

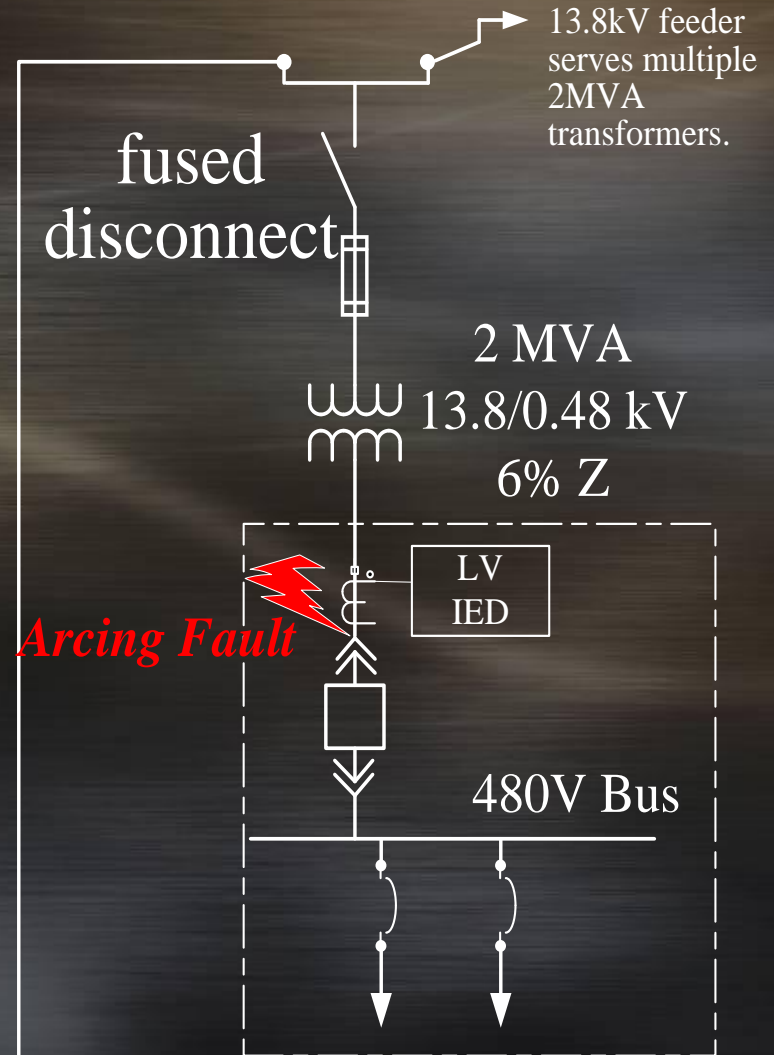
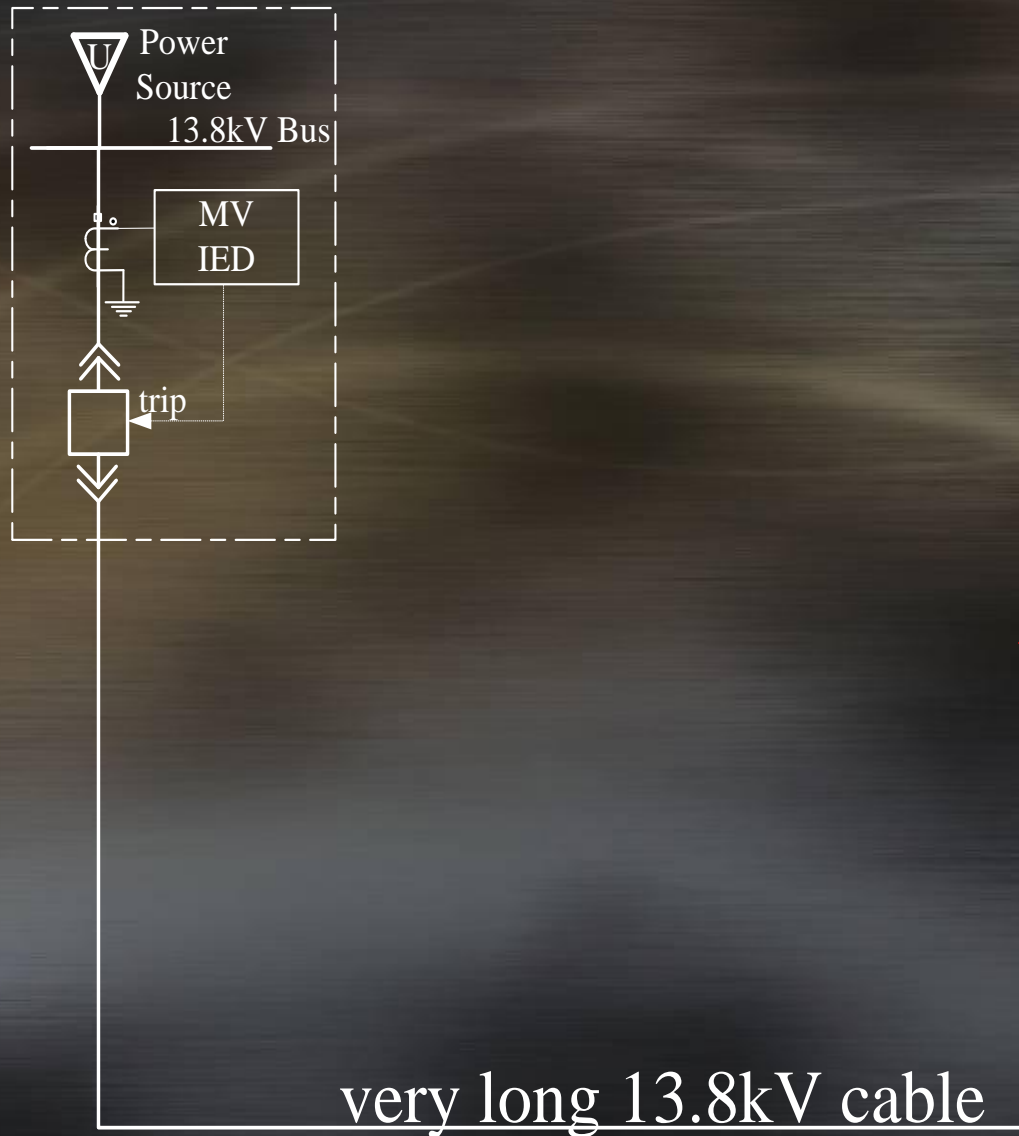
Considerations for Sending a Breaker Trip Command over Great Distances for the Purpose of Arc Flash Mitigation

Matt Proctor

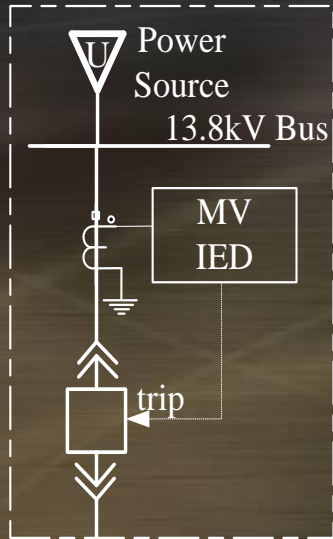
GE Digital Energy

Texas A&M Relay Conference 2014

Sample System



Sample System

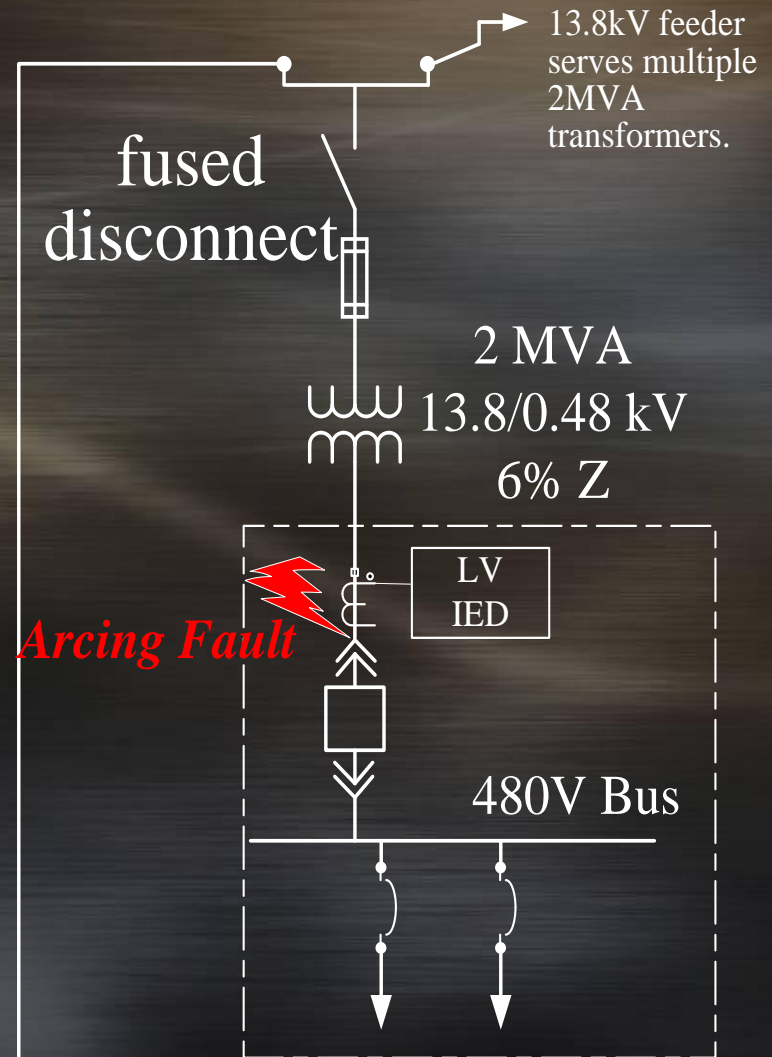


Arcing Fault = 20kA @ 480 V
= 727 A @ 13.8 kV

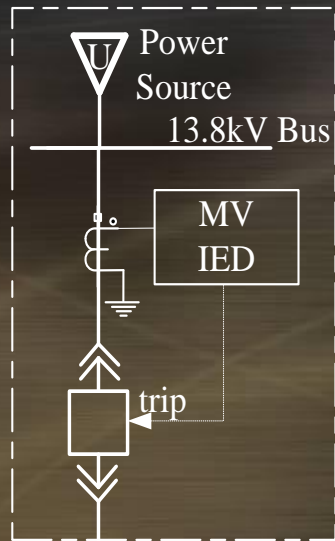
Fuse Clear Time > 2 sec.

Incident Energy >
40cal/cm²

very long 13.8kV cable

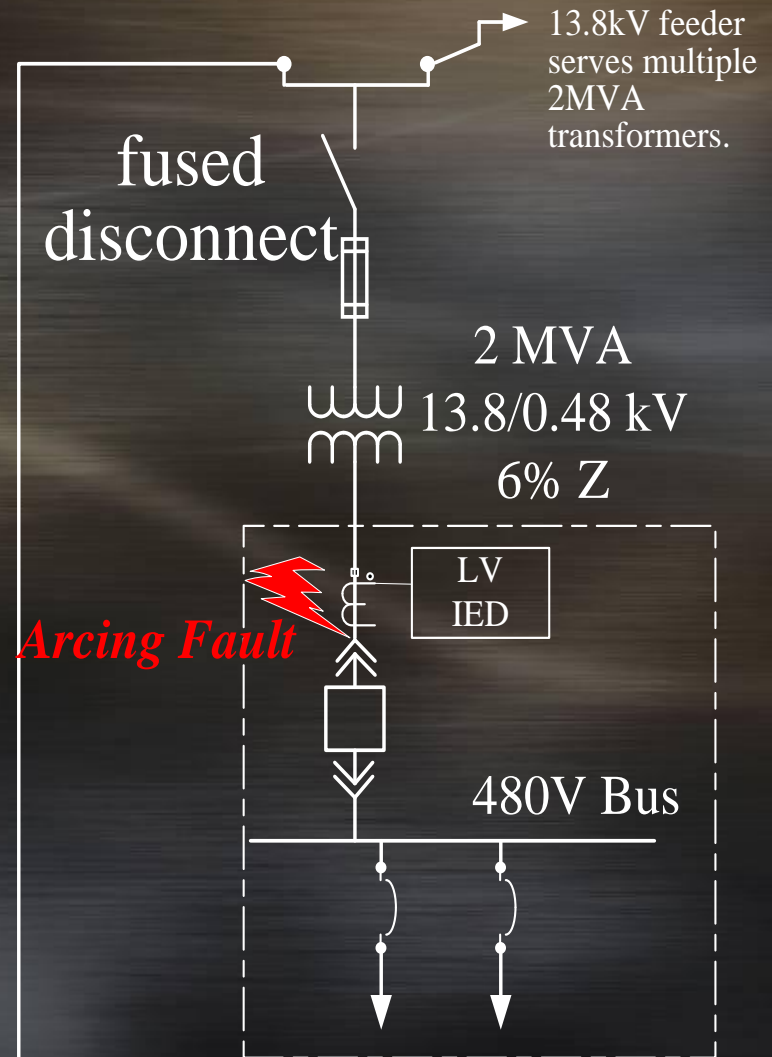


Maintenance Switch Solution?



727 Amps @ 13.8kV
Set pickup at 600A.
May trip under load.
Conclusion:
Fault must be sensed at LV Sub.

very long 13.8kV cable



How Do We Trip the MV Breaker?

- Hardwired Solution
- Digital Communications
 - Proprietary Solution
 - IEC 61850 GOOSE - Open Standard

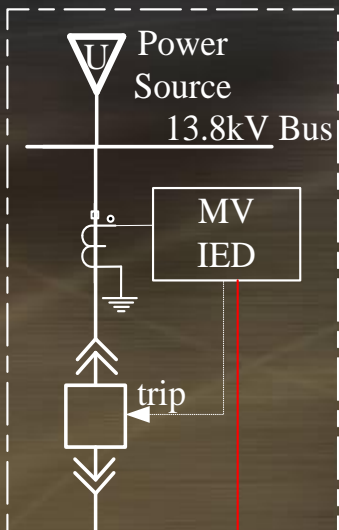
Hardwired Solution – Pro's

- Conventional, Intuitive
- Relatively Secure
- Simple Design and Setup
- Fast

Hardwired Solution – Cons

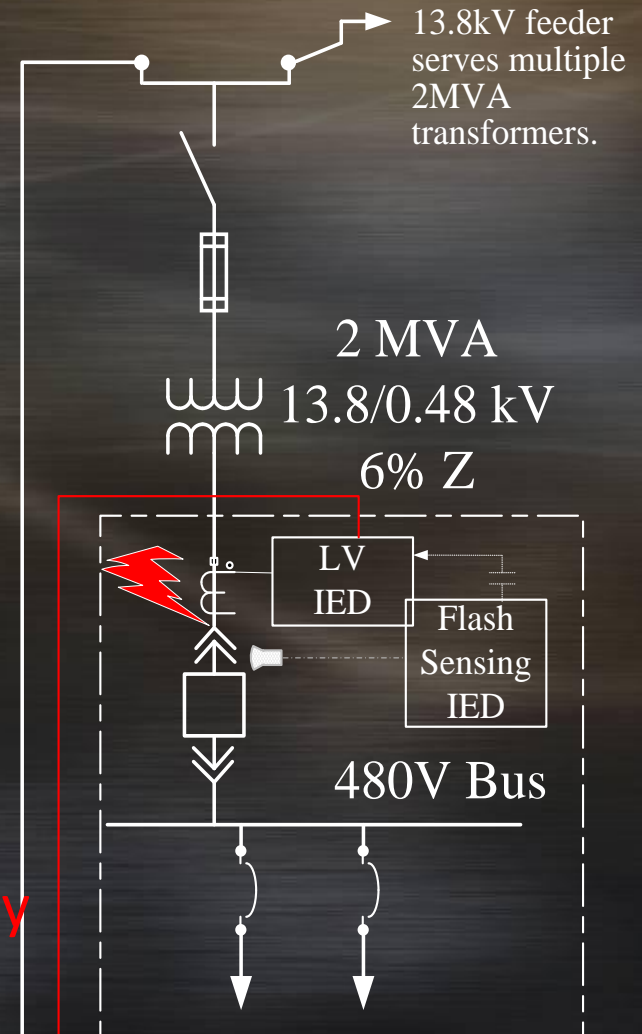
- Significant copper usage.
- Large conductors can be difficult to install.
- Interposing relays may be required.
- Self-Monitoring is not always possible.
- If more alarms/signaling between the subs is desired, it increases the copper investment.

Direct Peer-to-Peer (Proprietary)

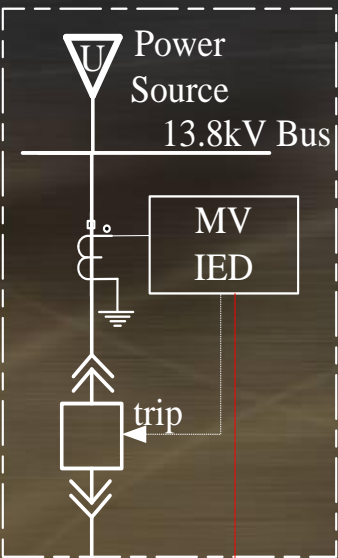


Direct link between IED's for transfer tripping.

- Self-monitoring.
- Speeds vary but generally fast.
- Complications with one-to-many or many-to-one messaging.
- Dedicated channels.

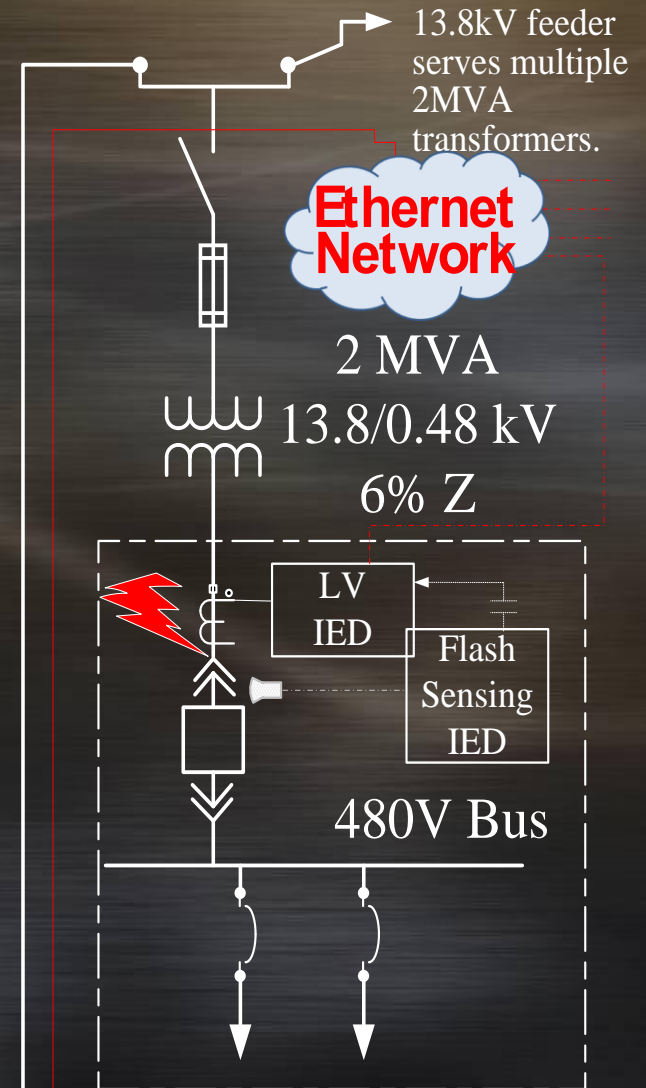


Open Standard Digital Solution



IEC 61850 GOOSE

- Open standard, interoperability.
- Doesn't require a dedicated network.
- Messages are multicast.
- Fast, self-monitoring



GOOSE Considerations - Time

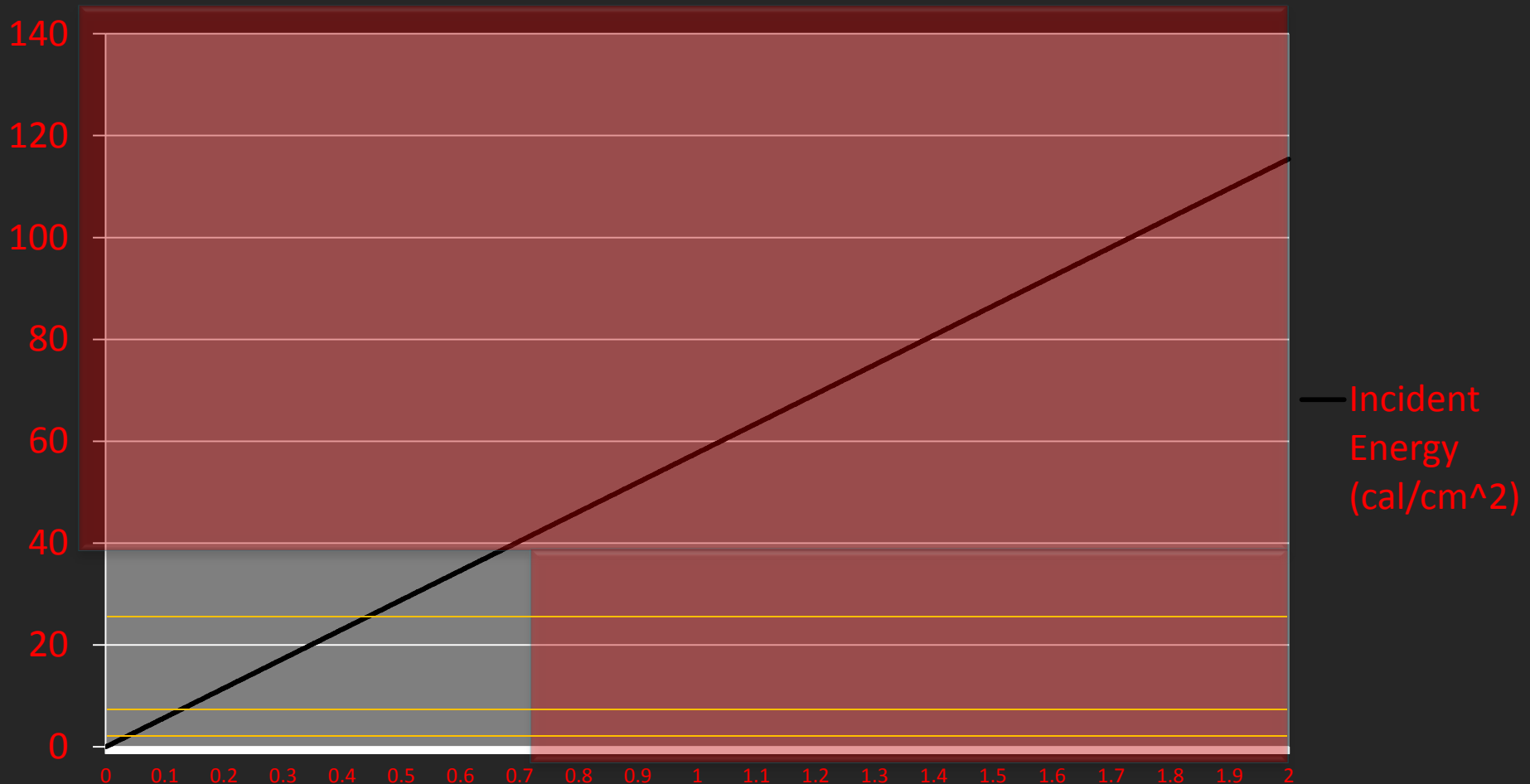
- Use fastest GOOSE message, Type 1A.
- Use an aggressive retransmission rate.
- Use the highest priority tag, the “fast lane”.

GOOSE Considerations - Network

- Limit number of switches on a ring.
- Make use of Rapid Spanning Tree Protocol.
- Make use of VLAN's to separate traffic.
- Network architecture becomes increasingly important during failures.

Impact on Incident Energy

Incident Energy as a Function of Clearing Time



*IEEE 1584 Calculations for Sample System, 40kA bolted fault, LV switchgear

Alarms and Monitoring

- Trip Coil Monitor
- IED/Arc Sensor Critical Failure
- Network Switch (Simple Architectures)
- Test Signaling (Optional)

Conclusions

- Digital transfer tripping is fast, secure, tested
- Using Ethernet network for multiple purposes can result in cost savings.
- Continuous monitoring of the system enhances safety.

Conclusions

The best method of avoiding arc flash hazards is to completely de-energize equipment prior to working on it!

Thank You

Questions?