

NPEG

Network Protector Enabled Generation

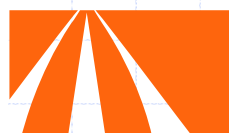
Presented to the
**California Alliance for
Distributed Energy Resources**

10th Anniversary Symposium
January 31, 2008

by:

James M. Bing, PE
President
New Energy Options, Inc.
410 Great Road, B-6
Littleton, MA 01460

jbing@newenergyoptions.com



MASSACHUSETTS
TECHNOLOGY
COLLABORATIVE

RENEWABLE ENERGY TRUST



Topics



- ◆ IEEE 1547 & P1547.6 Working Group
- ◆ Massachusetts Initiatives: Mass Tech Collaborative (MTC) DG Collaborative
- ◆ Importance to State, Rate Payer, Environmental, Utility & DG communities
- ◆ "Secondary Network" Distribution System Basics:
 - Grid (Street or Area) Networks
 - Spot Networks
- ◆ Interconnections: Utility Concerns/DG Concerns
- ◆ Sample solutions used by some utilities
- ◆ Network Protector Enabled Generation (NPEG)



IEEE 1547 4.1.4: DG on Secondary Networks

- ◆ IEEE 1547 4.1.4.1 Leaves Grid Networks for future revisions of 1547
- ◆ IEEE 1547 4.1.4.2 Provides basic requirements for DG on Spot Networks
- ◆ IEEE P1547.6 ("P" for proposed: currently under development) Recommended Practice For Interconnecting Distributed Resources With Electric Power Systems Distribution Secondary Networks

New Massachusetts DG Context



◆ "The Massachusetts Executive Office of Energy and Environmental Affairs is interested in advancing direct connection of distributed generation on secondary networks and supports the development of technical solutions that can make that happen."



Massachusetts Efforts to Date:



- ◆ DG Collaborative studied network issue in detail 2002-2006
- ◆ DG Collaborative commissioned work on NPEG approach:
 - ◆ masstech.org/dg/interconnect/network-rfp.htm
- ◆ Elicited guidance from utilities, NP & DG manufacturers on appropriate technologies (technologically agnostic)
- ◆ Interest in pilot deployments of DG on Spot Networks without compromising the current high standard of safety & reliability:
 - ◆ Funded Williams Building PV and CHP on spot network
 - ◆ Seeks potential future demonstrations of NPEG or other technologies



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

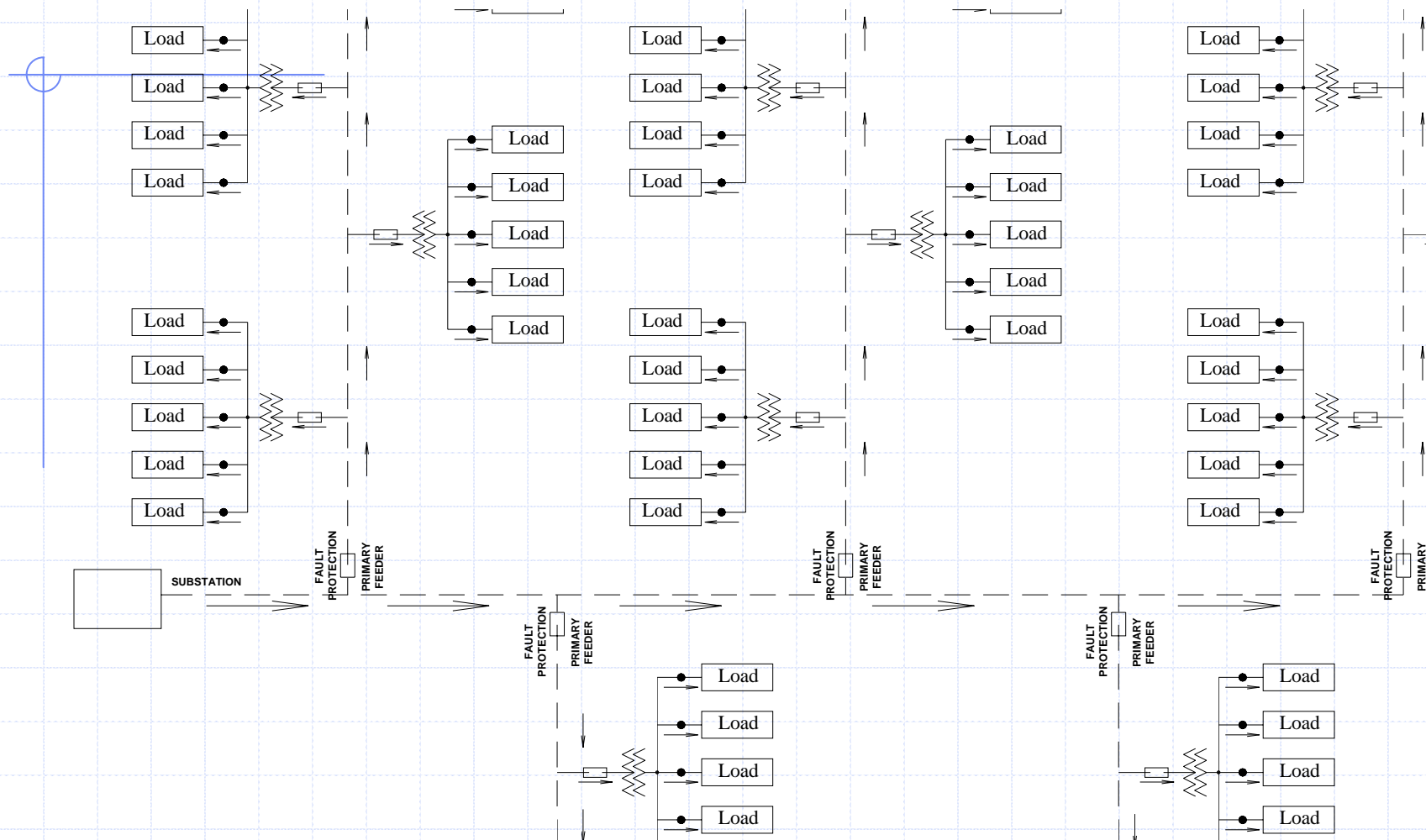
Importance of DG on Secondary Network Distribution Systems



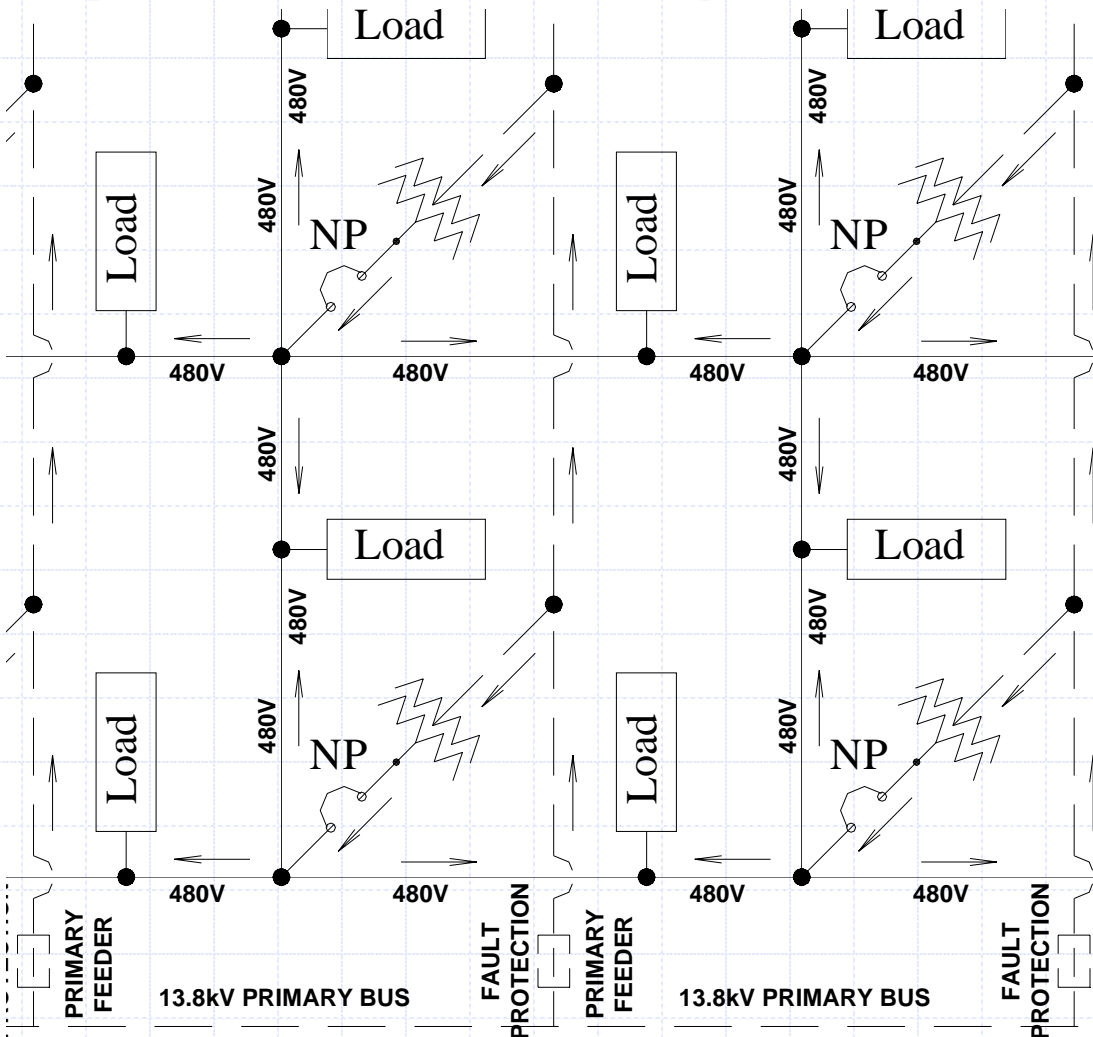
- ◆ States: new market-based policy tool for distribution planning & regulation
- ◆ Rate paying customers: new tool to managing energy costs
- ◆ Environmental: new opportunity & tool for carbon footprint reduction
- ◆ Utilities & Distcos: new load management and distribution planning tool
- ◆ DG manufacturers: new market opportunity



"Typical" Radial Distribution System



Secondary Distribution Systems: Grid (Street or Area) Networks



MASSACHUSETTS
TECHNOLOGY
COLLABORATIVE

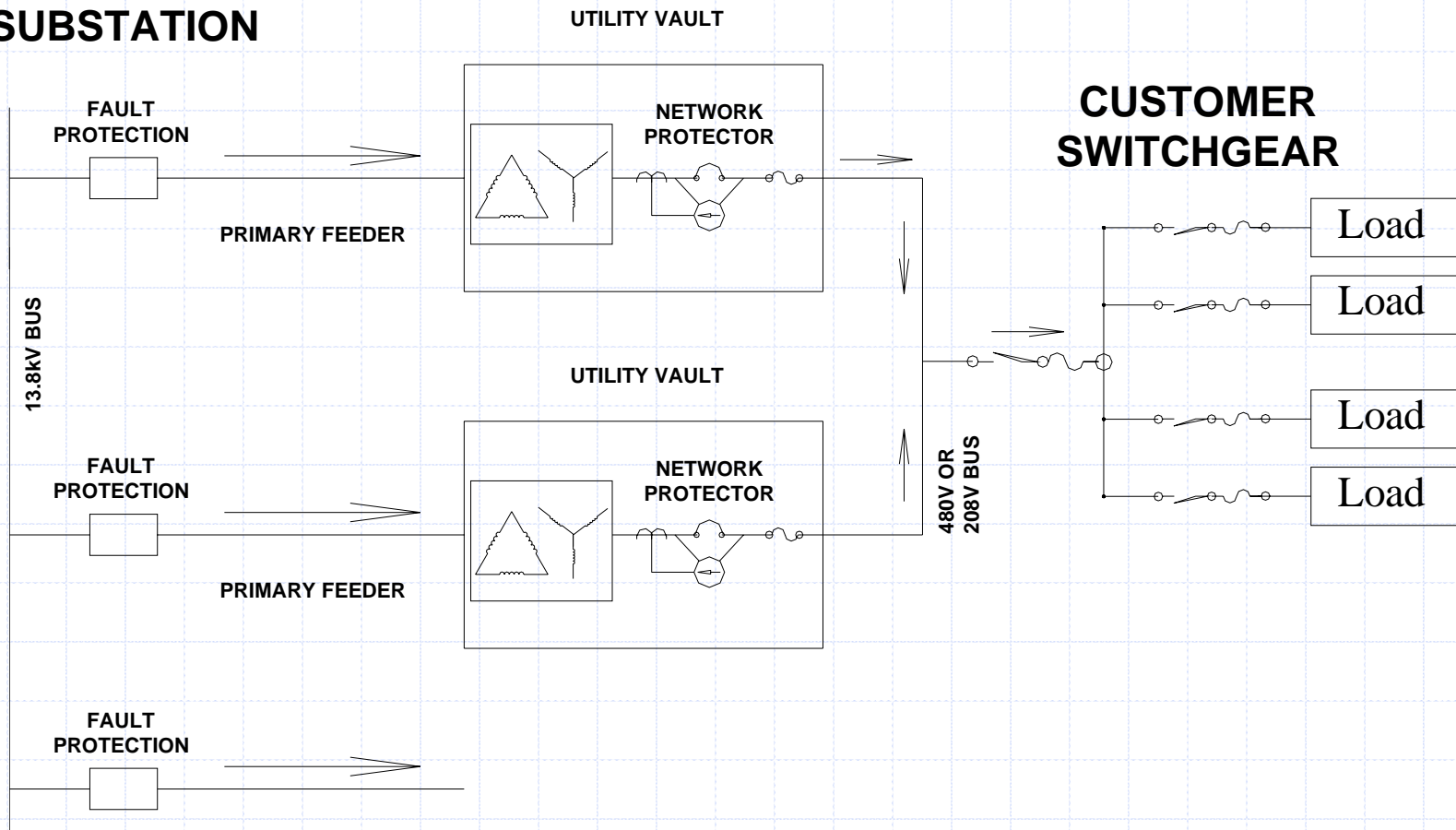
RENEWABLE ENERGY TRUST

CADER 2008
10th Anniversary Symposium



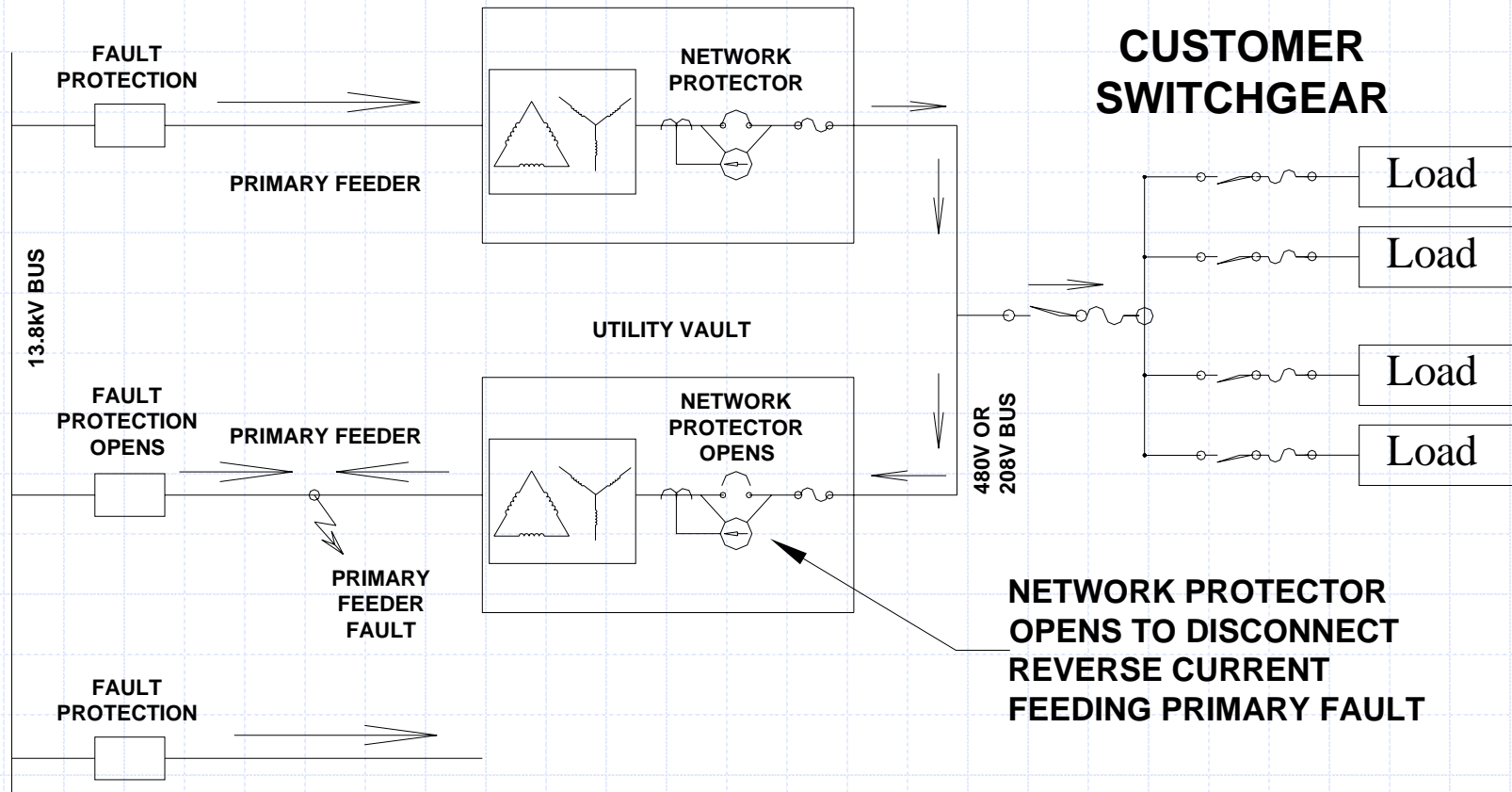
Secondary Distribution Systems: Spot Networks Normal Operation

SUBSTATION



Spot Networks Normal Response to Primary Feeder Fault

SUBSTATION

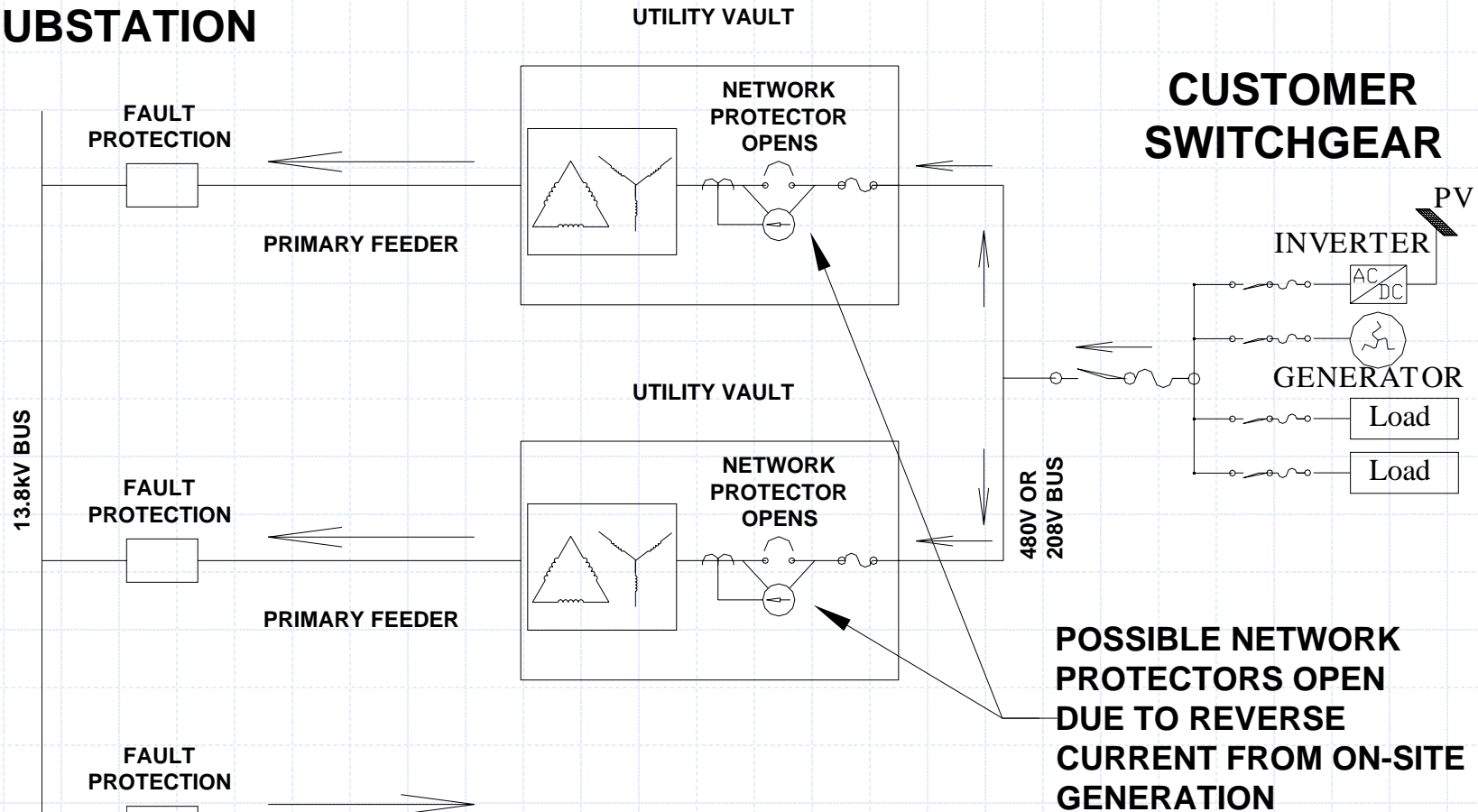


NETWORK PROTECTOR OPENS TO DISCONNECT REVERSE CURRENT FEEDING PRIMARY FAULT



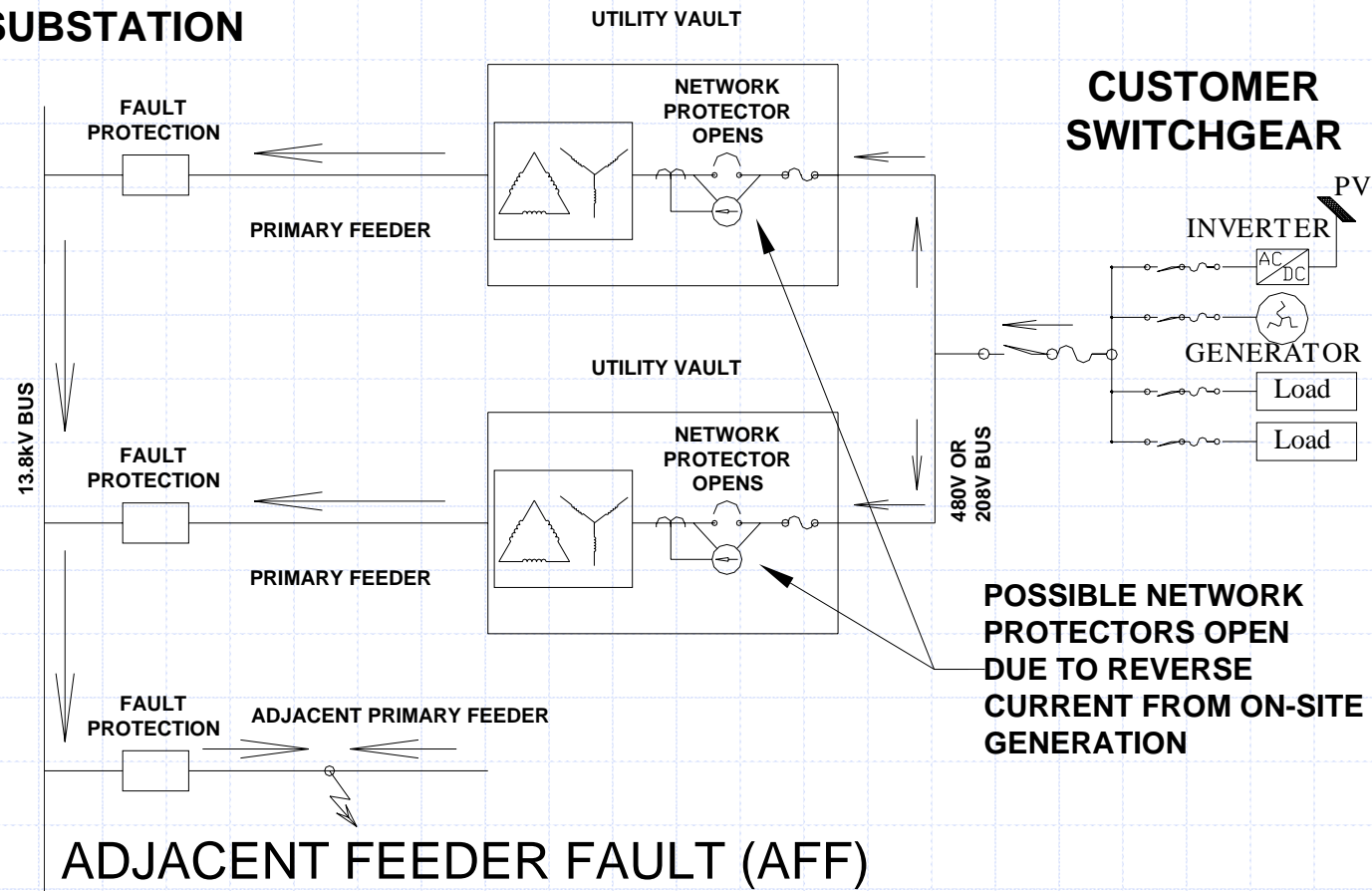
Spot Network with Light Load & Potential for DG Backfeed

SUBSTATION



Spot Network DG Backfeed During Adjacent Feeder Fault (AFF)

SUBSTATION



ADJACENT FEEDER FAULT (AFF)



Solutions Presently Used To Prevent Loss of Network Due to Contribution by DG

- ◆ Restrict DG to small % of minimum building load
- ◆ Trip DG if # of closed NPs \leq 50% Total NPs
- ◆ Require customer-owned protective (reverse power) relays
- ◆ Connect to nearest radial distribution line
- ◆ ATS isolated load (no parallel operation)

Network Protector Enabled Generation (NPEG)



◆ Technical Concept:

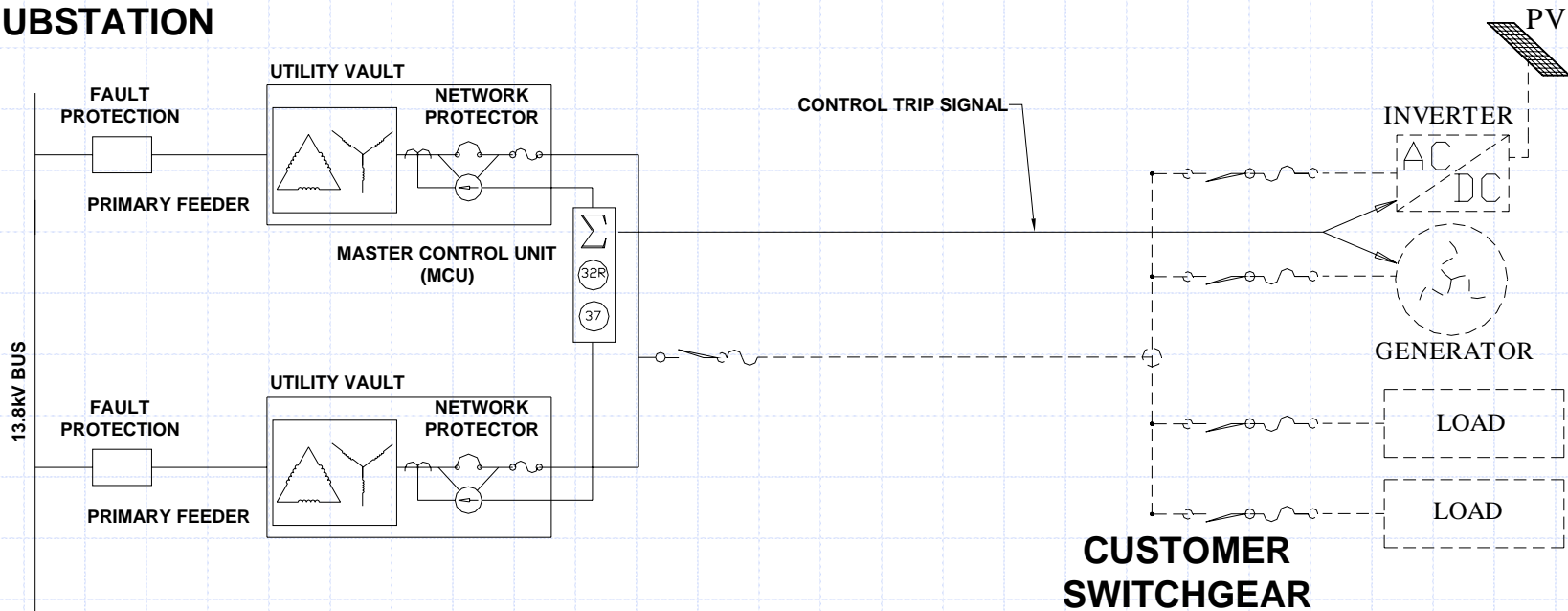
- Provides Operational Strategy
- Provides linkage with NP timing capabilities
- Provides sensing and monitoring at the NP:
 - ◆ Directional power: High and Low
 - ◆ Forward underpower
 - ◆ Closed NP sensing
- Provides control of customer-sited DG by the utility NP across the PCC
- Provides ownership and maintenance of monitoring and control equipment by the utility



Network Protector Enabled Generation (NPEG) Concept



SUBSTATION

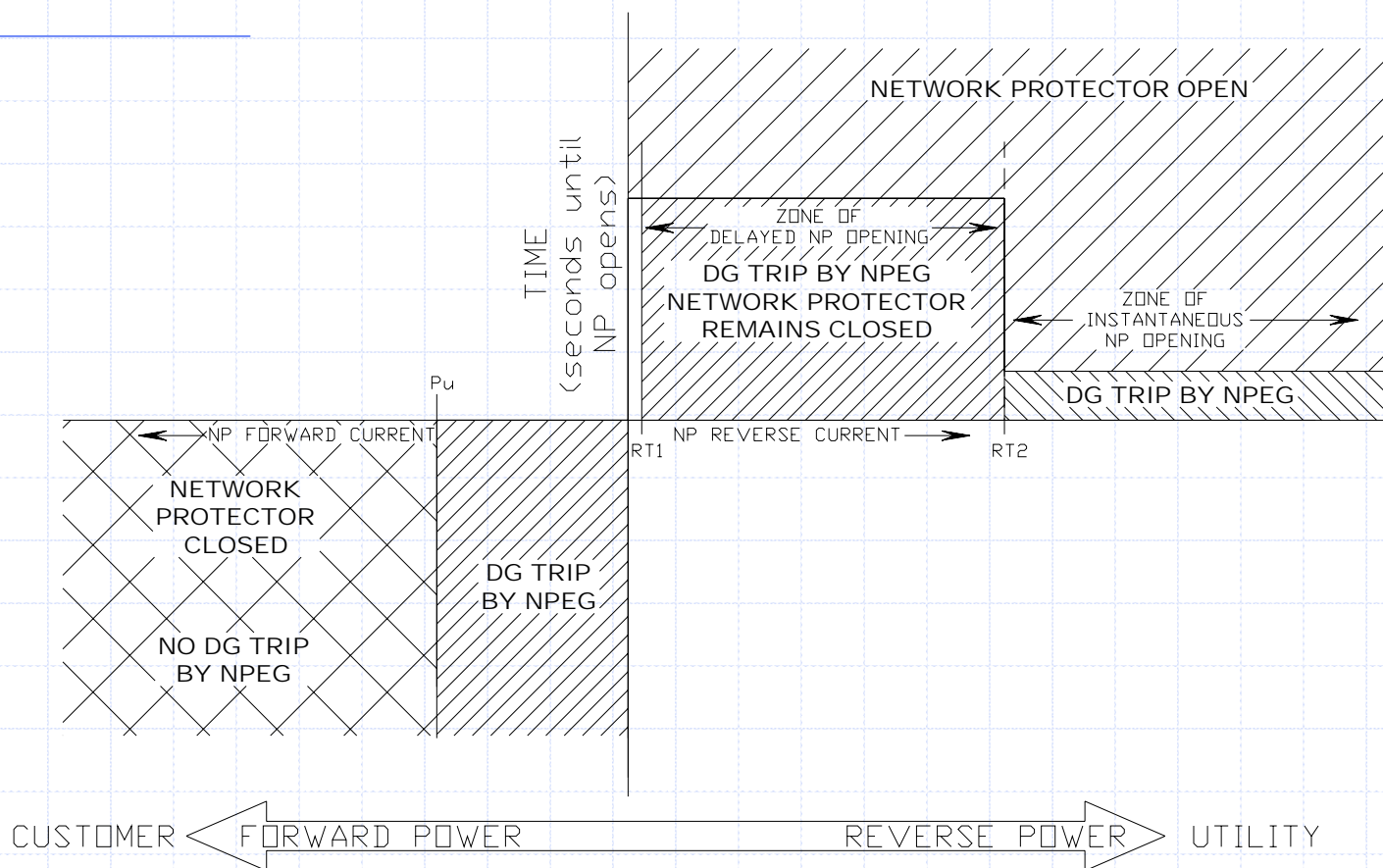


UTILITY OWNED & MAINTAINED: SOLID LINES

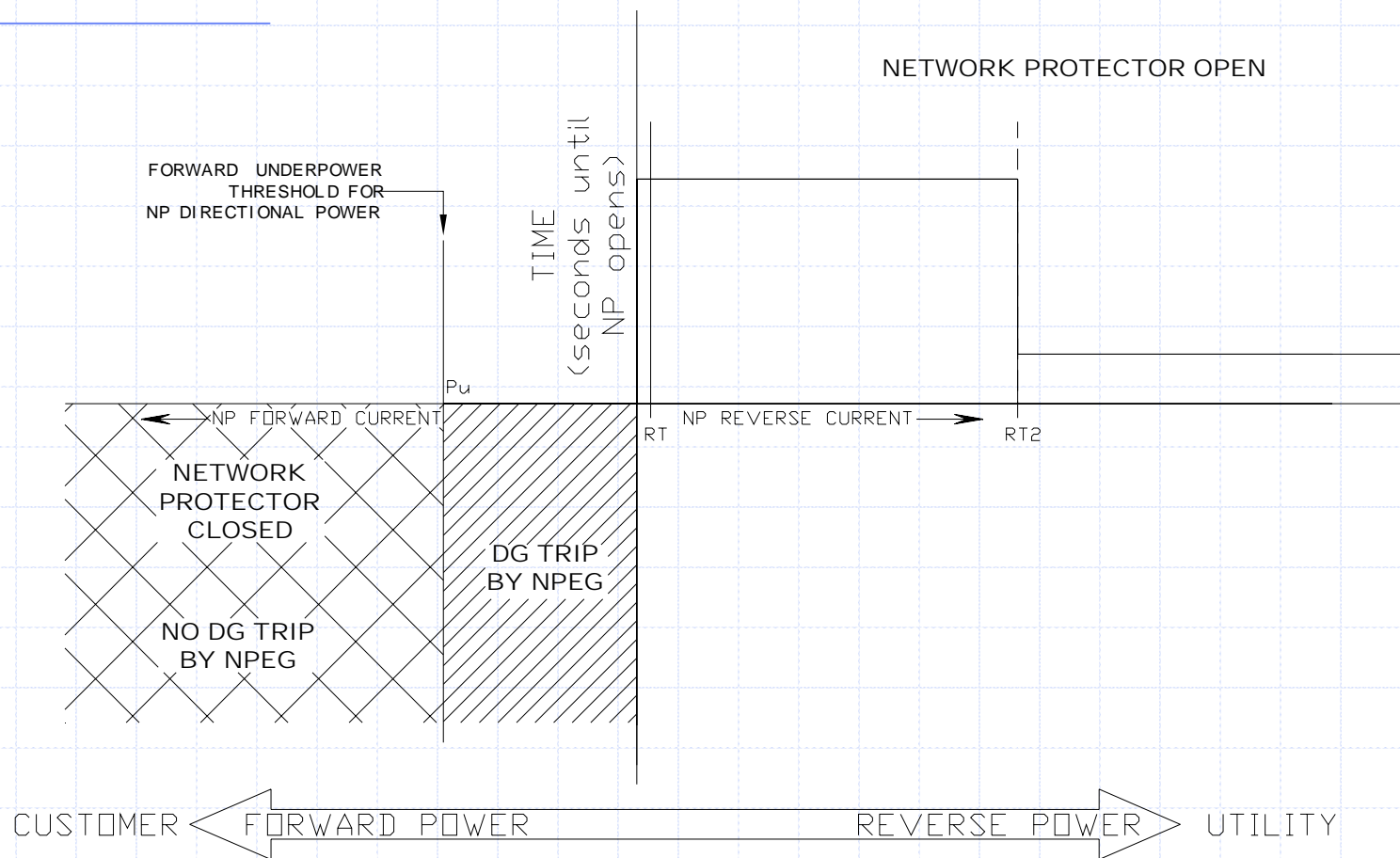
CUSTOMER OWNED & MAINTAINED: HIDDEN LINES



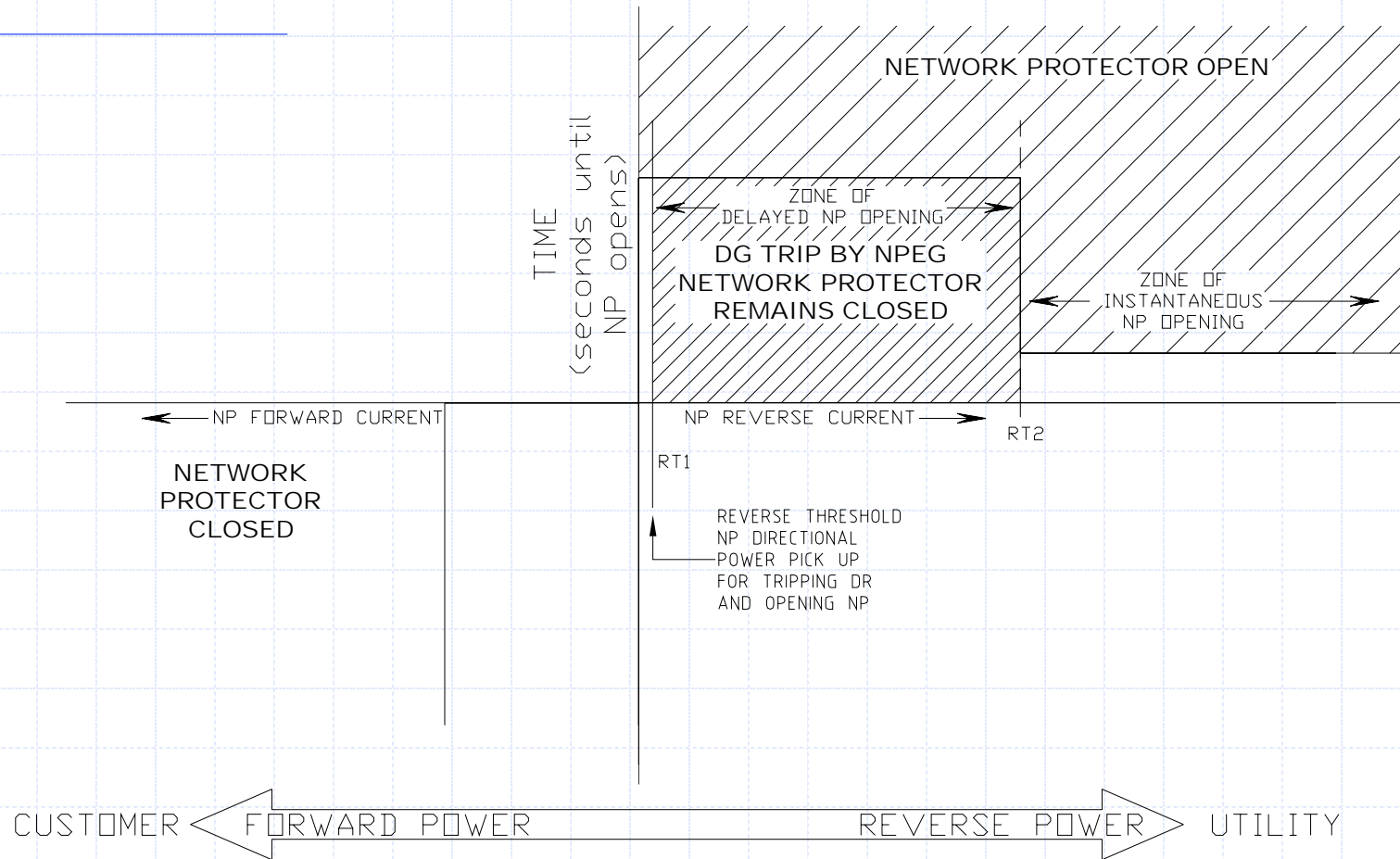
NPEG ZONES OF PROTECTION



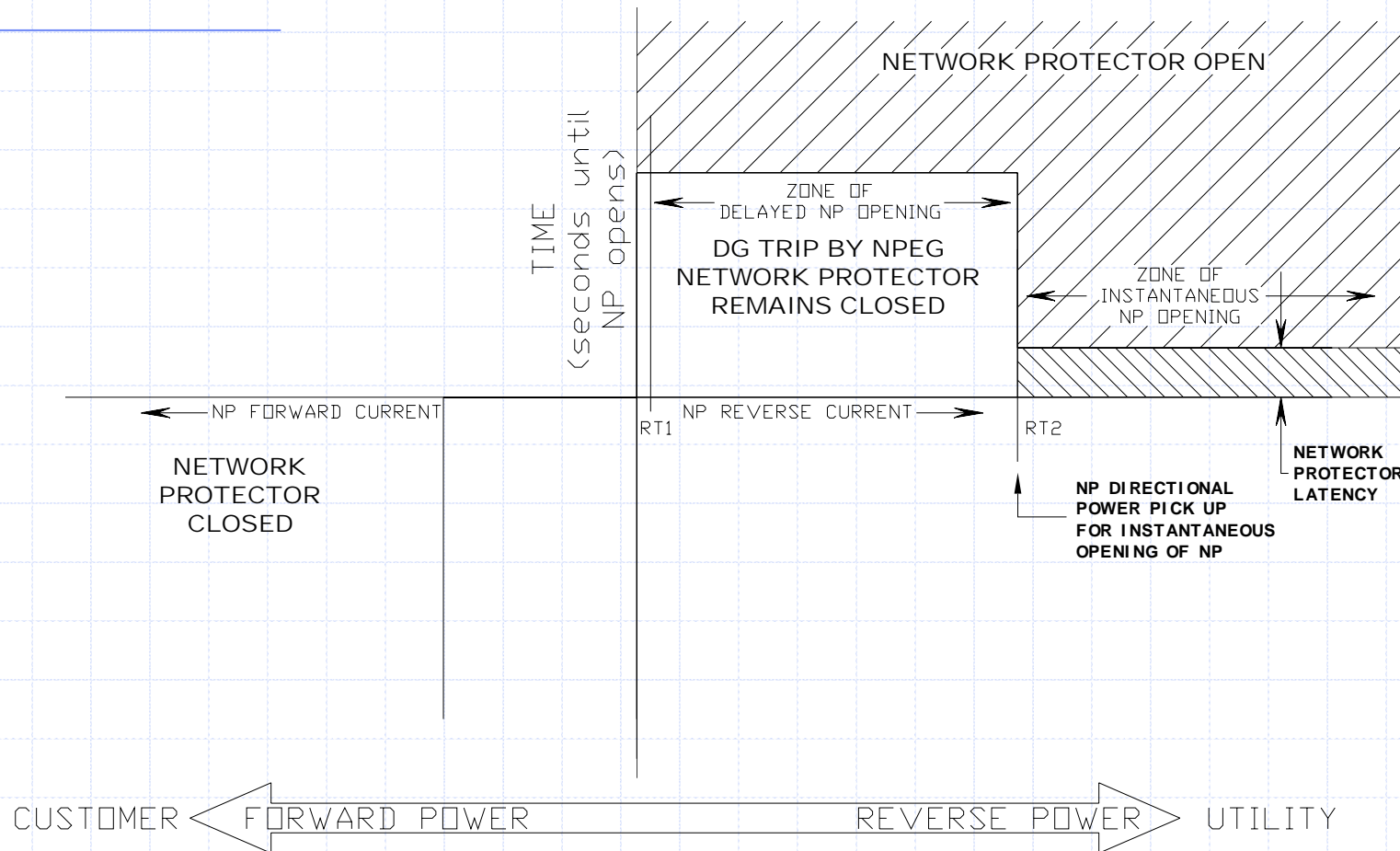
NPEG TRIPS DG ON FORWARD UNDERPOWER



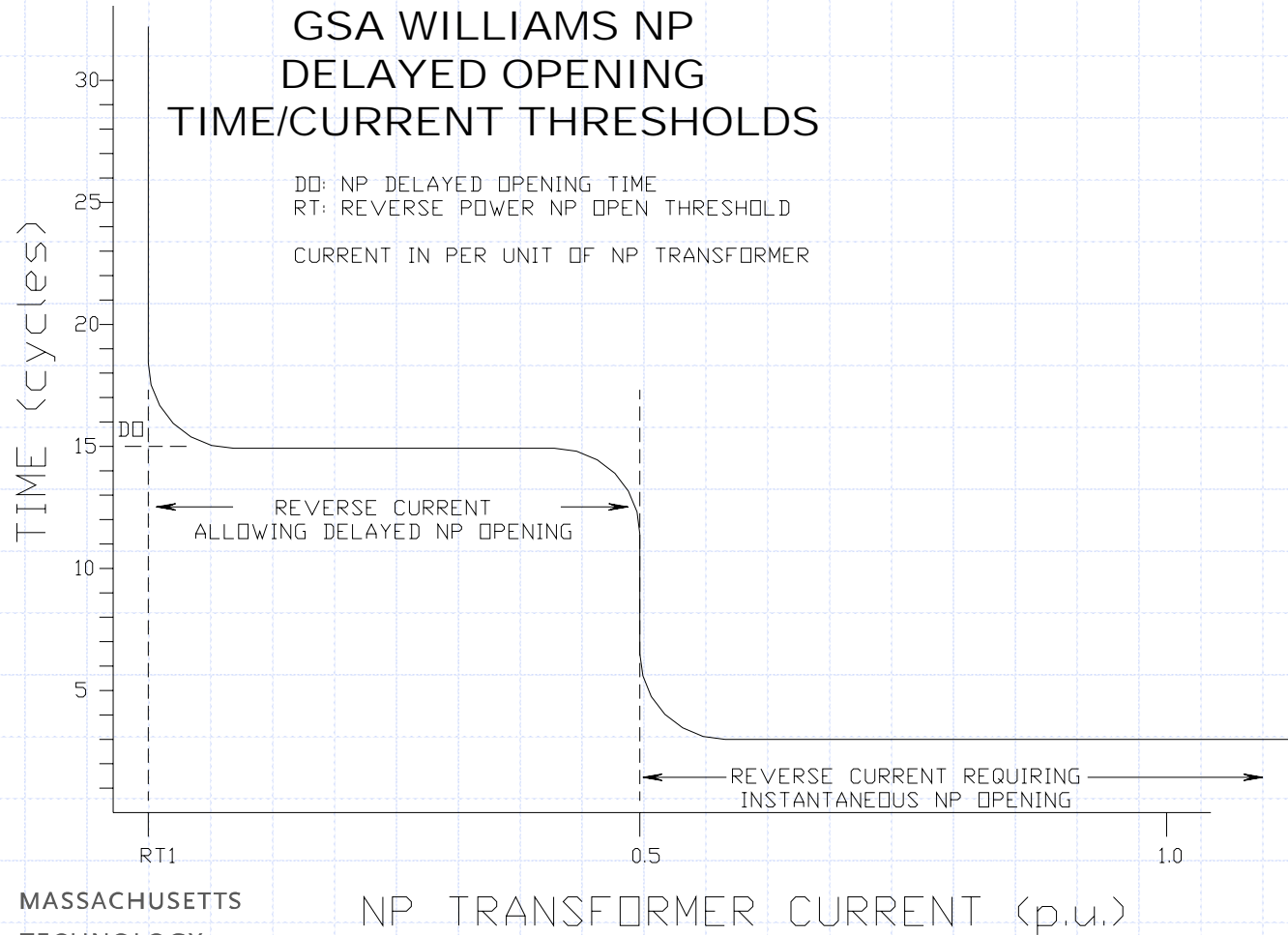
NPEG TRIPS DG FOR LOW REVERSE POWER NP REMAINS CLOSED



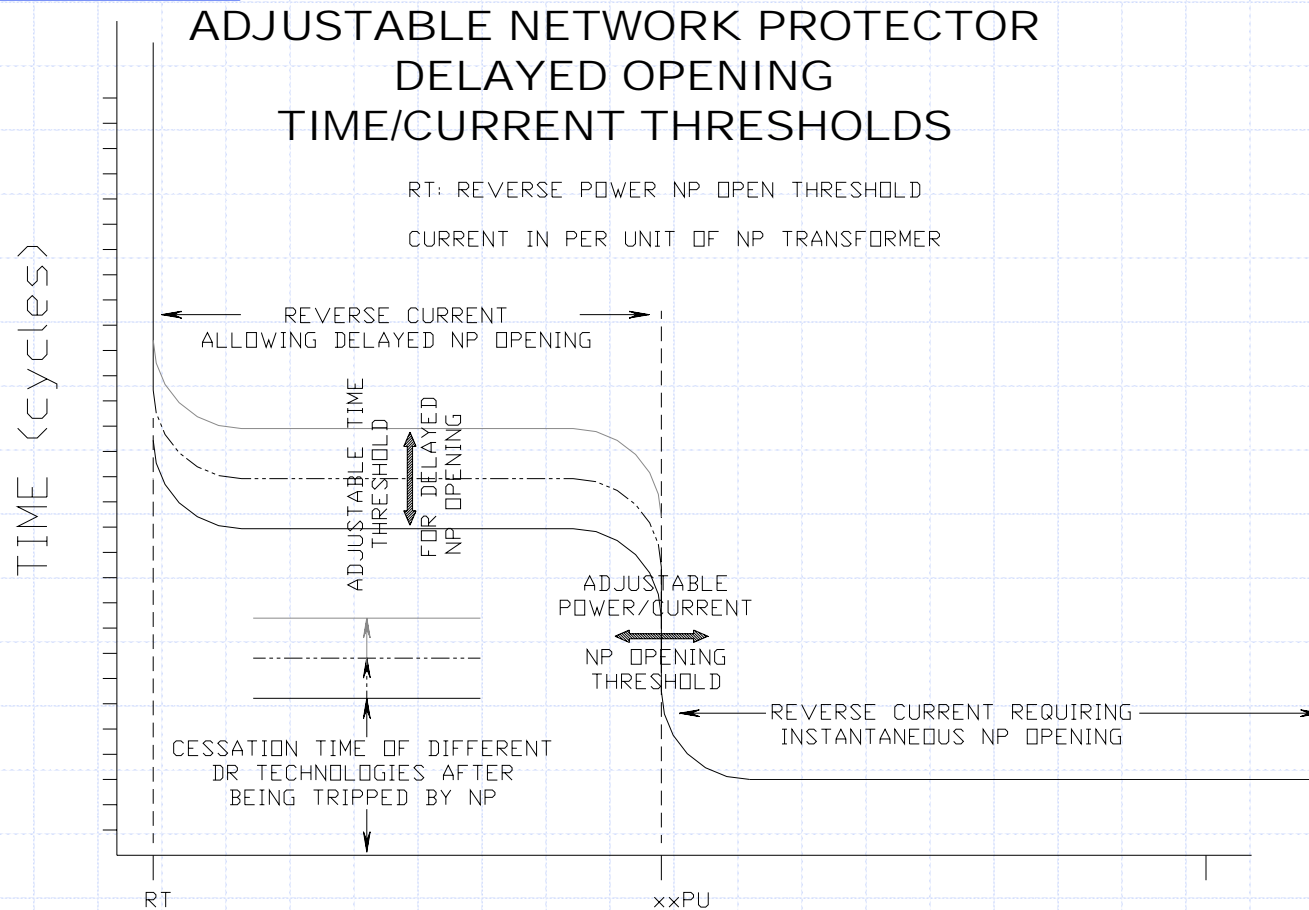
NPEG TRIPS DG FOR HIGH REVERSE POWER & NP OPENS INSTANTANEOUSLY



NPEG COORDINATION AT GSA WILLIAMS FEDERAL BUILDING



NPEG ADJUSTABLE TIME/CURRENT THRESHOLD CONCEPT



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



NPEG

Network Protector Enabled Generation

James M. Bing, PE
President

New Energy Options, Inc.
410 Great Road, B-6
Littleton, MA 01460

jbings@newenergyoptions.com



CADER 2008
10th Anniversary Symposium

