The Impact of Overcurrent Protection Practices on System Reliability

Jim Burke

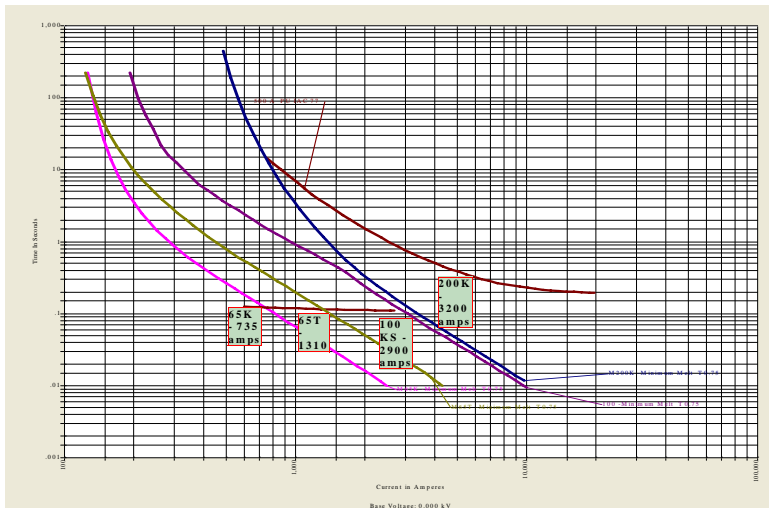**Quanta Technology**

IEEE T&D Conference in Chicago

QUANTA TECHNOLOGY

Topics

A. **Fuse Save vs. Fuse Blow**
B. **Automation**
C. **Reclosers**
D. **Sequence Coordination**
E. **Single Phase Tripping**
F. **Lateral Fuse Philosophy**
G. **Distribution Transformer Fusing**
H. **Fault Impedance Pitfalls**
I. **Fault Recording Advantages**
J. **New Products**
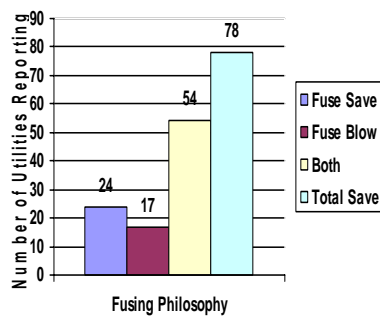K. **Challenges**

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A. Fuse Save vs. Fuse Blow

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Survey Results

- **Fuse Blow** Philosophy **reduces MAIFI** but **increases SAIDI**
- **Fuse Save** doesn't work in high short circuit areas
- Most utilities use **both** philosophies
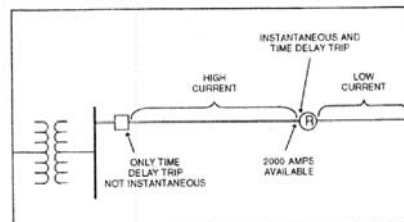
Industry Survey

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Limits of Coordination

Breaker/Recloser (total interrupt time in cycles)	65K Min Melt	200K Min Melt
2	1500	5962
3	1148	4700
4	1061	4334
6	813	3595

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High/Low Scheme

- **Fuse Blow** near the substation
- **Fuse Save** where fault currents are low enough to allow proper coordination

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Sectionalizers

- Reduce nuisance operations in high current areas
- Used where fuses are too fast
- No coordination curve
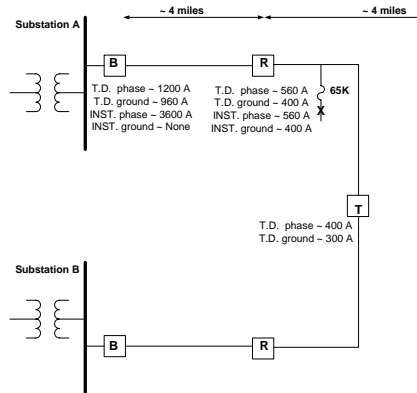- Some fit into existing cutouts

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B. Automation

- New systems are flexible and reliable
- No limit to number of controls
- Logic is programmed in
- Scaleable
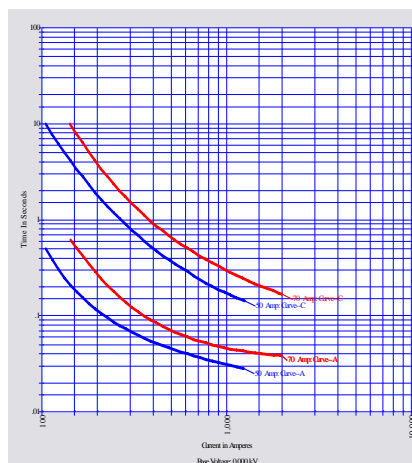
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C. Reclosers
(feeder contribution)

	SAIFI	SAIDI
Base Case (no line reclosers)	1.6	3.3
Add Midline Recloser	1.2	2.6
Add Loop Recloser	1.0	2.1
Allow Single Phase Switching	0.8	1.8

Substation A

~ 4 miles   ~ 4 miles

B   R

T.D. phase ~ 1200 A   T.D. phase ~ 560 A   65K
T.D. ground ~ 960 A   T.D. ground ~ 400 A
INST. phase ~ 3600 A   INST. phase ~ 560 A
INST. ground ~ None   INST. ground ~ 400 A

T

T.D. phase ~ 400 A
T.D. ground ~ 300 A

Substation B

B   R

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D. Sequence Coordination

- 2 reclosing devices in series
- Both reclosers see the fault
- Upstream device advances its control through its fast operation

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E. Single Phase Tripping

- New reclosers allow single phase operation
- Single or three phase lockout
- Can reduce SAIFI and SAIDI at virtually no cost

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F. Lateral Fuse Philosophies

- **Load** – tends to create nuisance operations. Difficult to "fuse save".
- **One size** (e.g. 65K) – simple but generally limits coordination near the substation

- **Fuse High** – use slower fuse links (e.g. 100 or 200 ampere and slower types such as T and KS links

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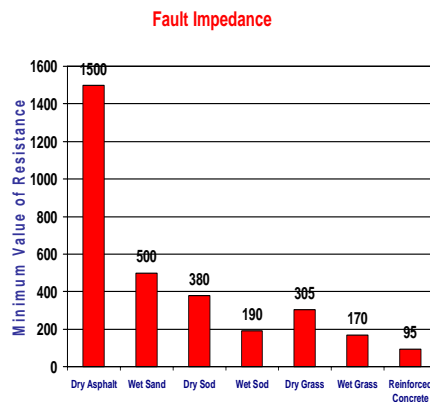# G. Distribution Transformer Fusing

- **ANSI Points** – usually result in numerous nuisance operations
- **>2 Times Load** – greatly reduces nuisance operations

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H. Fault Impedance Pitfalls

- The **40 ohm** fault impedance is absolutely incorrect
- Results in improper coordination philosophies
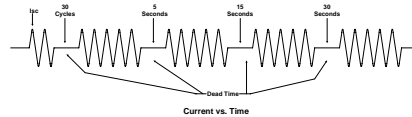- Detectable faults have **0 ohms** fault impedance

Fault Impedance

	Minimum Value of Resistance
Dry Asphalt	1500
Wet Sand	500
Dry Sod	380
Wet Sod	190
Dry Grass	305
Wet Grass	170
Reinforced Concrete	95

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I. Fault Recording Advantages

- Can determine success of **instantaneous reclose**
- Can help assess value of **extra reclosures**
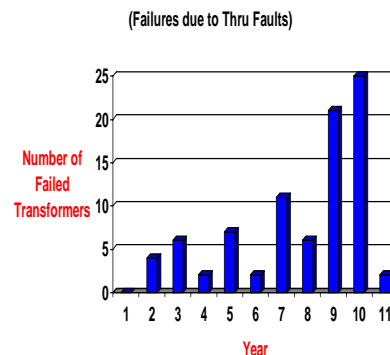- Help in determining **fault location** and **fault impedance**

Breaker Reclosing Sequence

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Reducing Substation Transformer Failures

- **Through faults** cause substation transformer failures
- **Recording** can help reduce number of reclosures
- **Pulsecoding** can reduce impact of reclosing

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J. New Products

- TripSaver
- Sectionalizers
- Pulseclosing devices
- Electronic Reclosers
- Microprocessor based relays

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K. Challenges

- **Reliability vs. Cost**
- **Arc Flash**
- **Distributed Generation**
- **Knowledgeable engineers**

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Questions????