

Listen to Your Relays!

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System Protection

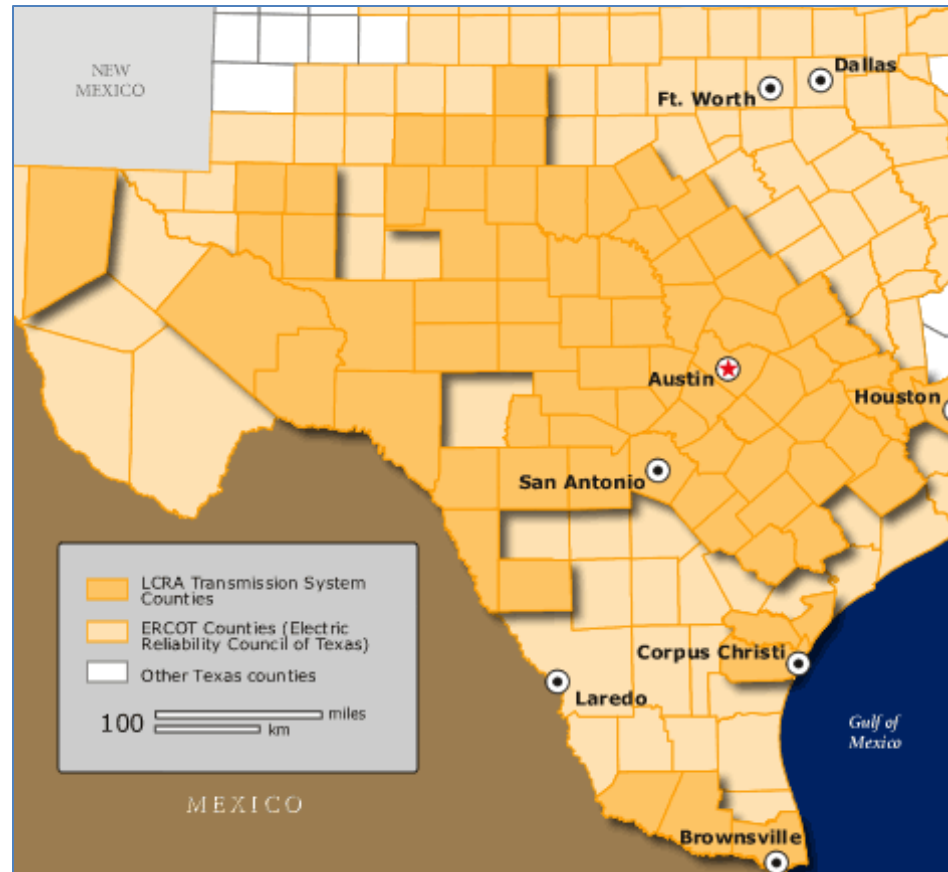
Texas A&M Relay Conference
College Station, TX
April 10, 2013

Topics

- Intro to LCRA Transmission Services
- Relay Data
- 4 mini case studies
 - Event #1 – 69kV generator tie line
 - Event #2 – 69kV substation cut-in
 - Event #3 – New 345kV line
 - Event #4 – 345kV CCVT

LCRA Transmission Services

- >840 miles of 345kV, >2400 miles of 138kV, >640 miles of 69kV

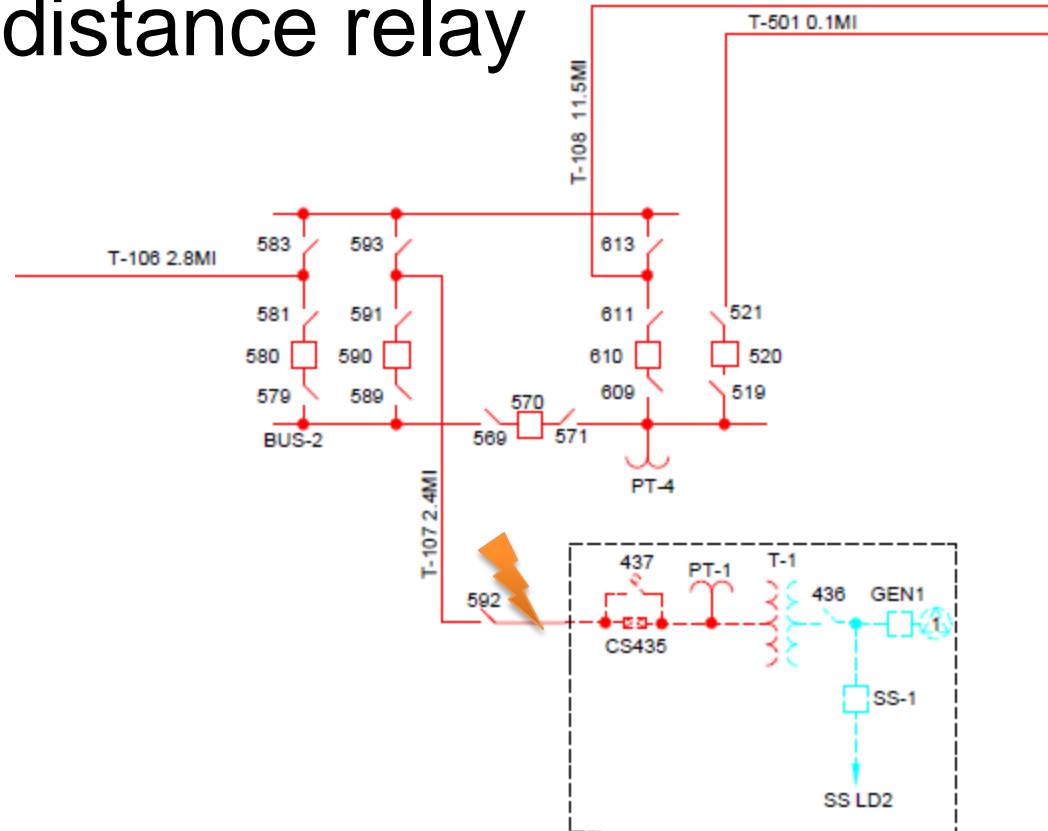


Relay Data

- More data available than you probably know what to do with:
 - Targets
 - Sequence of event recording
 - Metering quantities
 - Analog telemetry
 - Triggered oscillography
 - Distance-to-fault (DTF) reports
 - Synchrophasors
- But usually the trick is to listen to what the relay data is trying to tell you.

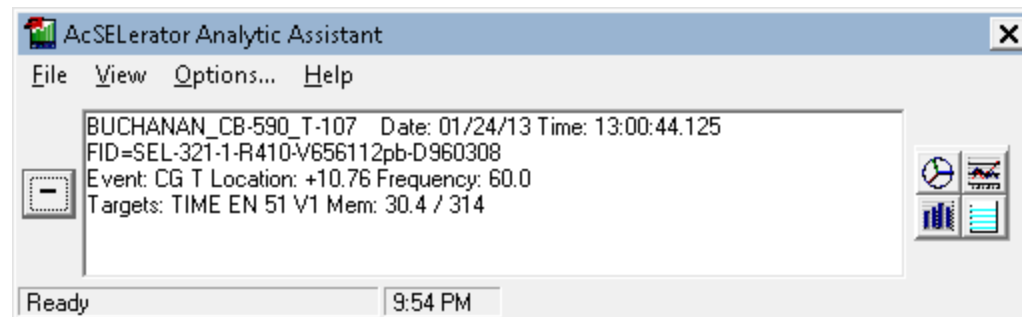
Event #1

- Radial 69kV line
- Connected to generator
- Step distance relay



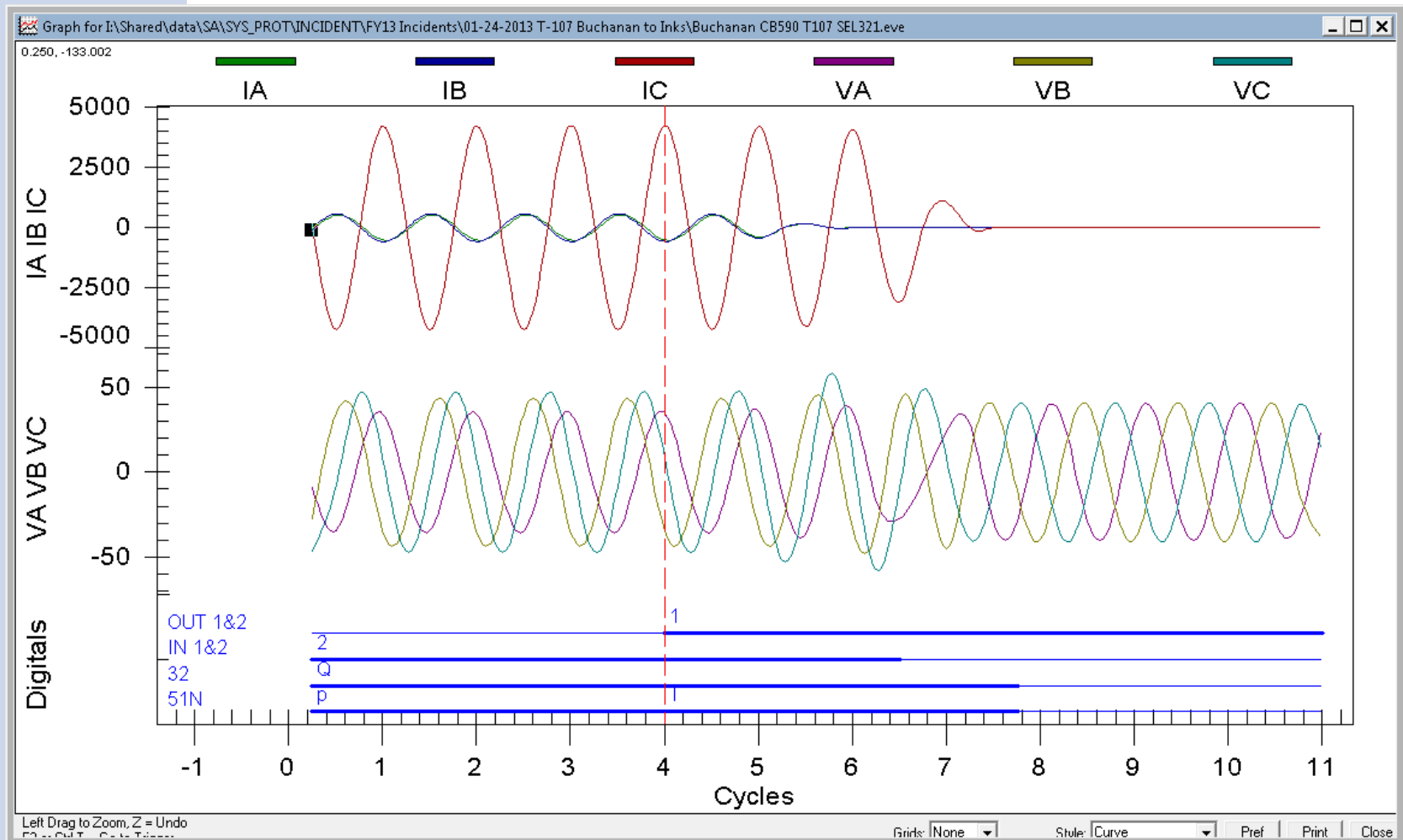
Event #1

- C-G line fault occurred on 1/24/13
- Distance elements did not operate
- Relay cleared on ground time overcurrent
- Line length is 2.38 miles, but fault location reported was 10.76 miles
- Fault duty is reasonable, but why no 21 operation, and why bad mileage?
- High impedance fault maybe?



Event #1

- Voltages look odd for a L-G fault



Event #1

- Consulted with relay vendor
- Recommended inspecting PT circuit, focusing on PT grounding
- Field crews investigated in field:

We found the PT-4 distribution panel 26 was drawn incorrectly. The orange and blue wires out of cable 306 were not landed the way the print shows. The orange was actually landed on 2604-8 and the blue on 2604-9. That means that the return for the voltage on panel 24 was not going to ground, it was tied to the orange wire or D1 voltage. I have attached a corrected print with the changes we made. I think this fix has solved the problem. Mr. Costello was correct, when we measured the impedance from a known ground to the neutral on the SEL-321 relay, it read 1.13 mega-ohms. Once we re-wired, it read .18 ohms.

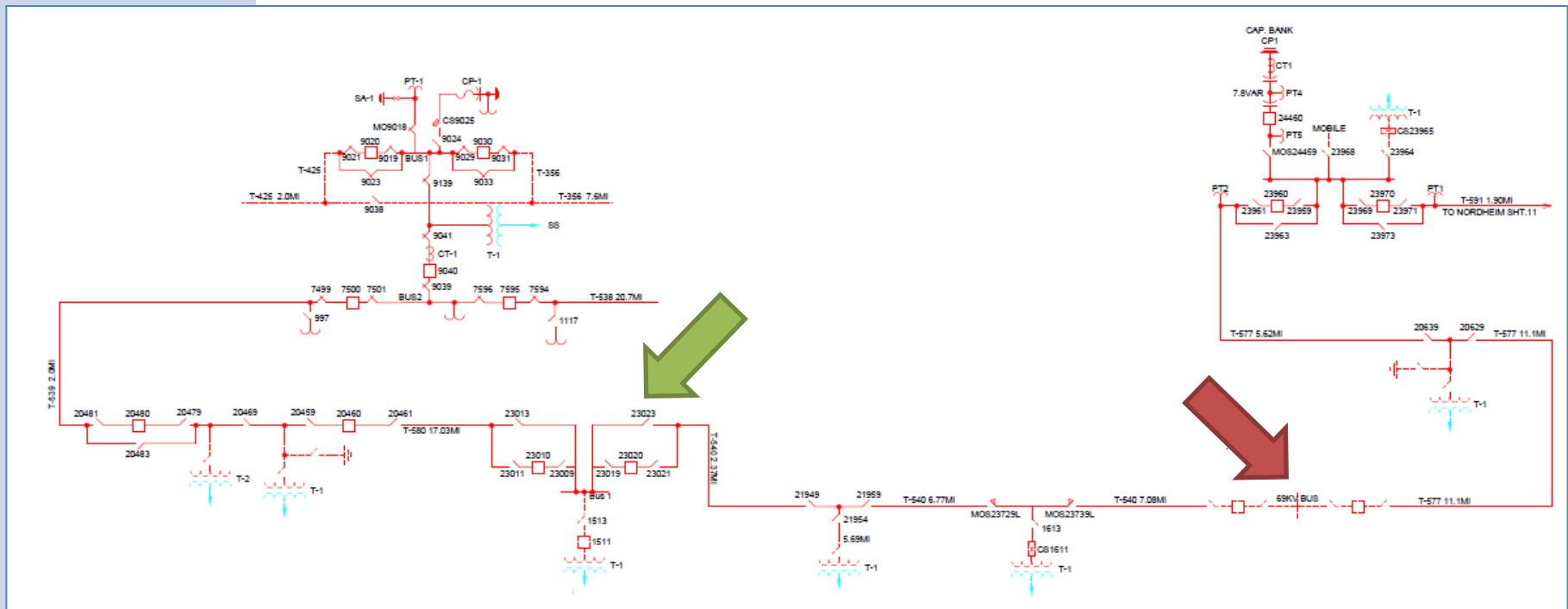
Event #1

- Moral of the story?
- Question event data that looks odd,
- Keep Dave's e-mail handy, and

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Event #2

- New 69kV substation, March 2012
- Cut-in on a tie line with another TSP
- Serves load for a 3rd TSP



Event #2

- First faults on adjacent line segments following the cut-in occur during May 2012
- Taken individually, fault reports indicate relay performance is good
- But, taken collectively, we notice:
 - For a system A-G fault on 5/21/12, both line relays at the new station reported a B-G fault.
 - For a system C-G fault on 5/10/12, both line relays at the new station reported an A-G fault.

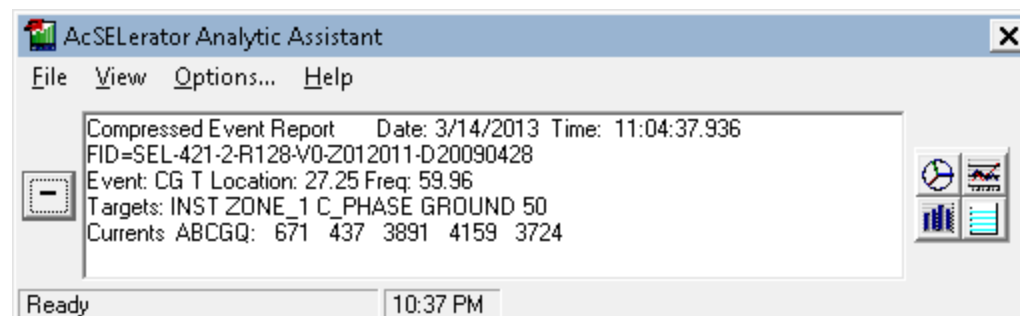
Event #2

- Moral of the story?
- Pay attention to relay records even on un-faulted line segments,
- Connect a good time reference, and

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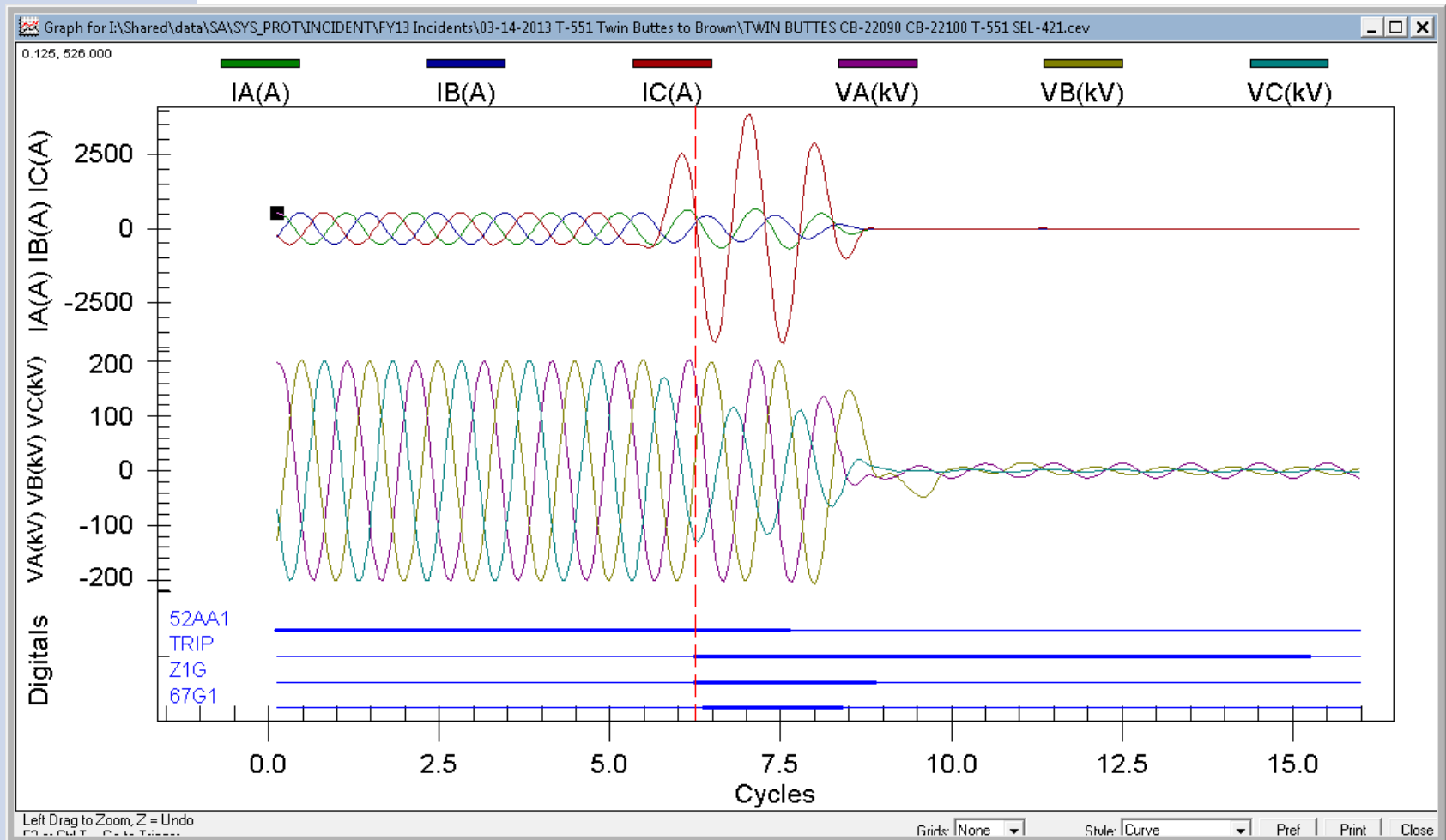
Event #3

- New 345kV tie line – 88 miles long
- First fault (C-G) occurred 3/14/13
- Clearing time looked pretty good
- Targets indicated zone 1 ground distance and instantaneous overcurrent



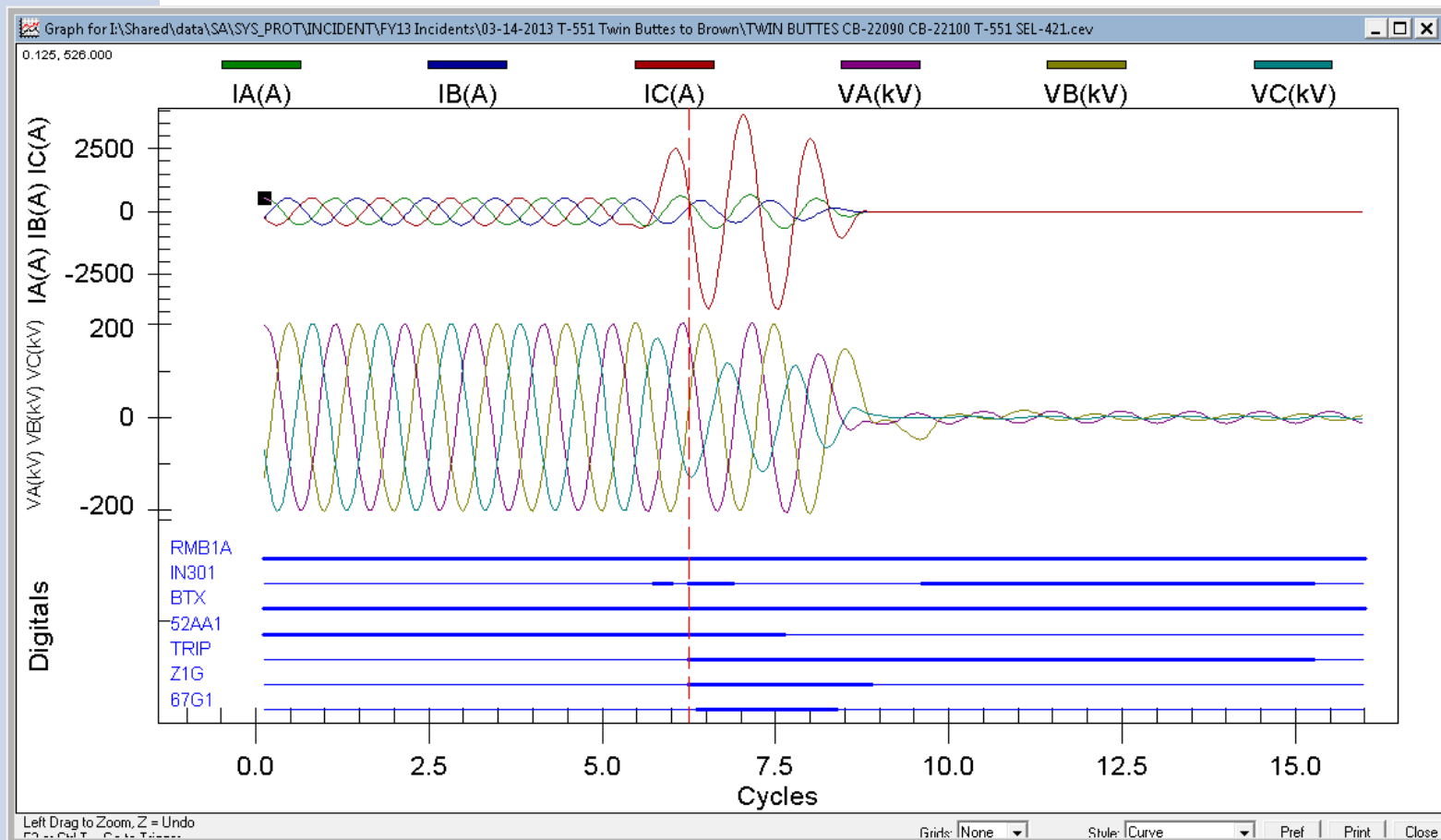
Event #3

- Case closed, right?



Event #3

- Let's check DCB scheme...why is block (BTX) asserted solid?



Event #3

- $BT := IN301 \text{ OR } RMB1A$
- $IN301$ = Power line carrier input
- $RMB1A$ is future (not installed yet)
- But if the mirrored bits circuit is future, why is $RMB1A$ asserted?
- $RMB1$ channel fail state options:
 - $RMB1FL := 0, \underline{1}, P$

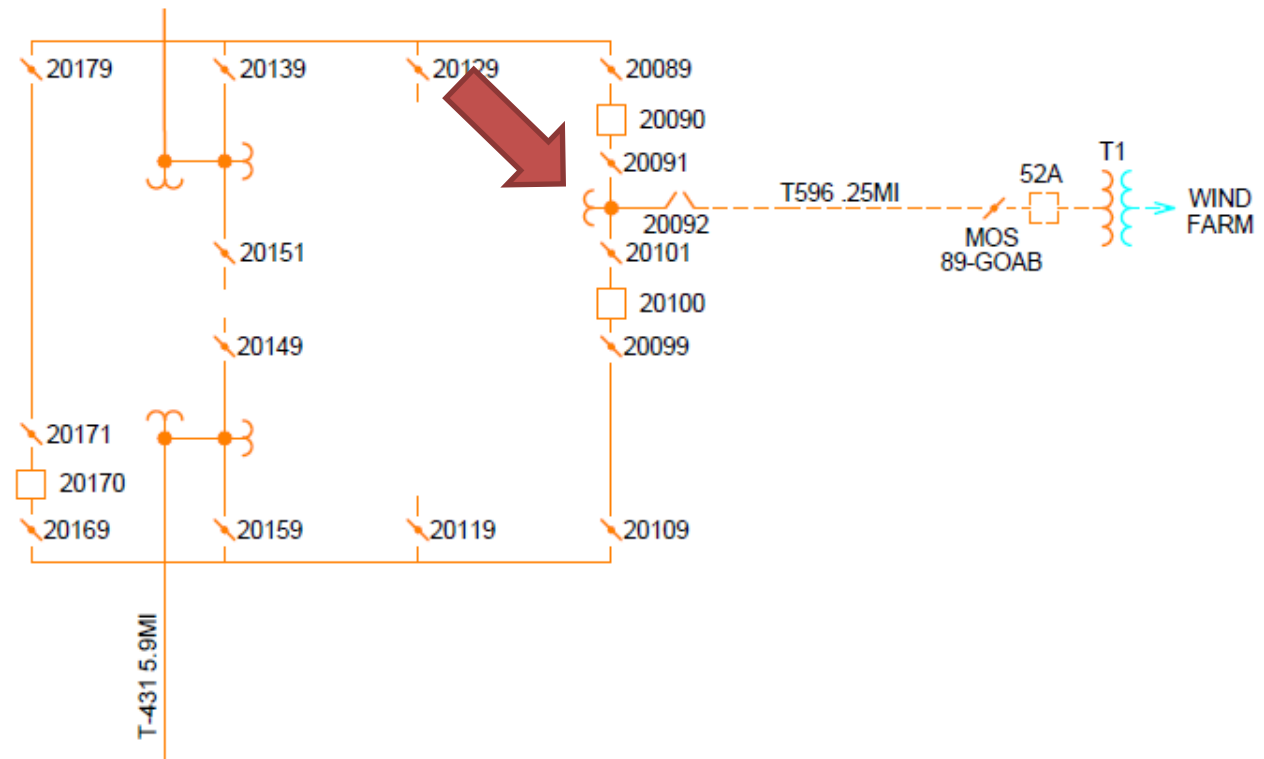
Event #3

- Moral of the story?
- Pay attention to need for temp settings,
- Check pilot scheme operation even for zone 1 faults, and

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Event #4 (last one)

- 345kV CCVT on wind farm gen tie
- Relay oscillography and SER indicate voltage deviations and LOP



Event #4 (last one)

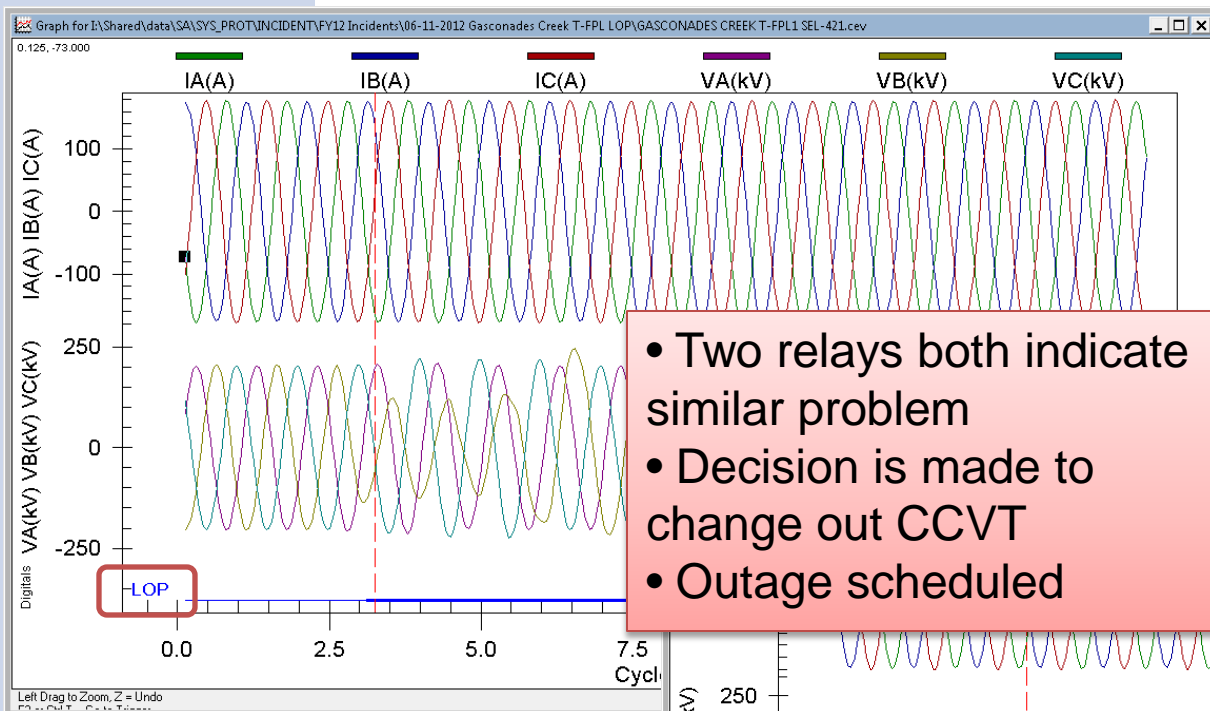
PRIMARY RELAY
CB-20090/20100

Date: 06/11/2012 Time: 16:01:54.866
Serial Number: 2005294204

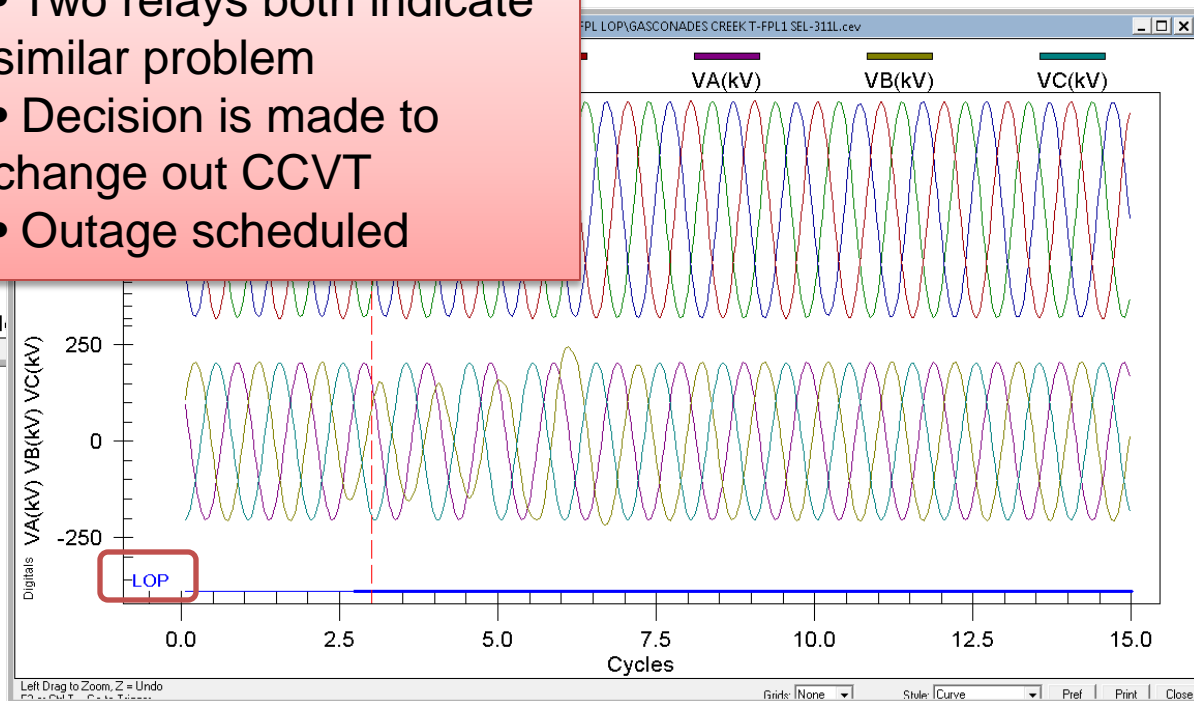
FID=SEL-421-1-R201-V0-Z007007-D20070220

#	DATE	TIME	ELEMENT	STATE
16	06/08/2012	21:38:38.380	LOP	ASSERTED
15	06/08/2012	21:38:38.382	LOP	DEASSERTED
14	06/08/2012	21:38:38.384	LOP	ASSERTED
13	06/08/2012	21:38:38.397	LOP	DEASSERTED
12	06/08/2012	21:38:38.584	LOP	ASSERTED
11	06/08/2012	21:38:38.905	LOP	DEASSERTED
10	06/08/2012	21:38:38.920	LOP	ASSERTED
9	06/08/2012	21:38:39.587	LOP	DEASSERTED
8	06/08/2012	22:11:55.428	LOP	ASSERTED
7	06/08/2012	22:11:55.441	LOP	DEASSERTED
6	06/10/2012	02:22:38.252	LOP	ASSERTED
5	06/10/2012	02:22:38.756	LOP	DEASSERTED
4	06/11/2012	12:43:30.626	LOP	ASSERTED
3	06/11/2012	12:43:32.288	LOP	DEASSERTED
2	06/11/2012	12:45:47.342	LOP	ASSERTED
1	06/11/2012	12:45:47.921	LOP	DEASSERTED

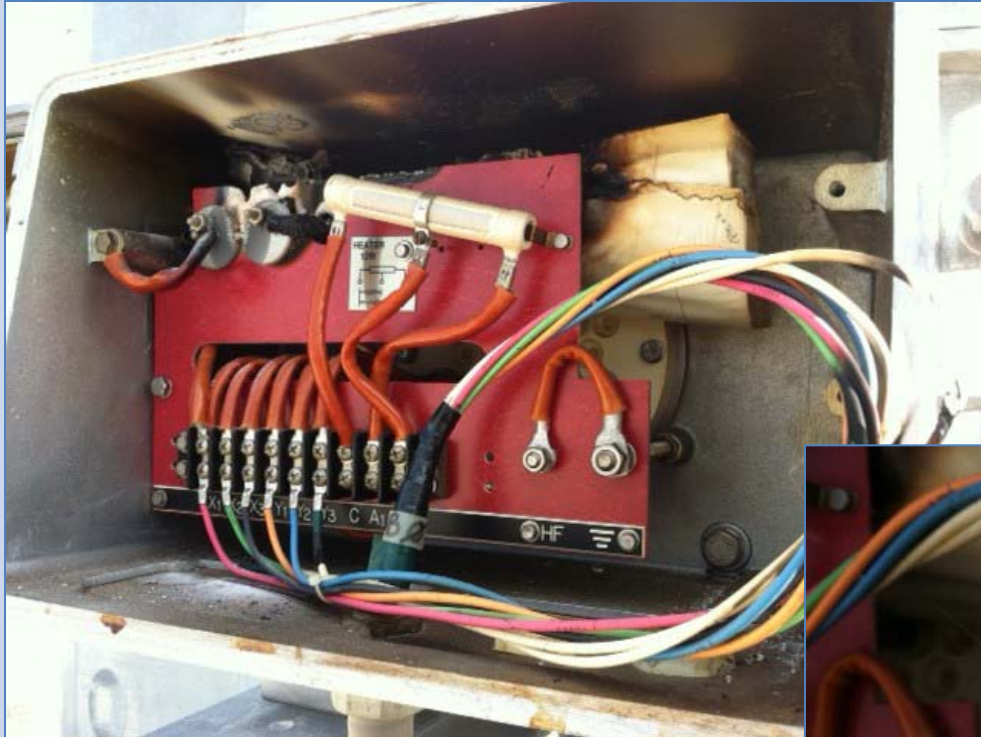
Event #4 (last one)



- Two relays both indicate similar problem
- Decision is made to change out CCVT
- Outage scheduled



Event #4 (last one)



Event #4 (last one)

- Moral of the story?
- Trust what relay tells you, but verify,
- Don't store manuals inside energized equipment (near heaters), and

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Thank-you for your time

• ~~Questions?~~ Lunch!

