WatchDog: A Software Visualization Tool for Monitoring of Wide-area Power Systems

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NASPI Meeting

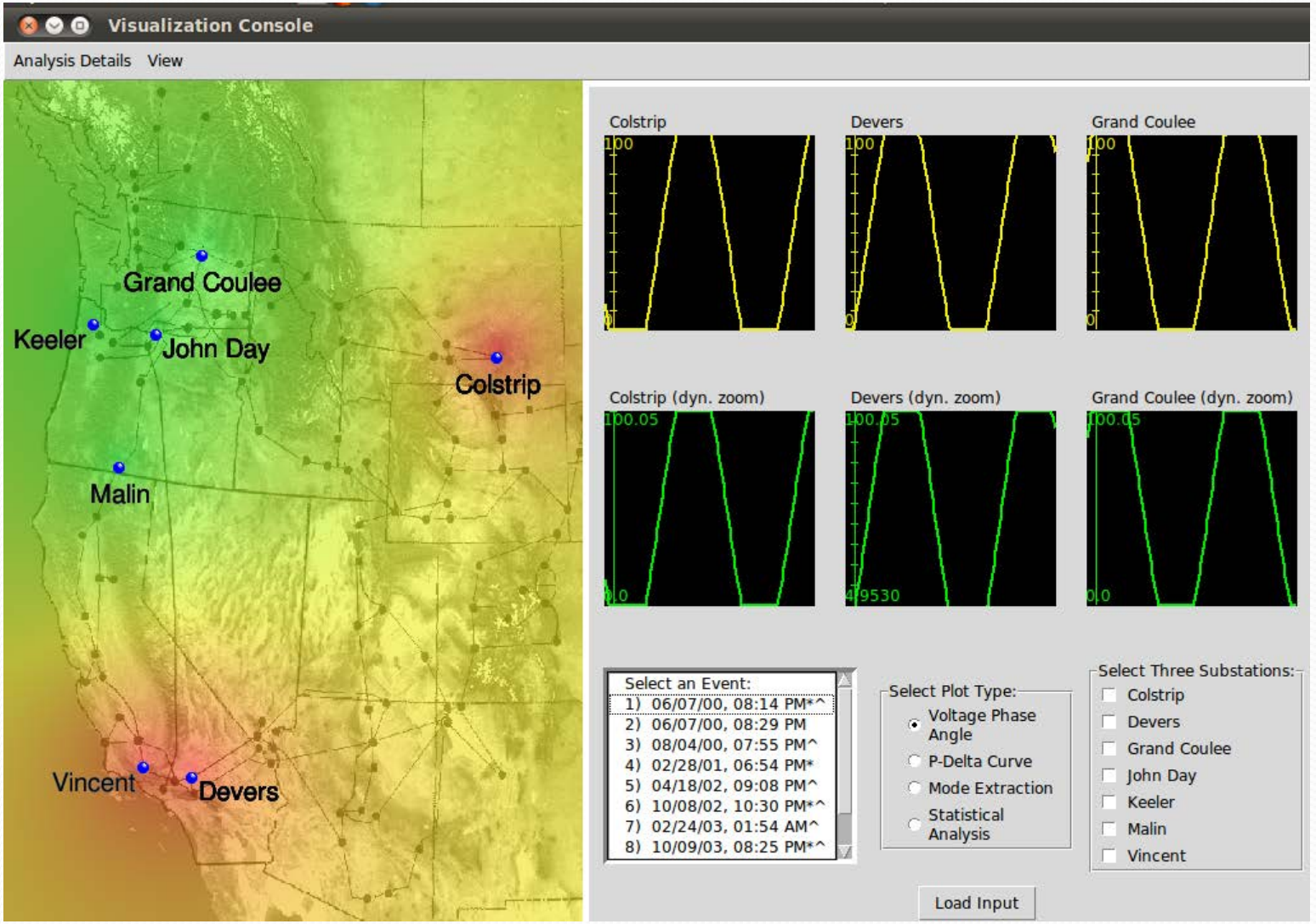
WatchDog

- Visualization software intended for streaming and analysis of real-time PMU data
- Written in Python using Tkinter and PyGame modules
  - Provides 6 fps with 512 color resolution
- Currently using real-time data from historic disturbances in WECC
  - Events ranging from June of 2000 to October of 2004

Current Modules

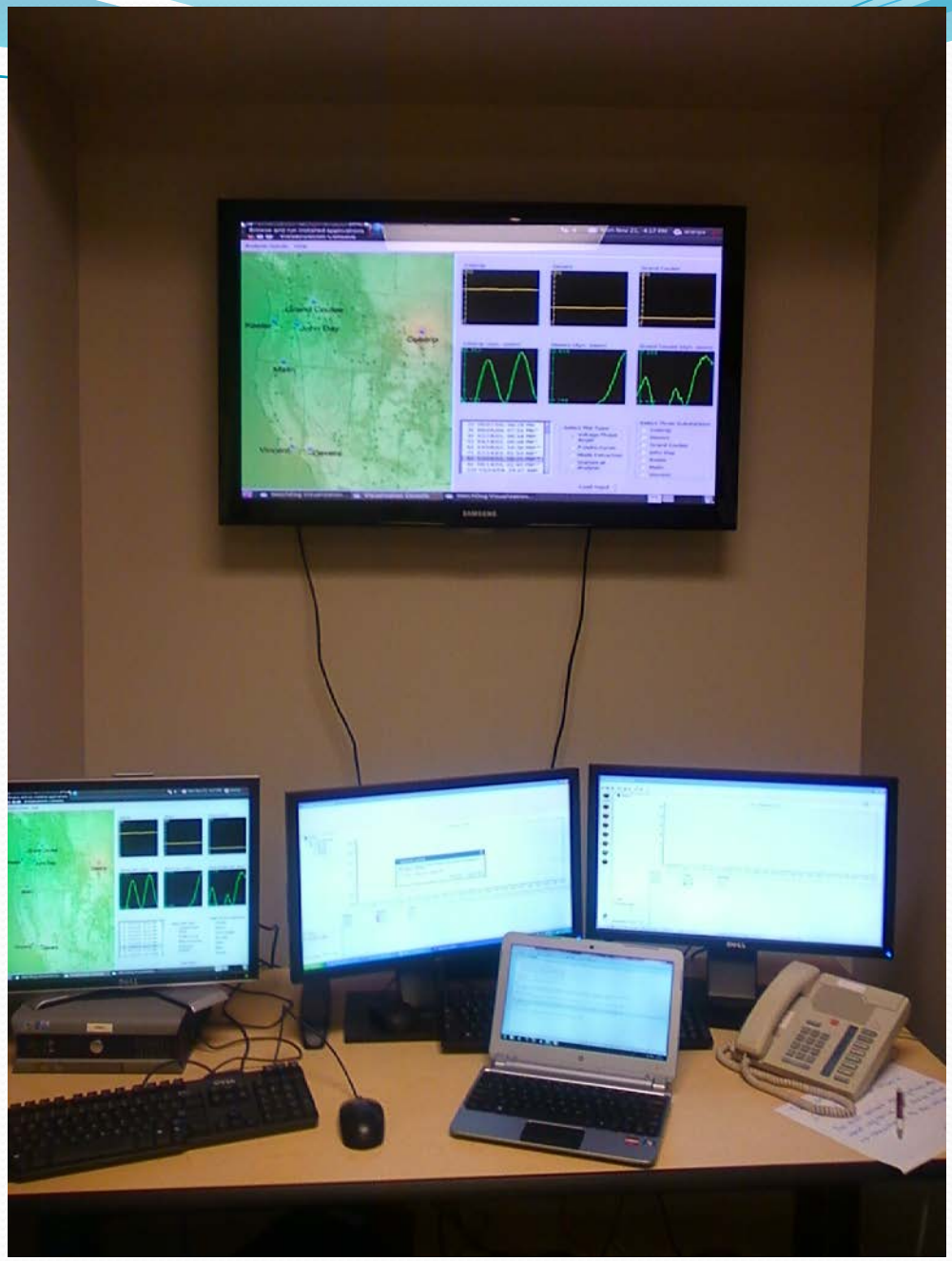
- Phase Angle Contour Videos
- Power-angle Curves
- Modal Analysis through ERA
- Inter-area response Visualization
- Statistical Analysis/baselining
- Streaming real-time data from 7 PMU stations
  - Grand Coulee, Keeler, John Day, Colstrip, Malin, Vincent, Devers
- Soon to have 3D baselining plots

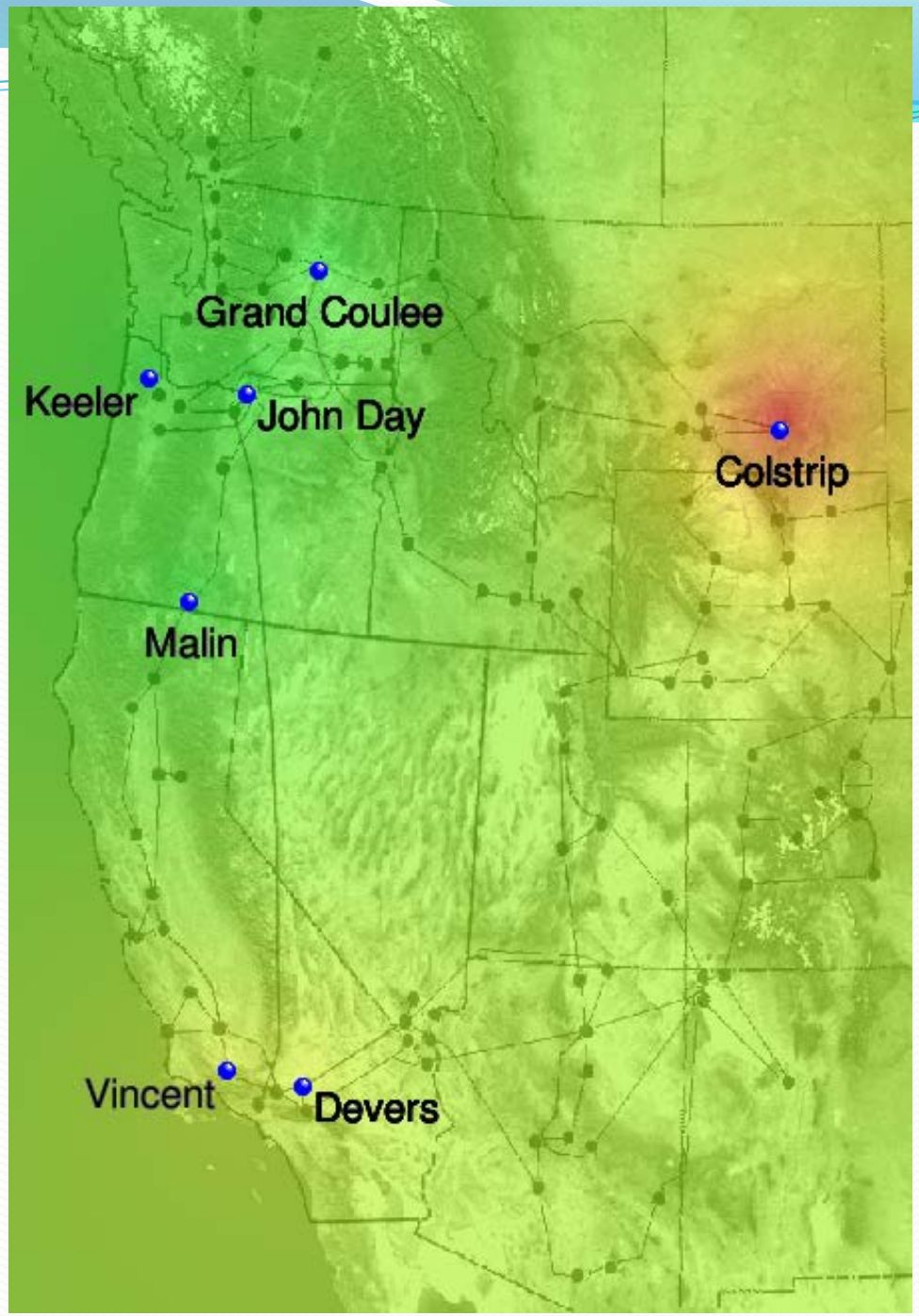
Main Interface

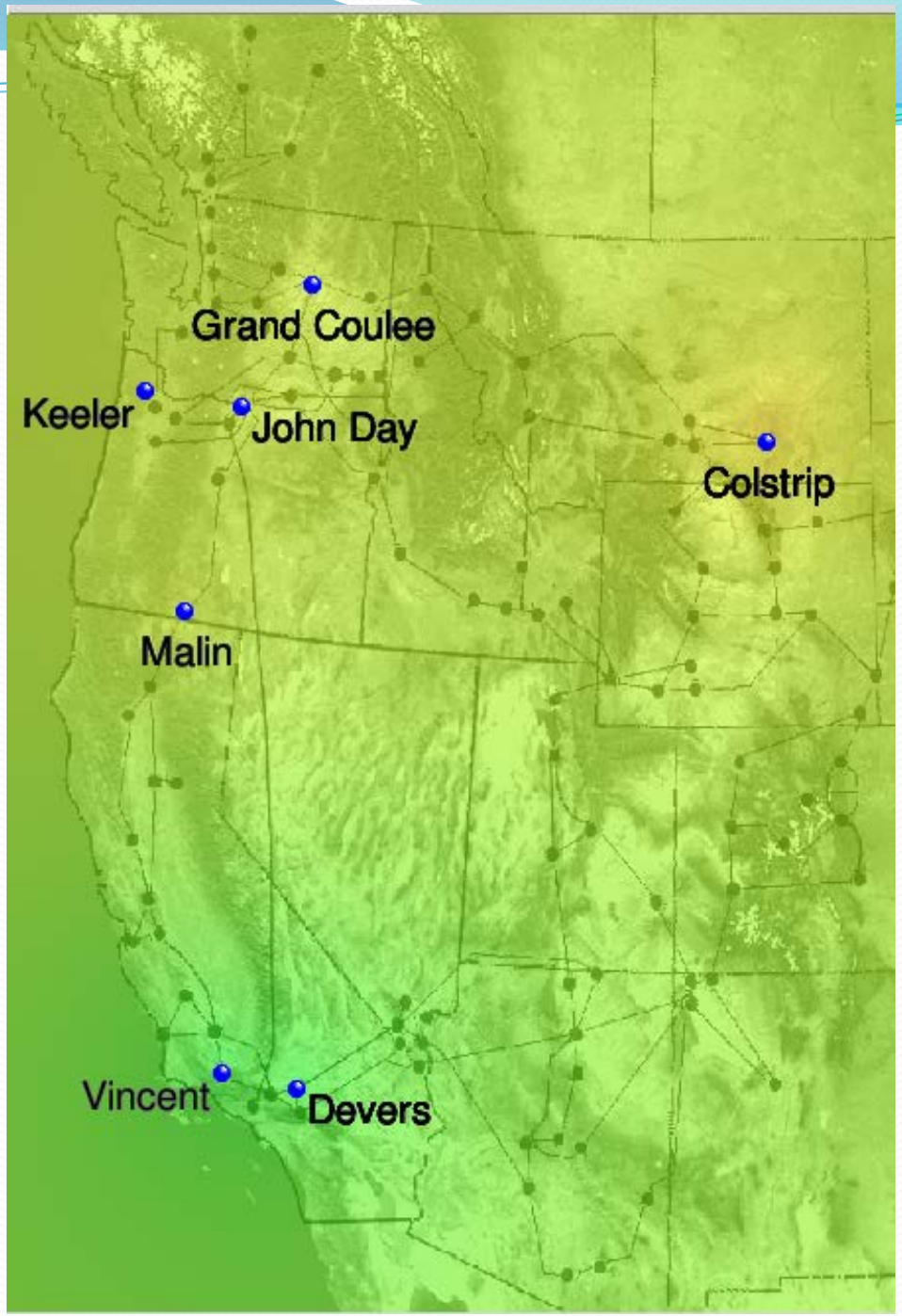


Lab Setup

- Running on standard desktop machine
- Linux environment
  - Ubuntu 10.04
- Viewed on widescreen display




Grand Coulee
Keeler
John Day
Colstrip
Malin
Vincent
Devers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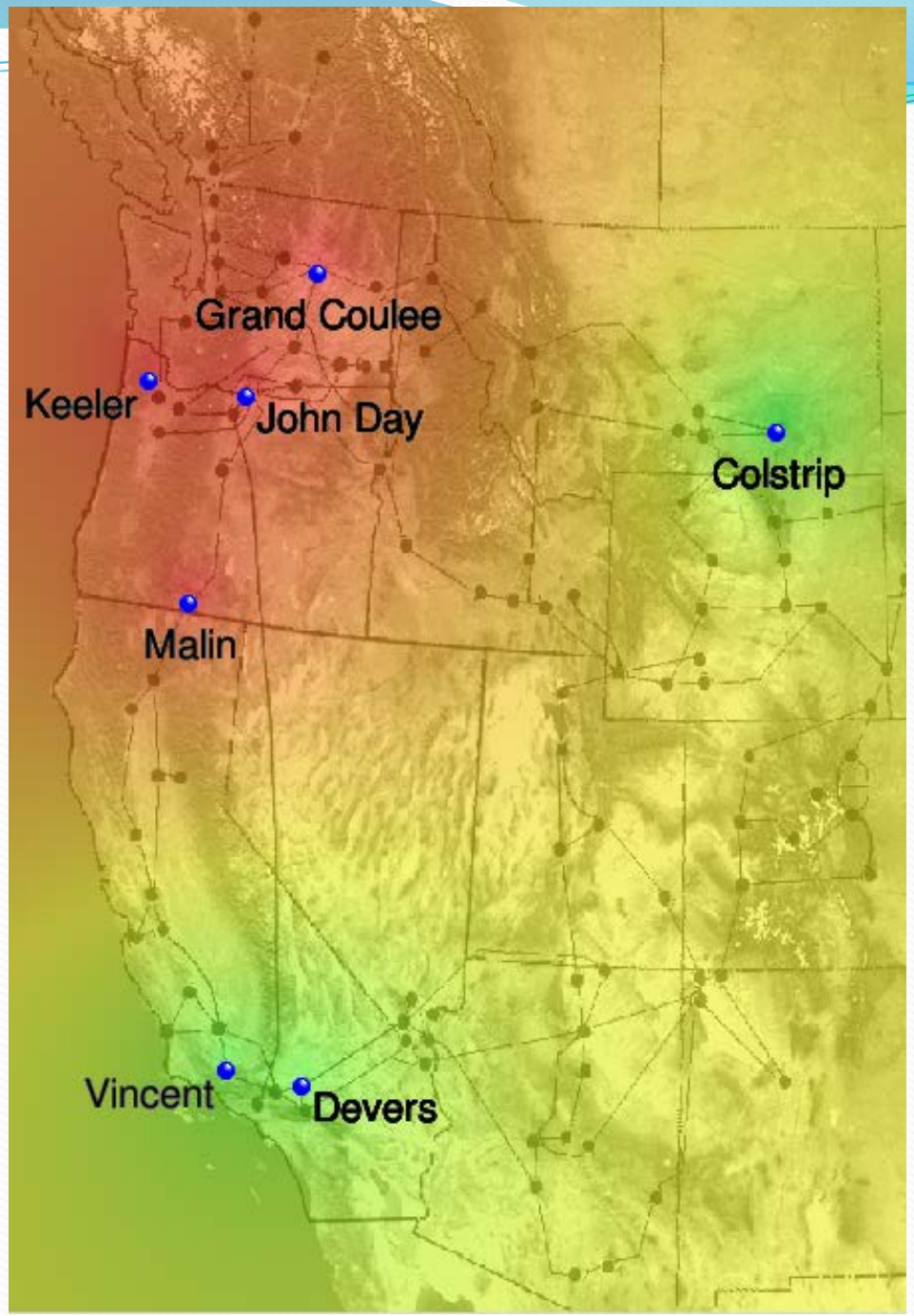
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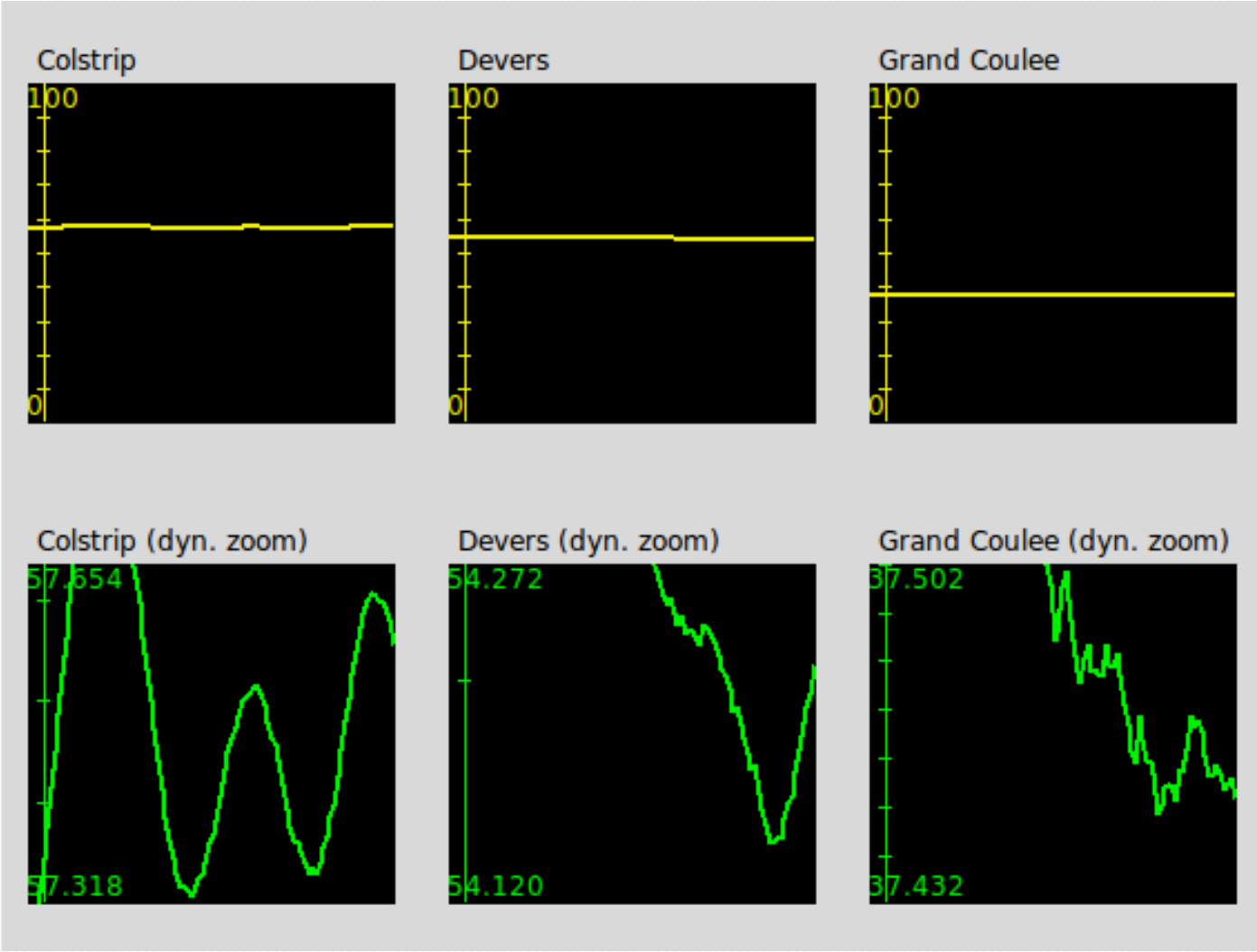
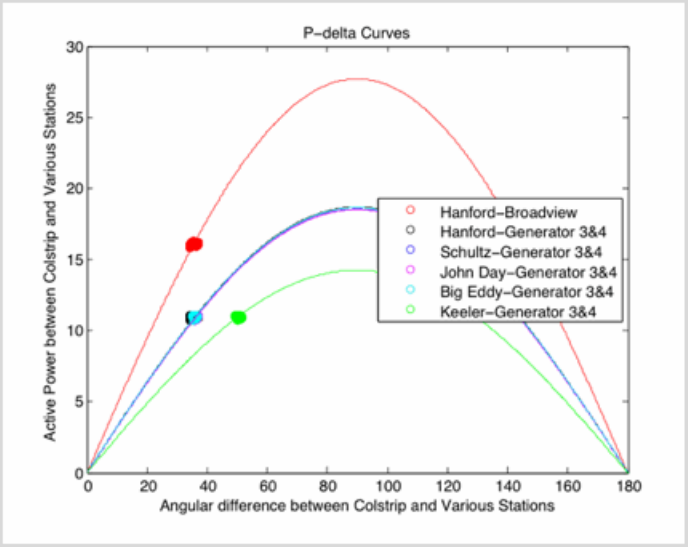
Scrolling Waveforms



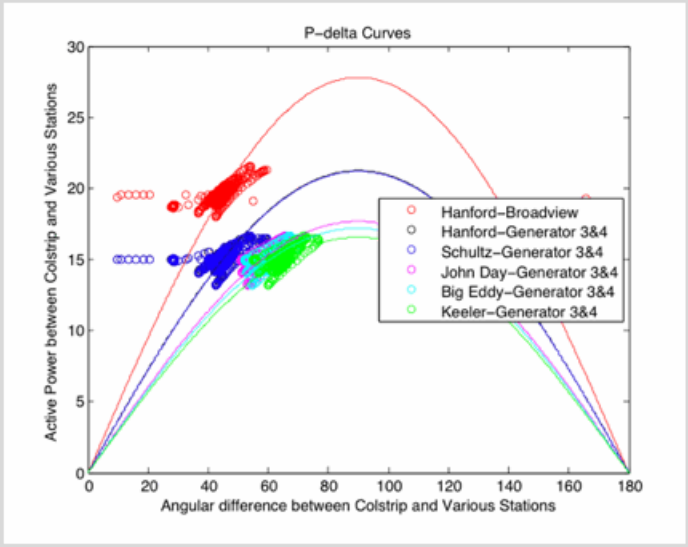
P-Delta Curves



Select an Event:
1) 06/07/00, 08:14 PM*^
2) 06/07/00, 08:29 PM
3) 08/04/00, 07:55 PM^
4) 02/28/01, 06:54 PM*
5) 04/18/02, 09:08 PM^
6) 10/08/02, 10:30 PM*^
7) 02/24/03, 01:54 AM^
8) 10/09/03, 08:25 PM*^

Select Plot Type:
- Voltage Phase Angle
- P-Delta Curve
- Mode Extraction
- Statistical Analysis

Select Three Substations:
- Colstrip
- Devers
- Grand Coulee
- John Day
- Keeler
- Malin
- Vincent



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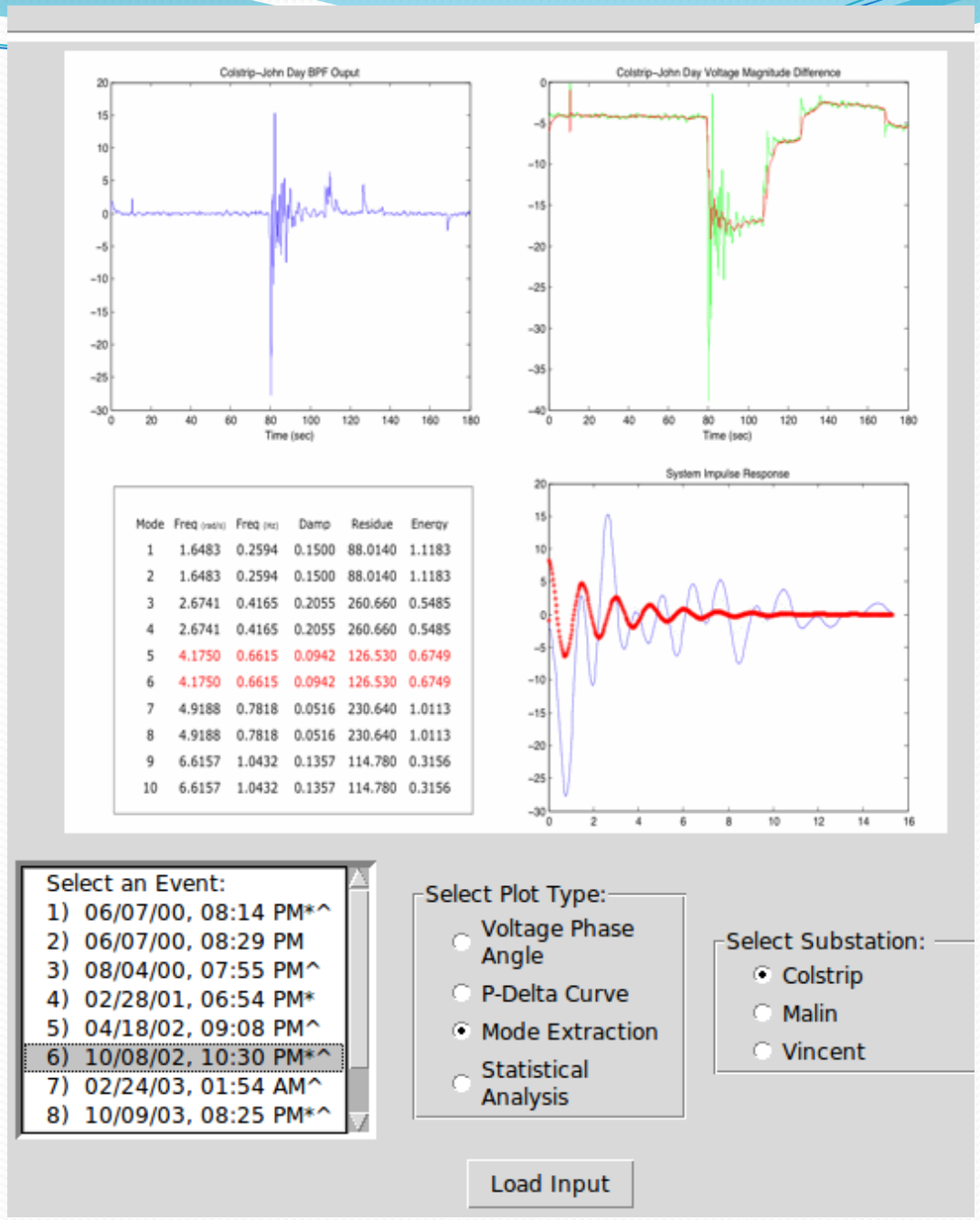
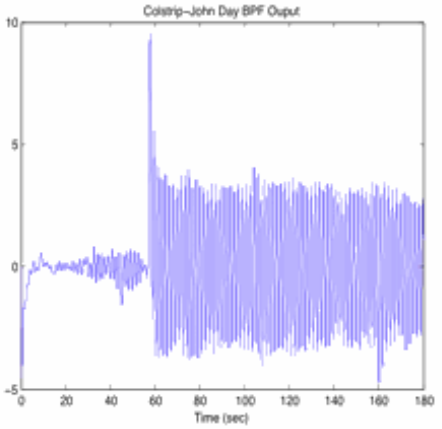
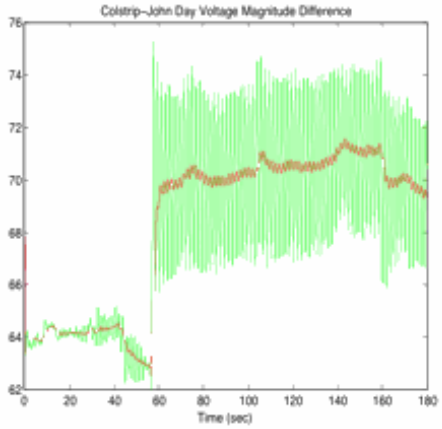
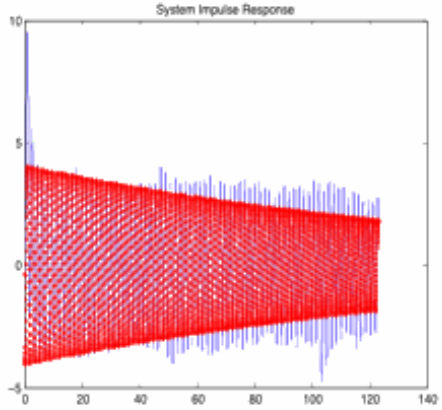
Mode Extraction Information







Mode	Freq (rad/s)	Freq (Hz)	Damp	Residue	Energy
1	1.3384	0.1852	0.4937	46.8610	0.7639
2	1.3384	0.1852	0.4937	46.8610	0.7639
3	3.2863	0.5095	0.2260	41.4470	0.4221
4	3.2863	0.5095	0.2260	41.4470	0.4221
5	3.6606	0.5826	0.0017	61.1310	31.0810
6	3.6606	0.5826	0.0017	61.1310	31.0810
7	4.9728	0.7884	0.0877	5.9191	0.6074
8	4.9728	0.7884	0.0877	5.9191	0.6074
9	7.3050	1.1623	0.0223	0.5458	1.5573
10	7.3050	1.1623	0.0223	0.5458	1.5573



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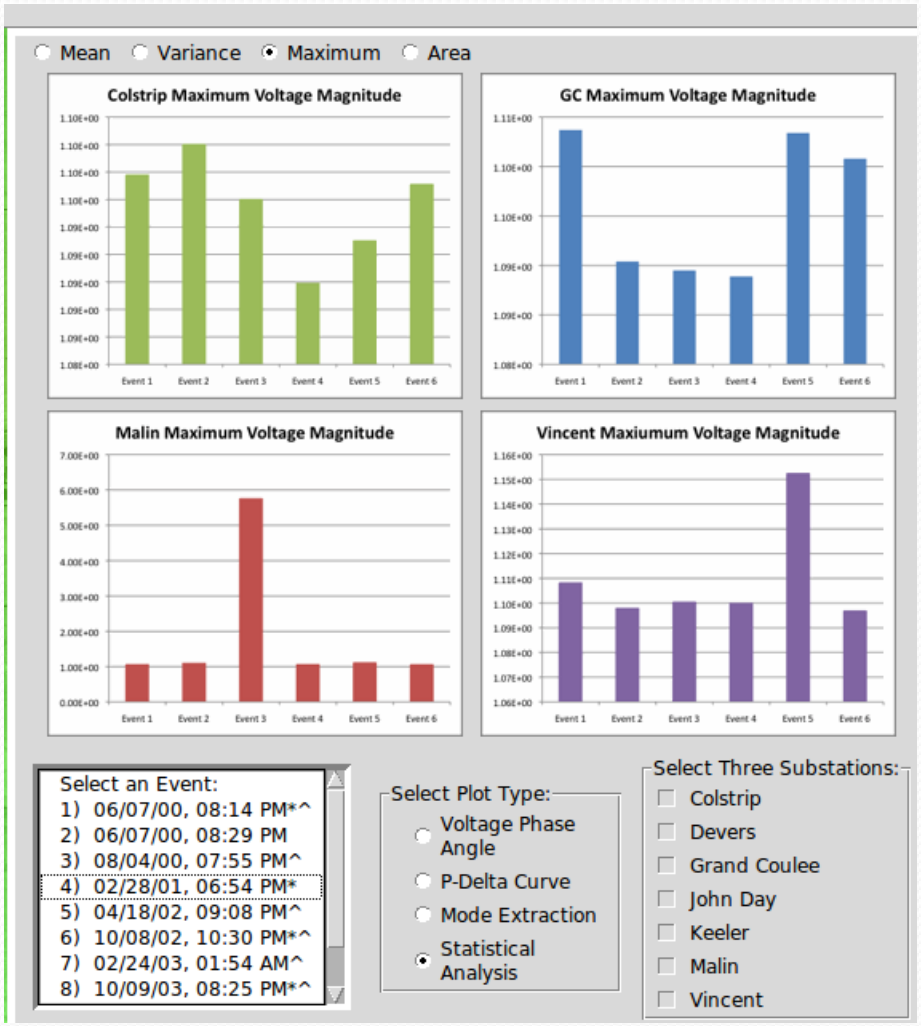
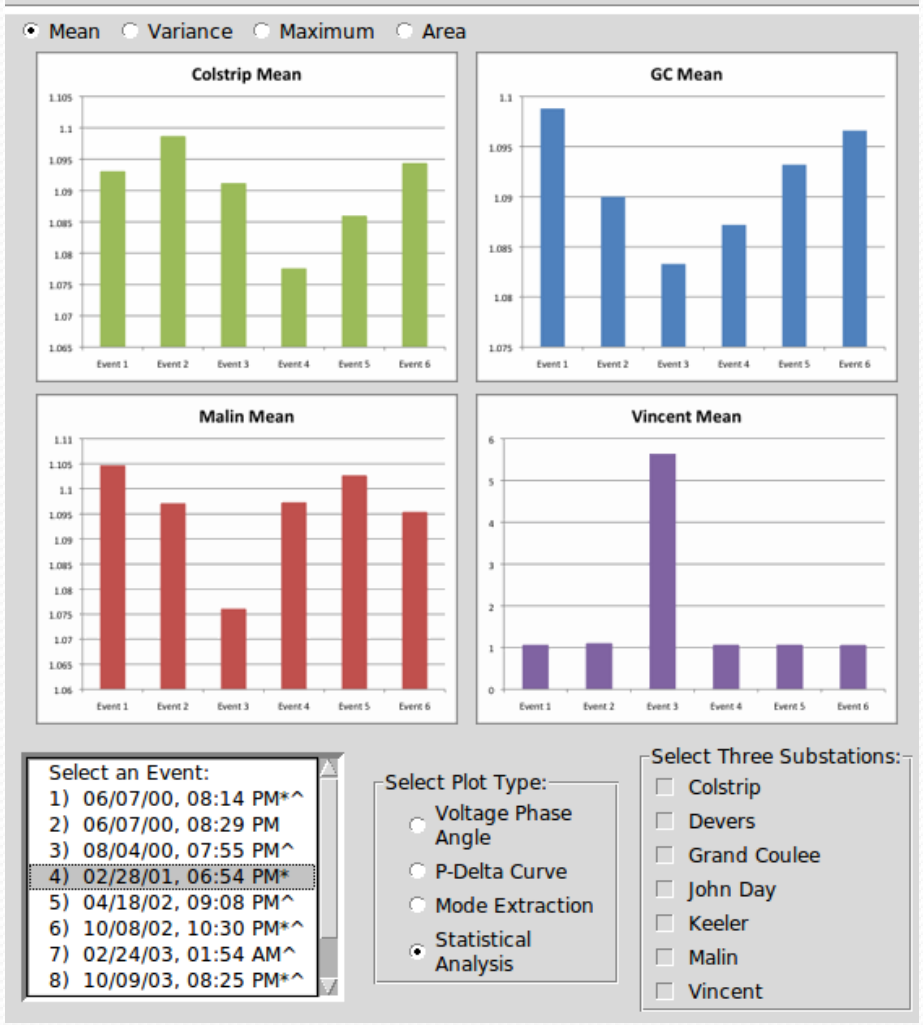
- ◉ Mode Extraction
- ○ Statistical Analysis

Select Substation:
- ◉ Colstrip
- ○ Grand Coulee
- ○ Malin
- ○ Vincent

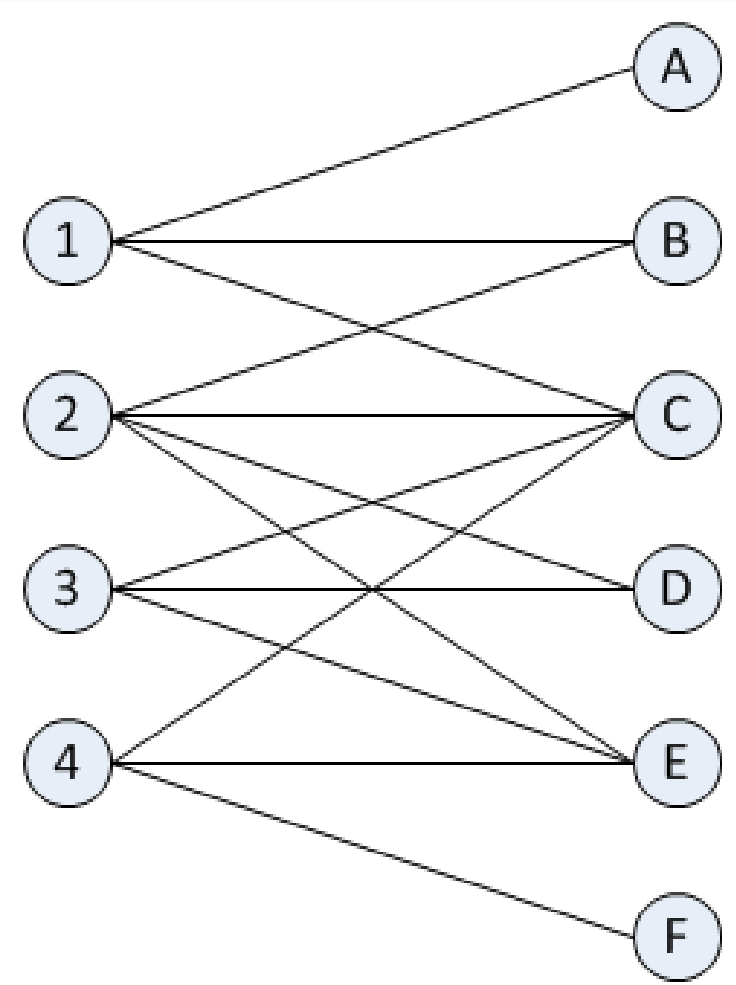
Load Input

Statistical Information

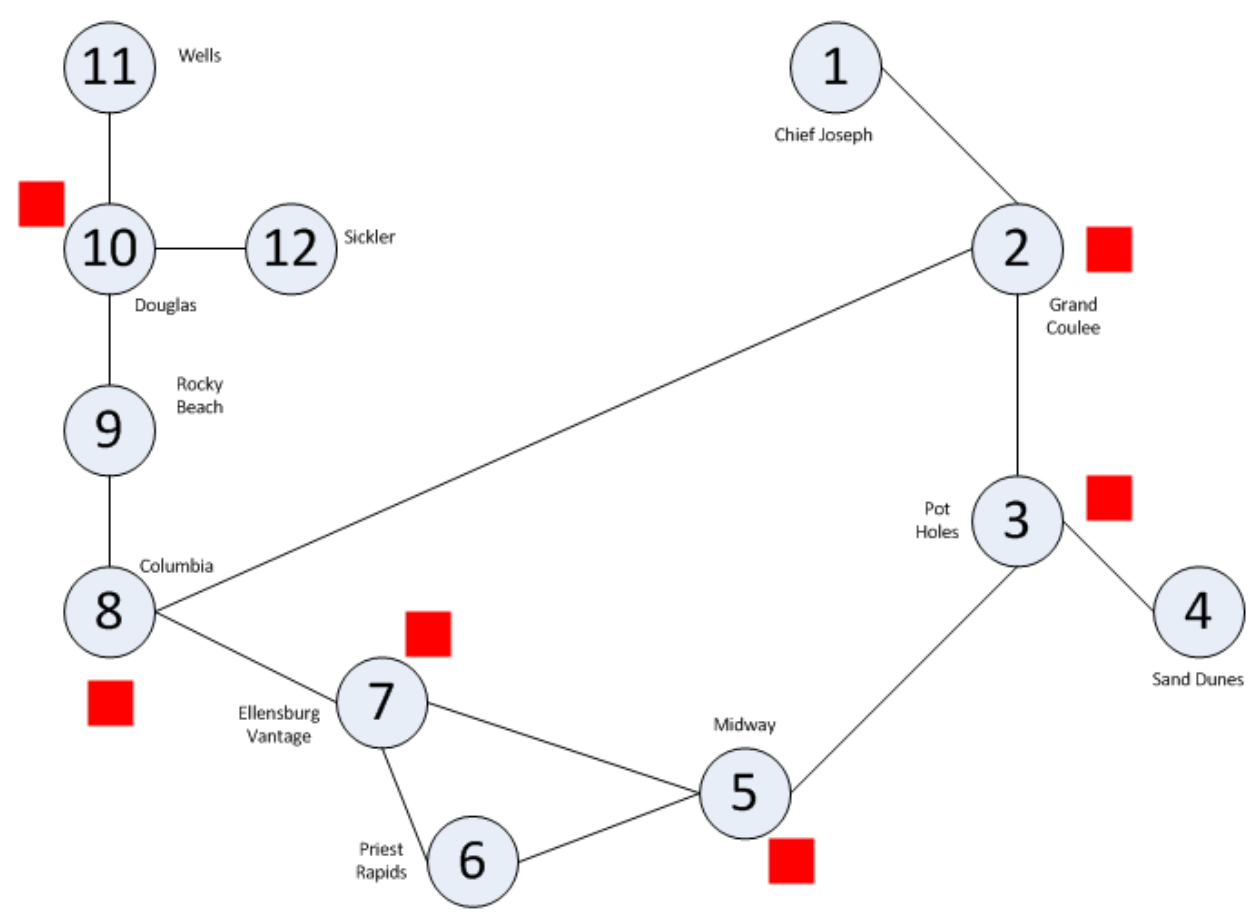




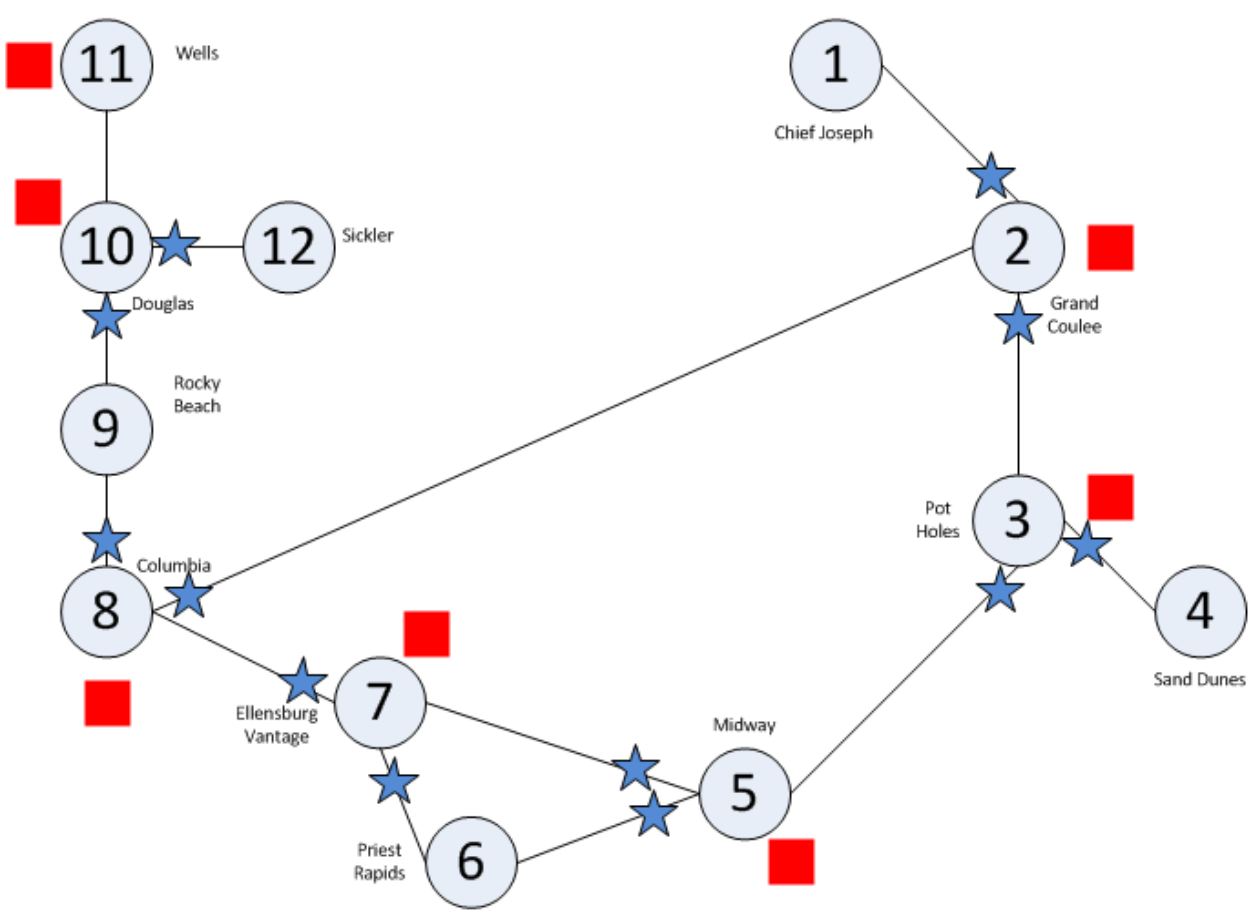
PMU Constrained Placement



WECC Algorithm Application



Constrained Placement Algorithm



Thank You