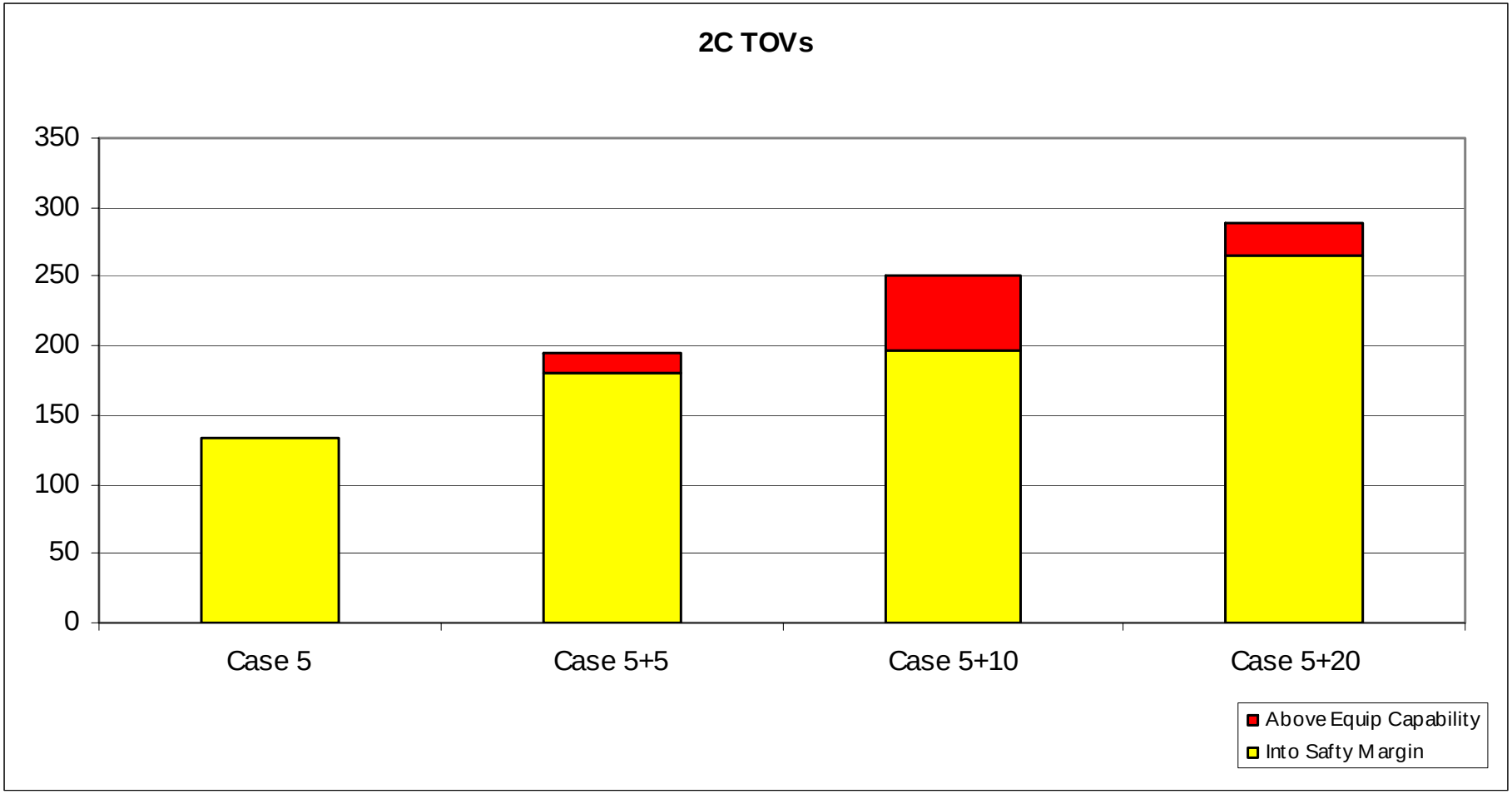
Additional Cases

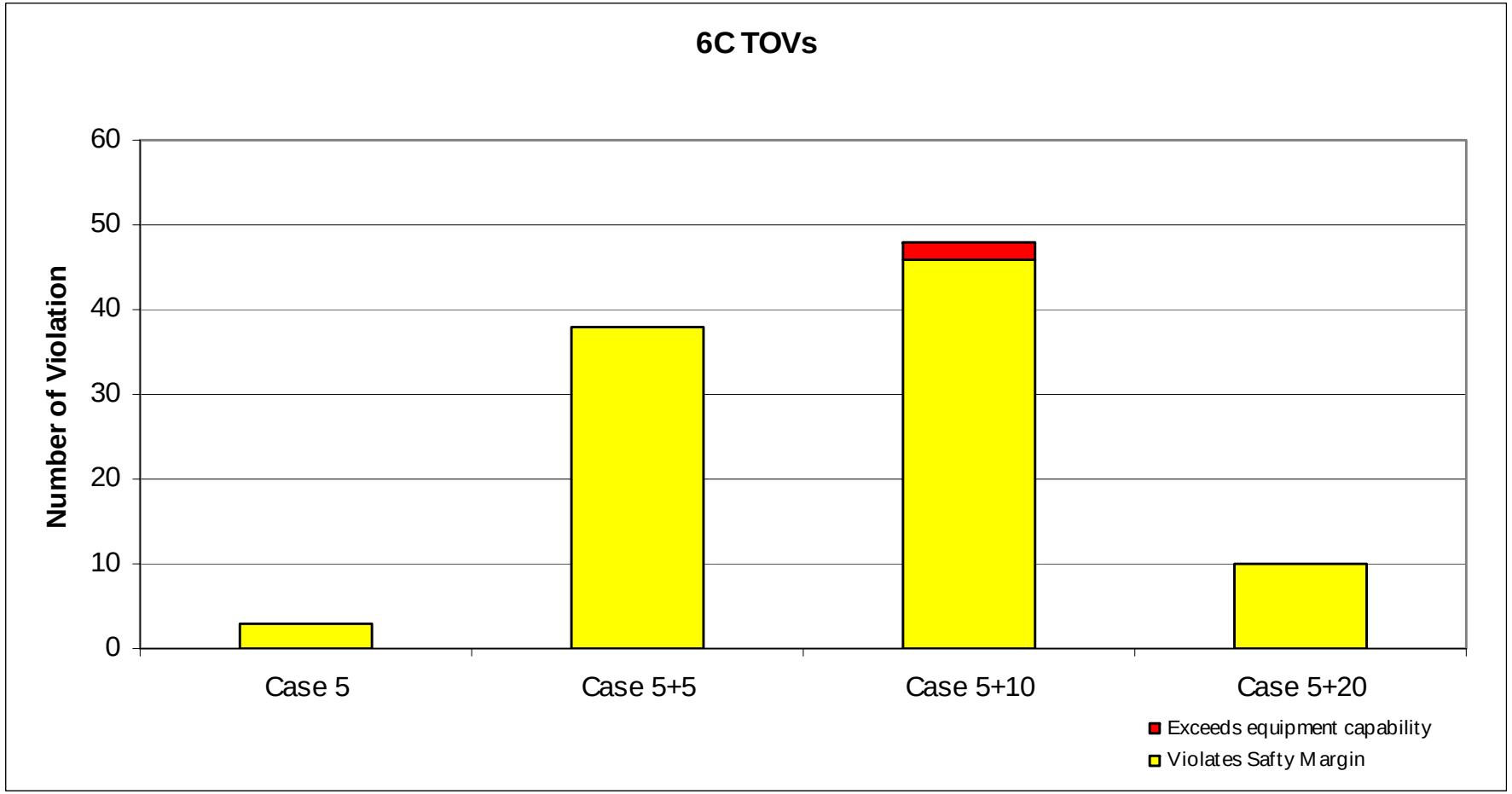
- Improved model – more consistent starting voltage profile (near 1.05 p.u.)
- More system configurations – 7104
- Counts in histograms reflect that each case has 10 measurement points
- Exhaustive search for “worst case” not done – cases based on expected system configurations
- EnerNex load model has more damping in the zero sequence than the GE model – results in somewhat lower TOV’s in some situations. Exhaustive exploration of load model impact not done.

Case 5	Case 5 with no extra miles of cable		
	Case5	148	Case 5 at 30, 40, 50 and 70% load Base system strength
	Case5-EQ8	148	Case 5 at 30, 40, 50 and 70% load 80 % system strength
	Case5-EQ8-C2	148	Case 5 at 30, 40, 50 and 70% load 80 % system strength and Extra Capactors
	Case5-EQ8-C2-AltLoad	148	Case 5 at 30, 40, 50 and 70% load 80 % system strength and Extra Capactors, Alternate Load Model
	Case5-EQ9	148	Case 5 at 40, 50 and 70% load 90 % system strength
	Case5-EQ9-AL	148	Case 5 at 40, 50 and 70% load 90 % system strength, alternate load model
	Case5-EQ9-C2	148	Case 5 at 40, 50 and 70% load 90 % system strength and Extra Capactors
	Case5-EQ9-C2-AL	148	Case 5 at 40, 50 and 70% load 90 % system strength and Extra Capactors, alternate load model
	Case5-EQ1-C2	148	Case 5 at 40, 50 and 70% load Base system strength and Extra Capacitors
	Case5-EQ1-C2-AL	148	Case 5 at 40, 50 and 70% load Base system strength and Extra Capacitors,alternate load model
	Case5-F2	148	Case 5 at 30, 40, 50 and 70% load with successive 0 faults 3.5 cycle clear
	Case5-F3	148	Case 5 at 30, 40, 50 and 70% load with successive 0 faults 4 cycle clear

Case 5A	Case 5 with 20 extra miles of cable		
	Case5A	148	Case 5A at 30, 40, 50 and 70% load and full system strength
	Case5A-EQ1-C2	148	Case 5A at 30, 40, 50 and 70% load, 100% system strength and extra capacitors
	Case5A-EQ1-C2-AL	148	Case 5A at 30, 40, 50 and 70% load, 100% system strength and extra capacitors, alternate load model
	Case5A-EQ9	148	Case 5A at 30, 40, 50 and 70% load, 90% system strength
	Case5A-EQ9-AL	148	Case 5A at 30, 40, 50 and 70% load, 90% system strength , Alternate Load
	Case5A-EQ9-C2	148	Case 5A at 30, 40, 50 and 70% load, 90% system strength and extra capacitors
	Case5A-EQ9-C2-AL	148	Case 5A at 30, 40, 50 and 70% load, 90% system strength and extra capacitors, alternate load model
	Case5A-EQ8	148	Case 5A at 30, 40, 50 and 70% load, 80% system strength
	Case5A-EQ8-C2	148	Case 5A at 30, 40, 50 and 70% load, 80% system strength and extra capacitors
	Case5A-EQ8-C2-AltLoad	148	Case 5A at 30, 40, 50 and 70% load, 80% system strength and extra capacitors, alternate load model
	Case5A-F2	148	Case 5A at 30, 40, 50 and 70% load with successive 0 faults 3.5 cycle clear
	Case5A-F3	148	Case 5A at 30, 40, 50 and 70% load with successive 0 faults 4 cycle clear

Bin	Case 5	Case 5+5	Case 5+10	Case 5+20
1	16	40	33	5
1.05	2033	2006	2023	1337
1.1	3987	3602	3605	3026
1.15	2960	3525	3611	2774
1.2	2780	3146	3097	2969
1.25	2229	2233	2145	2411
1.3	1414	1246	1217	1711
1.35	880	763	783	1172
1.4	634	446	462	852
1.45	329	268	273	596
1.5	237	186	156	386
1.55	127	104	104	232
1.6	93	79	90	127
1.65	35	45	47	65
1.7	6	34	41	39
1.75	0	14	10	21
1.8	0	8	9	14
1.85	0	5	8	10
1.9	0	1	14	12
1.95	0	4	10	1
2	0	1	6	0
More	0	4	16	0
Into Safty Margin	134	195	251	289
Above Equip Capability	0	15	54	23


2C TOVs
350
300
250
200
150
100
50
0
Case 5
Case 5+5
Case 5+10
Case 5+20
Above Equip Capability
Into Safty Margin


6C TOVs
Number of Violation
60
50
40
30
20
10
0
Case 5
Case 5+5
Case 5+10
Case 5+20
Exceeds equipment capability
Violates Safty Margin

- SWCT studies clearly show cases where TOV's worse with C-Type Filters tuned to the third harmonic – violates "do no harm" principal
- When tuned near the second harmonic, they effectively mitigate TOV's in the computer simulations
- Optimum design indicates the need for a very large inductor (> 2 Henries), which will likely require an iron core design
  - No experience with an iron core filter in this application
  - Audible noise issues
  - Yet another saturable element – must study inrush in switching filter itself
- Normally applied for harmonic control
  - Unproven for controlling TOV's – we cannot find any instances of such installations anywhere in the world
  - Filter component ratings different than common practice to withstand TOV's – no guidelines available
  - Protection practices complicated for filter in harmonic control application, would likely be more complicated for TOV control
- Too much capacitance under light load conditions
  - More effective design may require tuning near the second harmonic which adds even more capacitance to the system
  - May require switched bank and/or shunt reactors
- Consequences of TOV's so dire that C-Type filters must be designed for at least one contingency of a filter bank out of service – complicates optimization
- Optimization cannot account for all system contingencies, operating points, and unknowns
- Should be physically located close to problem areas – twice the physical size of normal cap bank