Selective Arc-Flash Protection
Selective Arc-Flash Protection

- Arc flash is a short circuit via ionized gas (air)
- Safety hazard to personnel
- Damage to equipment
- Interruptions to processes
How to mitigate the impact?

The incident energy depends on

• Distance
• Voltage
• Current
• Arcing time
Time is the critical factor

Incident energy with different arcing times

U = 480V, I = 65kA, gap = 32mm, distance = 610mm

According to IEEE Std 1584™-2002
Time is the critical factor

Short-circuit test, 50kA

Arcing time 450ms

Arcing time 47ms
In the beginning – there is light
In the beginning – there is light

In the beginning there is so much light that the camera is blinded.

Lauri Kumpulainen – Finland  Session 1  Paper ID 0660
Detection of the light

Optical sensors

• Point sensors

• Fibre sensors
Detection of arc light is the fastest way to detect arc.

The detection of light is often confirmed by the detection of instantaneous overcurrent.

Detection principles

- **Light & Current**
  - $I > (I_0)$
  - $L >$
  - &
  - Trip

- **Light only**
  - $L >$
  - Trip
Dedicated arc-flash protection

- Optical sensors
- Current measurement (CT’s of the normal protection system)
- Light I/O units
- (Current I/O units)
- Communication
- Arc Master
- Self-supervision
Detection and protection

• Detect the arc light
• Detect the instantaneous overcurrent (phase or earth-fault current)
• Initiate the trip of the appropriate circuit breaker within a few milliseconds
• Indicate the activated sensor

Lauri Kumpulainen – Finland Session 1 Paper ID 0660
Arc-Flash protection integrated into protection relays

• Numerical relays equipped with arc-flash option
• Low-cost alternative
Selective arc-flash protection

Zone 1
Zone 2

Zone 1.1
Zone 1.2
Zone 1.3
Zone 1.4

Zone 2.1
Zone 2.2
Zone 2.3
Zone 2.4

CIFP (L & I > int)
VAMP221
VAM 4C
VX001
VAM 10L

Lauri Kumpulainen – Finland Session 1 Paper ID 0660
Stand-alone arc-flash protection
Ultra-fast protection

Arcing time = detection & trip initiation time + CB time

= 1.15ms + 50.80ms

Pressure versus current at arc initialization

Source: Testing and Certification of Medium Voltage Control Centers to Arc Resistant Standards, 2005
John A. Kay, CET

Incident energy with different arcing times

U = 480V, I = 65A, gap = 32mm, distance = 610mm
Arc Eliminator

- Makes a controlled bolted fault
- Faulty zone potential free within 5ms
Summary

• Detection of light - the fastest method
• Selectivity by means of point sensors
• Self-supervision of all the components and cables

• Recognized by IEC standard 62271-200
• Thousands of installed units
• Easy retrofit