Improved line protection functions for high RES penetration
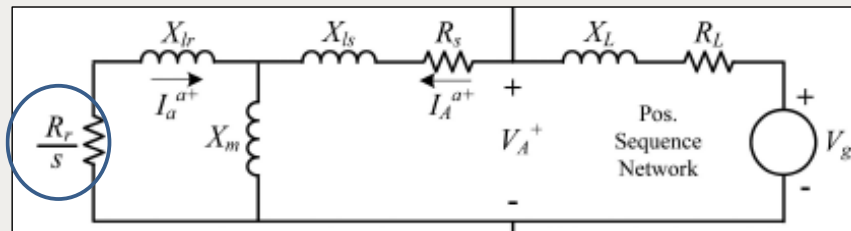
B5 PS1 Q 1.01

Roberto Cimadevilla SPAIN

Effect of RES on sequence-networks

- RES create changes in positive and negative-sequence networks
  - No negative-sequence current injection
  - Non-homogeneity of positive and negative-sequence pure fault networks: the angle of local source impedance can be far from 90⁰
  - Big difference between positive and negative-sequence networks
  - Due to current limitation and differences between sequence networks of an induction machine

Positive-sequence network   Negative-sequence network
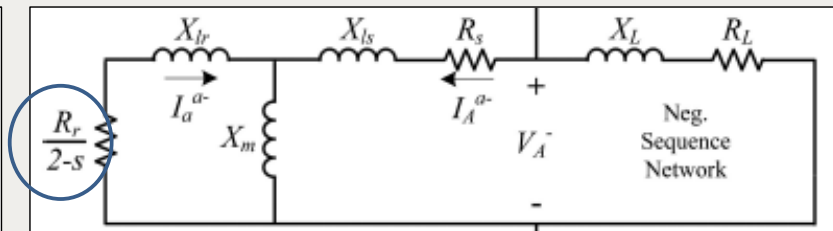
Reference: "Improved Sequence Network Model of Wind Turbine Generators for Short-Circuit Studies,"

Effect of RES on protection functions

- Impact on:
  - Reactance line polarization of quadrilateral characteristic:
    - No I2 injection→I2 is not reliable
    - Network non-homogeneity→ I1pure_fault and I2 non parallel to IF
  - Current based phase selectors
  - Directional units:
    - 67Q: no I2 injection
    - 67P: reactive / active power inversion during crowbar operation

New algorithms for improved operation with high RES penetration

- New polarizations with non-homogeneity compensation based on local source impedance measurement

- Phase selector based on sequence voltages

- Directional unit based on positive-sequence voltage and phase currents