Forced Oscillations

Austin White P.E.
Oklahoma Gas & Electric Company

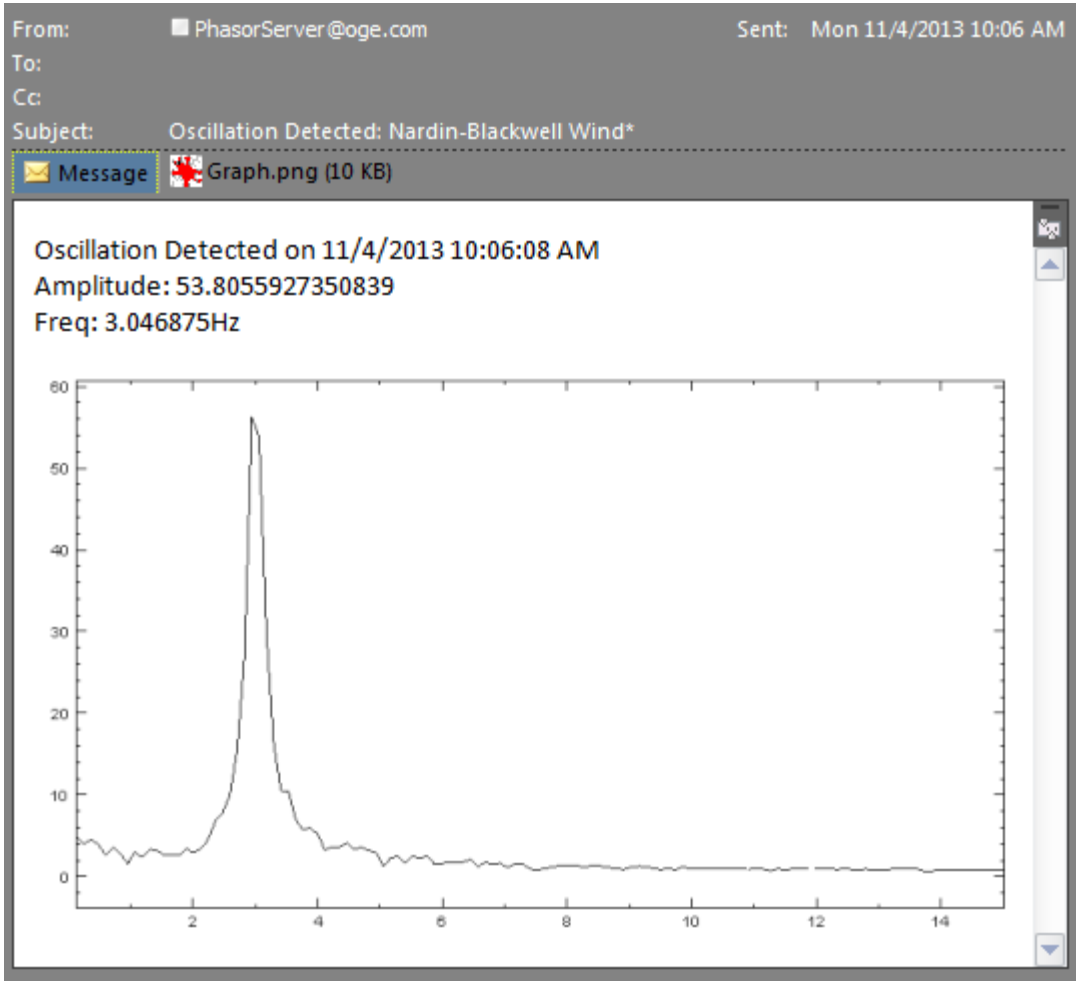
NERC-NASPI Forced Oscillation Workshop 2017

Background

- OG&E Oscillation Detection
- Since 2009 Forced Oscillations discovered at four power plants
- 1 CC Gas, 3 wind
- About 100 individual events
- Lots of curtailments required

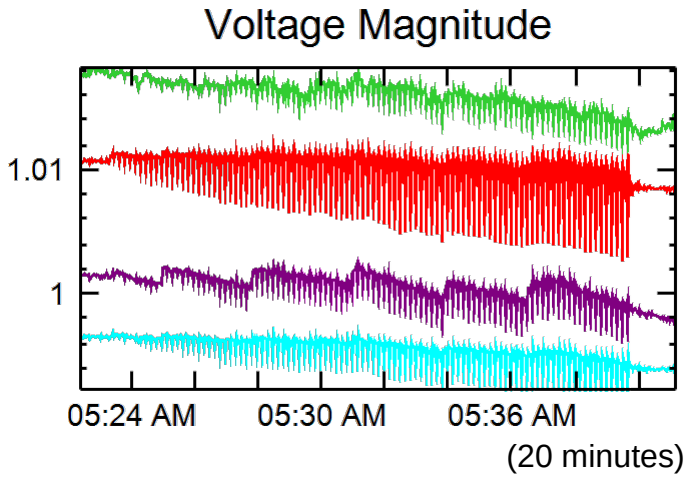
Oscillation Monitor - FFT

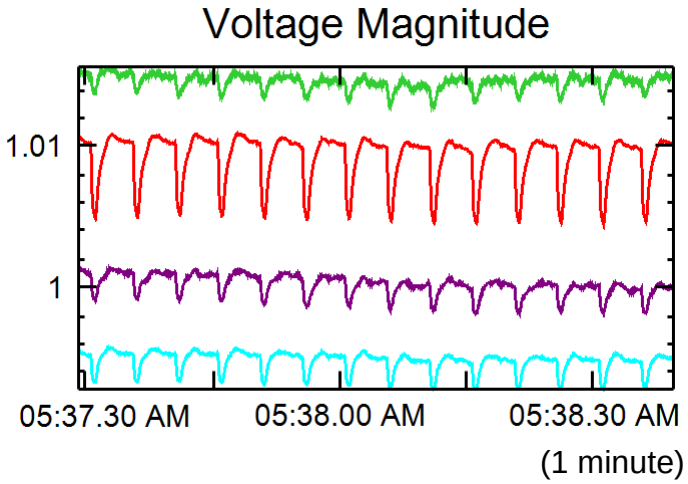
- FFT algorithm used to detect oscillations in real time
- Sends email or text message when the oscillations reach an objectionable level
- This PMU shows a sustained oscillation at 3Hz



Case 1: Redbud 0.2Hz

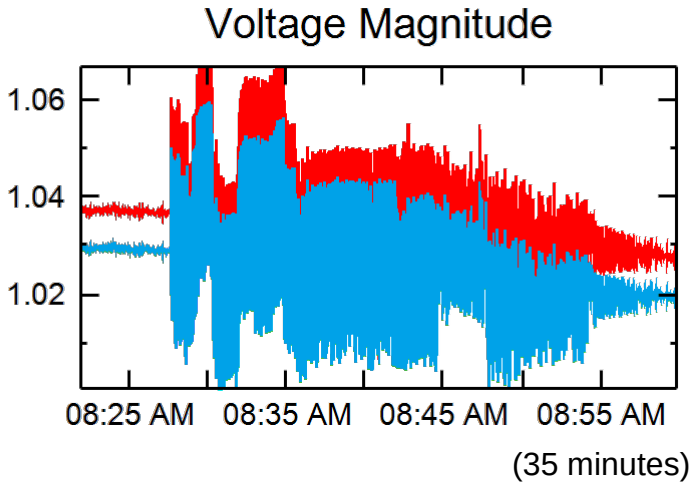
- Discovered voltage oscillations on EHV system (0.2Hz)
- Determined to be a problem with Redbud Unit 4 when in VAR control mode
- VAR control mode used during unit startup, oscillations stopped when operator switches to voltage control scheme

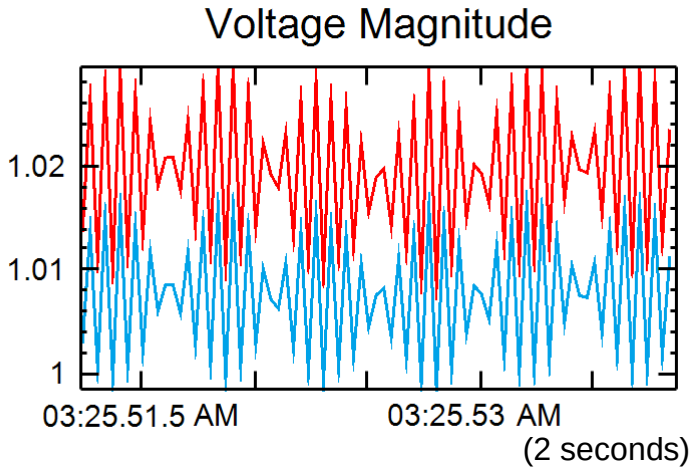




Case 2: Woodward Wind 13Hz

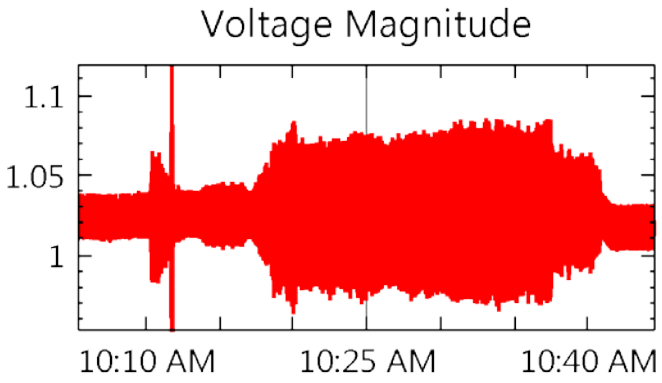
- Only during high winds
- FFT analysis shows 13-14Hz
- Voltage fluctuations as high as 5% at the 138kV POI
- Problem at two different wind farms with the same turbine model
- The only solution was to curtail output
- Solution from vendor took over two years



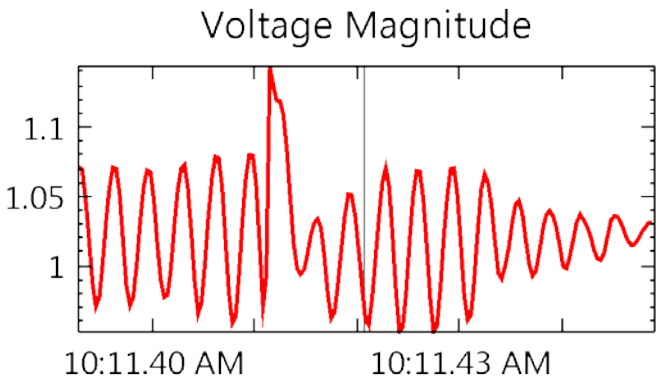


Case 3: Blackwell Wind 3Hz

- A line outage started a major 3Hz oscillation at a new wind farm
- Voltage deviation as high as 18% at 69kV POI
- Plant was curtailed to alleviate the oscillations
- Solution provided in 3 months



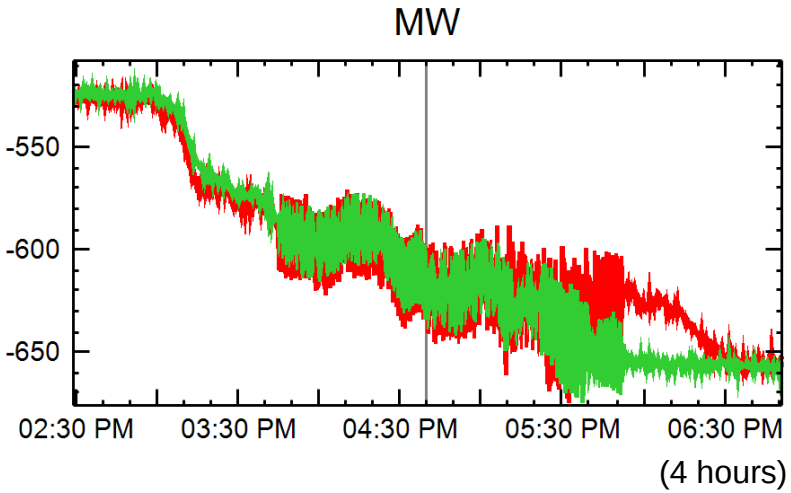
(45 minutes)

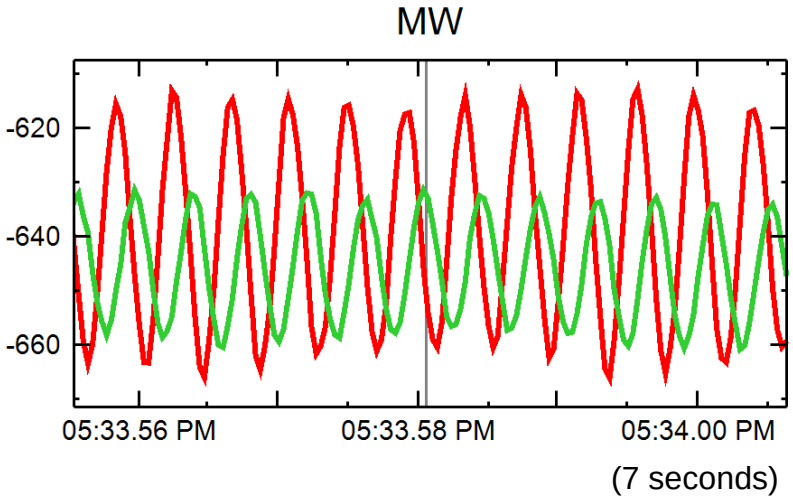


(5 seconds)

Case 4: Redbud 2.45Hz

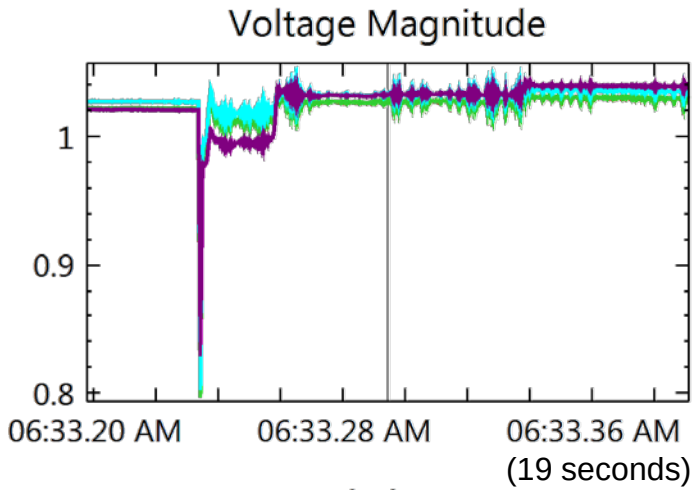
- 2.45Hz oscillation was observed near OKC
- Found Redbud units 1&2 swinging 50MW and 3&4 swinging 30MW
- Contacted plant and I&C tech swapped the active regulator on unit 1 from CPU1 to CPU2

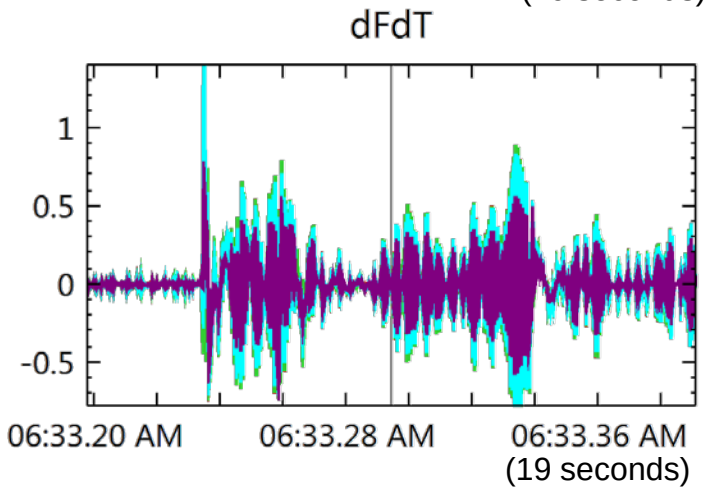




Need to monitor for F.O.

- Wind plant events usually triggered by something
- Change in system impedance, faults, etc.
- Weak POI more prone to issues with F.O.





Questions?

- Thanks! Feel free to contact me if you have any questions.
  - Austin White
    - whitead@oge.com (405-553-5996)