

Post Energization Commissioning via Event Reports

Martin Moon

Relay Application Innovation, Inc.



Commissioning

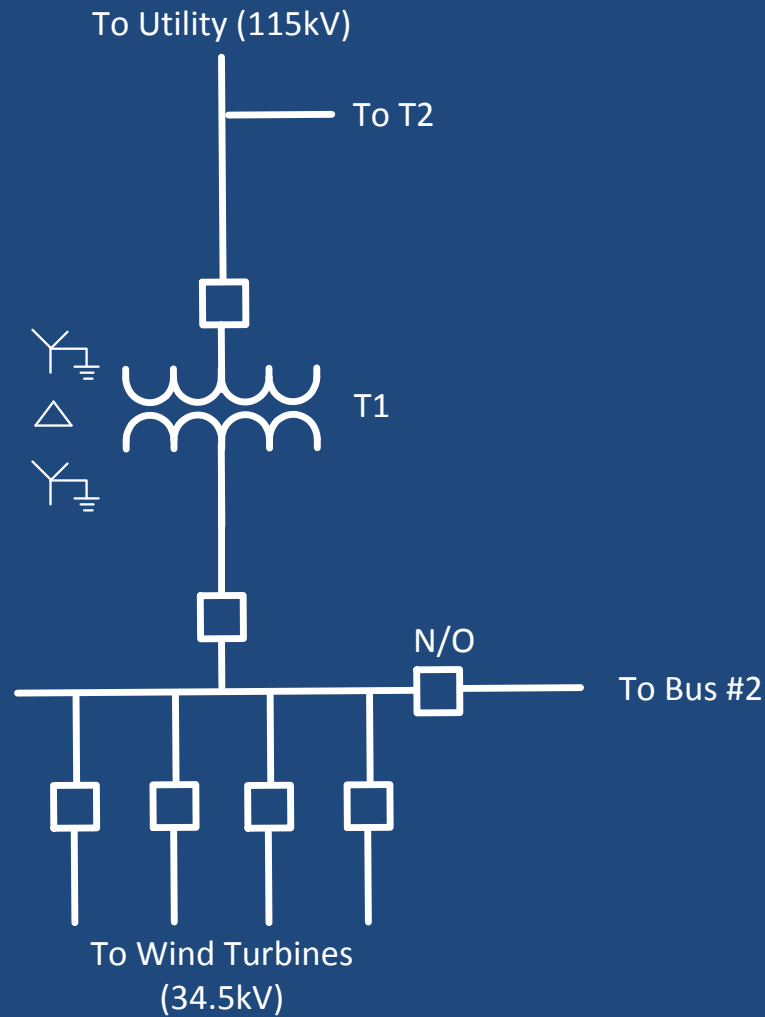
- The process of assuring that all systems and components are designed, installed and function to the design or specifications.

Background

- New 200MW windfarm
- 115kV line to utility
- Relay testing and commissioning completed
- RAI was asked to review relay operations



System Overview



Line Relay Operation

- Line protection
 - Line current differential (87L)
 - POTT
- Line successfully energized
- Line tripped when transformer energized
 - 87L tripped
- Attempted energization several times

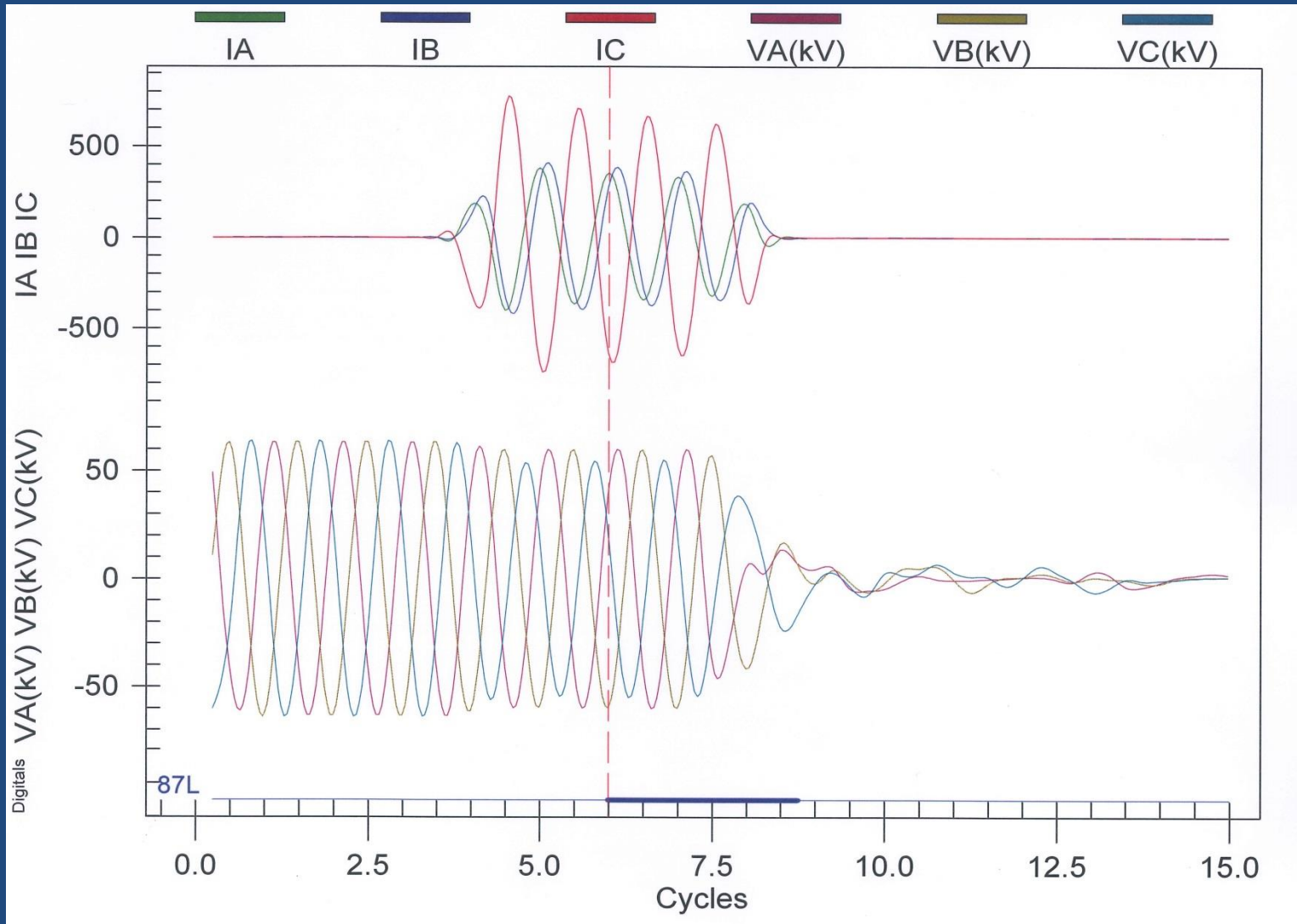
Onsite “Analysis”

- Tripping on inrush
- Problem with relay settings
- Cut out the 87L relay
- Successfully energized
- Cut in 87L relay – No trip
- Supported hypothesis of relay setting problem

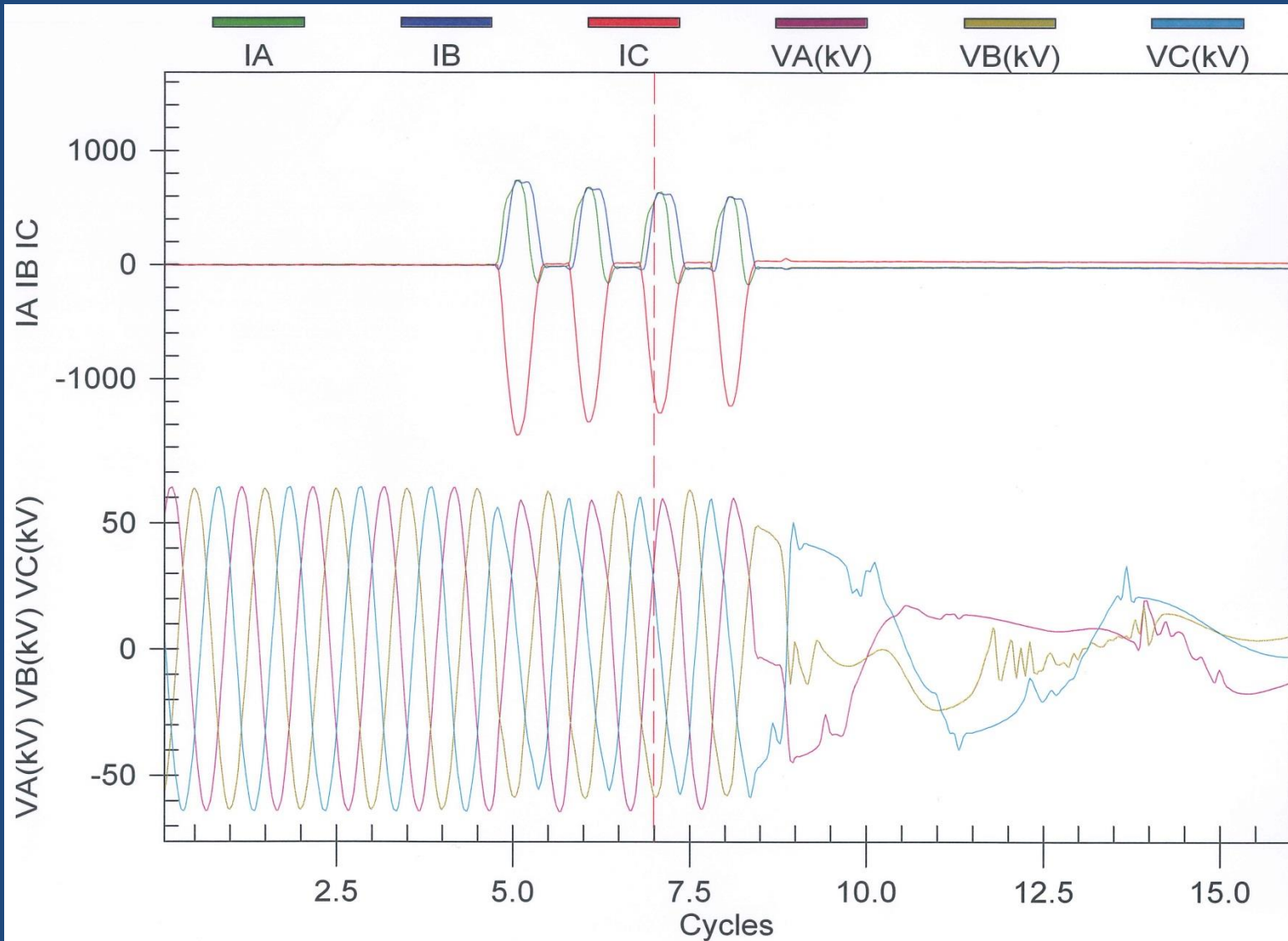
Questions

- Is this a fault?
- Is this a setting problem?
- Why does it trip on inrush?

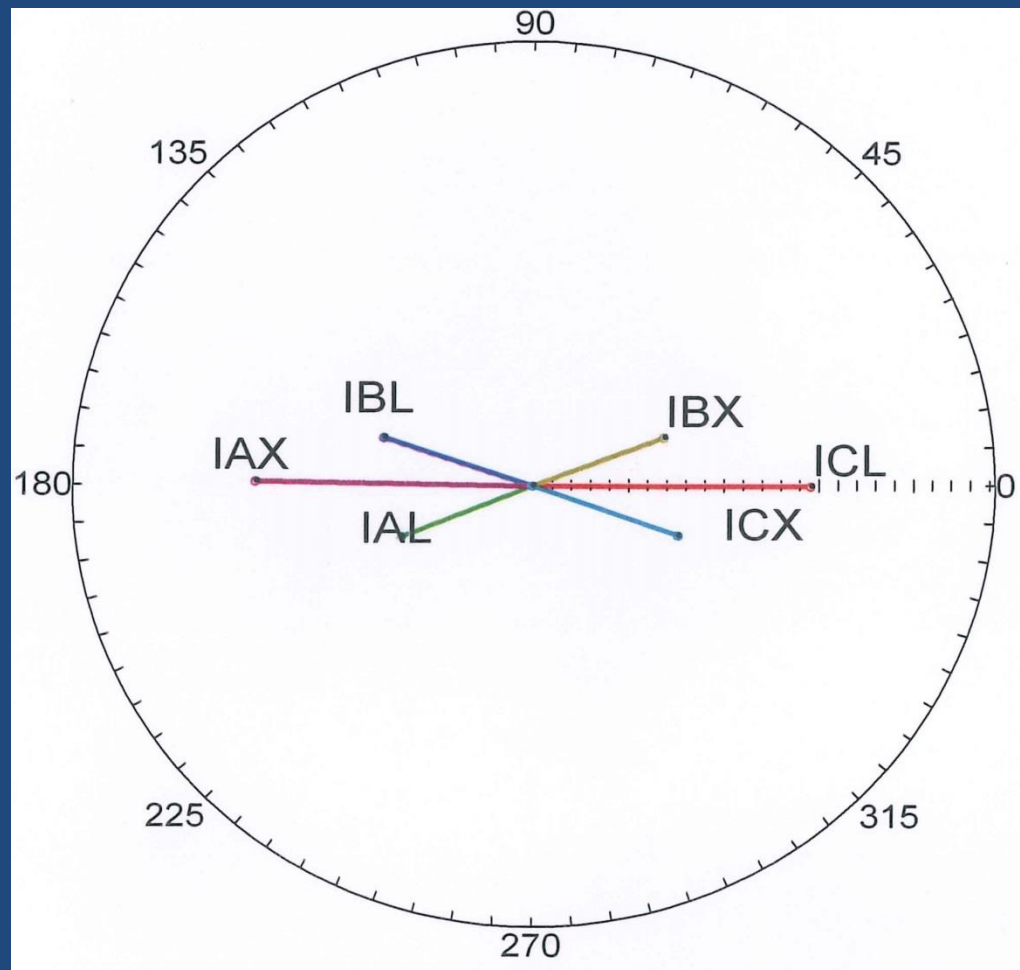
Event Waveform



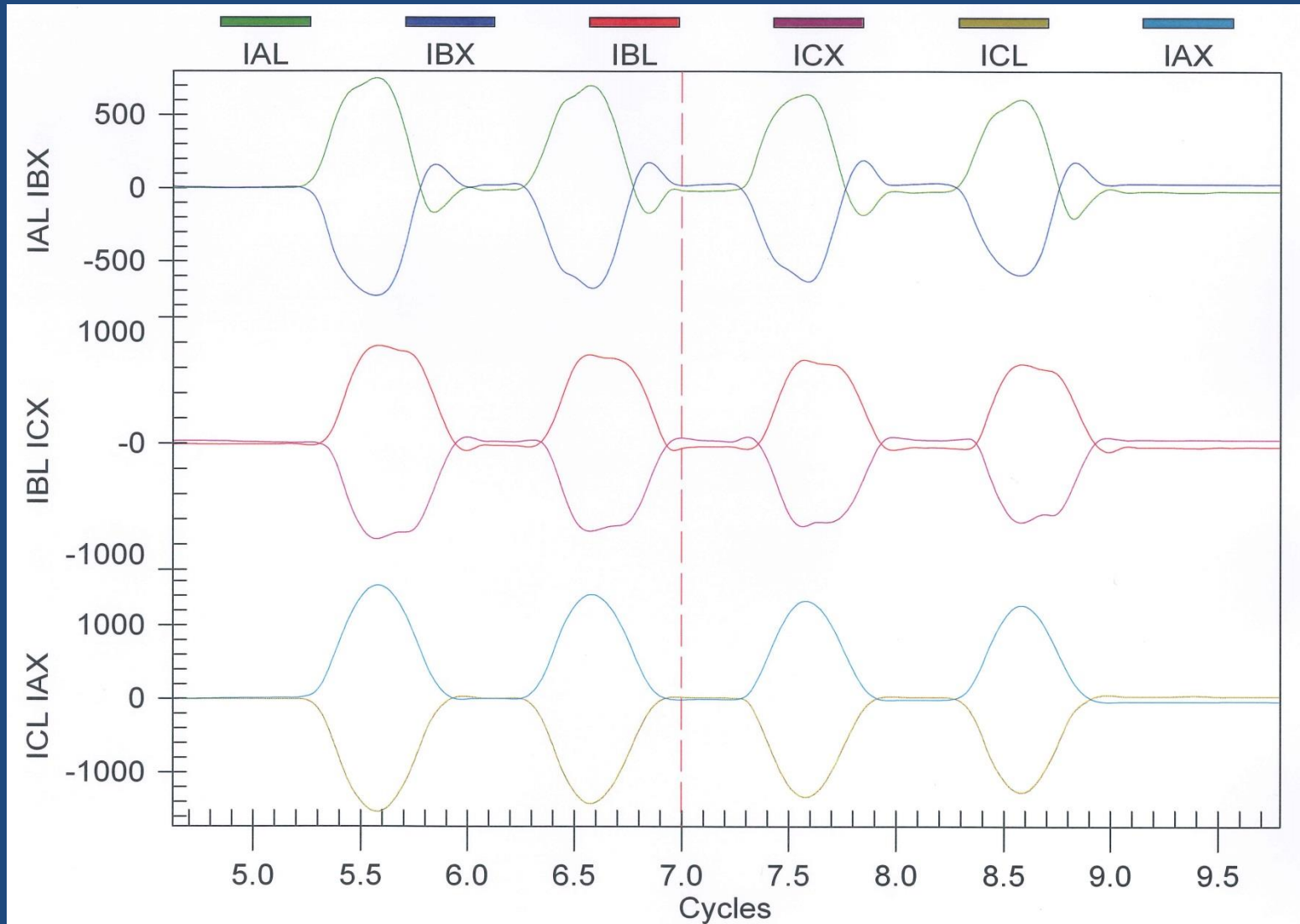
Waveform - Unfiltered



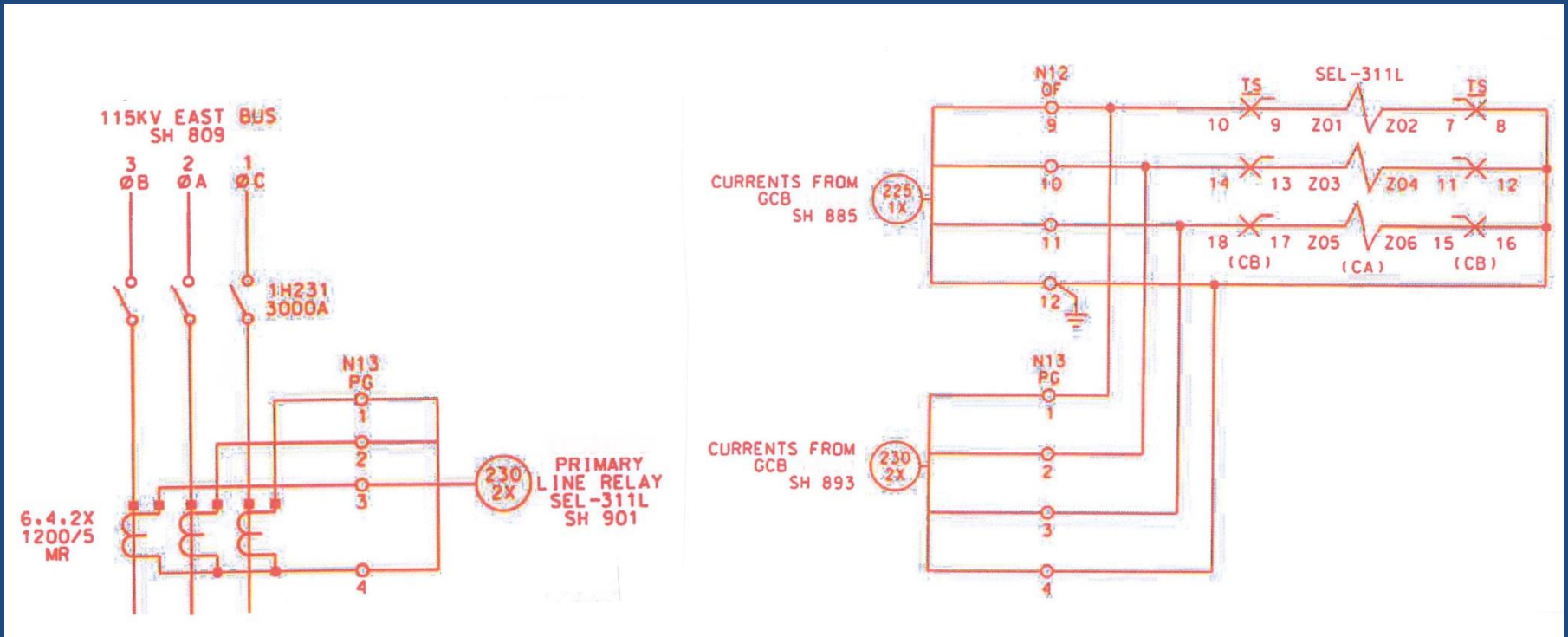
Phasor View



Waveform - Local vs. Remote



Remote End Wiring



- Rem Relay A = C primary = Loc Relay C
- Rem Relay B = A primary = Loc Relay A
- Rem Relay C = B primary = Loc Relay B

87L Analysis

- Is this a fault? No
- Is this a setting problem? No
- Why does it trip on inrush? Relay phasing

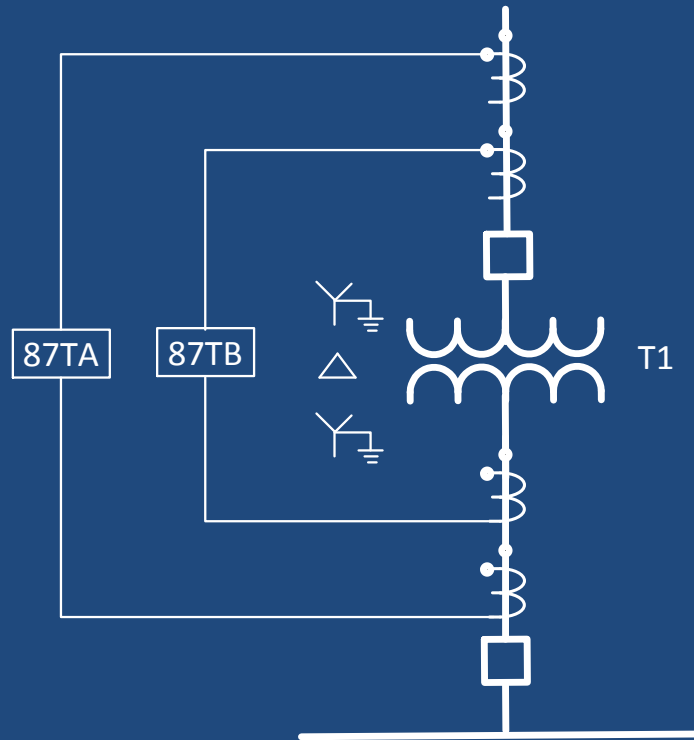
A Couple of Weeks Later....

- Substation has been energized
- Transformer #1 trips
 - Differential Relay 87TA – Trips
 - Differential Relay 87TB – No trip

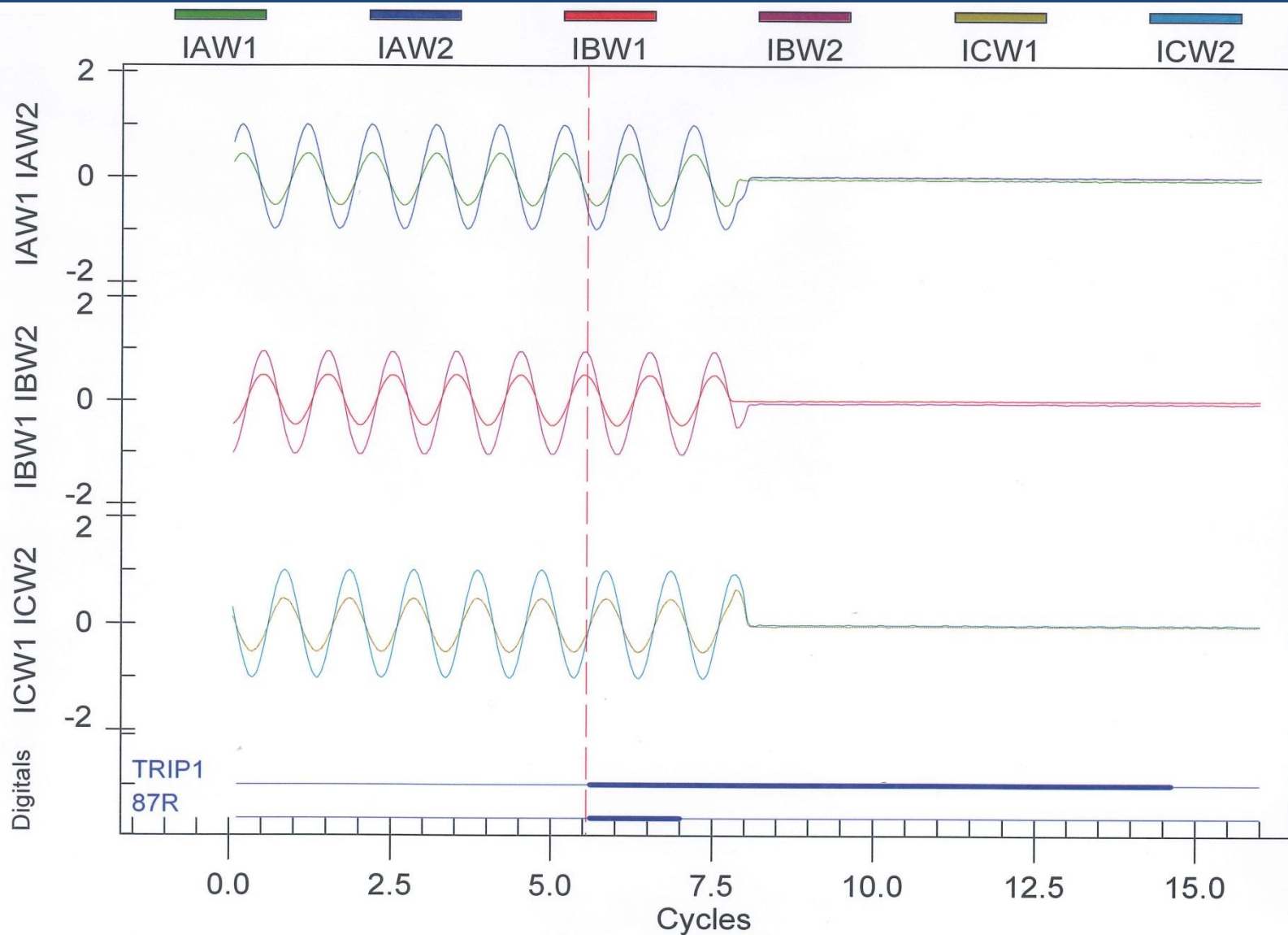
Questions

- Is this a fault?
- Is this a setting problem?

T1 Differential



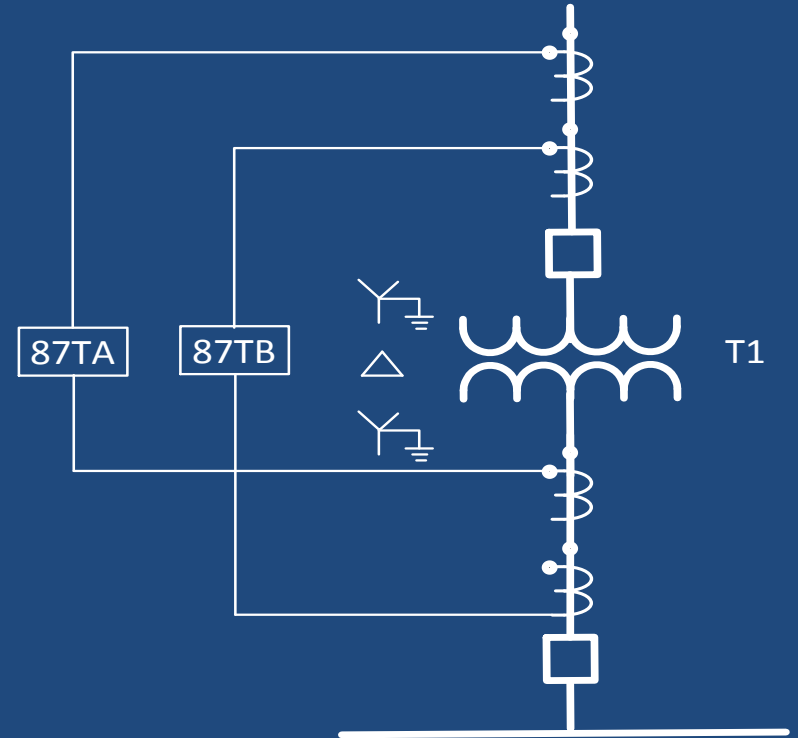
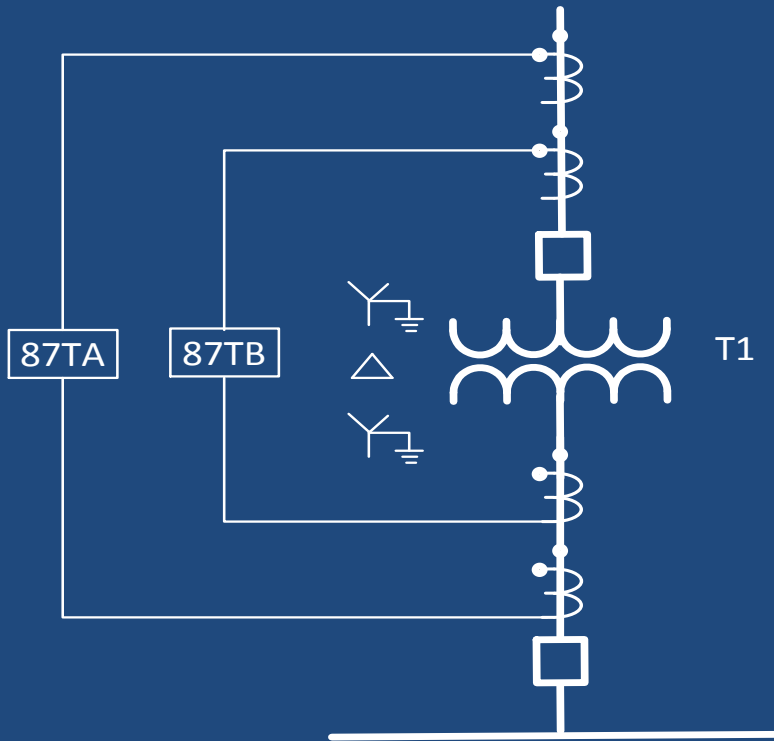
Event Waveform



T1 Analysis

- Is this a fault? No
- Is this a setting problem? No
- Tripped on generation due to polarity
 - 87TB 34.5kV CTs wired in reverse polarity
- Also found
 - 87TA wired to 87TB 34.5kV CTs
 - 87TB wired to 87TA 34.5kV CTs

Designed vs. Actual



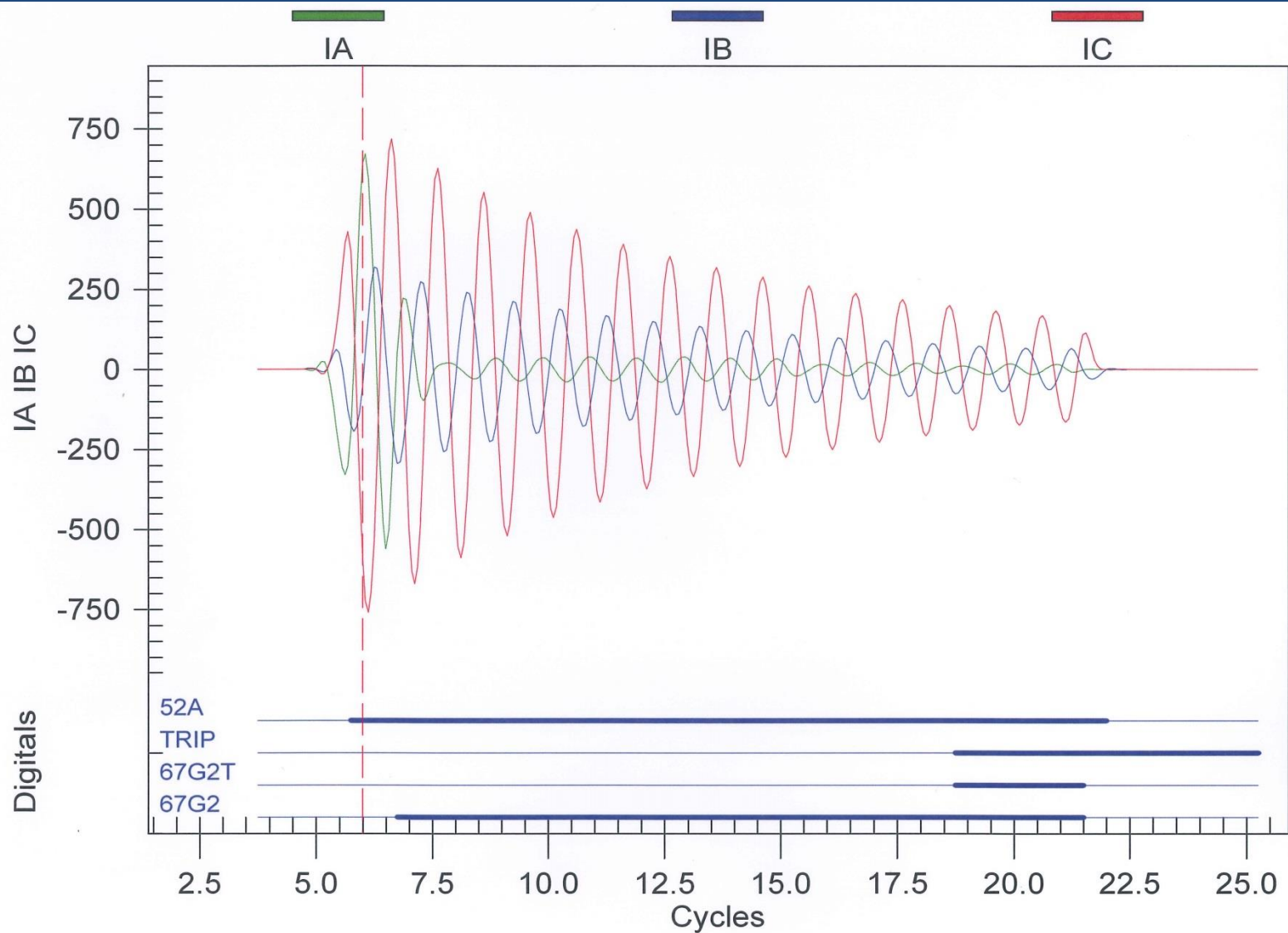
Another Week Passes....

- Following planned outage
- Collector circuit trips on energization

Questions

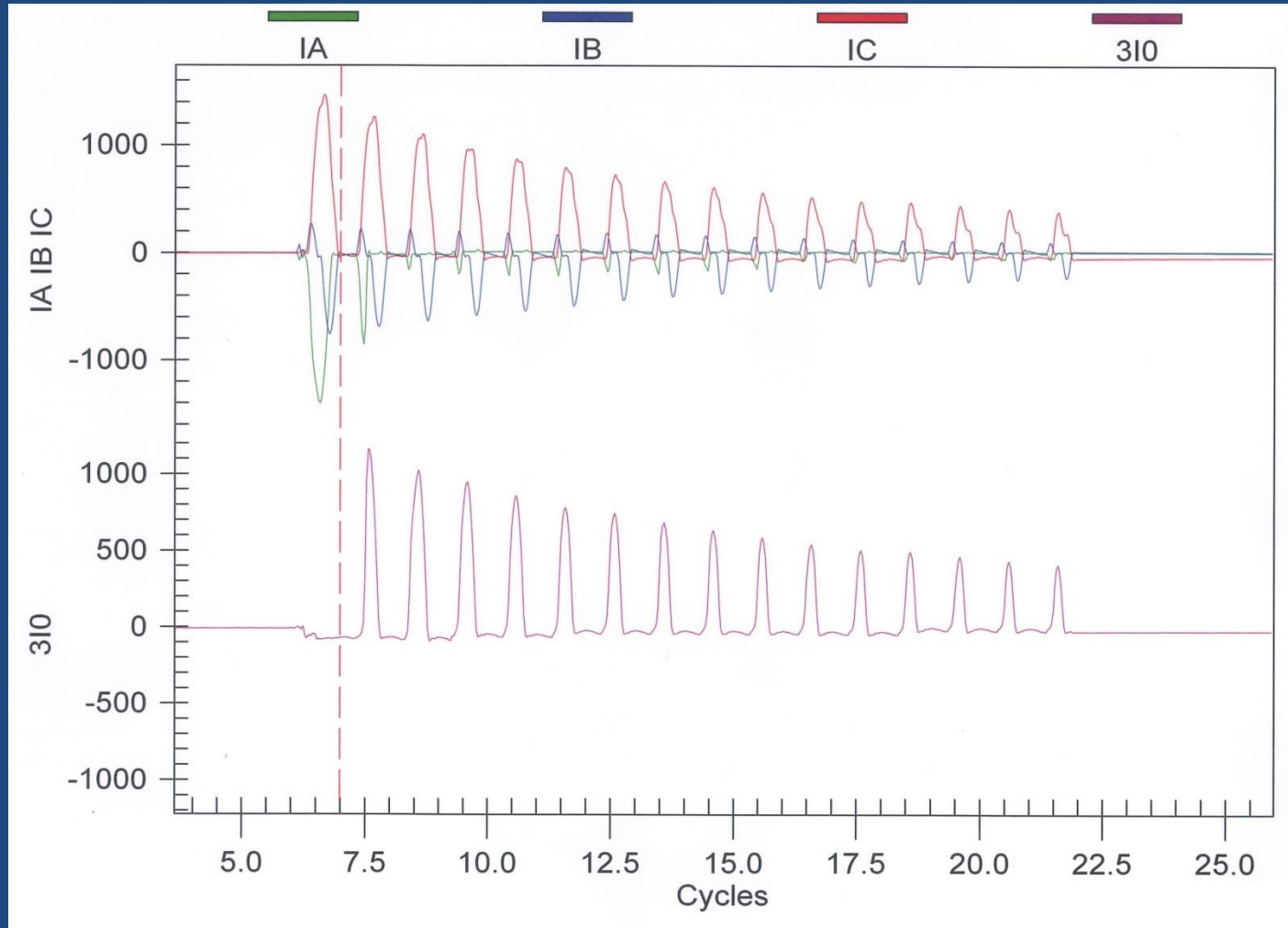
- Is this a fault?
- Is this a setting problem?

Event Waveform



Waveform – Unfiltered

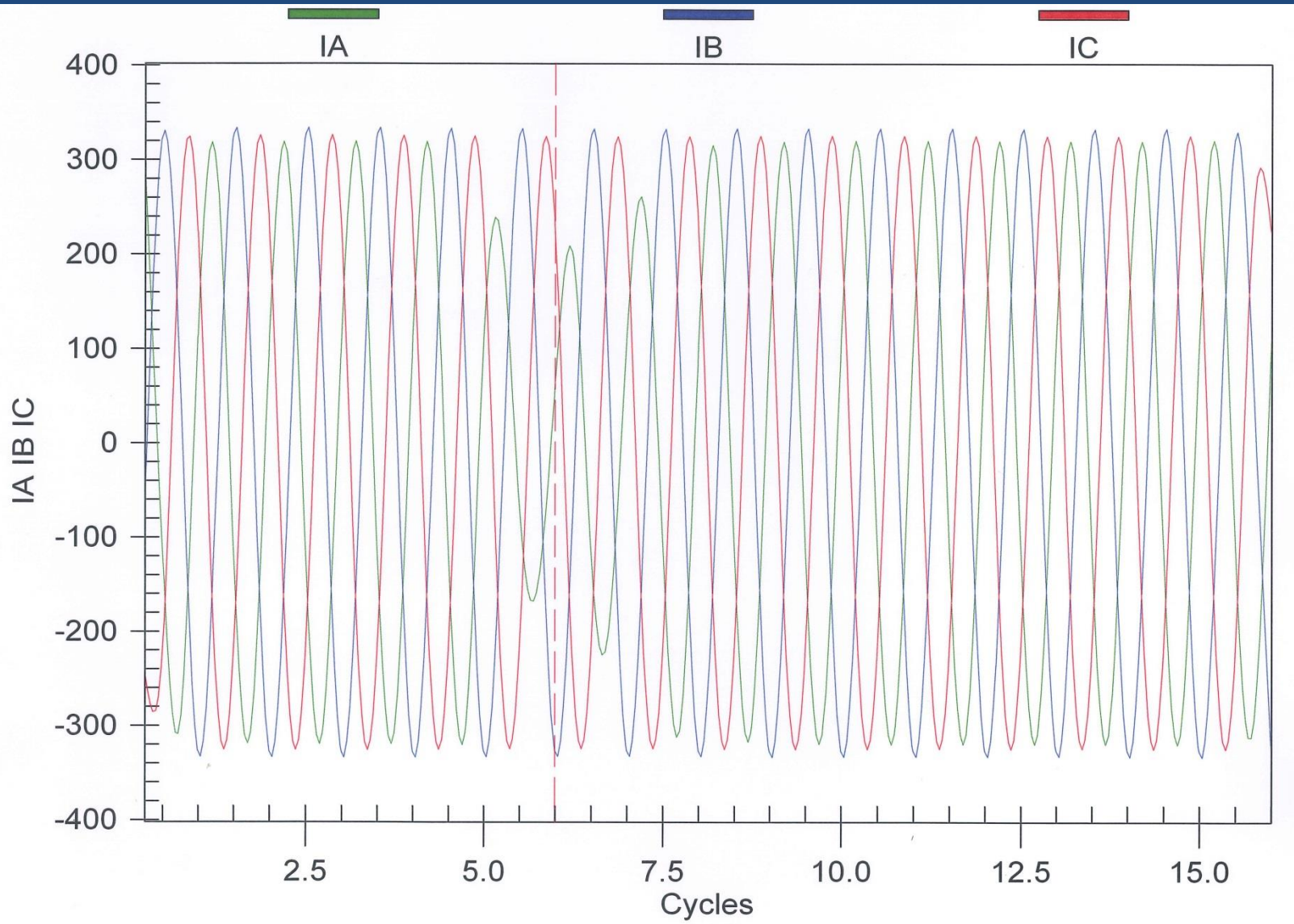
- Why do we have 3I0 current?



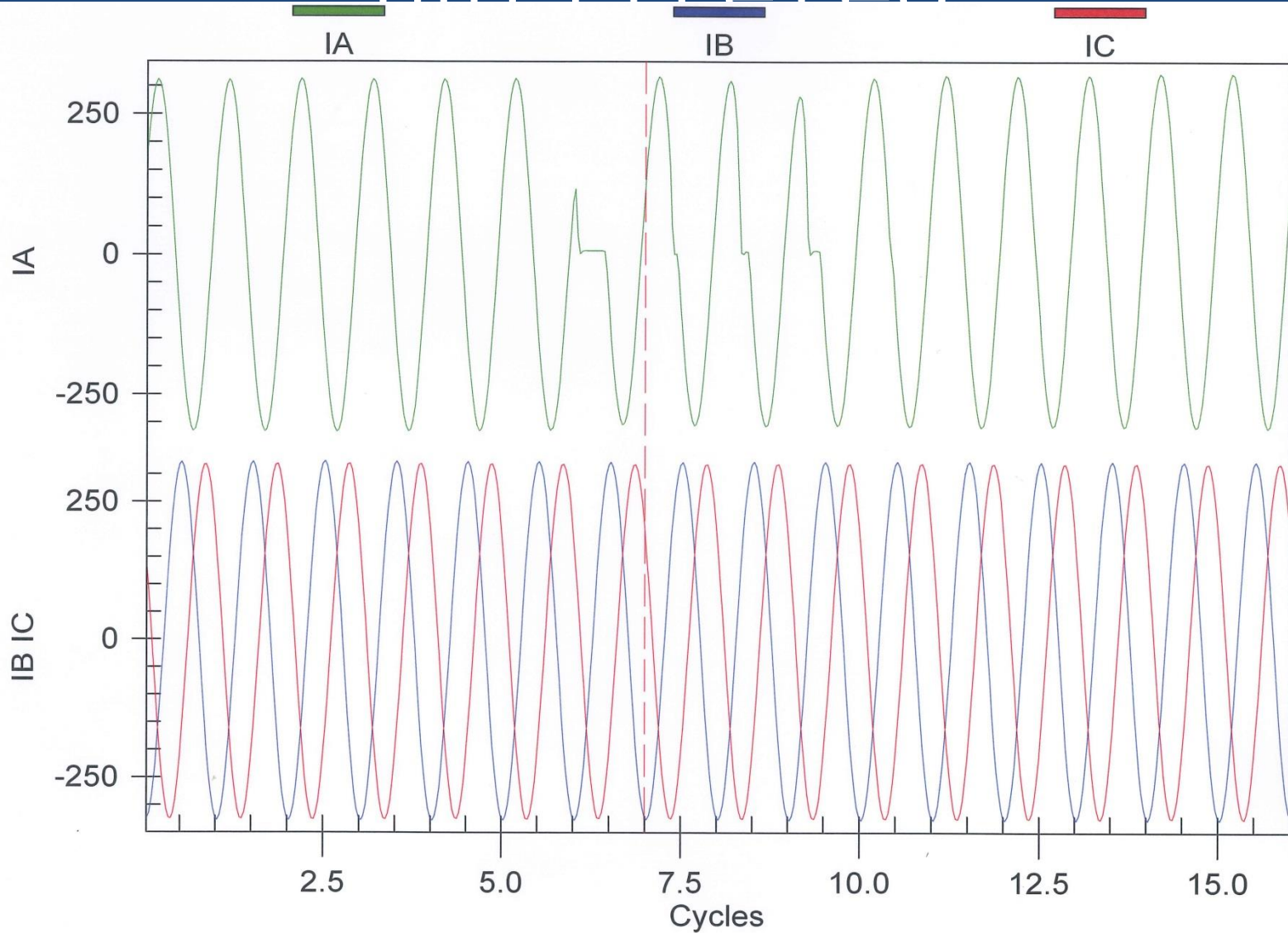
Review of Event History

- Reviewed event history
- Relay triggered prior events

Waveform – Load



Waveform Load - Unfiltered

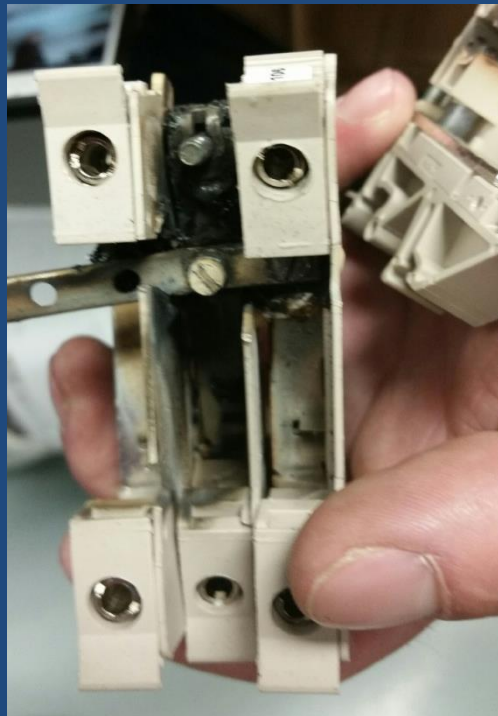


Collector Analysis

- Is this a fault? No
- Is this a setting problem? No
- Problem with A phase CT circuit
- 3I0 from A phase CT circuit problem

CT Terminal Block

- Field personnel asks “is this the cabinet we had the arcing”
- Terminal block was “cleaned-up” after earlier arcing



Lessons to be Learned

- Commissioning does not end with relay testing
- Proper end-to-end testing
- Look at the big picture - Don't blindly inject at the test block
 - Primary vs secondary phasing
 - CT polarity correct for application

Lessons to be Learned

- Secondary current injection from equipment proves wiring
- Perform in-service load checks or primary injection testing
- Review relay event history – Can you explain trigger?
- Problems with CT terminal blocks should be thoroughly investigated

Questions?

