

Photovoltaic Interconnection to Spot and Grid Networks

2007 ASES
Conference

Presented by:

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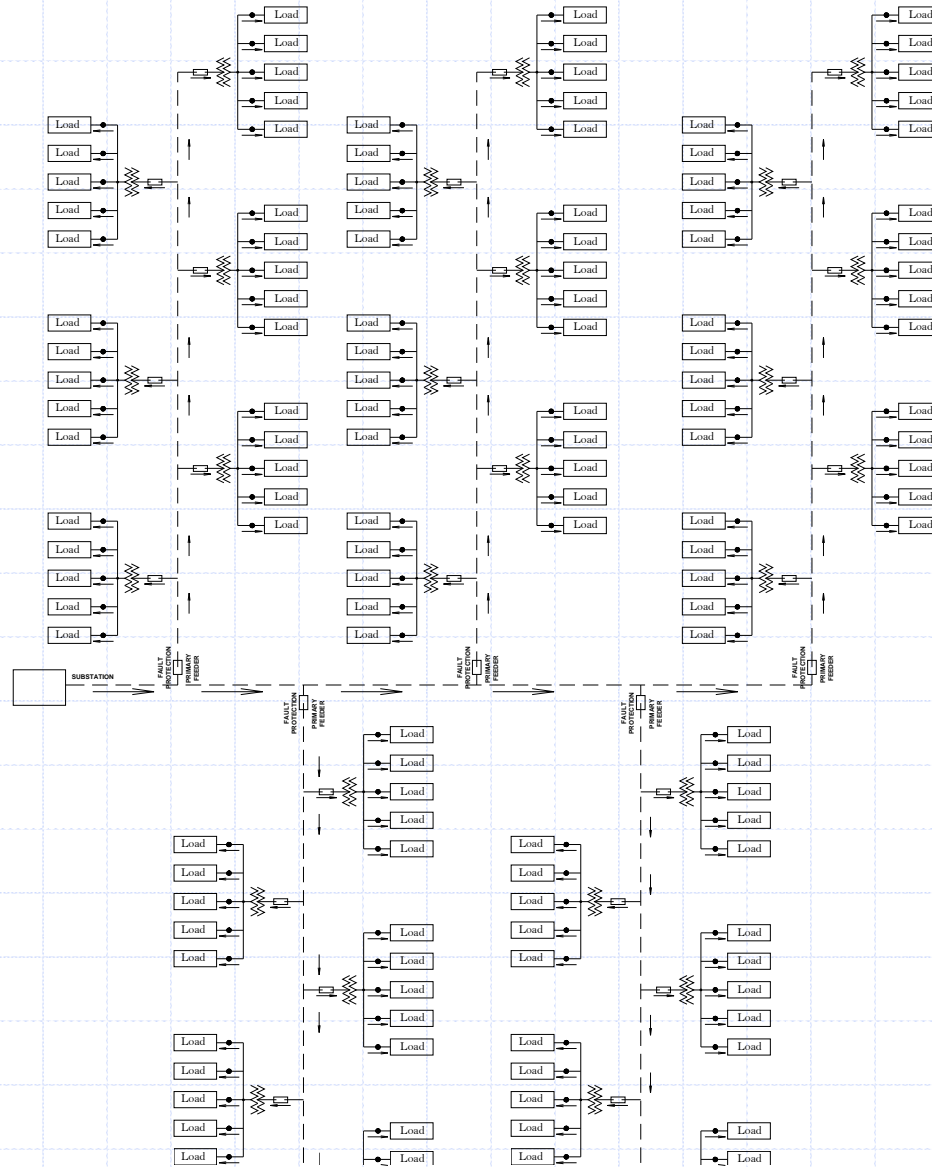


Topics

- ◆ "Secondary Network" Distribution System types:
 - Grid (Street or Area) Networks &
 - Spot Networks
 - Basics under Normal operating
- ◆ Utility Concerns about DG Interconnection
- ◆ Sample solutions used by some utilities
- ◆ IEEE P1547.6 Working Group
- ◆ Massachusetts Technology Collaborative (MTC)
DG Collaborative
- ◆ Network Protector Enabled Generation (NPEG)
- ◆ Coordinated Multi-state R&D

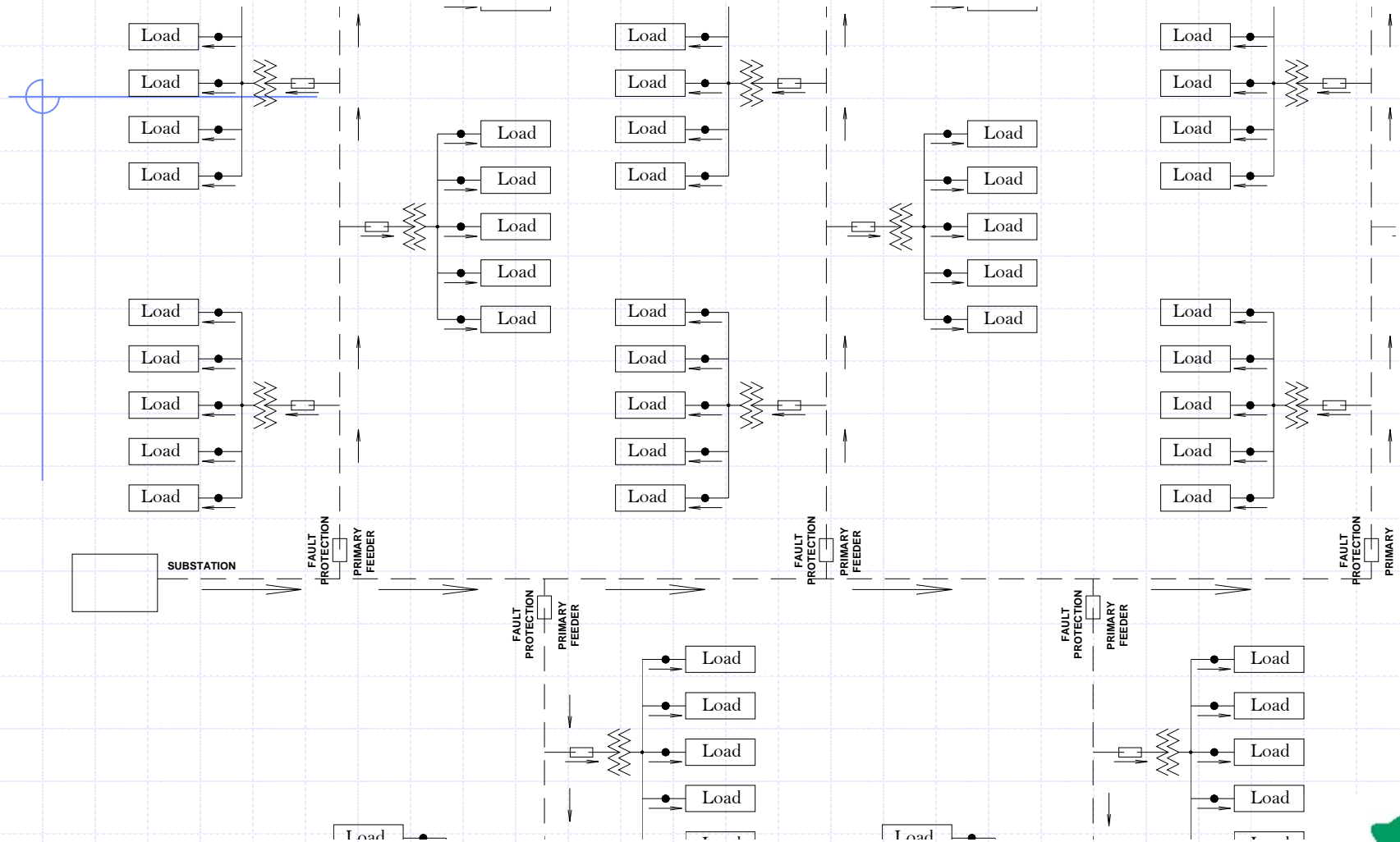


"Typical" Radial Distribution System



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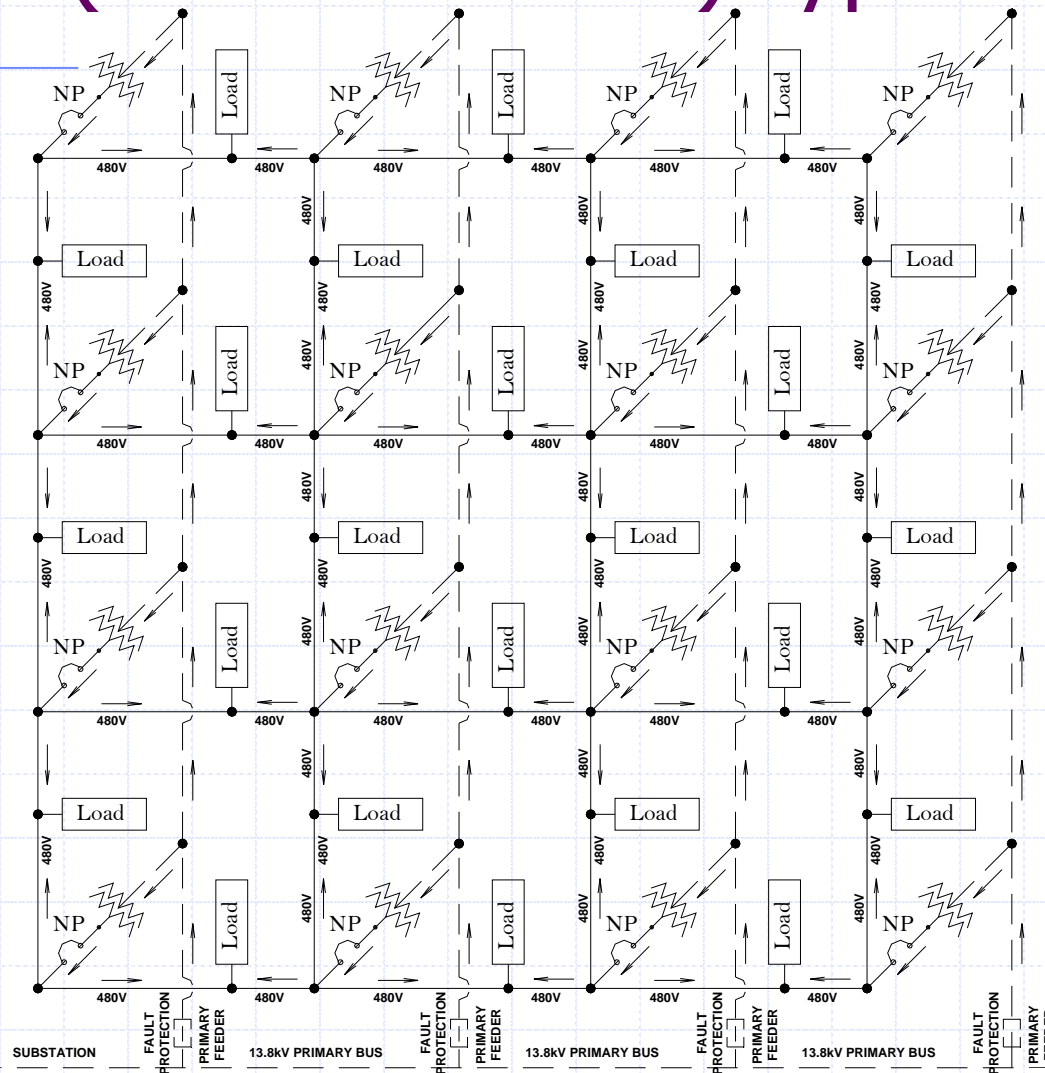
"Typical" Radial Distribution System



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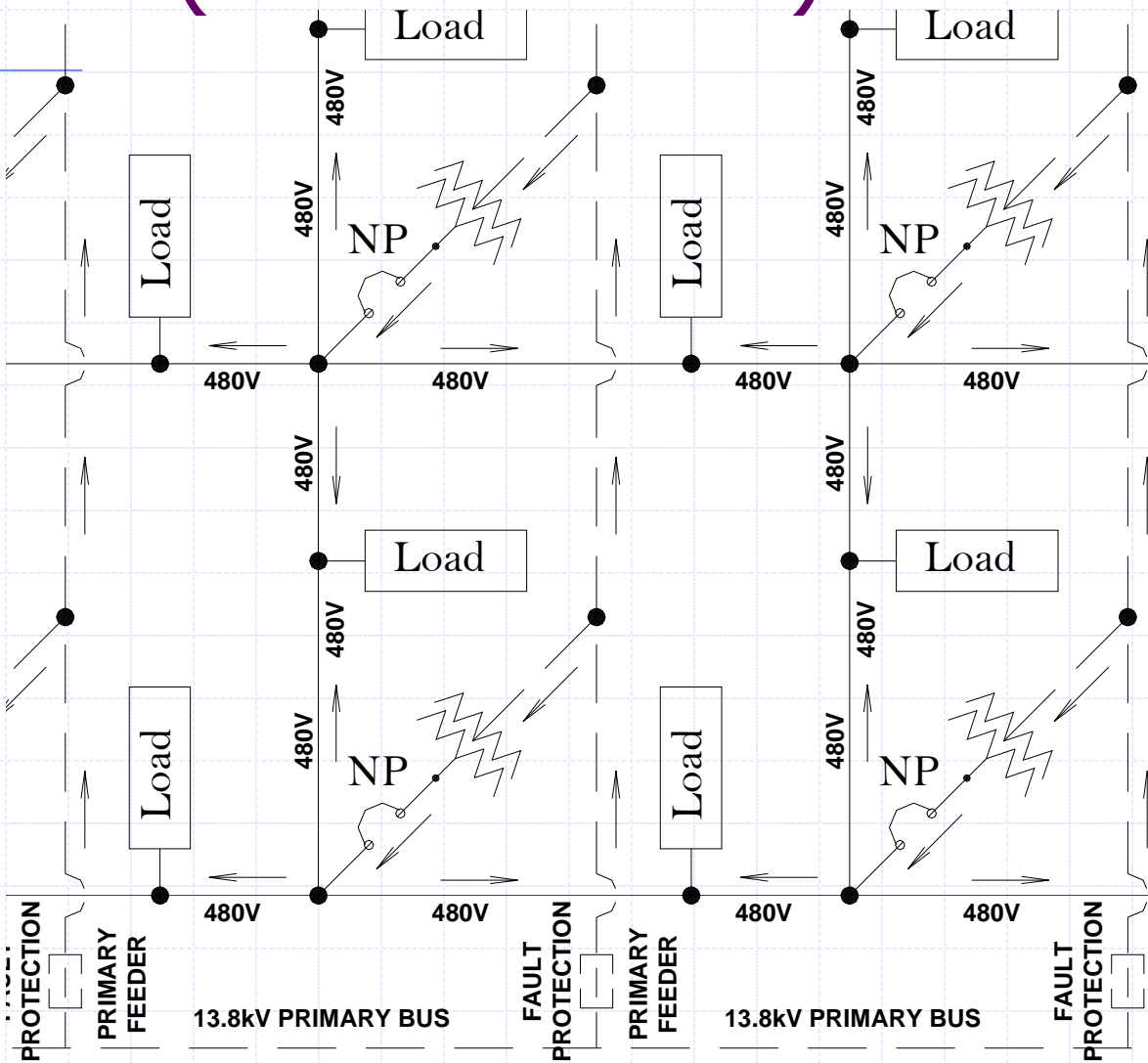
Secondary Distribution Systems: Grid (Street or Area) type Networks



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Secondary Distribution Systems: Grid (Street or Area) Networks

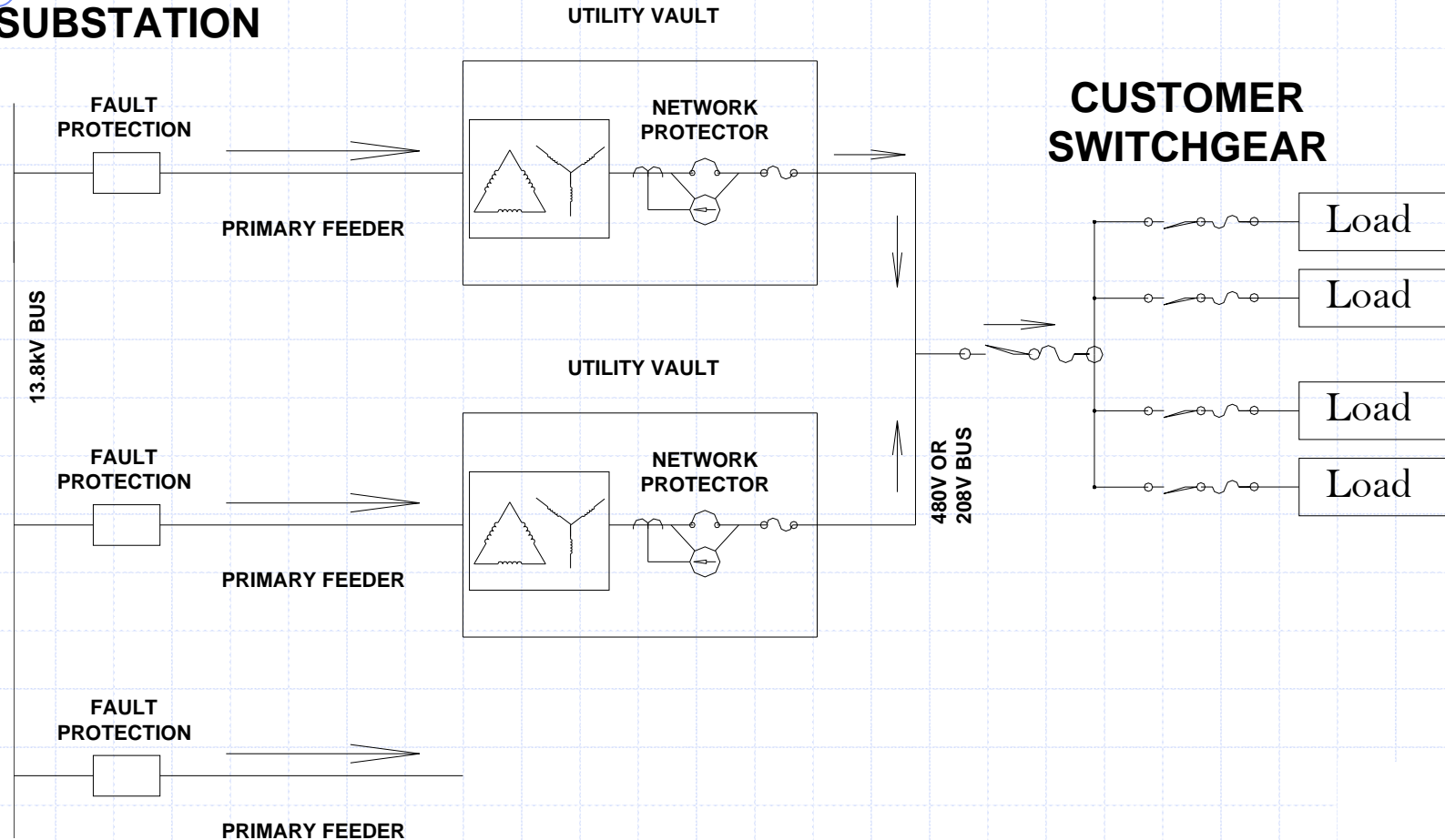


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Secondary Distribution Systems: Spot Networks Normal Operation

SUBSTATION

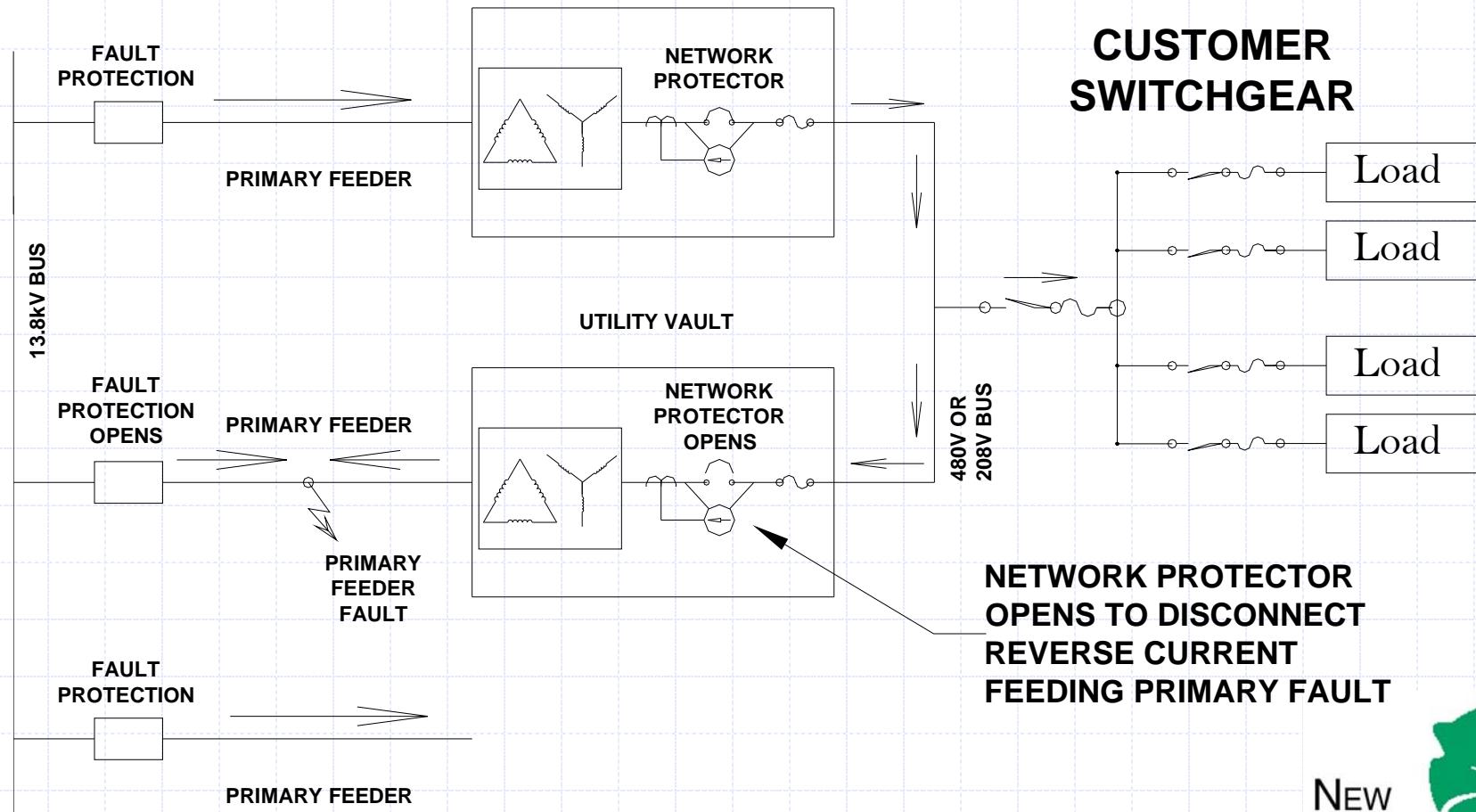


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Spot Networks Normal Response to Primary Feeder Fault

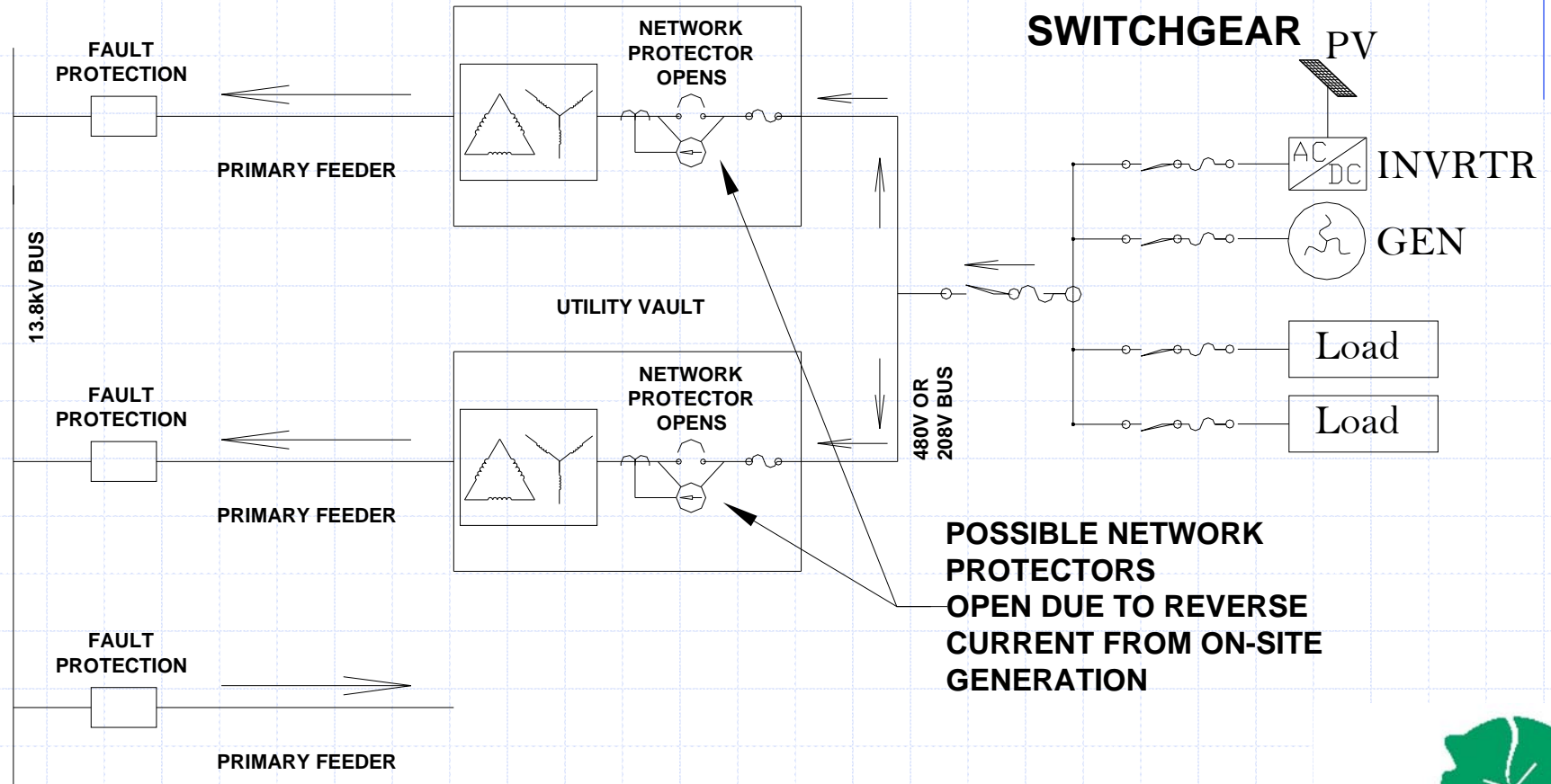
SUBSTATION



**NETWORK PROTECTOR
OPENS TO DISCONNECT
REVERSE CURRENT
FEEDING PRIMARY FAULT**

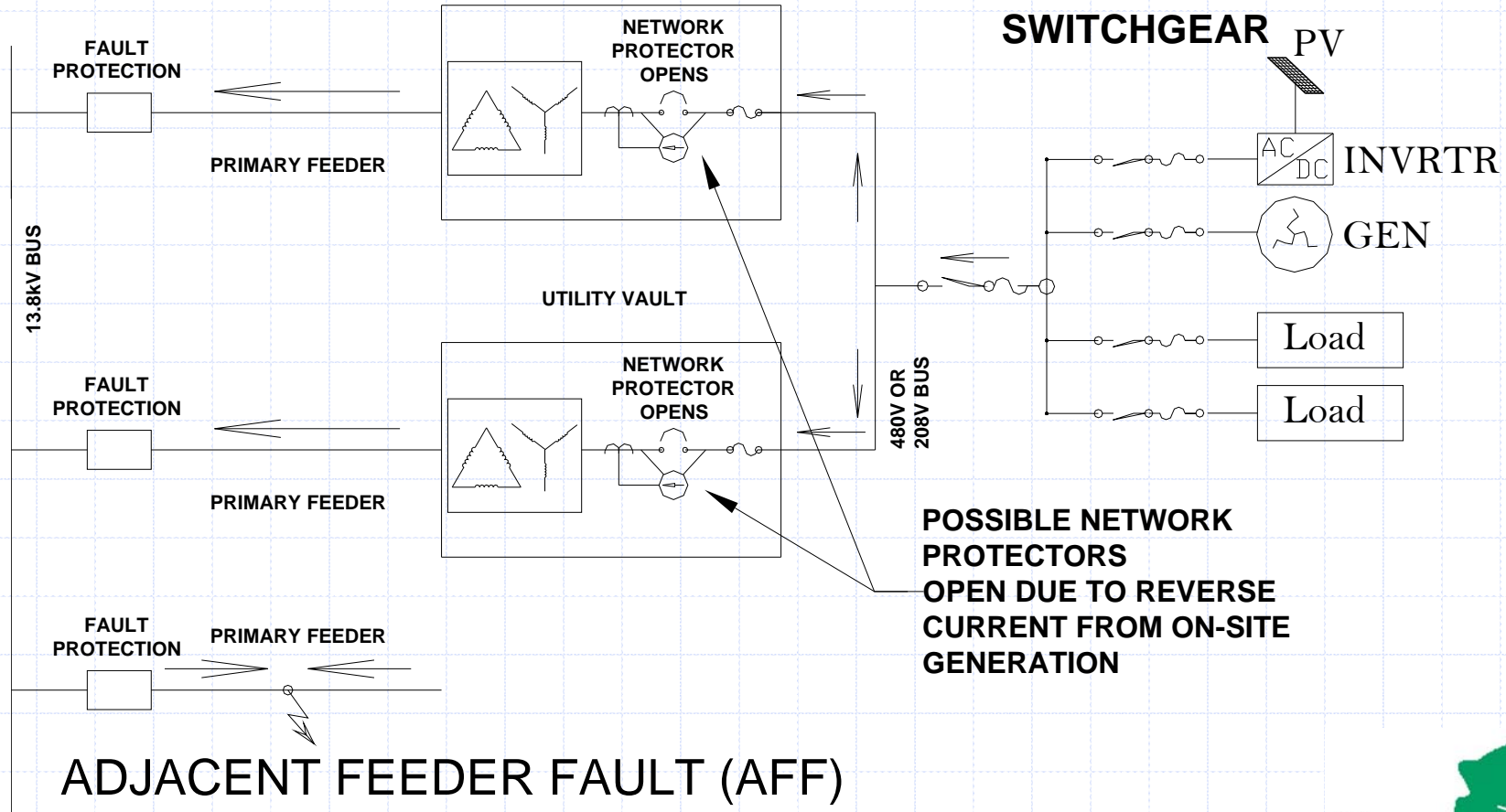
Spot Network with Light Load & Potential for DG Backfeed

SUBSTATION



Spot Network DG Backfeed During Adjacent Feeder Fault (AFF)

SUBSTATION



Examples of Solutions Used

◆ To prevent unnecessary Network loss due to load reduction by DG:

- Restrict DG to small % of minimum load
- Trip DG if # of closed NPs \leq 50% Total NPs
- Require Protective (reverse power) Relays

◆ To prevent unnecessary Network loss due to AFF:

- Add a time delay for low level backfeed

IEEE P1547.6 Working Group

- ◆ IEEE P1547.6: Recommended Practice For Interconnecting Distributed Resources With Electric Power Systems Distribution Secondary Networks

Massachusetts Technology Collaborative (MTC) DG Collaborative

◆ Objective:

- To advance acceptance of DG on Spot Networks through hardware development, without compromising the current high standard of safety and reliability on secondary distribution networks
- To seek operational consensus on both sides of the PCC

◆ Program Approach:

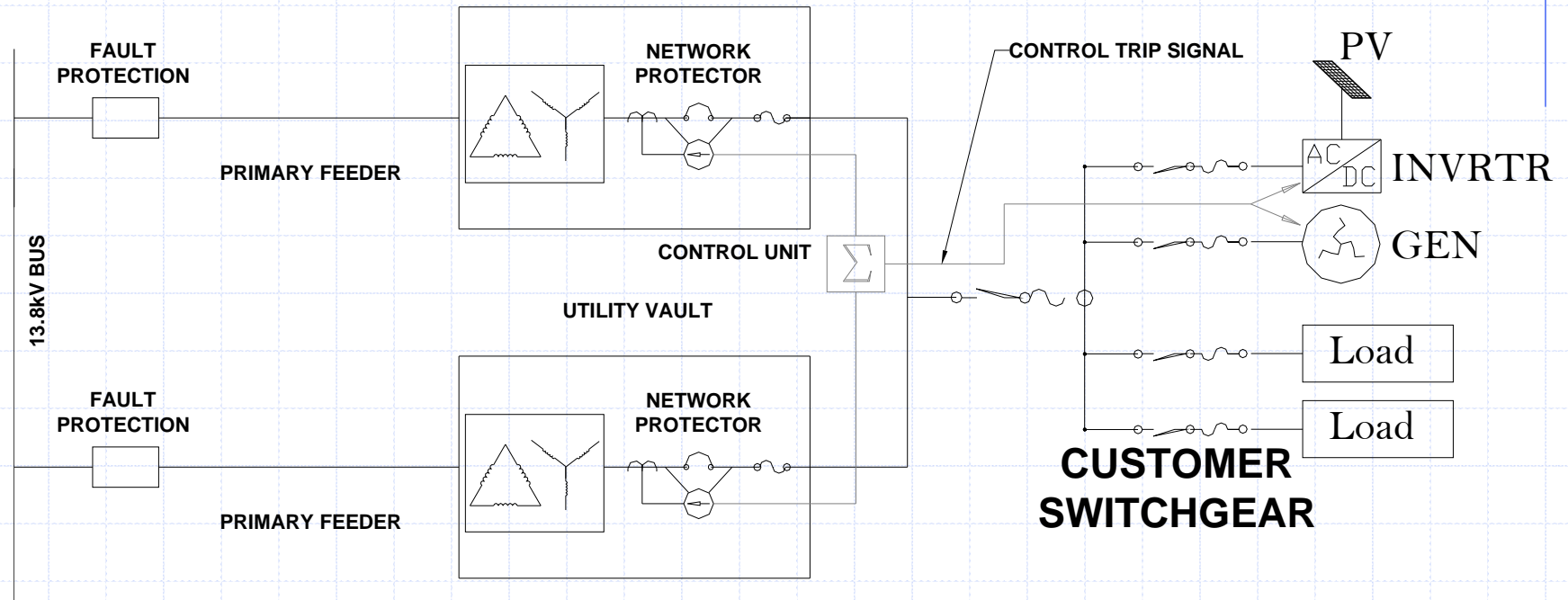
- Collaboratively funded R&D
- Operational guidance from utilities, NP & DG manufacturers
- Prototype development and testing

◆ Technical Concept:

- Provide directional power sensing at the NP
- Provide control of customer-sited DG by the utility NP across the PCC

Network Protector Enabled Generation (NPEG) Concept

SUBSTATION



MTC study: Generation Monitoring and Modeling of Feeder Fault Cases

◆ GSA Williams Building study (5/05):

- Two year study of two DG systems on Boston 2-transformer Spot network (May 2003 - Feb. 2005)
- [Technical report available](#) (see references)
- Unprecedented monitoring detail:
 - ◆ Single cycle resolution
 - ◆ 3.4M records per day
 - ◆ 54 captured events in two years
- “Prototype” demonstration of NEPG

Coordinated Multi-State R&D

- ◆ California
- ◆ Massachusetts
- ◆ New York

References:

◆ Feero 5/05:

- http://www.masstech.org/renewableenergy/public_policy/DG/resources/Collab_2005Collab05_05_31_FeeroNetworkReport.doc

◆ MA DG Collaborative 6/06:

- http://www.masstech.org/DG/02-38-C_Attachment-F_Network_RFP.pdf

◆ Presentations to IEEE 1547.6 meetings:

- [August 3, 2006 -- Bill Feero](#)
- [February 1, 2007 -- Jim Bing](#)

◆ Bing 2/07: Latest Summary

- <http://masstech.org/dg/2007-02-20-DENP-NEO-draft.pdf>

◆ Website:

- www.masstech.org/dg/interconnect/network-rfp.htm

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