# Outline Draft (06/24/2007)

## Trial Use Guide for Assessing Voltages at Publicly and Privately Accessible Locations (IEEE-P1695)

1. Overview (Required)
   - Scope and Purpose of the Guide

2. Normative References (Required)
   - Documents necessary to understand and use the Guide (e.g. USDA Handbook 696)

3. Definitions/Acronyms/Abbreviations (Required)

4. General Discussion
   - Reasons for confusion surrounding the issue, some amount of measurable voltage will always be present, contact voltage v. stray voltage, sources are both primary (utility) and secondary (customer), grounded v. ungrounded systems, etc.

5. Human and Animal Electrical Sensitivity

   5.1 General
   - Research summary, nerve stimulation model discussion, factors affecting sensitivity, sensitivity versus frequency and/or duration of exposure, people versus animals, etc.

   5.2 Sensitivity to Conducted Current

   5.3 Sensitivity in Terms of Voltage Exposure
   - Characteristics and importance of the exposure circuit (e.g. source impedance, contact impedance, body impedance, etc.), why it's difficult to create a voltage exposure standard, etc.

6. Accessible Voltages Related to Abnormal System Operation ("Contact Voltage")

   6.1 General
   - Potentially hazardous nature of contact voltage, degree of hazard dependent on exposure circuit not measurement circuit, number of incidents (i.e. putting the issue in perspective), existing proactive programs, etc.

### 6.2 Contact Voltage Sources

Fault current (i.e. shorts and opens), fault current availability, insulation degradation, wiring errors, broken conductors, voltages induced during fault conditions, etc.

### 6.3 Contact Voltage Investigation

#### 6.3.1 Test and Measurement Equipment

Electric field detection (e.g. proximity detectors, mobile platforms, etc.), multi-meters, load resistors, safety gear, etc.

#### 6.3.2 Investigation Protocol

Safety precautions, understanding remote earth, measurement location, measurement technique, data analysis, false positives, etc.

### 6.4 Contact Voltage Mitigation

Insulation failure, wiring errors, open conductors, etc.

### 6.5 Case Studies

Street light, manhole, etc.

## 7. Accessible Voltages Related to Normal System Operation ("Stray Voltage")

### 7.1 General

Historically considered a nuisance voltage. Generally associated with animal exposures, swimming pool & shower shocks. Primary (utility) and secondary (customer) sources. Harmonics, transients, etc.

### 7.2 Stray Voltage Sources

#### 7.2.1 Return Current

Systems with a neutral conductor, systems without a neutral conductor, SWER, etc.

#### 7.2.2 Induced Current

Transmission Source, Primary Source, Secondary Source, etc.

7.3 Stray Voltage Investigation

7.3.1 Test and Measurement Equipment

Recording devices, load boxes, copper plates, etc.

7.3.2 Investigation Protocol

7.3.2.1 Confined Livestock
7.3.2.2 Swimming Pools
7.3.2.3 Showers, faucets, drinking fountains, and other plumbing related exposure possibilities
7.3.2.4 Other

7.4 Stray Voltage Mitigation

Bad neutral connections, undersized conductors, poor grounding, phase balance, system voltage, etc.

7.5 Case Studies

Dairy farm, swimming pool, outdoor shower, etc.

Annex A: Flow Charts

Annex B: Sample Data Collection Forms

Annex C: Existing Regulation

Wisconsin, Idaho, Michigan, New York, etc.

Annex D: Previously Established Voltage Exposure Standards

IEEE, IEC, NEC, etc.

Annex E: Distribution System Grounding Alternatives