POWER FLOW AND SHORT CIRCUIT ANALYSIS

POWER FLOW:
Conduct a power flow analysis of the 7-bus power system shown in Fig. 1. Let
- Bus 1 at generator G1 be the reference bus with \( V_1 = 1 \angle 0^\circ \),
- At Bus 4 (i.e., generator G2), \( V_4 = 1.02 \) and \( P_4 = 100 \) MW
- At Bus 3 (i.e., tie bus), \( V_3 = 1.04 \) and \( P_3 = 150 \) MW

Record the following:
1) Bus voltages (circle those not acceptable)
   - \( V_1 = 1 \)
   - \( V_2 = \)
   - \( V_3 = 1.05 \)
   - \( V_4 = 1.02 \)
   - \( V_5 = \)
   - \( V_6 = \)
   - \( V_7 = \)

2) Real and reactive power generated by the generators and tie line
   - \( P_1 = \), \( Q_1 = \)
   - \( P_3 = 150 \) MW, \( Q_3 = \)
   - \( P_4 = 100 \) MW, \( Q_4 = \)

Calculate the efficiency of the system:
\[ n = \frac{100P_{out}}{P_{in}} = \]

Calculate the reactive power “consumed” by the system:
\[ Q = Q_{gen} - Q_{load} = \]

To correct the two bus voltages above, add a 12 MVAR capacitor bank at bus 7 and repeat the above.
1) New bus voltages
   - \( V_1 = 1 \)
   - \( V_2 = \)
   - \( V_3 = 1.05 \)
   - \( V_4 = 1.02 \)
   - \( V_5 = \)
   - \( V_6 = \)
   - \( V_7 = \)
3) New real and reactive power generated by the generators and tie line

- \( P_1 \), \( Q_1 \)
- \( P_3 = 150 \text{ MW} \), \( Q_3 \)
- \( P_4 = 100 \text{ MW} \), \( Q_4 \)

New efficiency of the system:

\[ n = 100 \frac{P_{\text{out}}}{P_{\text{in}}} = \]

New reactive power “consumed” by the system:

\[ Q = Q_{\text{gen}} - Q_{\text{load}} = \]

**SYMMETRICAL FAULTS**

Create a 3-phase fault at bus 5 then record

1) the sub-transient fault current

\[ I_5 = \]

2) The sub-transient fault current contribution from the 2 generators and tie line

\[ I_{G1} = \]
\[ I_{G2} = \]
\[ I_{\text{tie}} = \]

3) Resulting bus voltages due to fault at bus 5

- \( V_1 \)
- \( V_2 \)
- \( V_3 \)
- \( V_4 \)
- \( V_5 = 0 \)
- \( V_6 \)
- \( V_7 \)

Determine sub-transient fault current at all other buses

- \( I_1 \)
- \( I_2 \)
- \( I_3 \)
- \( I_4 \)
- \( I_5 \)
- \( I_6 \)
- \( I_7 \)
Fig. 1 Power System Under Study