Is Load Loss Real ?

2015 NERC-DOE FIDVR Conference

Presented by

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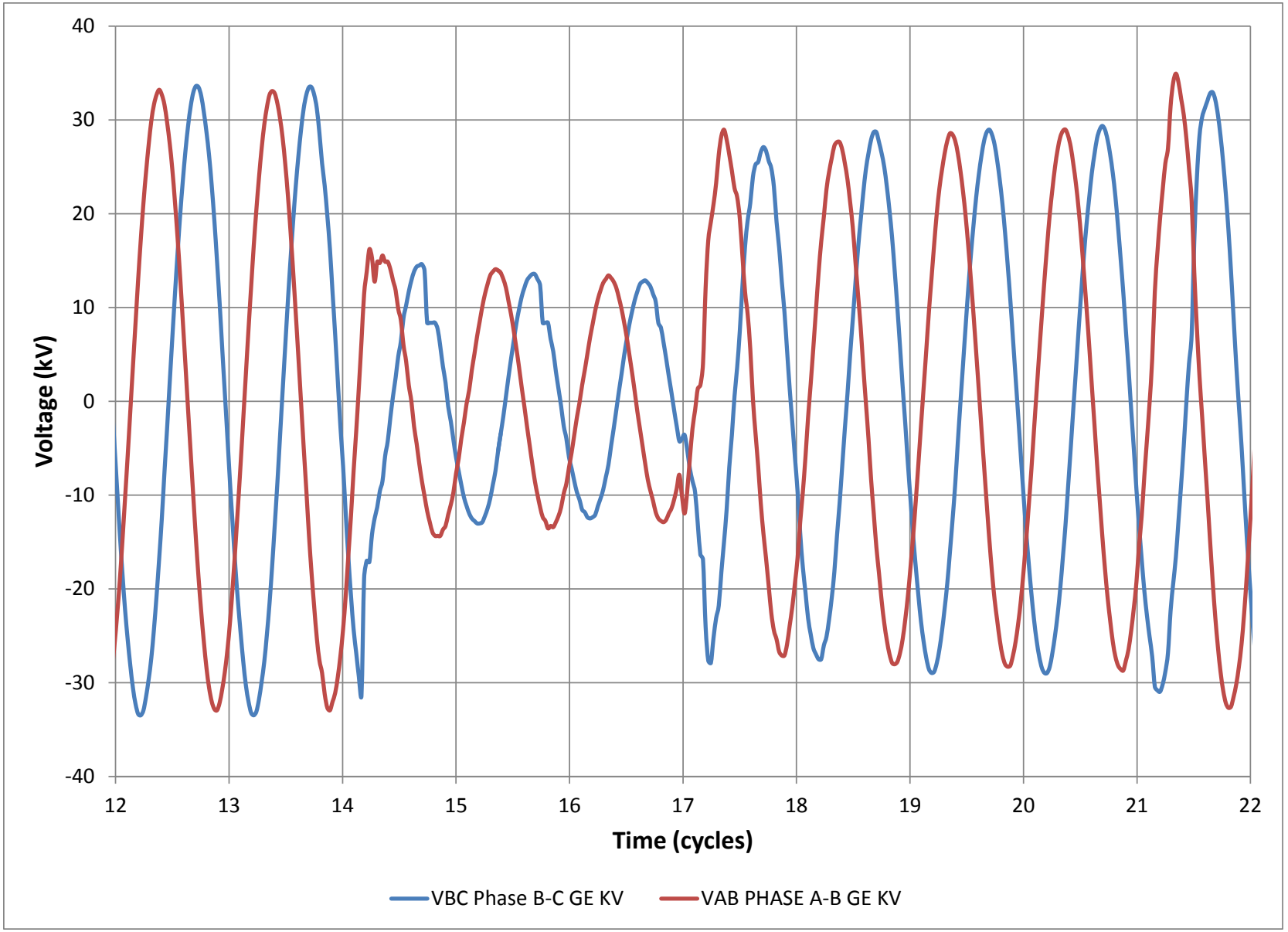
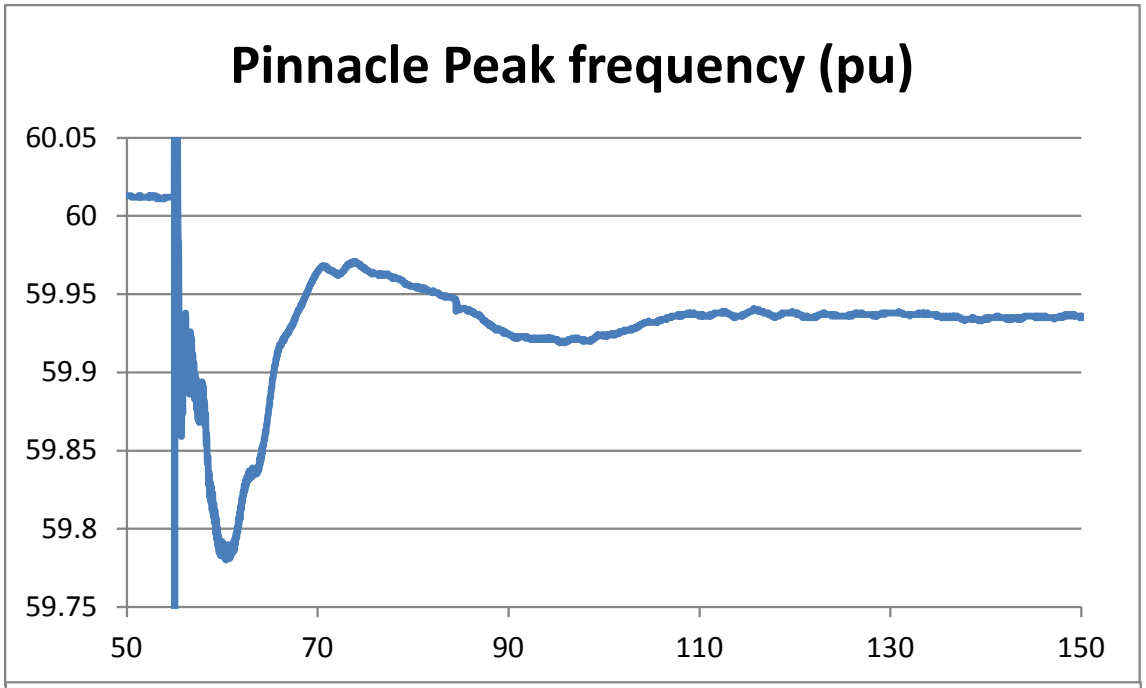
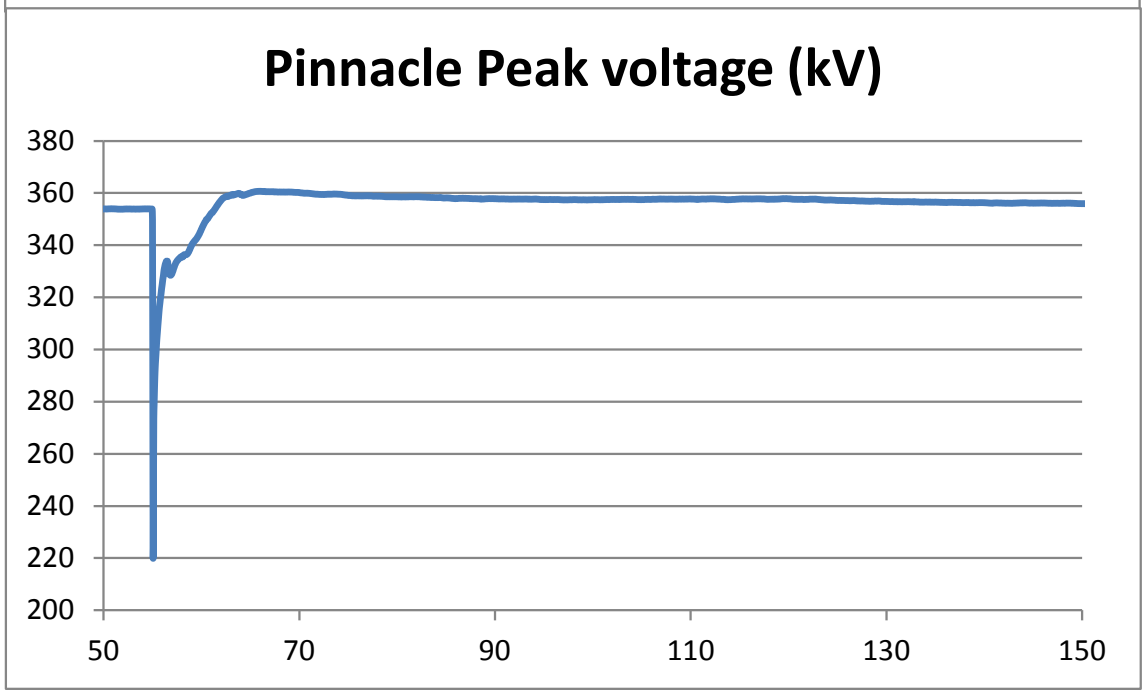
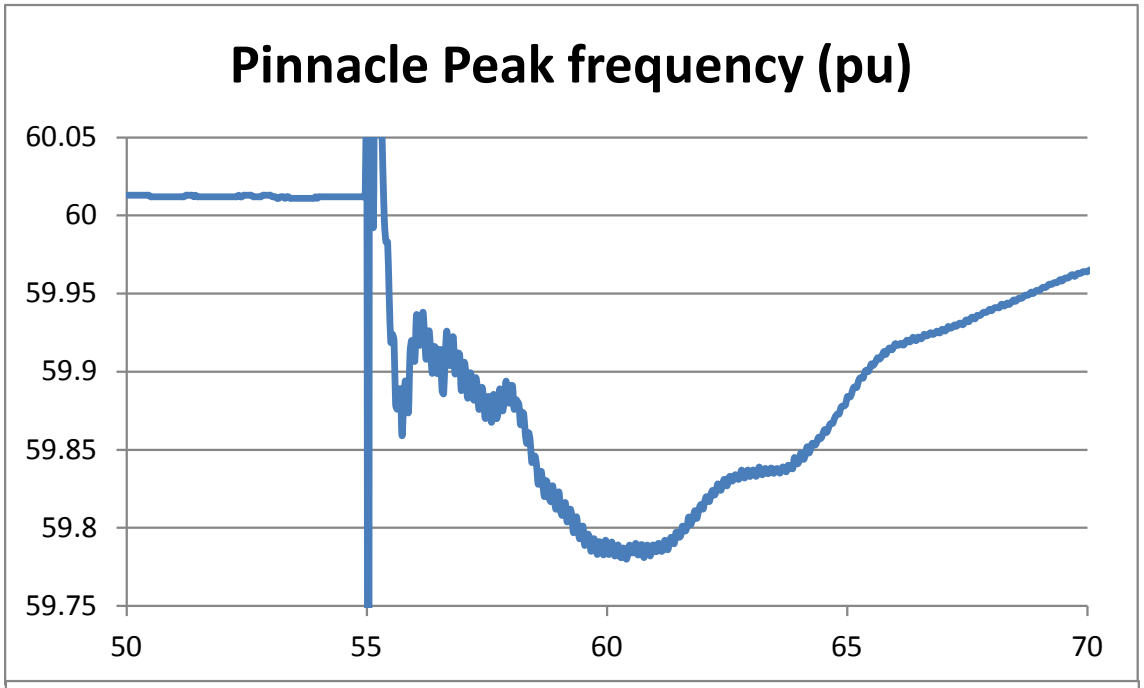
Hassayampa Event

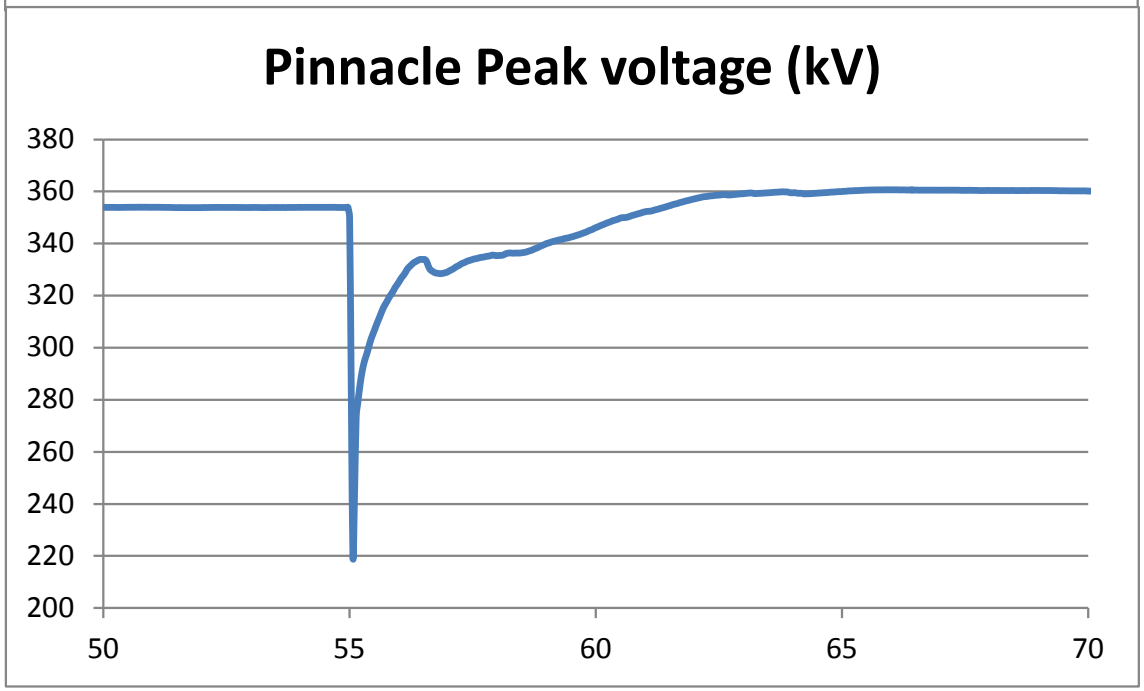
- July 28, 2003 at 18:54
- 3-phase fault at Hassayampa 500-kV substation west of Phoenix, AZ
- 2,685 MW of generation tripped following a fault


40
30
20
10
0
-10
-20
-30
-40
Voltage (kV)
12
13
14
15
16
17
18
19
20
21
22
Time (cycles)
VBC Phase B-C GE KV
VAB PHASE A-B GE KV


Pinnacle Peak frequency (pu)
60.05
60
59.95
59.9
59.85
59.8
59.75
50
70
90
110
130
150


Pinnacle Peak voltage (kV)
380
360
340
320
300
280
260
240
220
200
50
70
90
110
130
150


Pinnacle Peak frequency (pu)
60.05
60
59.95
59.9
59.85
59.8
59.75
50
55
60
65
70

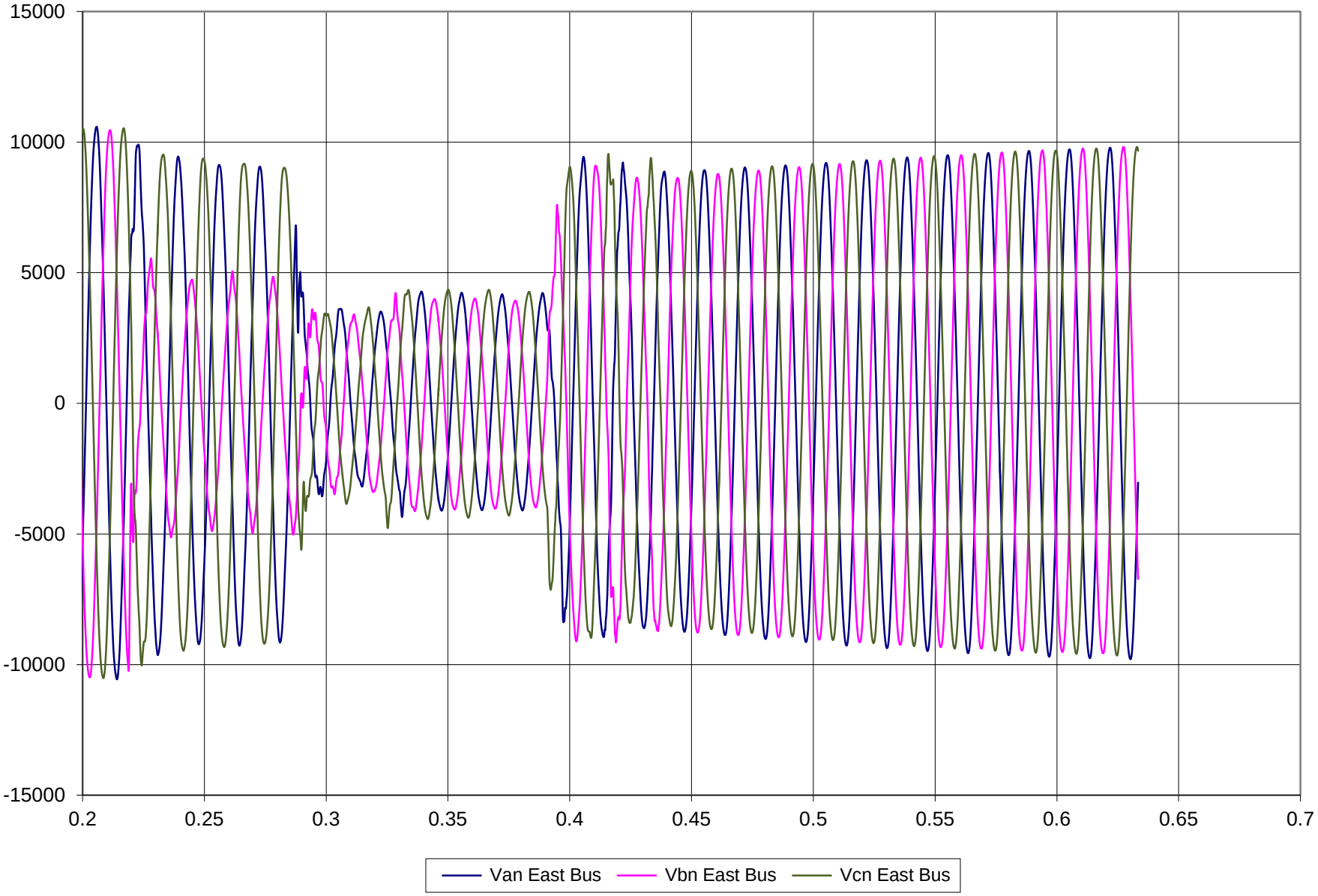

Pinnacle Peak voltage (kV)
380
360
340
320
300
280
260
240
220
200
50
55
60
65
70

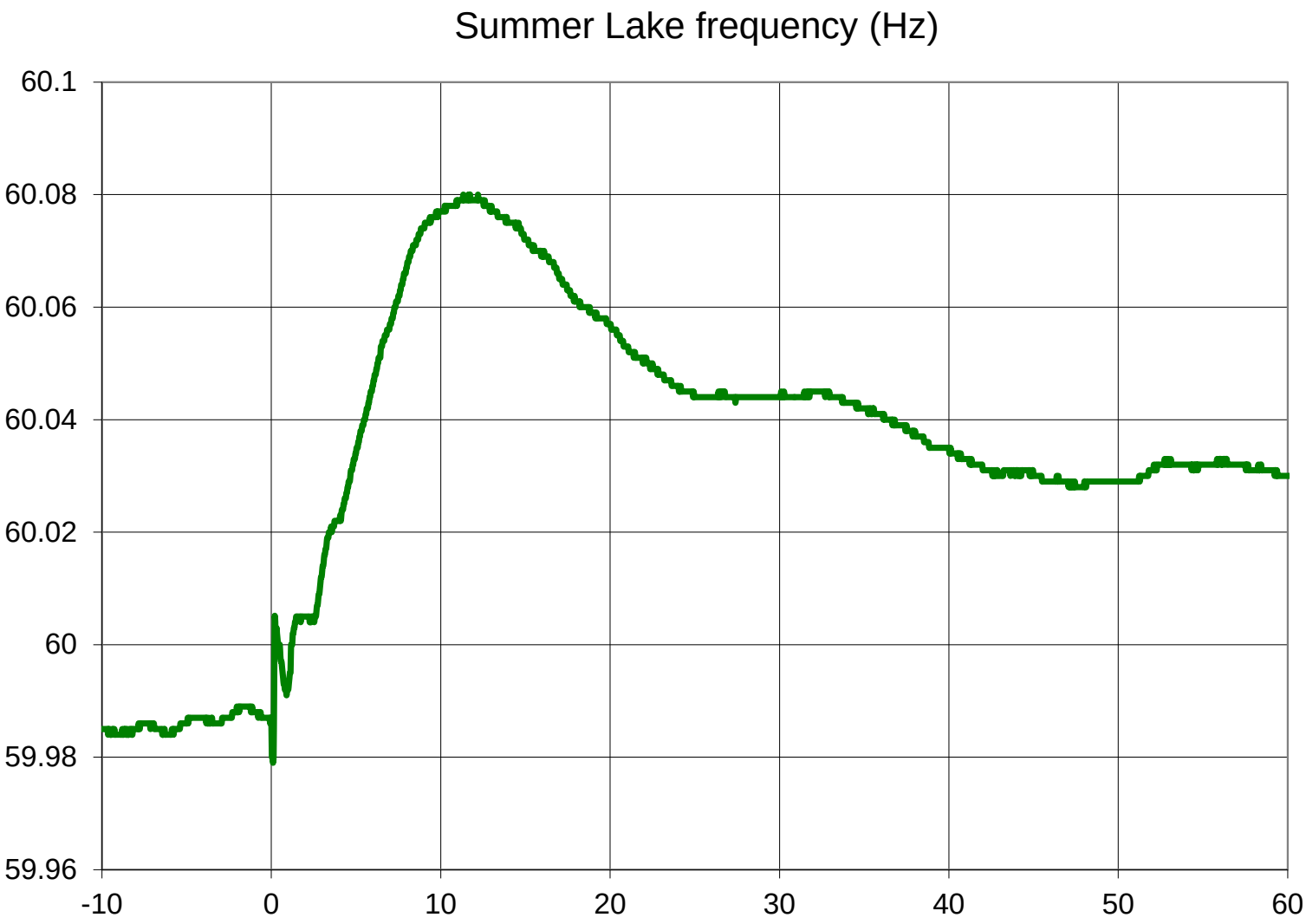
- Delta F = (60.011 – 59.938)= 0.073 Hz
- WECC Frequency Response is about 1,450 to 1,650 MW per 0.1 Hz (see next page)
- **Estimated Load Loss is 1,480 to 1,620 MW,** calculated as 2,685 – 0.073*10*FRM
- Load loss is due to FIDVR and load tripping during the fault

Mid-Valley Event

- July 28, 2009 at 21:18
- Mid Valley 138-kV substation, Salt Lake City, UT
- Capacitor bank failure
- Fault initiated as a four cycle single phase to ground fault that evolved into a three phase fault for an additional six cycles. The fault was cleared by action of the capacitor bank's protective relays. Total clearing time was about ten cycles.

- Temperatures were about 80 F

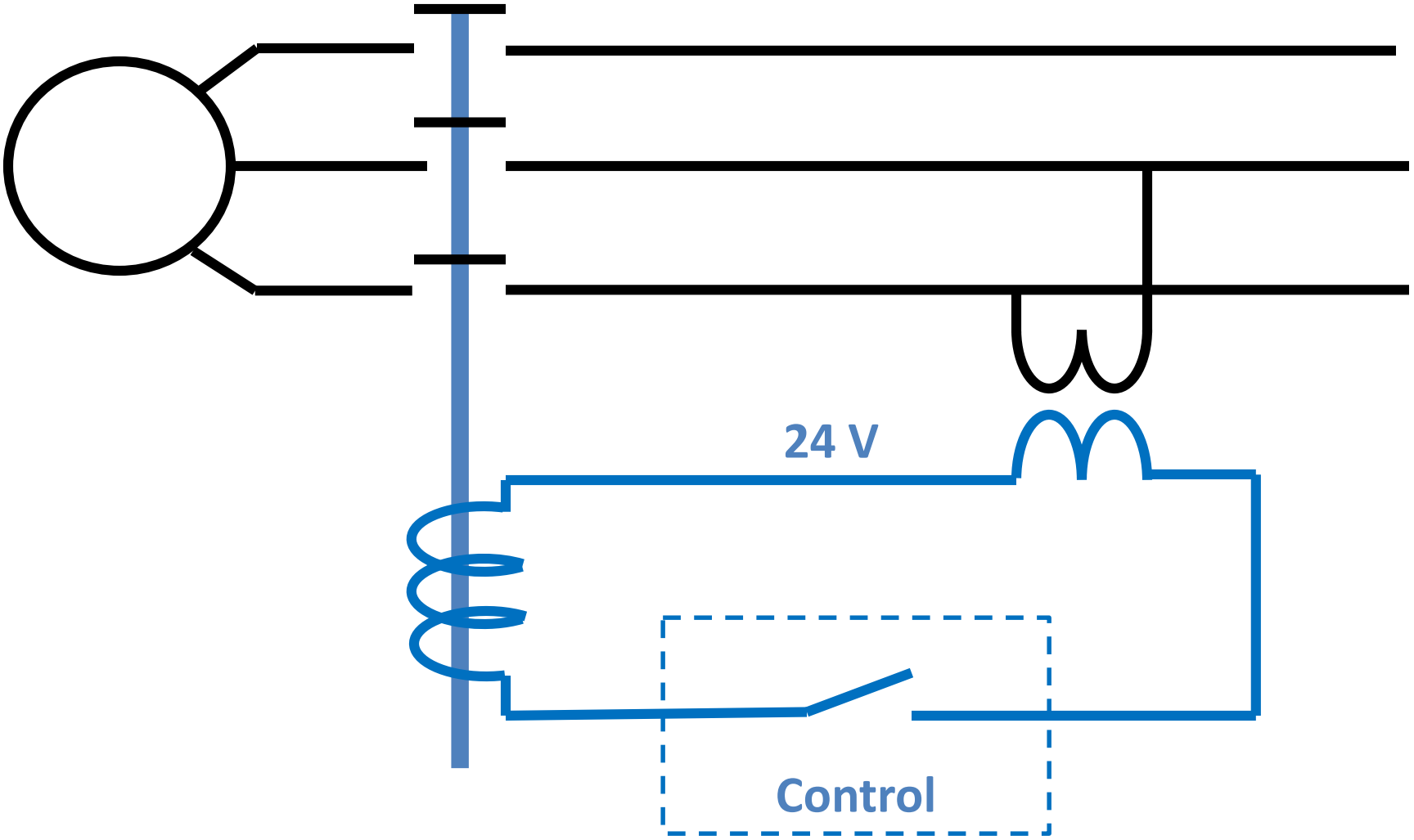

15000
10000
5000
0
-5000
-10000
-15000
0.2
0.25
0.3
0.35
0.4
0.45
0.5
0.55
0.6
0.65
0.7
Van East Bus
Vbn East Bus
Vcn East Bus


Summer Lake frequency (Hz)
60.1
60.08
60.06
60.04
60.02
60
59.98
59.96
-10
0
10
20
30
40
50
60

- Generation loss was about 190 MW

- Total load loss was about **920 MW**
  - 68 MW loss due to fault clearing
  - Loads tripped due to voltage sensitivity during the fault
  - No FIDVR detected

Modeling


24 V
Control

Commercial / residential loads:

- Motors B and C (fans and pumps)
  - 20% trip at 60% voltage, reclose at 75%
  - 30% trip at 50% voltage, reclose at 65%
- Motor A (compressors)
  - 20% trip at 70% voltage and lock out
  - 70% trip at 50% voltage, reclose at 70%
- Electronics
  - Ramp down linearly as voltage declines from 70% to 50%
  - 20% trip and remain off-line, 80% restart

Thank You