THE EASTERN SPECIALTY COMPANY

Fusing Metering Voltages for High Capacity Circuits

Notes from the Field

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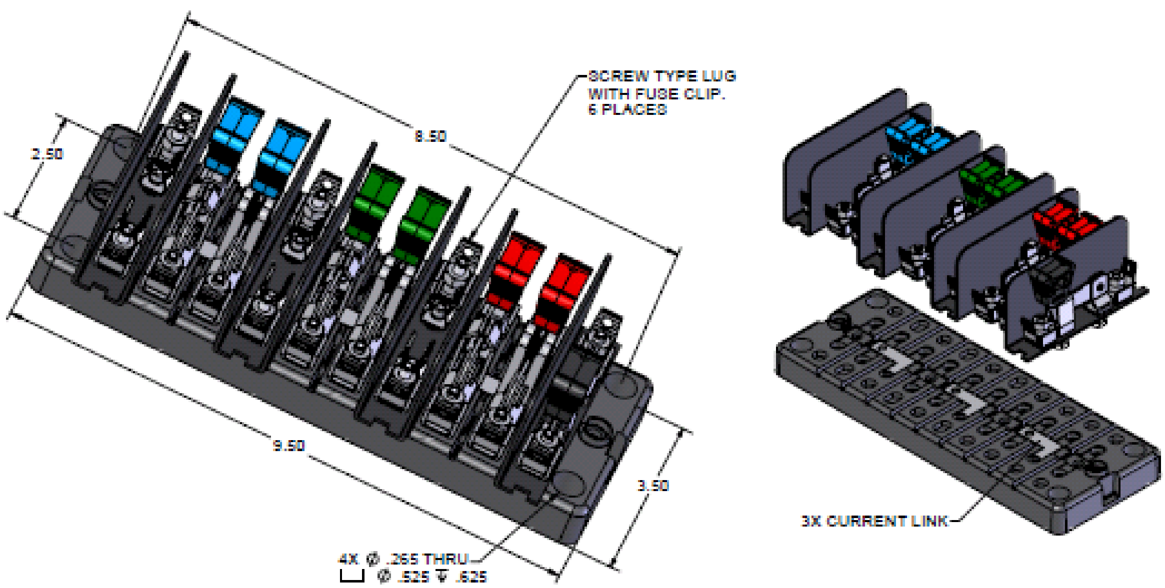
for the Spring ECNE Engineering & Operations Conference 2015

What is the Issue?

- Fused test switches have been around for many years.
- Fused potentials have been around for many years.
- However over the past twenty years they have boomed in popularity and boomed in usage.
- In the same time period fused test leads on field meter testing equipment have gone from a once in a blue moon request to a standard request.



What has changed?

- With the advent of auto-ranging meters Utilities started to recognize that VT's were no longer necessary on every service.
- And this is true. But…….

Voltage Transformers as Safety Devices?

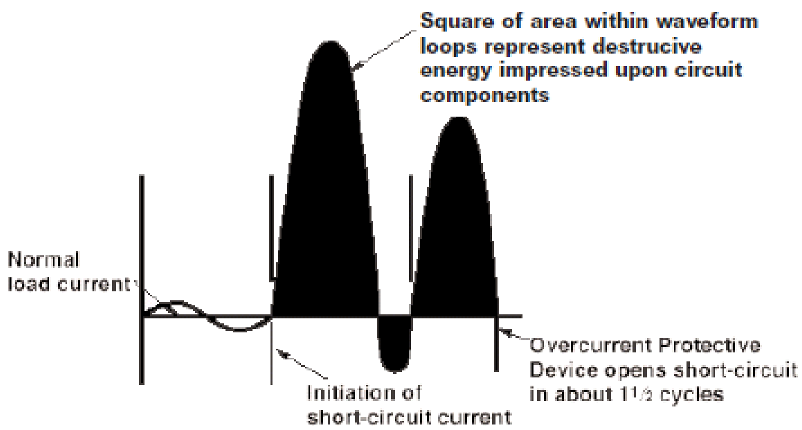
- The voltage transformer is designed to connect in parallel with the line to transform the line voltage to 115 or **120 volts** suitable for the meter or relay. To keep the voltage at the meters and relays at a safe value, the secondary circuit must be grounded. Source ABB
- The name instrument transformer is a general classification applied to current and voltage devices used to change currents and voltages from one magnitude to another or to perform an isolating function, that is, to isolate the utilization current or voltage from the supply voltage for safety to both the operator and the end device in use. Instrument transformers are designed specifically for use with electrical equipment falling into the broad category of devices commonly called instruments such as voltmeters, ammeters, wattmeters, watt-hour meters, protection relays, etc. Source GE
- VT's not only step down the voltage to 120v for metering purposes, but they provide a safety feature to the circuit. The VT is a current limiting component in the circuit.
- The fault current for a VT is typically the same or less than the fault amps of the meter (typ. 10,000 amps).

Autoranging meters

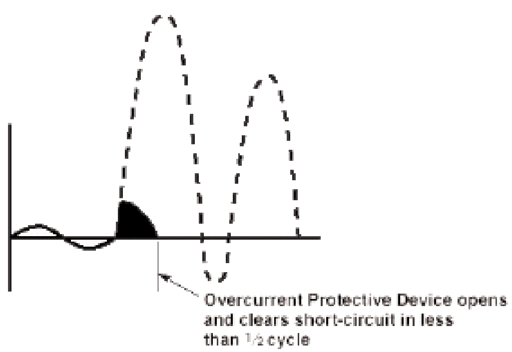
- Within recent years, auto-ranging meters have been introduced.
- VT's have been eliminated for many applications.
- This means the field technician is now dealing with the primary voltage.

A little about Fault Currents

How Much Fault Current can the equipment handle, and for **How Long?**



ACTION OF NON-CURRENT-LIMITING OVERCURRENT PROTECTIVE DEVICE



ACTION OF CURRENT-LIMITING OVERCURRENT PROTECTIVE DEVICE

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Short Circuit Current > Interrupt Rating =

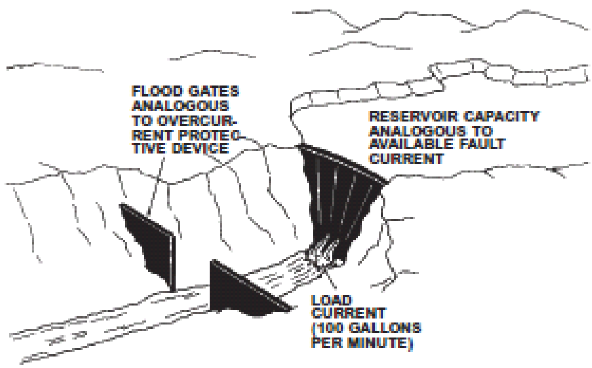
- A fuse or breaker designed to interrupt the largest potential short-circuit currents can be helpful on some days.

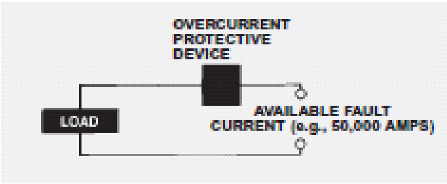
A little about Fault Currents

- Overcurrent protective devices must be selected for the proper
  - Voltage
  - Current
  - Interrupt rating
- This last one is the one most typically overlooked. This is also the one most people do not understand how to plan for or calculate.
- Current limiting is a type of over current protection
- An overcurrent protective device must be able to withstand the destructive energy of short-circuit currents.

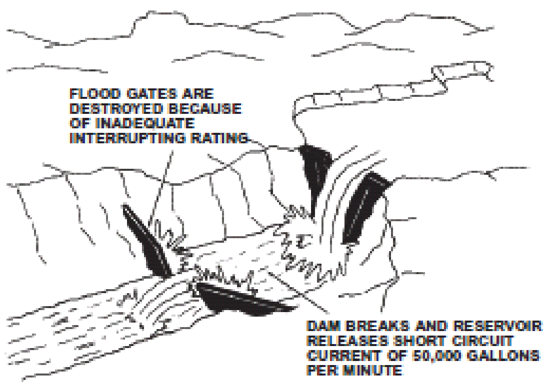
Short-Circuit Currents & Interrupting Rating

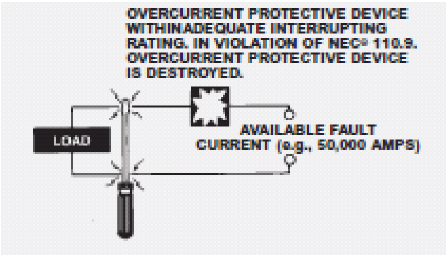
Normal Current Operation





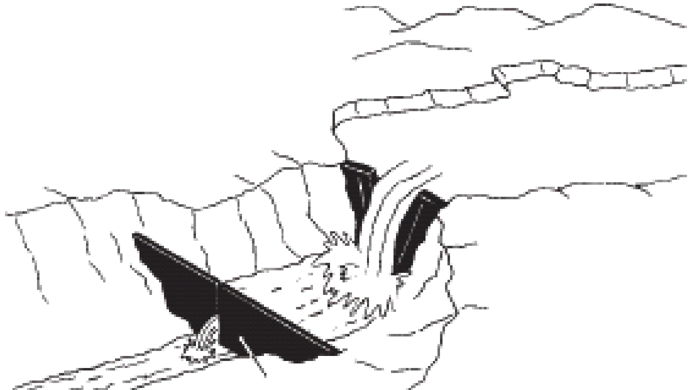
Short-Circuit Operation with Inadequate Interrupting Rating

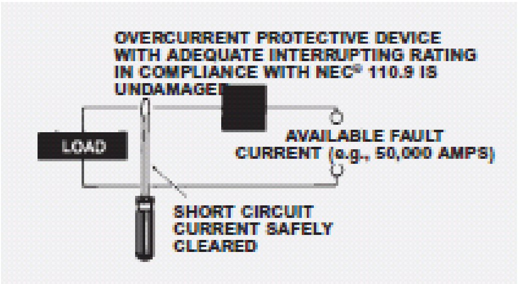




Short-Circuit Currents & Interrupting Rating

Short-Circuit Operation with Adequate Interrupting Rating





What is a Short-Circuit Current Rating (SCCR) ?

- SCCR's represent the maximum level of short-circuit current that the component or equipment can withstand under fault conditions .
- This is used for determining compliance with NEC® 110.10.
- This rating can be marked on individual components or assemblies.
- Assembly ratings take into account all components contained within the equipment rather than just the main overcurrent protective device.
- A common mistake is to assume that the interrupting rating of the overcurrent protective device protecting the circuit represents the SCCR for the entire circuit. Interrupting ratings, used for compliance with NEC® 110.9, apply solely to the overcurrent protective device. It is the characteristics of the overcurrent protective device (e.g. opening time, let-through energy) that need to be used in determining compliance with NEC® 110.10, not the interrupting rating.
- NOTE: Short-circuit current ratings (SCCRs) are different than interrupting ratings marked on overcurrent protective devices.

How is SCCR Determined?

- For meter disconnect switches, this withstand level (SCCR), is often determined by product testing. For assemblies, the marking can be determined through product listing or by an approved method.
- Any valid method uses the “weakest link” approach. The marking should represent the limits of the assembly for a safe installation.

Point-to-Point Method of Short-Circuit Calculations

Table 5. Short-Circuit Currents Available from Various Size Transformers

(Based upon actual field nameplate data, published information, or from utility transformer worst case impedance)

Voltage and Phase	KVA	Full Load Amps	% Impedance†† (nameplate)	Short Circuit Amps†
120/240 1 ph.*	25	104	1.5	12175
	37.5	156	1.5	18018
	50	208	1.5	23706
	75	313	1.5	34639
	100	417	1.6	42472
	167	696	1.6	66644
120/208 3 ph.**	45	125	1.0	13879
	75	208	1.0	23132
	112.5	312	1.11	31259
	150	416	1.07	43237
	225	625	1.12	61960
	300	833	1.11	83357
	500	1388	1.24	124364
	750	2082	3.50	66091
	1000	2776	3.50	88121
	1500	4164	3.50	132181
	2000	5552	4.00	154211
	2500	6940	4.00	192764
277/480 3 ph.**	75	90	1.0	10035
	112.5	135	1.0	15053
	150	181	1.20	16726
	225	271	1.20	25088
	300	361	1.20	33451
	500	602	1.30	51463
	750	903	3.50	28672
	1000	1204	3.50	38230
	1500	1806	3.50	57345
	2000	2408	4.00	66902
	2500	3011	4.00	83628

Table 5 Notes:

* Single phase values are L-N values at transformer terminals. These figures are based on change in turns ratio between primary and secondary, 100,000 KVA primary, zero feet from terminals of transformer, 1.2 (%X) and 1.5 (%R) multipliers for L-N vs. L-L reactance and resistance values and transformer X/R ratio = 3.

** Three-phase short-circuit currents based on "infinite" primary.

†† UL listed transformers 25 KVA or greater have a ±10% impedance tolerance. Transformers constructed to ANSI standards have a ± 7.5% impedance tolerance (two-winding construction). Short-circuit amps reflect a "worst case" condition (-10%).

† Fluctuations in system voltage will affect the available short-circuit current. For example, a 10% increase in system voltage will result in a 10% increase in the available short-circuit currents shown in the table.

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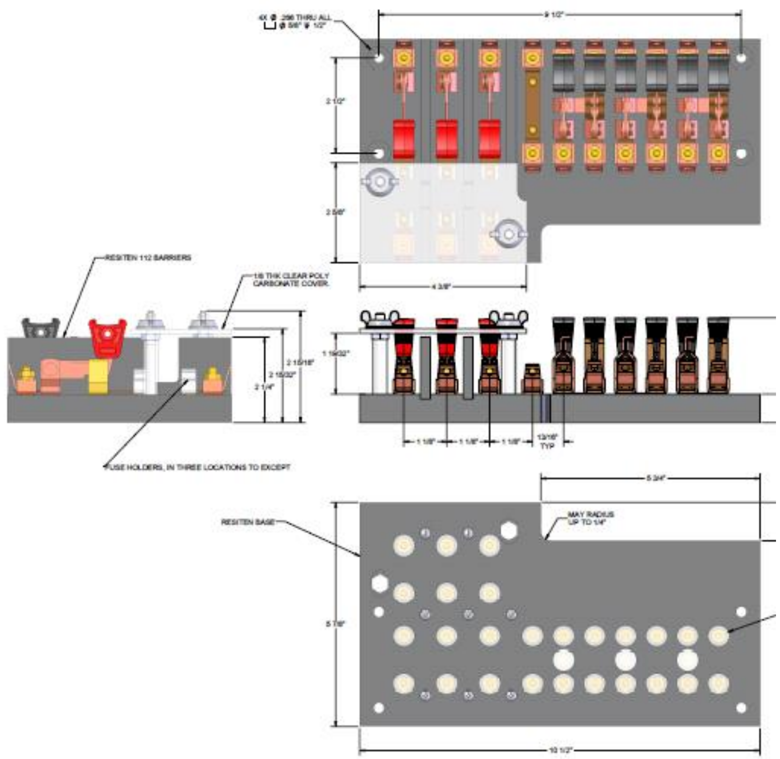
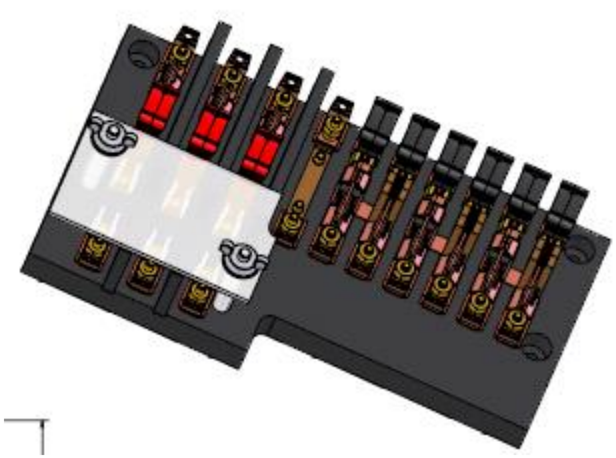
What have utilities changed as a result of losing the isolation and current limiting features of a voltage transformer?

- Some have added fused potentials in line or at the test switch for transformer rated services.





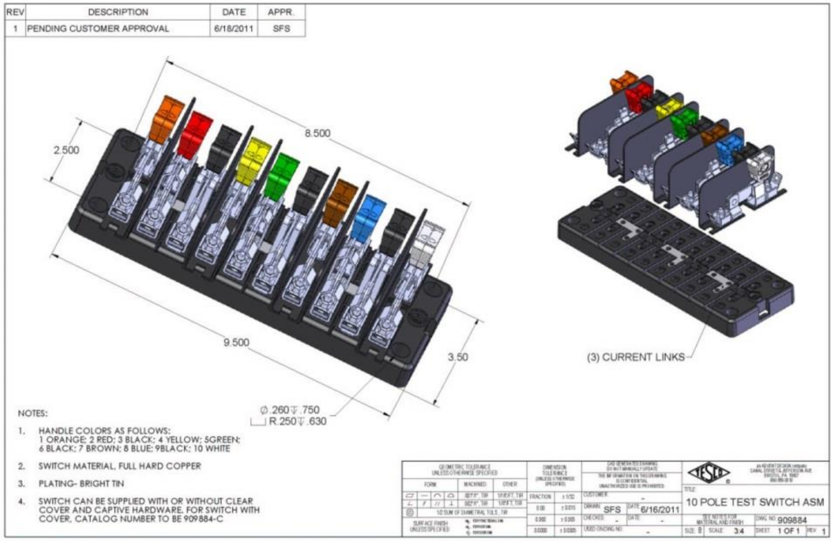
Fusing The Test Switch

- Some have gone to fused test leads for their field technicians.

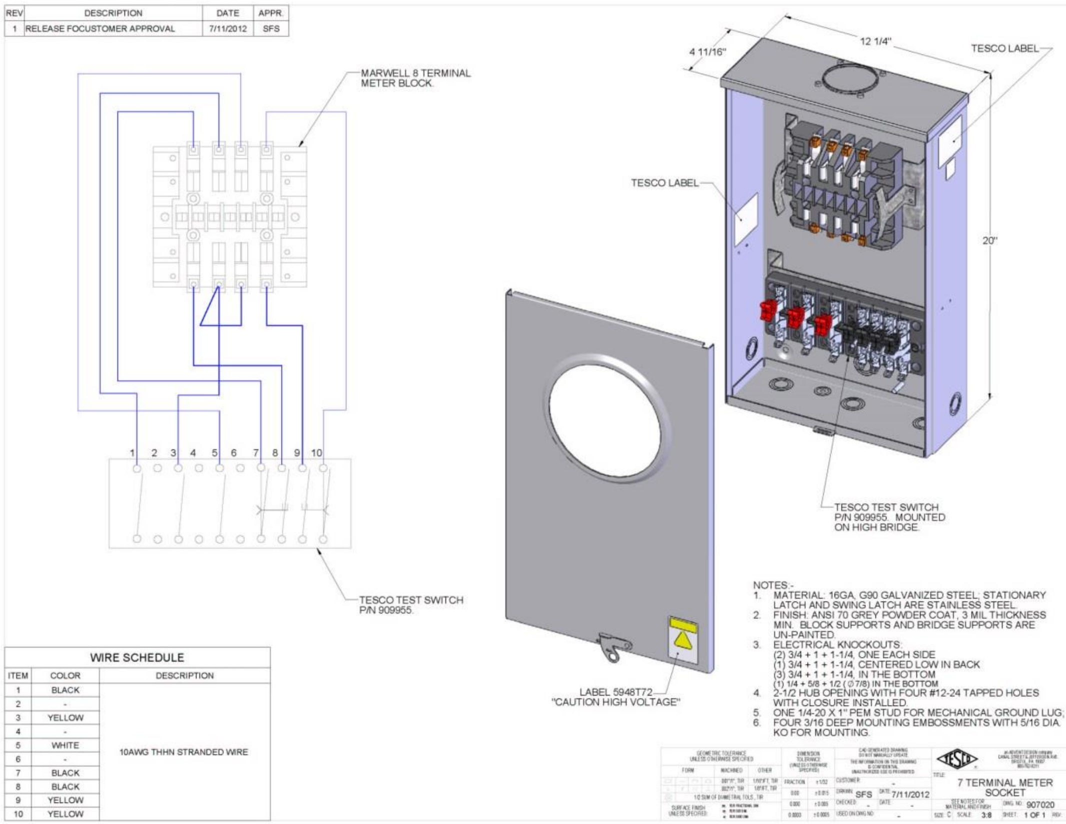
Meter Test Switch Configurations

- Layout
- Handle Colors
- Reversed vs. Normal Potentials
- Current Links
- Base Sizing
- Barrier Locations

NOTE: On installations that contain Test Switches, test leads terminated with a test switch safety test probe (test plug) should be used for CT testing. This provides a “make-before-break” connection to prevent accidental opening of the current transformer secondary loop.



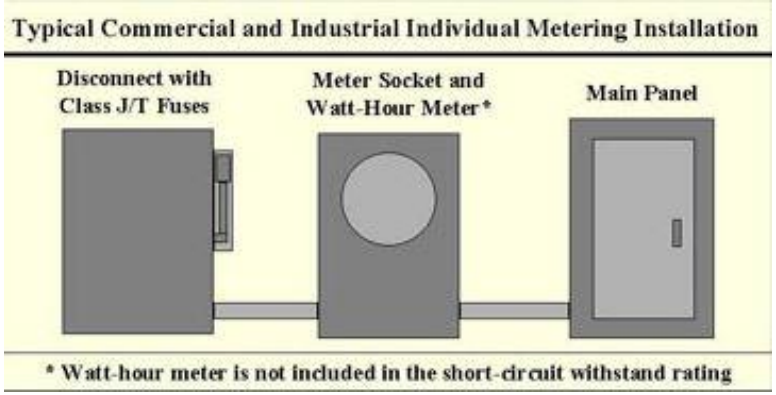
Fitting into a Pre-Wired Transformer Rated Enclosure?

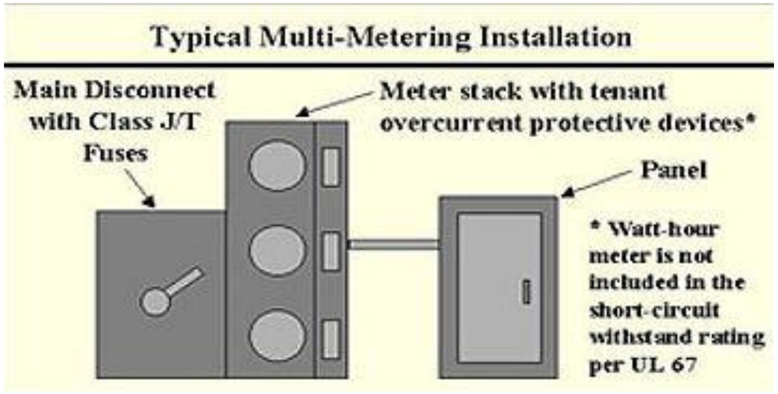


- Move items around
- Small nipple box with four pole switch base and fusing

Cold Sequencing

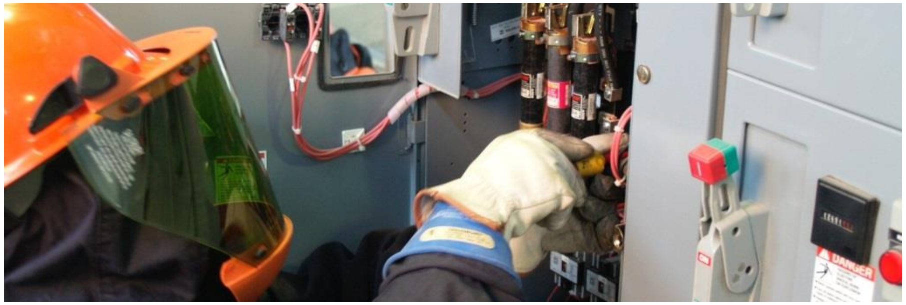
- Some have gone to cold sequencing for self contained services.

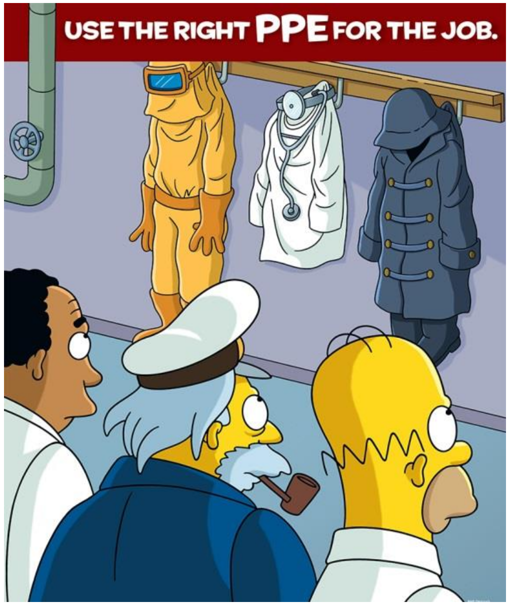




PPE

- Some rely on better PPE for their Meter Techs





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None of the Above!

- Some have not changed their metering practices at all.
- Utilities are not required to fuse the circuits.
- Do we really need to do anything?

Questions and Discussion

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