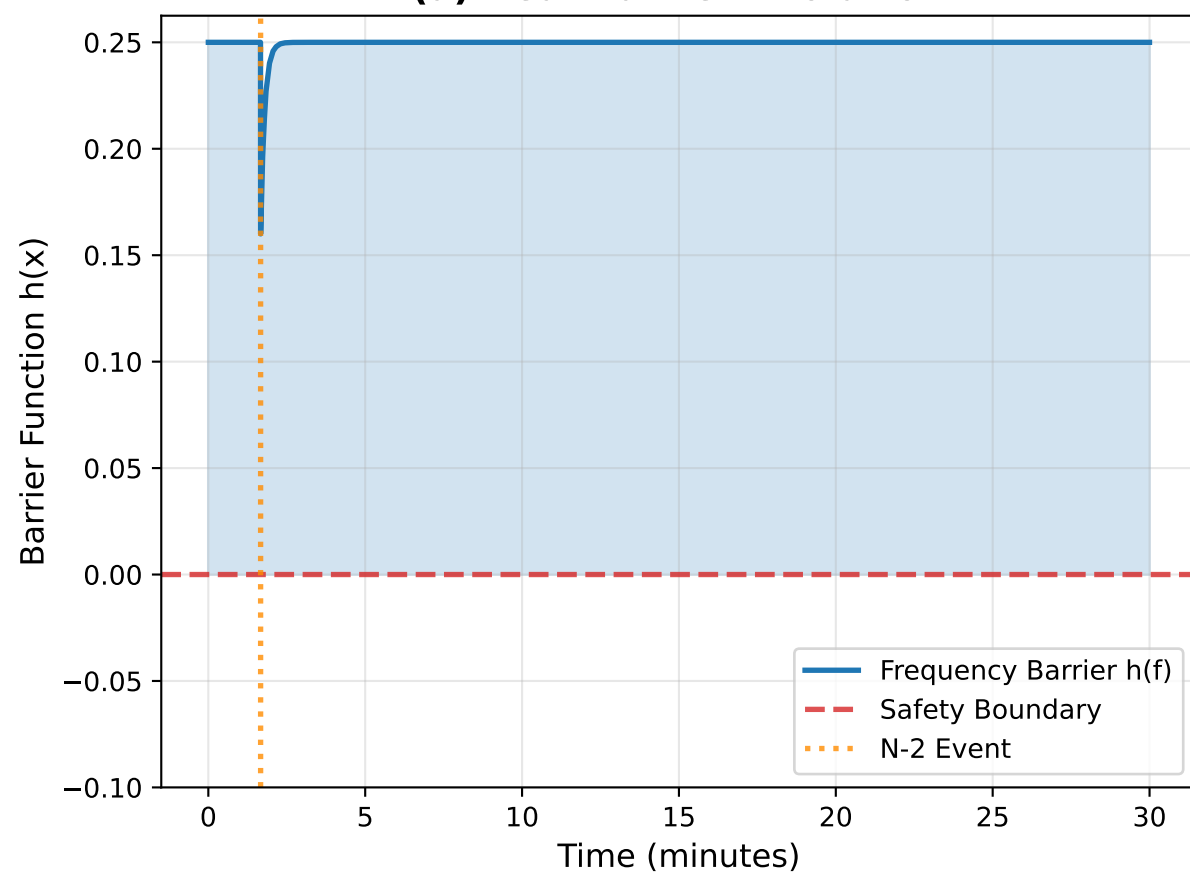


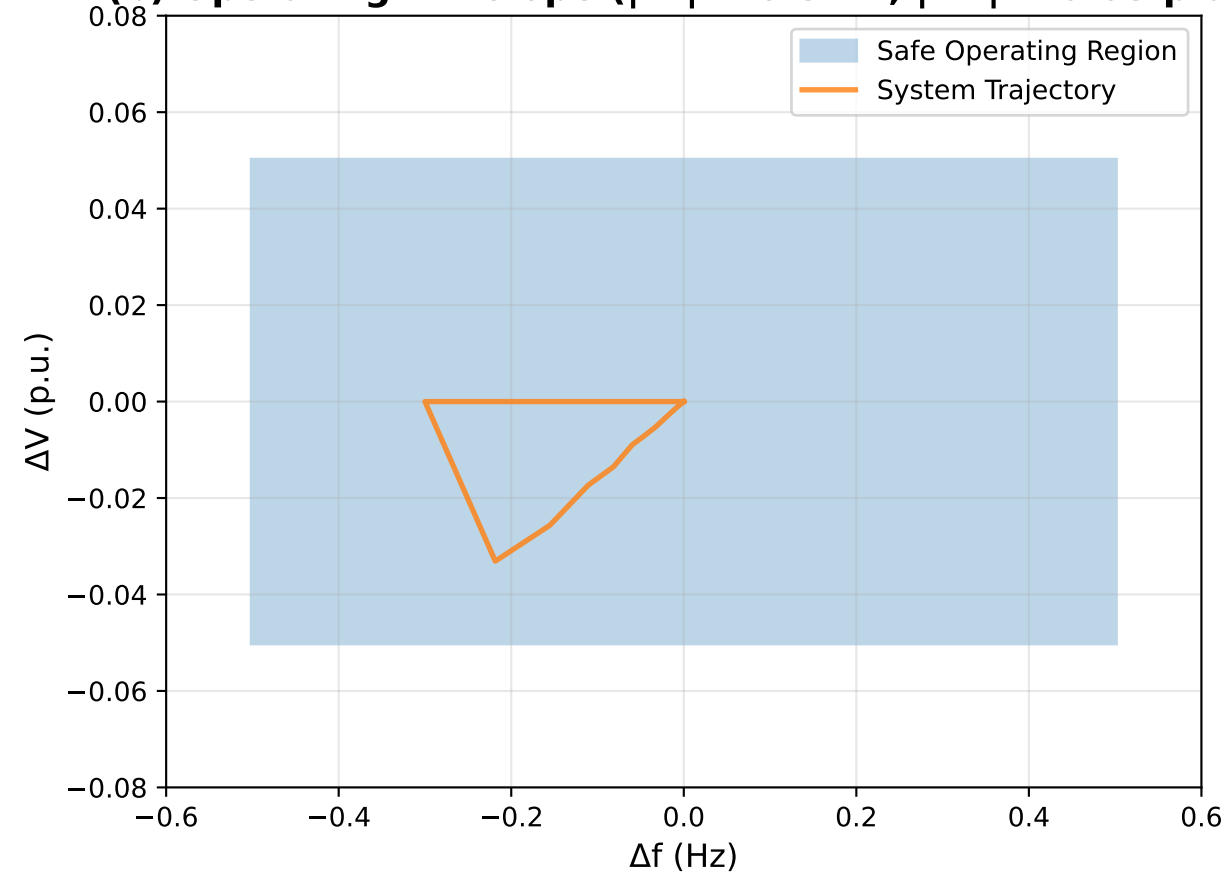
Control Barrier Function Safety Verification - Realistic Simulation

Test Conditions: Delay = 150 ms (jitter 10-150 ms), Packet Loss = 20% (Bernoulli i.i.d.), Violation dwell = 200 ms (min duration to count an event), $h_{\text{freq}} = 0.25 - (\Delta f)^2$, $\Delta t = 0.033$ s (30 Hz)

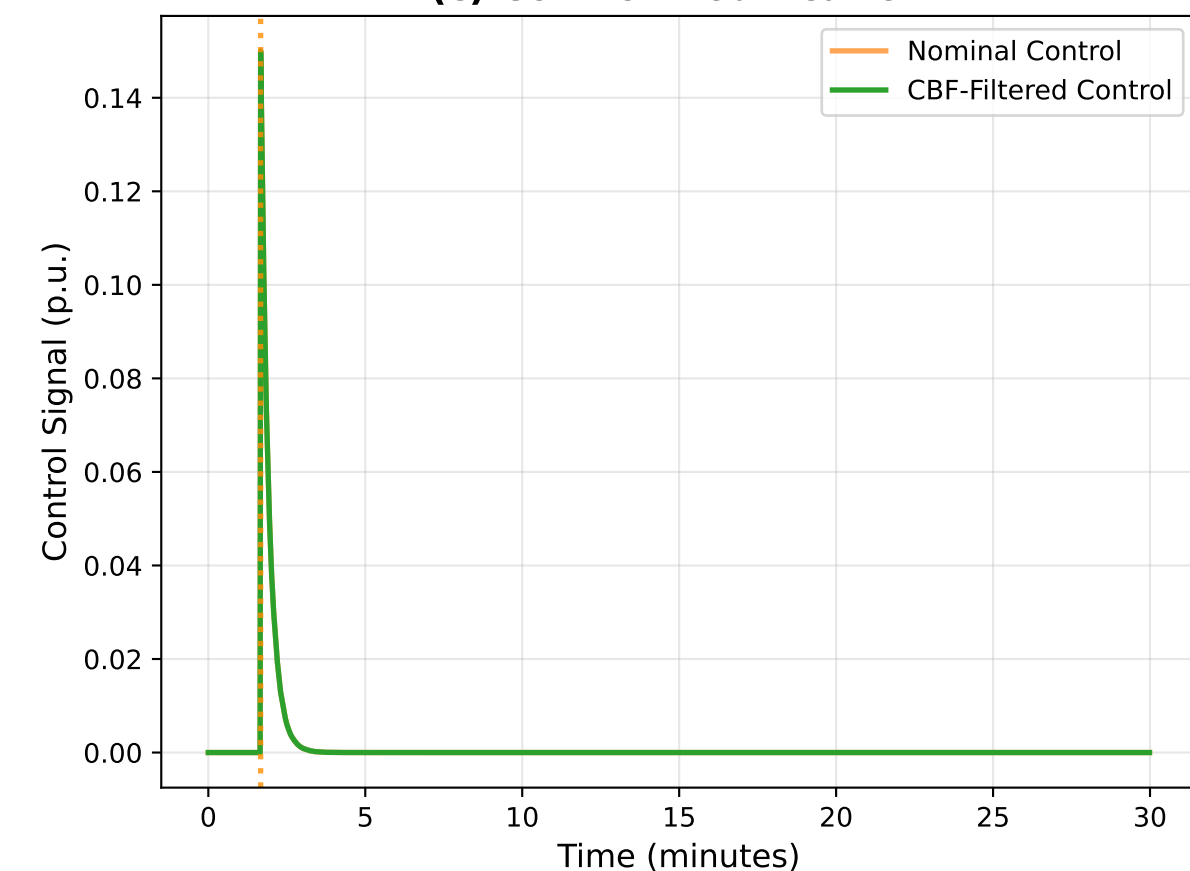
(a) Real Barrier Evolution



(b) Operating Envelope ($|\Delta f| \leq 0.5$ Hz, $|\Delta V| \leq 0.05$ p.u.)



(c) Control Modification



(d) N-2 Contingency Response

