Reducing Wildfire Risk through the Use of Advanced Electrical Waveform Monitoring and Analytics

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Wildfires – A Growing Problem

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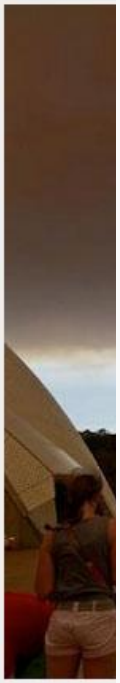
Power lines blamed for 2 of Australia's dozens of fires

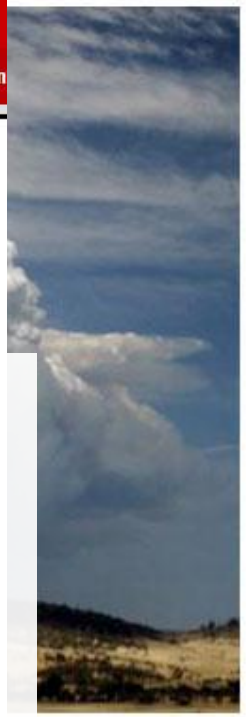
By **Kevin Wang**, CNN

updated 8:31 AM EDT, Sat October 19, 2013

"Two of the dozens of bush fires burning out of control in the eastern Australian state of New South Wales were sparked by power lines that had been buffeted by strong winds, fire officials said Saturday, citing preliminary investigations"
- CNN, 19 October 2013

Hundreds of homes burned in Australia

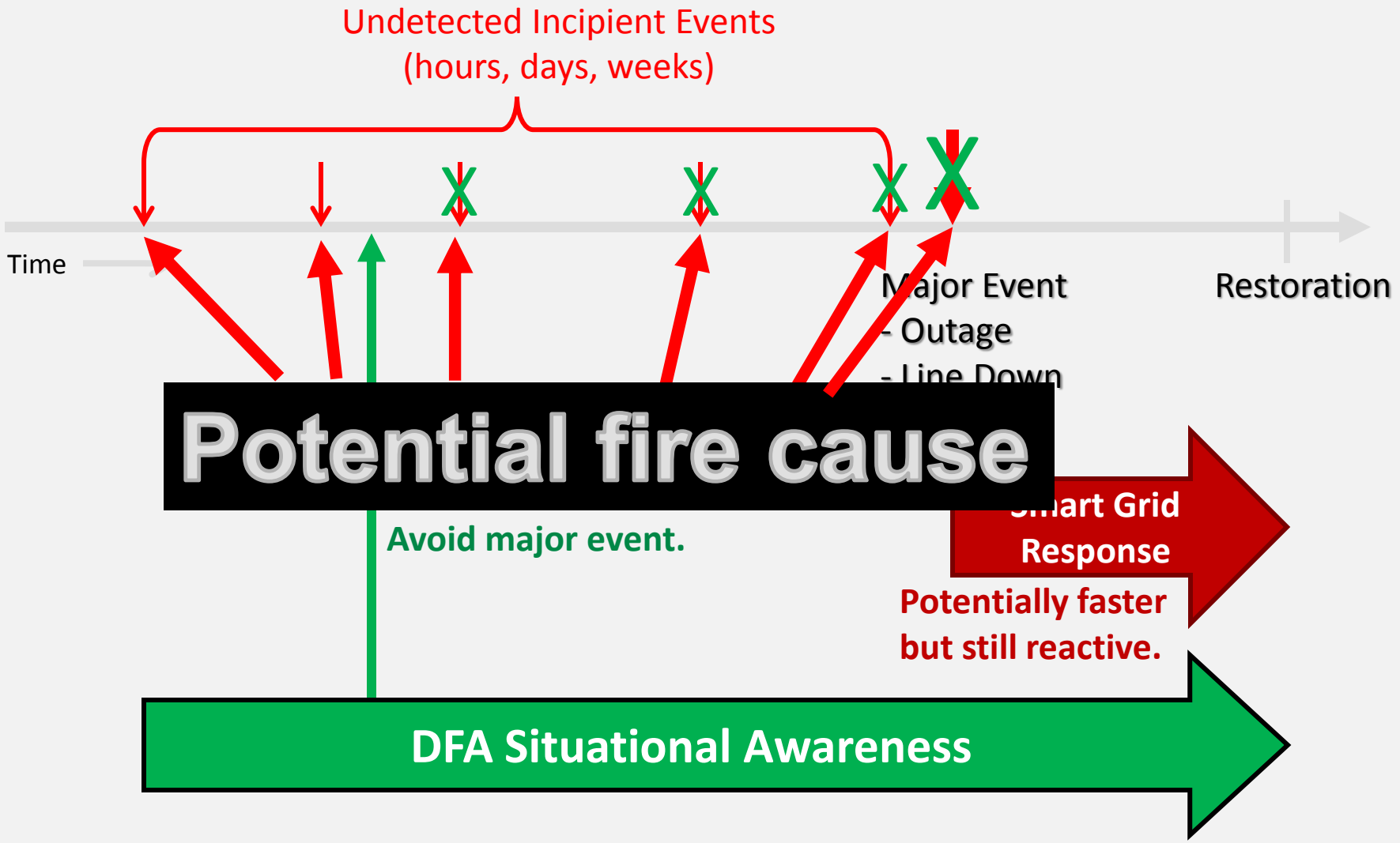




How Powerlines Cause Wildfires (Abbreviated List)

- Conductors that break but remain live, arcing on or near ground
- Poletop fires caused by failing apparatus
  - Intermittent high-current events (e.g., bushing flashovers)
  - Prolonged low-current “leakage” (e.g., switches, clamps)
- Conductors slapping together, creating falling, burning particles
  - Wind-blown conductors
  - Conductors pushed together by broken trees
  - Fault-induced conductor slap (FICS)
- Failing transformers and other apparatus that explode and eject burning oil.
- Trees/vegetation spanning phases

Situational Awareness or "Visibility"
(Conventional vs. Smart Grid vs. DFA)



Case Study: Vegetation Intrusion Results in Line Burndown

- In 2004, a tree branch fell across a phase conductor, and made intermittent contact with the neutral conductor.
- Over a 24 hour period, the branch caused 19 faults and eventually burned the line down.
- The utility knew *nothing* about the problem until customers called to report the outage.
- The burn down clearly was an ignition hazard. Although less obvious, each of the 19 flashover events also represented a potential ignition hazard.

Case Study: Vegetation Intrusion Results in Line Burndown

- In 2011, at the same utility, a DFA unit notified utility personnel of a repetitive fault that resulted in four momentary interruptions of a midpoint recloser.
- As with the previous event, the utility had no notification of the problem by conventional means.
- After the fourth occurrence of the fault, the utility crew initiated a search to find the problem.
- Using information provided by DFA analytics, the crew was able to narrow their search to a small portion of the affected feeder.
- The crew found vegetation intruding into overhead lines, and performed spot trimming.
- No further faults were recorded, indicating the underlying problem was corrected.

Case Study: Vegetation Intrusion Results in Line Burndown

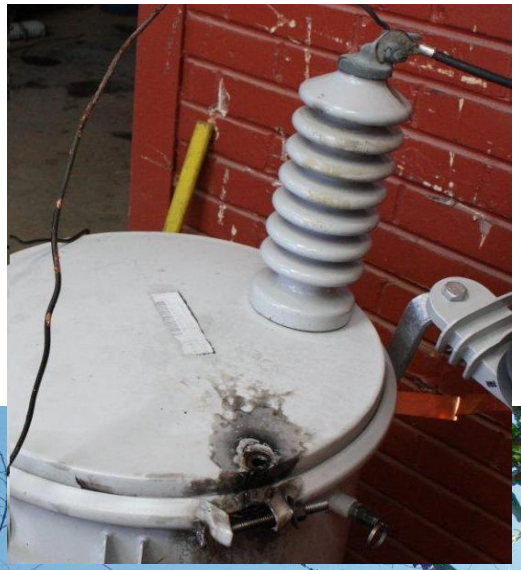
- Case 1 (without DFA)
  - Multiple faults cause momentary interruptions of a midpoint recloser.
  - Utility is unaware of any problem.
  - After 24 hours, repeated faults cause the line to burn down in the middle of the night.
- Case 2 (with DFA)
  - Multiple faults cause momentary interruptions of a midpoint recloser.
  - DFA analytics automatically inform utility of a potential problem.
  - Utility searches a small area of the feeder, corrects the underlying issue, and prevents a line from burning down.

Case Study: Failing Transformer

- During a rainstorm, a DFA monitored feeder with 125 circuit-miles of overhead line experienced a fault, resulting in an outage for 82 customers.
- Crews investigated the outage, but were unable to find any cause.
- Four days later, during another rainstorm, another fault tripped a midpoint recloser, but did not result in an outage.
- Online DFA analytics determined the two faults were related, and automatically notified the utility, which initiated a search.

Case Study: Failing Transformer

- Crews searched a small portion of the feeder and found a transformer with arc marks on its jumper wire, and with a hole in its lid (right).
- It was determined that vegetation growing around the transformer caused flashovers between the jumper wire and the transformer lid.



Case Study: Failing Transformer

- A breached transformer lid can result in moisture ingress, which can, in extreme cases, lead to an internal transformer fault and explosion.
- Even if the transformer did not fail explosively, each flashover represents a potential ignition source for a fire.
- Often incipient problems remain in place for days, weeks, months, or years, continuing to cause momentary interruptions and potentially starting fires.

Analytics and Fire Risk: Summary

- Failing components on power systems represent competent ignition sources.
  - Wildfire risk is not only about the apparatus that *fail,* but apparatus that are in the *process of failing*.
- These components constitute a fire risk of which most utilities are unaware.
- In many cases, DFA waveform analytics allow utilities to know about and act on potential liabilities, rather than allowing them to develop into actual liabilities.