E-911 Tower and Transmitter Site

Grounding Challenges:

Special Considerations Necessary for Sites with End-of-Branch Commercial Power Supply

GroundLinx

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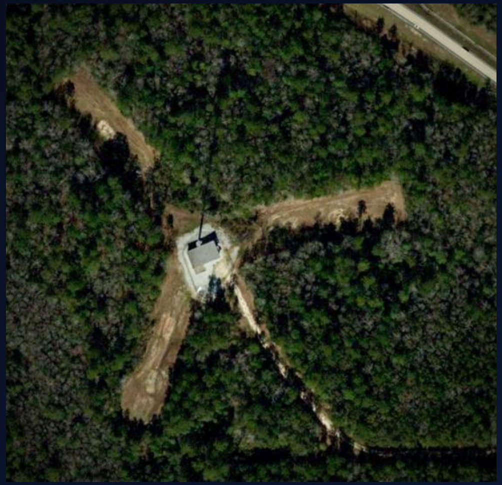
Grounding Challenges:

- Broadcast transmitter sites are often in remote locations.

- Electric service is frequently delivered via a branch line which can be thousands of feet long.

- Electric utility pole grounding is rarely adequate for extreme, or high energy faults.



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Grounding Challenges:

- The quality and consistency of commercial electric service is critical for E-911 operations.

- Standardized utility company grounding is often sufficient for low frequency, lower energy pulses (surges and spikes).

- HOWEVER, lightning induced, and major switchgear faults routinely overwhelm common utility grounding.

- Unattenuated faults WILL reach structures and equipment located at the end of branch lines when shelter and tower grounding is deficient.

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Grounding Challenges:

- *Force multiplier:* Both tower structures AND inbound commercial power lines can become conduits for carrying high energy fault current *into* equipment and transmitter shelters.
- Traditional site grounding design commonly *overlooks* this consideration.
- An aggressive grounding strategy that incorporates mitigation of faults from all sources is essential to largely prevent equipment damage and off-air events.

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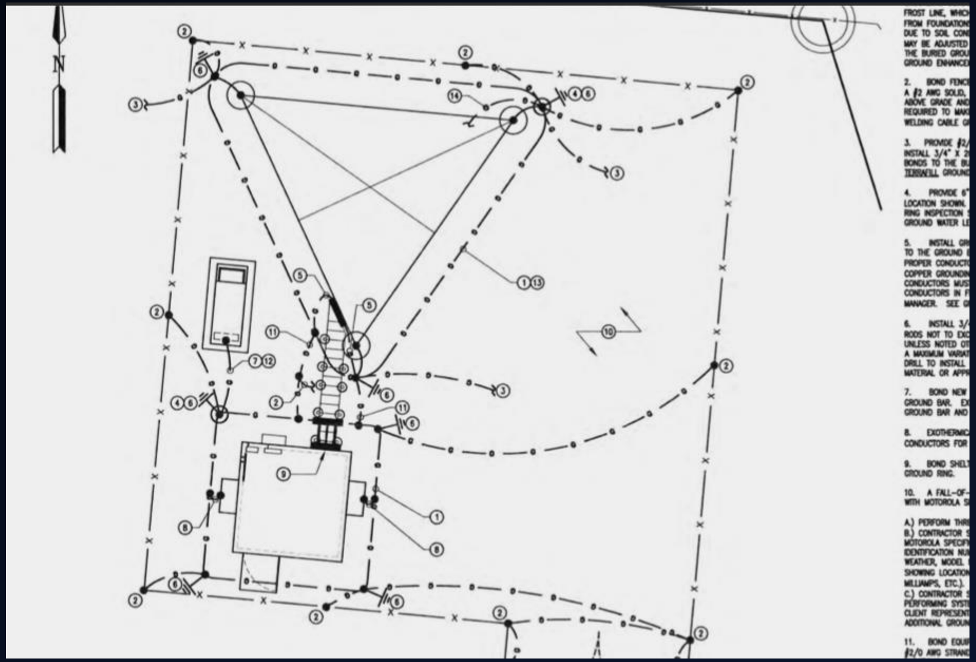
Grounding Challenges:

- Transmitter site grounding strategies are typically primarily focused on creating *equipotential* throughout the compound, i.e. tower, shelter, fence, etc. *This is wise.*

- However, the vast majority of sites we visit (E-911, broadcast, or telecom) have **insufficient or obsolete** grounding with respect to severe fault current brought to the site via commercial electric service.



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Grounding Challenges:

- To understand end-of-branch-line fault dangers, a little background on fault current frequencies and the dynamics of a fault event are necessary.

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Grounding Challenges:

- If properly installed and maintained, standard utility service pole grounding can generally manage low frequency (50-60 Hz) and common voltage transients.

- Lightning-grade faults are another story:
  - Lightning has both AC and DC characteristics
  - The mélange of AC Frequencies in lightning often exceeds 150MHz.
  - Voltages and current can be greater than 250kV and 30kA.
  - Peaking occurs nearly instantaneously.
  - *Creation of a major fault can occur many thousands of feet "upstream" on a commercial power network.*
  - When this fault reaches a branch line, in the majority of cases, it will flow to the end of the line and likely into customer equipment if insufficiently grounded.

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Grounding Challenges:

- **More on fault and grounding system dynamics:**
  - Lightning induced faults have a very "steep wave front".
  - Highest frequencies and energy reside at the initiation of the event.
  - Standard utility company and broadcast grounding strategies employing traditional copper-based conductors and rods are quickly inundated.
  - Massive impedance mismatches between copper grounding devices and native soil exacerbate dissipation issues.
  - Mechanical protection devices (i.e. "surge" protectors, cut-outs, etc.) also fail to stop the initial high energy, high frequency wave. They are too slow to react.

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Grounding Challenges:

- With respect to end-of-branch served sites…..
  - Traditional transmitter site grounding for inbound power is no match for a massive unattenuated freight-train-of-a-fault "crashing into the station".
    - Initial high frequencies swamp the system. Subsequent low frequencies have no place to go – except into *insufficiently* protected equipment.
    - Reliance on mechanical protection devices is not appropriate.
- The probability of damage is very high.

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Grounding Challenges:

- With respect to end-of-branch served sites…..
  - Facilities and systems *dependent* on very sensitive electronic equipment MUST have extremely capable, robust grounding.
  - It is unrealistic to expect utility companies to 100% "harden" their extensive and elaborate distribution networks against high energy faults.
  - Deploying a more capable grounding defense as an end-of-the-line customer is entirely prudent.

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Grounding Challenges:

- More capable grounding MUST include:
  - An ability to accept and manage a full range of frequencies up to and beyond 200MHz. (Copper loses effectiveness above 60MHz.)
  - An impedance "gradient" between grounding electrodes and native soil.
  - Stability to properly and completely function for the entire duration of a fault event.

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Grounding Challenges:

- Circling back:
  - Many E-911 sites have "branch-end" electric service.
  - This requires special attention in terms of grounding and facility protection.
  - Combining insufficient grounding with branch-end electric supply nearly ensures future damage.

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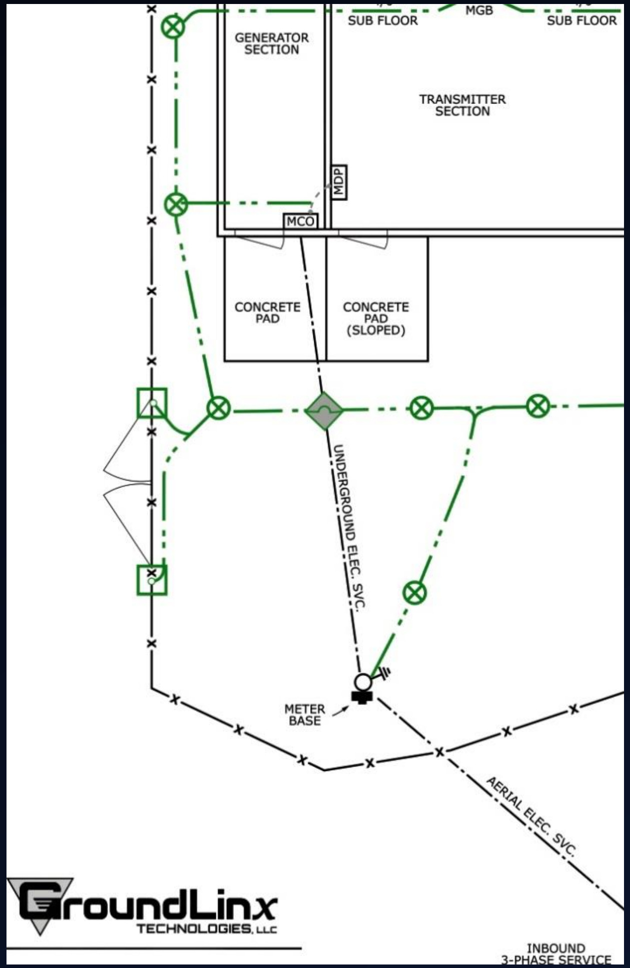
Grounding Challenges:

- Circling back:
  - A stepped up "grounding game" will dramatically minimize damage possibilities.
  - Grounding that specifically addresses inbound electric power quality and consistency is essential.
  - Grounding that can fully mitigate extreme frequencies and current is equally important.



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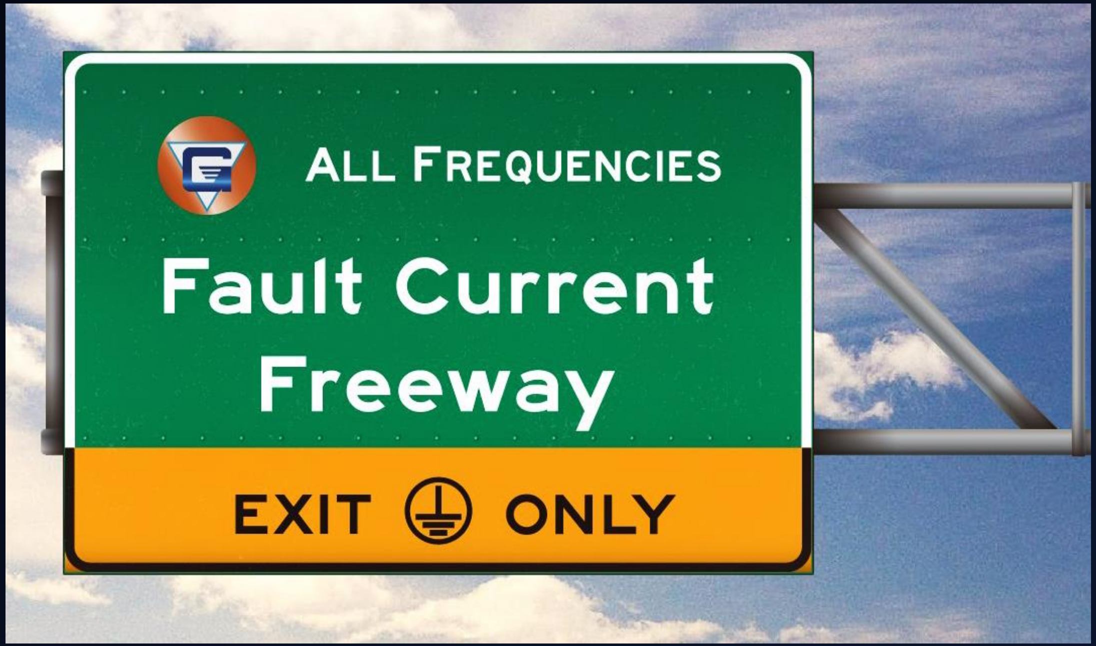
Grounding Challenges:

- Circling back:
  - The goal is to keep fault currents away from your critical equipment – regardless of their source.
  - For branch-end served transmitters, it is just as important to give commercial power faults an "off ramp" as it is to provide proper grounding to your towers and shelters.



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Grounding Challenges:

Thank you for your kind attention.

Grounding isn't the most exciting topic, but for system reliability....it is essential to understand, especially in a mission critical environment.

Your comments and questions are welcomed.

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