

Tree Limb Burns Down Line, Causes Outage

DFA Technology Could Have Prevented Damage, Outage

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At 6:57 AM on the morning of November 2, 2004, an overcurrent fault tripped a three-phase pole-top recloser on a feeder at Pickwick Electric Cooperative's North Adamsville substation. The recloser closed back in normally and the fault did not persist. As a customer of TVA, Pickwick participates in the Distribution Fault Anticipation (DFA) project that EPRI is sponsoring at Texas A&M University. A DFA Prototype at North Adamsville substation recorded this fault and others discussed in this article.

Faults like this are not uncommon, and there did not appear to be anything out of the ordinary. An hour later, however, there was another fault, with the same characteristics. This time, the recloser tripped and reclosed twice, but again, did not lock out. Figure 1 shows the RMS phase current the DFA measured at the substation during this second episode.

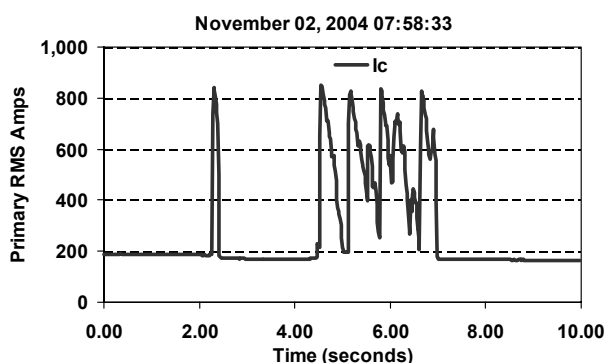


Figure 1. Second fault tripped recloser twice but did not lock out.

All was quiet for the next 16 hours. Then, shortly after midnight, another similar fault occurred. Over the next six hours, the fault recurred multiple times, tripping the recloser 11 more times. However, the faults were not close enough together in time to allow the recloser to lock out and isolate the problem. Then, at 6:19 AM, the fault became more persistent and locked out the recloser, during the episode illustrated in Figure 2. By this time, the recloser had tripped 17 times! The following list tabulates the individual interruptions:

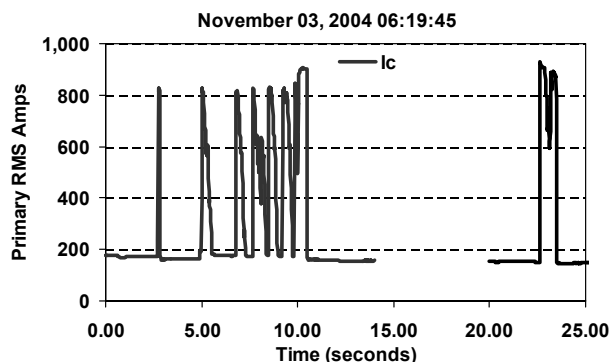


Figure 2. Final instance of fault locked out recloser.

Date	Time	Trips
11/02/2004	06:57:47	1
	07:58:33	2
11/03/2004	00:09:06	1
	00:16:48	1
	00:40:38	1
	00:40:53	1
	01:10:51	1
	01:12:37	1
	01:15:30	1
	03:24:47	1
	04:19:39	1
	04:30:36	1
	05:51:01	1
	06:19:45	3
	Total	17

The ensuing outage resulted in customer lights-out calls. Investigation revealed a broken tree limb that had burned down a span of line. 140 customers were without service for 62 minutes while the crew repaired the line.

The line was of standard single-phase construction, without crossarms. The phase conductor was mounted on pole-top insulators. The neutral conductor was mounted on standoffs several feet down the sides of the poles.

The crew found that a fork in the broken tree limb had hung on the phase conductor. The limb pulled the phase conductor down to within about two feet of the neutral conductor. The fork was in continuous contact with the phase conductor. Casual contact with the neutral occurred a few feet farther along the limb, causing the intermittent faults.



Figure 3. Tree limb tripped recloser 17 times and burned line down.

Figure 3 shows the offending tree limb. There is evidence of burning along about three feet of the limb's length. This would be consistent with the fork (left side of upper picture) hanging from the phase conductor and another position on the limb contacting the under-hung neutral conductor.

The DFA recorded each fault as it happened. The DFA currently is a research project and is not integrated into normal operations at Pickwick. Because a pole-top recloser operated, instead of the substation breaker, Pickwick had no indication

of a problem until the lights-out calls that followed the burn-down.

If real-time DFA technology had been available to operations personnel, Pickwick would have dispatched a crew around 1:00 AM on November 3. Using information from the DFA, Pickwick personnel believe that they would have located the source of the problem within a few hours. They would have had time to take remedial action and could have avoided the burn down and the outage.