

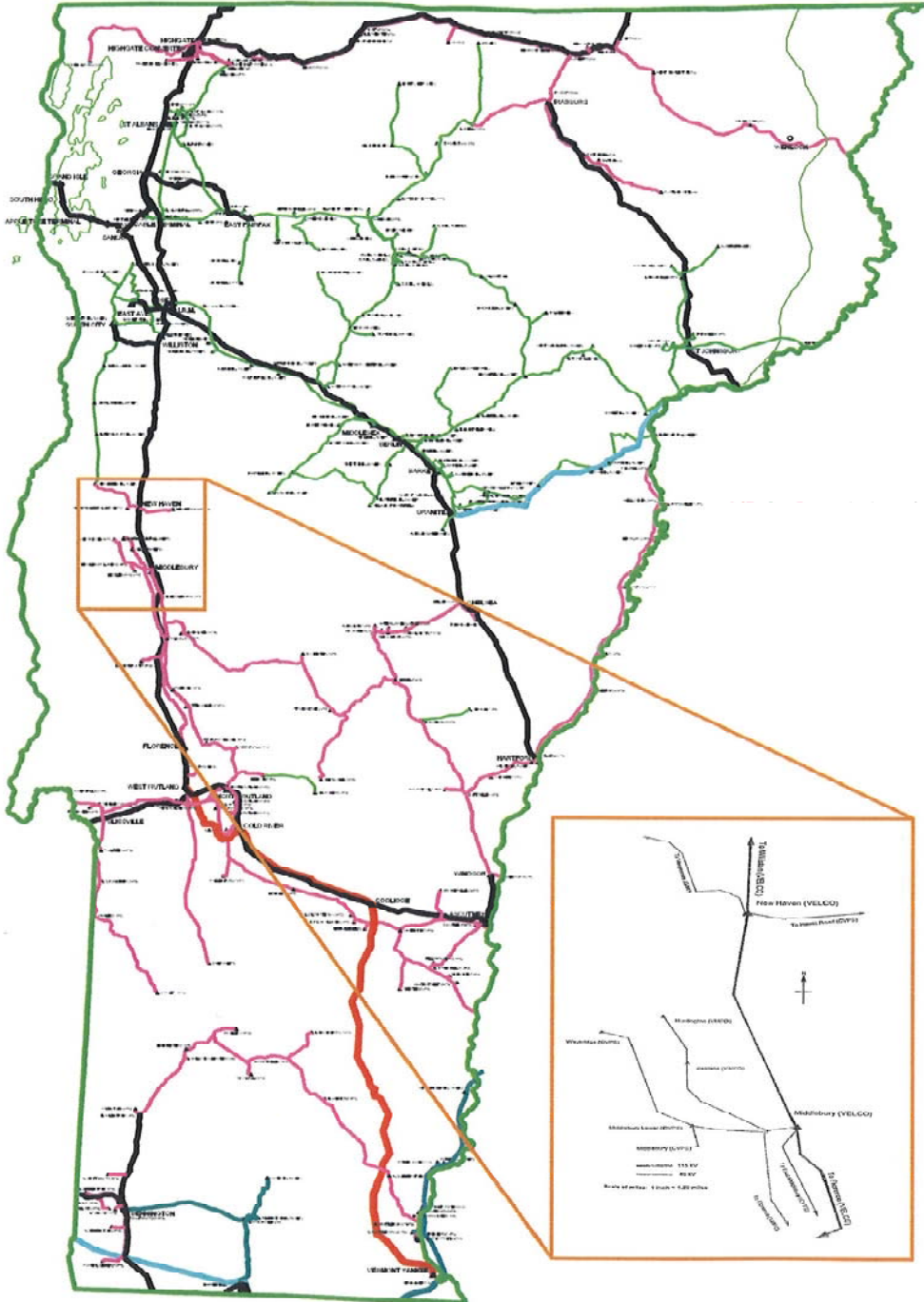


Presentation to the VSPC General  
Committee regarding the proposed  
CVPS Middlebury / New Haven  
Reliability Project

September 10, 2008

# Project Area

(existing system in detailed view)

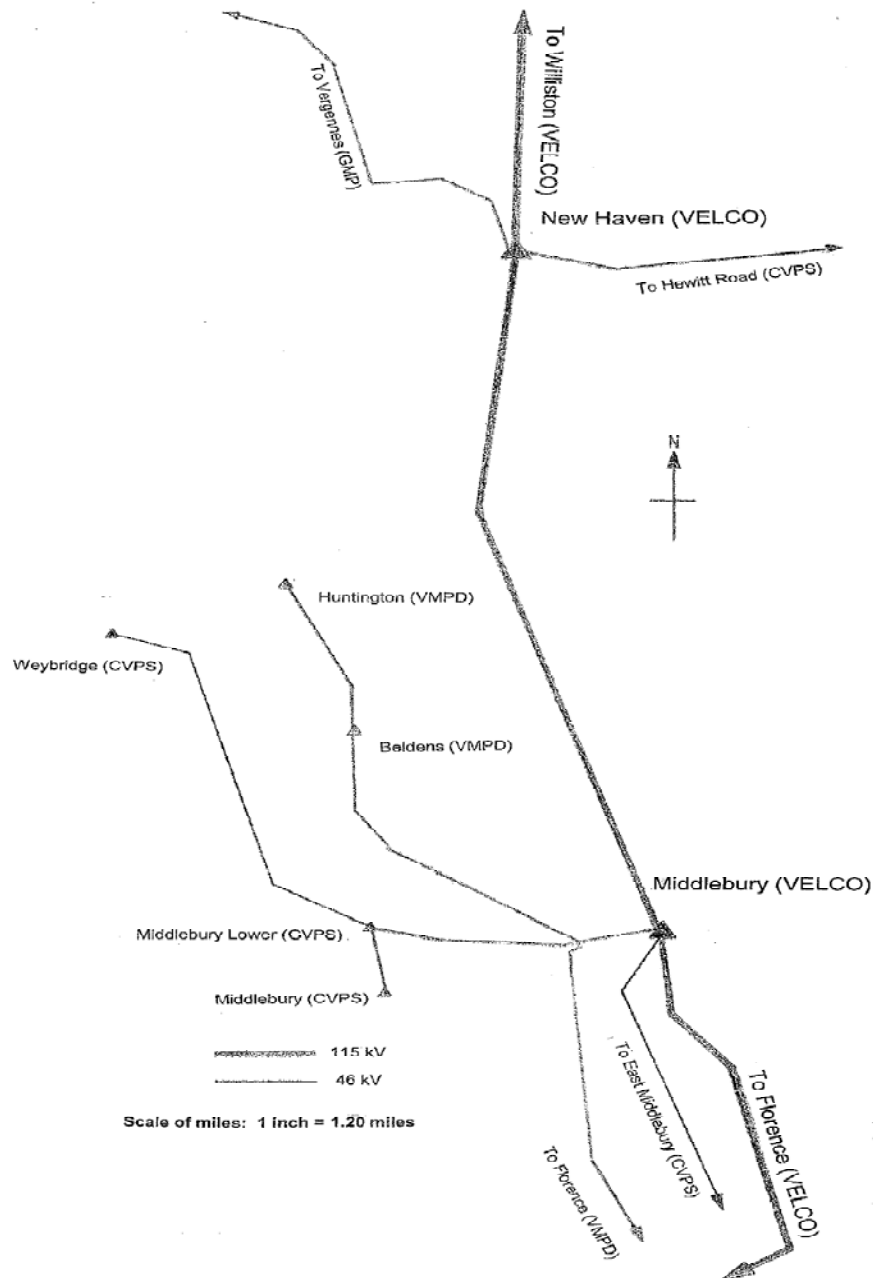


# Problem 1

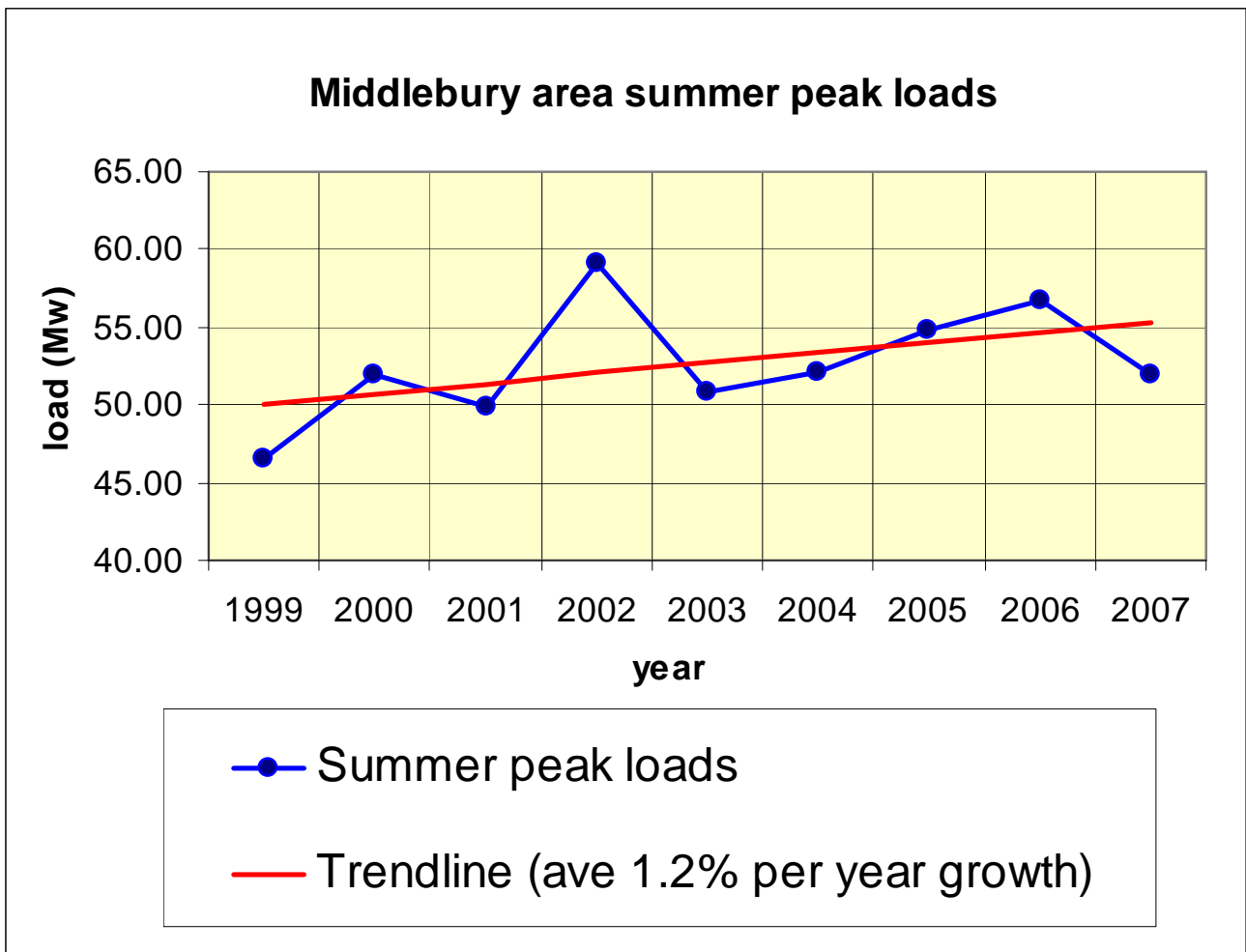
22 Mw in this area are served by radial 46 kV lines with no redundancy or backup.

# Problem 2

Loss of VELCO's 115/46 kV Middlebury or New Haven transformers, although not radial, will often cause severe undervoltage for CV customers.



Growing area load (averaging 1.2% annually) will exacerbate both problems over time



Distributed resources cannot save the day (at least not economically), but new transmission facilities can!

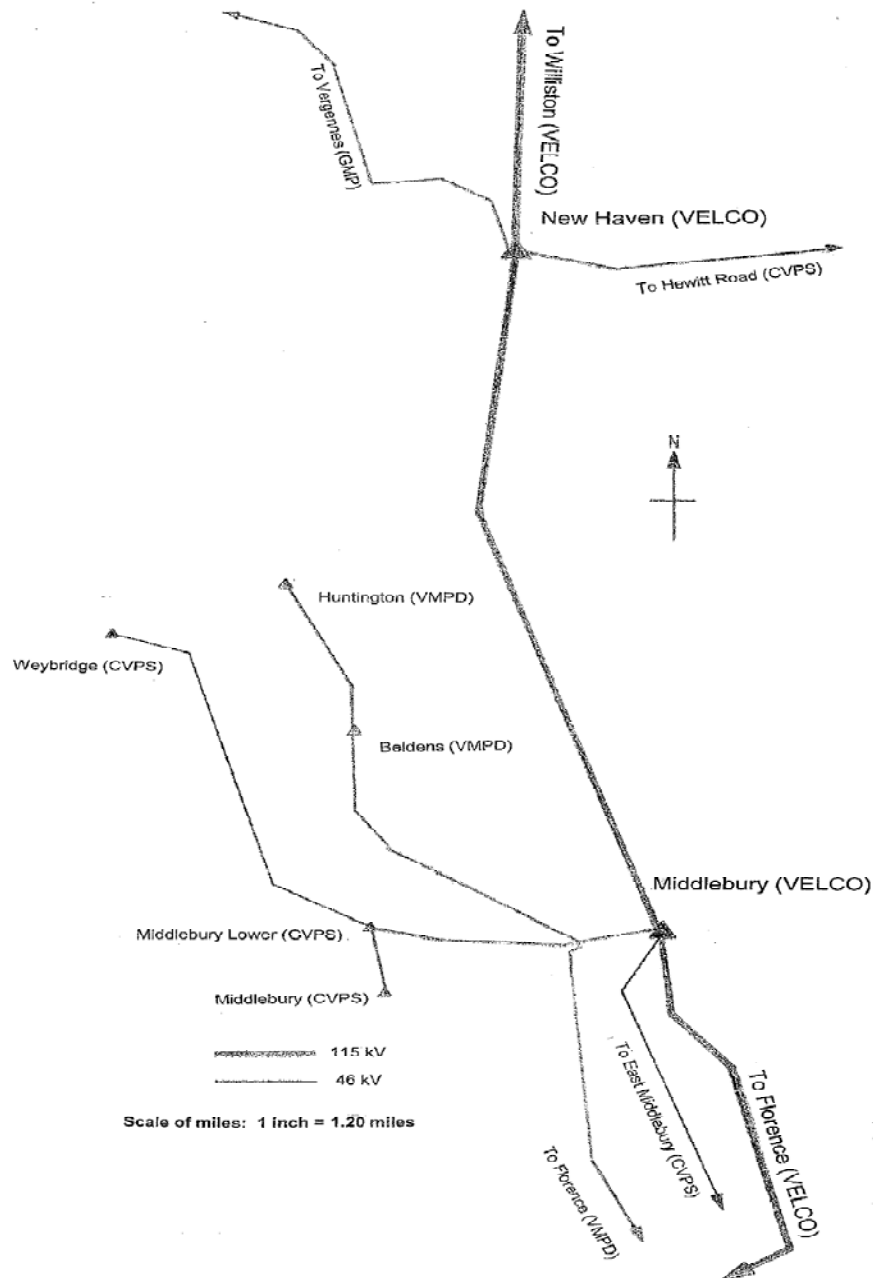


# Problem 1

22 Mw in this area are served by radial 46 kV lines with no redundancy or backup.

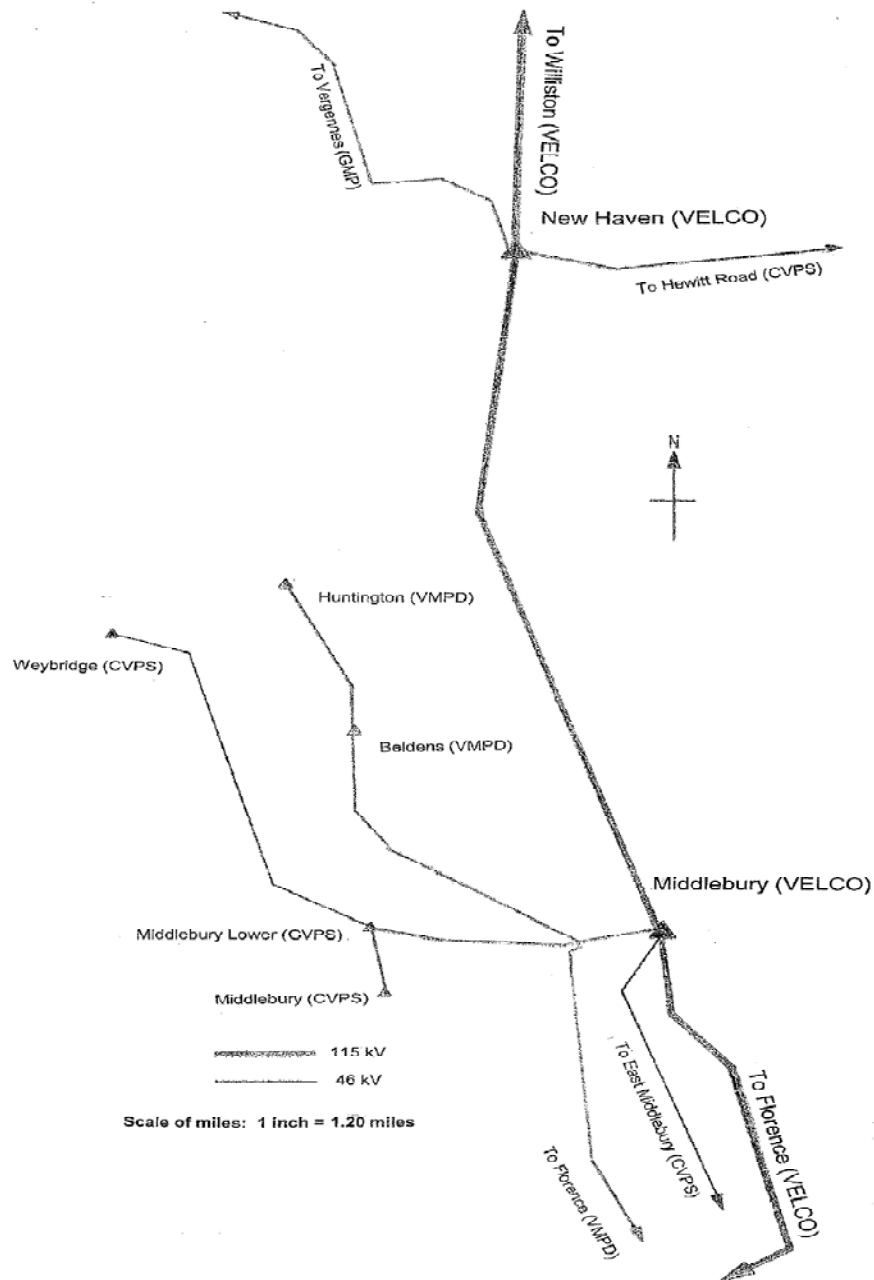
# Problem 2

Loss of VELCO's 115/46 kV Middlebury or New Haven transformers, although not radial, will often cause severe undervoltage for CV customers



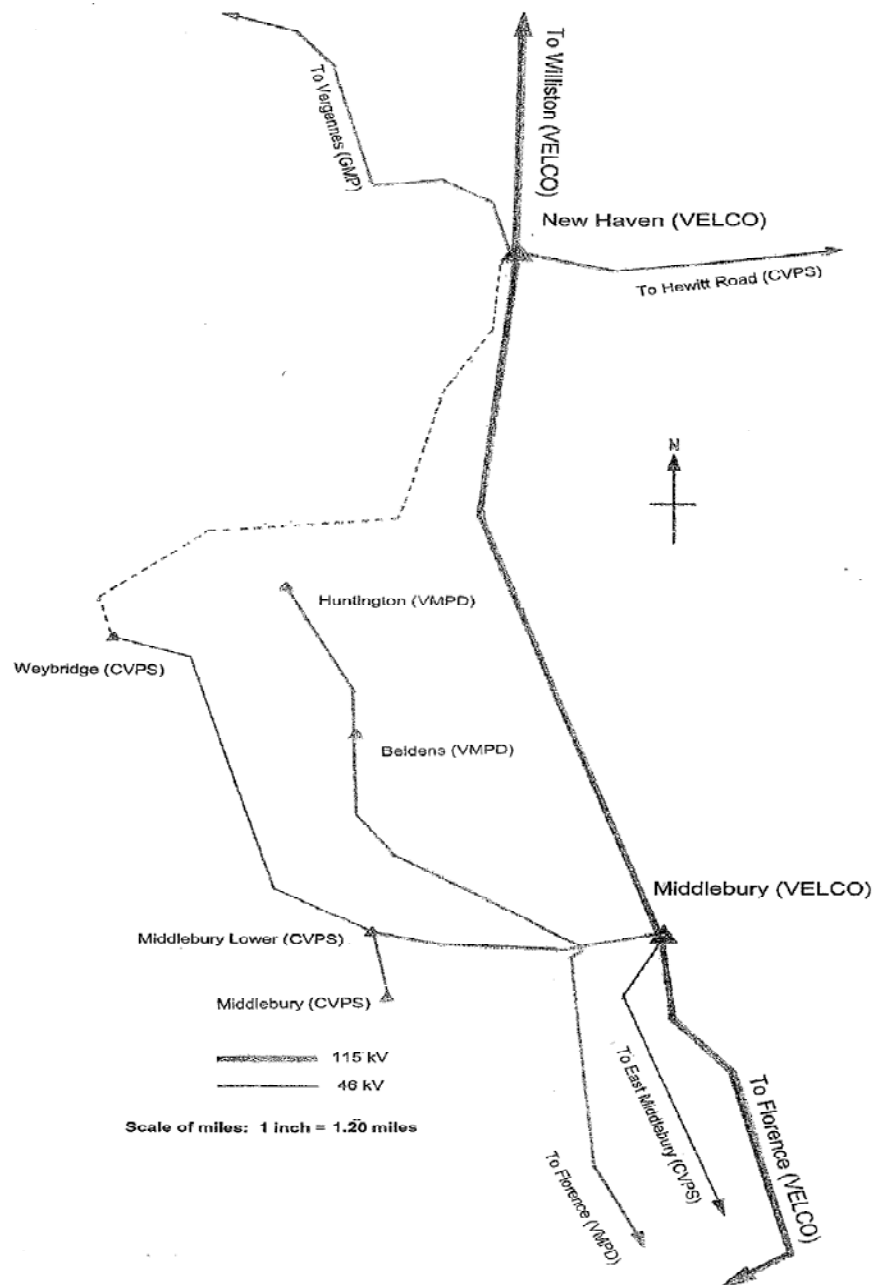


Tying the two inadequate systems together with a new 5.4 mile 46 kV subtransmission line would economically solve problems #1 and #2 by providing mutual backup and stronger connectivity / lower impedance.

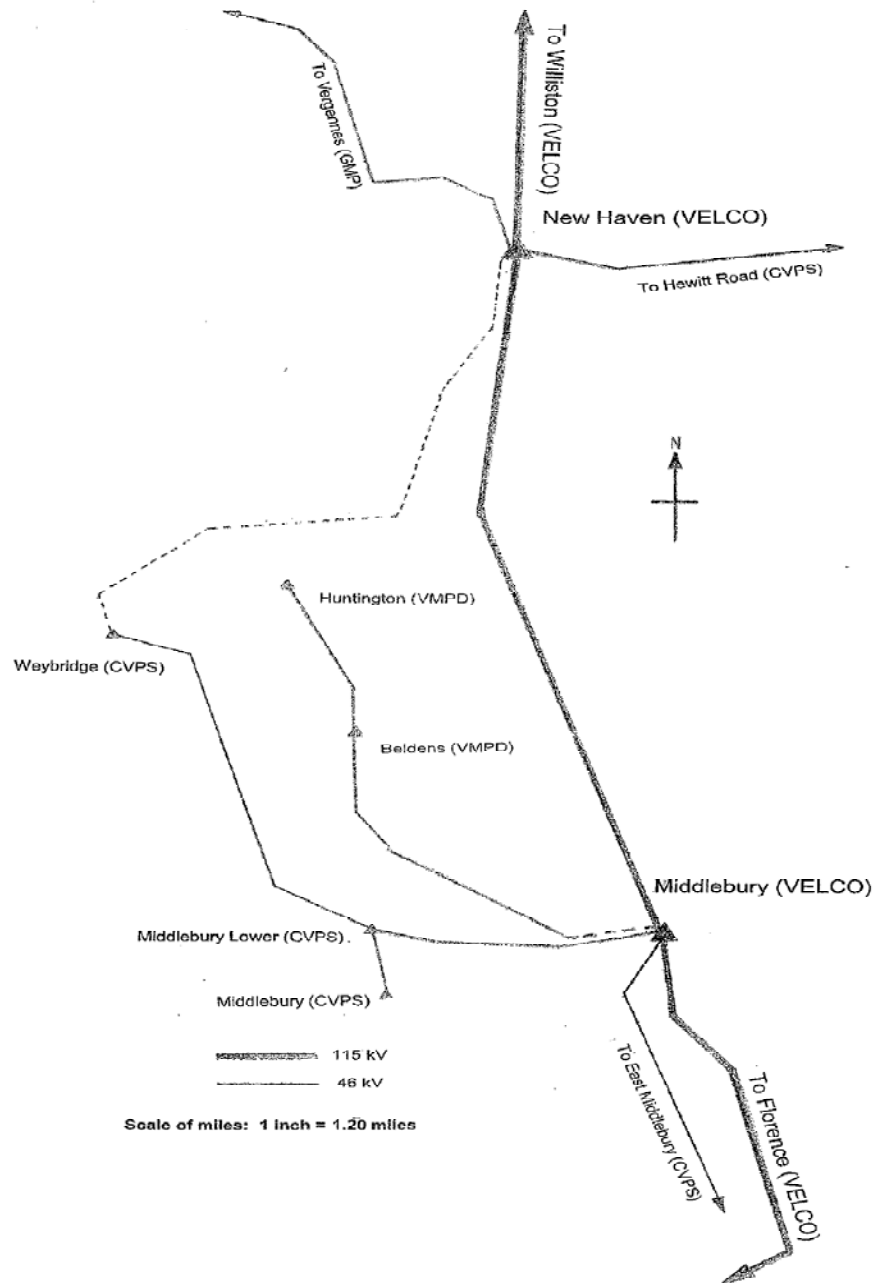




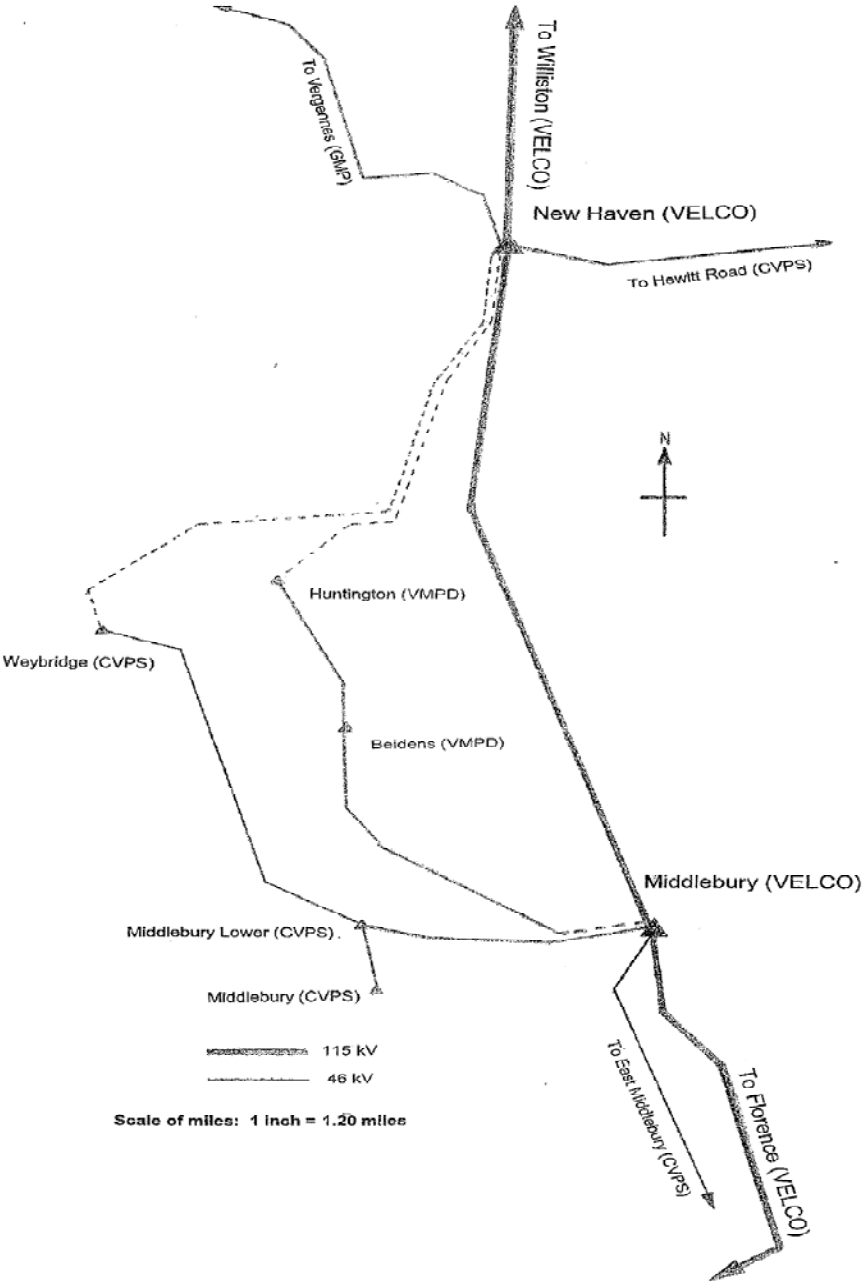
The proposed 46 kV line and associated substation upgrades could potentially be the first of three sequential improvements...



# Optional 2<sup>nd</sup> phase...



# Optional 3<sup>rd</sup> phase...



# Preliminary Cost Data

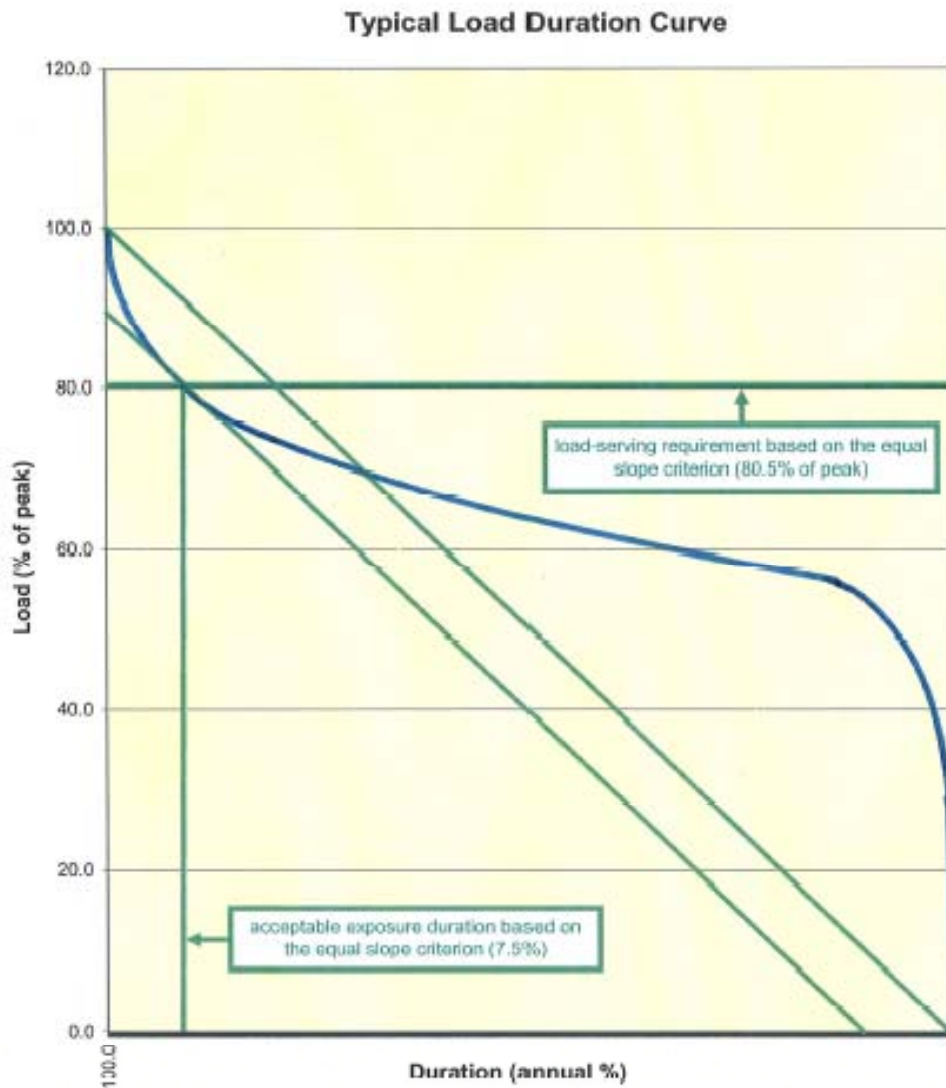
Configuration “A” (the one we’re proposing) has a total cost of \$3.95 M as seen in the table below, which includes \$0.69 M in Weybridge-New Haven distribution rebuild costs. \$1.25 M will have to be spent for “stand alone” Weybridge-New Haven distribution upgrades and Middlebury Lower switches if the 46 kV line project is not built. Therefore, the net cost of the project could be viewed as equivalent to  $$(3.95-(1.25-0.69))M = \mathbf{\$3.39 M}$ .

Configurations “B” and “E” are the two sequential improvements described earlier, and would add costs that would be borne solely by Vermont Marble Power Division.

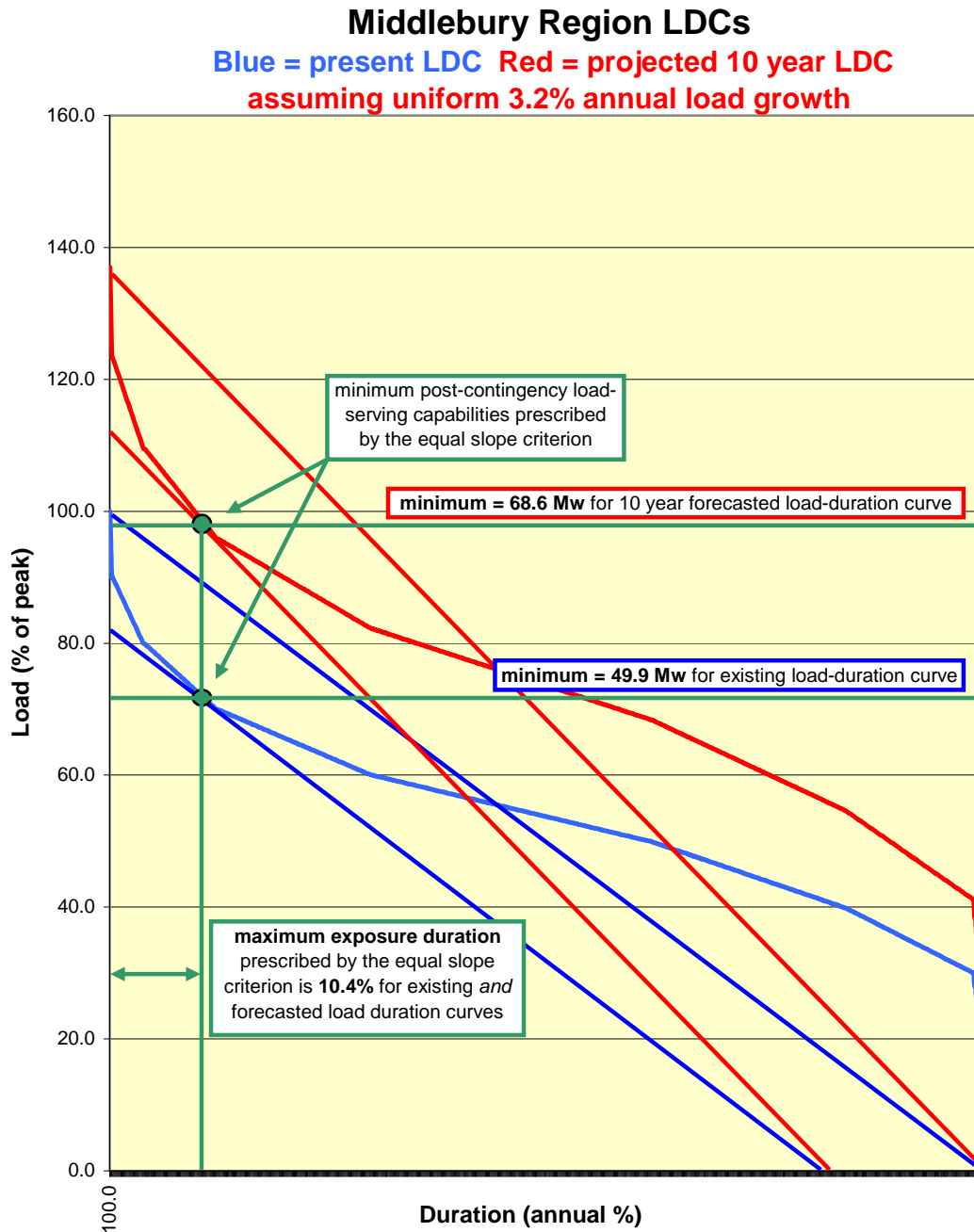
Project elements	Config A	Config B	Config E
Weybridge to New Haven 46 kV line addition <sup>4</sup>	\$897,000	\$897,000	\$897,000
Huntington to New Haven 46 kV line addition <sup>3,4</sup>	\$0	\$0	\$1,230,000
Cheapest Weybridge to New Haven 12.5 kV dist. rebuild <sup>5</sup>	\$686,000	\$686,000	\$686,000
New Haven sub work and Hewitt Road line relocation	\$655,000	\$655,000	\$655,000
Middlebury Lower sub breaker additions and other work <sup>1</sup>	\$1,171,000	\$1,171,000	\$1,171,000
Reconductor Middlebury Lower to Weybridge to 477 ACSR	\$308,000	\$308,000	\$308,000
Line and other to connect VMPD hydros to VELCO Midd <sup>2</sup>	\$0	\$150,000	\$150,000
VELCO 46 kV breaker at New Haven for Huntington line	\$0	\$0	\$376,000
Upgrade Huntington / Beldens protection to CV's standards	\$0	\$129,000	\$129,000
Capacitor addition at Hewitt Road	\$236,000	\$236,000	\$0
Costs to retire 9 miles of VMPD lines (Midd-Salisb)	\$0	\$188,000	\$188,000
Costs to retire 13 miles of VMPD lines (Salisb-Florence)	\$0	\$0	\$0
<b>Totals</b>	<b>\$3,953,000</b>	<b>\$4,420,000</b>	<b>\$5,790,000</b>
<sup>1</sup> These breaker additions help to leverage the reliability advantage of the new network connections by allowing the Middlebury distribution customers to "ride through" the loss of a line to Midd Lower sub, rather than suffering an outage and then restoring the load from the unfaulted side.			
<sup>2</sup> Excludes cost of a new VELCO breaker at its Middlebury sub, estimated to be \$300,000.			
<sup>3</sup> This includes \$160,000 for a breaker at VMPD's Huntington sub and a mile of new ROW.			
<sup>4</sup> This estimate excludes the associated distribution rebuild (separate line item).			
<sup>5</sup> This assumes the transfer of the existing wire to new, shared structures, but several other (costlier) possibilities exist.			
<b>NOTE:</b> This table assumes that CV will be in compliance with VELCO-mandated distribution PF requirements. Non-compliance would require one additional 46 kV cap at Hewitt Road and one additional 46 kV cap at East Middlebury, for all solution options.			
<b>NOTE:</b> If no transmission project is built, certain costs must still be incurred within the next several years to permit continued operation of the existing system. These consist of a Weybridge to New Haven 12.5 kV distribution rebuild (est. \$1.19M) and new switches at Middlebury Lower (est. \$60,000). Further discussion of this issue appears later in this report, in the final bullet under section XIII Discussion and Conclusions.			

Questions ?

# Equal slope - generic example



# Equal slope reliability requirements for Middlebury / New Haven (old data)



Peak Load of Base Curve (MW) = **69.3**

Peak Load of Grown Curve (MW) = **94.9**

Load Factor of Base Curve (%) = **54.2**

Load Factor of Grown Curve (%) = **54.2**

**Disclaimer:** Growth assumptions are for purposes of discussion only and are not necessarily indicative of actual system behavior.

# Equal Slope requirements for Middlebury / New Haven compared to actual post-project performance predicted by load flow simulation

The previous slide showed that the required exposure duration limit for present and future loading in this area is 10.4% for a 1<sup>st</sup> contingency.

The actual performance of the reinforced system, for the three most important 1<sup>st</sup> contingencies is denoted in this table...

*Addendum I Table 1 - Load limits and exposure durations of important Middlebury-area contingencies*

entry	case name	configuration	contingency	critical load level (Mw)	critical load level (% of present peak)	exp duration - present load (% of time)	exp duration - 10 yr growth (% of time)	limiting condition
1	Prob-1-Midd.sav	Existing	Middlebury 115/46 kV transformer	27.2	39%	86%	99%	low voltage at Middlebury
2	Prob-1-NHaven.sav	Existing	New Haven 115/46 kV transformer	37.2	54%	49%	85%	low voltage at Hewitt Road
3	Prob-1-Seminary.sav	Existing	VELCO Middlebury 46 kV bus fault <sup>1</sup>	0.0	0%	100%	100%	radial supply of Middlebury substation
4	Prob-1A-Midd.sav	Config A	Middlebury 115/46 kV transformer	64.6	93%	< 1%	16%	low voltage at Leicester
5	Prob-1A-NHaven.sav	Config A	New Haven 115/46 kV transformer	78.3	113%	0%	3%	thermal relay setting on Midd transformer
6	Prob-1A-Seminary.sav	Config A	VELCO Middlebury 46 kV bus fault <sup>1</sup>	53.6	77	6%	42%	low voltage at Leicester <sup>2</sup>

**NOTE:** All Config A cases assume an additional 5.4 Mvar shunt cap at Hewitt Road 46 kV. All cases assume NRP in-service, and 98% PF in all Middlebury-region loads.

<sup>1</sup> Or loss of VELCO Middlebury to Middlebury Lower 46 kV line.

<sup>2</sup> In fairness, this undervoltage and the corresponding load limit are not really related to any deficiency of the project, but rather a deficiency of the existing system.