Power Quality Impact Study for Interconnection of Heterogeneous Distributed Energy Resources

Presenter: Ali Hariri
Ph.D student at FAMU/FSU College of Engineering
RA at Center for Advanced Power Systems at FSU
ahh13@my.fsu.edu

PI: Md. Omar Faruque, Ph.D
Outline

• Research Objectives
• Research Significance
• Results
Research Objectives

• This project aims to study the combined impacts on power quality due to the interconnection of multiple distributed generators on a distribution utility feeder.

• The study involves investigating the following:
  – Harmonic injections
  – Voltage fluctuations
  – Voltage swell/sag
  – Flicker
  – Impact of low frequency anti-islanding signal injection
  – Different switching frequency converters
  – Impact of harmonics on nearby transformers
Research Significance

• **Power Quality:**
  – Refers to a wide variety of electromagnetic phenomenon that characterize the voltage and current at a given location on the power system. [IEEE Std. 1159]

• Penetration of renewable energy sources to the grid in the form of local generation sources is increasing.

• Grids are moving towards bidirectional power flow where customers can produce power and inject the excess onto the grid as a part of a “Smart Grid” concept involving smart metering, automation, and lots of other new concepts.

• It is better to be prepared to what to expect as the DG penetration increases and start looking for early solutions.
Modeling

- 12.47 kV distribution system.
- Connects to substation at 138 kV level through a 22 MVA, 138 kV/12.47 kV transformer.
- Recloser located at 2.2 miles from substation
- Feeder splits to two laterals after the recloser extending to two miles.
- SVR with ±10% regulation with 32 steps, 2 minute operation time.
- Four switched capacitor banks, total of 3.3 MVAR.
- Average loading of 5 MW, and peak around 6-7 MW.
- 1200 line sections and 800 distribution transformers.
Some Results

PV Plant Current Injected

Frequency Spectrum of Substation Current

Irradiance (W/m²)

Voltage (pu)

Time (s)

Frequency Spectrum of Substation Current

Irradiance (W/m²)

Voltage (pu)

Time (s)

case 2 vs case 1 voltage comparison

V200 comparison

V204 comparison

V205 comparison