

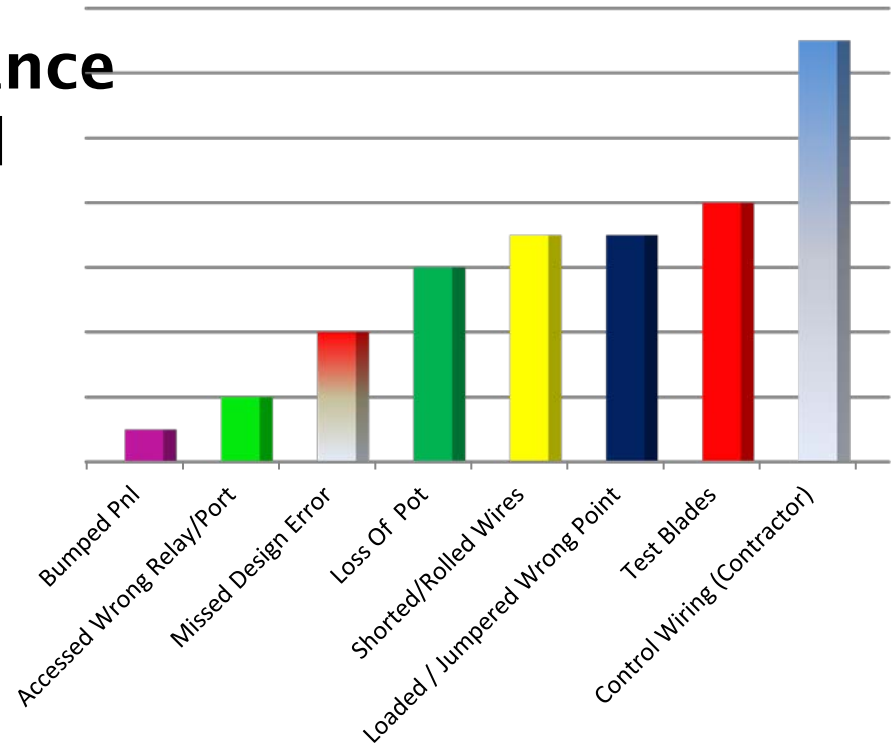
Electric Transmission Work Zone Identification Kit



Dominion Virginia Power – System Protection

- **Relay protection, metering and data acquisition for Transmission - Distribution Substations (800) & Generation (30) facilities**
- **120 System Protection Technicians - 3 states
80 “contract” electricians**
- **40% of our technical work force < 3 years experience
Nearly triple the number of “contract” electricians since 2008**
- **Our Human Performance tools and training is focused on eliminating the inadvertent outages caused by human error**

July 2009 - studied disturbance database for outages caused by System Protection human errors



Four most common errors:

Control wiring errors

Misoperation of test blades

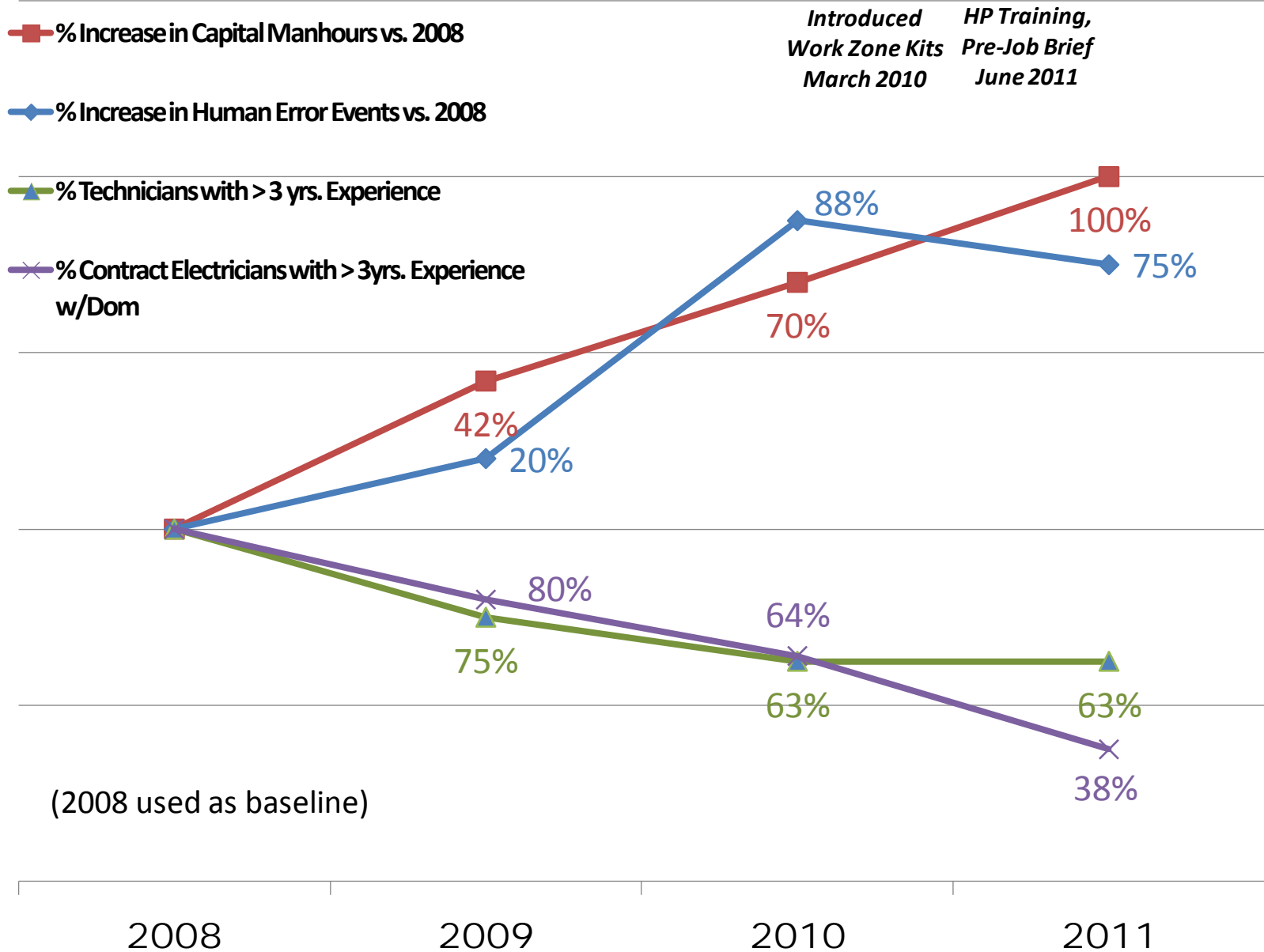
Test jumpering incorrect point

Accessing incorrect control panel/control switch/device

We designed tools to address these “most common” errors

“Formalization” of the tools into a kit was key to our improvement

Human Error Events vs. Capital Man-hours, Experience Levels



Work Zone Kit aimed at eliminating inadvertent equipment operations from:

Wiring Errors

Test Jumpering Incorrect Points

Accessing Incorrect Panel/Device



Use the Work Zone Kit Tools

- Equipment or components that look similar
- Equipment or components - manipulated multiple times
- On or near trip sensitive or risk important equipment



Work Zone Kit

Train on How and When to Use the Kit

Reinforce

Pre- Job Briefing

Supervisor provides assessment and coaching



What's Included in Dominion's Kit?



Work Zone Identification Kit Insert (front)



**Front Panel Barriers
Using Magnets
To Secure**



**Rear Panel Barriers
Using Velcro Straps
To Secure**



**Use of High Visibility
Clip Jumper**



**Use of Flame Retardant
Plastic Sheetting as a
Barrier**



**Use of Flagging Hangers
“Testing in Progress” and
“Do Not Operate”**



**Use of Flagging Hanger
“Abnormal Condition”**



**Use of Terminal
Point Barriers**



**Use of
“STOP - Equipment
Under Test” Magnet**

Work Zone Identification Kit Insert (back)

WORK ZONE BARRICADE and FLAGGING

BARRICADE and FLAG similar looking equipment that should be avoided during construction or equipment checkouts.

BARRICADE and COVER UP any terminal points that may operate equipment if contacted inadvertently.

FLAGGING

GREEN - FLAGGING

To Identify the correct device to be operated.

RED - FLAGGING

To Identify a device that should be avoided.

YELLOW - FLAGGING

To Identify an abnormal condition.

REMOVE

Remove barricades and flagging once the job is complete or at the end of the work shift.

Do not leave barricade and flagging on in-service equipment (i.e. panel fronts, control switches) after work shift has ended.



Work Zone Identification Kit Banners

- Create physical barriers – direct worker to correct equipment/components & away from high risk equipment
- Text reminds of our human performance tools & terminology



Work Zone Identification Hangers for Flagging

- Identifies correct device to operate
- Flags abnormal conditions

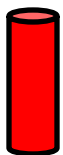


Work Zone Identification Signage

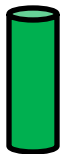
- **Out of service equipment under test**

○ Wire caps to provide an insulated cover up for wires and lugs during transitional periods such as construction jobs.

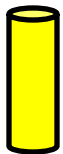
○ Wire caps are color coded:



○ Red caps - new wiring to be terminated in the future.

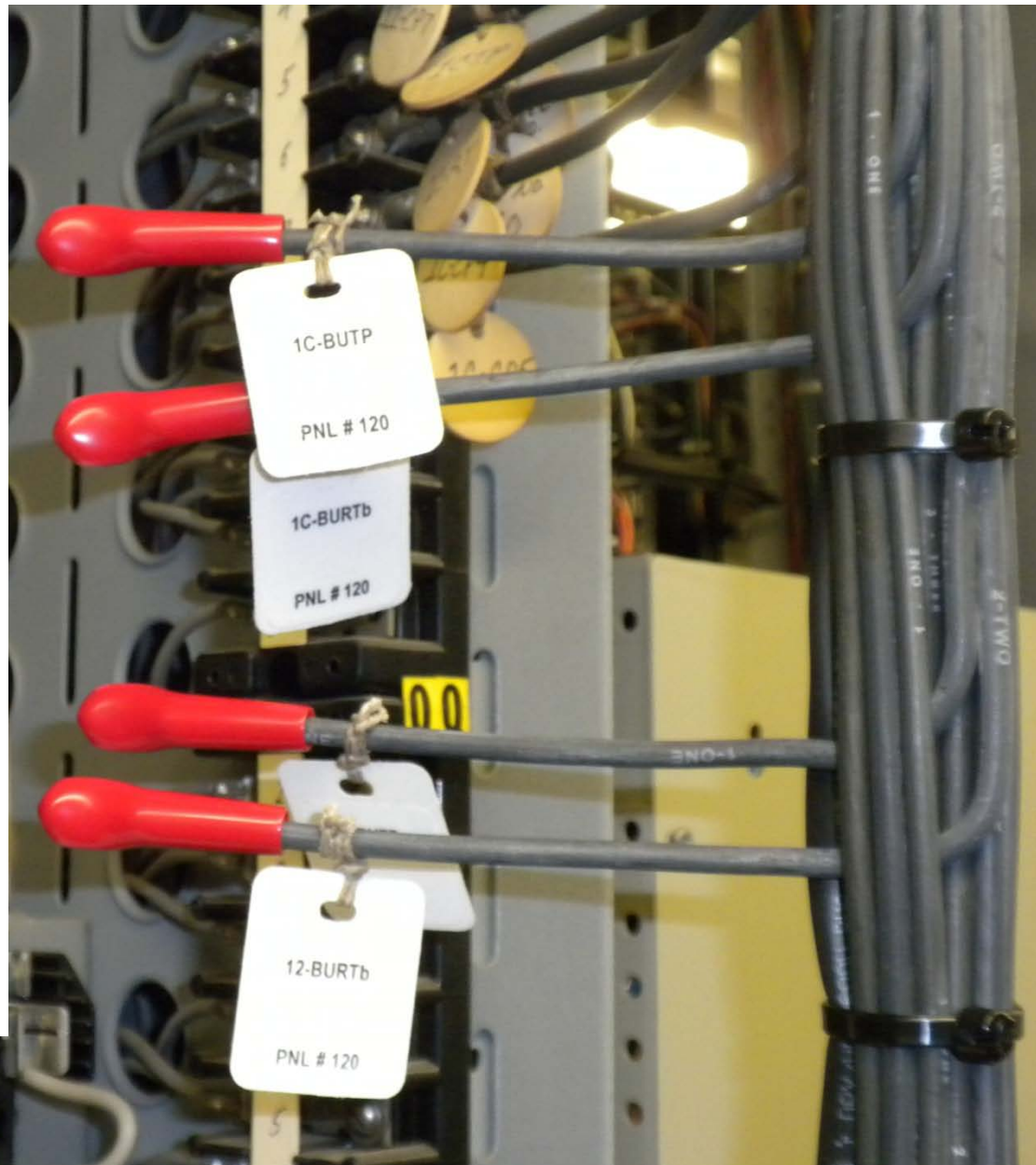


○ Green caps - wiring being removed.



○ Yellow caps - temporary conditions.

○ Wire caps sized to provide a secure fit (sock like) for multiple sized wires and lugs.

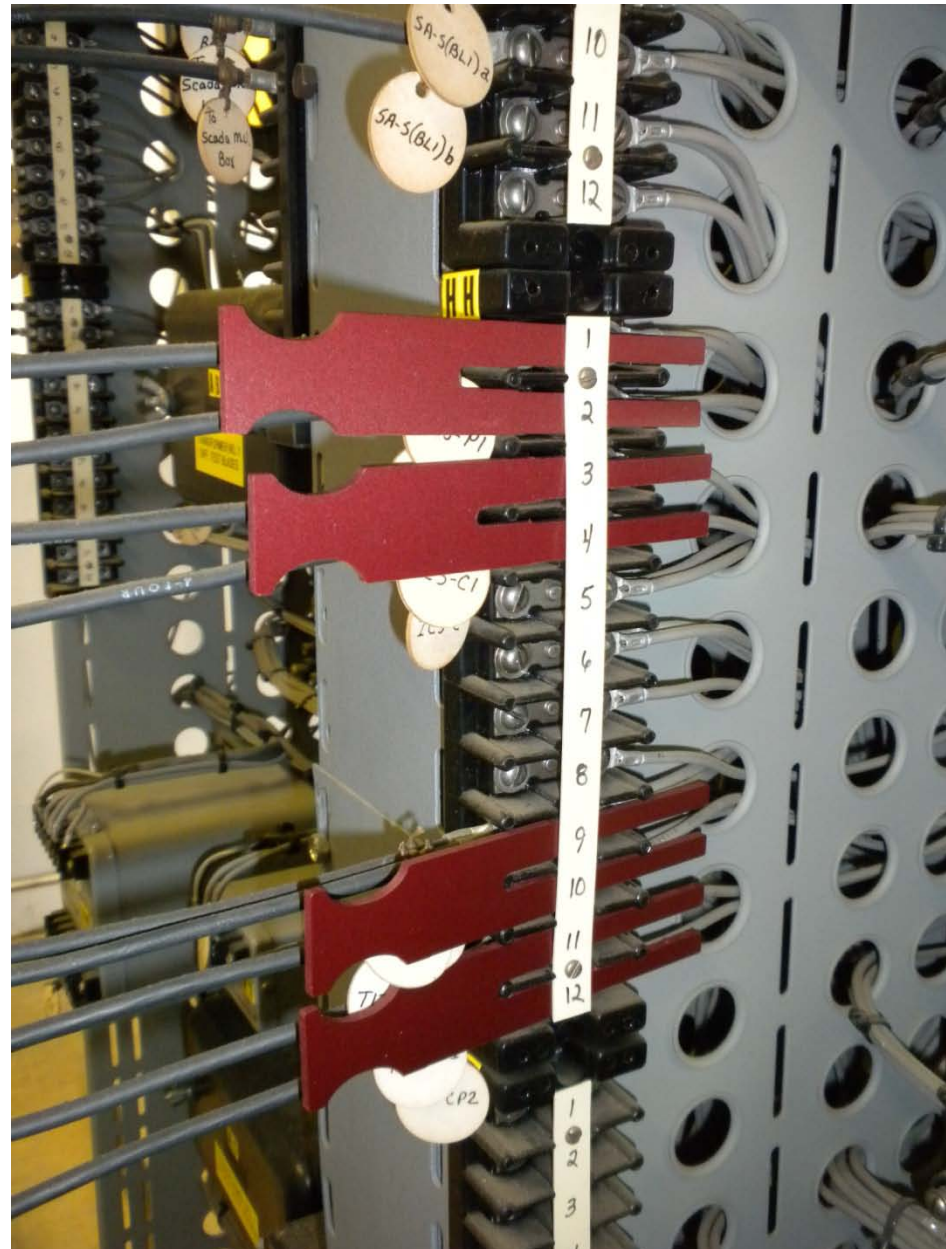


Wire Caps Instead of Tape

Terminal Point Barriers

○ Terminal point barriers to cover up trip sensitive points on wiring blocks & provide a visual indication of the “trip” point locations.

○ Cover any “trip” point that may result in an unwanted event if inadvertently touched or bridged.



Terminal Point Barriers

P = Positive DC Voltage

T = Trip Point

"P" wire

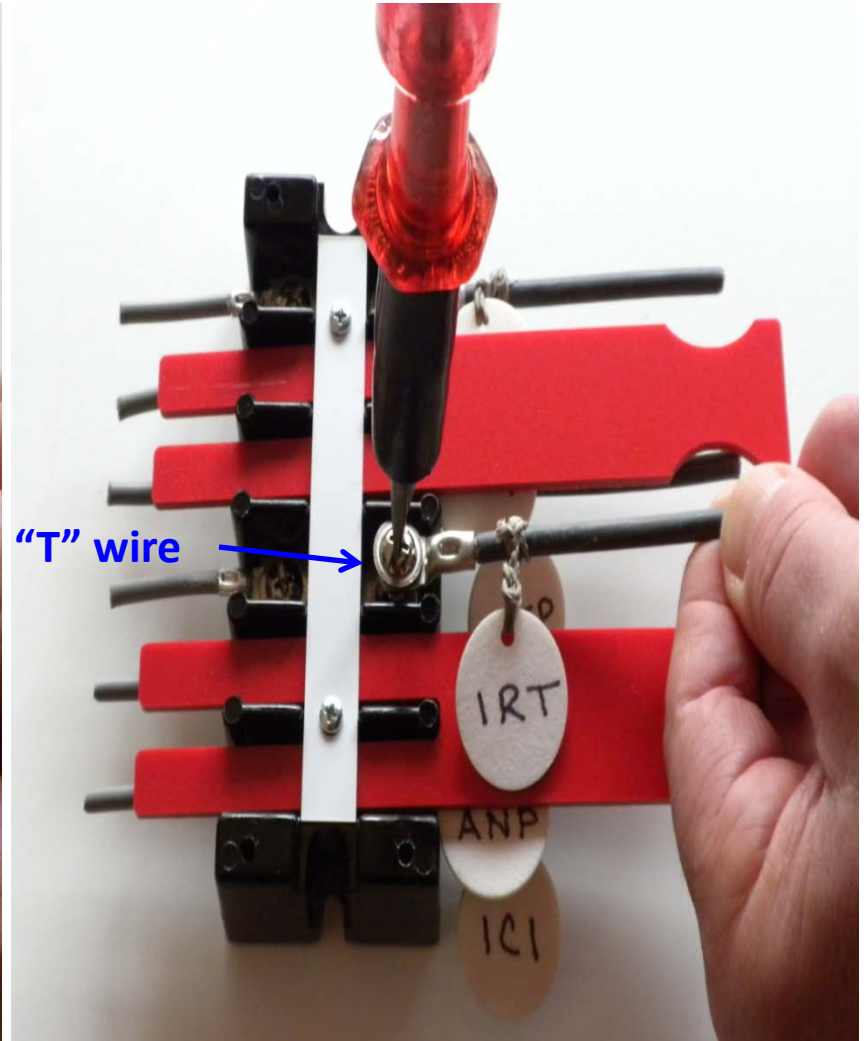
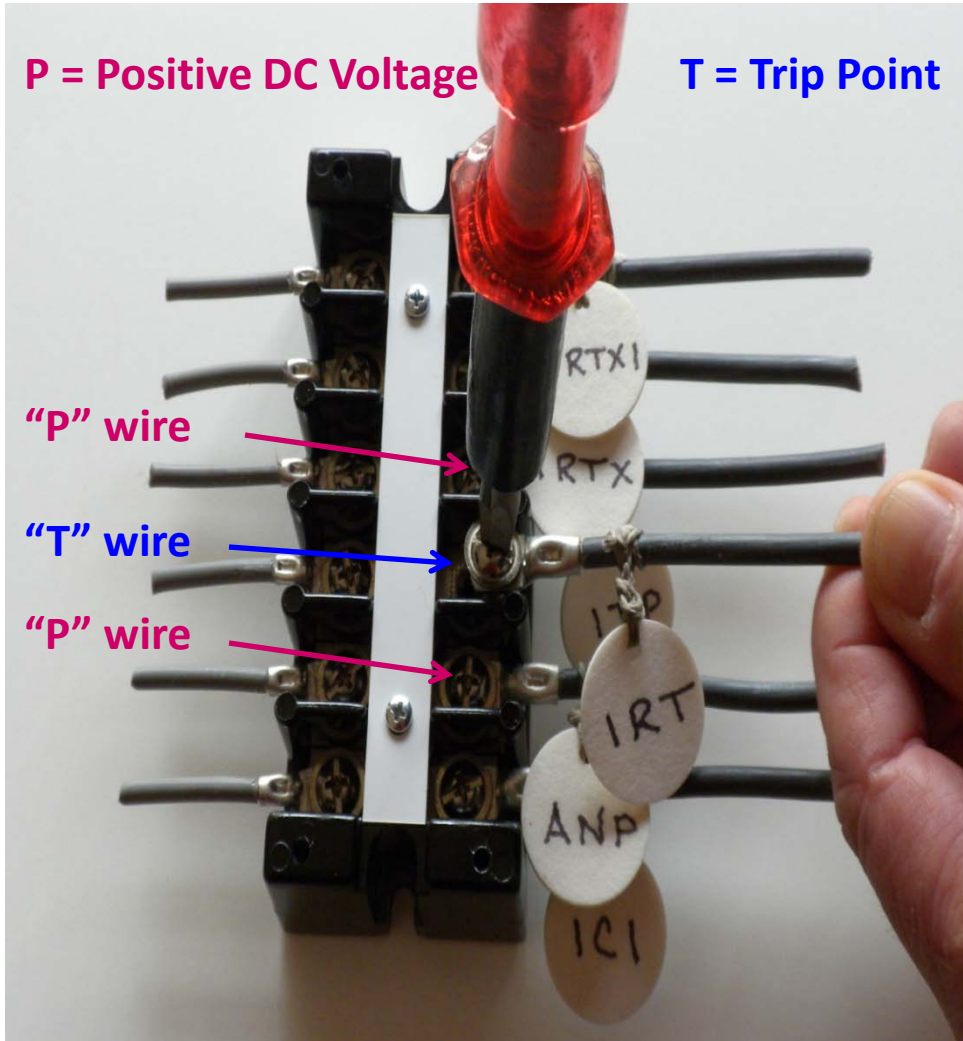
"T" wire

"P" wire

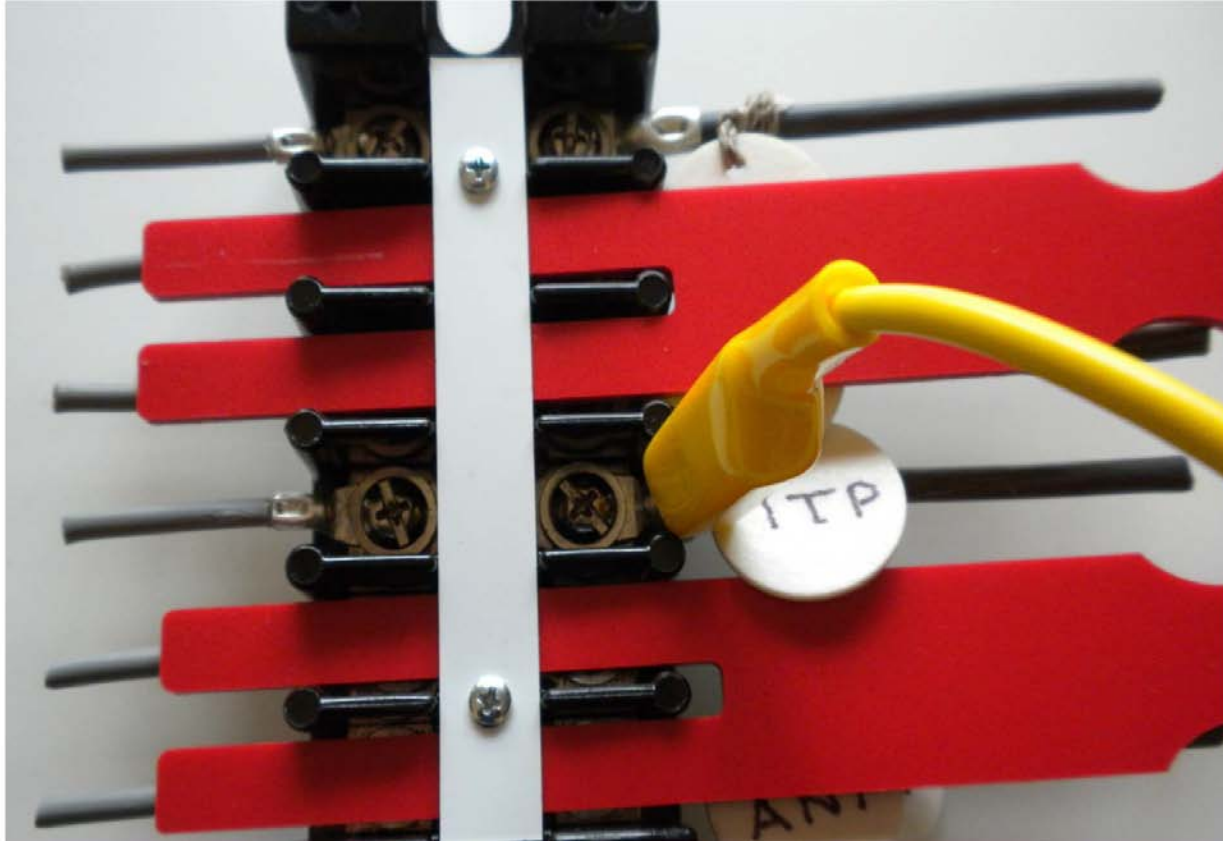
"T" wire

Without Terminal Point Barriers

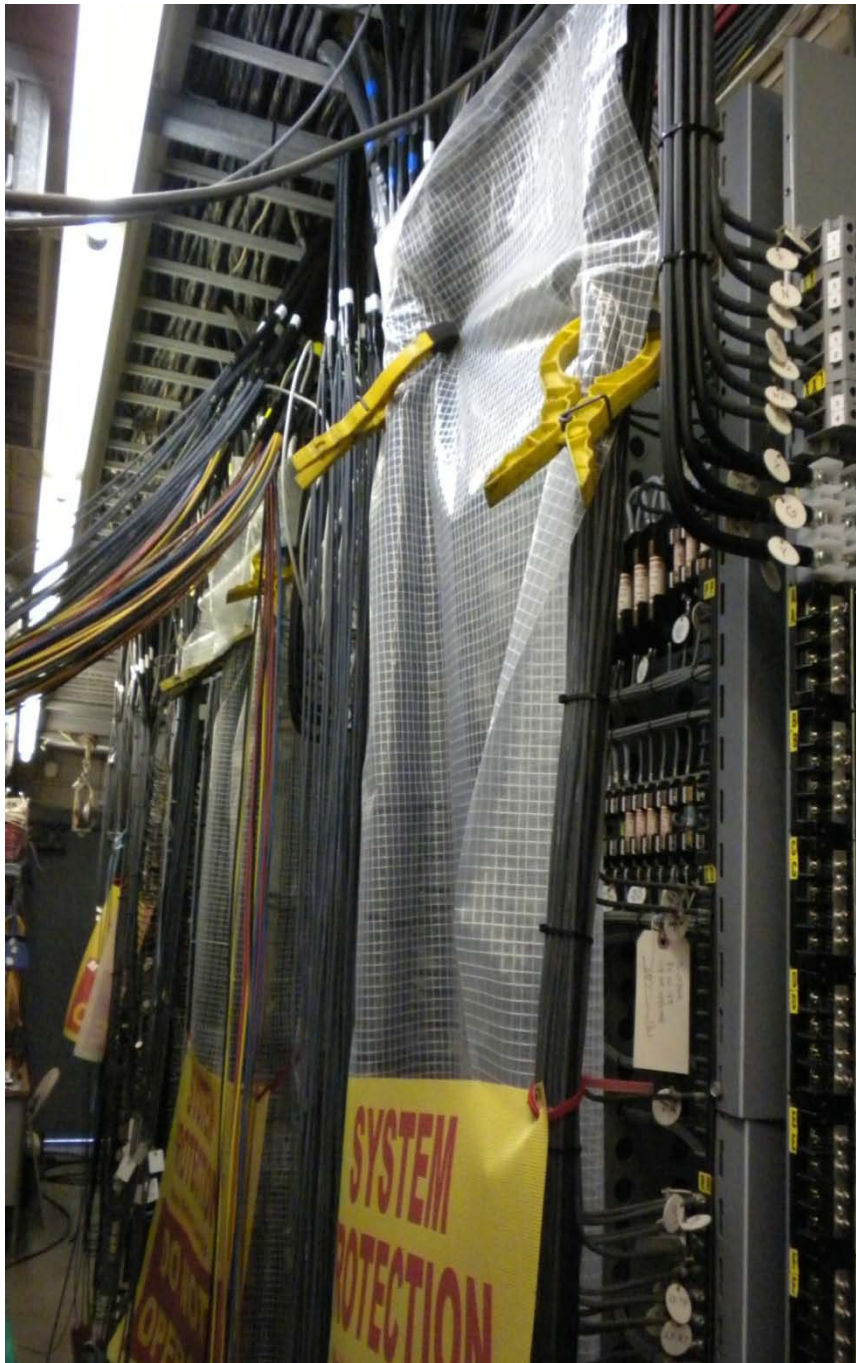
With Terminal Point Barriers



Terminal Point Barriers



- **Cover adjacent points when using test jumper**



Plastic Sheeting as Barrier

- **Flame retardant plastic builds a physical barrier preventing incidental contact with “live” electrical control components.**
- **Plastic held in place with nylon blanket clamps.**



The Requirement, the Expectation

- **Technicians & Electricians work together to identify task risks during pre- job briefing/task preview**
- **Once risks are identified, use work zone kit tools to build appropriate barriers and defenses to prevent unwanted equipment operation**
- **Reduce the errors that cause outages!**

All we ask is...

You borrow it

You use it

You improve it

You share it