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Substation Grounding

Impacts of Design Inputs on Results

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POWER ENGINEERS

Overview

- Substation Ground Analysis Theory
- Inputs for consideration
- Practical applications

Substation Grounding

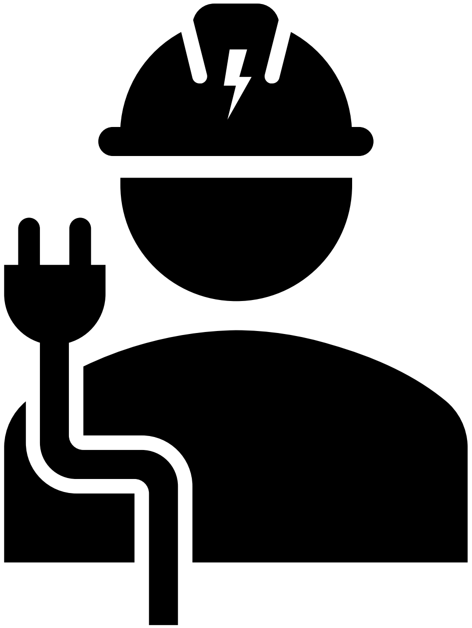
Analysis Theory

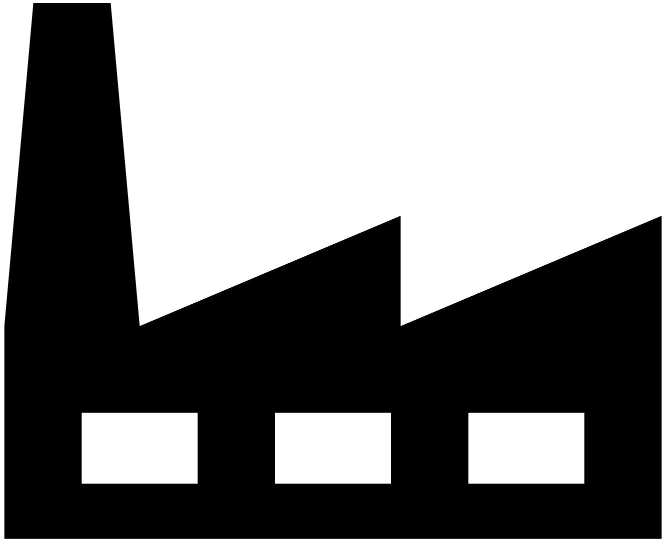
What is Grounding

A connection between anything that needs to be grounded and a metallic system you design (or use) to dissipate and allow current to return to its source

Goal is to provide a solid, low impedance path

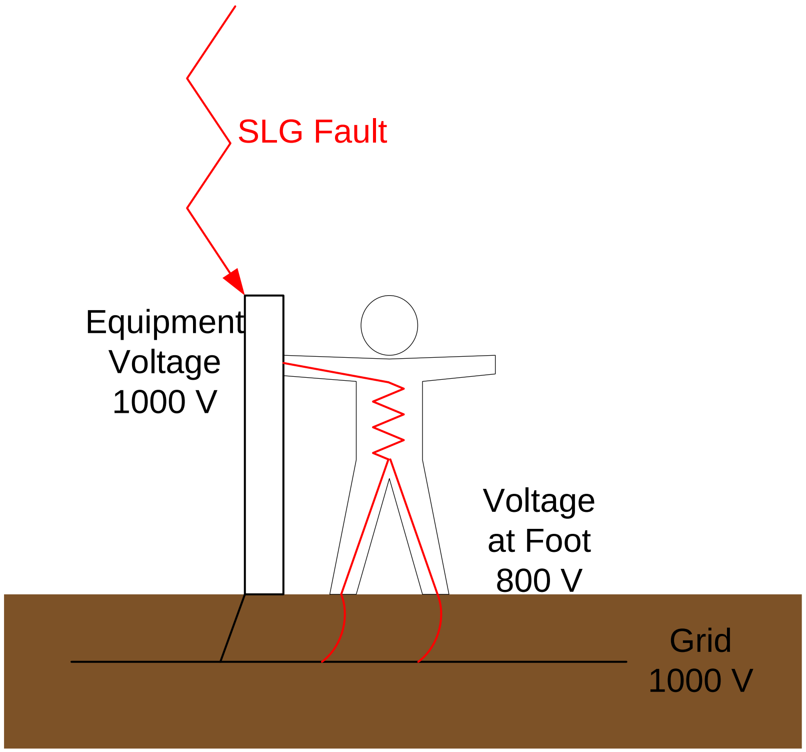
Why is Grounding Needed



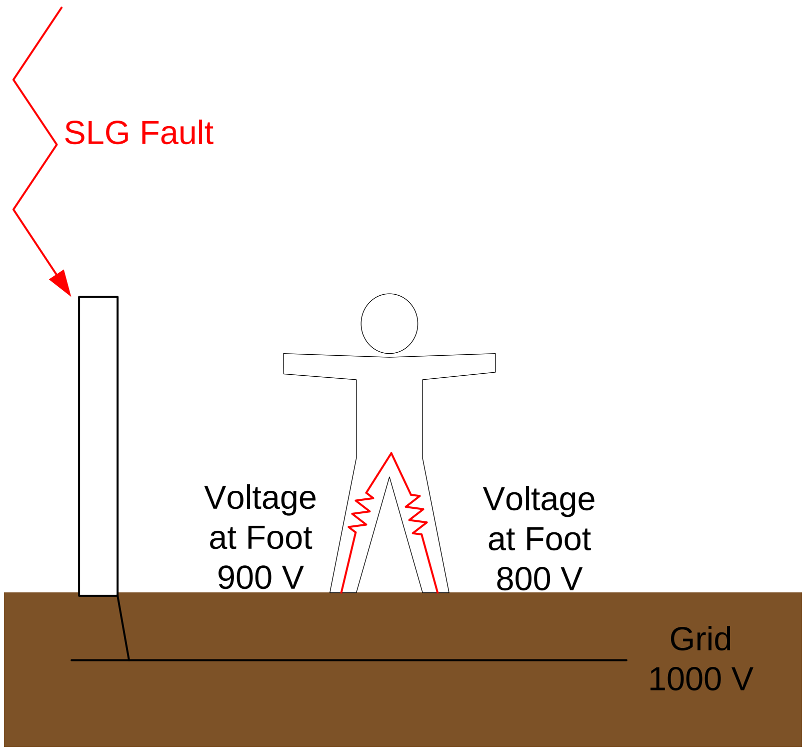


Personnel Protection – Allowable Voltages

Touch Voltage Scenario



Step Voltage Scenario



Behavior of Substation Under Fault Conditions

Ground Potential Rise

V = I * R

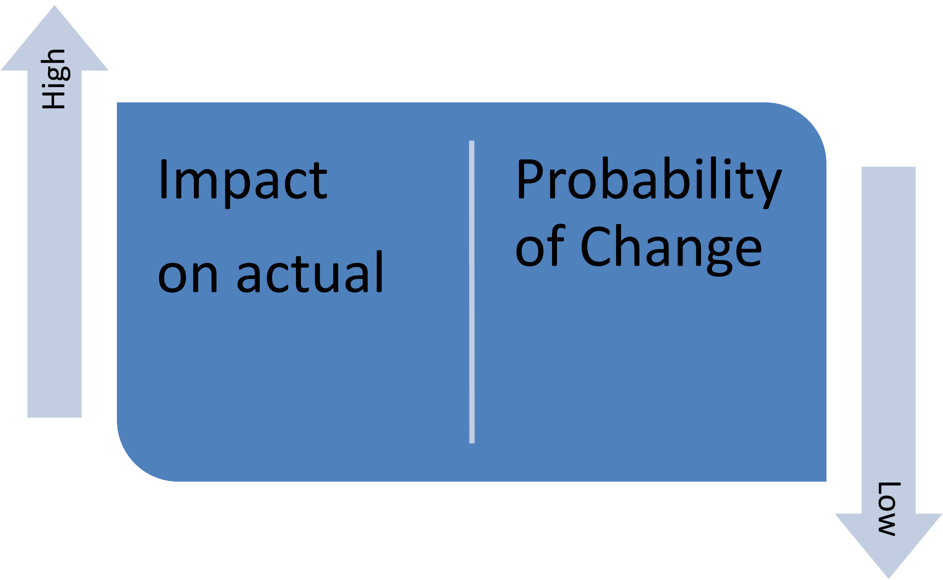
Fault current into grounding system times resistance to “remote earth”

Basis for determining touch and step voltages

Ω’s Law

Inputs for consideration

Soil Data



- Acquired from Resistivity Measurements
- Layering plays important role
- Soil near surface affects allowable touch and step voltages the greatest
- Deep soil affects resistance (and GPR) the most
- Generally, for uniform soil, if you double resistivity you will double resistance (and thus GPR and thus touch and step voltages)

Fault Current

High

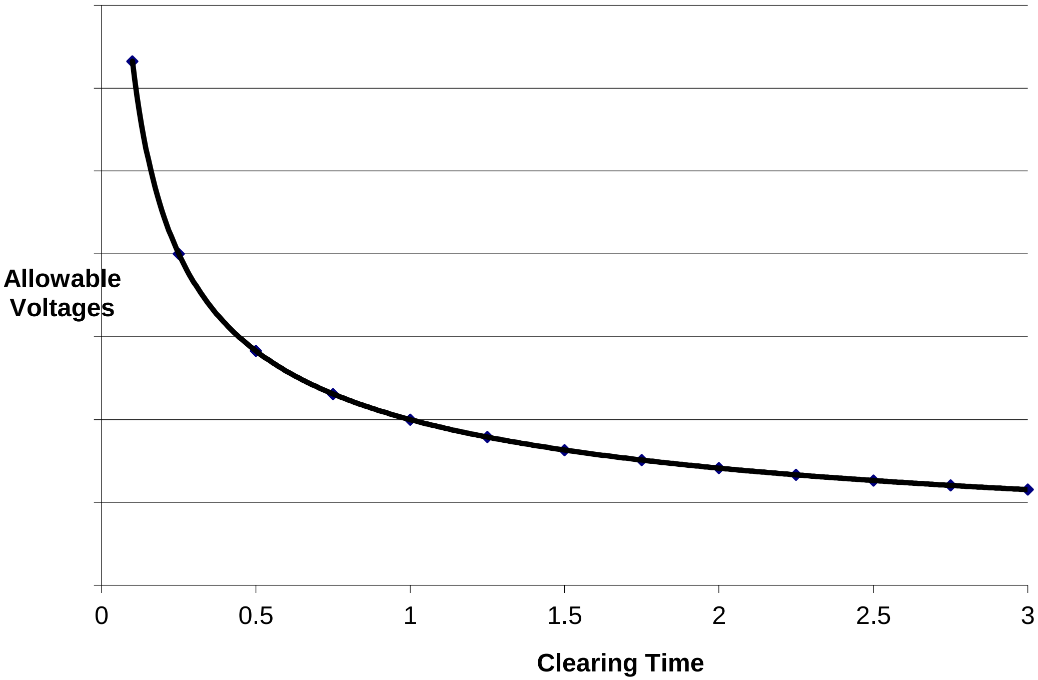
Impact

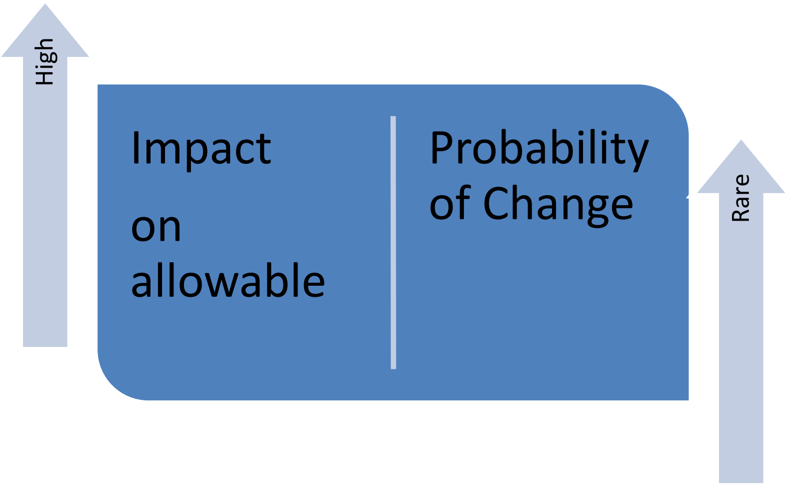
on actual

Probability of Change

High

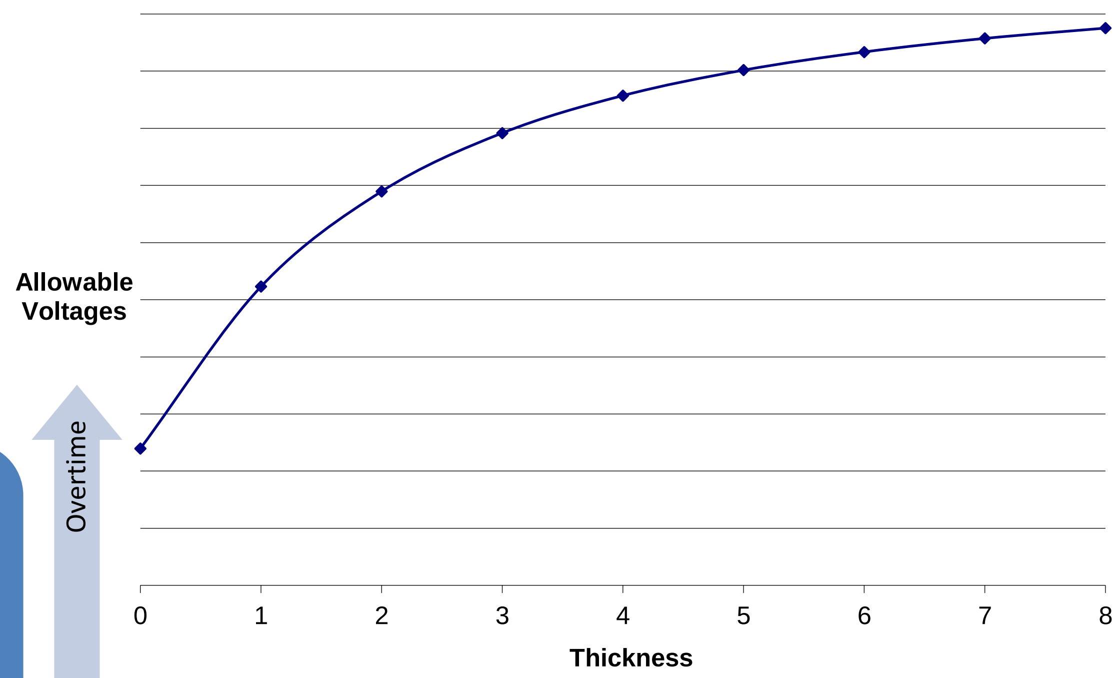
Fault Duration

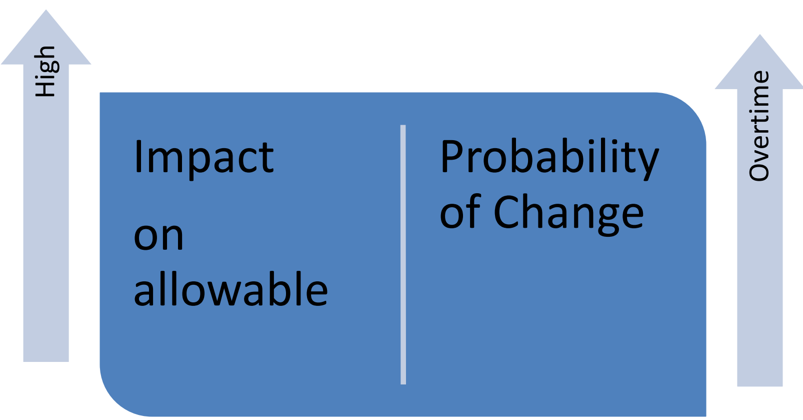




Substation Surfacing

- Resistivity
- Thickness





Practical Applications

Observe

Documentation

- On the drawing
- In your system

ƆING TABLE R ROD DETAILS	
	* ITEM No.
ƽ30	675A
ƽ40	675B
650	675C
ƽ10	675D
ƽ20	
ƽ90	
760	675G
Ɔ30	675J
Ɔ60	675I

GROUND GRID CALCULATION DATA		
GRID DEPTH	24	INCHES
MEASURED SOIL RESISTIVITY	100.0	OHM-M
FAULT CURRENT	58.0	kA
GROWTH FACTOR	120%	
DESIGN FAULT CURRENT	70.0	kA
FAULT DURATION	0.50	SECS
GROUND POTENTIAL RISE (GPR)	208,800.0	VOLTS
MAXIMUM CALCULATED TOUCH VOLTAGE	100.7	VOLTS
MAXIMUM ALLOWABLE TOUCH VOLTAGE	660.1	VOLTS
MAXIMUM CALCULATED STEP VOLTAGE	81.7	VOLTS
MAXIMUM ALLOWABLE STEP VOLTAGE	2172.6	VOLTS

LEGEND

SYM	DESCRIPTION
— — ·	BELOW GRADE 4/0 AWG, 19 STRAND, SOFT DRAWN COPPER, (ABOVE GRADE SHOWN SOLID)

Thoughts?