\arg(Y21) - \arg(V21) + \arg(V11))$

$P2it2b := |V21| \cdot |V21| \cdot |Y22| \cdot \cos(\arg(Y22) - \arg(V21) + \arg(V21))$

$P2it2c := |V21| \cdot |V31| \cdot |Y23| \cdot \cos(\arg(Y23) - \arg(V21) + \arg(V31))$

$P2it2 := P2it2a + P2it2b + P2it2c \qquad P2it2 = -3.870945$

$P3it2a := |V31| \cdot |V11| \cdot |Y31| \cdot \cos(\arg(Y31) - \arg(V31) + \arg(V11))$

$P3it2b := |V31| \cdot |V21| \cdot |Y32| \cdot \cos(\arg(Y32) - \arg(V31) + \arg(V21))$

$P3it2c := |V31| \cdot |V31| \cdot |Y33| \cdot \cos(\arg(Y33) - \arg(V31) + \arg(V31))$

$P3it2 := P3it2a + P3it2b + P3it2c \qquad P3it2 = -1.030291$

$Q2it2a := -|V21| \cdot |V11| \cdot |Y21| \cdot \sin(\arg(Y21) - \arg(V21) + \arg(V11))$

$Q2it2b := -|V21| \cdot |V21| \cdot |Y22| \cdot \sin(\arg(Y22) - \arg(V21) + \arg(V21))$

$Q2it2c := -|V21| \cdot |V31| \cdot |Y23| \cdot \sin(\arg(Y23) - \arg(V21) + \arg(V31))$

$Q2it2 := Q2it2a + Q2it2b + Q2it2c \qquad Q2it2 = -2.988878$

SELISIH ANTARA DAYA PERHITUNGAN DENGAN DATA PEMBEBANAN

$\Delta P2it2 := P2sch - P2it2 \quad \Delta P3it2 := P3sch - P3it2 \qquad \Delta Q2it2 := Q2sch - Q2it2$

$\Delta P2it2 = -0.129055 \qquad \Delta P3it2 = 0.030291 \qquad \Delta Q2it2 = -0.211122$

PENYUSUNAN ELEMEN MATRIKS JACOBIAN

$J112a := |V21| \cdot |V11| \cdot |Y21| \cdot \sin(\arg(Y21) - \arg(V21) + \arg(V11))$

$J112b := |V21| \cdot |V31| \cdot |Y23| \cdot \sin(\arg(Y23) - \arg(V21) + \arg(V31))$

$J112 := J112a + J112b$

$J122 := -|V21| \cdot |V31| \cdot |Y23| \cdot \sin(\arg(Y23) - \arg(V21) + \arg(V31))$

$J132a := |V11| \cdot |Y21| \cdot \cos(\arg(Y21) - \arg(V21) + \arg(V11))$

$J132b := 2 \cdot |V21| \cdot |Y22| \cdot \cos(\arg(Y22) - \arg(V21) + \arg(V21))$

$J132c := |V31| \cdot |Y23| \cdot \cos(\arg(Y23) - \arg(V21) + \arg(V31))$

$J132 := J132a + J132b + J132c$

$J212 := -|V31| \cdot |V21| \cdot |Y32| \cdot \sin(\arg(Y32) - \arg(V31) + \arg(V21))$

$J222a := |V31| \cdot |V11| \cdot |Y31| \cdot \sin(\arg(Y31) - \arg(V31) + \arg(V11))$

$J222b := |V31| \cdot |V21| \cdot |Y32| \cdot \sin(\arg(Y32) - \arg(V31) + \arg(V21))$

$J222 := J222a + J222b$

$J232 := |V31| \cdot |Y32| \cdot \cos(\arg(Y32) - \arg(V31) + \arg(V21))$

$J312a := |V21| \cdot |V11| \cdot |Y21| \cdot \cos(\arg(Y21) - \arg(V21) + \arg(V11))$

$J312b := |V21| \cdot |V31| \cdot |Y23| \cdot \cos(\arg(Y23) - \arg(V21) + \arg(V31))$

$J312 := J312a + J312b$

$J322 := -|V21| \cdot |V31| \cdot |Y23| \cdot \cos(\arg(Y23) - \arg(V21) + \arg(V31))$

$J332a := -|V11| \cdot |Y21| \cdot \sin(\arg(Y21) - \arg(V21) + \arg(V11))$

$J332b := -2 \cdot |V21| \cdot |Y22| \cdot \sin(\arg(Y22) - \arg(V21) + \arg(V21))$

$J332c := -(|V31|) \cdot |Y23| \cdot \sin(\arg(Y23) - \arg(V21) + \arg(V31))$

$J332 := J332a + J332b + J332c$

$$Jac2 := \begin{pmatrix} J112 & J122 & J132 \\ J212 & J222 & J232 \\ J312 & J322 & J332 \end{pmatrix} \qquad Jac2 = \begin{pmatrix} 49.931512 & -19.549335 & -3.995013 \\ -19.549335 & 61.92283 & 0.986115 \\ -3.870945 & 0.95549 & 45.362529 \end{pmatrix}$$

$$\Delta Pit2 := \begin{pmatrix} \Delta P2it2 \\ \Delta P3it2 \\ \Delta Q2it2 \end{pmatrix} \qquad \Delta\delta2 := Jac2^{-1} \cdot \Delta Pit2 \qquad \Delta\delta2 = \begin{pmatrix} -3.144265 \times 10^{-3} \\ -4.252433 \times 10^{-4} \\ -4.913454 \times 10^{-3} \end{pmatrix}$$

HASIL PEROLEHAN TEGANGAN DAN BEDA FASA ITERASI KEDUA

$V1it2 := V1it1$ $\qquad$ $V2it2 := |V2it1| + \Delta\delta2_{2,0}$ $\qquad$ $V3it2 := V3it1$

$sdtV1it2 := \arg(V1it2)$ $\qquad$ $sdtV2it2 := \arg(V21) + \Delta\delta2_{0,0}$ $\qquad$ $sdtV3it2 := \arg(V31) + \Delta\delta2_{1,0}$

ITERASI KETIGA

KONVERSI TEGANGAN KE DALAM BENTUK KOMPLEKS

$V12 := V1it2 \angle 0$ $\quad$ $V22 := V2it2 \angle sdtV2it2$ $\qquad$ $V32 := V3it2 \angle sdtV3it2$

$|V12| = 1.05$ $\quad$ $|V22| = 0.964031$

PENYELESAIAN PERSAMAAN DAYA

$P2it3a := |V22| \cdot |V12| \cdot |Y21| \cdot \cos(\arg(Y21) - \arg(V22) + \arg(V12))$

$P2it3b := |V22| \cdot |V22| \cdot |Y22| \cdot \cos(\arg(Y22) - \arg(V22) + \arg(V22))$

$P2it3c := |V22| \cdot |V32| \cdot |Y23| \cdot \cos(\arg(Y23) - \arg(V22) + \arg(V32))$

$P2it3 := P2it3a + P2it3b + P2it3c \qquad P2it3 = -3.999228$

$P3it3a := |V32| \cdot |V12| \cdot |Y31| \cdot \cos(\arg(Y31) - \arg(V32) + \arg(V12))$

$P3it3b := |V32| \cdot |V22| \cdot |Y32| \cdot \cos(\arg(Y32) - \arg(V32) + \arg(V22))$

$P3it3c := |V32| \cdot |V32| \cdot |Y33| \cdot \cos(\arg(Y33) - \arg(V32) + \arg(V32))$

$P3it3 := P3it3a + P3it3b + P3it3c \qquad P3it3 = -1.000273$

$Q2it3a := -|V22| \cdot |V12| \cdot |Y21| \cdot \sin(\arg(Y21) - \arg(V22) + \arg(V12))$

$Q2it3b := -|V22| \cdot |V22| \cdot |Y22| \cdot \sin(\arg(Y22) - \arg(V22) + \arg(V22))$

$Q2it3c := -(|V22|) \cdot |V32| \cdot |Y23| \cdot \sin(\arg(Y23) - \arg(V22) + \arg(V32))$

$Q2it3 := Q2it3a + Q2it3b + Q2it3c \qquad Q2it3 = -3.198631$

SELISIH ANTARA DAYA PERHITUNGAN DENGAN DATA PEMBEBANAN

$\Delta P2it3 := P2sch - P2it3 \qquad \Delta P3it3 := P3sch - P3it3 \qquad \Delta Q2it3 := Q2sch - Q2it3$

$\Delta P2it3 = -7.72045 \times 10^{-4} \qquad \Delta P3it3 = 2.729451 \times 10^{-4} \qquad \Delta Q2it3 = -1.368746 \times 10^{-3}$

PENYUSUNAN ELEMEN MATRIKS JACOBIAN

$J113a := |V22| \cdot |V12| \cdot |Y21| \cdot \sin(\arg(Y21) - \arg(V22) + \arg(V12))$

$J113b := |V22| \cdot |V32| \cdot |Y23| \cdot \sin(\arg(Y23) - \arg(V22) + \arg(V32))$

$J113 := J113a + J113b$

$J123 := -|V22| \cdot |V32| \cdot |Y23| \cdot \sin(\arg(Y23) - \arg(V22) + \arg(V32))$

$J133a := |V12| \cdot |Y21| \cdot \cos(\arg(Y21) - \arg(V22) + \arg(V12))$

$J133b := 2 \cdot |V22| \cdot |Y22| \cdot \cos(\arg(Y22) - \arg(V22) + \arg(V22))$

$$J133c := |V32| \cdot |Y23| \cdot \cos(\arg(Y23) - \arg(V22) + \arg(V32))$$

$$J133 := J133a + J133b + J133c$$

$$J213 := -|V32| \cdot |V22| \cdot |Y32| \cdot \sin(\arg(Y32) - \arg(V32) + \arg(V22))$$

$$J223a := |V32| \cdot |V12| \cdot |Y31| \cdot \sin(\arg(Y31) - \arg(V32) + \arg(V12))$$

$$J223b := |V32| \cdot |V22| \cdot |Y32| \cdot \sin(\arg(Y32) - \arg(V32) + \arg(V22))$$

$$J223 := J223a + J223b$$

$$J233 := |V32| \cdot |Y32| \cdot \cos(\arg(Y32) - \arg(V32) + \arg(V22))$$

$$J313a := |V22| \cdot |V12| \cdot |Y21| \cdot \cos(\arg(Y21) - \arg(V22) + \arg(V12))$$

$$J313b := |V22| \cdot |V32| \cdot |Y23| \cdot \cos(\arg(Y23) - \arg(V22) + \arg(V32))$$

$$J313 := J313a + J313b$$

$$J323 := -|V22| \cdot |V32| \cdot |Y23| \cdot \cos(\arg(Y23) - \arg(V22) + \arg(V32))$$

$$J333a := -|V12| \cdot |Y21| \cdot \sin(\arg(Y21) - \arg(V22) + \arg(V12))$$

$$J333b := -2 \cdot |V22| \cdot |Y22| \cdot \sin(\arg(Y22) - \arg(V22) + \arg(V22))$$

$$J333c := -(|V32|) \cdot |Y23| \cdot \sin(\arg(Y23) - \arg(V22) + \arg(V32))$$

$$J333 := J333a + J333b + J333c$$

$$Jac3 := \begin{pmatrix} J113 & J123 & J133 \\ J213 & J223 & J233 \\ J313 & J323 & J333 \end{pmatrix} \qquad Jac3 = \begin{pmatrix} 49.666385 & -19.447544 & -4.148445 \\ -19.447544 & 61.820191 & 1.04097 \\ -3.999228 & 1.003527 & 44.883556 \end{pmatrix}$$

$$\Delta Pit3 := \begin{pmatrix} \Delta P2it3 \\ \Delta P3it3 \\ \Delta Q2it3 \end{pmatrix} \qquad \Delta\delta3 := Jac3^{-1} \cdot \Delta Pit3 \qquad \Delta\delta3 = \begin{pmatrix} -1.857588 \times 10^{-5} \\ -8.874596 \times 10^{-7} \\ -3.21308 \times 10^{-5} \end{pmatrix}$$

HASIL PEROLEHAN TEGANGAN DAN BEDA FASA ITERASI KETIGA

$$V1it3 := V1it2 \qquad V2it3 := |V2it2| + \Delta\delta3_{2,0} \qquad V3it3 := V3it2$$

$$sdtV1it3 := \arg(V1it3) \qquad sdtV2it3 := \arg(V22) + \Delta\delta3_{0,0} \qquad sdtV3it3 := \arg(V32) + \Delta\delta3_{1,0}$$

KONVERSI TEGANGAN KE DALAM BENTUK KOMPLEKS

$V13 := V1it3 \angle 0$ $V23 := V2it3 \angle sdtV2it3$ $V33 := V3it3 \angle sdtV3it3$

$|V13| = 1.05$ $|V23| = 0.963999$ $|V33| = 1.01$

$arg(V13) = 0$ $arg(V23) = -5.6625\,deg$ $arg(V33) = -2.7075\,deg$

$Q3a := -|V33| \cdot |V13| \cdot |Y31| \cdot \sin(arg(Y31) - arg(V33) + arg(V13))$

$Q3b := -|V33| \cdot |V23| \cdot |Y32| \cdot \sin(arg(Y32) - arg(V33) + arg(V23))$

$Q3c := -(|V33|) \cdot |V33| \cdot |Y33| \cdot \sin(arg(Y33) - arg(V33) + arg(V33))$

$Q3 := Q3a + Q3b + Q3c$ $Q3 = -0.613523$

$P1a := |V13| \cdot |V13| \cdot |Y11| \cdot \cos(arg(Y11) - arg(V13) + arg(V13))$

$P1b := |V13| \cdot |V23| \cdot |Y12| \cdot \cos(arg(Y12) - arg(V13) + arg(V23))$

$P1c := |V13| \cdot |V33| \cdot |Y13| \cdot \cos(arg(Y13) - arg(V13) + arg(V33))$

$P1 := P1a + P1b + P1c$ $P1 = 5$

$Q1a := -|V13| \cdot |V13| \cdot |Y11| \cdot \sin(arg(Y11) - arg(V13) + arg(V13))$

$Q1b := -|V13| \cdot |V23| \cdot |Y12| \cdot \sin(arg(Y12) - arg(V13) + arg(V23))$

$Q1c := -|V13| \cdot |V33| \cdot |Y13| \cdot \sin(arg(Y13) - arg(V13) + arg(V33))$

$Q1 := Q1a + Q1b + Q1c$ $Q1 = 4.584577$

$V13 = 1.05$ $V23 = 0.959295 - 0.095116i$ $V33 = 1.008872 - 0.04771i$

Daya Nyata dan Reaktif Pada Bus Ayun dan
Bus Pembangkit 3 Dalam MW dan MVAR

$Pbus1 := P1 \cdot MVAdasar$ $Pbus3 := P3sch \cdot MVAdasar$

$Qbus1 := Q1 MVAdasar$ $Qbus3 := Q3 MVAdasar$

$S1 := Pbus1 - Qbus1 \cdot i$ $S3 := Pbus3 - Qbus3 \cdot i$

$S1 = 499.999998 - 458.457685i$ $S3 = -100 + 61.352336i$

Aliran Daya Kompleks Pada Saluran Dalam MW dan MVAR

$$S12 := \left[V13 \cdot \overline{(\overline{V13} - \overline{V23})} \cdot -\overline{Y12} + \left(V13 \cdot \overline{V13} \cdot \overline{y12} \right) \right] \cdot MVAdasar$$

$$S12 = 299.616276 + 285.722175i$$

$$S21 := \left[V23 \cdot \overline{(\overline{V23} - \overline{V13})} \cdot -\overline{Y12} + \left(V23 \cdot \overline{V23} \cdot \overline{y12} \right) \right] \cdot MVAdasar$$

$$S21 = -299.616276 - 233.898419i$$

$$S13 := \left[V13 \cdot \overline{(\overline{V13} - \overline{V33})} \cdot -\overline{Y13} + \left(V13 \cdot \overline{V13} \cdot \overline{y13} \right) \right] \cdot MVAdasar$$

$$S13 = 200.383722 + 172.735509i$$

$$S31 := \left[V33 \cdot \overline{(\overline{V33} - \overline{V13})} \cdot -\overline{Y13} + \left(V33 \cdot \overline{V33} \cdot \overline{y13} \right) \right] \cdot MVAdasar$$

$$S31 = -200.383722 - 156.864491i$$

$$S23 := \left[V23 \cdot \overline{(\overline{V23} - \overline{V33})} \cdot -\overline{Y23} + \left(V23 \cdot \overline{V23} \cdot \overline{y23} \right) \right] \cdot MVAdasar$$

$$S23 = -100.383721 - 86.101575i$$

$$S32 := \left[V33 \cdot \overline{(\overline{V33} - \overline{V23})} \cdot -\overline{Y23} + \left(V33 \cdot \overline{V33} \cdot \overline{y23} \right) \right] \cdot MVAdasar$$

$$S32 = 100.383721 + 95.512154i$$

Rugi Daya Kompleks Pada Saluran

$$SL12 := S12 + S21 \qquad SL12 = 51.823756i$$

$$SL13 := S13 + S31 \qquad SL13 = 15.871019i$$

$$SL23 := S23 + S32 \qquad SL23 = 9.410579i$$

$$Rugi\_daya\_total := SL12 + SL13 + SL23 \qquad Rugi\_daya\_total = 77.105354i$$

$$P\_beban\_total := (P2sch) \cdot MVAdasar \qquad P\_beban\_total = -400$$

$$Q\_beban\_total := (Q2sch) \cdot MVAdasar \qquad Q\_beban\_total = -320$$

KEBUTUHAN DAYA TOTAL

$P\_TOTAL := P\_beban\_total - Re(Rugi\_daya\_total)$ $P\_TOTAL = -400$

$Q\_TOTAL := Q\_beban\_total - Im(Rugi\_daya\_total)$ $Q\_TOTAL = -397.105354$

SUPLAI DAYA BUS AYUN DAN PEMBANGKIT

$S\_total := S1 + S3$ $S\_total = 399.999998 - 397.105348i$

TAHAPAN OPTIMASI

LANGKAH PERTAMA

$Ybusop := Ybus$

$$Ybusop = \begin{pmatrix} -70i & 30i & 40i \\ 30i & -50i & 20i \\ 40i & 20i & -60i \end{pmatrix}$$

LANGKAH KEDUA

$Z := Ybusop^{-1}$

$$Z = \begin{pmatrix} 7.036874i \times 10^{13} & 7.036874i \times 10^{13} & 7.036874i \times 10^{13} \\ 7.036874i \times 10^{13} & 7.036874i \times 10^{13} & 7.036874i \times 10^{13} \\ 7.036874i \times 10^{13} & 7.036874i \times 10^{13} & 7.036874i \times 10^{13} \end{pmatrix}$$

$$Zbusop := \begin{pmatrix} Z_{0,0} & Z_{0,1} & Z_{0,2} & Z_{0,2} \\ Z_{1,0} & Z_{1,1} & Z_{1,2} & Z_{1,2} \\ Z_{2,0} & Z_{2,1} & Z_{2,2} & Z_{2,2} \\ Z_{2,0} & Z_{2,1} & Z_{2,2} & Z_{2,2} \end{pmatrix}$$

LANGKAH KETIGA

Menentukan Matrik Resistansi Bus

$$Rbus := \begin{pmatrix} Re(Z_{0,0}) & Re(Z_{0,1}) & Re(Z_{0,2}) & Re(Z_{0,2}) \\ Re(Z_{1,0}) & Re(Z_{1,1}) & Re(Z_{1,2}) & Re(Z_{1,2}) \\ Re(Z_{2,0}) & Re(Z_{2,1}) & Re(Z_{2,2}) & Re(Z_{2,2}) \\ Re(Z_{2,0}) & Re(Z_{2,1}) & Re(Z_{2,2}) & Re(Z_{2,2}) \end{pmatrix}$$

LANGKAH KEEMPAT

Menghitung Arus Masing-masing Bus

$$\text{I3d} := \frac{\text{P3schb} + \text{Q3schb} \cdot i}{\overline{\text{V33}}} \qquad\qquad \text{I2} := \frac{\text{P2sch} - \text{Q2sch} \cdot i}{\overline{\text{V23}}}$$

LANGKAH KELIMA

Menghitung Harga d

$$\text{d2} := \frac{\text{I2}}{\text{I3d} + \text{I2}} \qquad\qquad \text{d3} := \frac{\text{I3d}}{\text{I3d} + \text{I2}}$$

LANGKAH KEENAM

Menghitung Harga t

$$\text{t1} := \frac{\text{Zbusop}_{0,0}}{\text{d2} \cdot \text{Zbusop}_{0,1} + \text{d3} \cdot \text{Zbusop}_{0,2}}$$

$$\text{t3} := \frac{\text{Zbusop}_{0,2}}{\text{d2} \cdot \text{Zbusop}_{0,1} + \text{d3} \cdot \text{Zbusop}_{0,2}}$$

LANGKAH KETUJUH

Menentukan Matriks Transformasi C

$$\text{C} := \begin{pmatrix} 1 & 0 & 0 \\ 0 & 0 & 1 \\ -\text{d2} \cdot \text{t1} & -\text{d2} \cdot \text{t3} & -\text{d2} \cdot \text{t1} \\ -\text{d3} \cdot \text{t1} & -\text{d3} \cdot \text{t3} & -\text{d3} \cdot \text{t1} \end{pmatrix}$$

Konjugasi C

$$\text{Ck} := \overline{\text{C}}$$

$$Ck = \begin{pmatrix} 1 & 0 & 0 \\ 0 & 0 & 1 \\ 1.308617 \times 10^{-3} + 0.013251i & 1.308617 \times 10^{-3} + 0.013251i & 1.308617 \times 10^{-3} + 0.01325\cdot \\ -1.001309 - 0.013251i & -1.001309 - 0.013251i & -1.001309 - 0.013251i \end{pmatrix}$$

Matriks Transpose C

$$Ct := Ck^T$$

$$CT := \overline{Ct}$$

LANGKAH KEDELAPAN

Menentukan Matriks CT.R.Rk

$$CtRCk := CT \cdot Rbus \cdot Ck$$

LANGKAH KESEMBILAN

Menghitung Arus Tanpa Beban dan Harga α

$$Inoload := \frac{-V13}{Zbusop_{0,0}}$$

$$\alpha 1 := \frac{\dfrac{\overline{S1}}{Re(S1)}}{\overline{V13}} \qquad \alpha 2 := \frac{\dfrac{\overline{S3}}{Re(S3)}}{\overline{V33}}$$

Menghitung Matriks Alpha

$$\alpha := \begin{pmatrix} \alpha 1 & 0 & 0 \\ 0 & \alpha 2 & 0 \\ 0 & 0 & Inoload \end{pmatrix}$$

Menentukan Konjugate Matriks Alpha

$$\alpha k := \overline{\alpha}$$

LANGKAH KESEPULUH

$$h := \alpha \cdot CT \cdot Rbus \cdot Ck \cdot \alpha k$$

$$hk := h^T$$

Menghitung Matriks Hermitian

$$\underset{\sim}{H} := \frac{h + hk}{2}$$

$$\gamma1 := 0.8 \qquad \gamma3 := 0.9 \qquad \lambda0 := 8 \quad \beta1 := 7 \qquad \beta3 := 6.3$$

LANGKAH KESEBELAS

Iterasi 1

$$E := \begin{bmatrix} \left(\dfrac{\gamma1}{\lambda0}\right) + H_{0,0} & H_{0,2} \\ H_{2,0} & \left(\dfrac{\gamma3}{\lambda0}\right) + H_{2,2} \end{bmatrix} \qquad D := \begin{bmatrix} 1 - \left(2H_{0,2}\right) - \dfrac{\beta1}{\lambda0} \\ 1 - \left(2H_{1,2}\right) - \dfrac{\beta3}{\lambda0} \end{bmatrix}$$

Tebakan Awal Nilai Lambda:

lambda0 := 8

$$P := E^{-1} \cdot D \qquad P = \begin{pmatrix} 1.25 \\ 1.888889 \end{pmatrix}$$

$$Pg := P \cdot 100 \qquad Pd := \frac{400}{100}$$

LANGKAH KEDUABELAS

Menghitung rugi daya nyata sistem pada kondisi optimal

$$Plosa := H_{0,0} \cdot (P_0)^2 + 2H_{0,1}P_0P_1 + 2H_{0,2}P_0P_2 + 2H_{0,3}P_0 + 2H_{1,3}P_1 + 2H_{2,3}P_2 + (H_{1,}$$

$$Plosb := 2H_{1,2}P_1P_2 + \left[(H_{2,2})(P_2)^2 + H_{3,3}\right]$$

$$\text{Plosses} := \text{Plosa} + \text{Plosb} \qquad \text{Plosa} =$$

1i

$_1)(P_1)^2$