

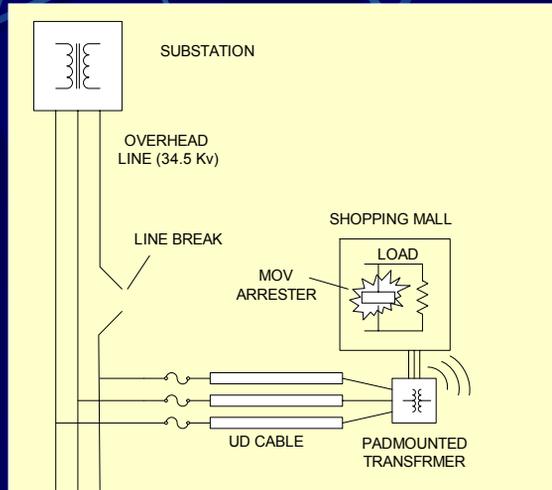
[Three] Examples of Ferroresonance in Distribution Systems

Roger C. Dugan
Sr. Consultant
Electrotek Concepts, Inc.

3 Examples

- Shopping Mall Incident
- Single-Phasing Distributed Generation
- Delta-connected Padmount Transformers on 12 kV

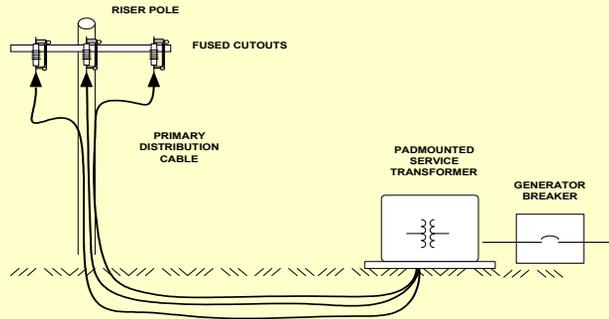
Shopping Mall Incident



Shopping Mall Incident

- 34.5 kV distribution system
- “Power Surge” & Noisy Transformer
- Paint on top bubbled, charred
- Transformer tested OK
- Root Cause: Automobile accident
- Failures: TVSS in mall registers, etc
- 3-phase load likely tripped

Distributed Generation



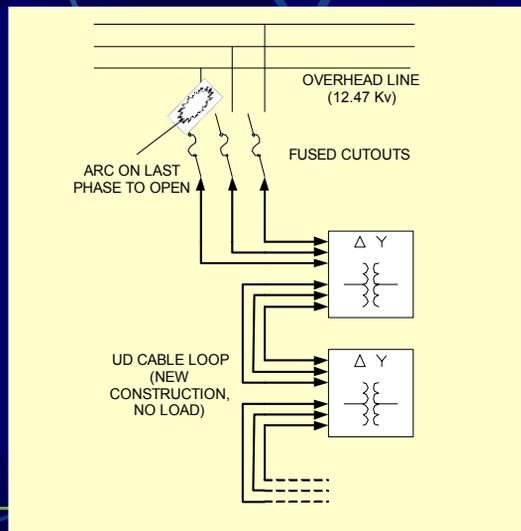
Distributed Generation

- Interconnection requirements conflict
- DG must have separate transformer
- DG must separate at first sign of trouble
- If trouble is a blown riser pole fuse, unloaded transformer yields ideal ferroresonance condition
- Same issue in modern commercial buildings

Solutions

- Three-phase switchgear at riser pole
 - Too expensive for small generators
 - Recommendation: No fuses between substation and 3-phase DG
- 3-phase reclosers or sectionalizers
- Replace cutouts with solid blade
 - Potentially detrimental to PQ

12 kV Delta Padmounts



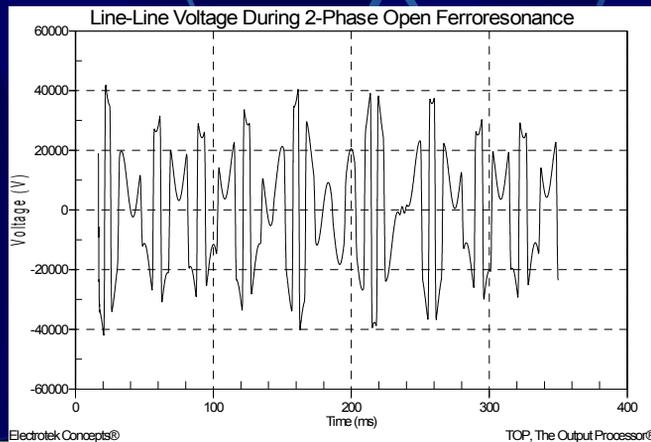
12 kV Padmounts...

- Ferroresonance less likely at 12 kV than at 25 or 35 kV
- Grd Wye-wye transformers the norm at 25 and 35 kV
- Many utilities continue to use delta-connection in 12 kV systems without many known problems

The incident ...

- Load noises noticed during testing of new installation
- Large arc drawn on 3rd phase to open
 - Despite being no load on system
- Transformers were not measurably damaged
- LV TVSS blown off the wall
- May require more load to damp out

Computed Results ...



Observations

- Opening one or two phases
 - either intentionally or accidentally
- UD cable service drop
- Light load or no load
 - Load may have been dumped
- Transformers not permanently damaged
- Damage did occur to load side equipment

Corrective Measures

- 3-phase switchgear
- Open or close all three cutouts as simultaneously as possible
- Ensure the transformer is loaded while being switched.
- Eliminate fuses
- Prevent inadvertent fuse operation
 - Animal guards, etc.