IEEE-1584 Review and Meeting Update

hood patterson & dewar

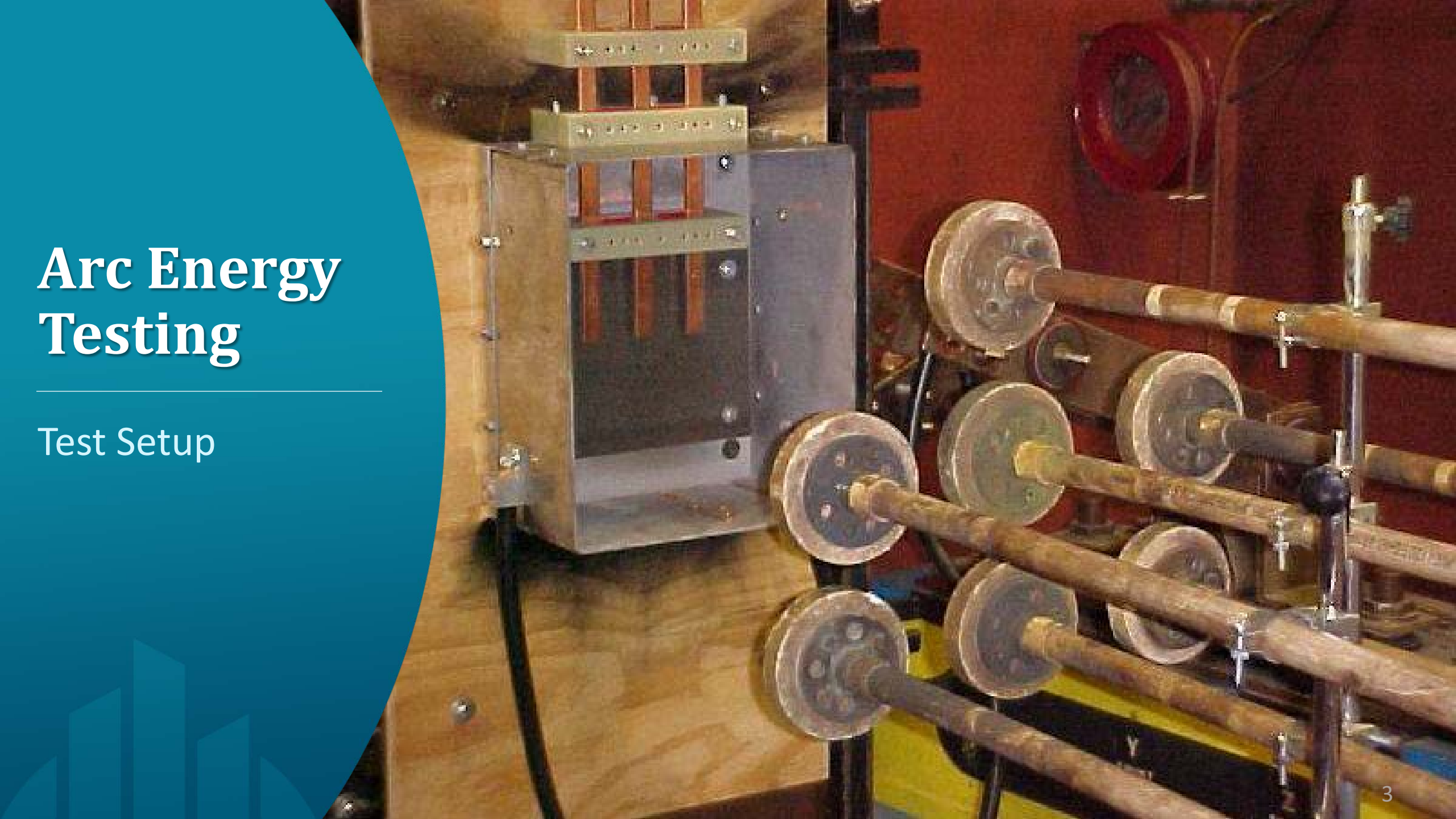
Theory in Practice

Turn of the Century

- IEEE-1584 was born in early 2000's
  - Decided on wide range of currents and voltages
  - Raised ~$75,000 in funding
  - Used 20 cubic inch box
  - Tested MCC's using a smaller size box
  - Testing facilities – Square D in Cedar Rapids & Ontario Hydro in Toronto
  - Bussmann played a big roll as well
- Navy got involved
  - Wanted to see how an arc flash would damage ship
  - Built a 15' cube
  - Obtained funding for 13.8kV testing
- Completed document went through a robust approval process
  - Three rounds of 100s of questions
  - Approved June 2002 (2 year cycle)

Arc Energy Testing

Test Setup



IEEE 1584-2002

Developing the 2002 Revision

- Based on the results of > 300 arc flash tests
- Four calculation criteria:
  1. Systems less than 1000 V
  2. Systems from 1000 to 15,000 V
  3. Incident energy (cal/cm^2)
  4. Flash hazard boundary (AKA arc flash boundary)
- 85% rule
  - Slow burn vs. Rapid Energy Release
- 125kVA transformer rule
  - Based on data, would not sustain an arc
- 2-second rule
  - Would leave the arc with-in two seconds

125 kVA Exception

- **Section 4.2 page 6 states, "Equipment below 240 V need not be considered unless it involves at least one 125 kVA or larger low impedance transformer in its immediate power supply."**
  - Two problems with this statement
    - 125kVA is not a standard size transformer
    - Tests have shown that faults fed from 112.5 and 75kva transformers do sustain an arc

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Revision Process Begins

Questions immediately arose

1. What if the electrodes were horizontal instead of vertical?
2. What about difference size enclosures?
3. What about DC arc flash?

PCIC established a collaboration committee between IEEE and NFPA

- 6.5 Million Requested
- 3.5 Million Received
- 2003-Recommended 10-year Project Authorization Request (PAR)
- PAR extension was granted until 12/31/17

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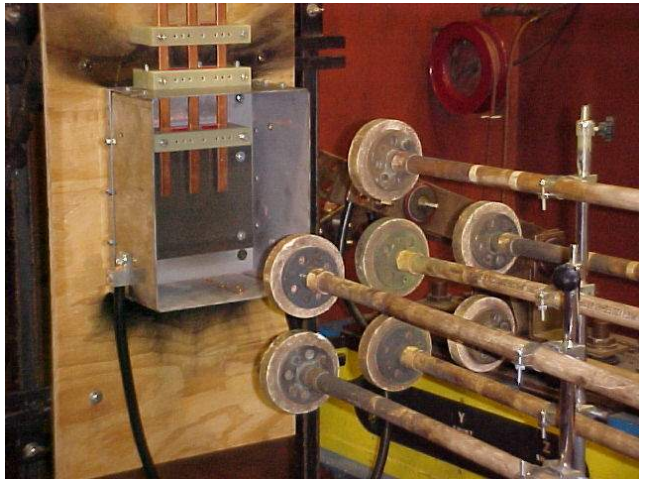
1700 Tests Conducted

Voltage	~ Number of tests
208V (3ph) 240V (1ph)	195
480V	400
600V	340
2700V	320
4160V	180
14.3kV	270



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Study Complexity

- New standard makes modeling more complex
- Proposed variables
  - Configurations (VCB, VCBB, HCB, VOA, HOA)
  - V_{oc}
  - I_{bf}
  - Working Distance
  - Duration (Breaker or fuse curve)
  - Gap
  - Enclosure Size
    - Box Size & Gap defaults to conservative NEMA size and gap distance

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Test Configurations

The 1584 Committee decided to conduct tests using five configurations

- VCB – Vertical electrodes in a Cubic Box (IEEE 2002)
  - Load side of BKR
- VCBB – Vertical electrodes in a Cubic Box terminated in a “Barrier”
  - line side of BKR
- VOA – Vertical electrodes in Open Air (IEEE 2002)
- HOA – Horizontal electrodes in Open Air
- HCB – Horizontal electrodes in a Cubic Box
  - Busbar
  - HCBB was considered but HCB was considered worst case

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Other Parameters

- Blast Pressure
  - Injury potential based on fault level
    - Slow burn vs. Rapid Energy Release
- Sound Pressure
  - Risk of severe hearing damage
  - Tests at 4,160 volts have produced sound levels upwards of 160 dB at distances of more than 3-meters
- Light
  - Bright summer day is 100,000 lux (light intensity)
    - 1 lux= 1 lumen per square metre squared
  - Tens of millions of lux have been measured during arc flash testing
- Enclosure Size (now a variable)
  - Based on standard NEMA sizes

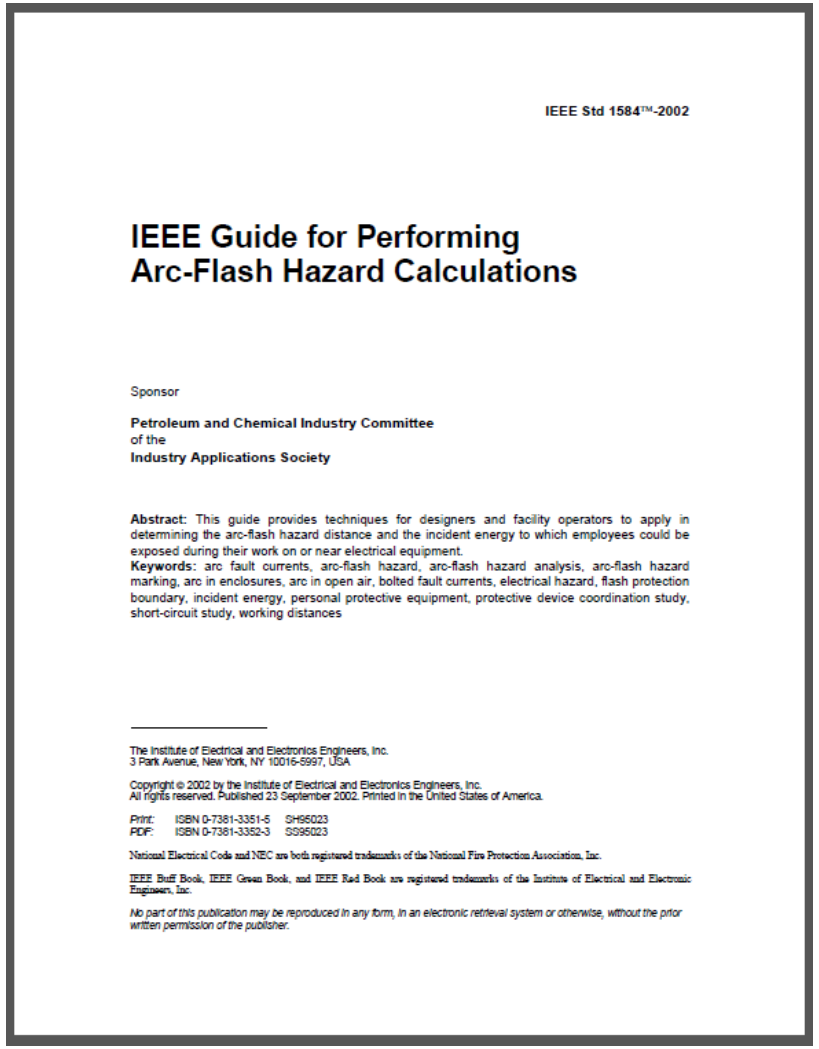
Study Complexity

Standard practices taken out

- 125kVA Rule will not be in the new text
  - Instead a proposal was made – *"No tests were done at 208V and less than 2500A, therefore should not be considered."*
- 85% rule will not be in new text
  - Statistical deviation was such that confidence in formulas
  - So no need to have this rule
- 2 second rule will not be in new text

IEEE 1584 and 1584.1

Two Documents



IEEE Std 1584™-2002

IEEE Guide for Performing Arc-Flash Hazard Calculations

Sponsor

Petroleum and Chemical Industry Committee
of the
Industry Applications Society

Abstract: This guide provides techniques for designers and facility operators to apply in determining the arc-flash hazard distance and the incident energy to which employees could be exposed during their work on or near electrical equipment.
Keywords: arc fault currents, arc-flash hazard, arc-flash hazard analysis, arc-flash hazard marking, arc in enclosures, arc in open air, bolted fault currents, electrical hazard, flash protection boundary, incident energy, personal protective equipment, protective device coordination study, short-circuit study, working distances

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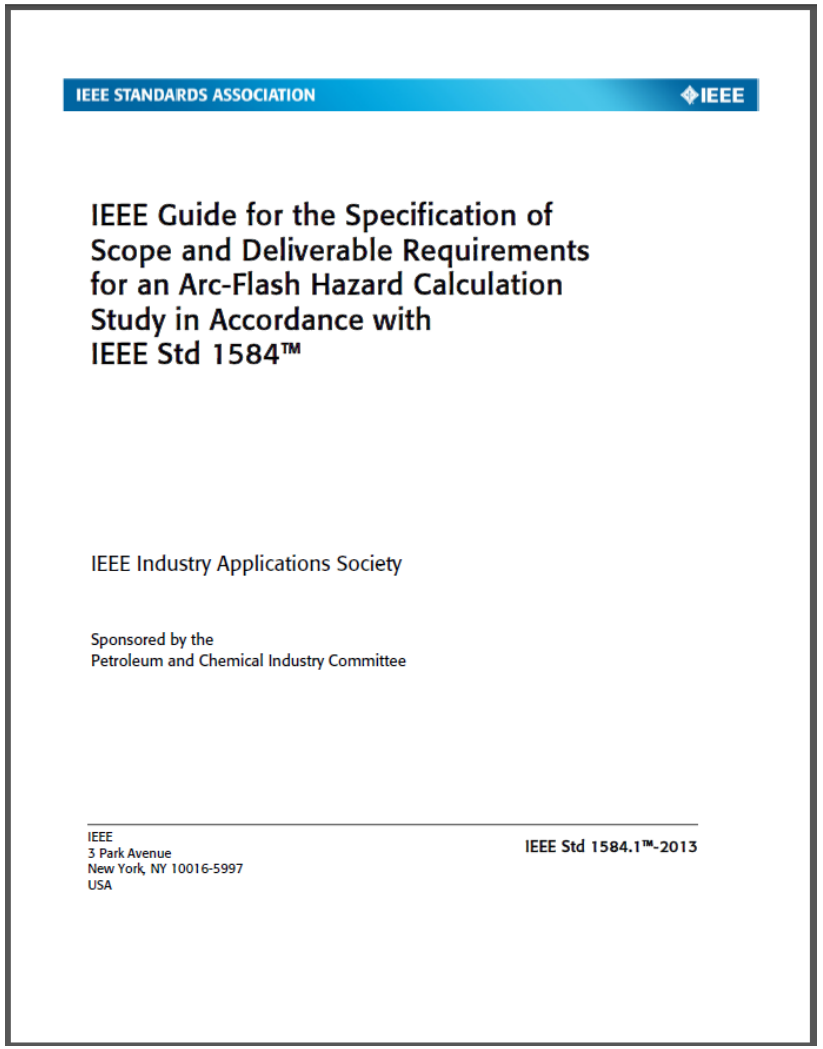
Technical Information



IEEE STANDARDS ASSOCIATION IEEE

IEEE Guide for the Specification of Scope and Deliverable Requirements for an Arc-Flash Hazard Calculation Study in Accordance with IEEE Std 1584™

IEEE Industry Applications Society

Sponsored by the
Petroleum and Chemical Industry Committee

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IEEE Std 1584.1™-2013

IEEE-1584.1-2018
Deliverable Requirements

So What Does This Mean to Me?

- Design Engineers / Owners
  - Arc flash analysis per 1584.1
  - Engineers to collect data?
- Study Engineers
  - Consistency within your own group
  - Plan the data collection
- Manufacturers
  - Make data visible so we can collect it without taking energized equipment apart

Thank You

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