

A Modern Approach to Protecting Wayside Railroad Equipment from Lightning Damage



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Legacy System Railroad Tracks

- Use railroad tracks as signal paths
- DC, AC, or AC/DC energized
- Crossing signals
- Shared right-of-way

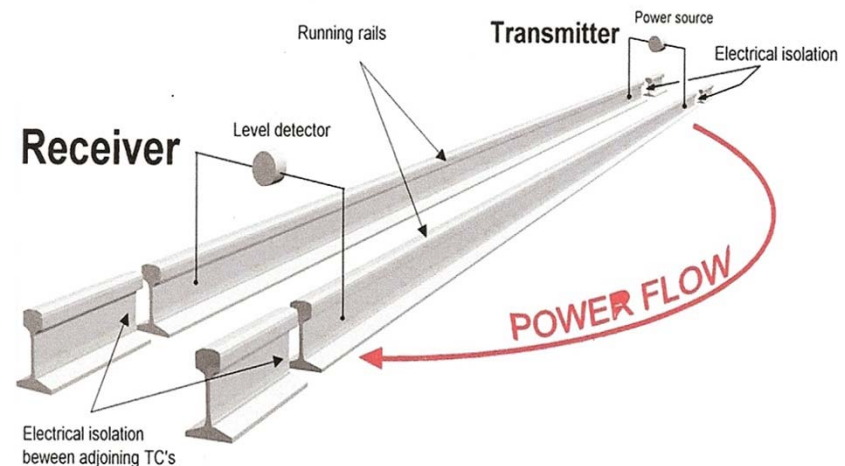
➤ Photo source: EPRI Power System and Railroad Electromagnetic Compatibility Handbook



Legacy System Railroad Tracks Track Circuit

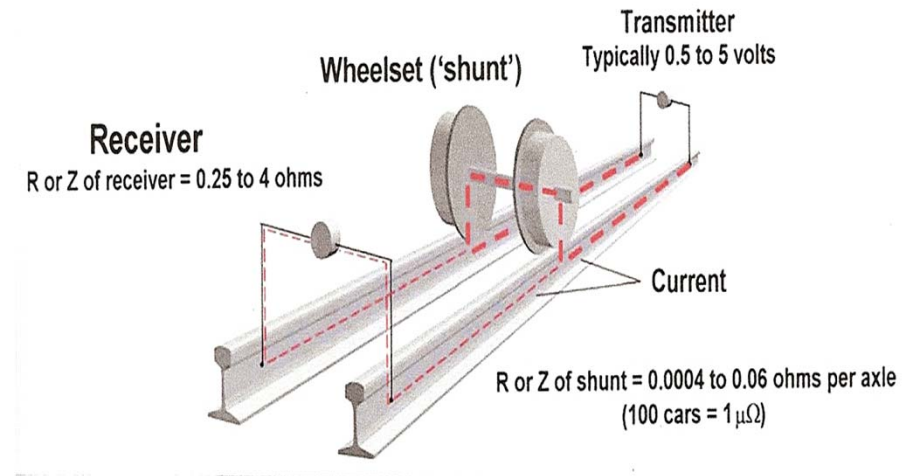
- Transmitter/receiver
- Electrically isolated block of track
- Signal and communication control

➤ Image source: EPRI Power System and Railroad Electromagnetic Compatibility Handbook



Legacy System Railroad Tracks Shunt Circuit

- Train detection
- Track resistance
- Ballast variation
- Track isolation problems



➤ Image source: EPRI Power System and Railroad Electromagnetic Compatibility Handbook

Legacy System Signals and Communications Wayside Bungalows and Panels

- Wayside bungalows and panels are used as concentrators for signal circuits, protection circuits, communication circuits, power requirements, etc.
- Bungalow circuits are susceptible to failure due to direct or indirect lightning strikes, current surges, etc.

Legacy System

Typical Wayside Bungalow



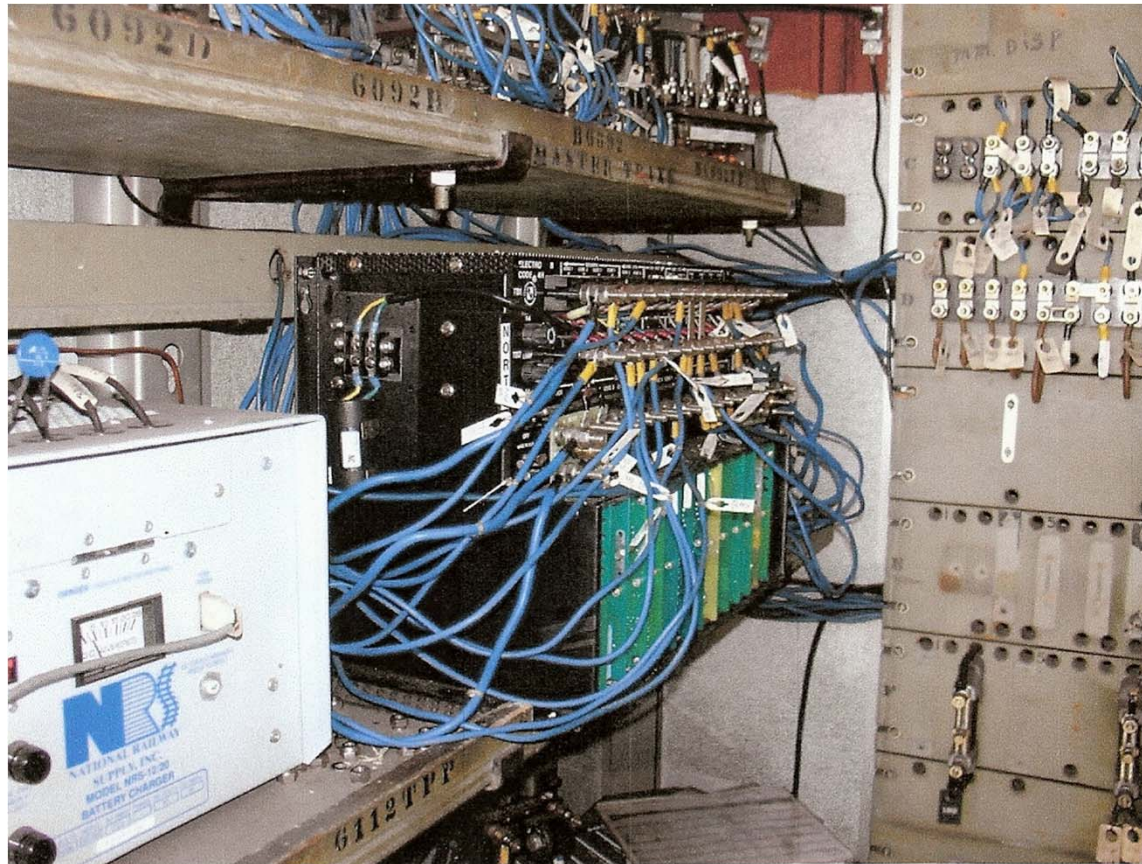
Legacy System Typical Wayside Bungalow



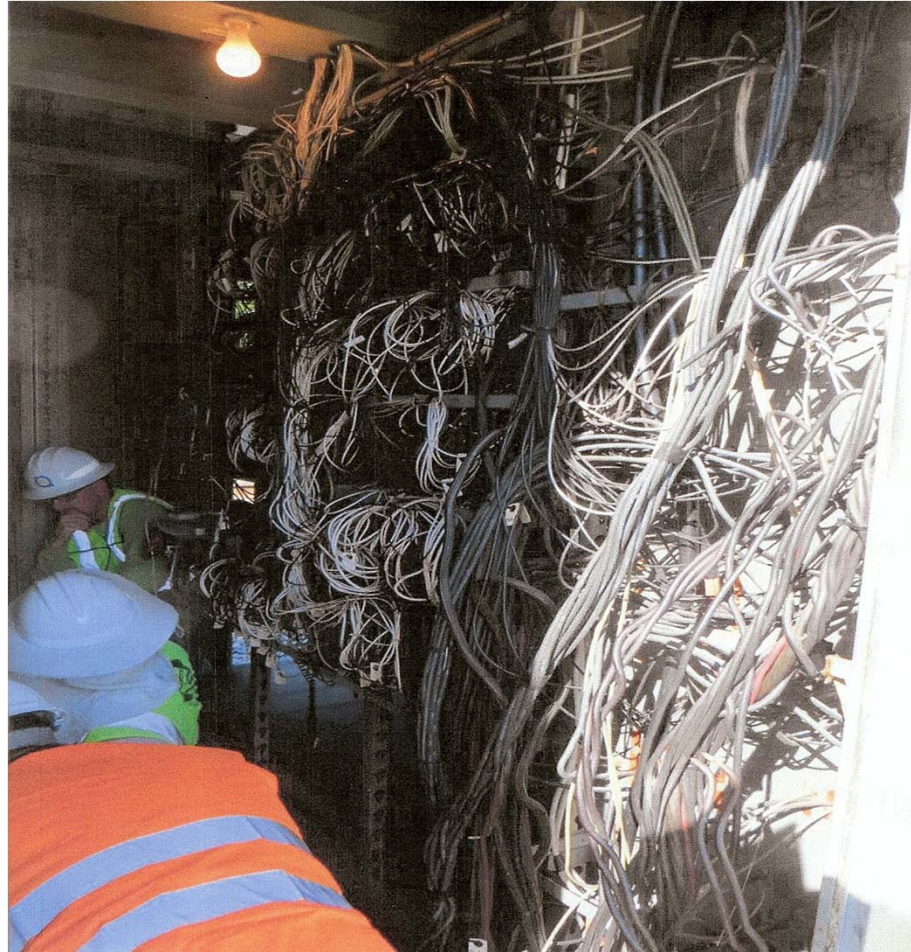
Legacy System Typical Panel



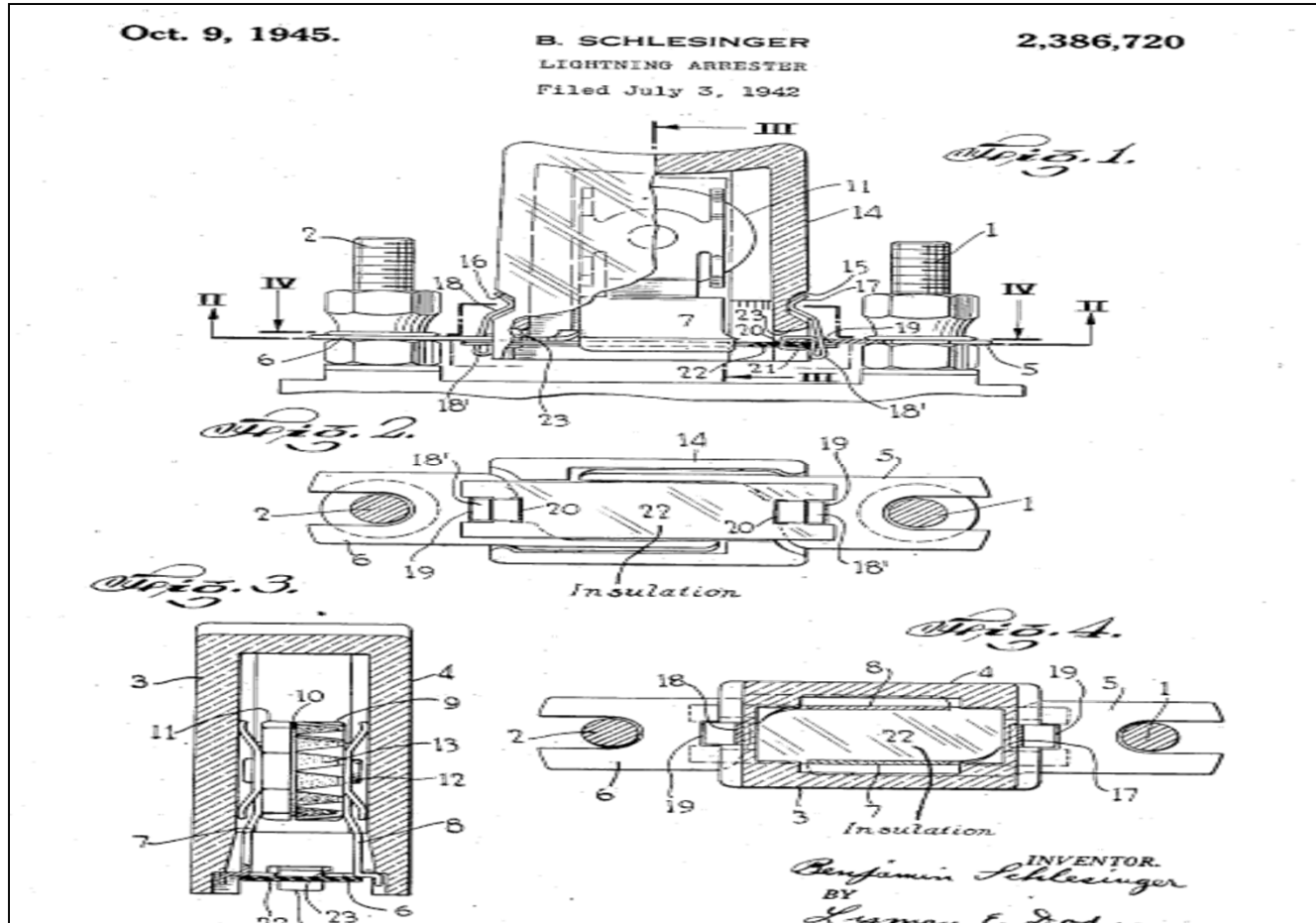
Legacy System Internal Bungalow Wiring Practices



Legacy System Internal Bungalow Wiring Practices



Legacy Technology Lightning Protection



Legacy Lightning Protection Methods

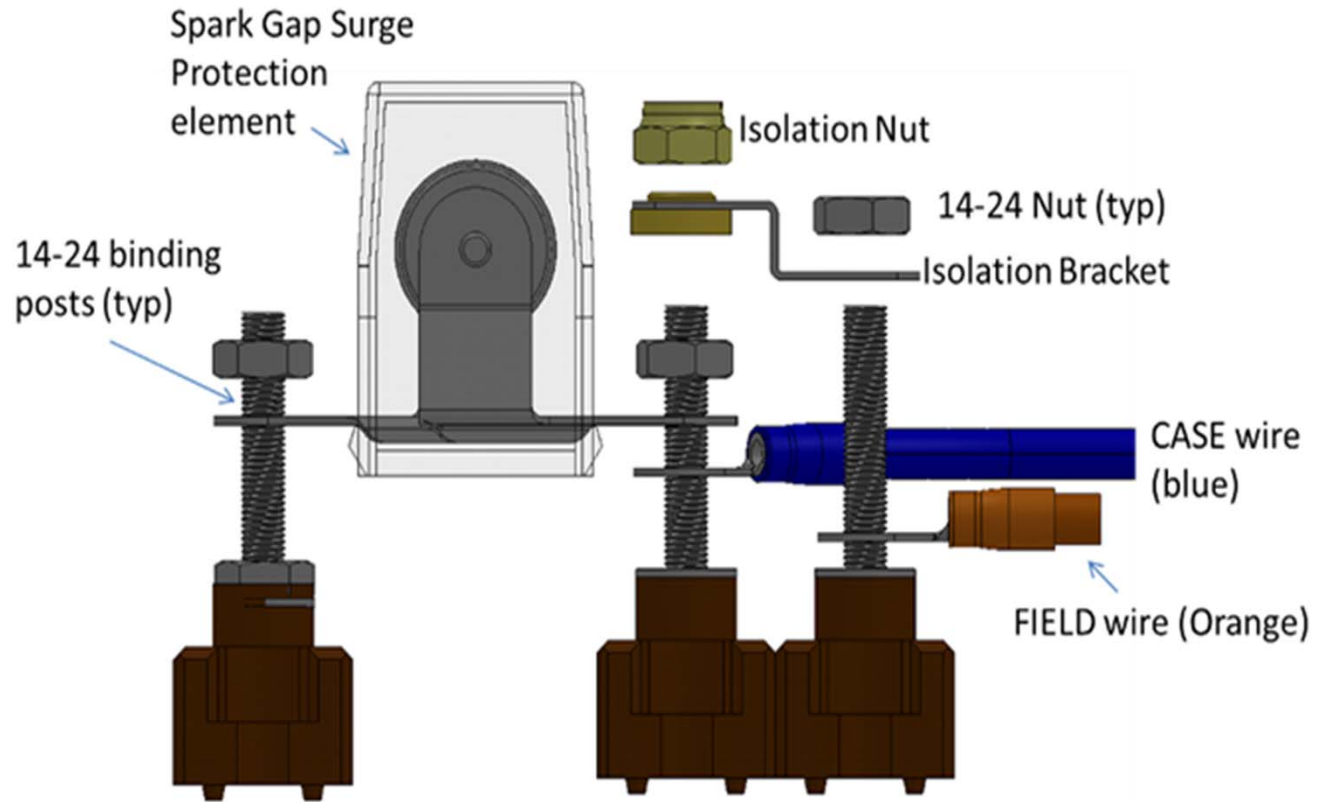
Present Day Example

- Signal line protection has been provided by the use of spark-gap-based product



Legacy Technology

Mechanical Characterization



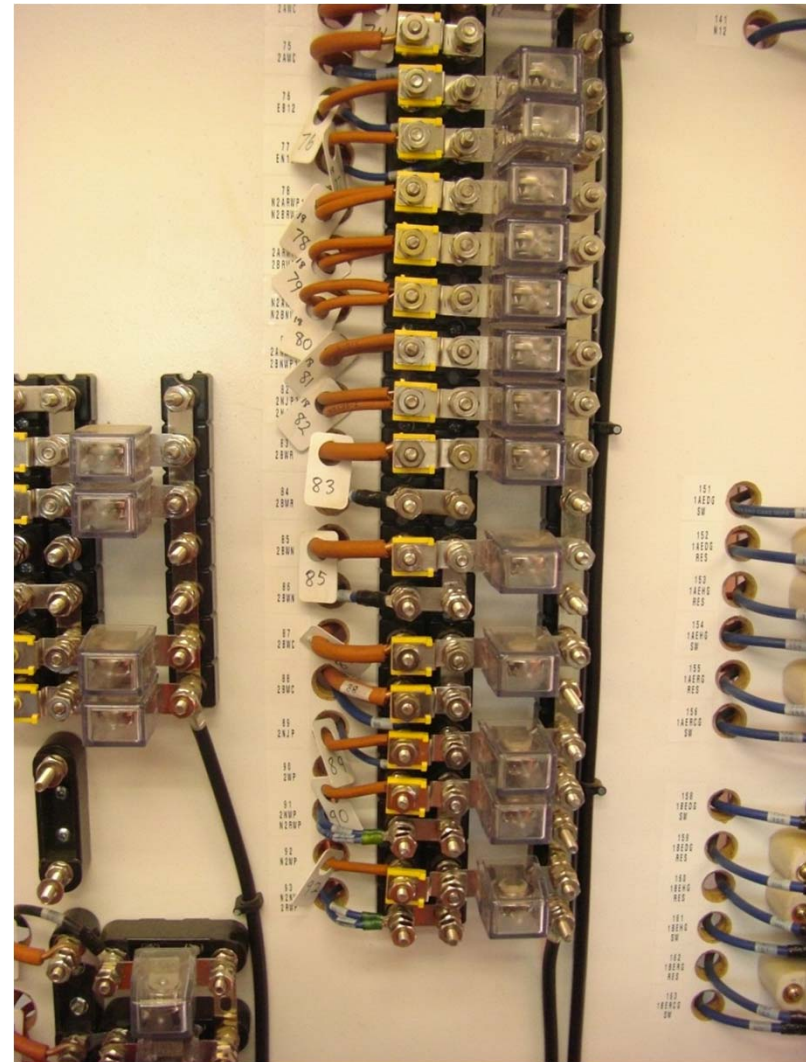
Legacy Technology

Electrical Characterization

- **Electrical characteristics**
- Surge protective device technology: spark-gap based
- Operating voltage: 0 to 50 V DC
- Breakdown voltage: 700 to 1000 Volts
- Discharge current: 50 kA_{max}
- Let-through voltage = 2500 V_{nom}

Legacy Technology Typical Use Slide

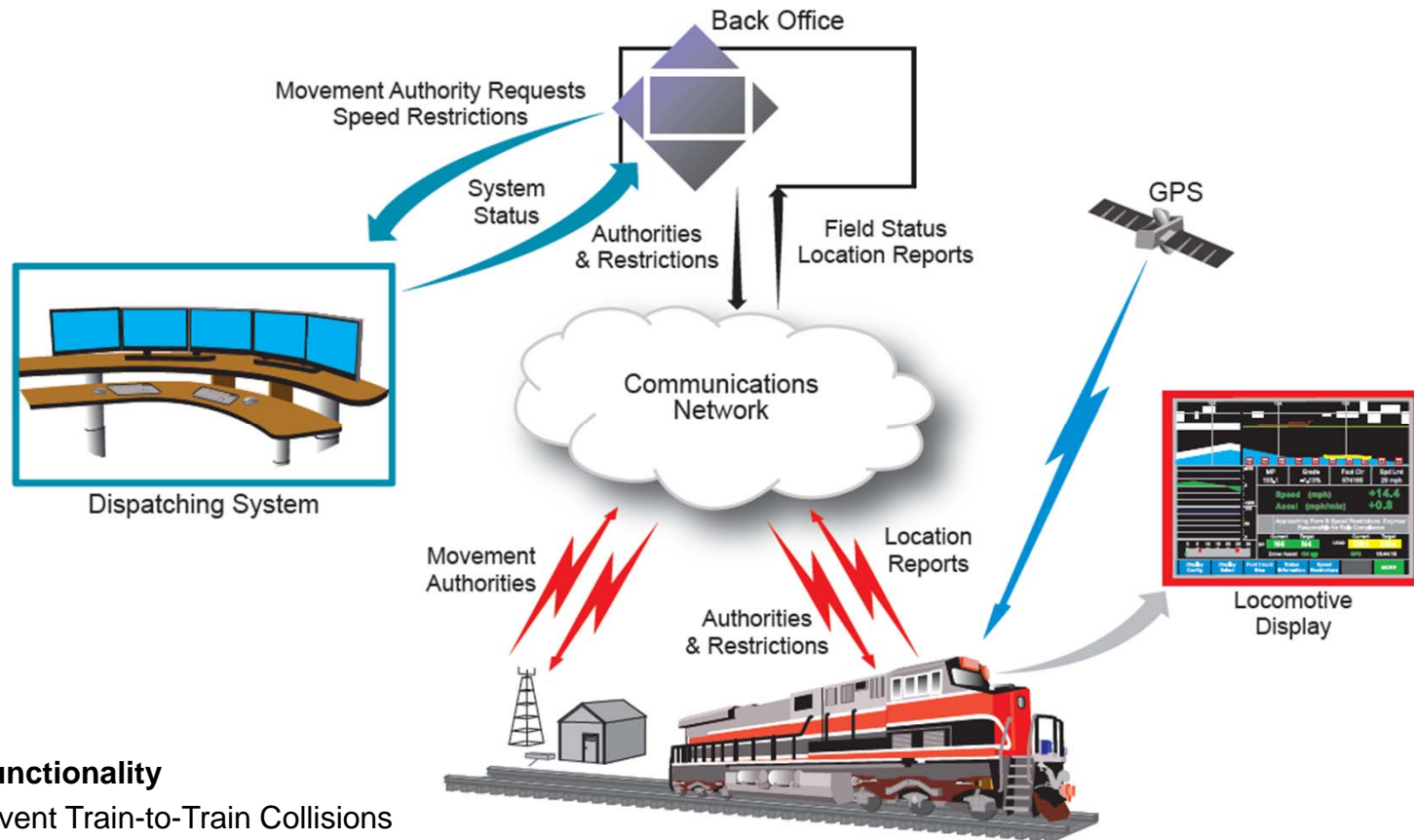
- Spark-gap-based technology is used in the bungalow environment, as shown on the right.



Positive Train Control (PTC)

- High-profile accidents
- Rail Safety Improvement Act of 2008
- “Each Class I railroad carrier and each entity providing regularly scheduled intercity or commuter rail passenger transportation shall develop ... a plan for **implementing a Positive Train Control system by December 31, 2015**, governing operations on—
 - “(A) its main line over which intercity rail passenger transportation or commuter rail passenger transportation ...;
 - “(B) its main line over which poison- or toxic-by-inhalation hazardous materials ... are transported; and
 - “(C) such other tracks as the Secretary may prescribe by regulation or order ...
- The railroad carrier **shall implement a Positive Train Control system in accordance with the plan.**”
- The rest (“Class I railroad, a railroad carrier that has inadequate safety performance (as determined by the Secretary), or a railroad carrier that provides intercity rail passenger or commuter rail passenger transportation”) have until December 2018 to implement PTC.

Positive Train Control – Generic Example



◆ Safety Functionality

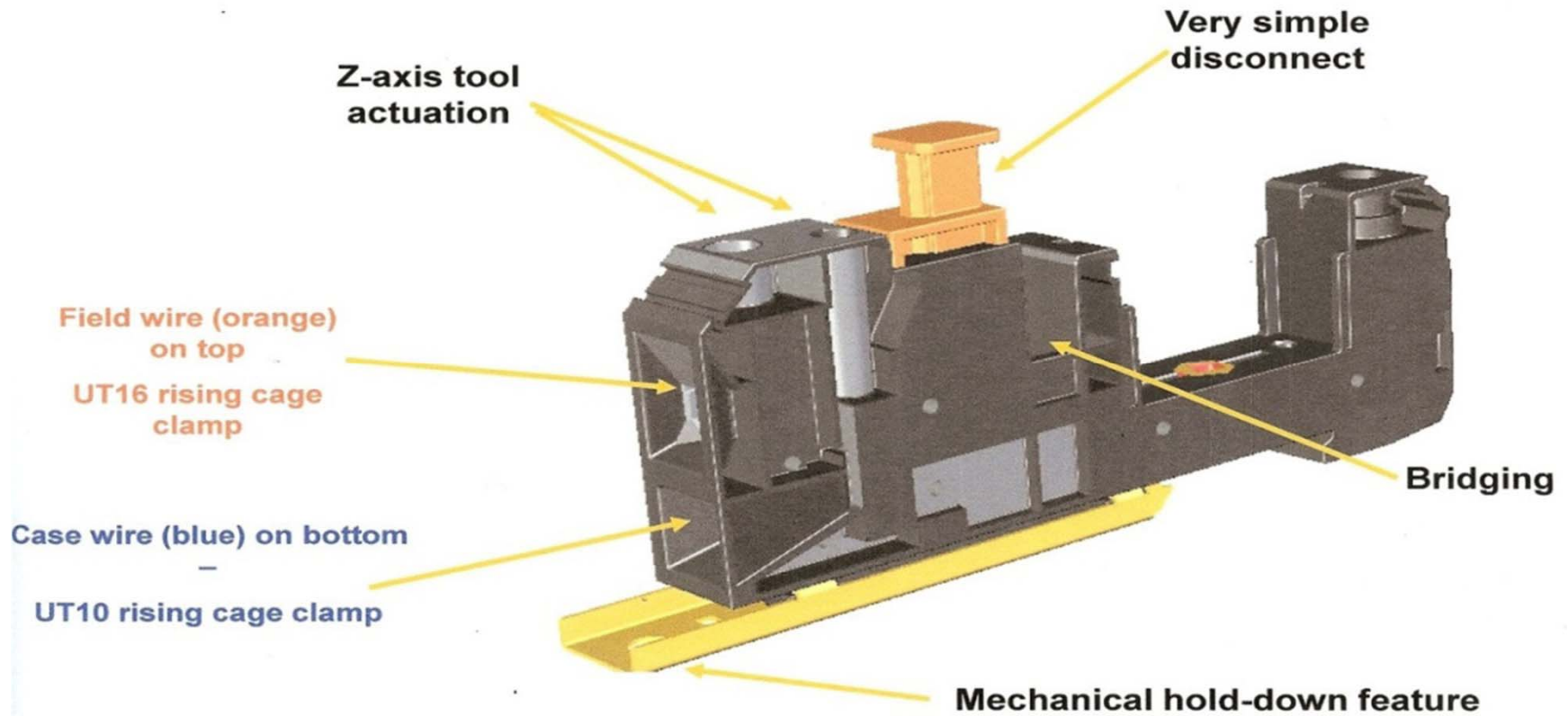
- Prevent Train-to-Train Collisions
- Enforce Speed Restrictions
- Protect Roadway Workers Operating Under Specific Authorities

Present Day Technology

MOV-Based Device

- The MOV-based device consists of a two piece design:
 - A base element that contains wire and base attachment features, testing features, and an available remote monitoring feature.
 - A removable product plug that can be designed for different applications, including track circuits, track equalizer circuits, relay circuits, and digital circuit applications.

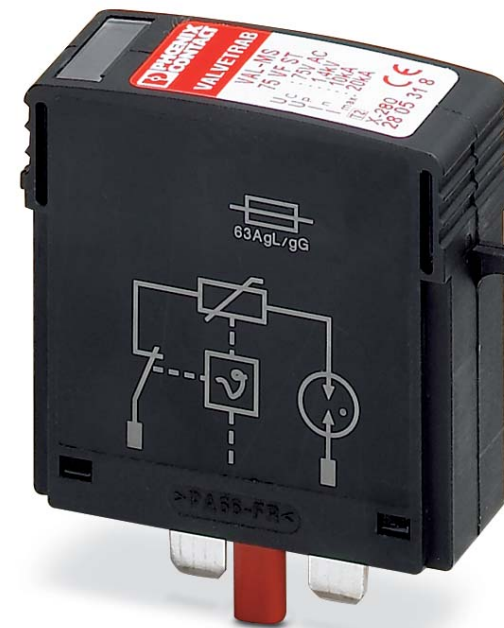
Present Day Technology Base Element



Present Day Technology Surge Protection Plug

■ Electrical Characteristics

- Hybrid MOV and Gas Tube Technology
- Operating Voltage (U_n): 100 VDC
- Breakdown Voltage: 1.4 KV
- Discharge Current (I_{max}): 20KA
- Let Thru Voltage: 450V

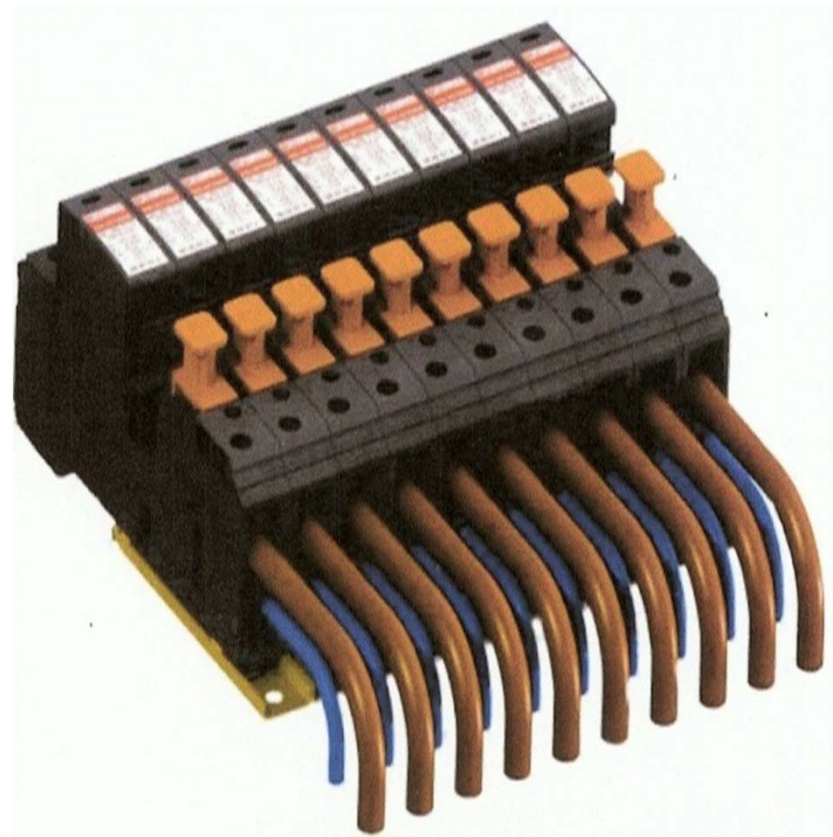


Legacy and Present Day Technology SPD comparison

Legacy Technology



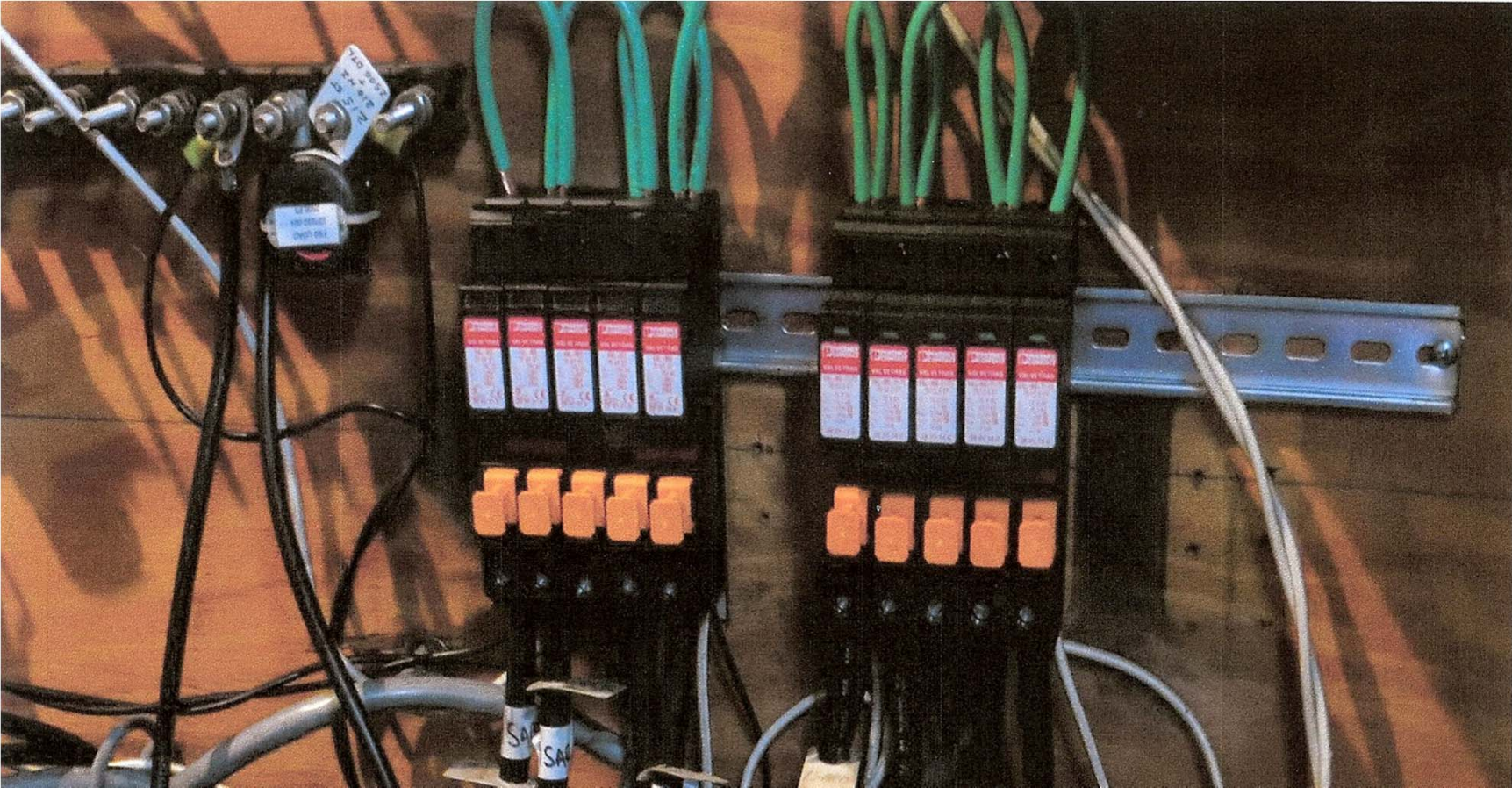
Present Day Technology



Legacy and Present Day Technology Application Comparison



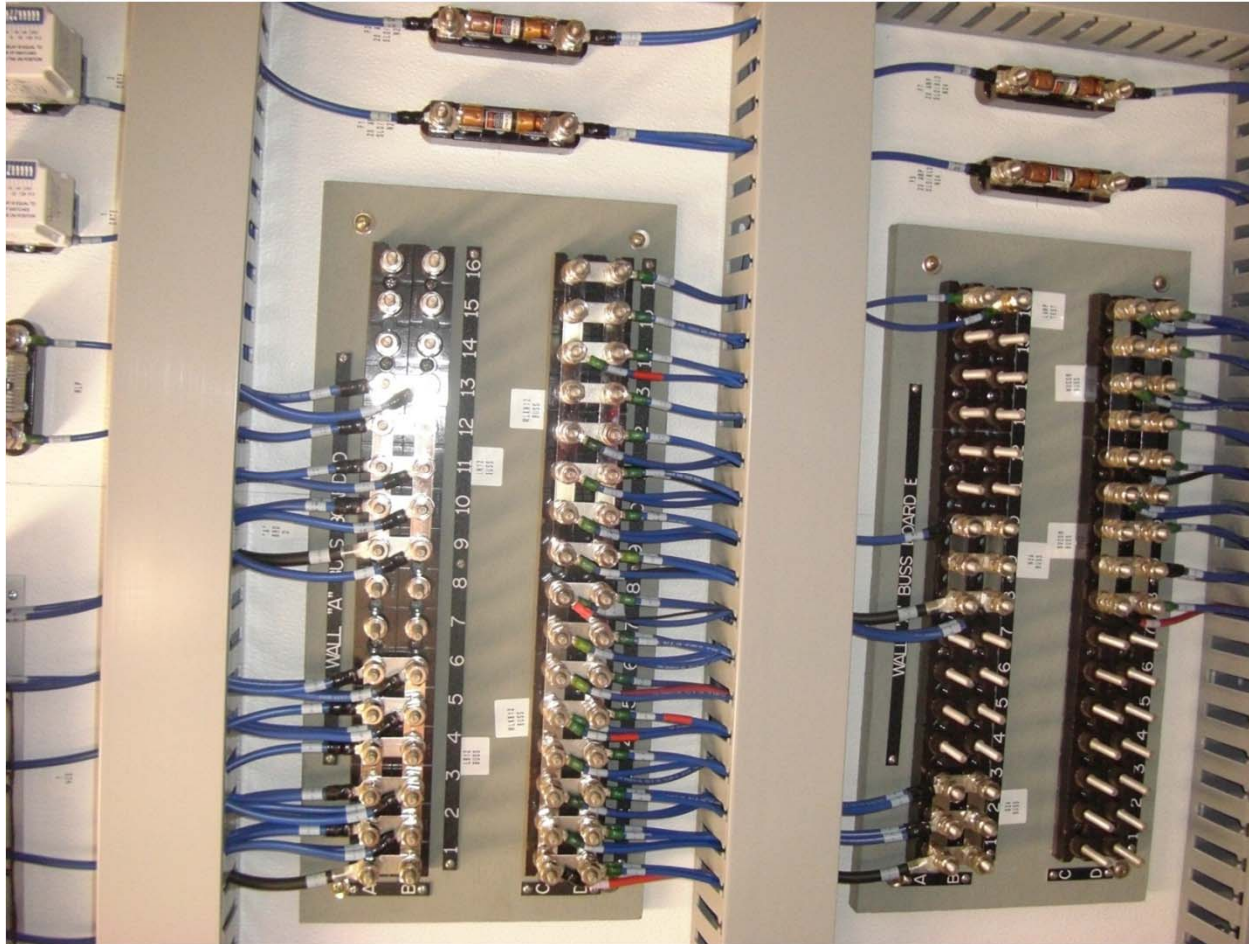
Present Day Technology Application Illustration



Present Day Technology Application Illustration



Present Day Technology Application Illustration



Issues to be Resolved

Wayside Bungalow Lightning Protection

- ❖ No industry consensus on a method to protect wayside signal circuitry from damage due to lightning strikes.
 - Independent companies
 - Track circuits & legacy methods.

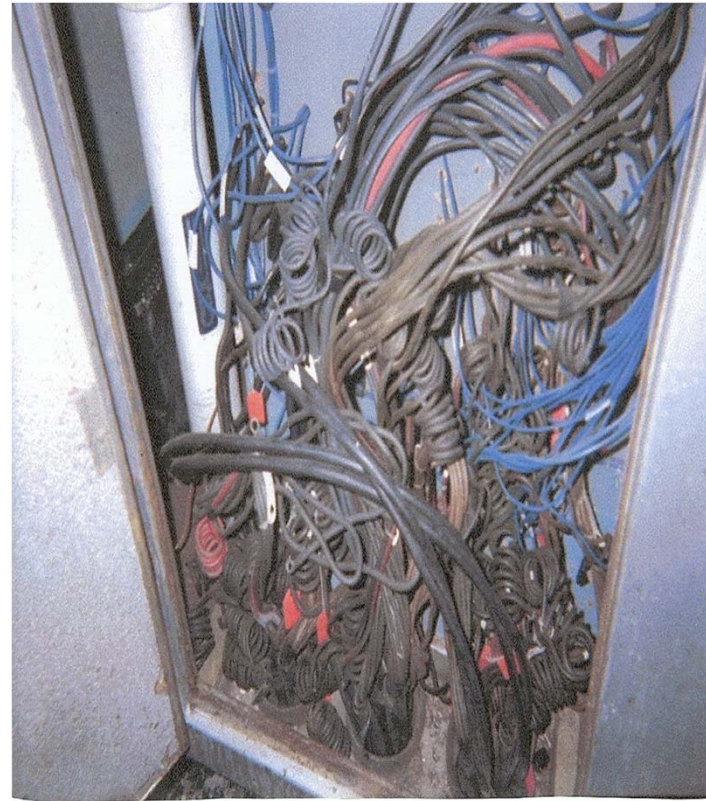


Issues to be Resolved

Wayside Bungalow Lightning Protection

❖ Various protection schemes have been evaluated with varying results

- Faraday cages
- Wire separation and length minimization

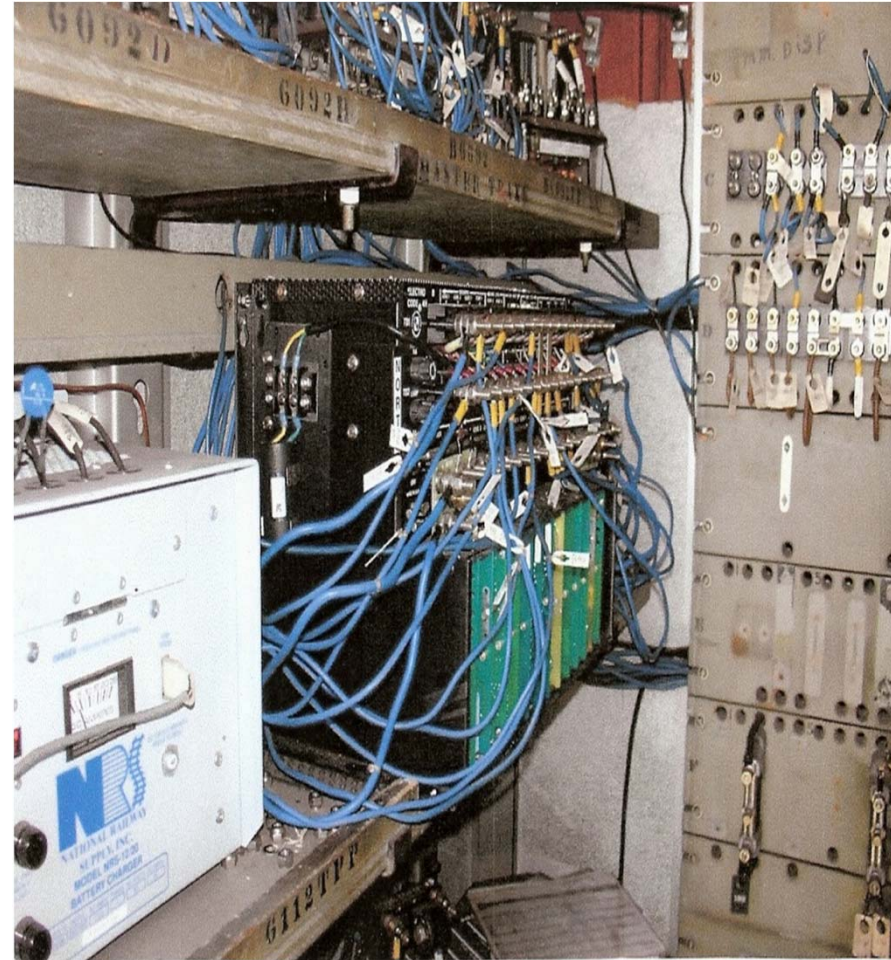


Issues to be Resolved

Wayside Bungalow Lightning Protection

❖ Various protection schemes have been evaluated with varying results.

- Costs associated with existing installations
- Cost demands of PTC implementation



Conclusion

This presentation has:

- ✓ Reviewed the legacy method of protecting railway signal lines against lightning strikes.
- ✓ Presented a state of the art method of protecting signal lines from lightning strikes.
- ✓ Discussed issues that will need to be addressed to further reduce the effects of lightning damage within the bungalow structure.

Thank You !