



August 1996 West Coast Blackout

STABILITY ANALYSIS OF NONLINEAR SYSTEMS (EEEN50100)

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- This information was extracted from a presentation by Dr. Prabha Kundur, President and CEO of PowerTech Labs Inc.
- The material is available at:

toronto.ieee.ca/events/oct0303/prabha.ppt

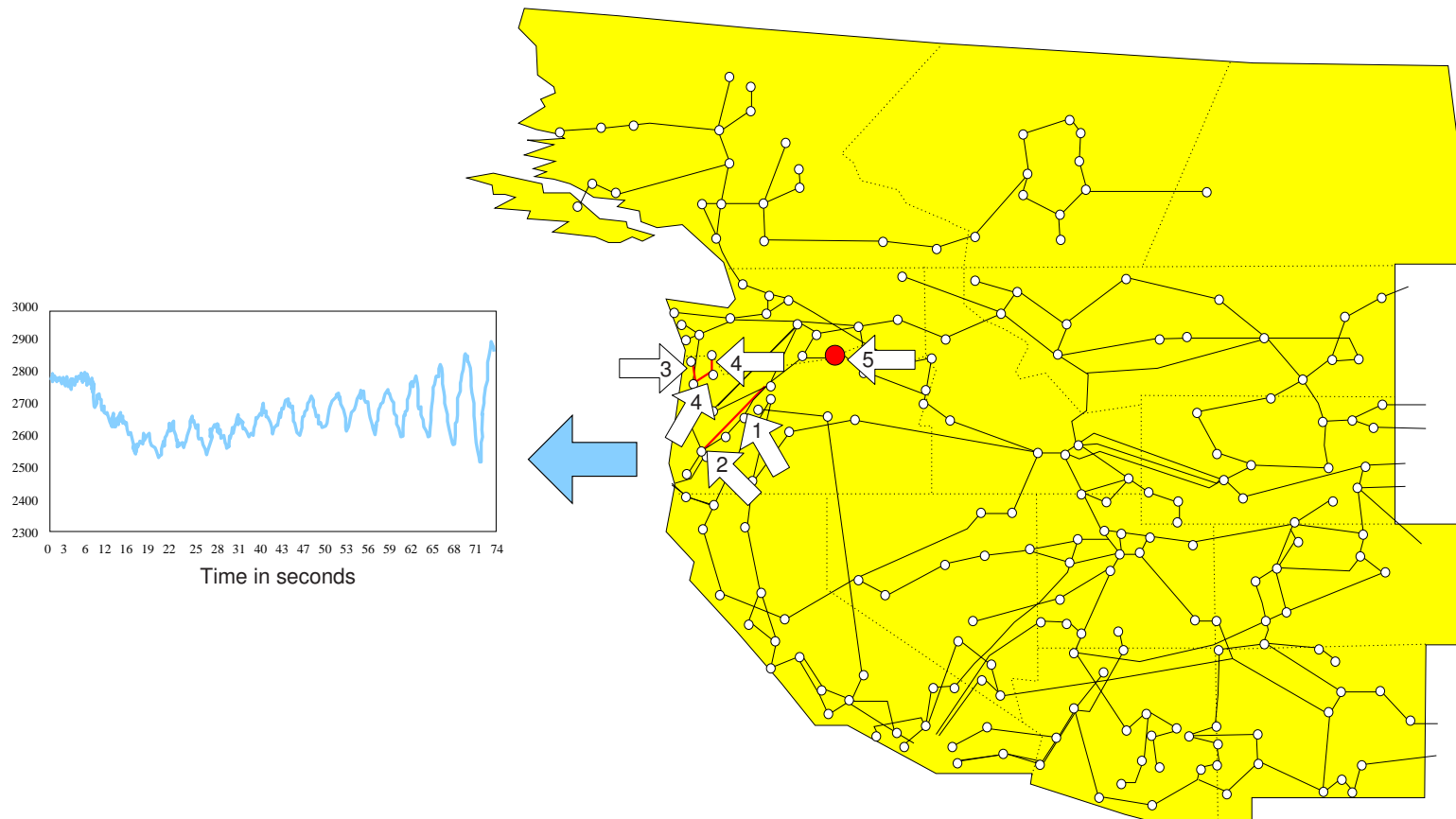


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- System conditions:
 - High ambient temperatures in Northwest, and hence high power transfers from Canada to California.
 - Prior to main outage, three 500 kV line sections from lower Columbia River to loads in Oregon were out of service due to tree faults.
 - California-Oregon interties loaded to 4330 MW north to south.
 - Pacific DC intertie loaded at 2680 MW north to south.
 - 2300 MW flow from British Columbia.

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- Growing 0.23 Hz oscillations caused tripping of lines:



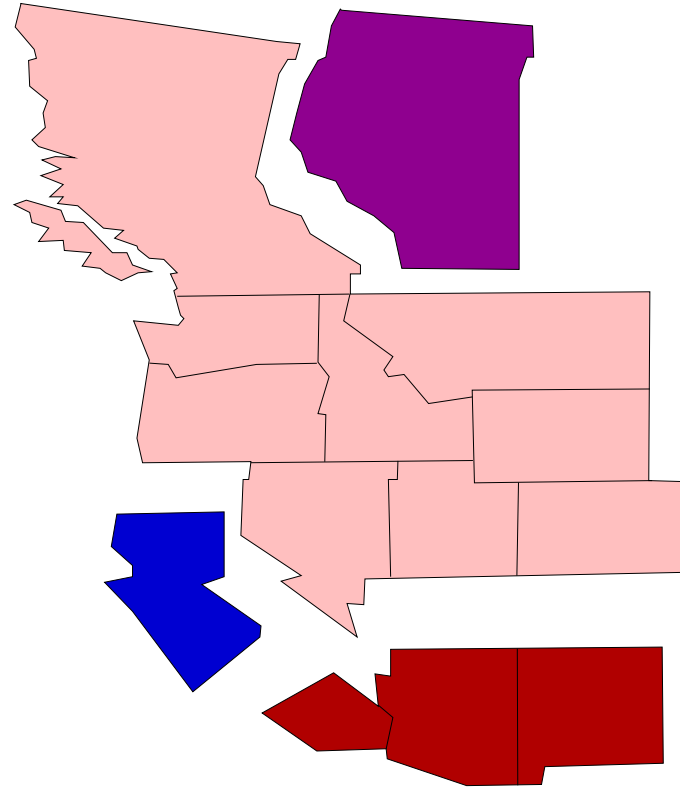


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- Event 1: 14:06:39
→ Big Eddy-Ostrander 500 kV LG fault - flashed to tree
- Event 2: 14:52:37
→ John Day-Marion 500 kV LG -flashed to tree
- Event 3: 15:42:03
→ Keeler-Alliston 500 KV - LG - flashed to tree
- Event 4: 15:47:36
→ Ross-Lexington 500 kV - flashed to tree
- Event 5: 15:47:36-15:48:09
→ 8 McMary Units trip

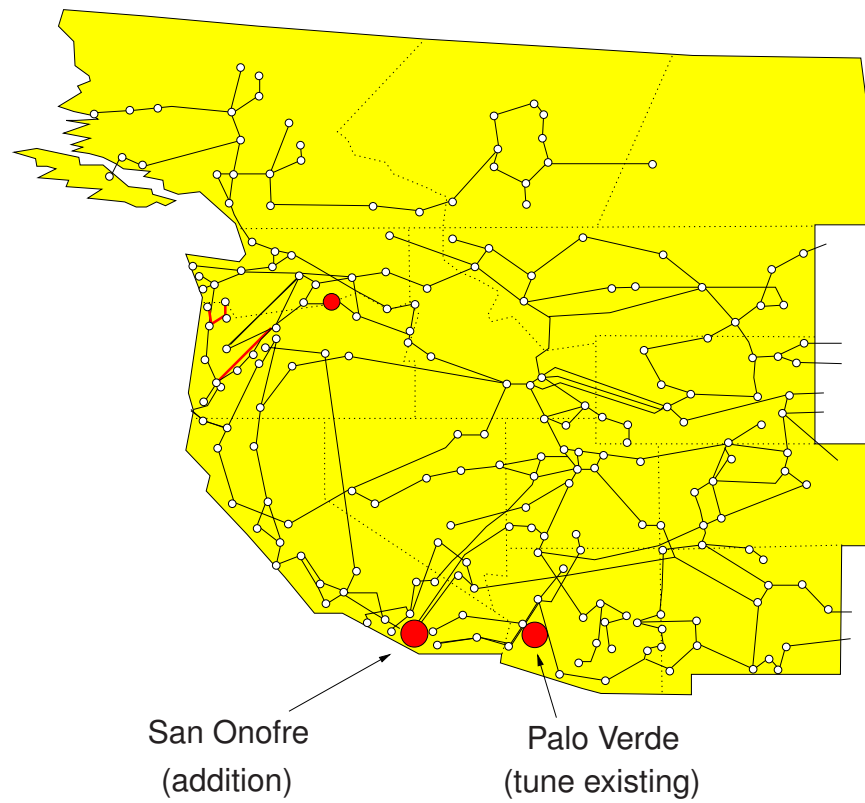
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- As a result of the undamped oscillations, the system split into four large islands.



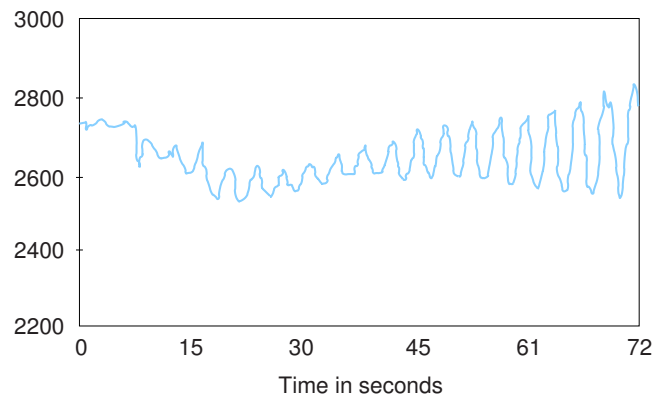
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- PSS solution:



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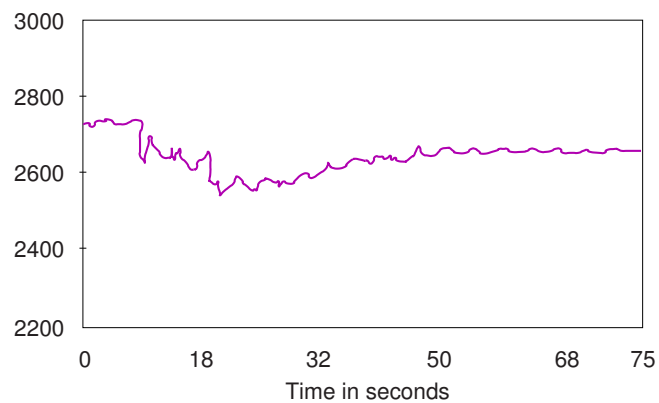


With existing controls

$$\text{Eigenvalue} = 0.0597 + j1.771$$

$$\text{Frequency} = 0.2818 \text{ Hz}$$

$$\text{Damping} = -0.0337$$



With PSS modifications

$$\text{Eigenvalue} = -0.0717 + j1.673$$

$$\text{Frequency} = 0.2664 \text{ Hz}$$

$$\text{Damping} = -0.0429$$



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- 7.5 million customers experienced outages from a few minutes to nine hours.
- Total load loss: 35,500 MW.