An Introduction to Earth Potential Rise

APEX Summit 2016: “Managing Uncertainty and Risk”

September 6, 2016

Terrence Ibasco

Presentation Overview

AIM:

To raise awareness regarding the existence of earth potential rise, its hazards and identify ways to manage uncertainty and risks

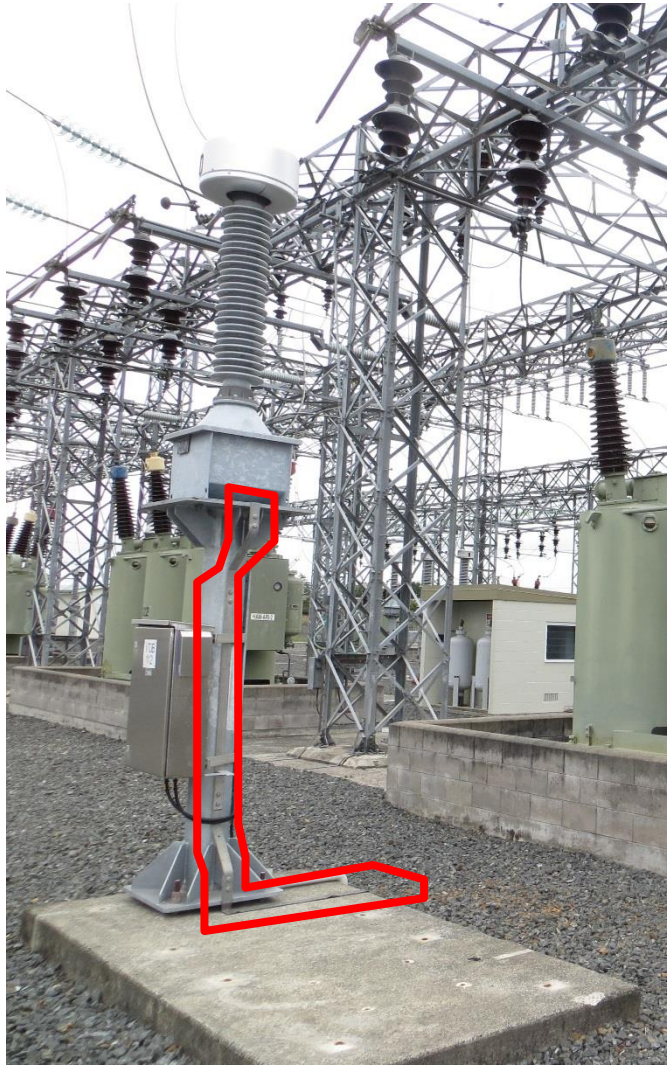
- What is Earthing?
- What is EPR?
- What makes it hazardous?
- How do we mitigate it?
- Applications

What is Earthing?

- It is the practice of embedding metallic structures (“electrodes”) into the earth and electrically connecting them to the neutral [earth] of the power system

- Meliopoulos 1988

What is Earthing?

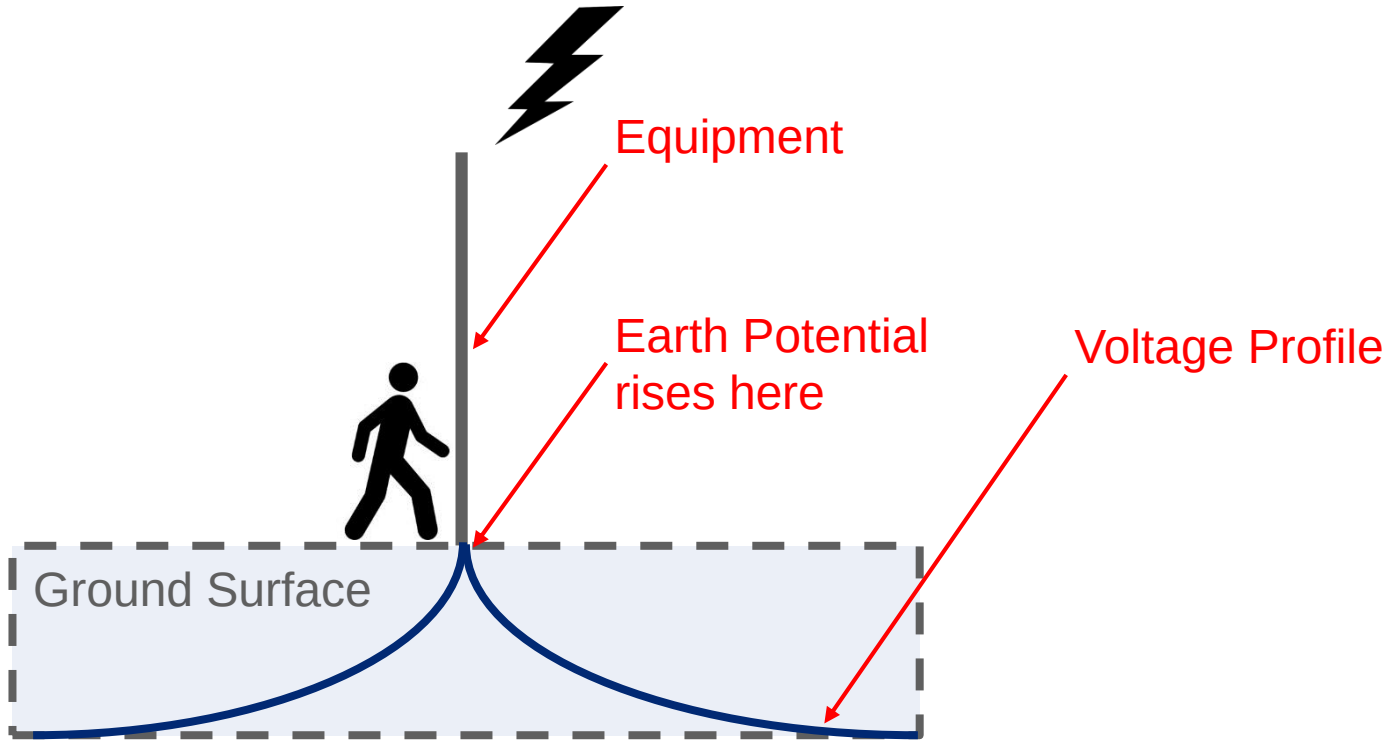


What is Earthing?

What is EPR?

Earth Potential Rise

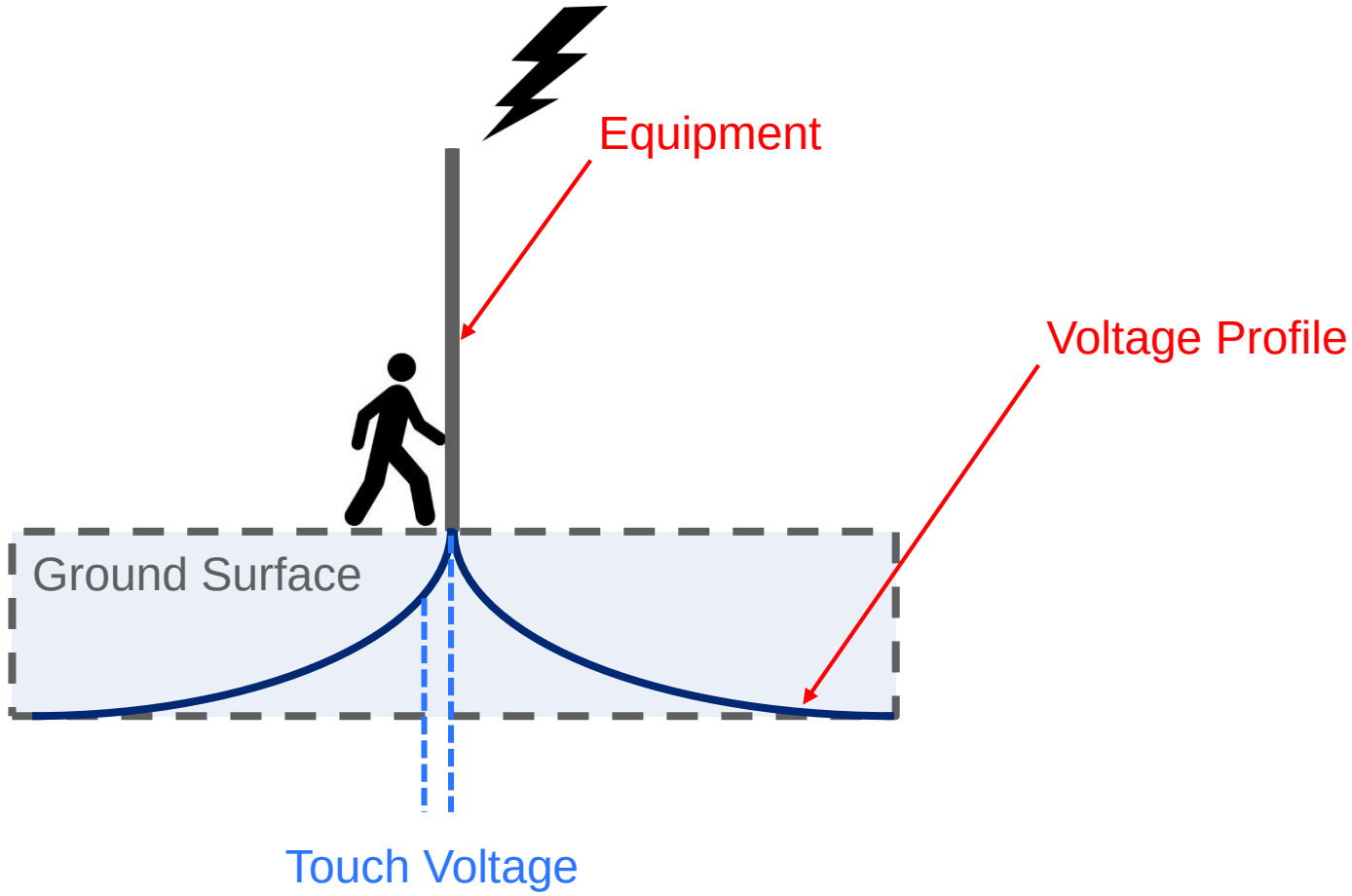
What is EPR? Earth Potential Rise



What makes it hazardous?

- Touch Voltage

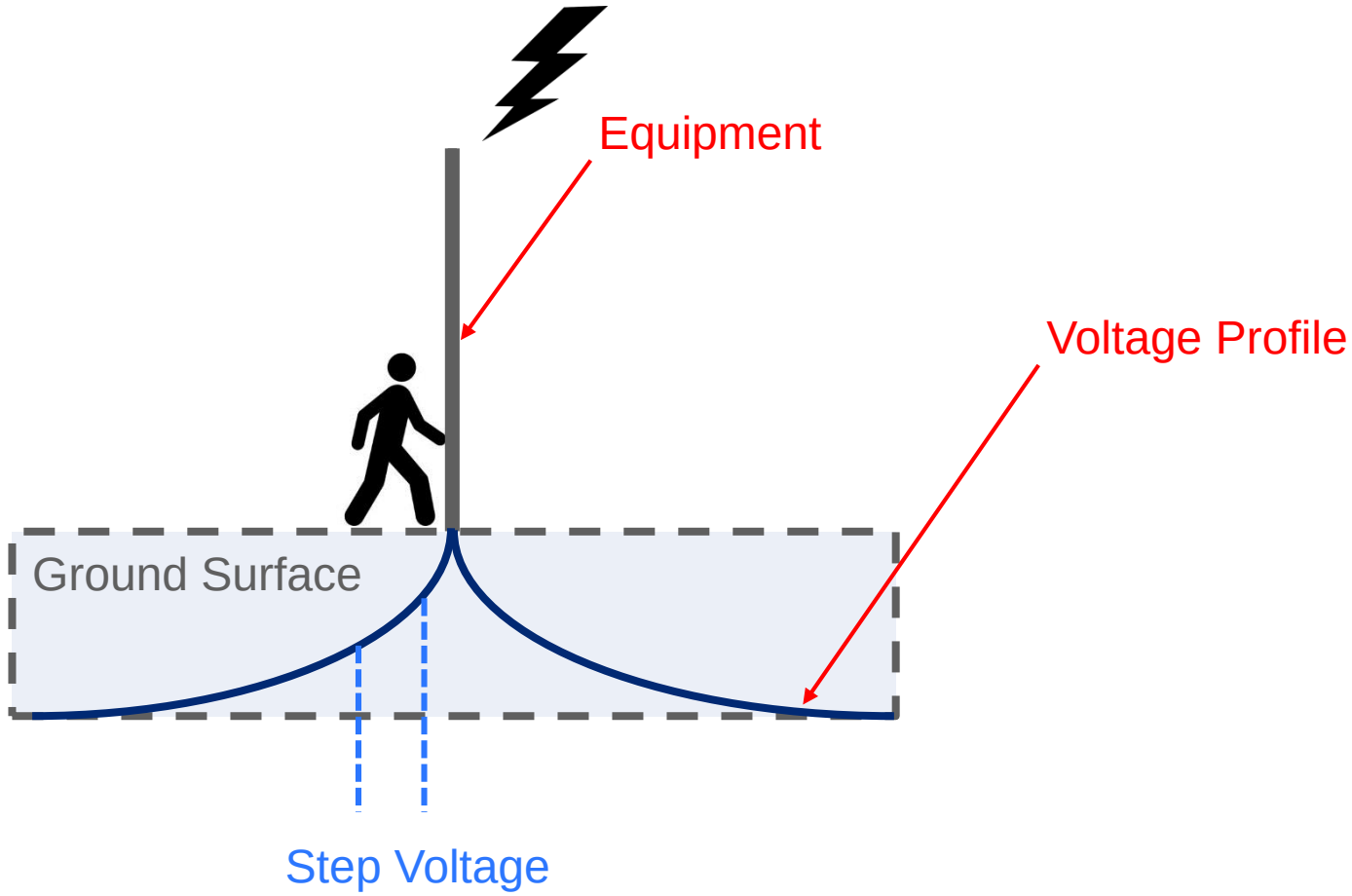
What makes it hazardous? Touch Voltage



What makes it hazardous?

- Touch Voltage
- Step Voltage

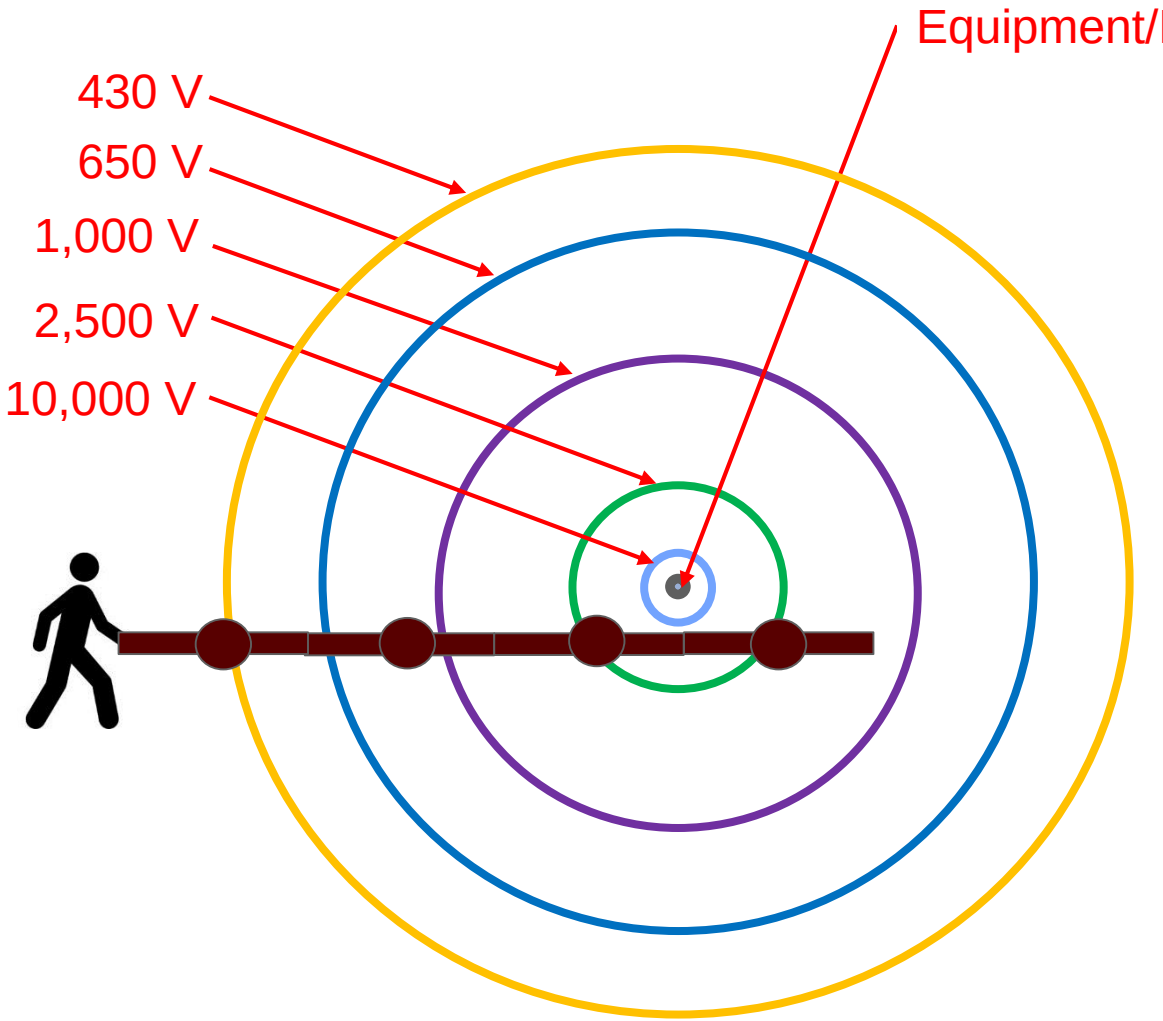
What makes it hazardous? Step Voltage



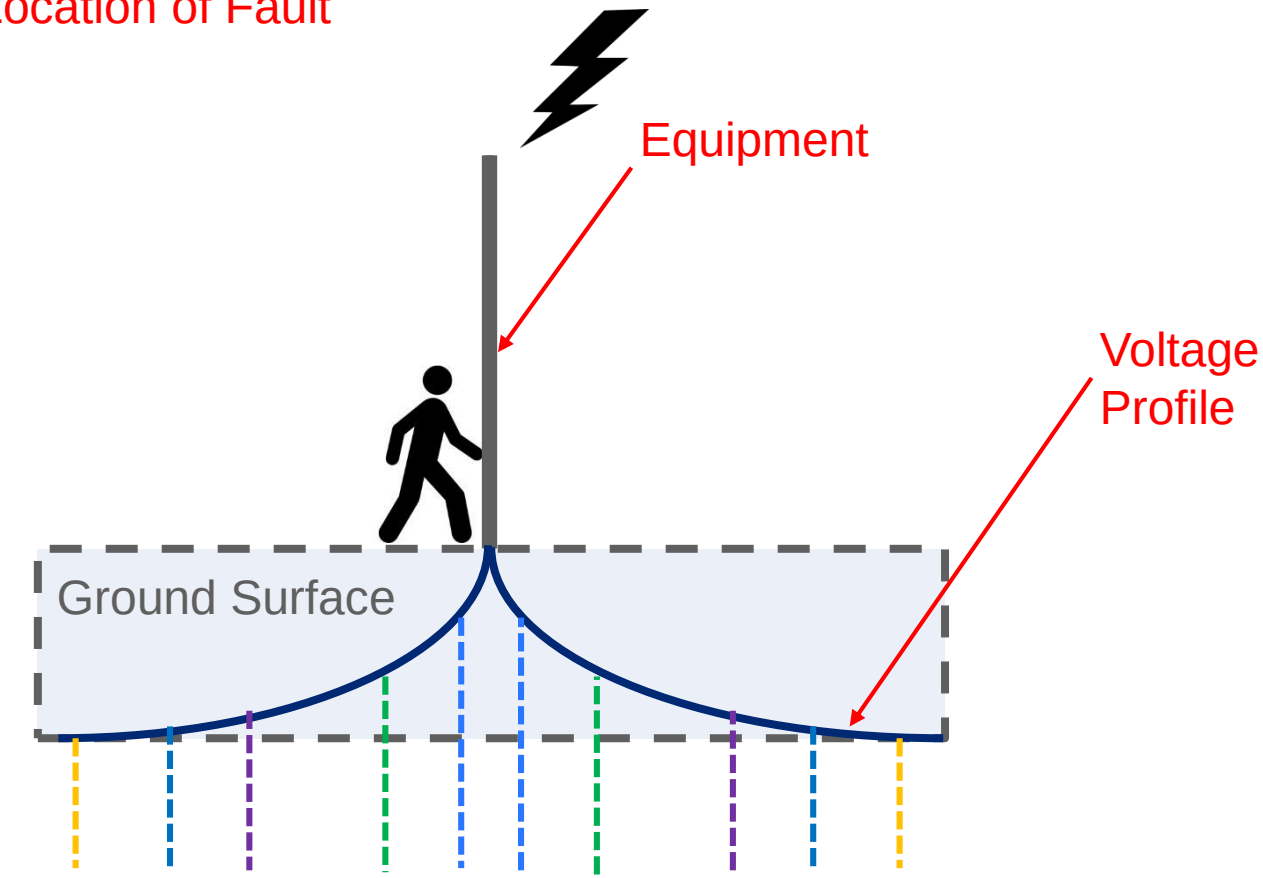
What makes it hazardous?

- Touch Voltage
- Step Voltage
- Transferred Voltage

What makes it hazardous? Transferred Voltage



Plan



Elevation

Beca

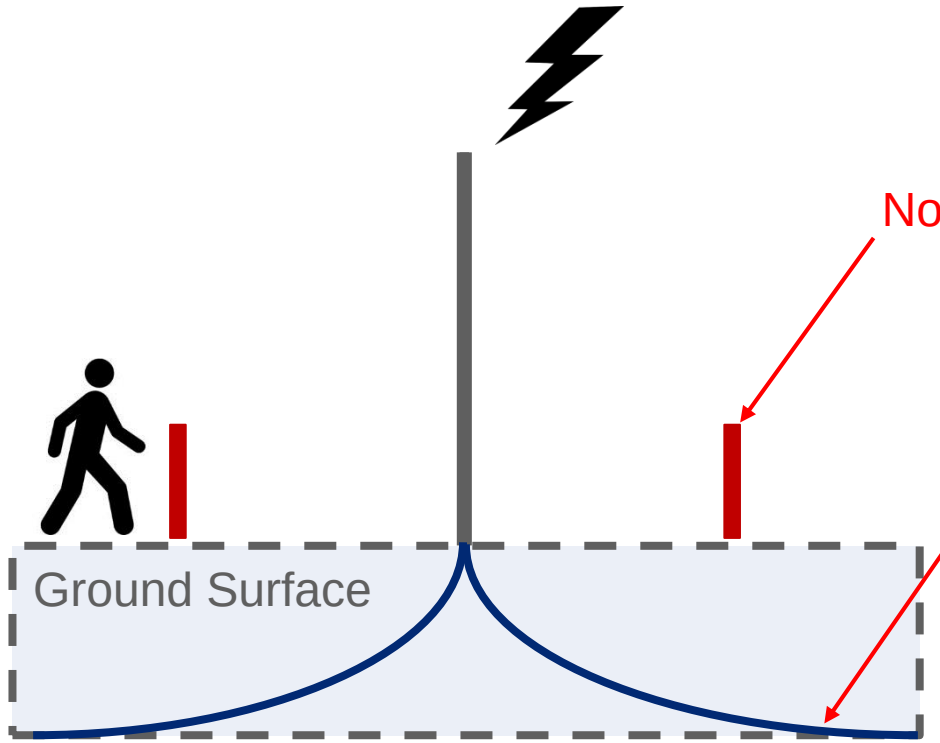
What makes it hazardous? Transferred Voltage

EPR Contour	Why?
10,000 V	Insulated Steel Water or Gas Pipelines
2,500 V	Copper-pair telecommunications cables
1000 V	MEN
650 V	Telecommunications asset with protection <0.5s
430 V	Telecommunications asset with protection >0.5s

How do we mitigate it?

METHOD	PROS	CONS
Non-Metallic Fence		

How do we mitigate it? Non-Metallic Fence



Serves as a physical barrier between the structure and the person

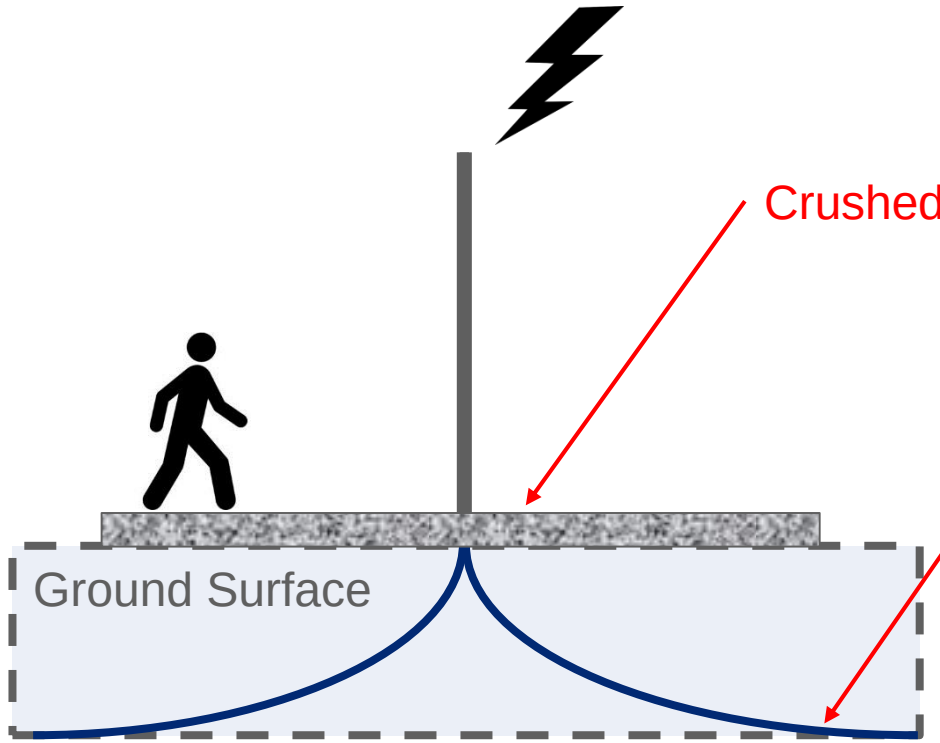
How do we mitigate it?

METHOD	PROS	CONS
Non-Metallic Fence	• Cheap • Easy to install • Easy to maintain	• Removable • Does not reduce touch and step voltage levels

How do we mitigate it?

METHOD	PROS	CONS
Non-Metallic Fence	• Cheap • Easy to install • Easy to maintain	• Removable • Does not reduce touch and step voltage levels
Crushed Rock/Asphalt Layering		

How do we mitigate it? Crushed Rock/Asphalt



Adds another layer of impedance between your feet and the soil

How do we mitigate it?

METHOD	PROS	CONS
Non-Metallic Fence	• Cheap • Easy to install • Easy to maintain	• Removable • Does not reduce touch and step voltage levels • Requires maintenance
Crushed Rock/Asphalt Layering	• Easy to install	• Removable • Does not reduce touch and step voltage levels • Requires maintenance

How do we mitigate it?

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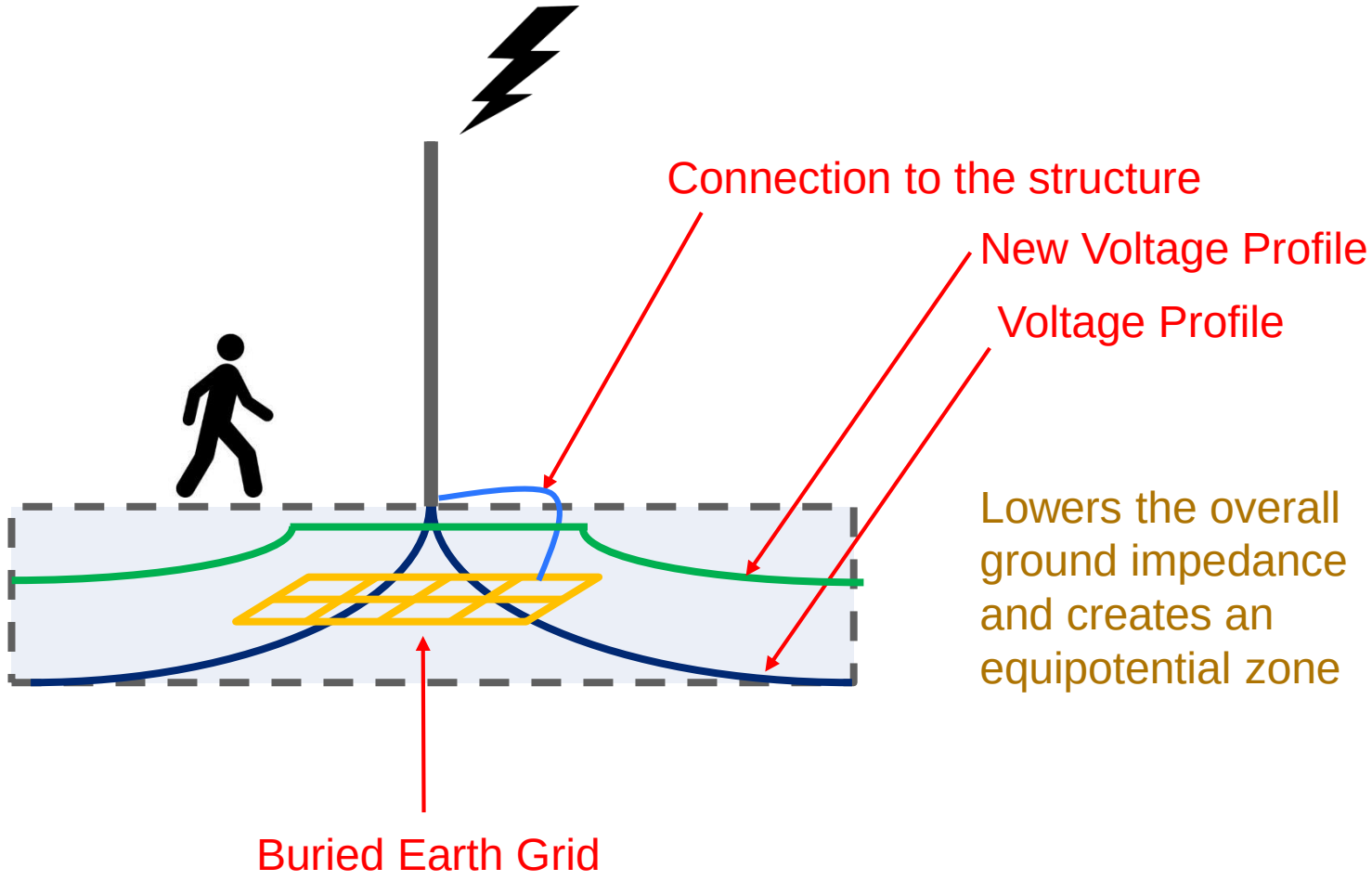
Buried Earth Grid		

How do we mitigate it? Buried Earth Grid



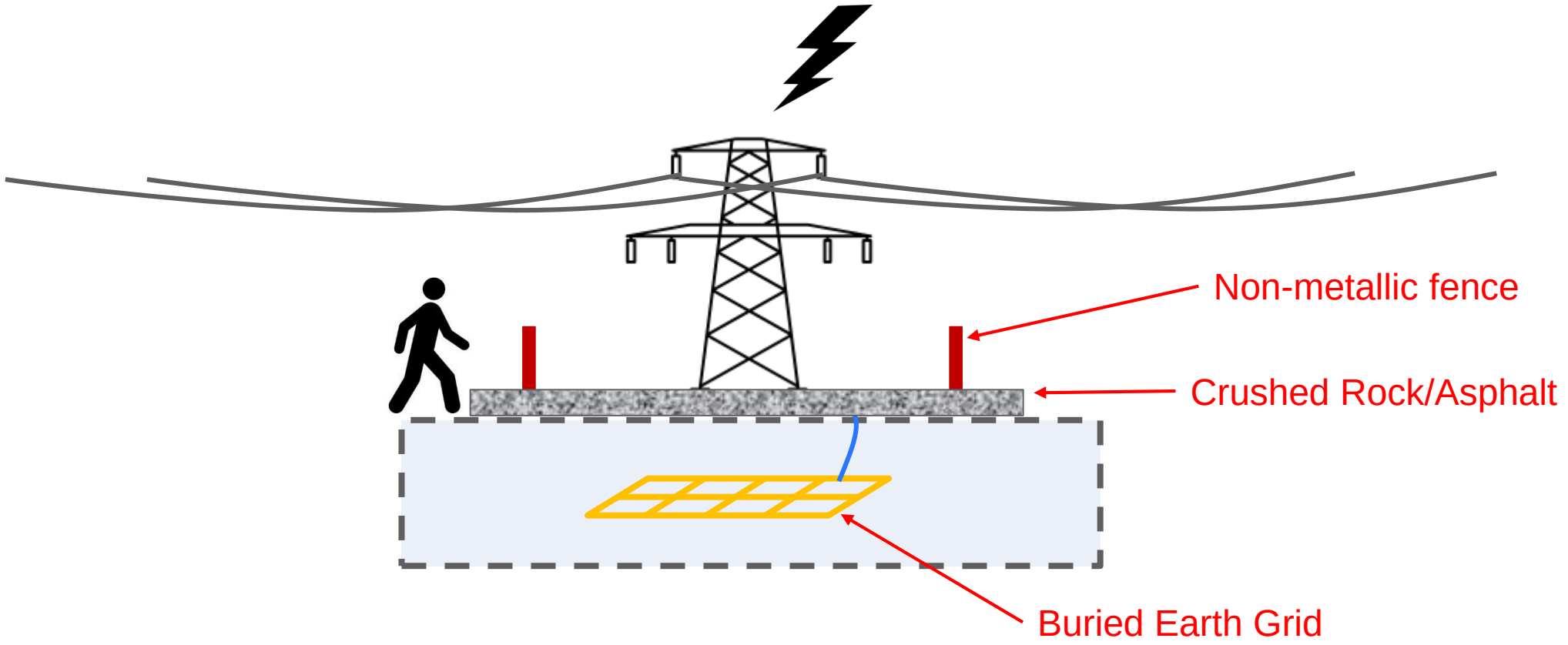
How do we mitigate it?

METHOD	PROS	CONS
Non-Metallic Fence	• Cheap • Easy to install • Easy to maintain	• Removable • Does not reduce touch and step voltage levels • Requires maintenance
Crushed Rock/Asphalt Layering	• Easy to install	• Removable • Does not reduce touch and step voltage levels • Requires maintenance
Buried Earth Grid	• Reduces touch and step voltage levels	• Expensive • Difficult to install • Difficult to maintain • EPR contours spread out

Applications

- Transmission Towers

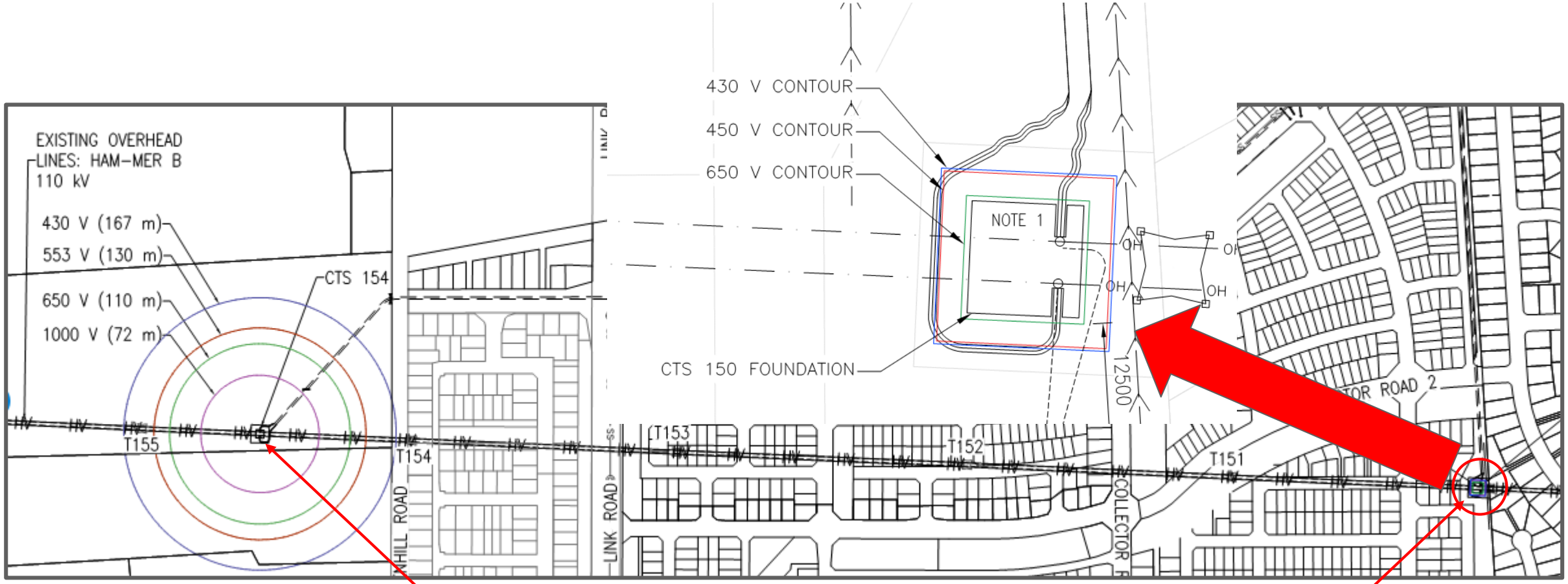
Applications - Transmission Towers



Applications

- Transmission Towers
- Cable Transition Structures

Applications - Cable Transition Structures

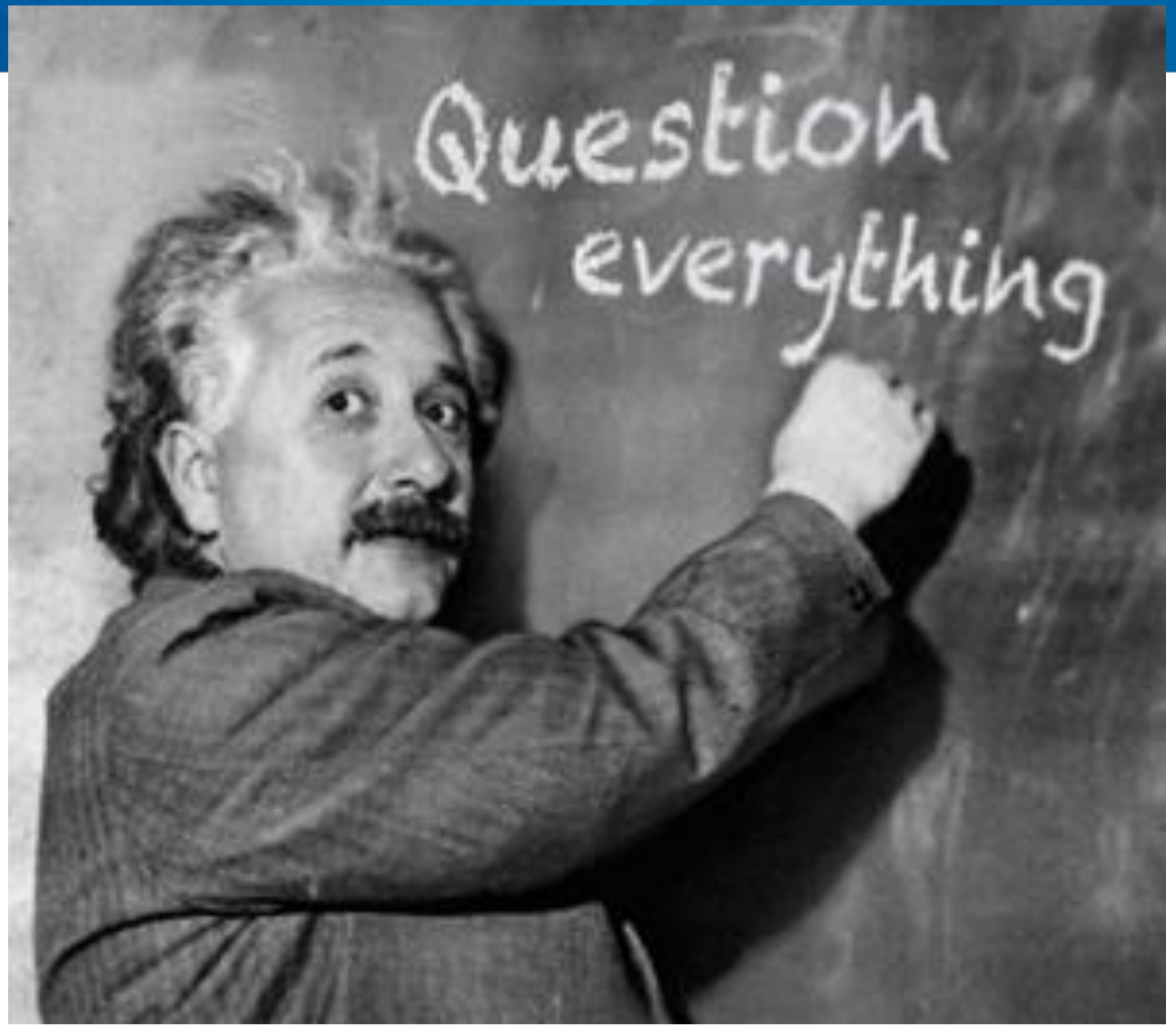


Northern CTS

Southern CTS

Conclusions

- What is Earthing?
  - electrically connecting metallic structures to the neutral/earth
- What is EPR?
  - Earth Potential Rise
- What makes it hazardous?
  - Step, Touch and Transferred Voltages
- How do we mitigate it?
  - Non-Metallic Fence, Crushed Rock/Asphalt Layering, Buried Earth Grid
- Applications
  - Transmission Towers, Cable Transition Structures


Question
everything

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