INFLUENCES OF SYNCHRONOUS AND INDUCTION DISTRIBUTED GENERATORS ON THE VOLTAGE PROFILE, SHORT-CIRCUIT CURRENTS, AND VOLTAGE DIPS

UTICAJI SINHRONIH I ASINHRONIH DISTRIBUIRANIH GENERATORA NA NAPONSKI PROFIL, STRUJE KRATKIH SPOJEVA I NAPONSKE PROPADE

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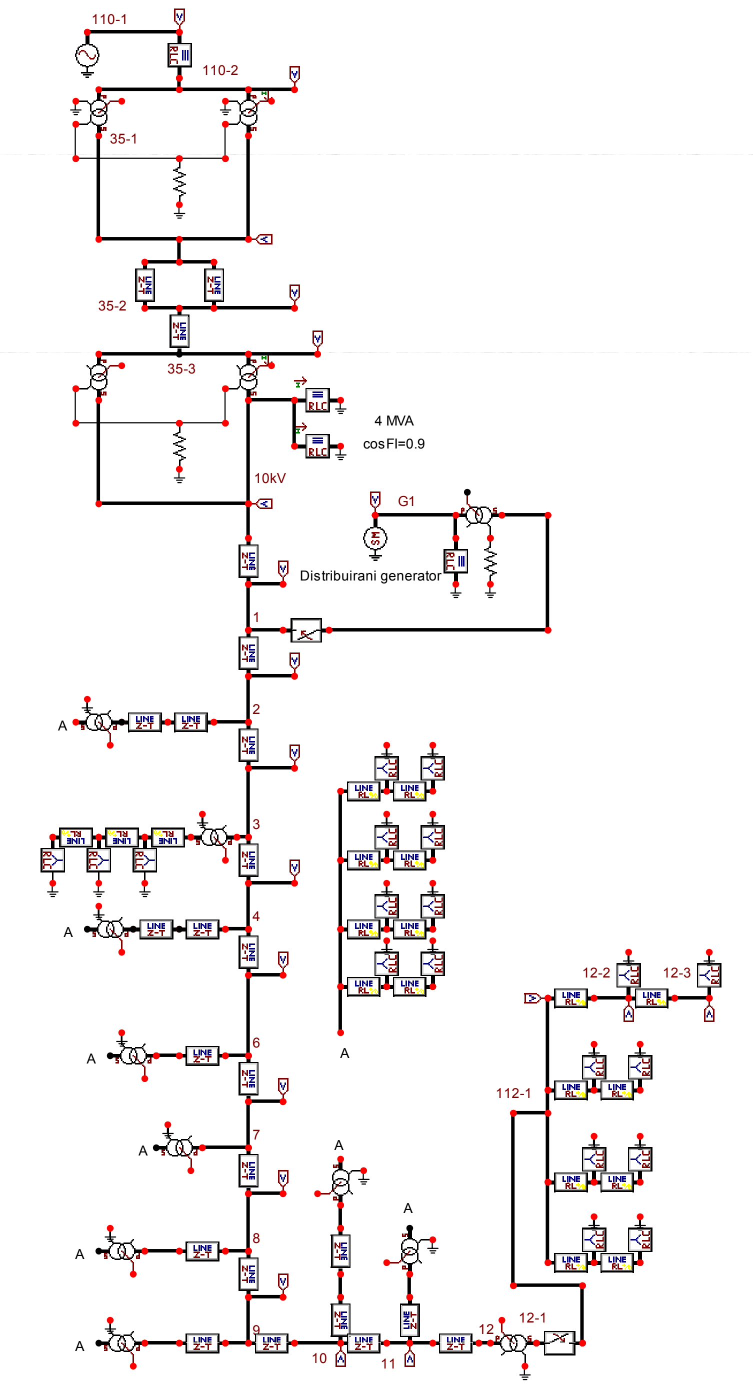
Content

2. SIMULATION MODEL



3. STEADY-STATE VOLTAGE PROFILE

Fig. 2 Maximum load, generators connected to node 1, all transformers with rated turn ratios (35/10.5 kV/kV)

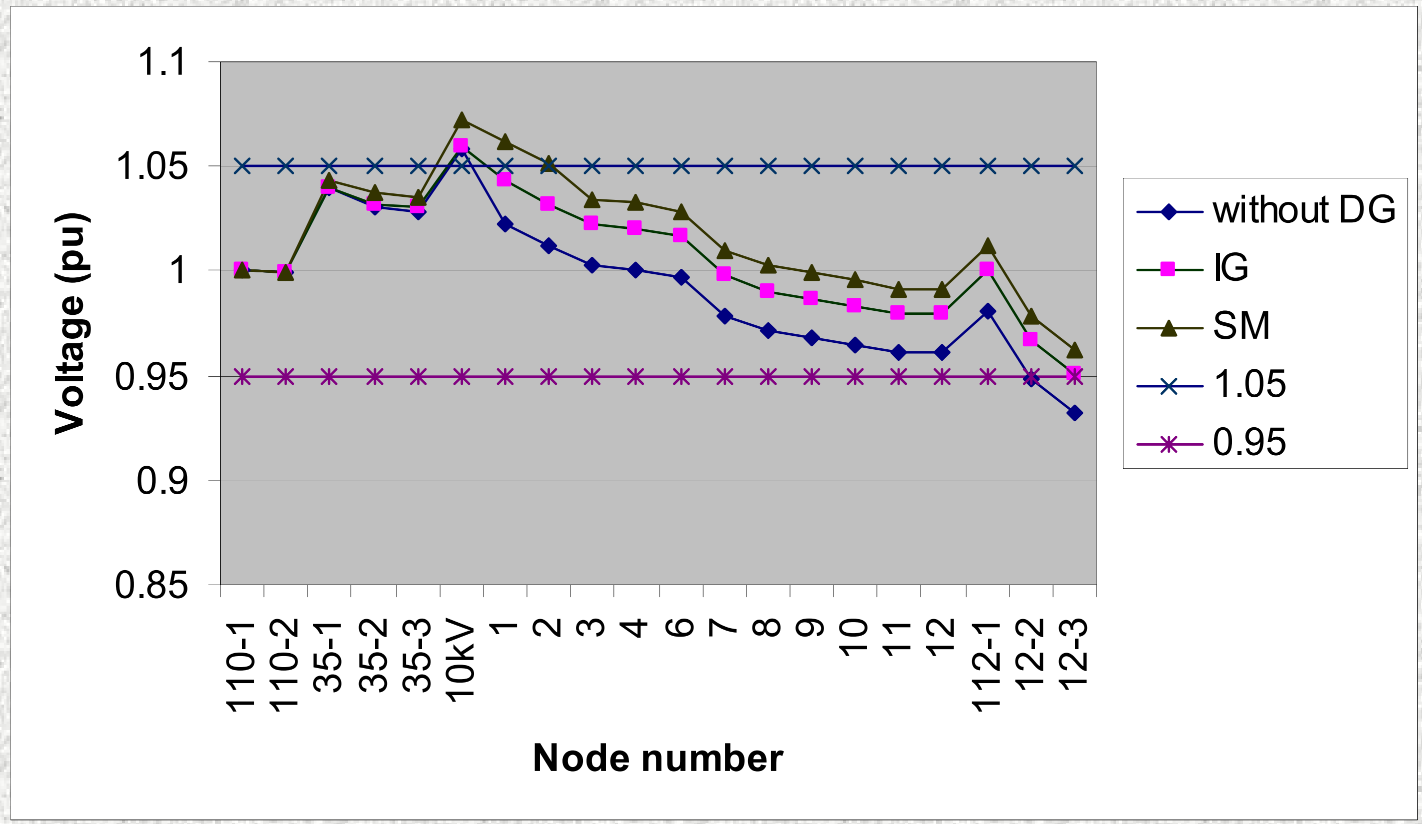


Fig. 3 A half load, generators connected to node 1, all transformers with rated turn ratios (35/10.5 kV/kV)

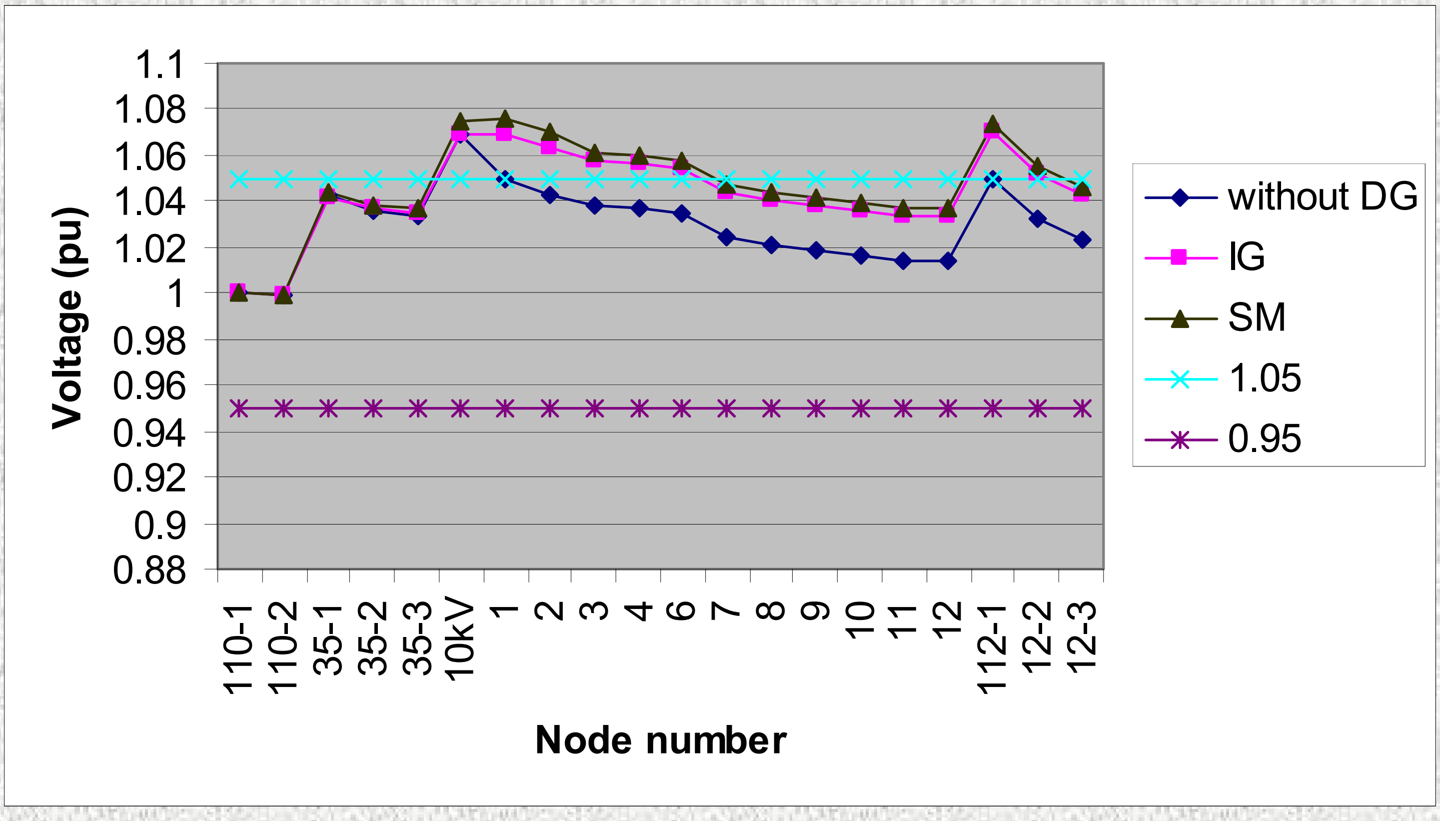


Fig. 4 Network with no distributed generation (DG) with maximum load, network with DG with a half load, generators connected to node 1, turns ratio 35/10 kV/kV, other transformers with rated turns ratios

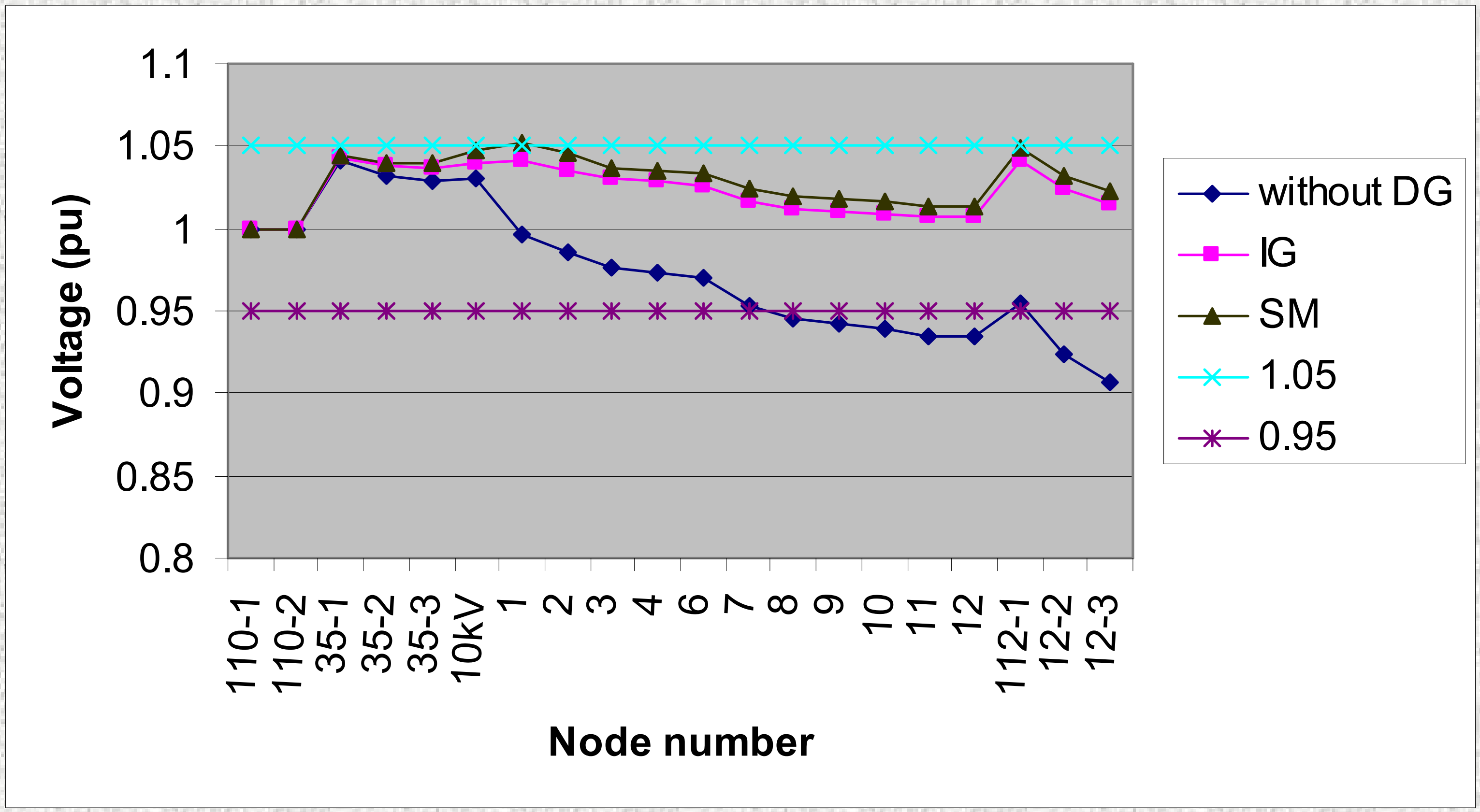


Fig. 5 Network with no distributed generation (DG) with maximum load, network with DG with a half load, generators connected to node 1, turns ratio 35/10.2 kV/kV, other transformers with rated turns ratios

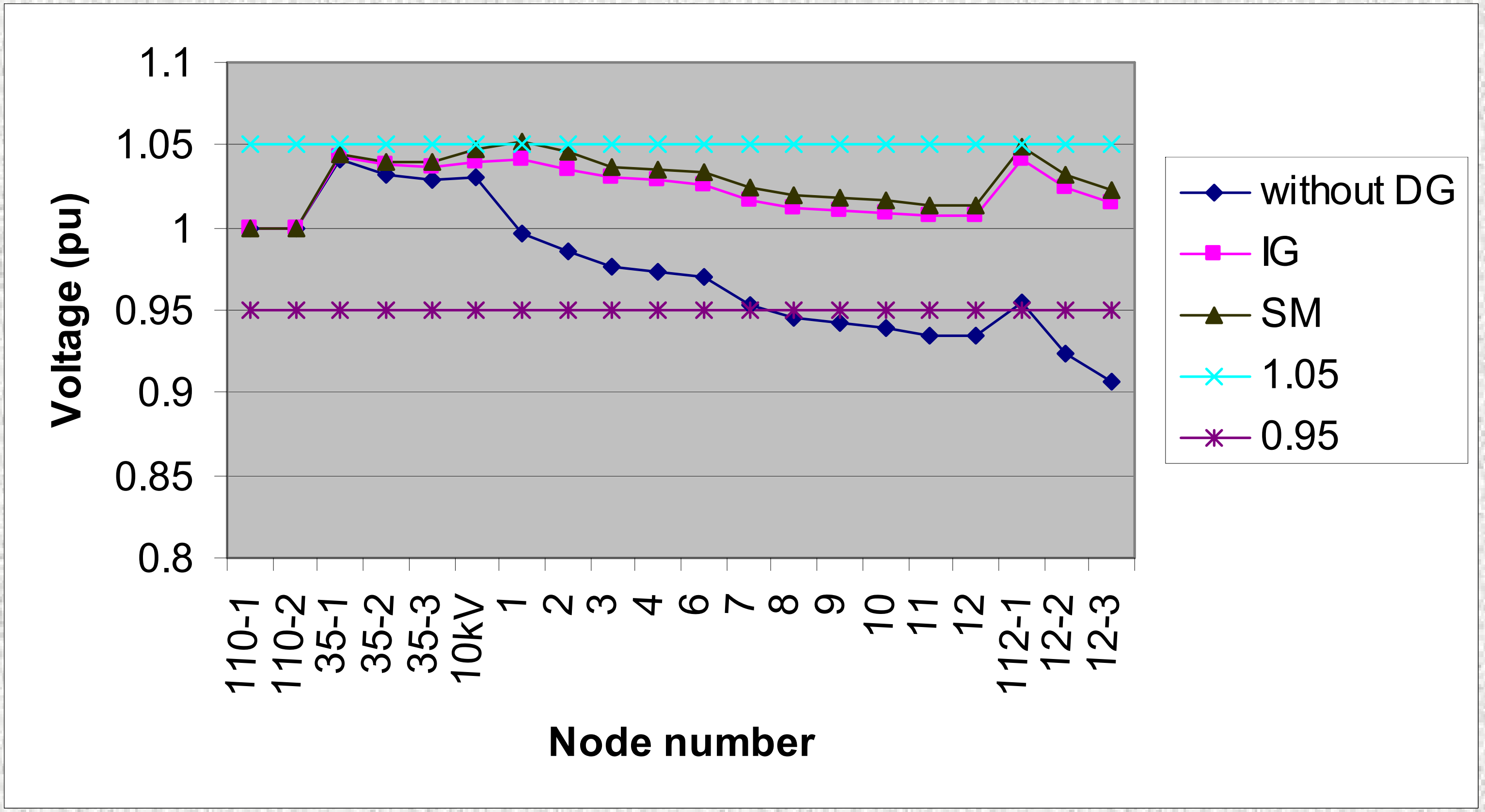
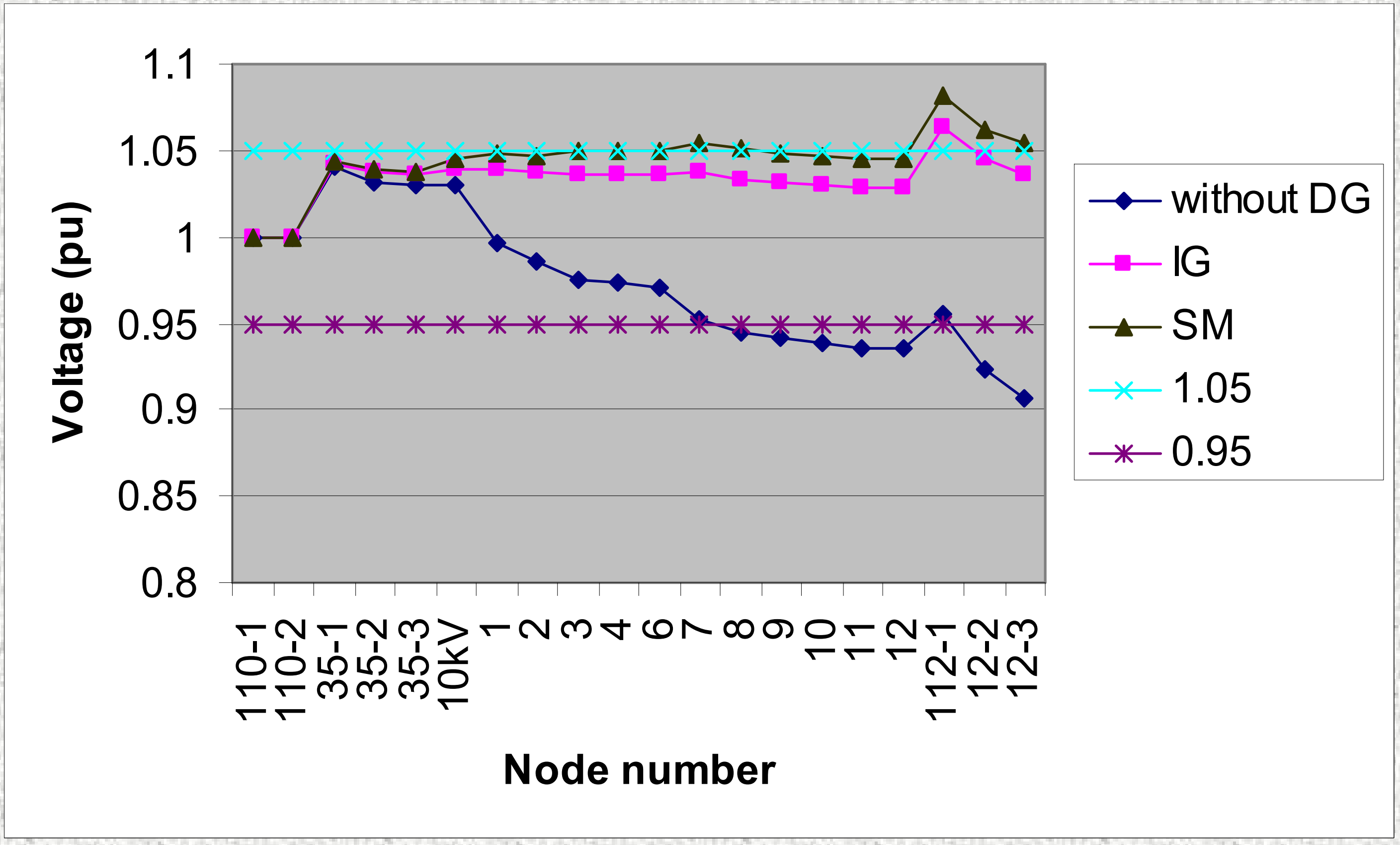


Fig. 6 Network with no distributed generation (DG) with maximum load, network with DG with a half load, generators connected to node 7, turns ratio 35/10.2 kV/kV, other transformers with rated turns ratios



How much the nodal voltages will change when the distributed generators are suddenly disconnected?

$$V_1 = \frac{1}{nb} \cdot \frac{\sum_{i=1}^{nb} \left\lfloor V_i^{\,g} - V_i^{\,n} \right\rfloor \times 100}{\sum_{i=1}^{nb} V_i^{\,n}}$$

Induction generator: 1.4%

Synchronous machine: 2.46%

How much the nodal voltages change between maximum and minimum load cases?

$$V_2 = \frac{1}{nb} \cdot \sum_{i=1}^{nb} \left| V_i^{\max} - V_i^{\min} \right| \times 100$$

Without distributed generation: 3.7%

Induction generator: 3.73%

Synchronous machine: 3.07%

4. SHORT-CIRCUIT CURRENTS

Fig. 7 Three-phase short circuit at node 1, generators connected at node 1
(triangle: synchronous generator, circle: induction machine, square: with no distributed generation)

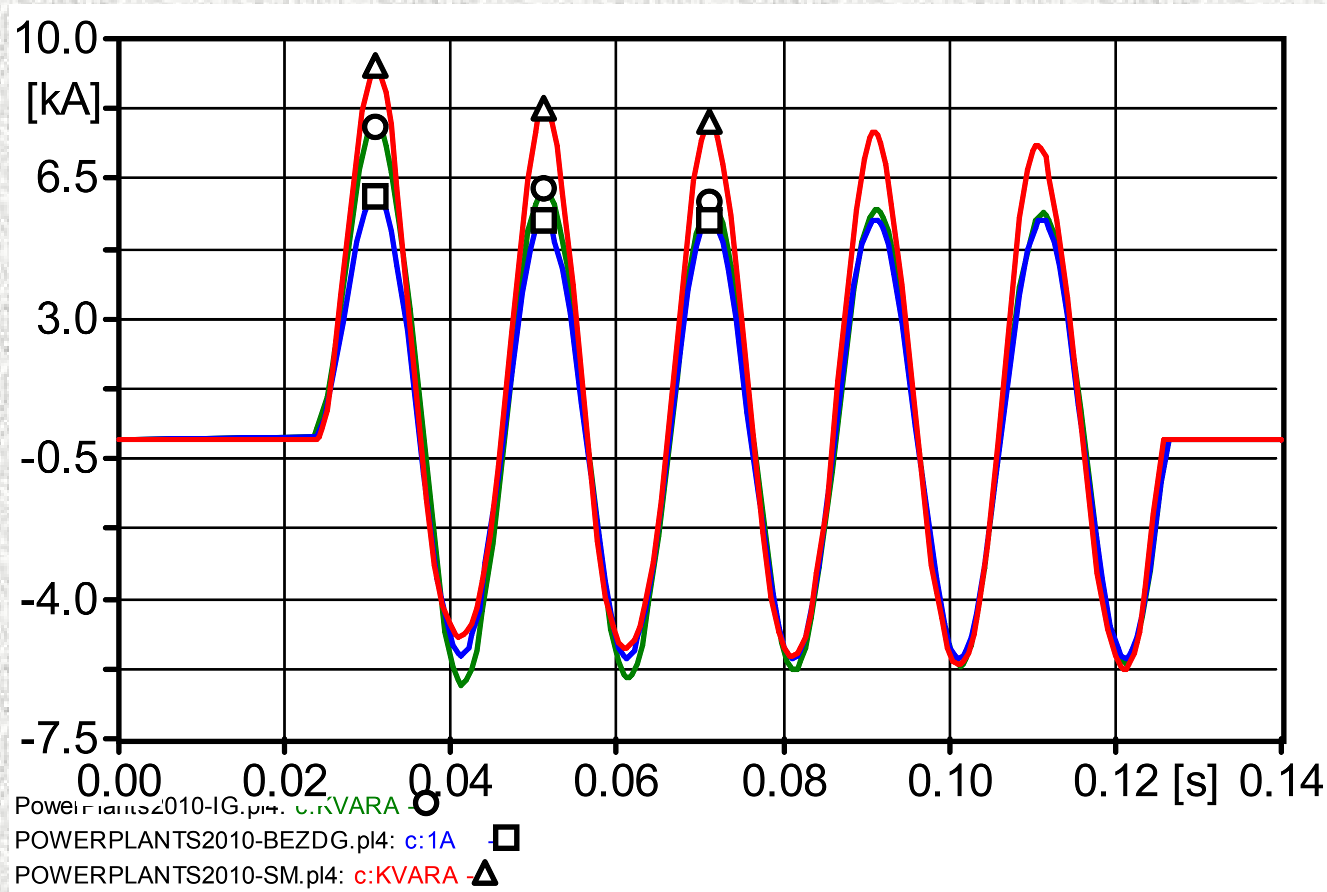
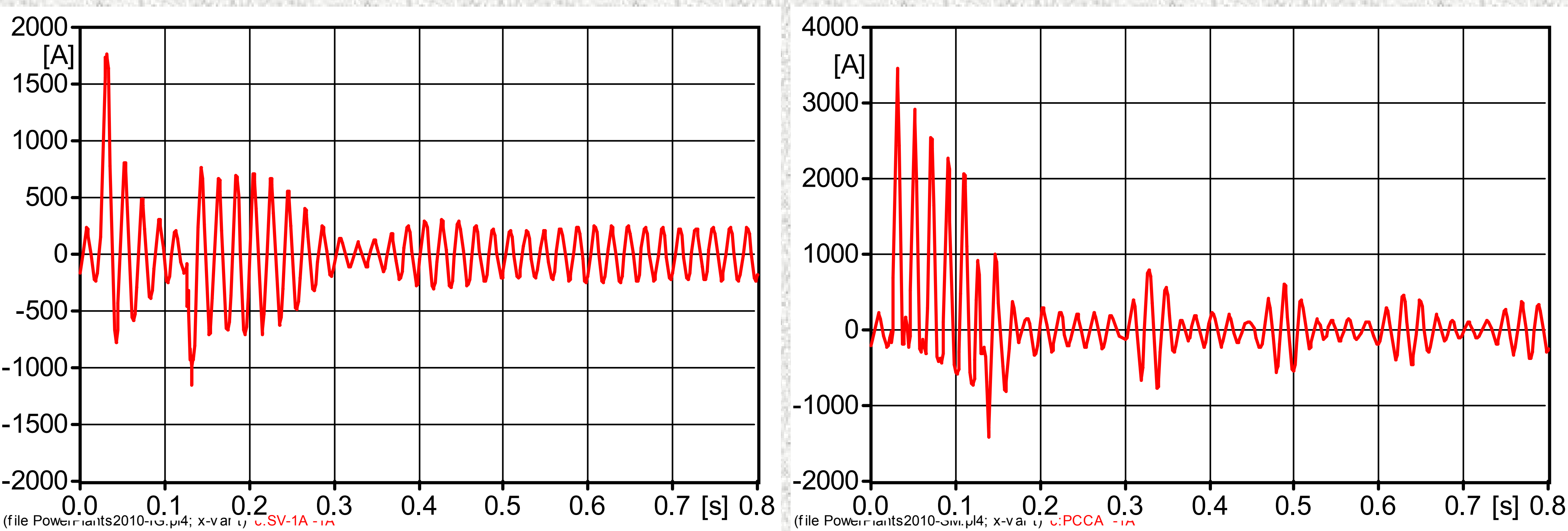


Table I: Maximum values of three-phase short circuit currents (generators connected to node 1)

Fault at node No.	With no DG [kA]	IG [kA]	$\frac{I_{IG} - I_{withot\ DG}}{I_{without\ DG}} \cdot 100$	SM [kA]	$\frac{I_{SM} - I_{withot\ DG}}{I_{without\ DG}} \cdot 100$
1	**6.046**	**7.713**	**27.6%**	**9.3**	**53.8%**
7	**2.93**	**3.34**	**14**	**3.42**	**16.7**
12	**1.97**	**2.19**	**11.1**	**2.23**	**13.2**

Fig. 8 Three-phase short circuit current of induction machines (left) and of synchronous generator (right) during the fault at node 1



5. VOLTAGE DIPS

Fig. 9 Voltage dip at node 1 during three-phase short circuit at node 7

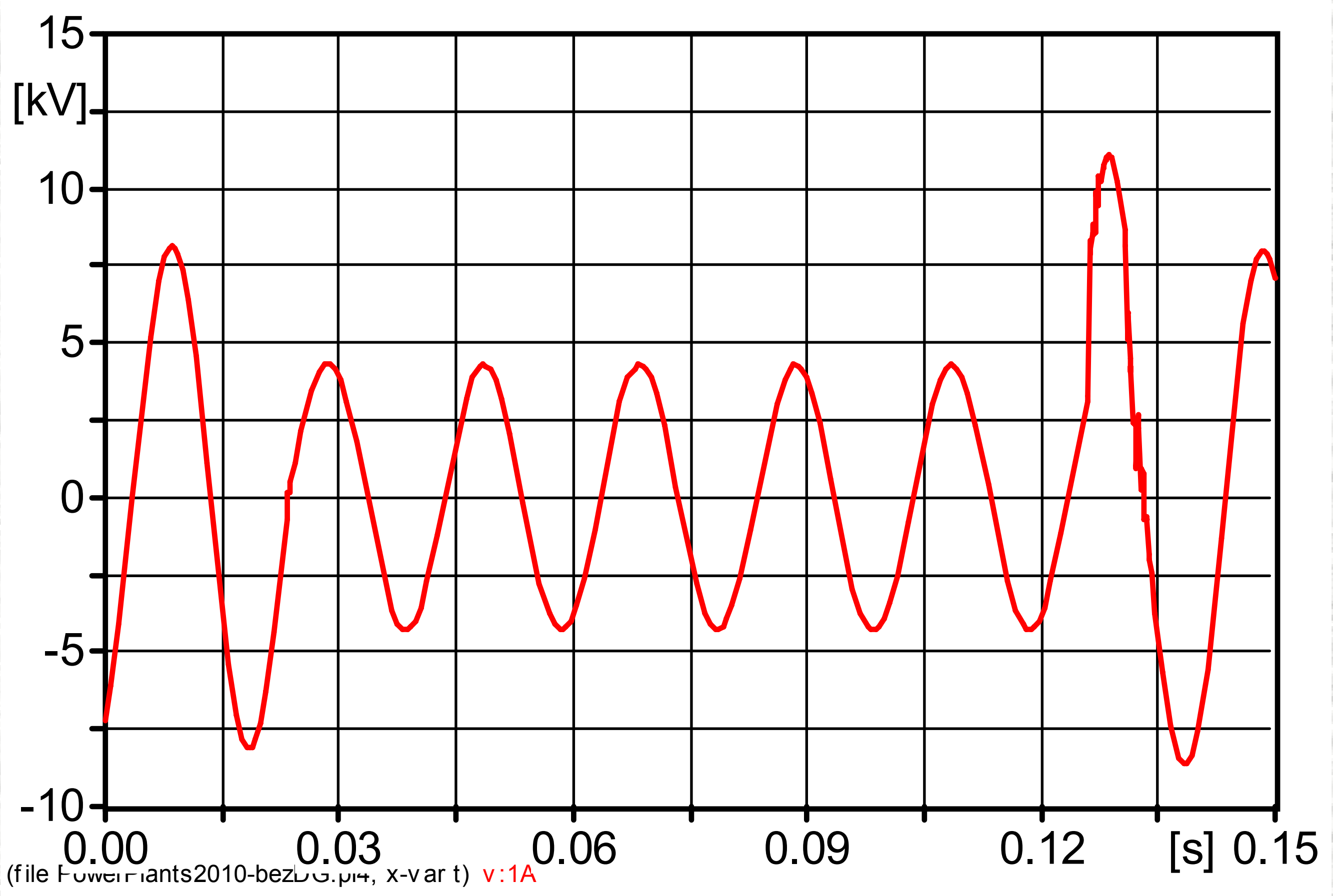


Table II: Voltage dips at node 1

Fault at node	without DG $\frac{U_{\max\ faultt}}{U_{\max\ prefault}}\cdot 100$	IG $\frac{U_{\max\ fault}}{U_{\max\ prefault}}\cdot 100$	IG $\frac{U_{\max\ fault}}{U_{\max\ raedt}}\cdot 100$	SM $\frac{U_{\max\ fault}}{U_{\max\ prefault}}\cdot 100$	SM $\frac{U_{\max\ faultt}}{U_{\max\ prefaultt}}\cdot 100$
3	$\frac{2.375}{8.11}=29.3\%$	$\frac{2.46}{8.5}=28.9\%$	$\frac{2.46}{8.16}=30.1\%$	$\frac{3.12}{8.58}=36.4\%$	$\frac{3.12}{8.16}=38.2\%$
7	$\frac{4.29}{8.054}=52.3\%$	$\frac{4.446}{8.5}=52.3\%$	$\frac{4.446}{8.16}=54.5\%$	$\frac{4.854}{8.58}=56.6\%$	$\frac{4.854}{8.16}=59.5\%$

6. CONCLUSIONS

- Influences of synchronous and asynchronous machines on the distribution network performance are analysed by using computational simulations. The technical factors analysed in this paper are voltage profile, peak short-circuit currents, and voltage dips.

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- Distributed generators can greately influence the node voltages. Voltage violations due to presence of DG can arise easely. This paper shows that DG can generate a great impact on network voltages. In some cases, the problem could be solved only by lowering of DG production, but that is not economicaly feasible. Voltage profile problem in the presence of distributed generation is much prominent than in the case without DG.

6. CONCLUSIONS

- The installation of distributed generators may increase the values of the short-circuit currents. Regarding the impact of DG on short-circuit currents, induction machines are more favourable than the synchronous one. It can be very important if DG have to be installed in the distribution network in which the peak values of fault currents are near the network design margin.

6. CONCLUSIONS

- It has been shown that synchronous machines are preffered regarding voltage dips because during the fault they give reactive power to the network. That is the reason why the remaining voltage is greater for such machines, what is more appropriate as network is of concern. Voltage dips in the presence of induction generators are nearly equal as in the case of network without distributed generators.

THANKS FOR YOUR ATTENTION!

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