

Can Two-Wire Systems Coexist in a Three-Wire World?

Safety, performance and reliability parameters of mixing Grounding Topologies



Presented by:

Dan McMenamin

President

Dan McMenamin and Associates, Inc.

Purpose

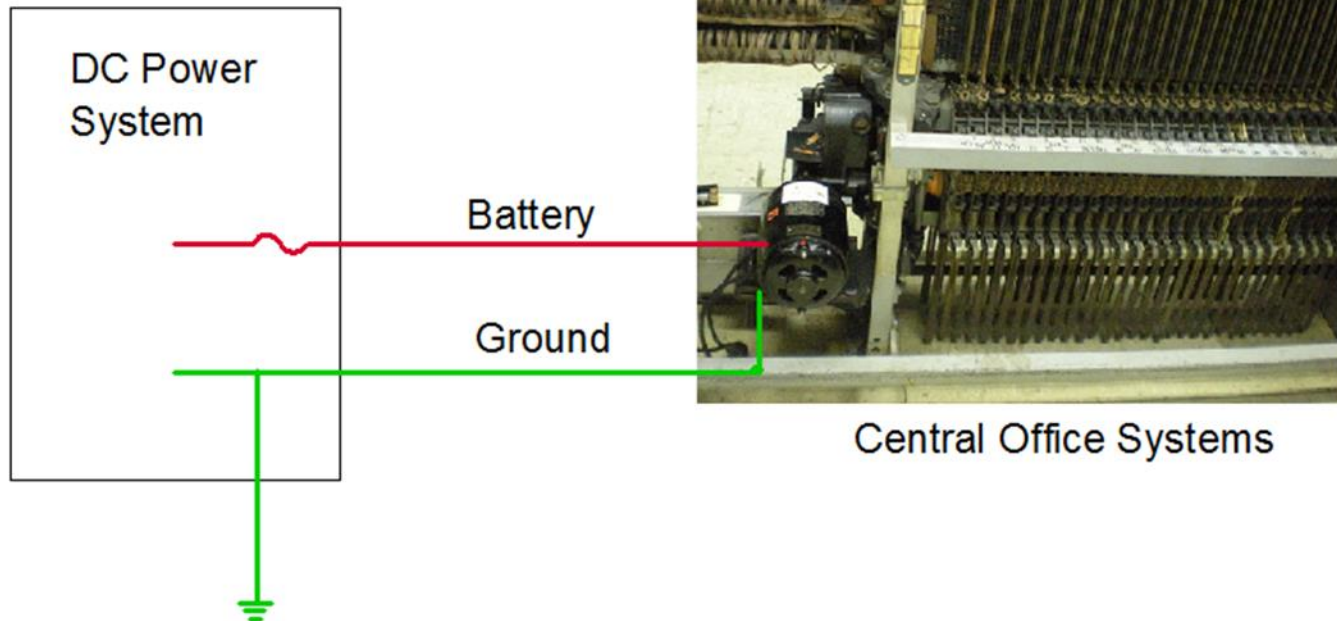
- Examine grounding issues associated with 2-Wire systems in central office applications
- Examine grounding issues associated with 2-Wire systems in cell site remote radio head applications

Amen Brothers



® Various entities and legal rivals

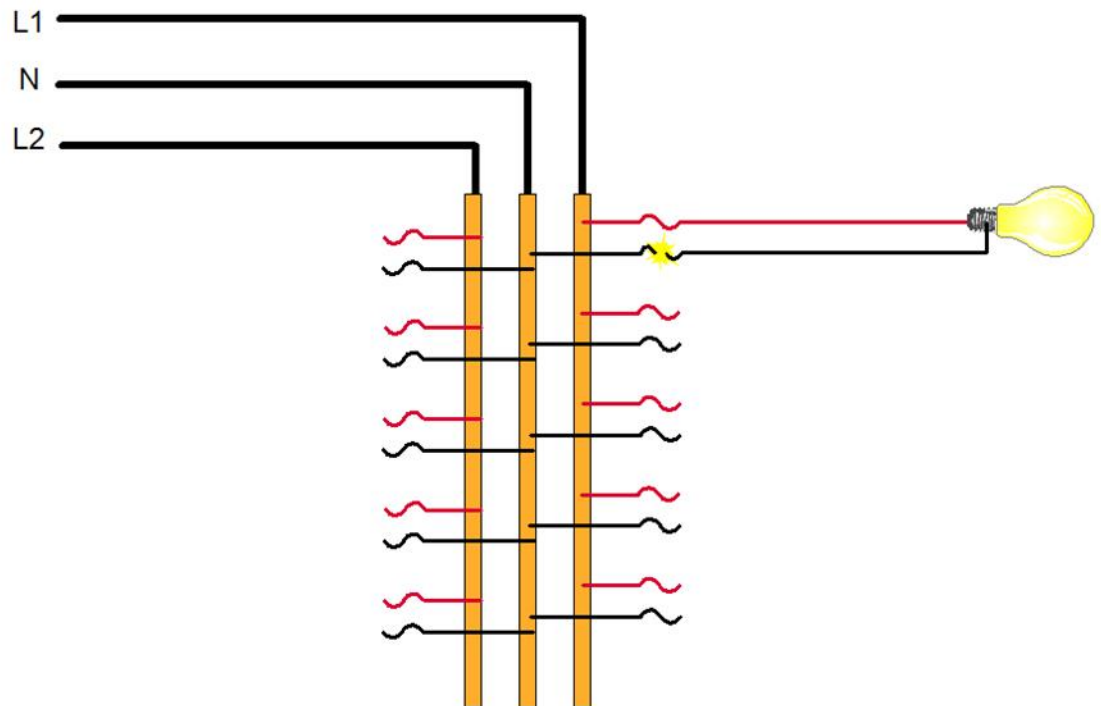
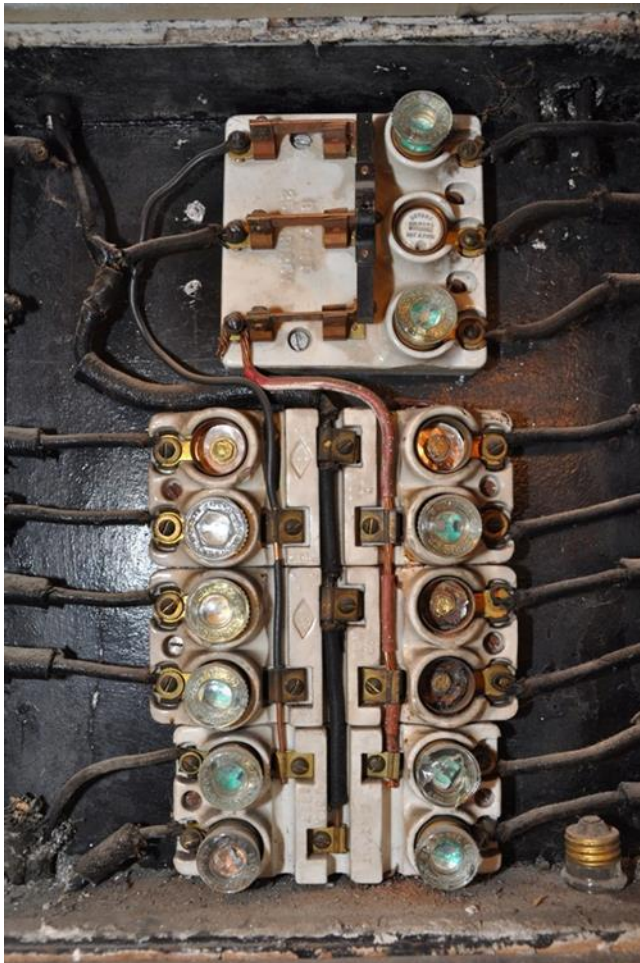
Two-Wire DC Circuits



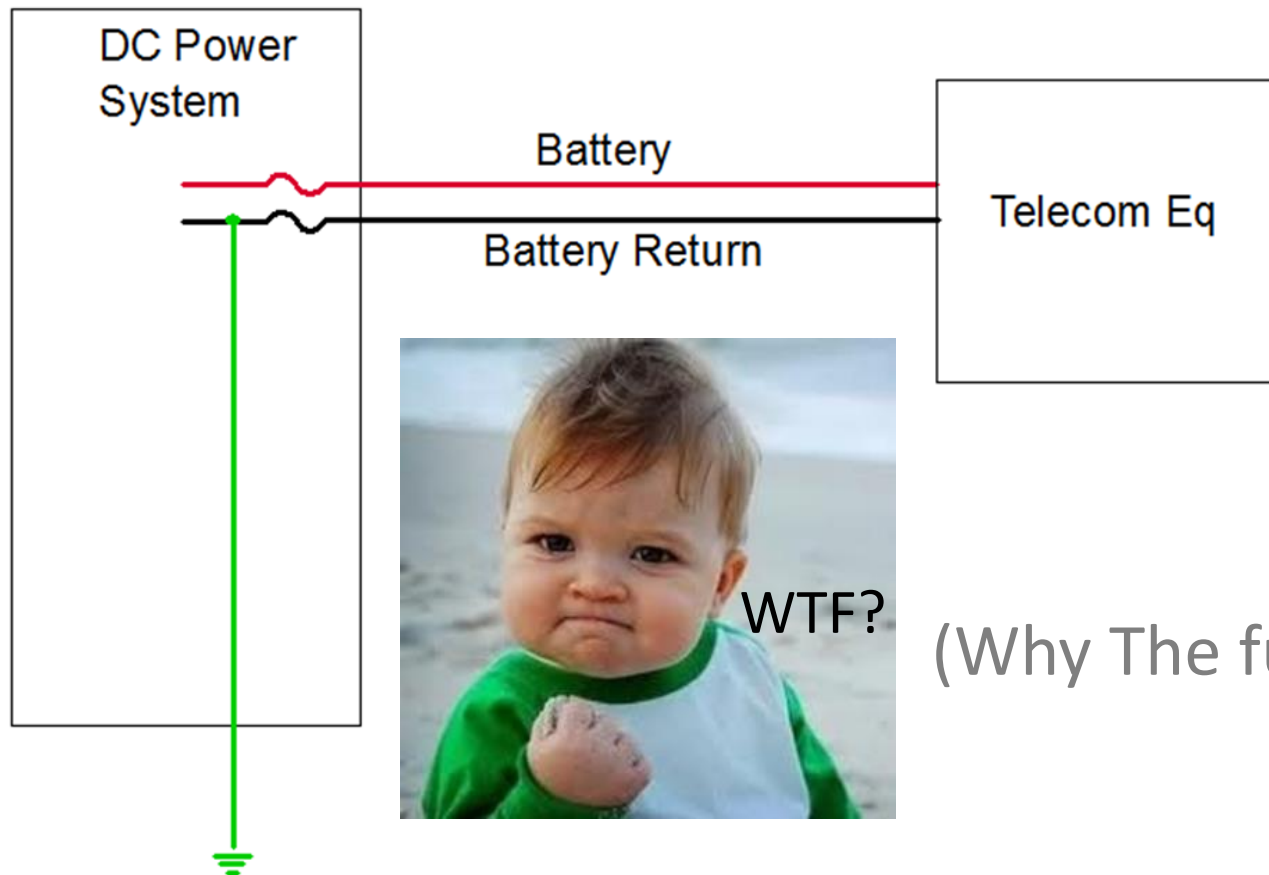
Two-Wire AC Circuits



Hot & Neutral were fused (Dangerous)

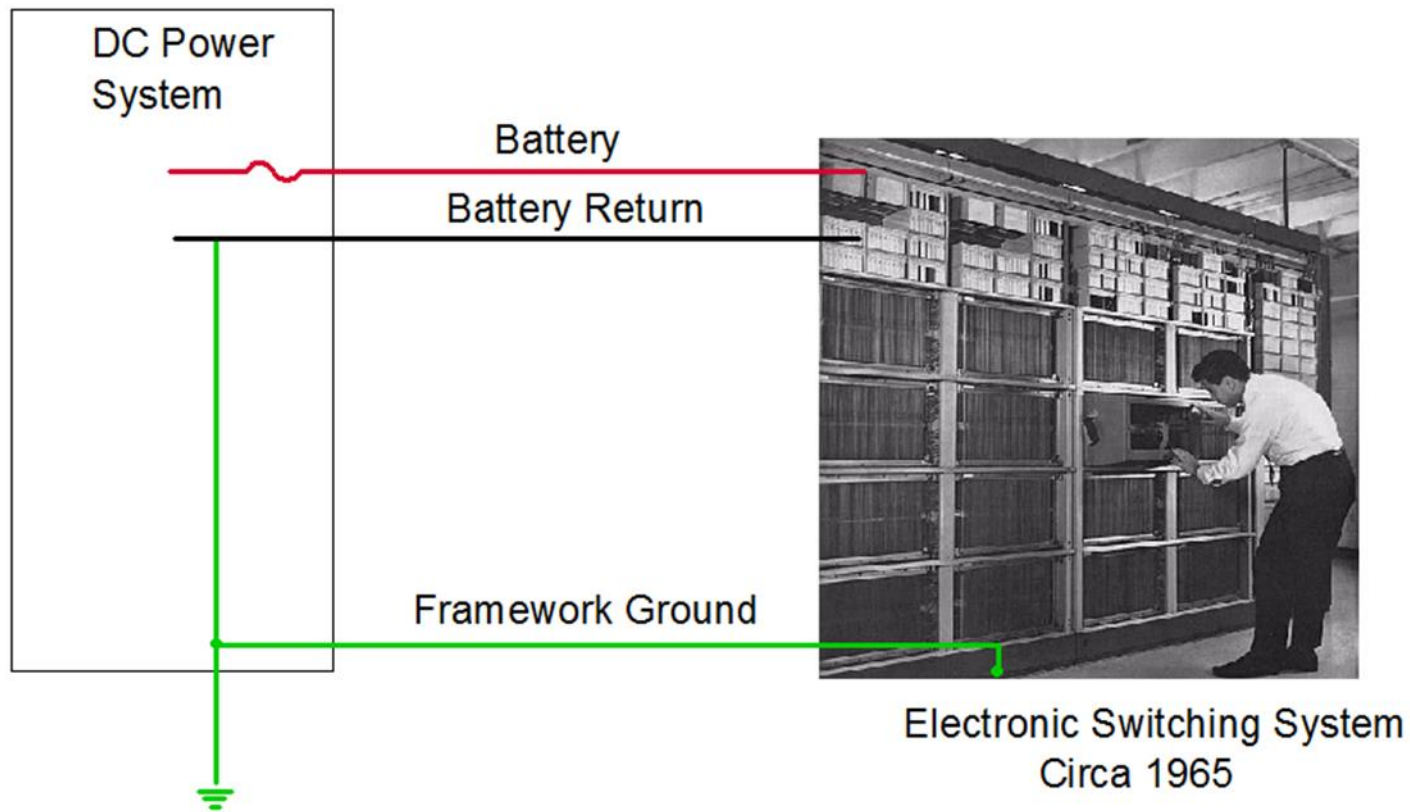


One I.T. Equipment Vendor proposed:



(Why The fuse?)

Three-Wire DC Systems

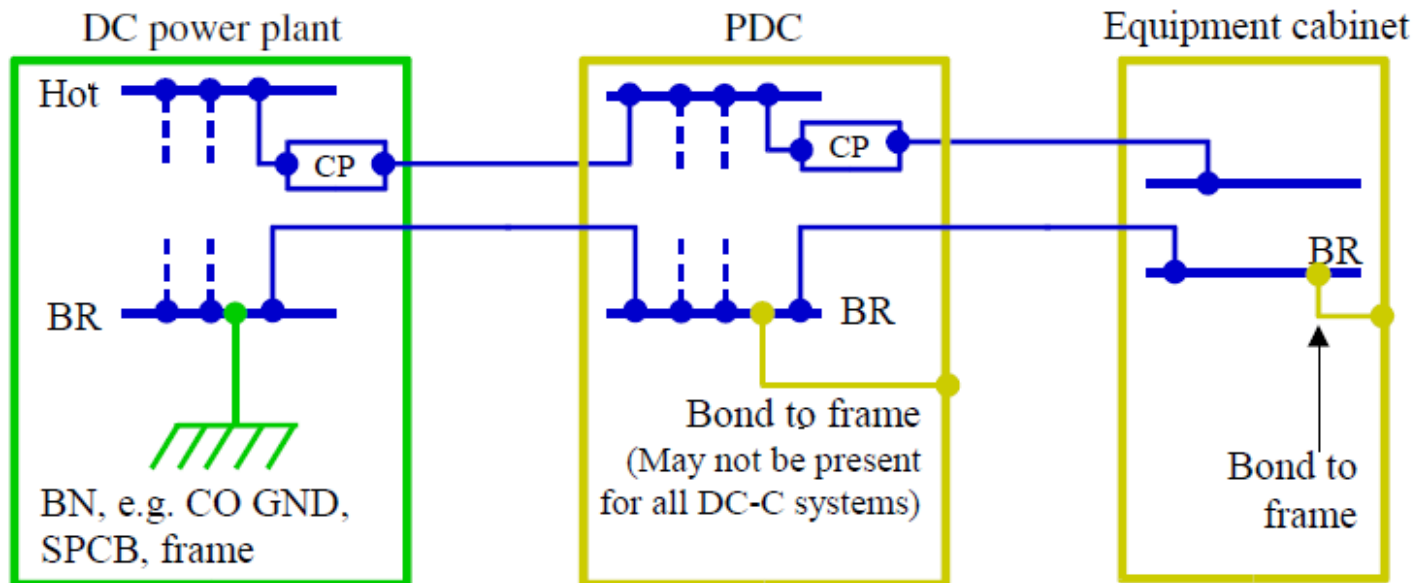


So, can Two-Wire equipment
coexist in a Three-wire
environment?

Yes, but it's not easy.

GR-295 Iss 1 (2004)

Figure 2-3 Illustration of a DC-C Power Distribution System



TR-NWT-00295, Issue 1

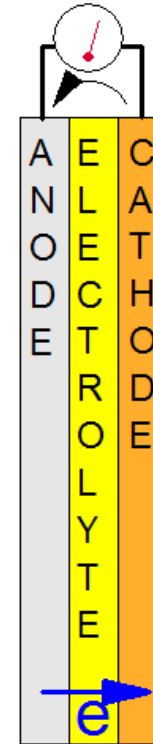
TR-NWT-00295, Issue 2

TR-EOP-000295, Issue 1, November 1987

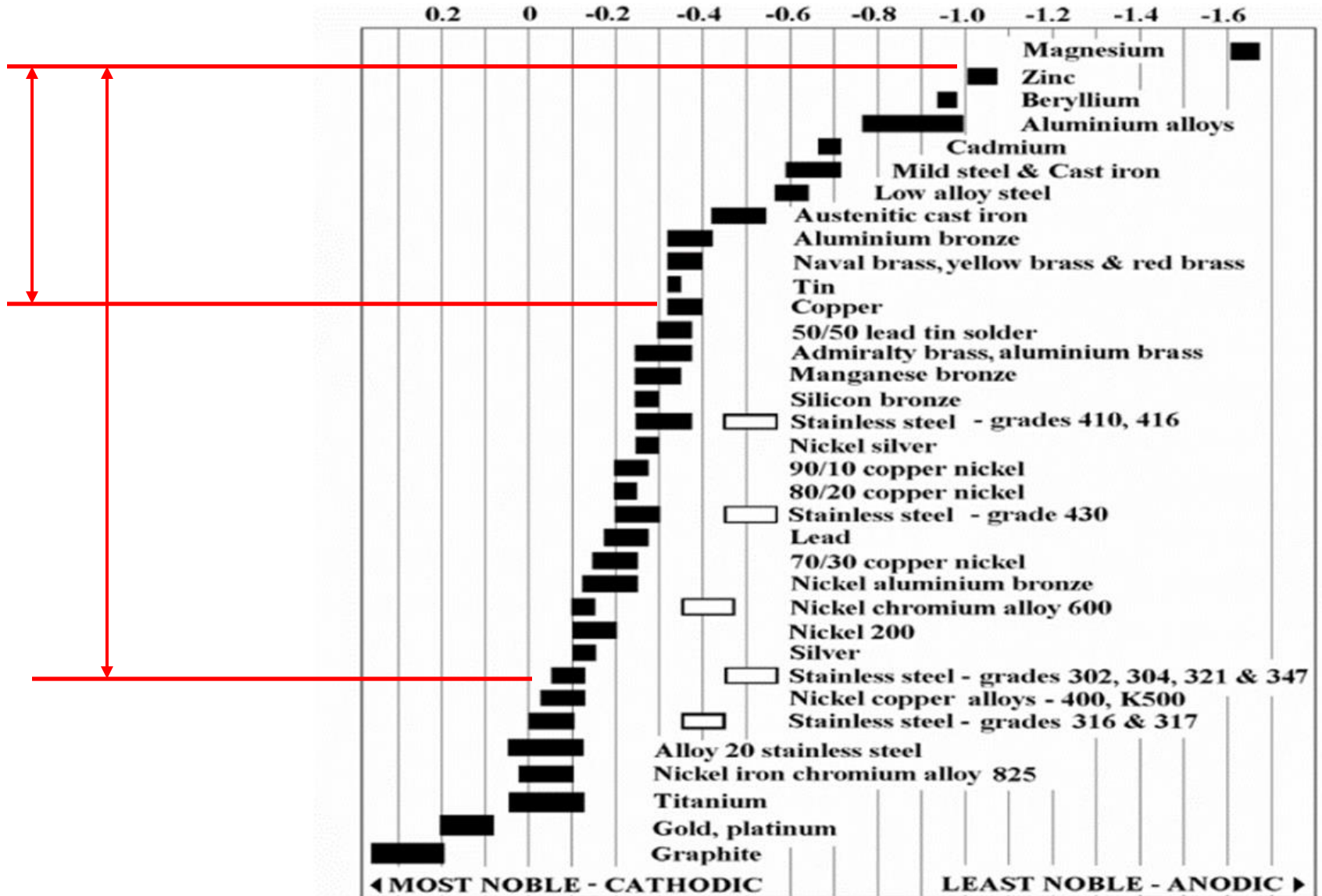
TR-EOP-000295, Issue 2, July 1992

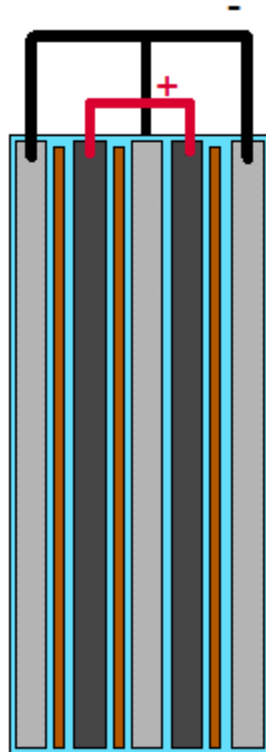
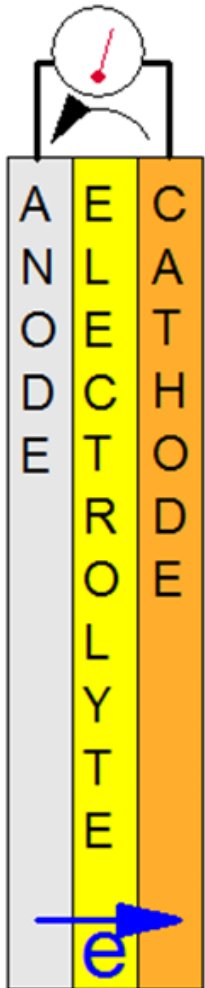
Cell Site Corrosion





- If dc Battery Return current is carried on the tower structure there are serious concerns about the impact of electrolytic corrosion exacerbating galvanic corrosion on the underground structural elements of the tower.



Galvanic corrosion occurs within a galvanic cell: fundamentally, two metals submersed in an electrolyte - resulting in an electrochemical attack on one metal at the expense the other. To form a galvanic cell two electrochemically different metals must exist within an electrolytic environment.

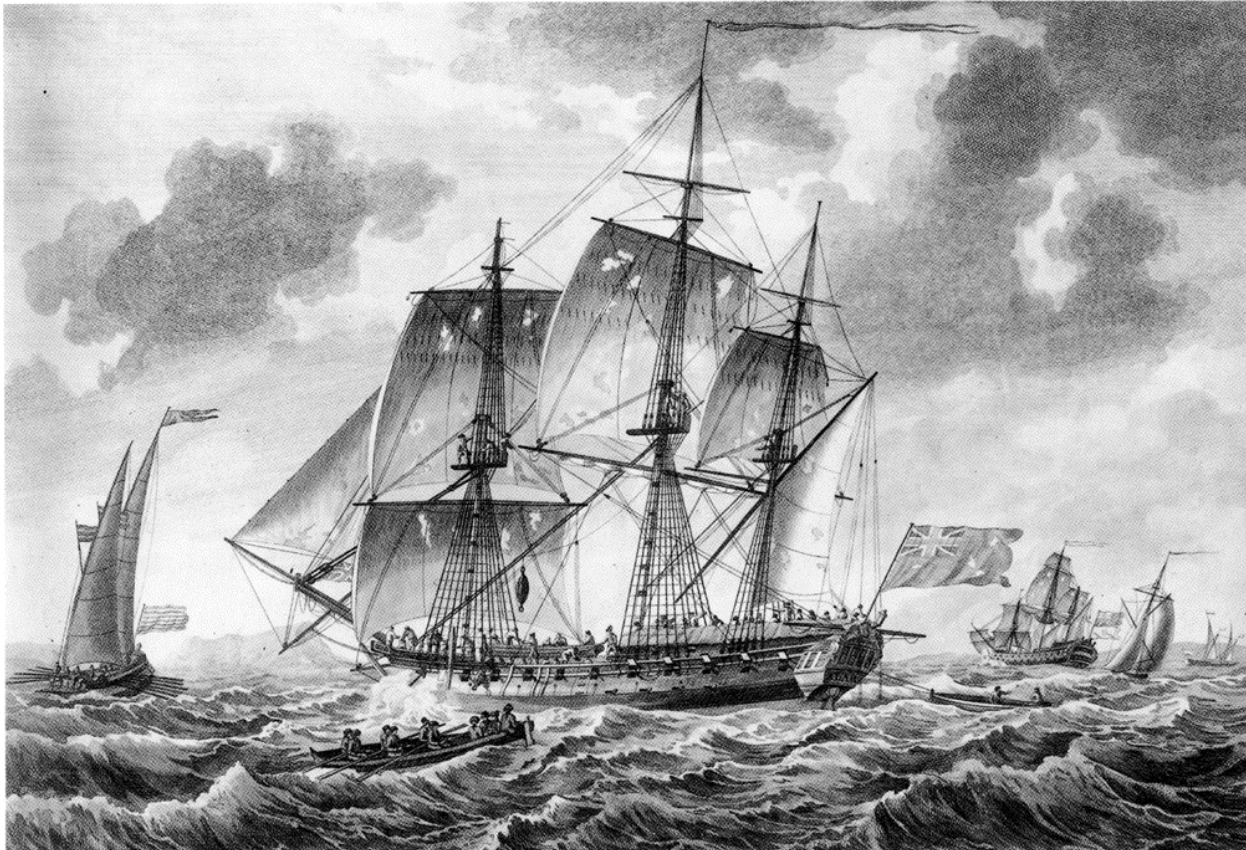




-  Negative plate
-  Plate Separator
-  Positive plate
-  Electrolyte



HMS Alarm Circa 1758

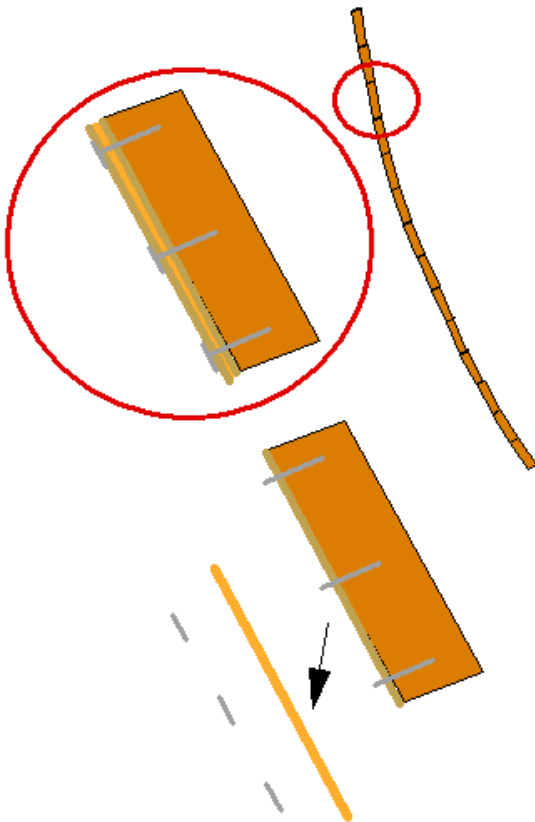


Sheet copper nailed to the sides creates a film of oxychloride which is toxic to wood worms and marine growth. This improvement made the vessel faster and reduced maintenance.

Corrosion however, "ate" the iron nail heads, causing the sheet copper plates to fall into the sea.

Some of the copper sheets were wrapped in brown paper which was not removed.

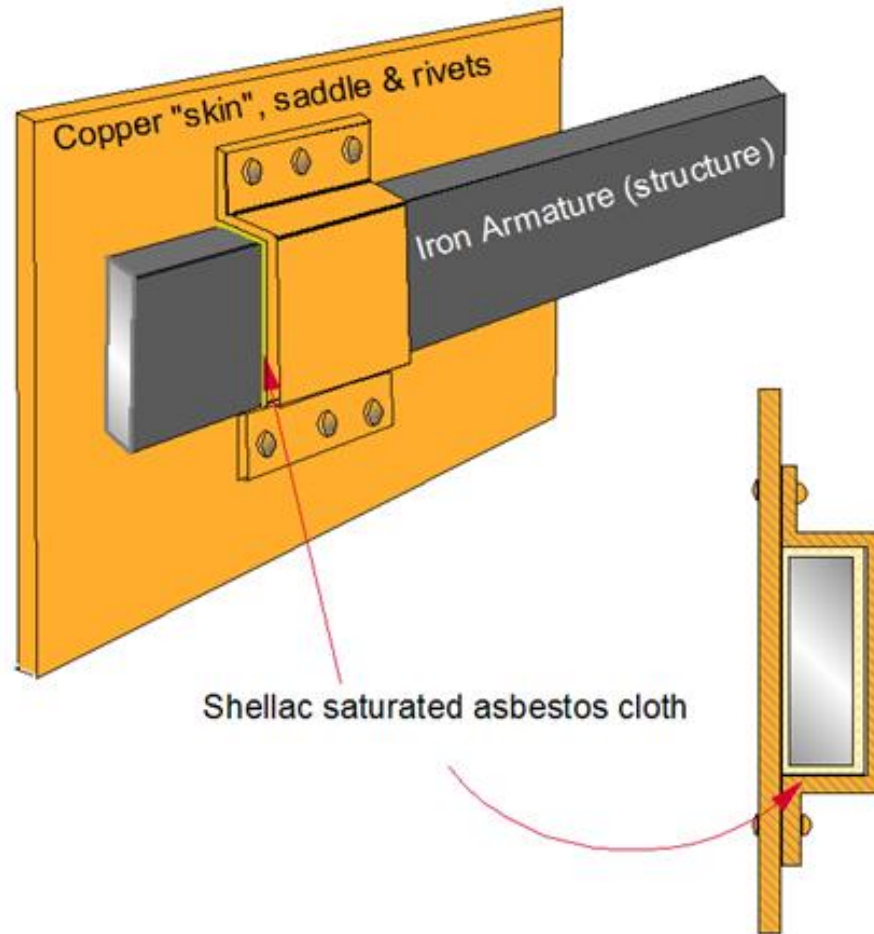
Where the brown paper remained under the nail heads, there was less corrosion because the iron was not in direct contact with the copper.

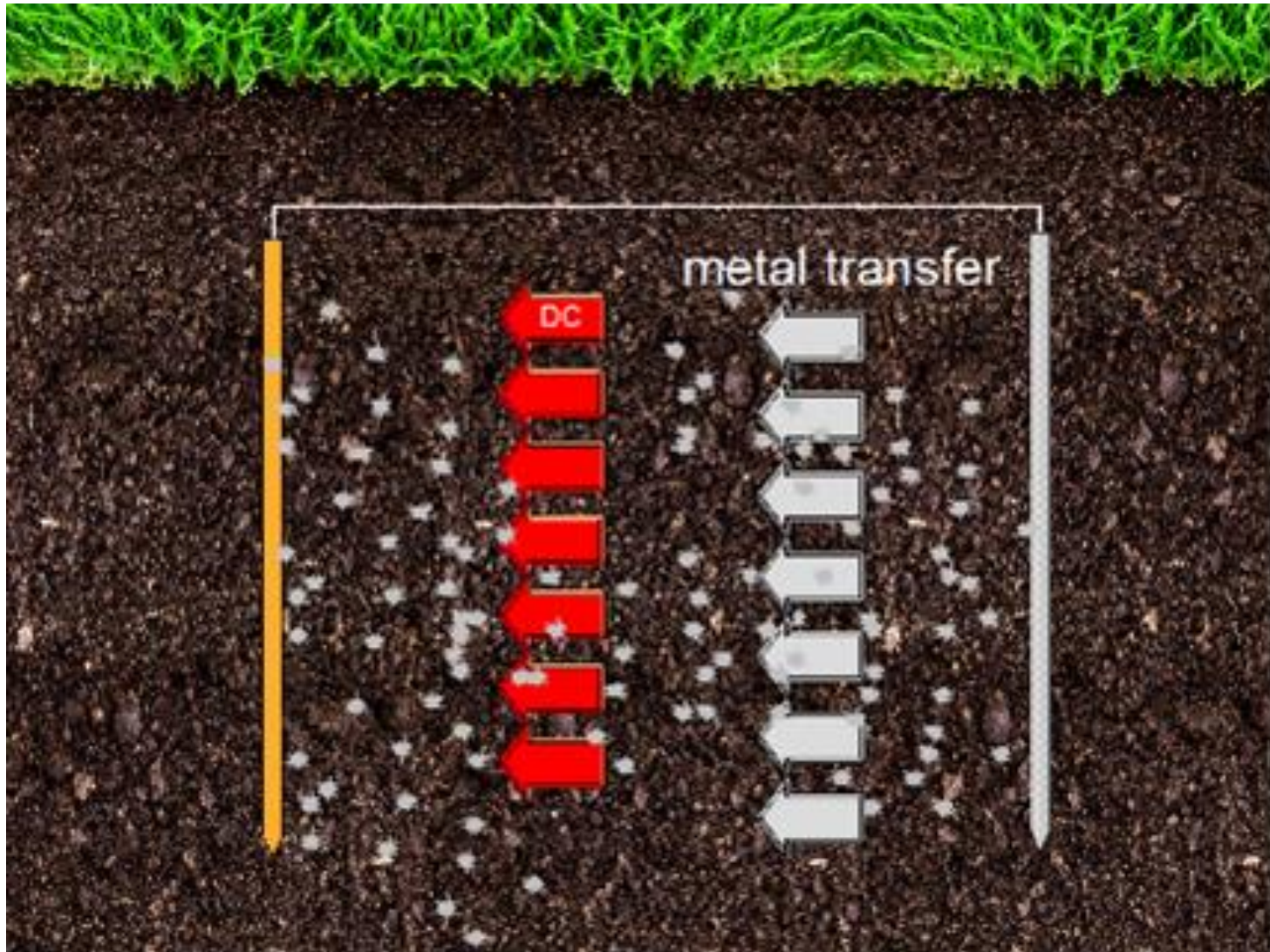




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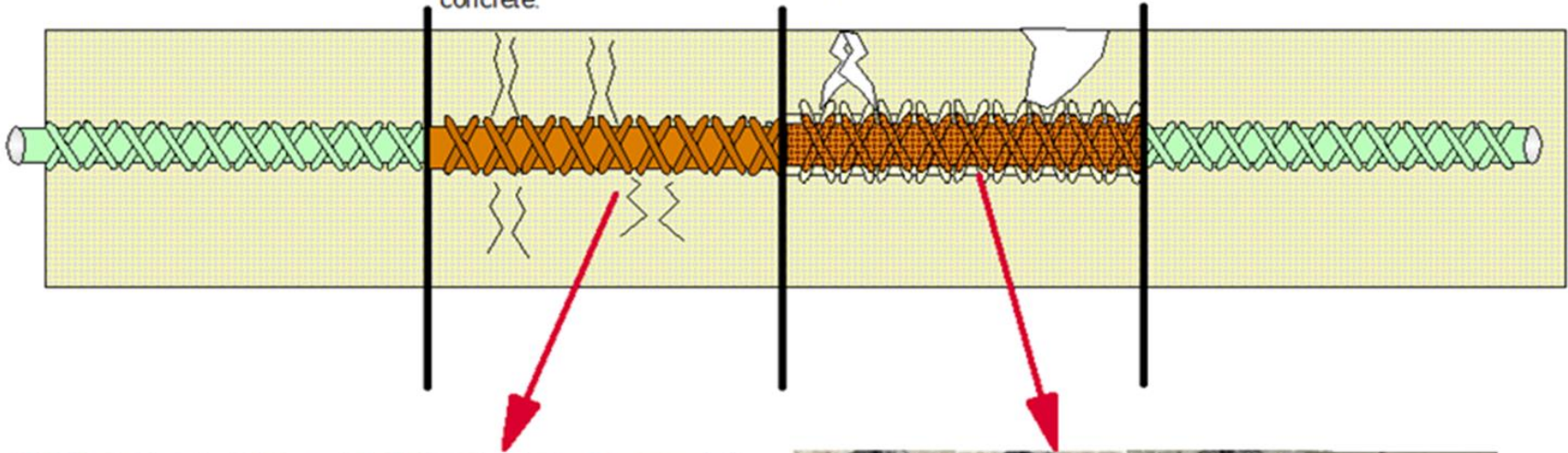


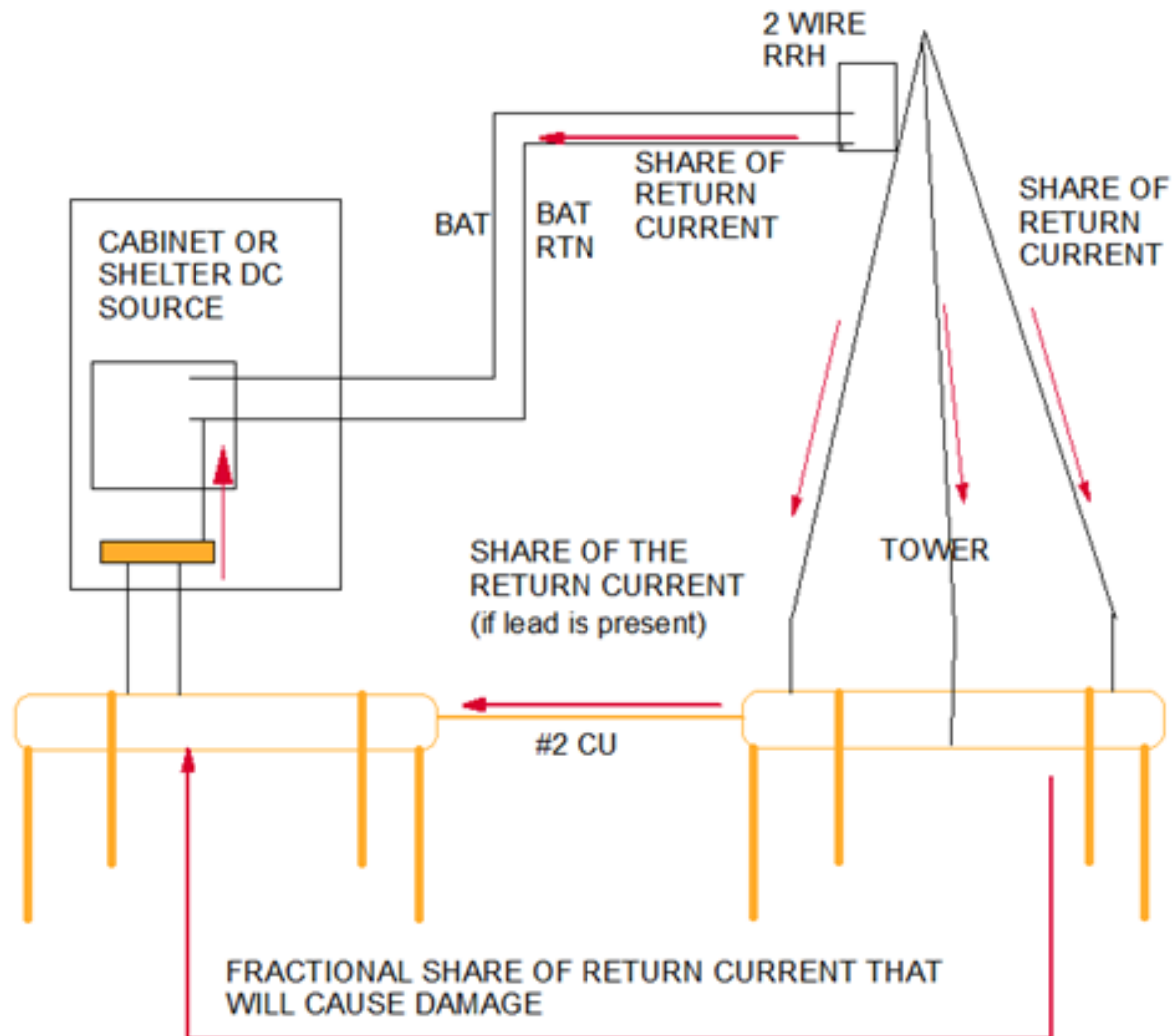


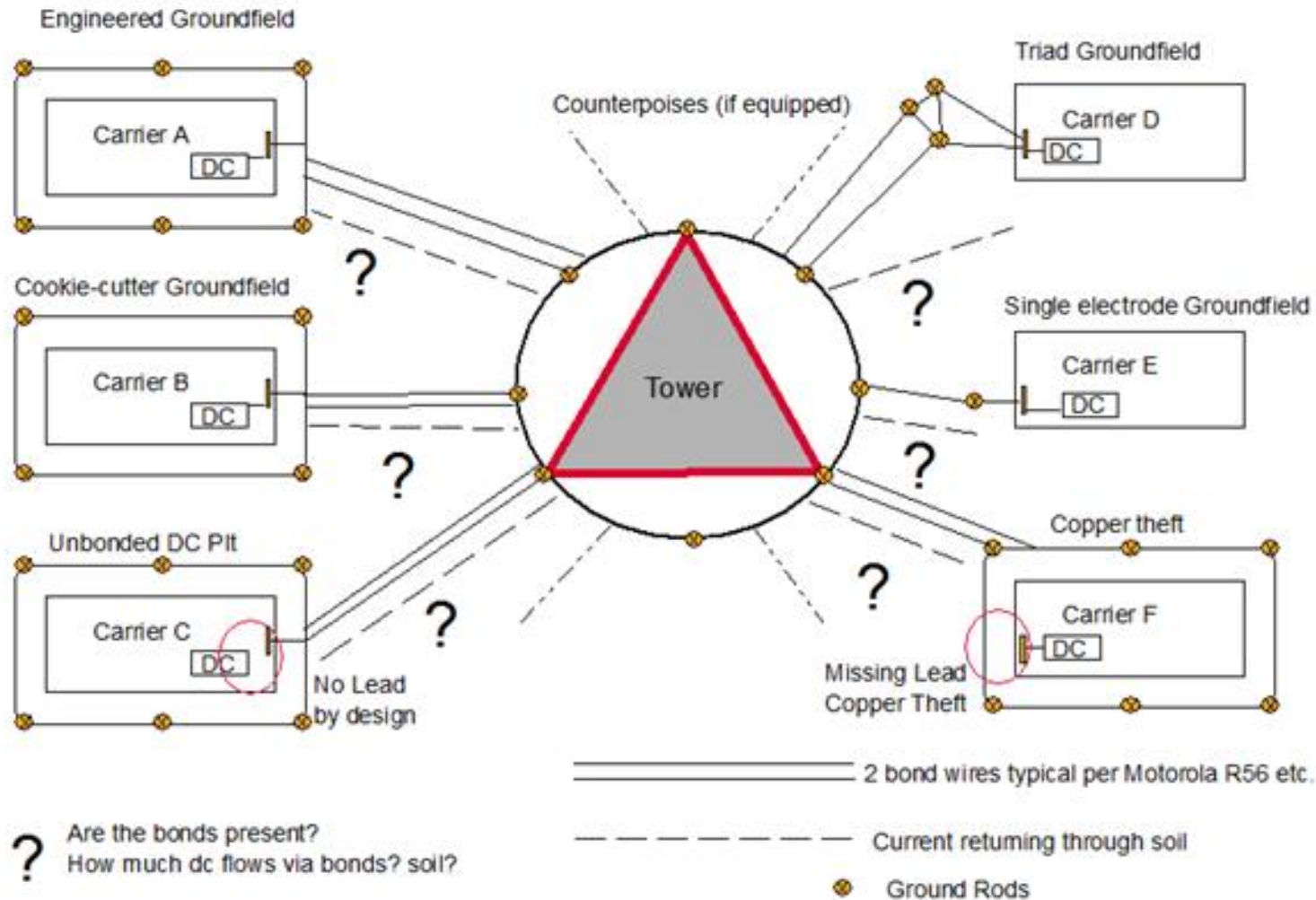


Products of corrosion cause the rod to swell and cause small cracks in the concrete.

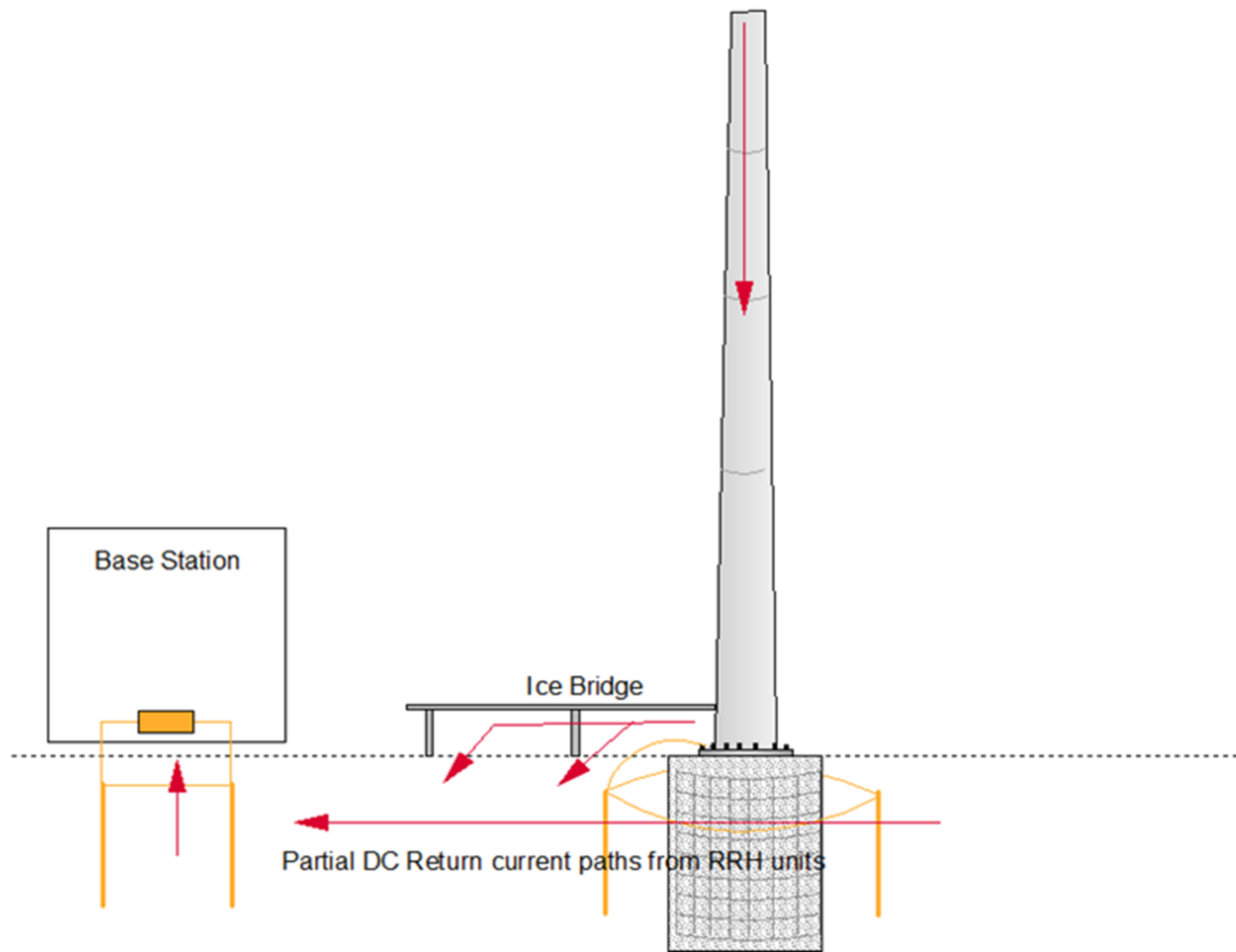
Water enters the cracks where freeze/thaw cycles spall the concrete.

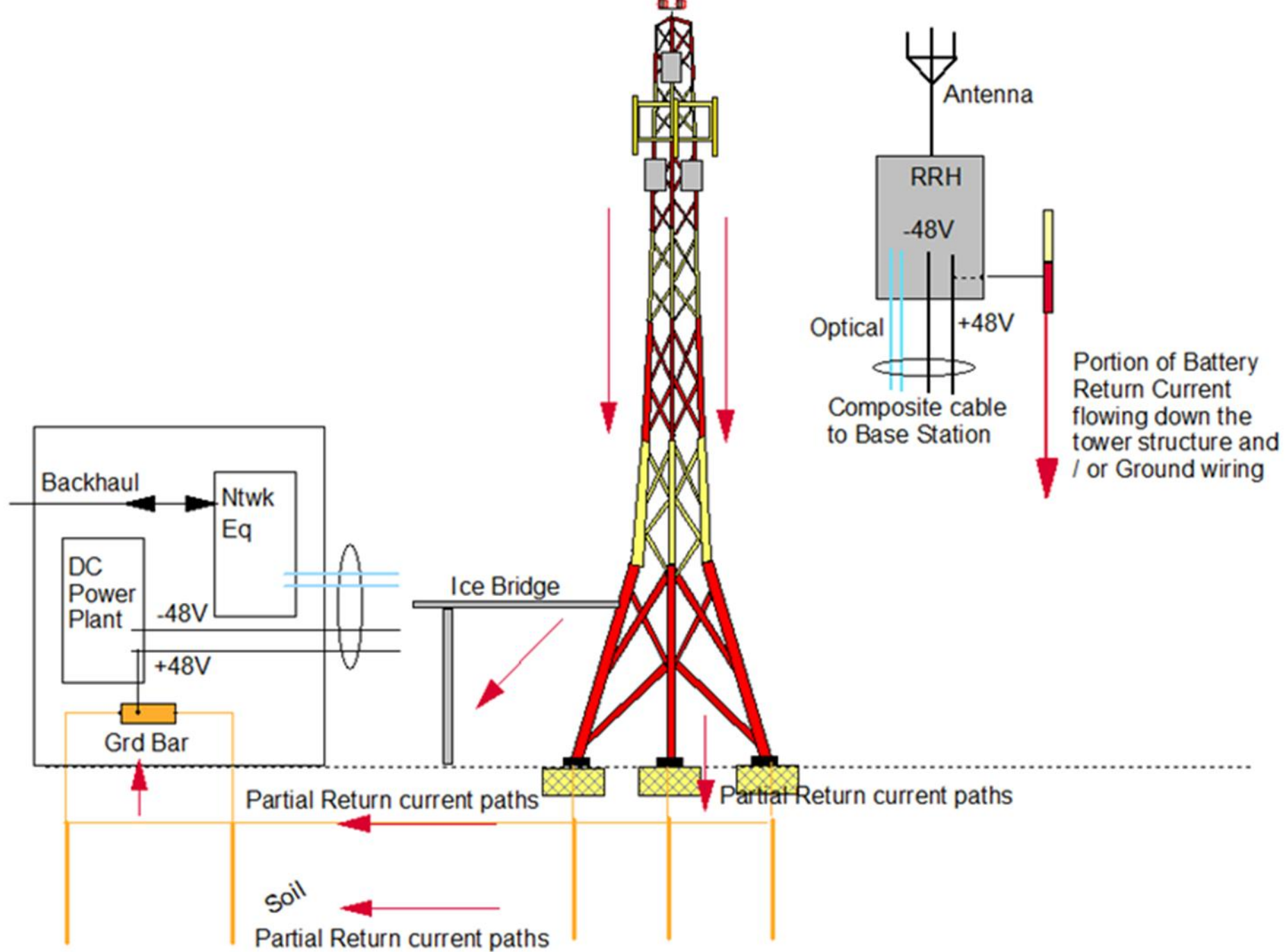




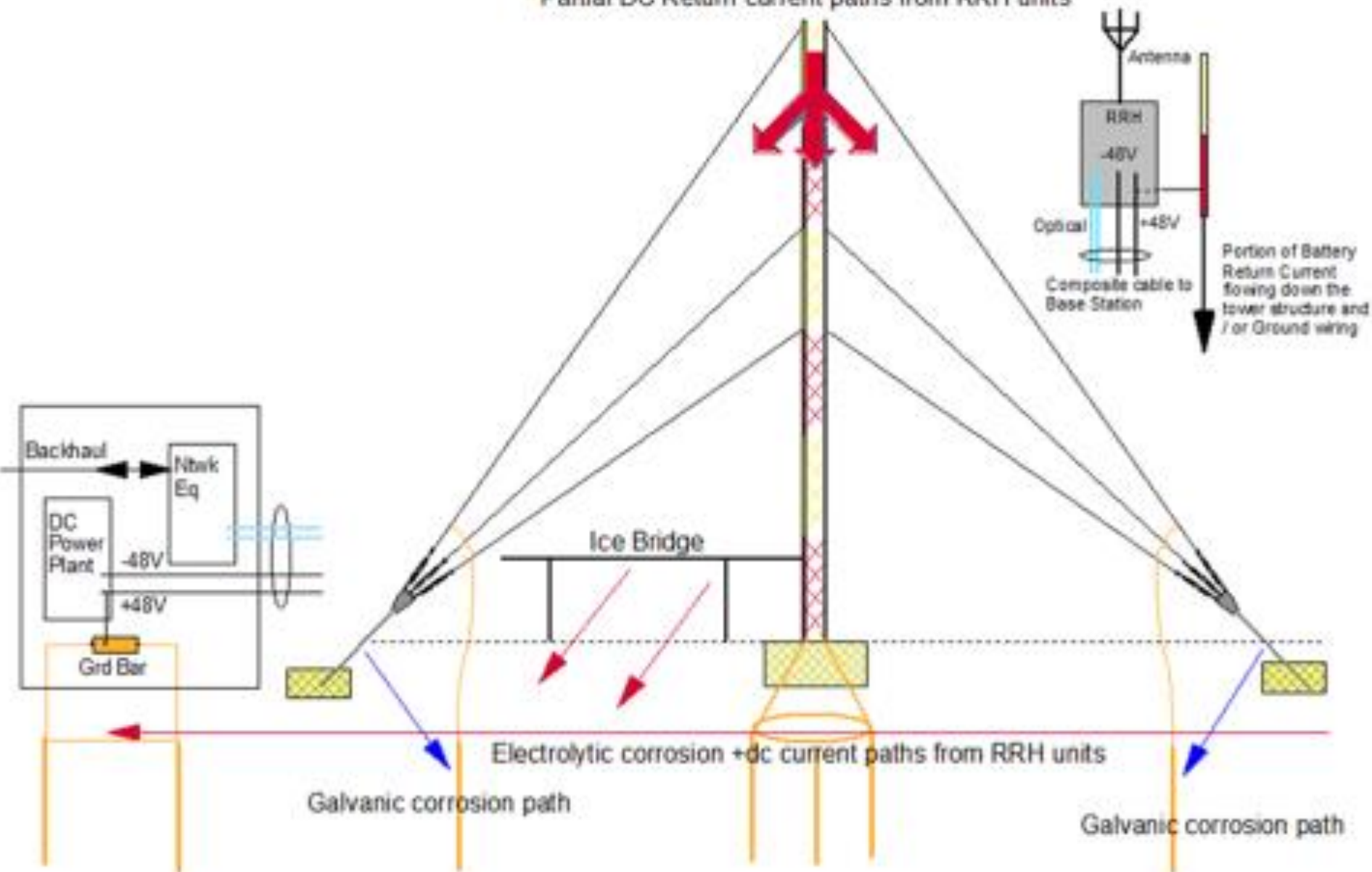


Partial DC Return current paths from RRH units





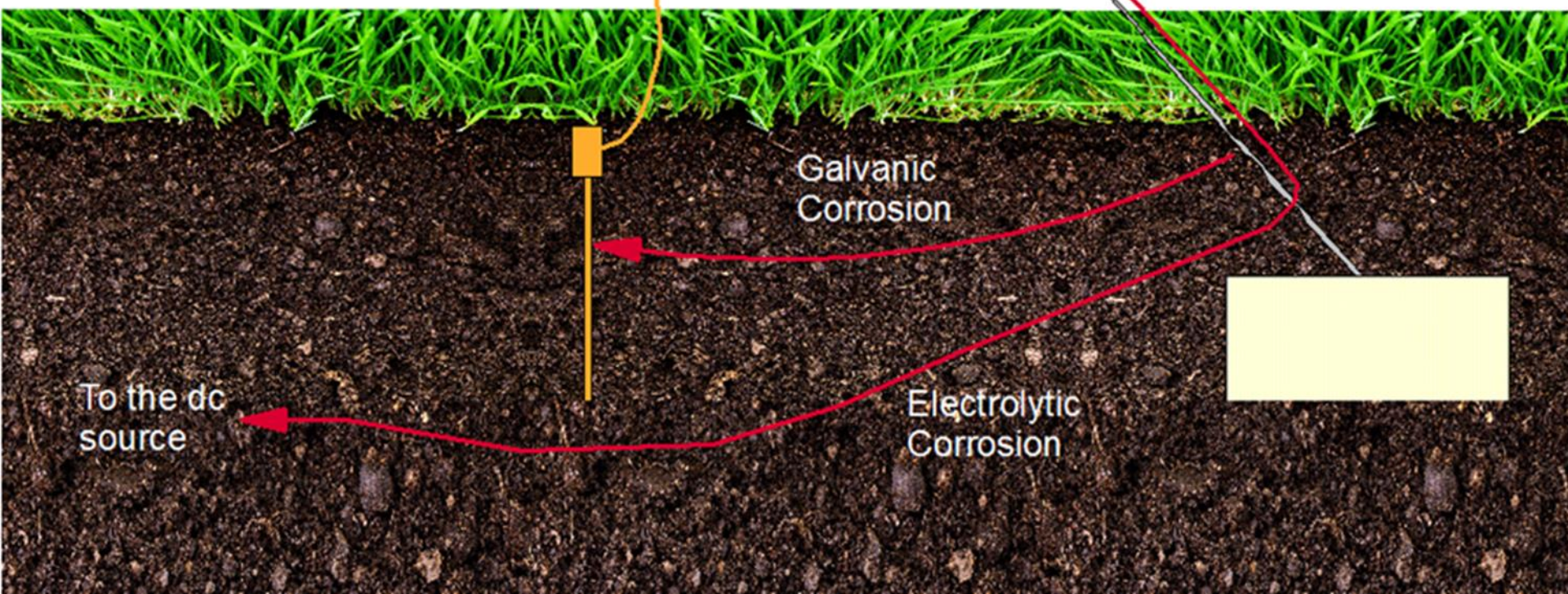
Partial DC Return current paths from RRH units

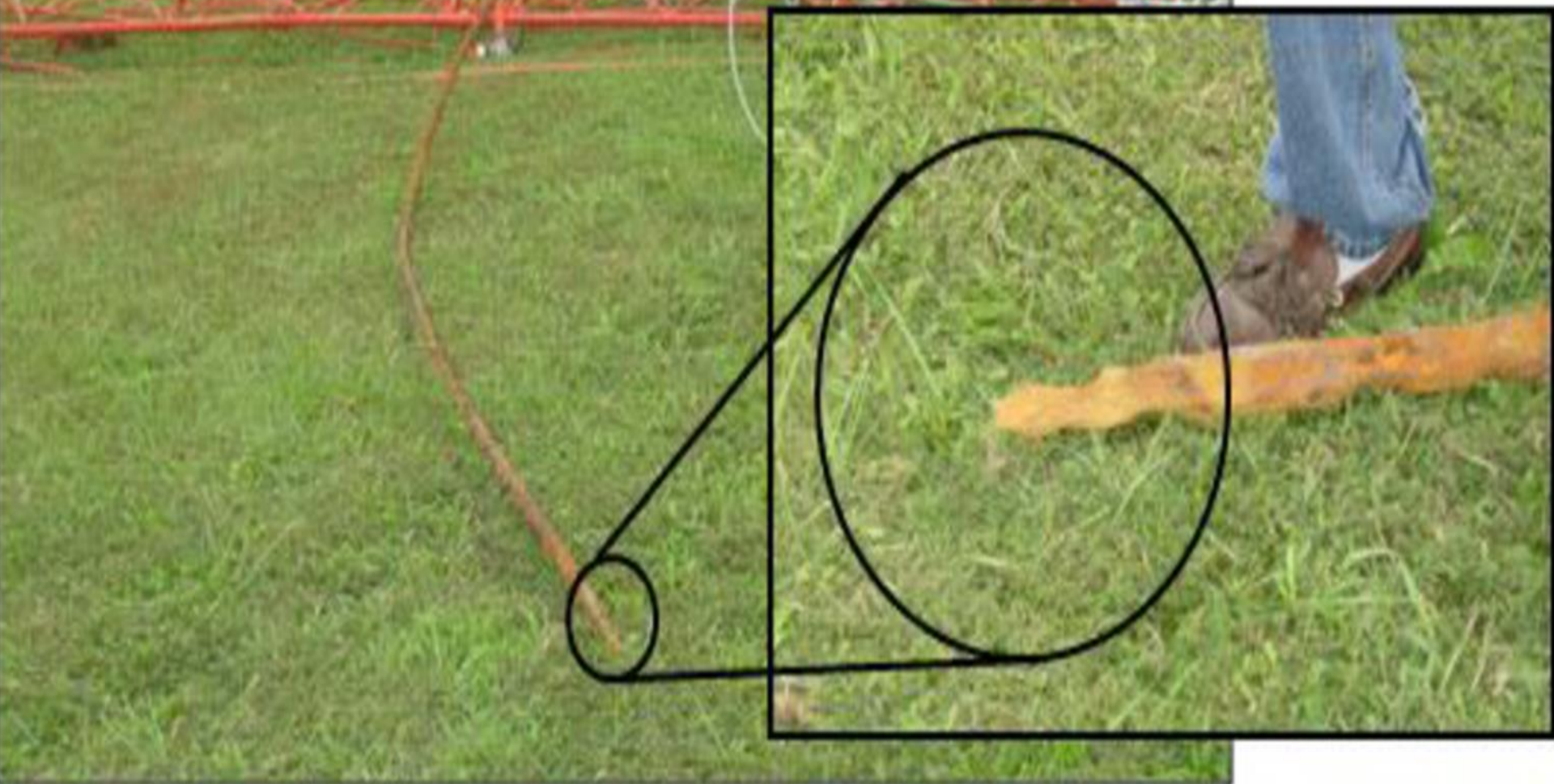


From the
dc source

DC

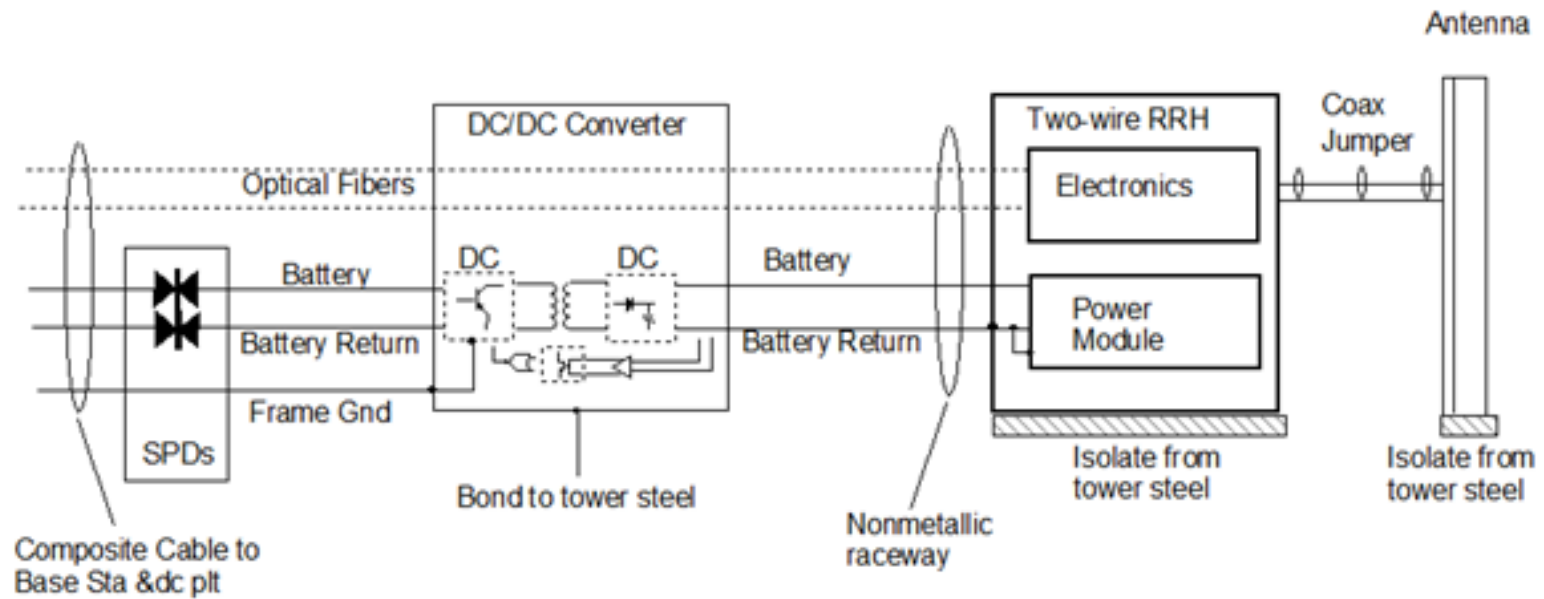
In the case of electrolytic
corrosion galvanic corrosion or
both, the galvanized steel
anchor rod is the less noble
metal and it corrodes.

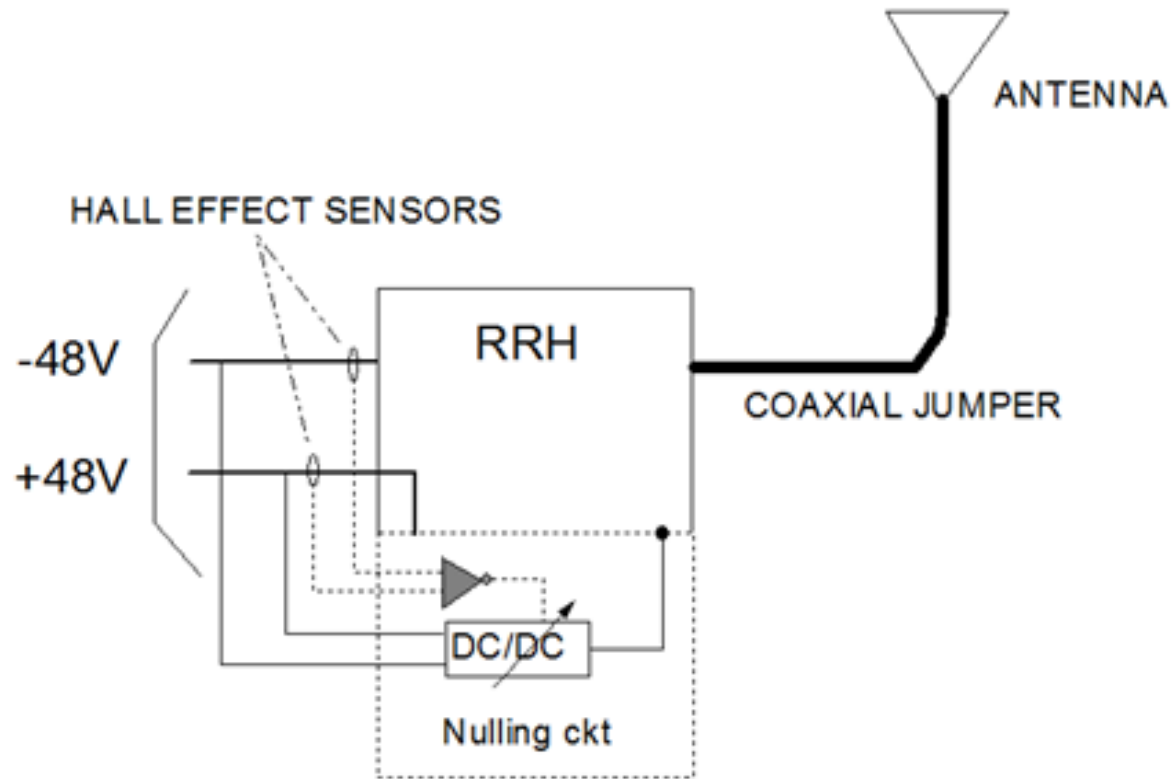


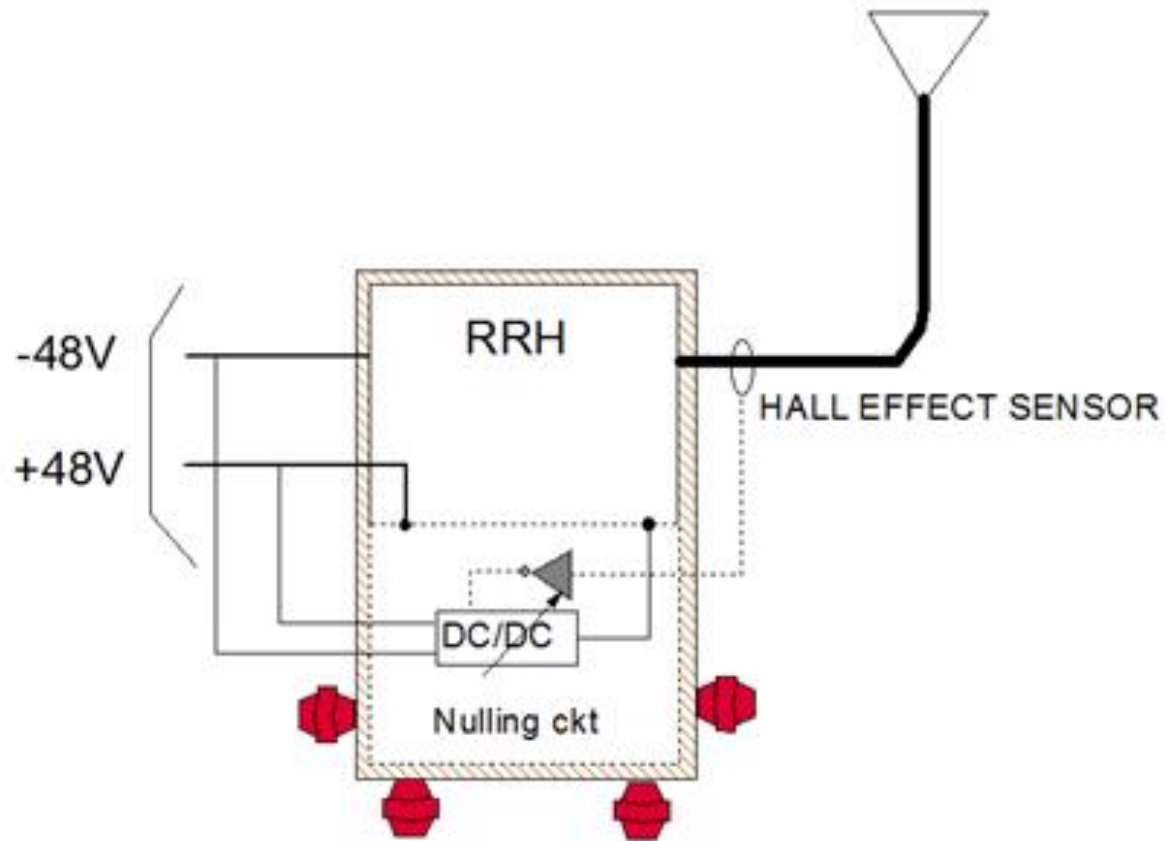


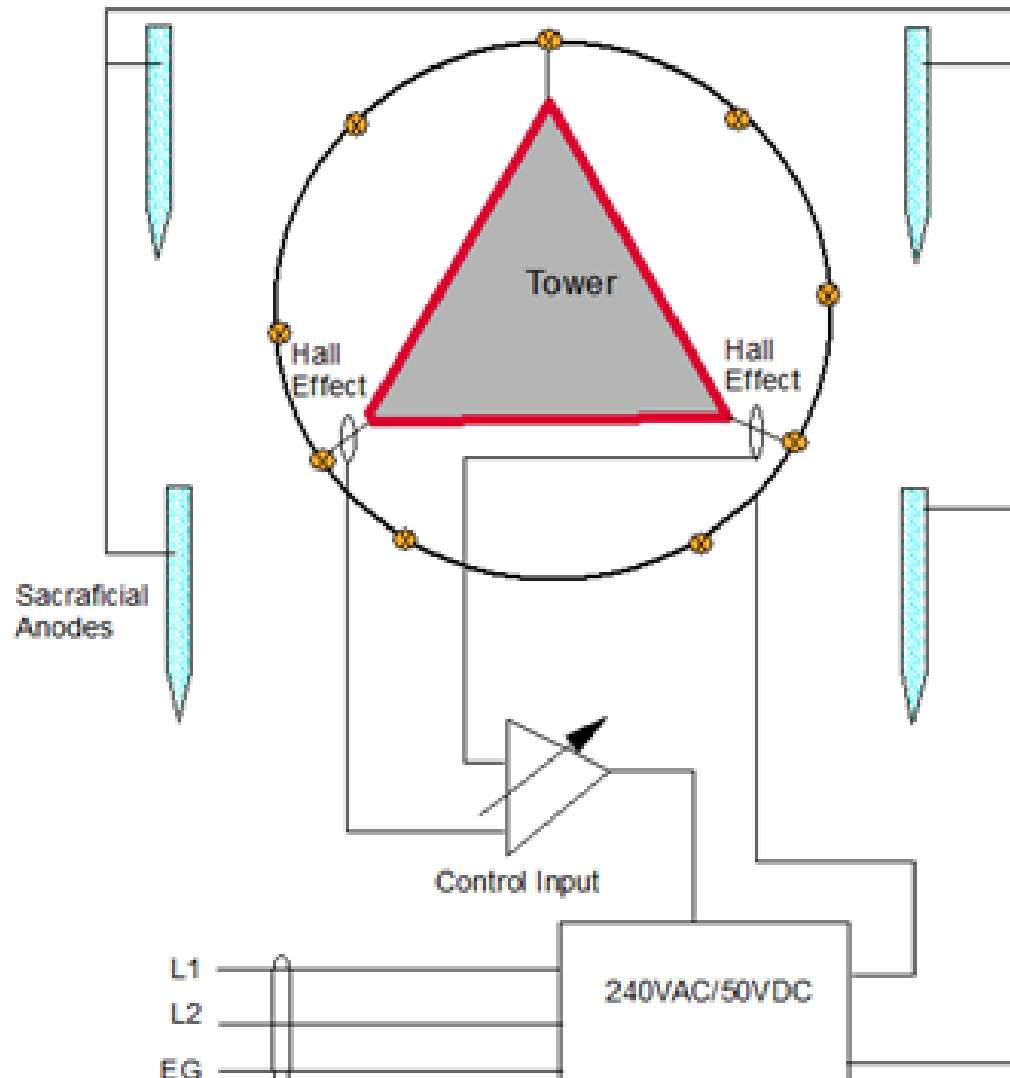
Anchor Pin Metal Loss











Conclusions

- Tower structures, guys etc should not carry dc
- Guyed towers need more maintenance inspections than previously known.
 - Untrasconic
 - Visual
- 3. Security for tower sites needs to be more effective at controlling copper theft of grounding system elements.