

Unintended Consequences of Extra Sensitive Protection

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Dr. B. Don Russell, Distinguished Professor, bdrussell@tamu.edu (presenter)

Carl L. Benner, Research Professor, carl.benner@tamu.edu

Dr. Karthick Manivannan, Assoc. Research Professor, karthick@tamu.edu

Dr. Jeffrey Wischkaemper, Assoc. Research Professor, jeffw@tamu.edu

Department of Electrical and Computer Engineering

Texas A&M University, College Station, Texas 77843-3128 USA

Extreme wildfire danger and exceptional weather events have caused utilities to revisit distribution circuit protection

- Extreme case: preemptively deenergize circuits during risk periods
(California Public Safety Power Shutoff)
- Normal case: block reclosing during high risk periods
- Setting reclosers and breakers to extra sensitive protection
(One very fast trip, no reclose)

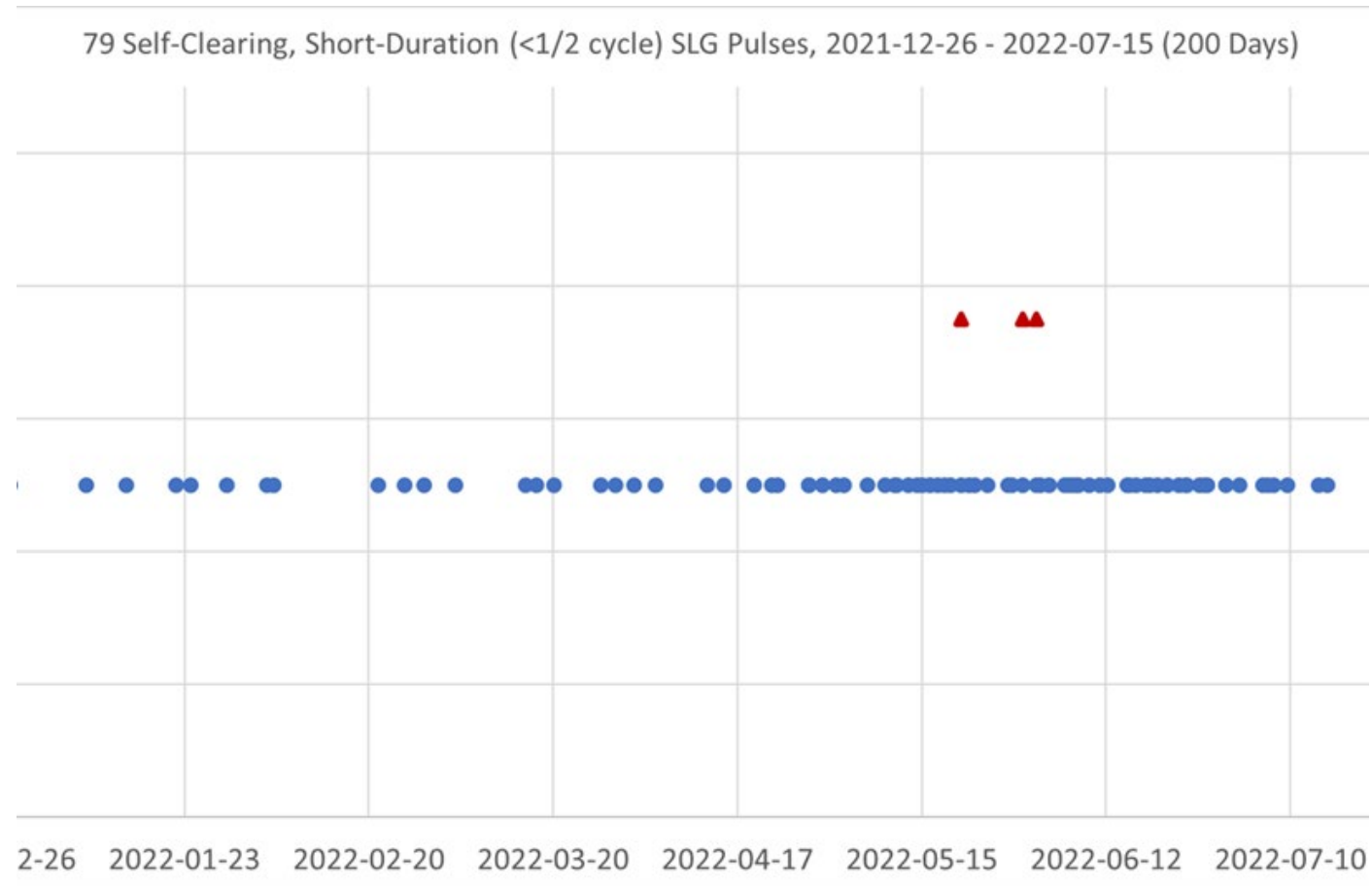
Each of these affects system reliability but can reduce risk of fire ignition or unsafe conditions

Unintended or negative consequences

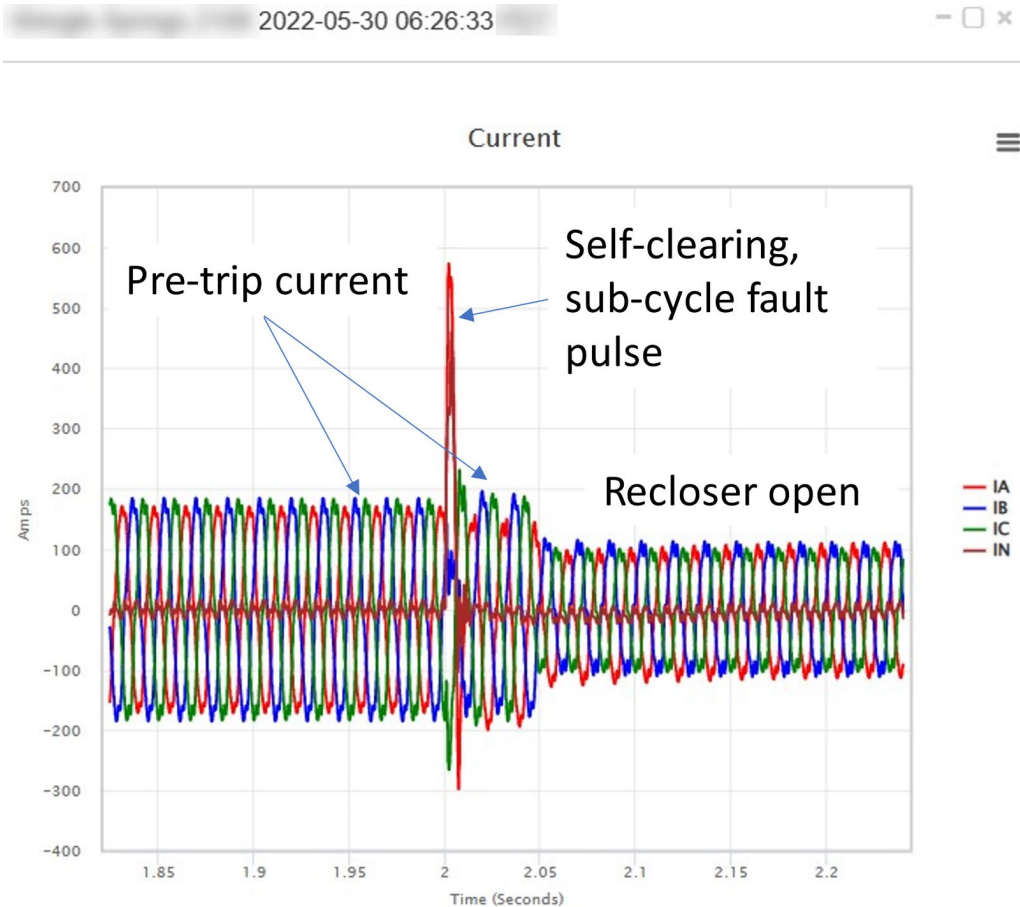
- Blocking reclosing results in many unnecessary outages
(up to 90% of faults are temporary/self-clearing)
- Extra sensitive protection with blocked reclosing can result in unnecessary trip operations and very long outages due to the need to patrol circuits before they are reenergized

It is important to understand the consequences of extra sensitive protection, including hyper-sensitivity to short duration faults.

Time sequence of 79 short-duration pulses related to failure of a single cable fitting

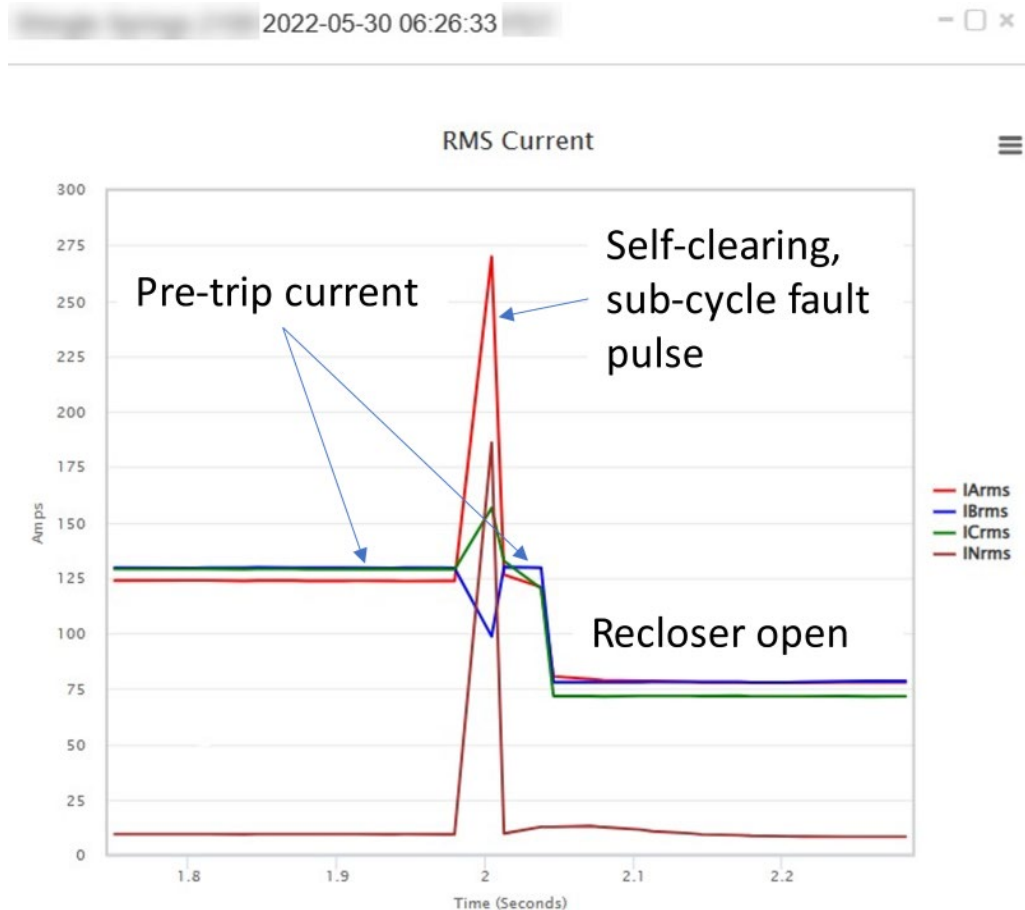


Cable-fitting current pulse that self-cleared but the recloser tripped



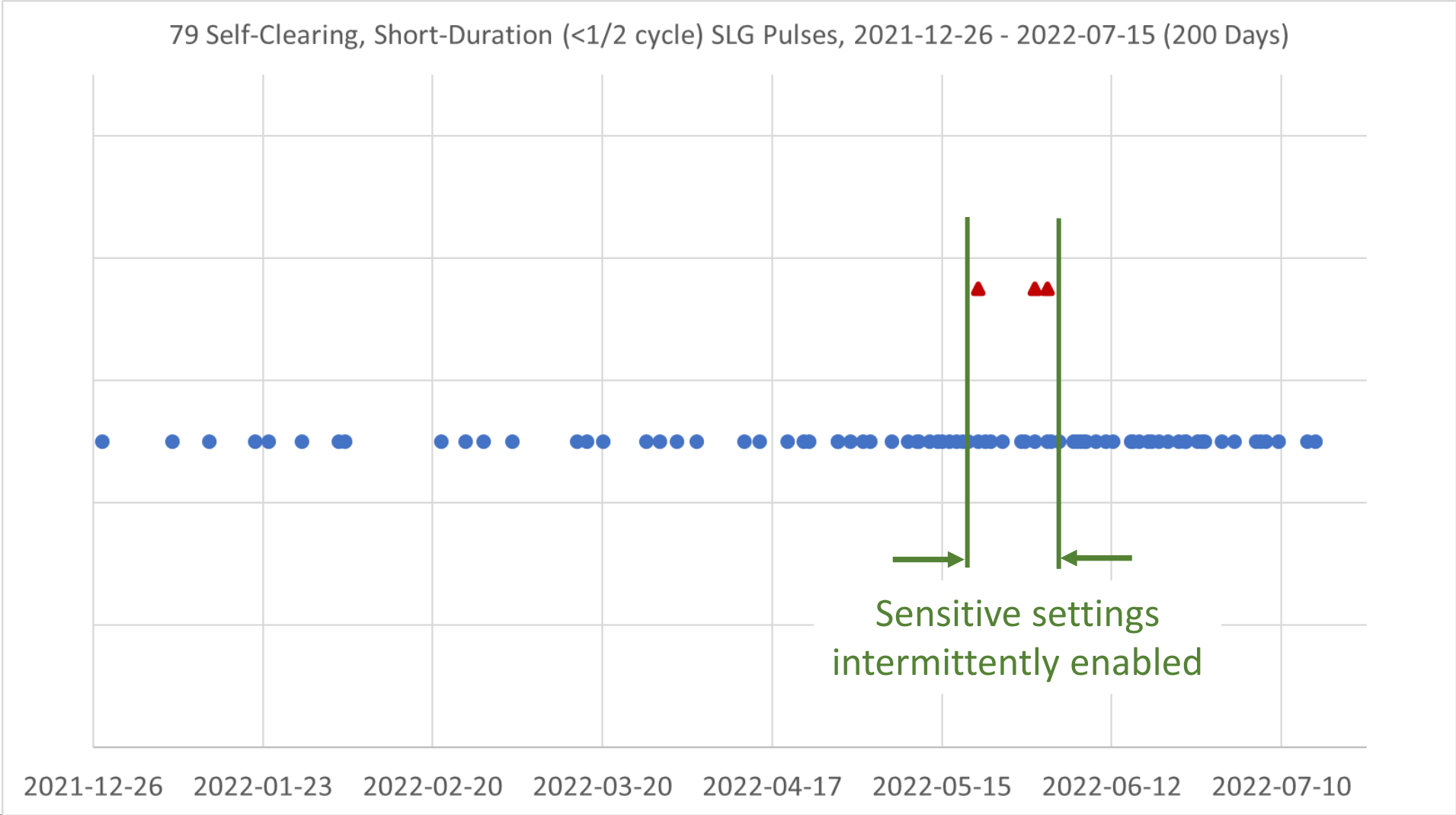
- Each pulse drew hundreds of amps.
- Each pulse self-cleared in $\sim 1/2$ cycle.
- No pulse was cleared by protection ...
 - But three occurred when extra sensitive protection was enabled...
 - and caused protection to trip – after the faults self-cleared!
- The only consequence of the trips was interruption of 1900 customers.

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Three protection trips when sensitive protection enabled



Conclusions and findings

- There were 79 faults in 200 days without load interruption.
- Conventional protection did not trigger on the short pulses ($< \frac{1}{2}$ cycle).
- When extra sensitive protection was initiated, three trips occurred.

MAJOR OBSERVATION

- All the faults self-cleared.
- The recloser trips, during extra sensitive settings, did not clear the faults.
- The only impact of the recloser operation was to cause an outage for 1,900 customers for an extended period.