

44-kV Substation Grounding Tests

Distribution Company Awareness

ESA has completed a study on issues with stand-alone factories, commercial or condominium developments fed from the 3 wire, 44 kV subtransmission system. The study was commissioned due to concerns with the susceptibility of these substations to high ground potential rise, including the associated step and touch stresses.

Specifically this study investigates potential hazards, within the zone of influence as outline in the IEEE standard for substation grounding, for a 44 / 0.6-kV transformer and switchgear cabinet (substation) located in Ontario.

Safety Awareness

The study details potential hazards within the zone of influence. Some of the measured results of the study are shown below. More information is available to LDCs contained within the body of the Report. Note that voltages should be scaled up by a factor of five to generalize results where fault levels are higher. The attached measured values vary depending on weather conditions and moisture content.

Touch Voltages: Tolerable Body Limits as per IEEE - > 178V	Without Neutral	With Neutral
	Measured	Measured
Substation	142	10
West End of Building	444	43
Light Standard of Parking Lot	170	17
44kV Riser Pole	17	4
Water Faucet: Residential Home Next To Substation	87	17
Residential Meter	106	17
Grounded Appliance at Residential Home	345	1

Ground Potential Rise (Line to Ground Fault 1682amps)

Location	Without Neutral Connection	With Neutral Connection
	Measured	Measured
Substation	572*	60

* High current in the telephone shield would cause a burn-off of the shield and ground potential rise would elevate to approximately 7kV

ESA Recommends

Substations shall continue to meet the requirements of IEEE 80, but increase the scope of the ground studies to include zone of influence. When studying the zone of influence other grounding systems must be considered and the effects of tying those systems together must be evaluated to ensure safety to persons and plant that would be affected by a 44-kV substation fault. The study shows that interconnection of the neutral has significant impact on the safety of the installation and may have prevented a serious incident or fatality.