



Ride Through and Trip Envelopes, Including PJM Straw Proposal v3

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Undervoltage Trip

Multiphase transmission faults → wide area undervoltage

DER trips before transmission fault cleared in ~100 ms

Fault-Induced Delayed Voltage Recovery > 2 s

Frequency Trip

Catastrophic islanding of interconnection

Black start

Safety of lineworkers working on hot primary lines exposed to arc flash risk

Calorie rating of personal protective equipment vs. duration of nearby arc flash

How low do arcs faults drive feeder voltage, e.g. < 30%?

Reclosing with failed anti-islanding

If DER could sustain an island, then to avoid out-of-phase reclose, DER should trip prior to distribution recloser timing.

Similar concern for Distribution Automation to avoid reclosing into an island

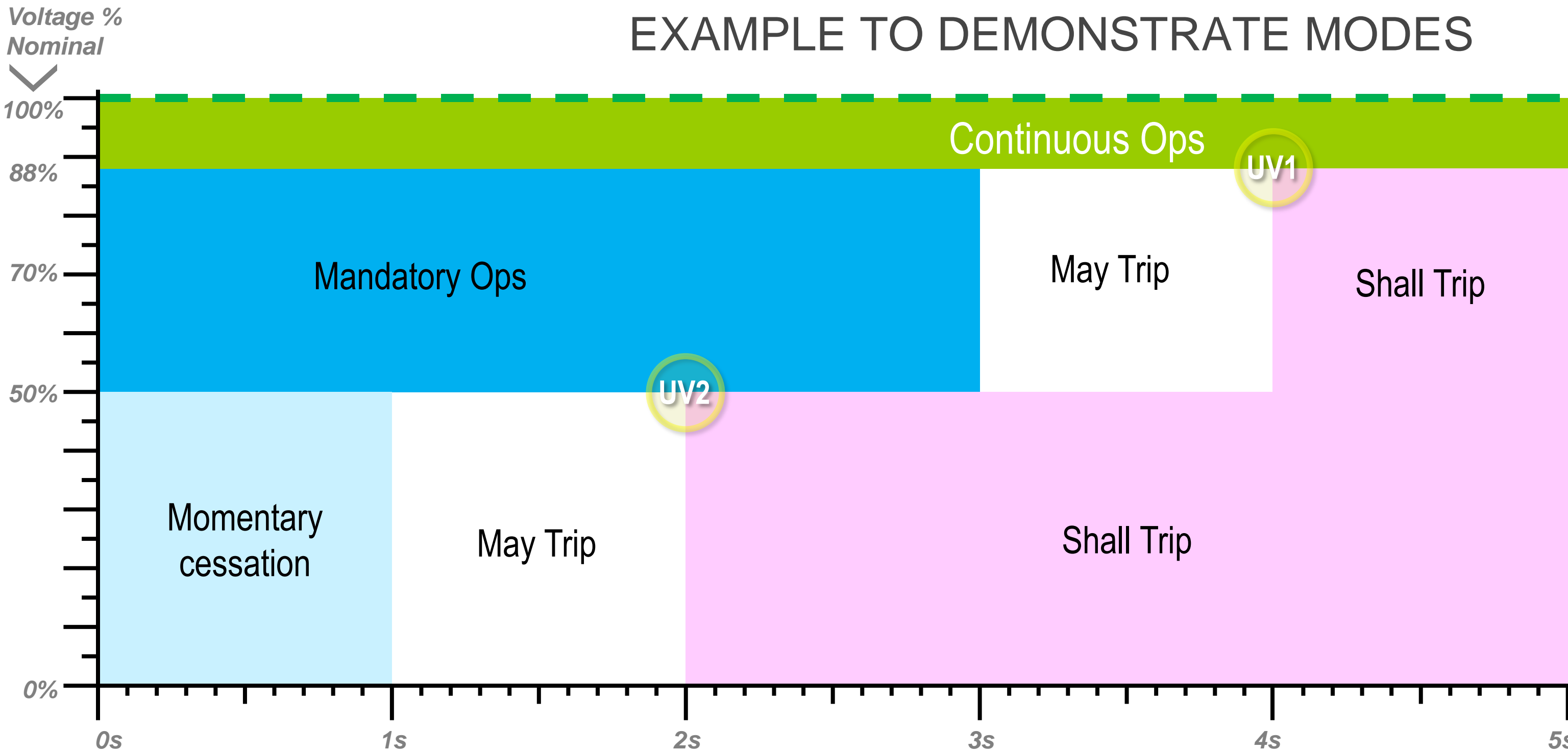
System Protection

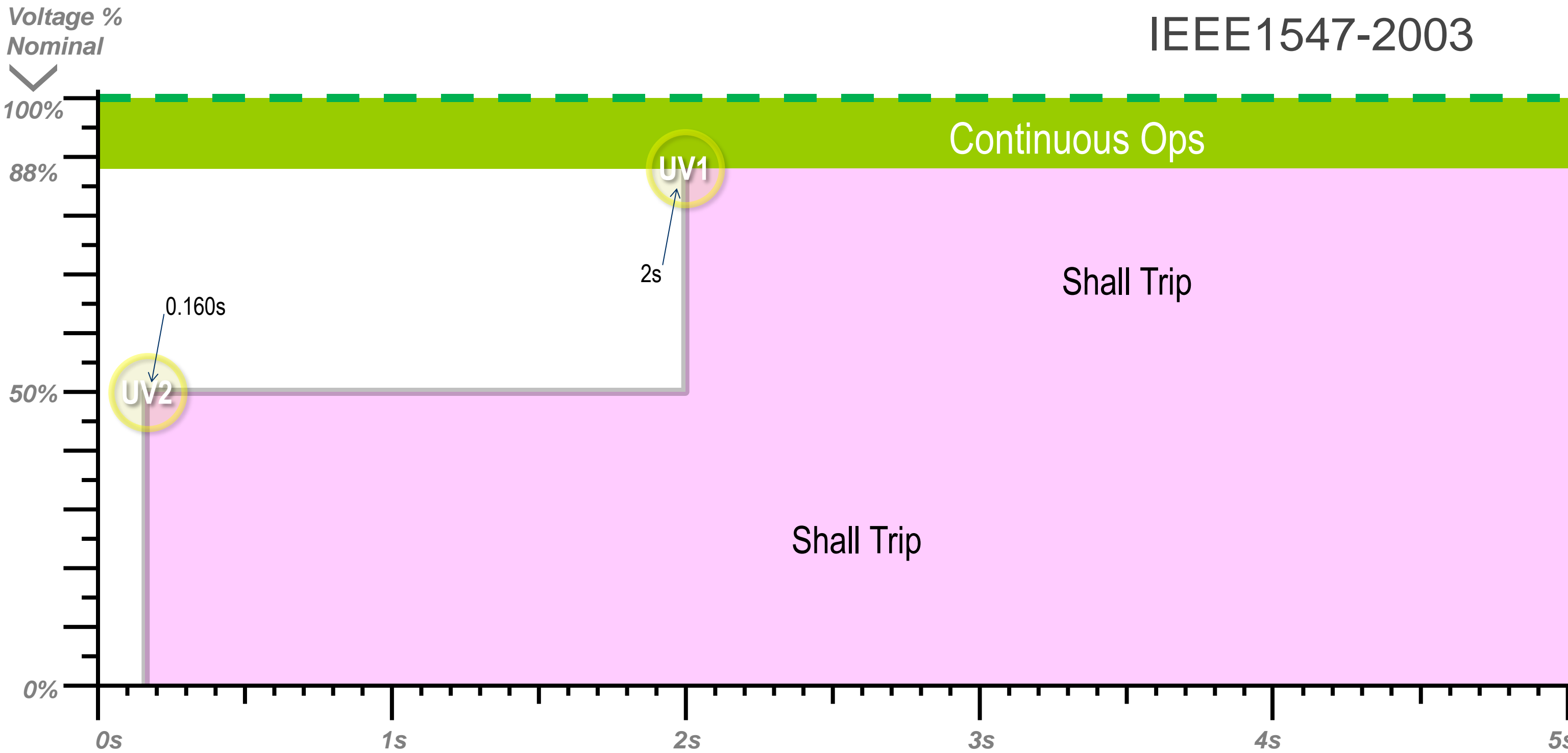
For feeder-level faults, avoid desensitizing existing relay schemes by entering "momentary cessation" mode immediately

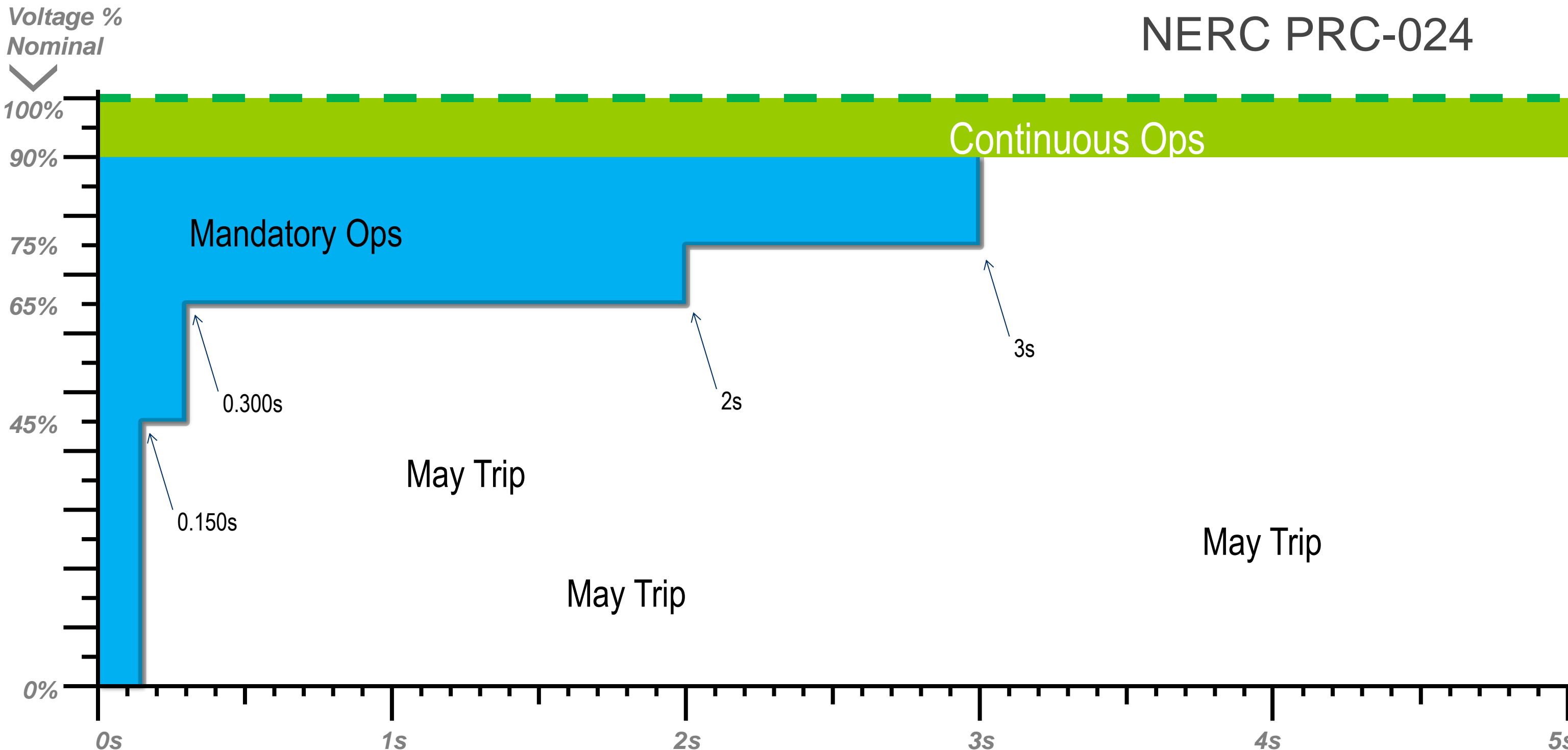
1. IEEE 1547-2003
2. NERC PRC-024-02
3. PJM Straw Proposal v3 Options A and B (IEEE 1547-2018 Cat II)
4. California Rule 21 and IEEE 1547-2018 Cat III
5. ISO New England Inverter Source Requirement Document (IEEE 1547-2018 Cat II)

- **Mandatory Ops** = Ride through, don't trip, continue to supply power.
- **Momentary Cessation** = Ride through, don't trip, stop supplying power within 83ms and then come back 400ms after conditions return to normal.
- **Shall Trip** = Stop supplying power immediately and stay offline for at least a few minutes.
- **Continuous Ops** = Normal conditions.
- **May Trip** = May continue supplying power, or enter momentary cessation, or trip, or anything in between.

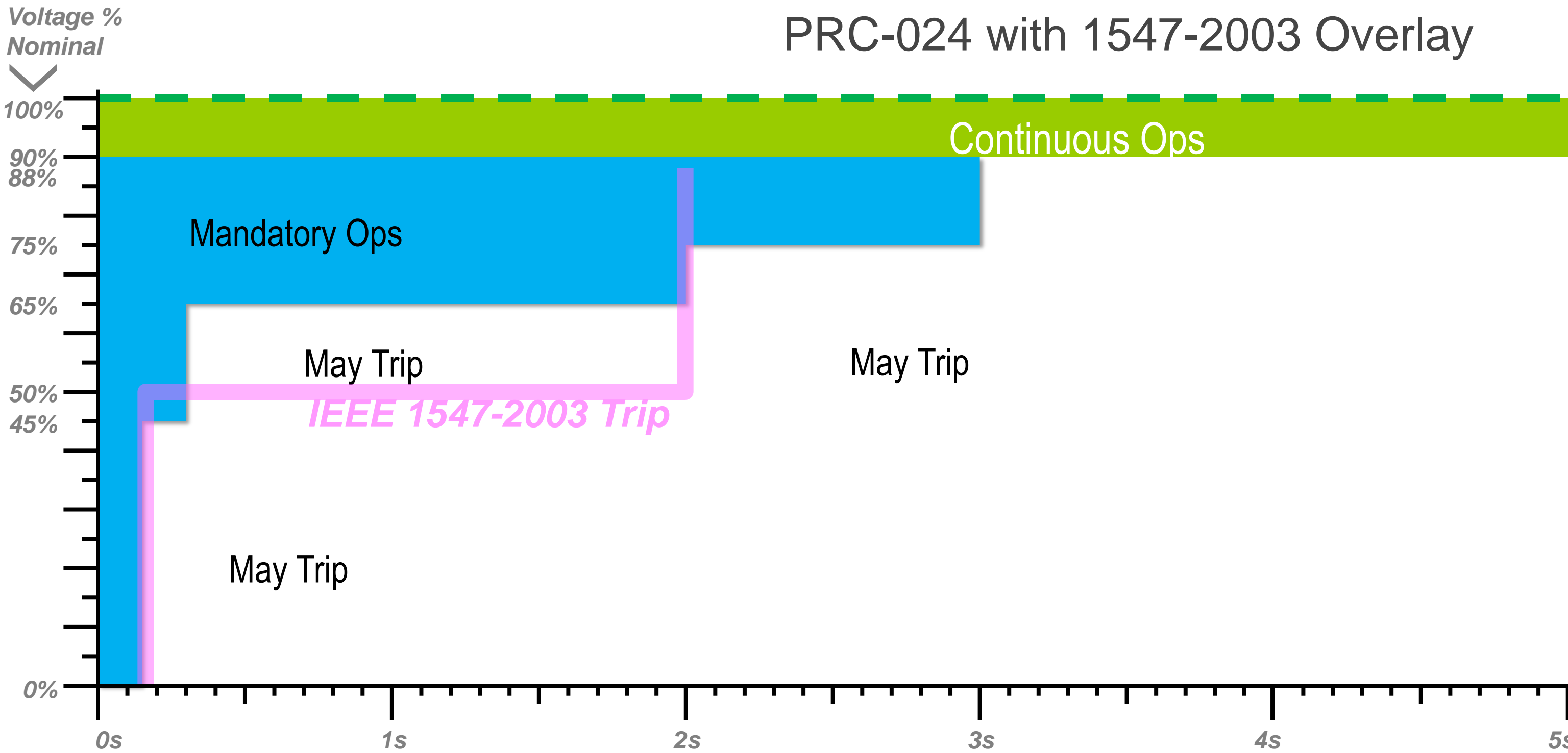
EXAMPLE TO DEMONSTRATE MODES



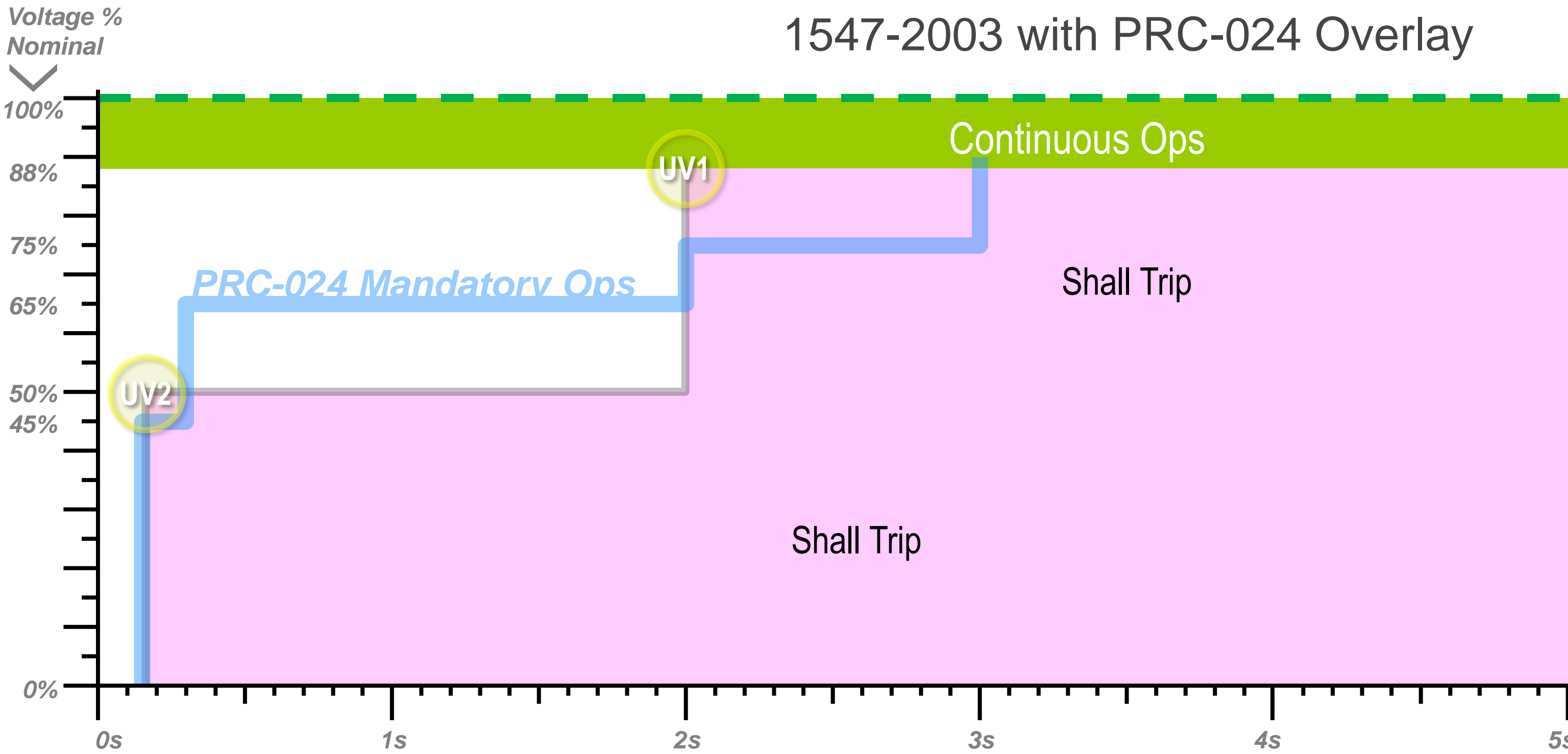




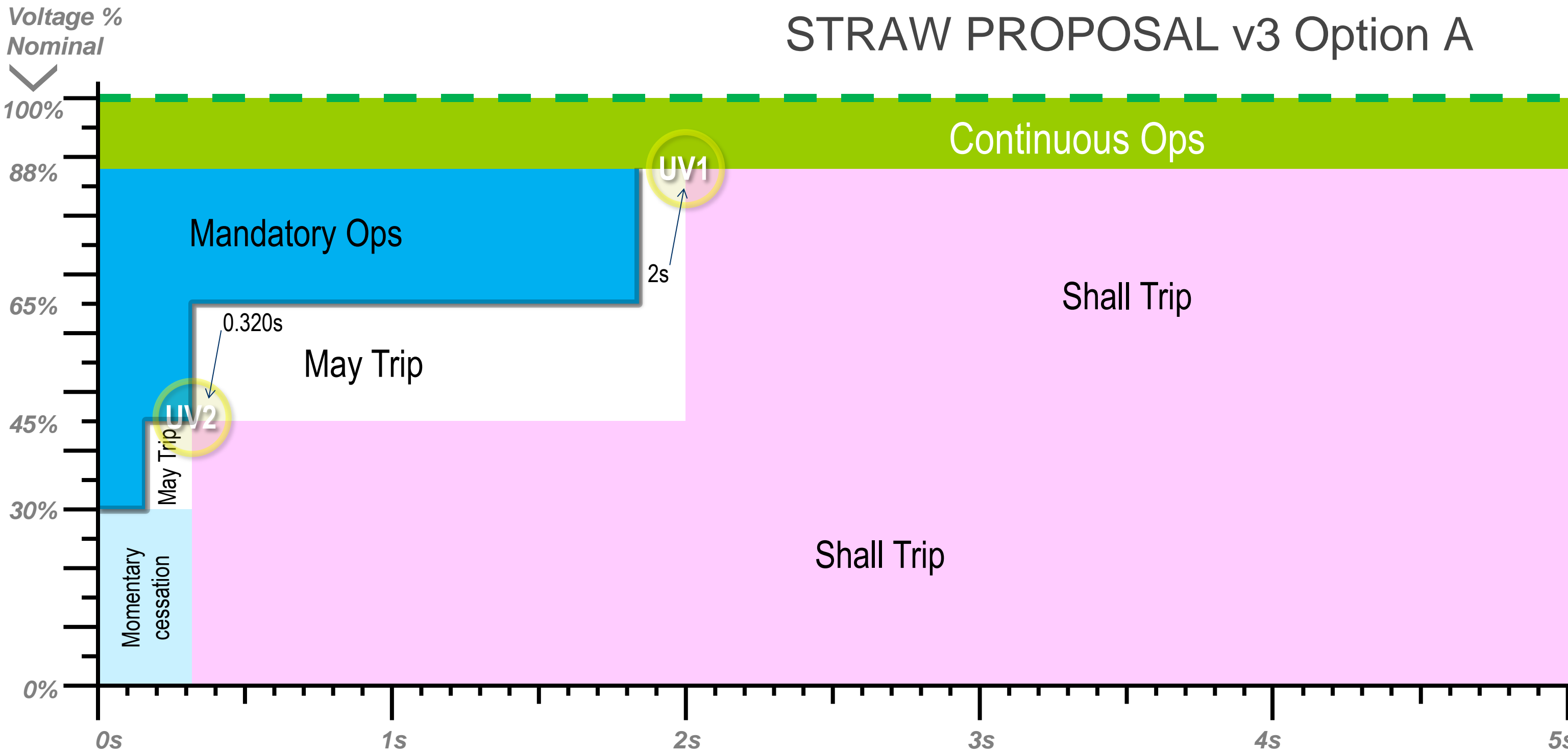
PRC-024 with 1547-2003 Overlay



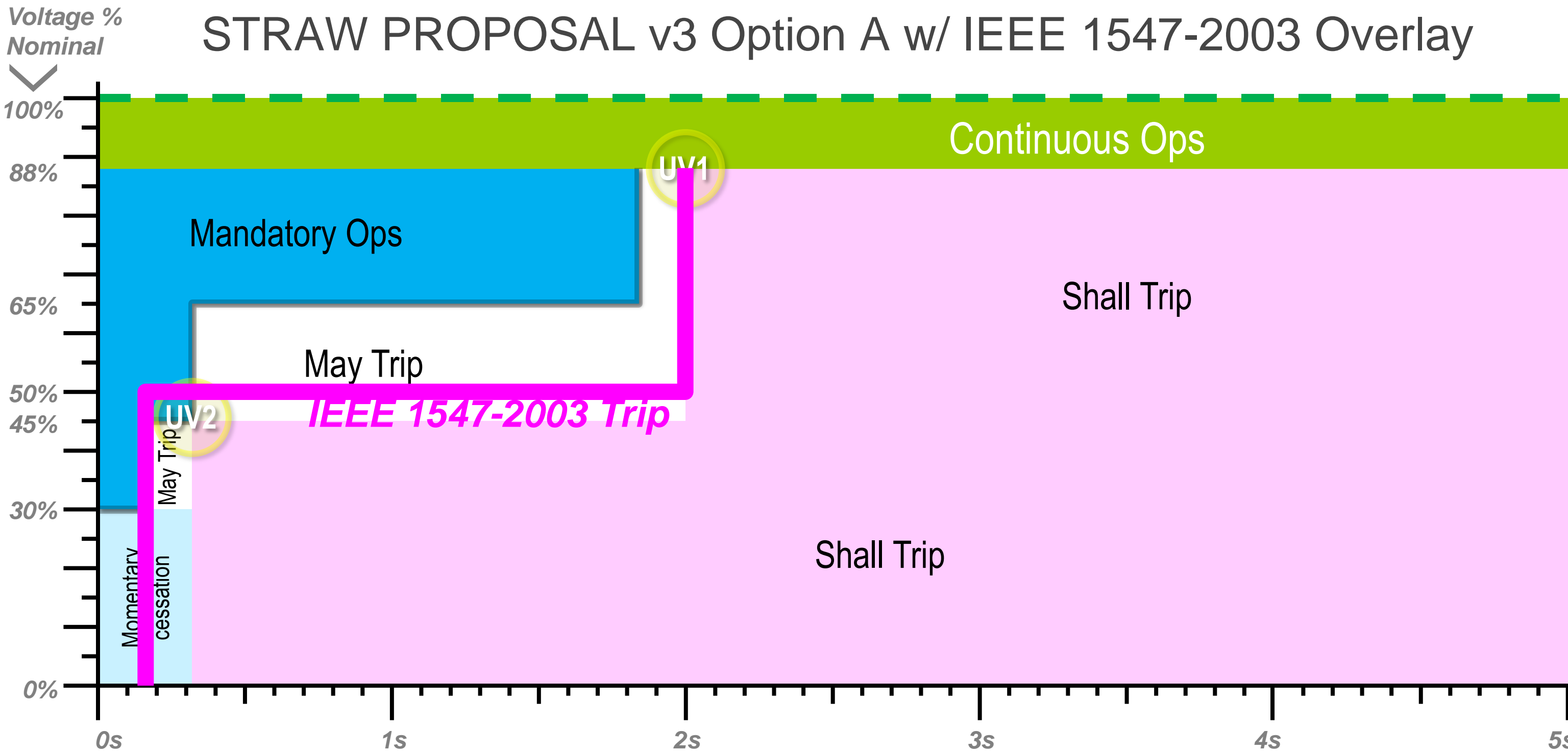
1547-2003 with PRC-024 Overlay



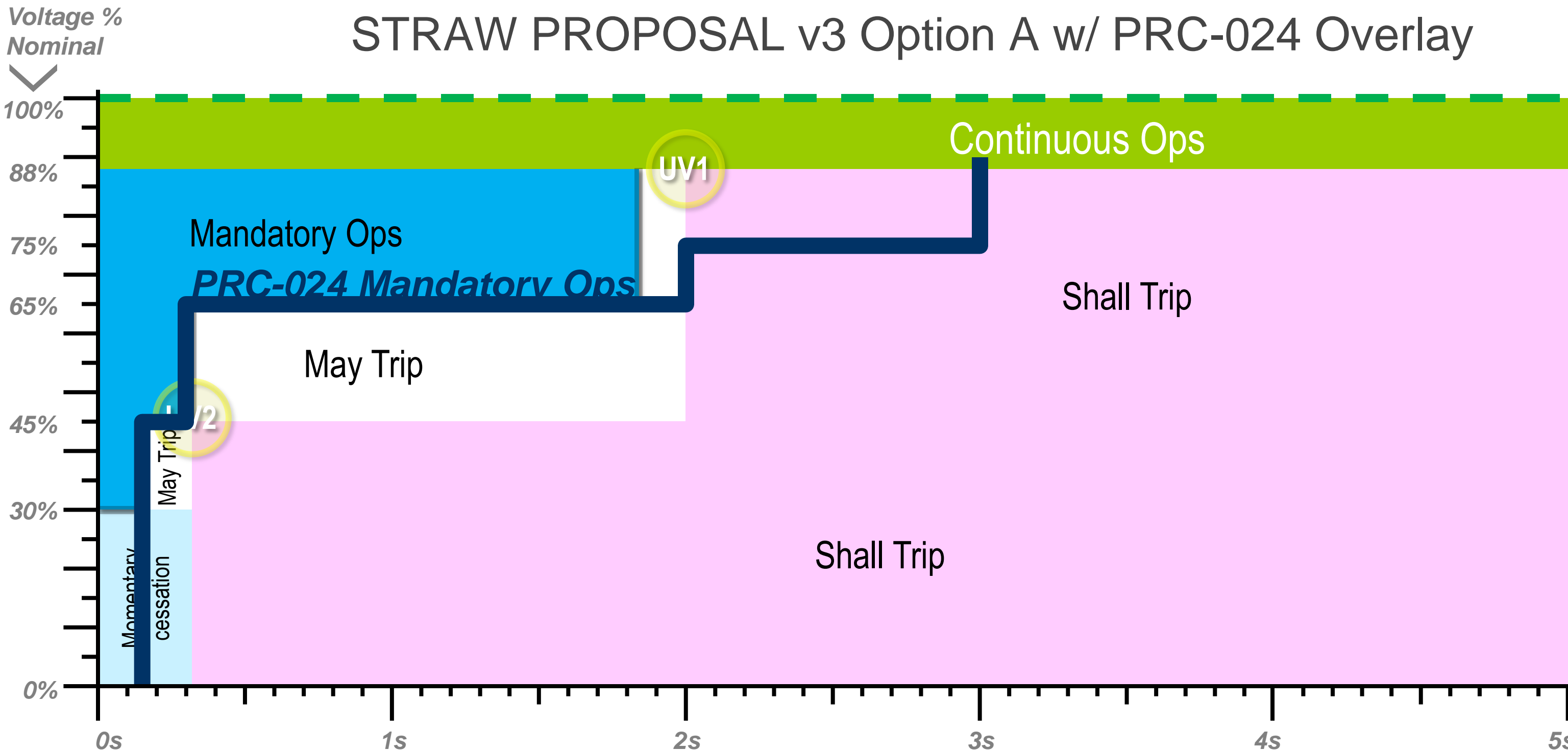
STRAW PROPOSAL v3 Option A



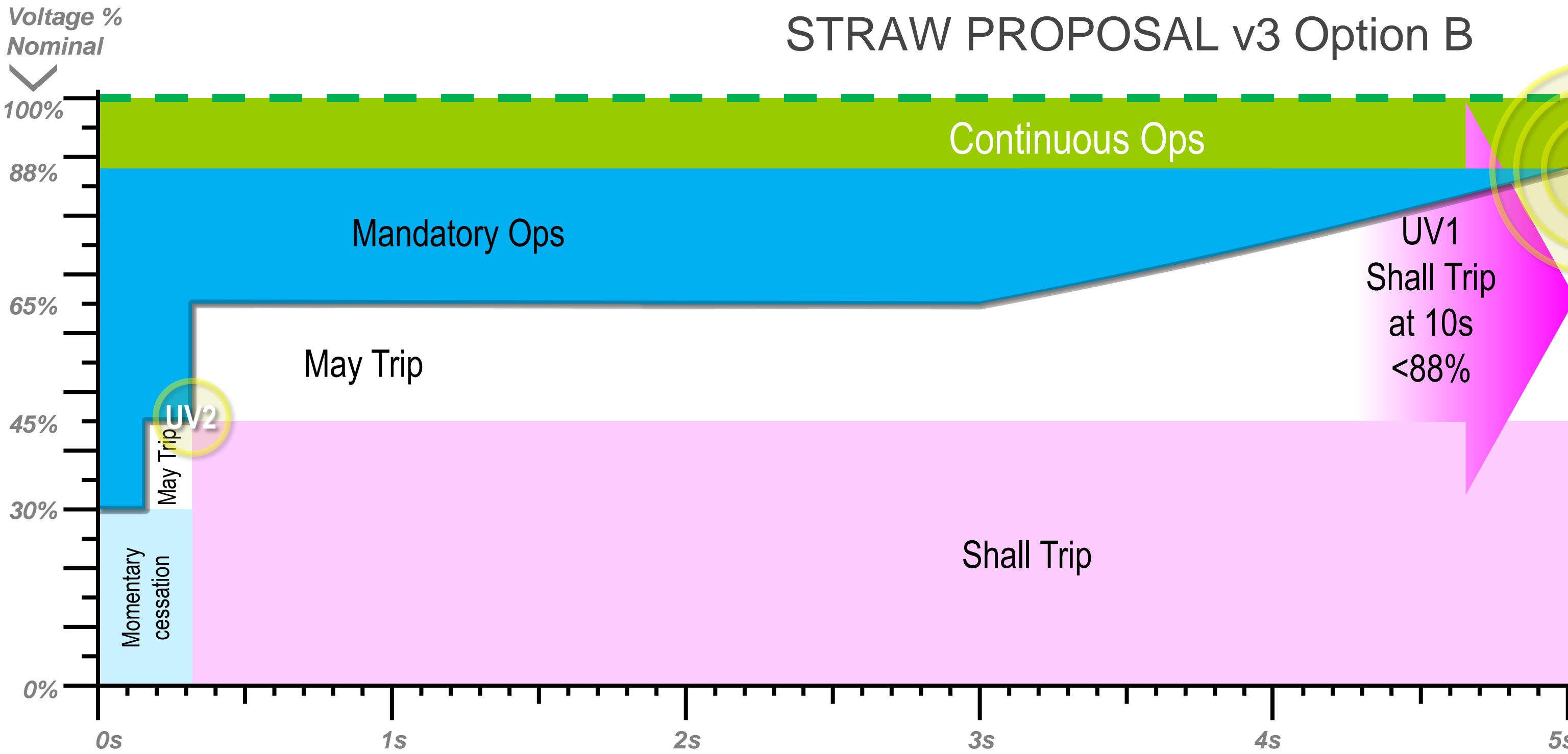
STRAW PROPOSAL v3 Option A w/ IEEE 1547-2003 Overlay



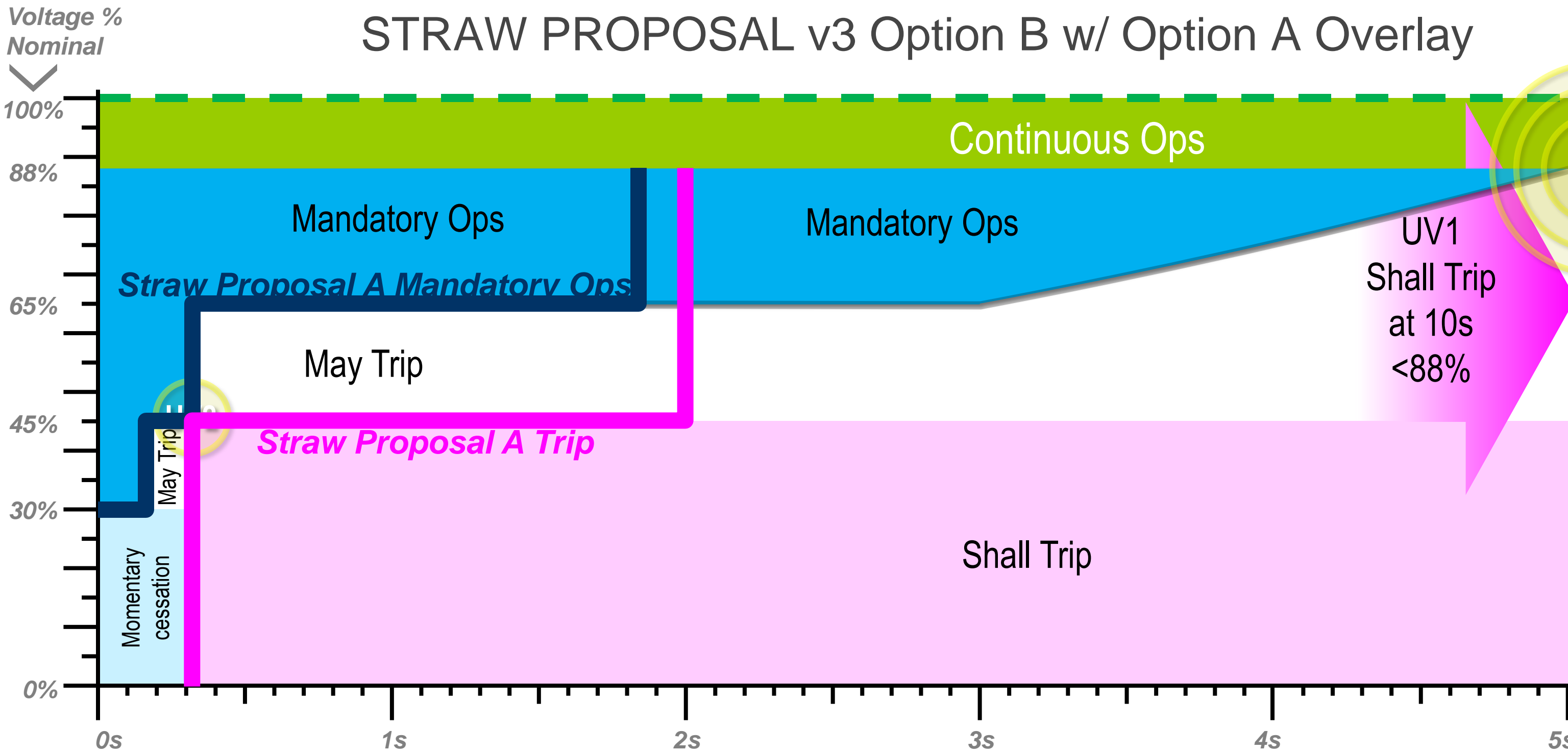
STRAW PROPOSAL v3 Option A w/ PRC-024 Overlay



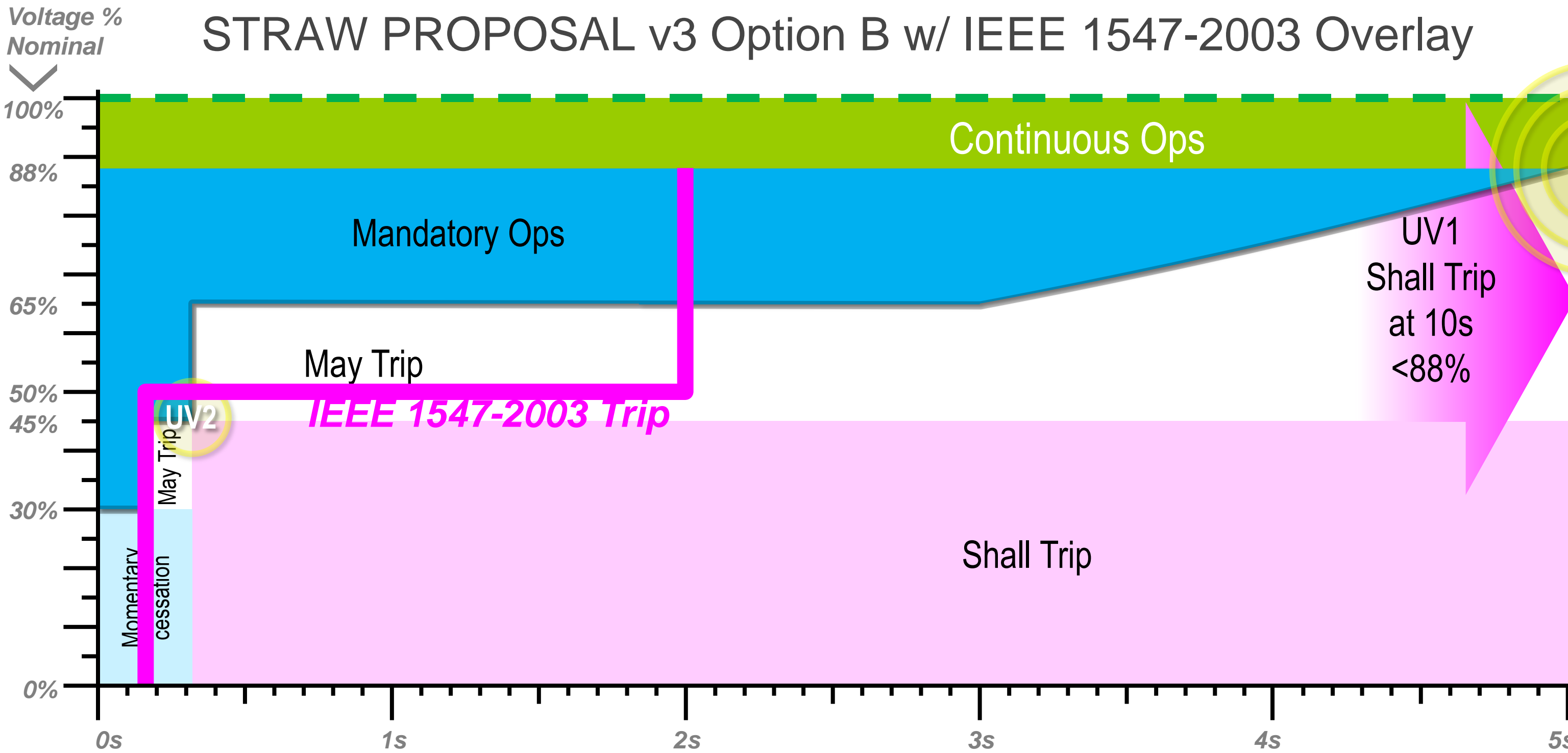
STRAW PROPOSAL v3 Option B



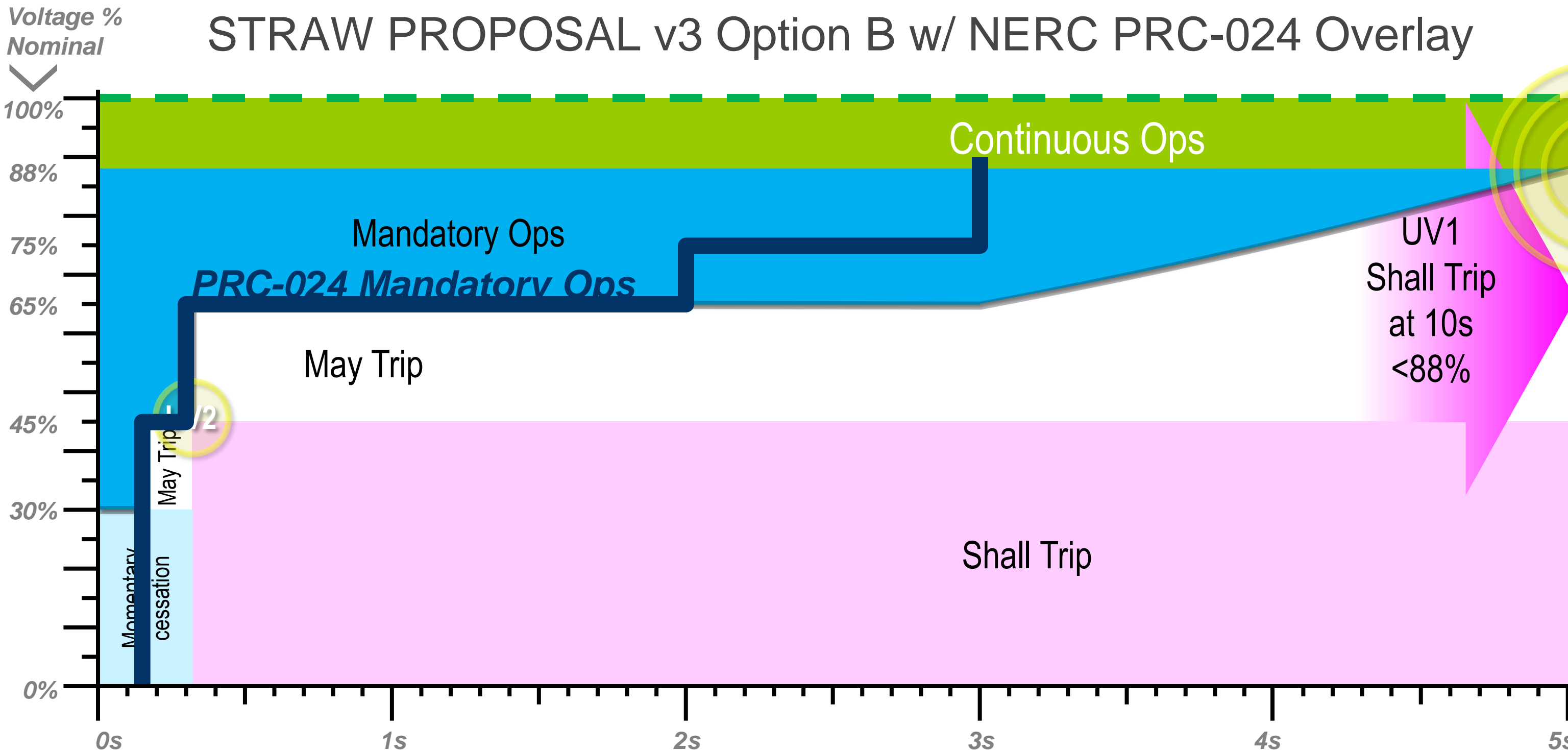
STRAW PROPOSAL v3 Option B w/ Option A Overlay



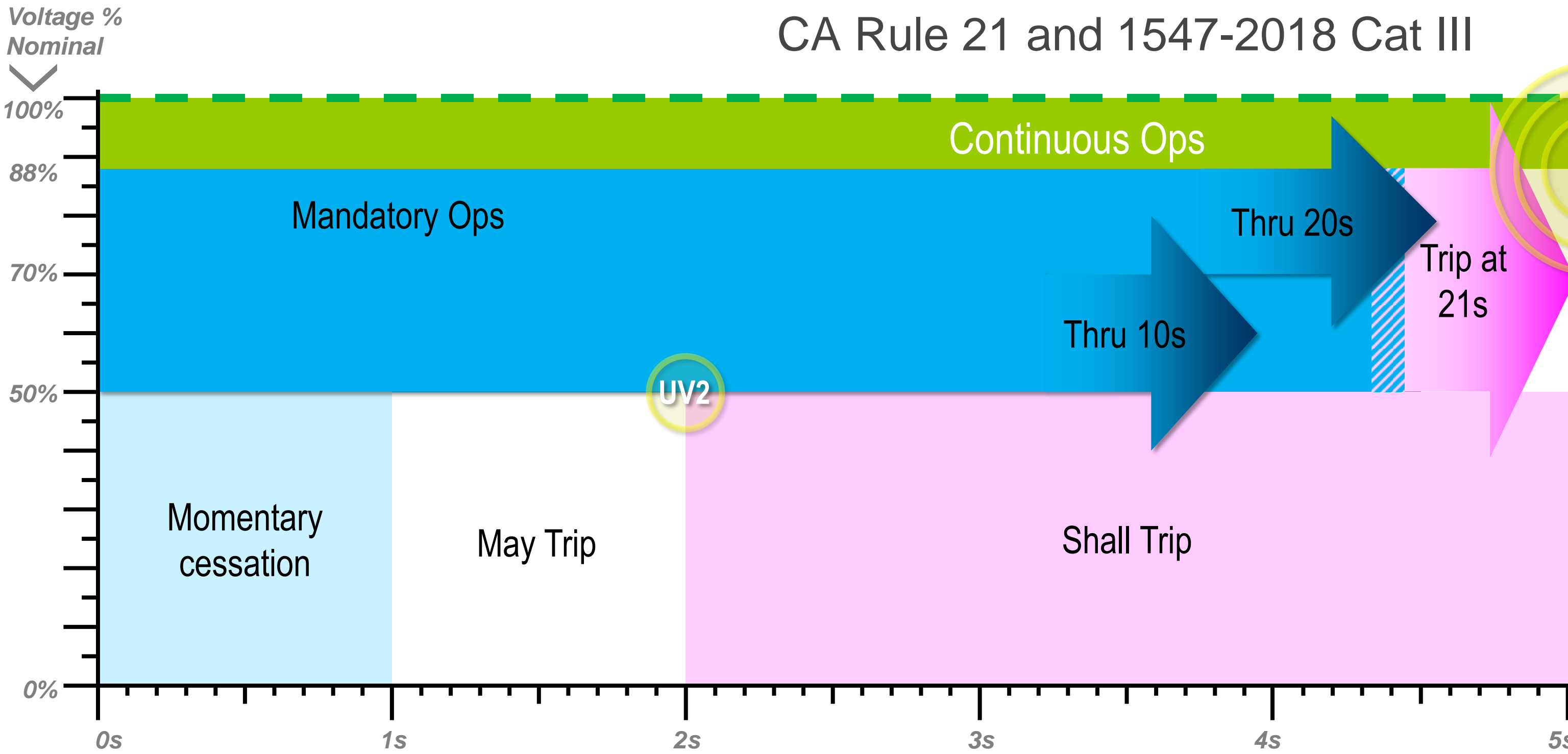
STRAW PROPOSAL v3 Option B w/ IEEE 1547-2003 Overlay



STRAW PROPOSAL v3 Option B w/ NERC PRC-024 Overlay

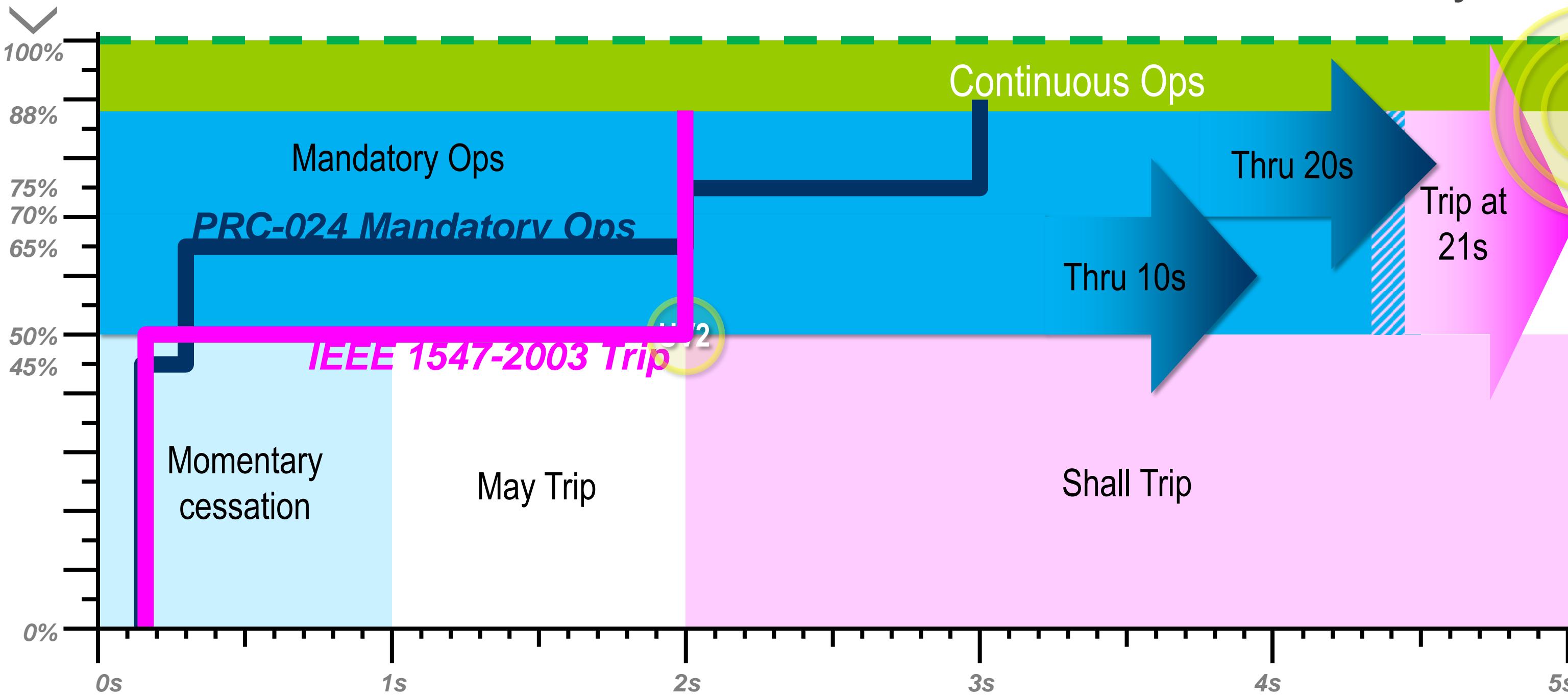


CA Rule 21 and 1547-2018 Cat III

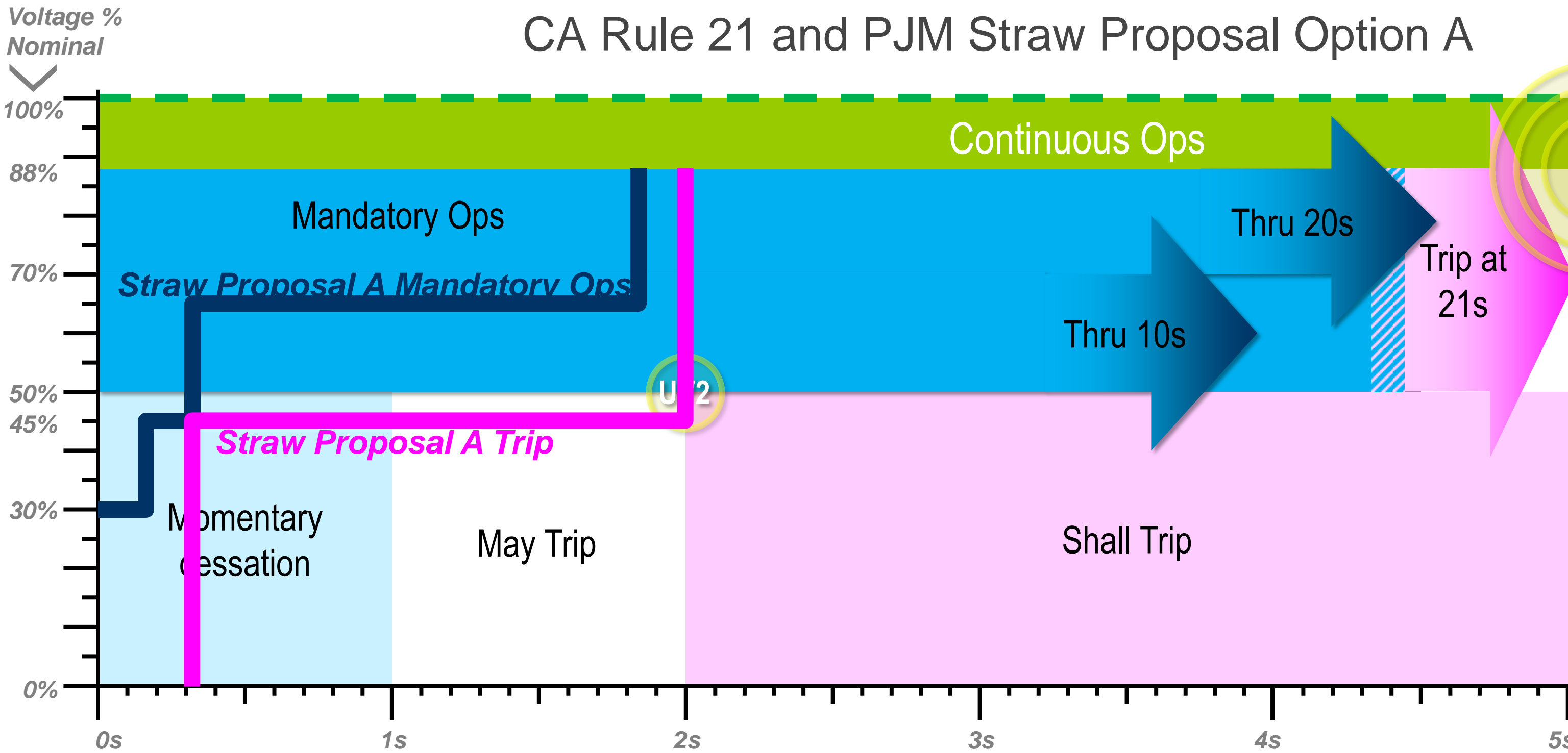


Voltage %
Nominal

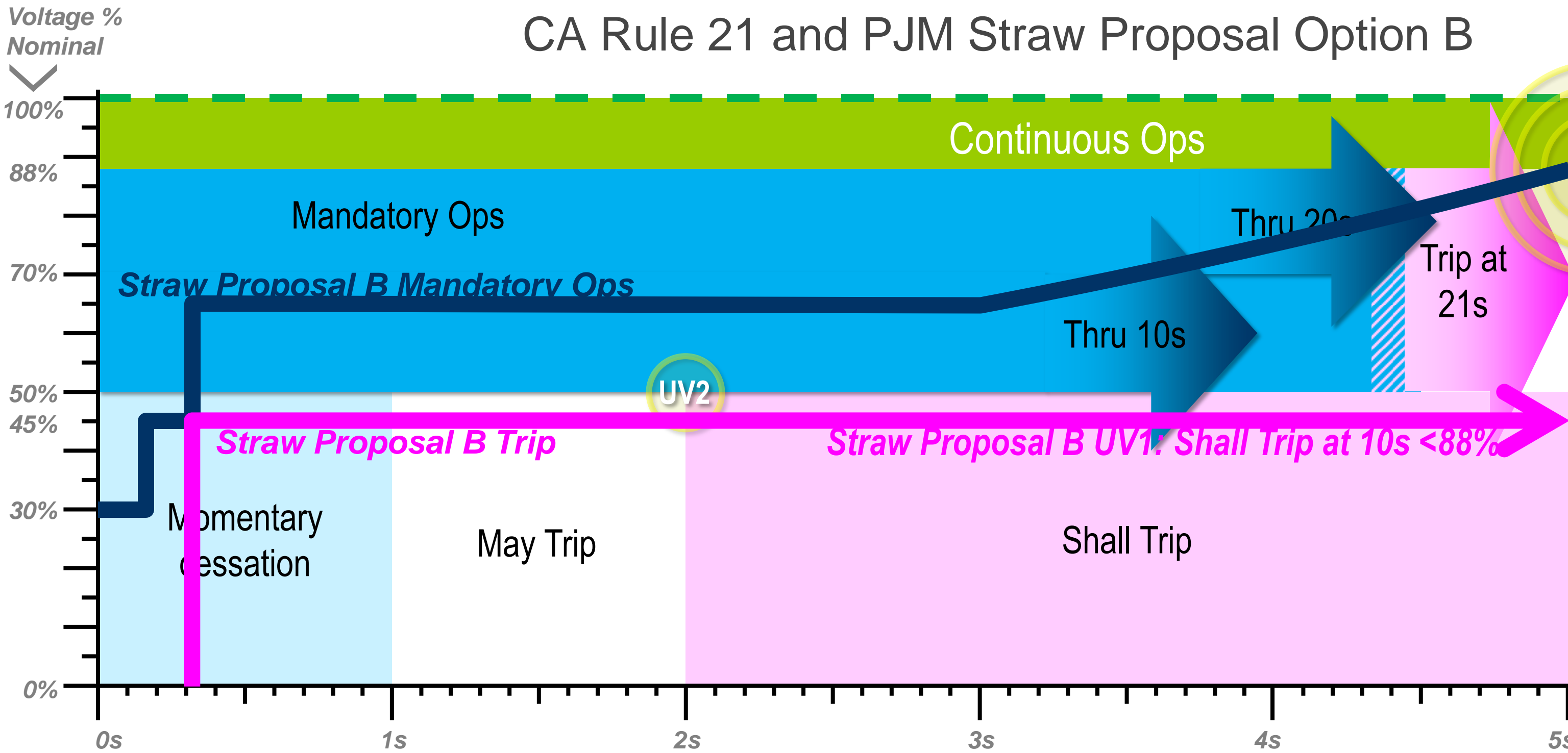
CA Rule 21 and 1547-2018 Cat III w/ IEEE 1547-2003 and PRC-024 Overlay



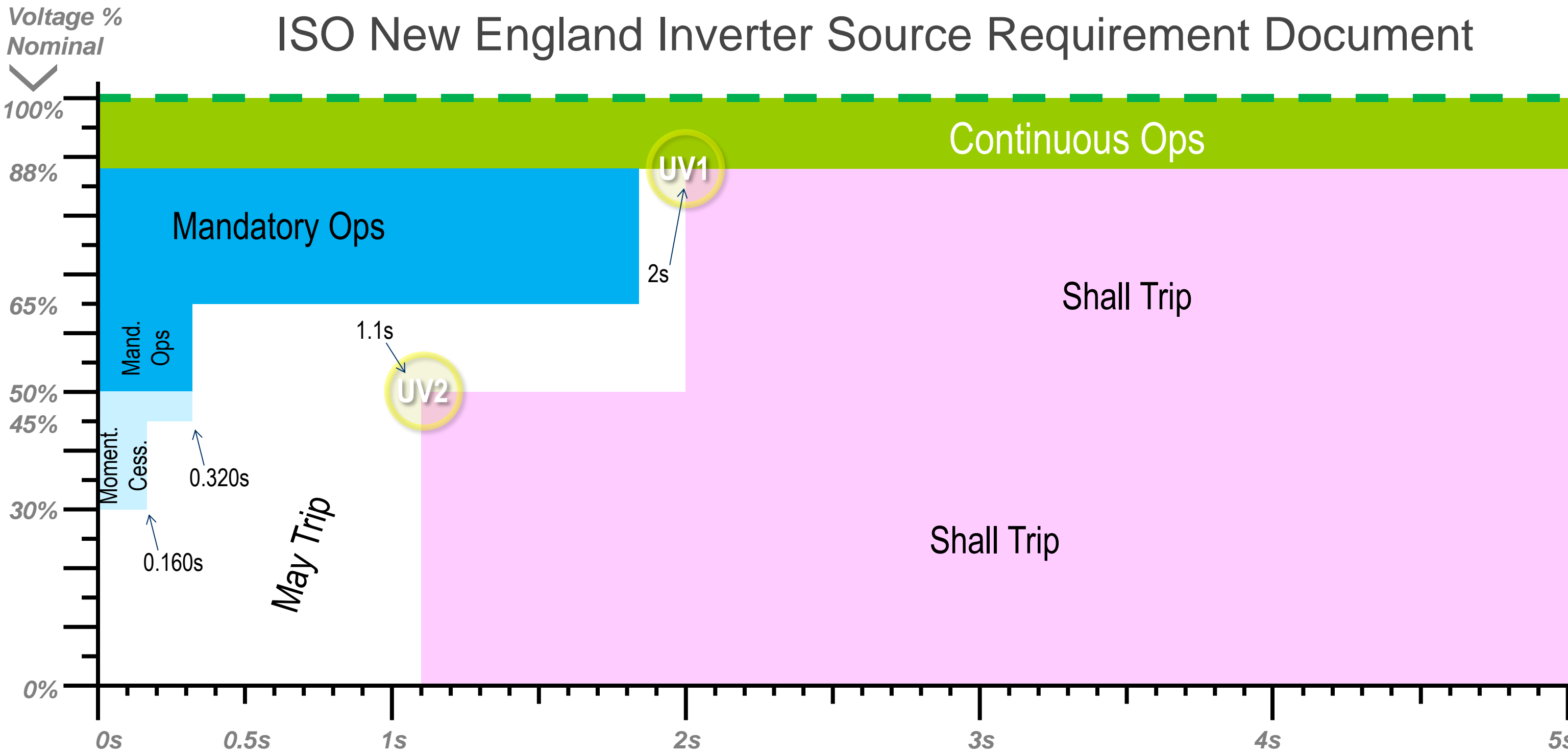
CA Rule 21 and PJM Straw Proposal Option A



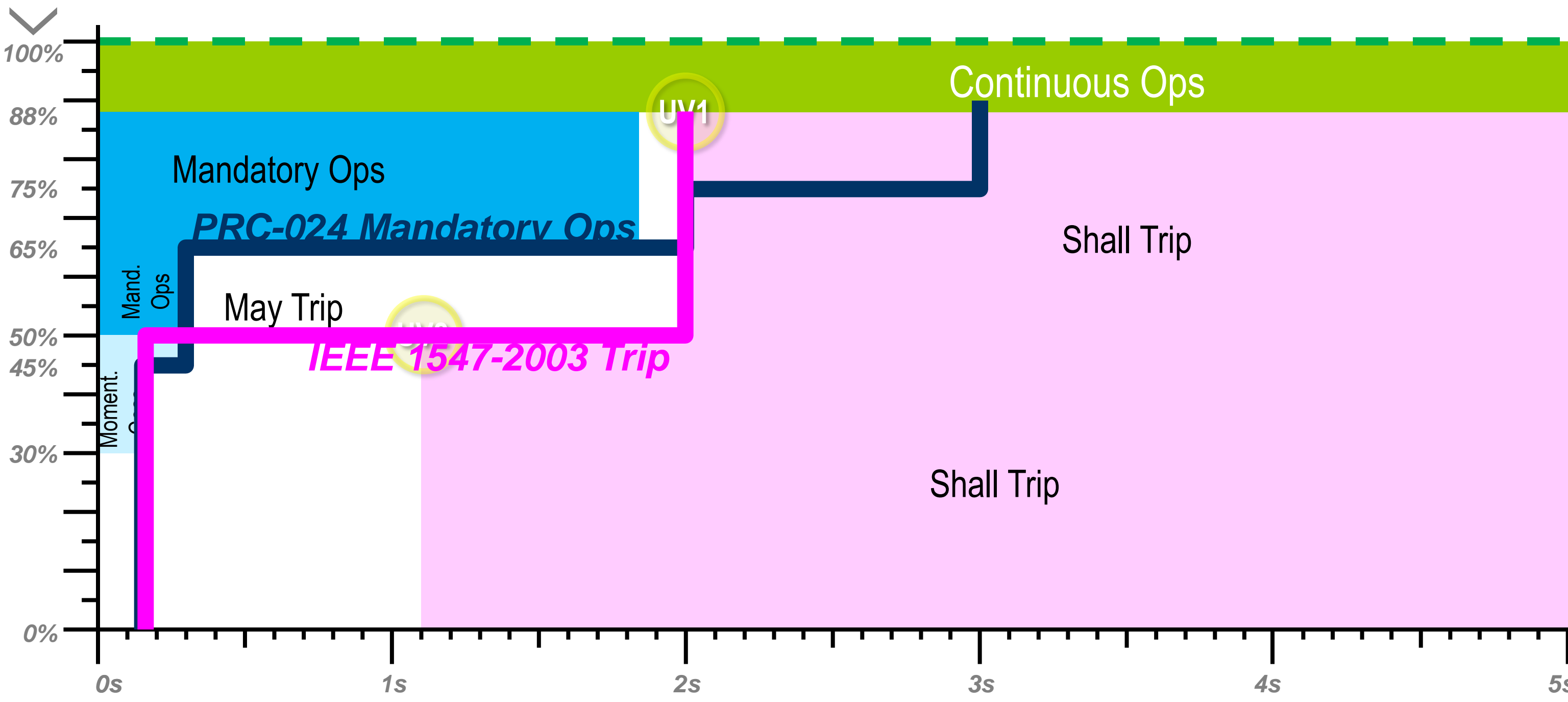
CA Rule 21 and PJM Straw Proposal Option B



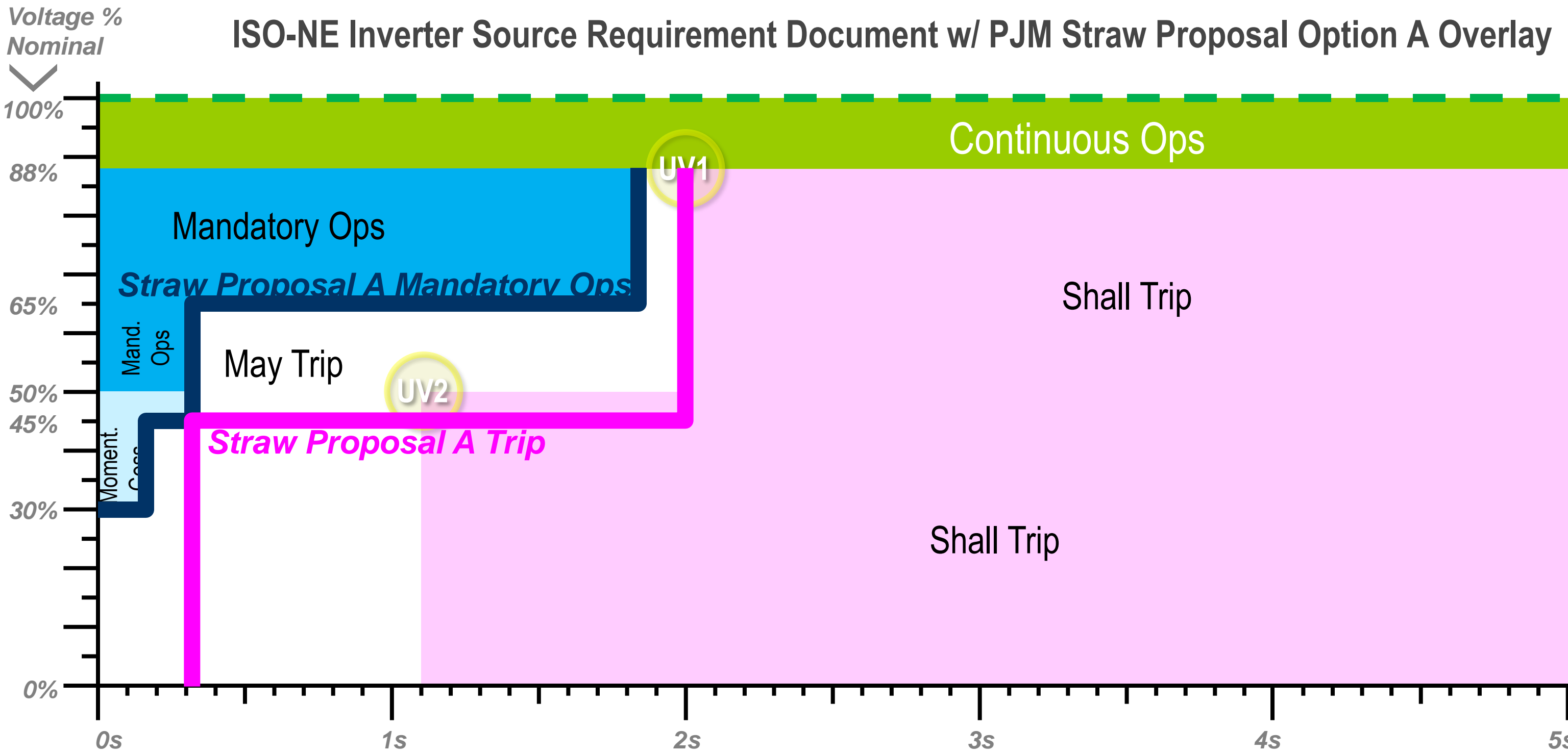
ISO New England Inverter Source Requirement Document



ISO-NE Inverter Source Requirement Document w/ IEEE 1547-2003 and PRC-024 Overlay



ISO-NE Inverter Source Requirement Document w/ PJM Straw Proposal Option A Overlay



ISO-NE Inverter Source Requirement Document w/ PJM Straw Proposal Option B Overlay

