Power GPR-Related Telecom Equipment Damages- Case Studies

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Two types of Power GPR Damage to Telecommunications Facilities:

- Communications path
  - Circuit Electronics
  - Communications conductors
- Metallic shielding and connectors
- Both resultant from dielectric breakdown.

GPR Damage Group 1:

Communications path damages from :

-longitudinal current flow through transmission components

-balanced or unbalanced overvoltage protector operation

- Regardless of coordinated protection

Case 1

Site 1- Power generating plant
without high voltage GPR protection

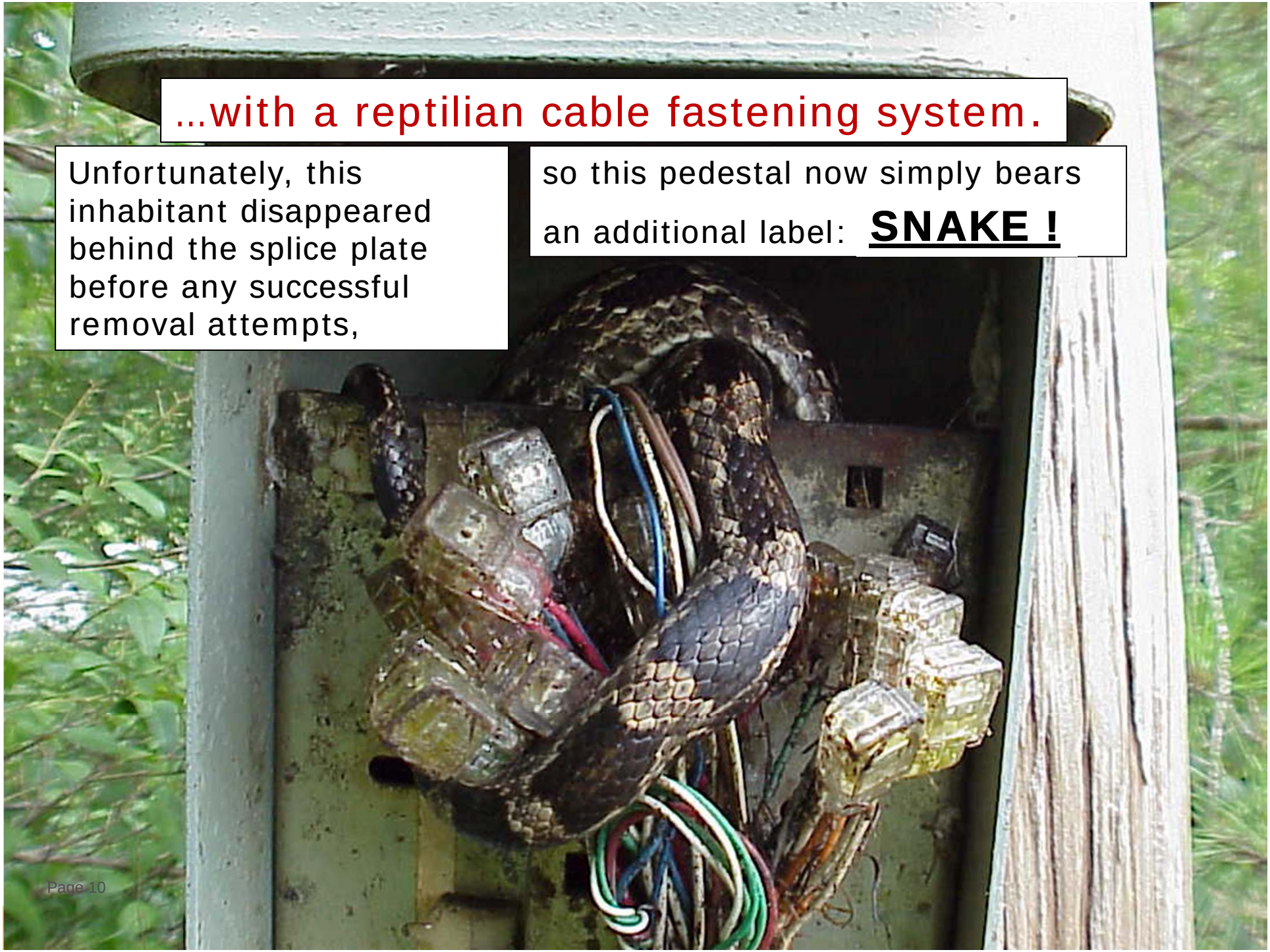
Site 1- A hydroelectric generating plant in a rural area. The serving terminal is located in a pedestal just outside the site fence, but the grid does not extend to the fence. No multi-grounded neutral is present at these pedestals.

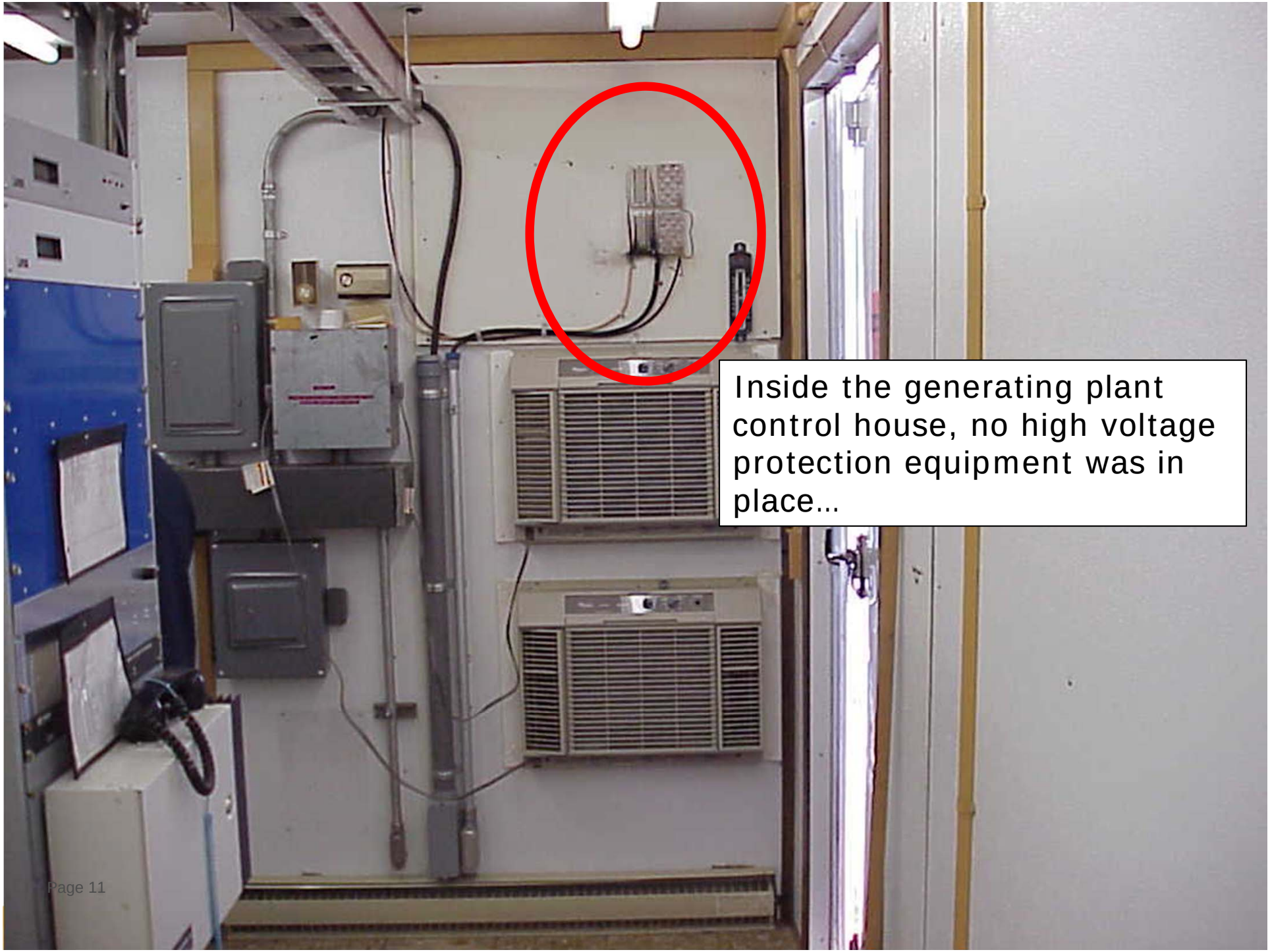
Serving pedestal houses buried cable installed in a standard configuration (not as a dedicated cable), without high voltage isolation at the power station. Pairs were damaged by flashover at base of ped.

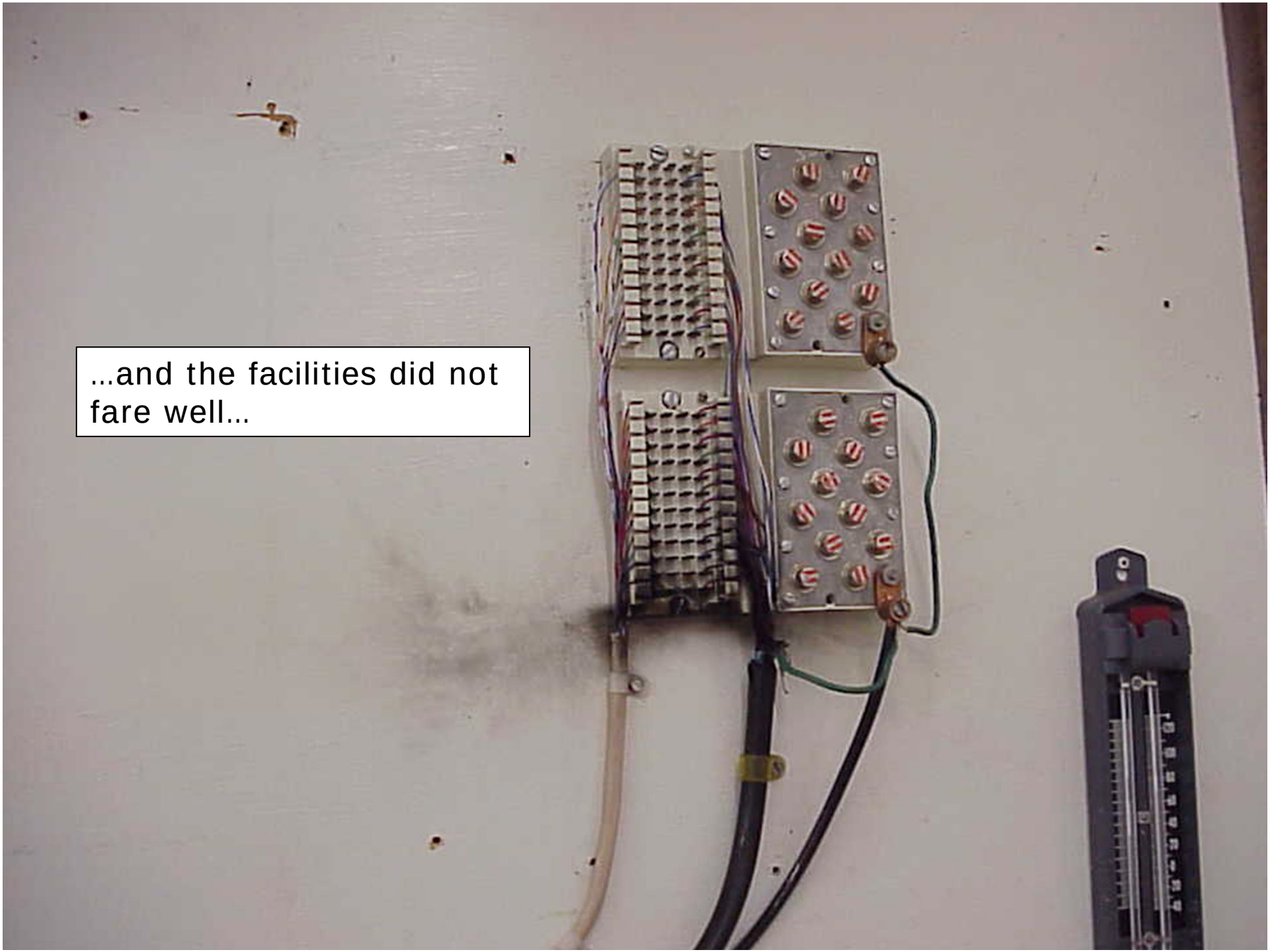
At the next pedestal toward the CO, rat's nests, spiders, and another local ground were confirmed…

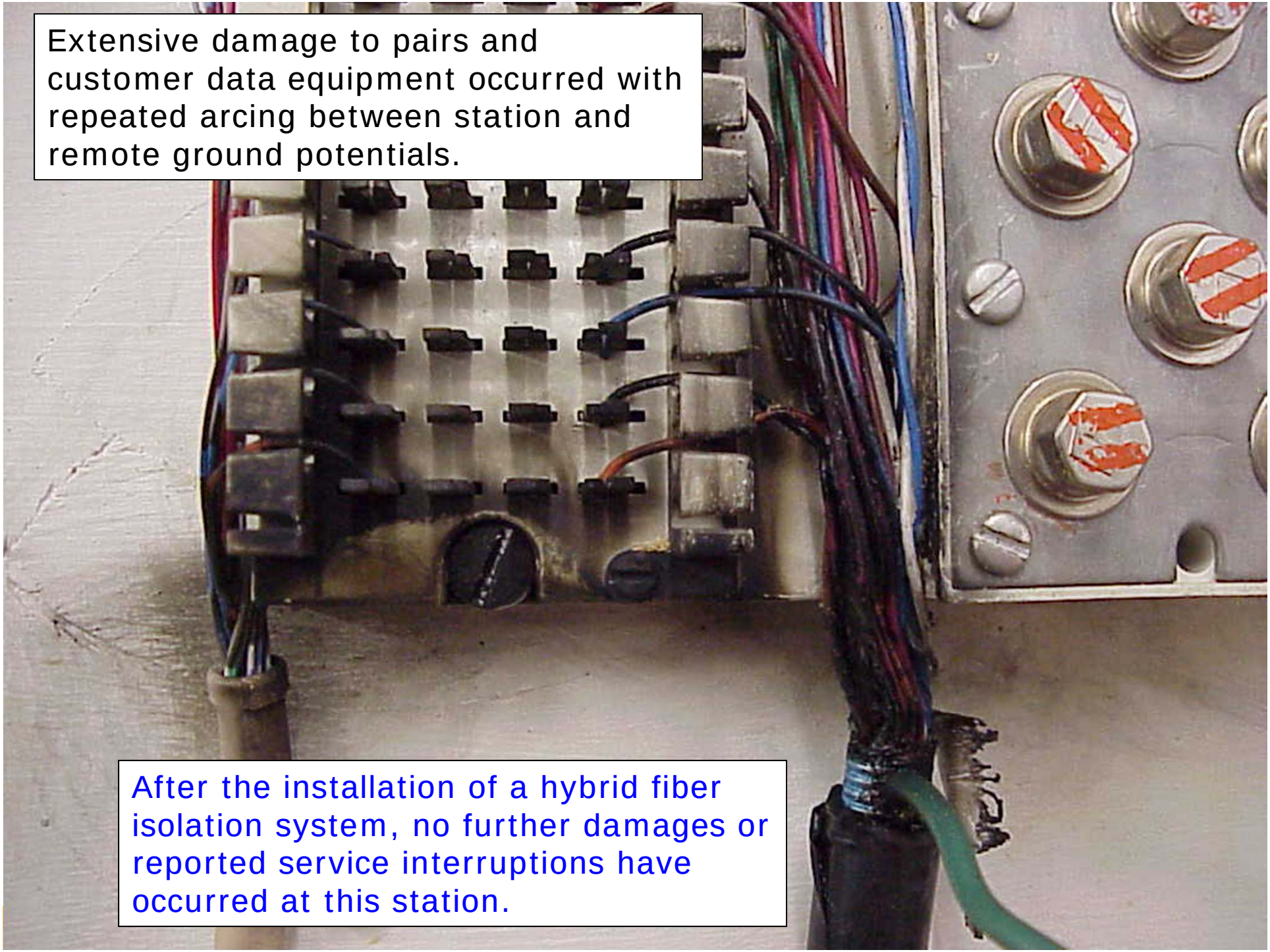
…along with more flashover from the serving pairs within.

This pedestal also came specially equipped…


...with a reptilian cable fastening system.
Unfortunately, this inhabitant disappeared behind the splice plate before any successful removal attempts,
so this pedestal now simply bears an additional label: SNAKE !


Inside the generating plant control house, no high voltage protection equipment was in place…


...and the facilities did not fare well...

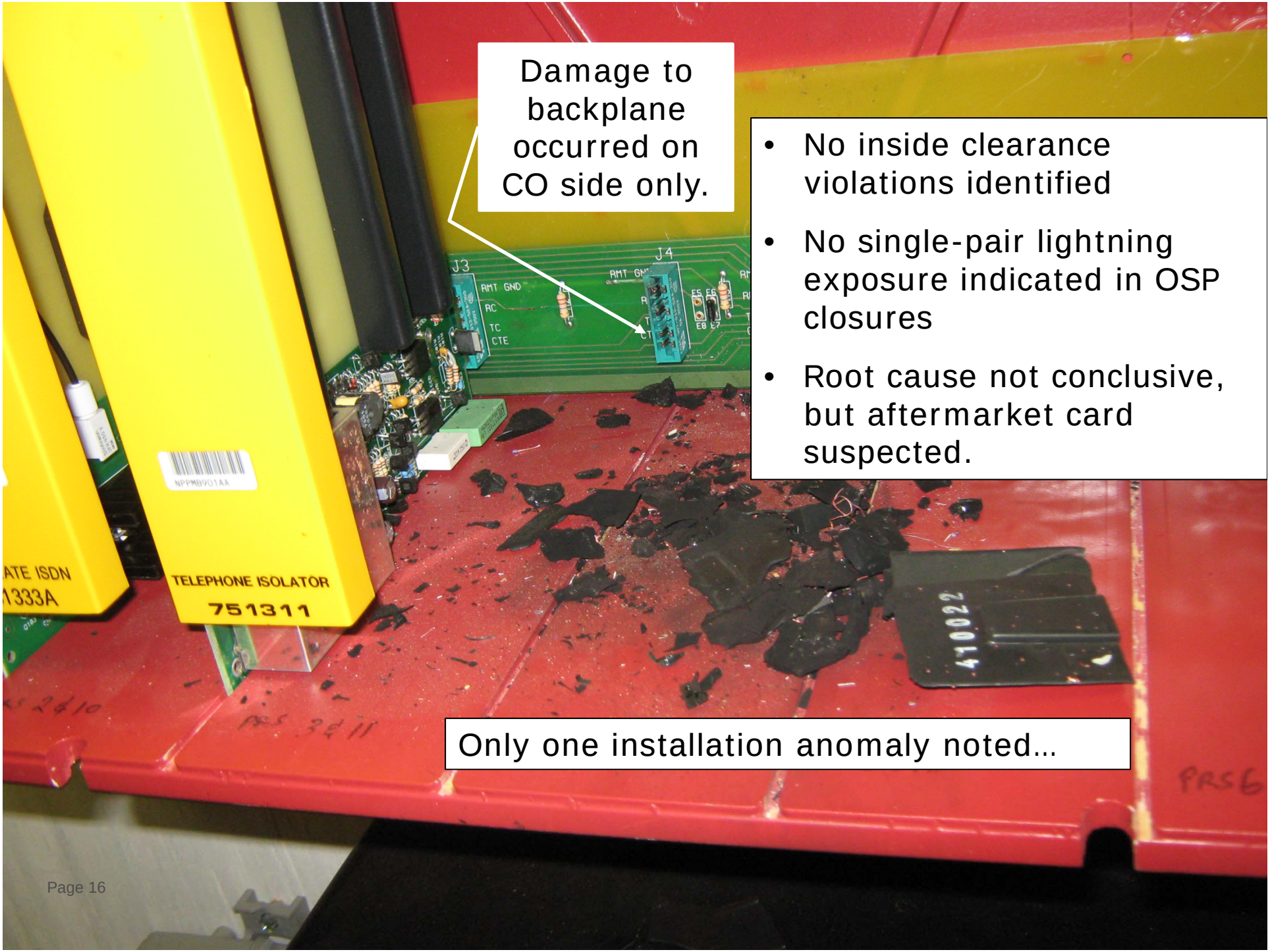

Extensive damage to pairs and customer data equipment occurred with repeated arcing between station and remote ground potentials.
After the installation of a hybrid fiber isolation system, no further damages or reported service interruptions have occurred at this station.

Case 2

Site 2- Power distribution substation with fractured and charred isolation transformer

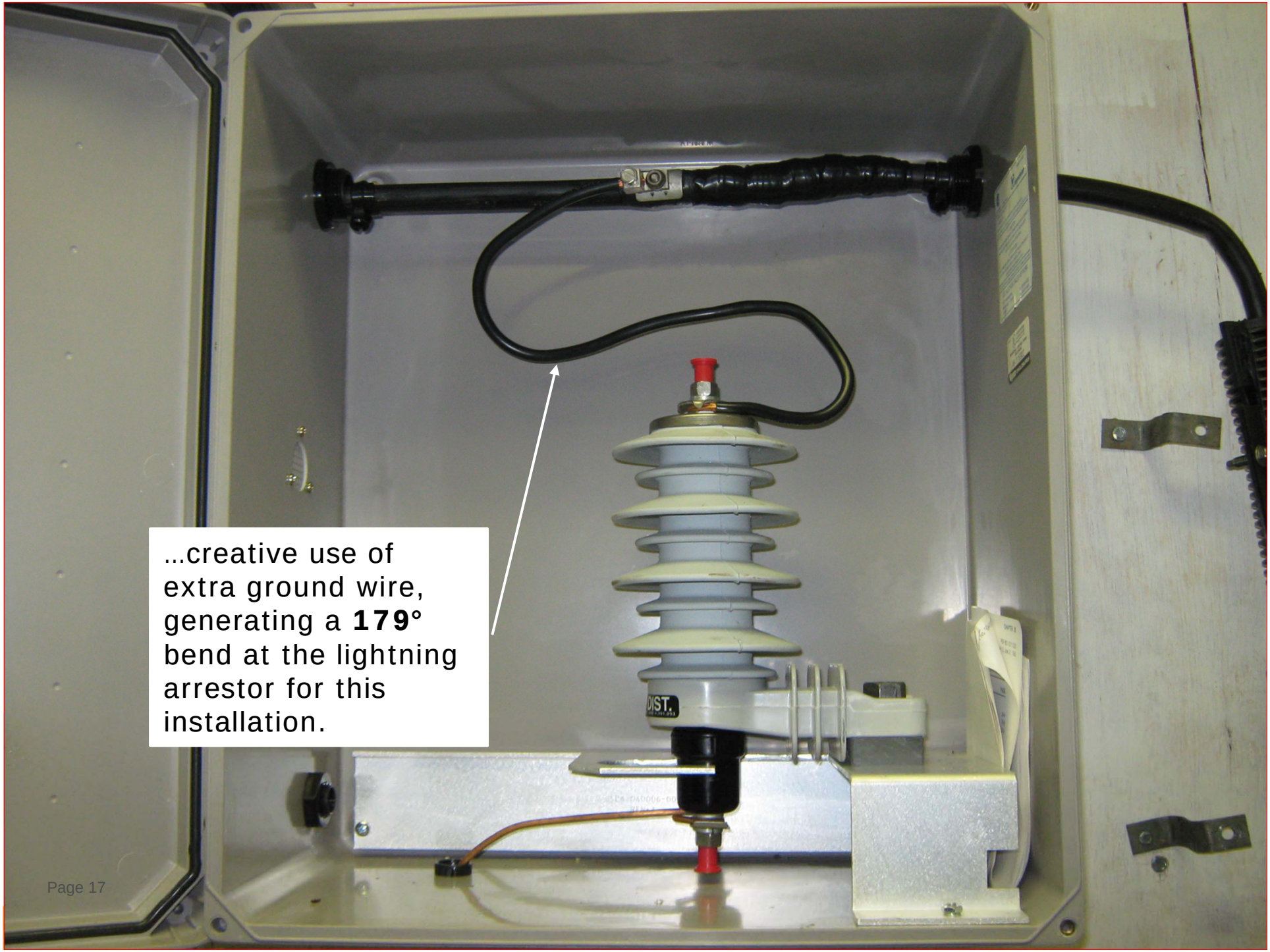
Only one of five cards damaged, at slot 4.

Unfortunately, the card was discarded and not available for inspection…



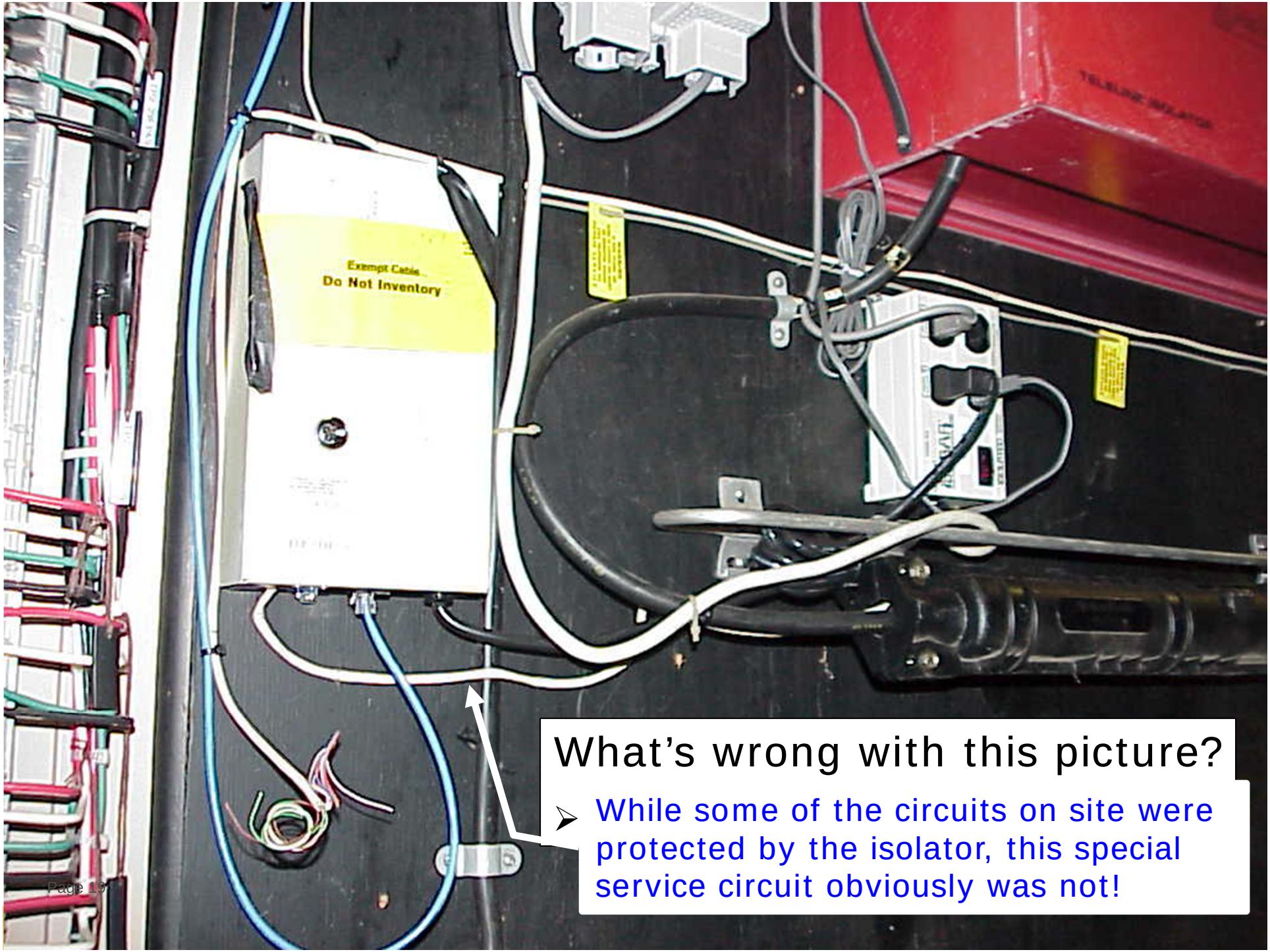
- No inside clearance violations identified
- No single-pair lightning exposure indicated in OSP closures
- Root cause not conclusive, but aftermarket card suspected.

Only one installation anomaly noted…


...creative use of extra ground wire, generating a **179°** bend at the lightning arrestor for this installation.

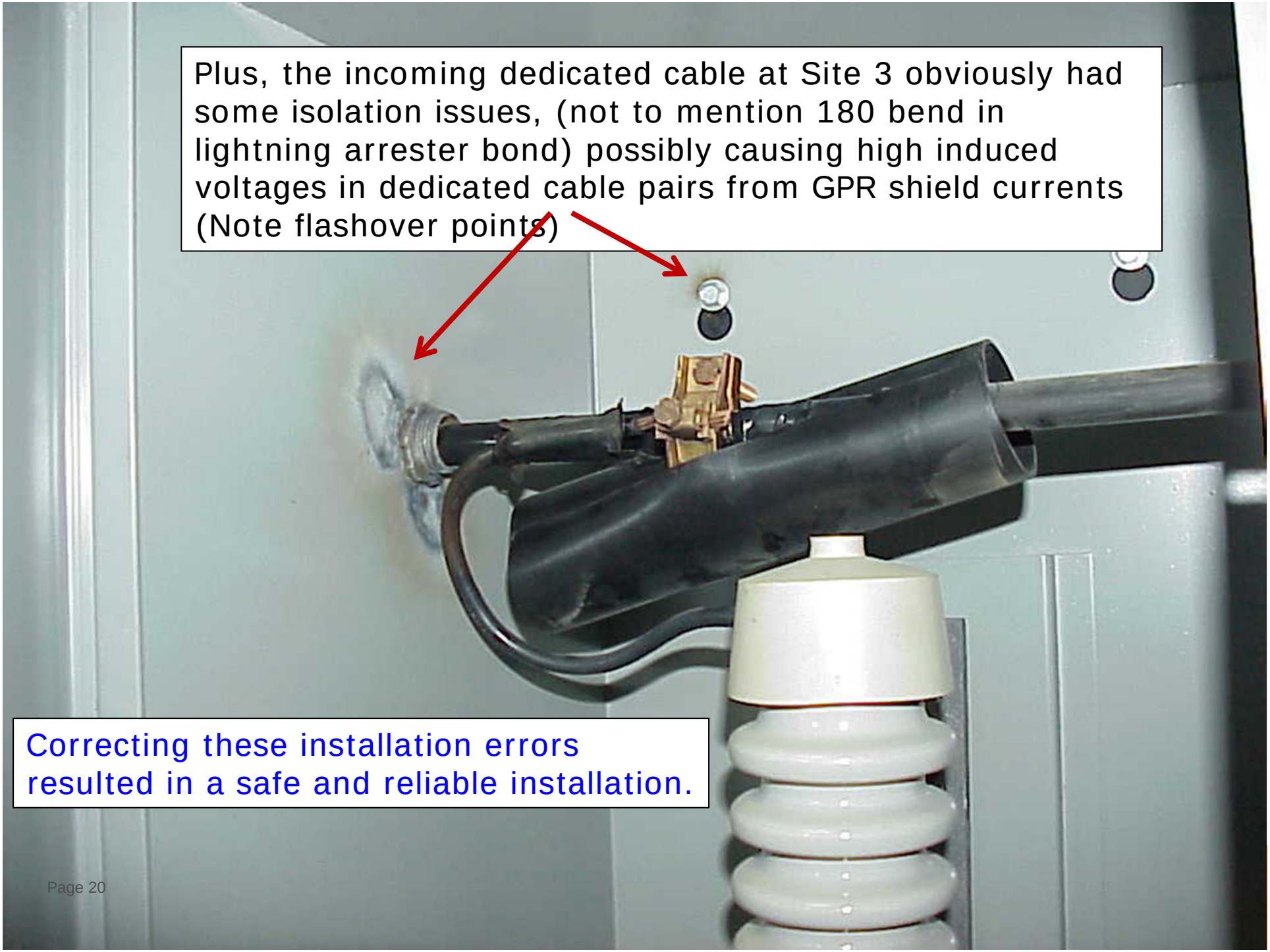
Case 3

Site 3- Power switching station with chronic circuit failures and NCTE damage



What's wrong with this picture?

- While some of the circuits on site were protected by the isolator, this special service circuit obviously was not!


Plus, the incoming dedicated cable at Site 3 obviously had some isolation issues, (not to mention 180 bend in lightning arrester bond) possibly causing high induced voltages in dedicated cable pairs from GPR shield currents (Note flashover points)
Correcting these installation errors resulted in a safe and reliable installation.

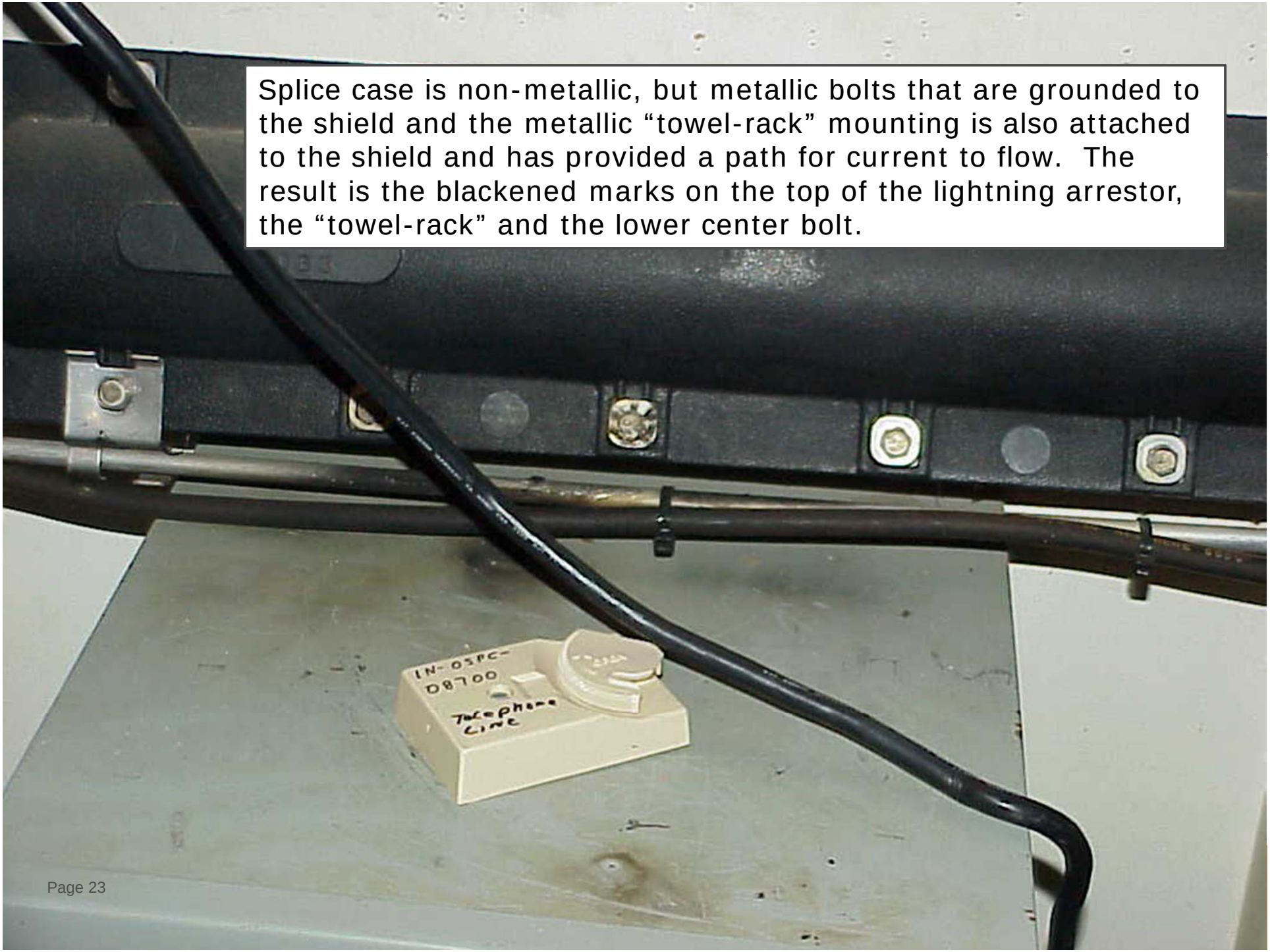
GPR Damage Group 2:

Metallic Facility damages from :

- fault current flow through cable shields
- heat and fire damage
  - "I^2t failure"

Case 4

Site 4- Power transmission substation
with intermittent service failures



Splice case is non-metallic, but metallic bolts that are grounded to the shield and the metallic “towel-rack” mounting is also attached to the shield and has provided a path for current to flow. The result is the blackened marks on the top of the lightning arrestor, the “towel-rack” and the lower center bolt.

...and inside the lightning arrestor case, notice the broken insulator and arc soot. The metallic shield has no gap toward isolator.

Is it an INT or a deer stand?
Another forgotten HVI installation.

Mitigating Power GPR Damage:

- Wireless service
- Reduce and standardize telco high voltage interface options
- Simplify HVP architectures
- Make sure the central office end of the cable shield is attached to the lightning arrestor. The cable shield must also have a 4" section removed on the customer side of the arrestor attachment.
- Various mitigation efforts utilized to reduce emissions with varying degrees of success.

- Other suggestions for solutions?

QUESTIONS?...

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