



# Solutions Matrix and Ride Through and Trip Envelopes, Including PJM Straw Proposal v3 and ComEd Smart Inverter Tariff

Andrew Levitt  
Senior Business Solution Architect  
Applied Innovation  
PJM DER Ride Through Task Force  
April 2, 2019

- Implementation – the interim “Source Requirements Document” path via UL1741SA vs. the final IEEE 1547-2018 path.
- IEEE 1547-2018 Abnormal Conditions Category – Adding Category III
- UV1 – Adding trip points from ComEd (they have two - 11 seconds and 21 seconds).
- UV2 – Adding trip points from ISO New England (1.1 seconds), ComEd (1.5 seconds), and 1547 Category III (2 seconds).
- Adding ISO New England momentary cessation and mandatory operation threshold of 50%.
- OV1 and OV2 – Adding 1547 Category III defaults.

1. ComEd Smart Inverter tariff rider and similar options within 1547-2018 framework
2. PJM Straw Proposal v3 Options A
3. ISO New England Inverter Source Requirement Document (IEEE 1547-2018 Cat II)

## APPENDIX

1. IEEE 1547-2003
2. NERC PRC-024-02
3. PJM Straw Proposal v3 Option B (IEEE 1547-2018 Cat II)
4. California Rule 21 and IEEE 1547-2018 Cat III

## 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.

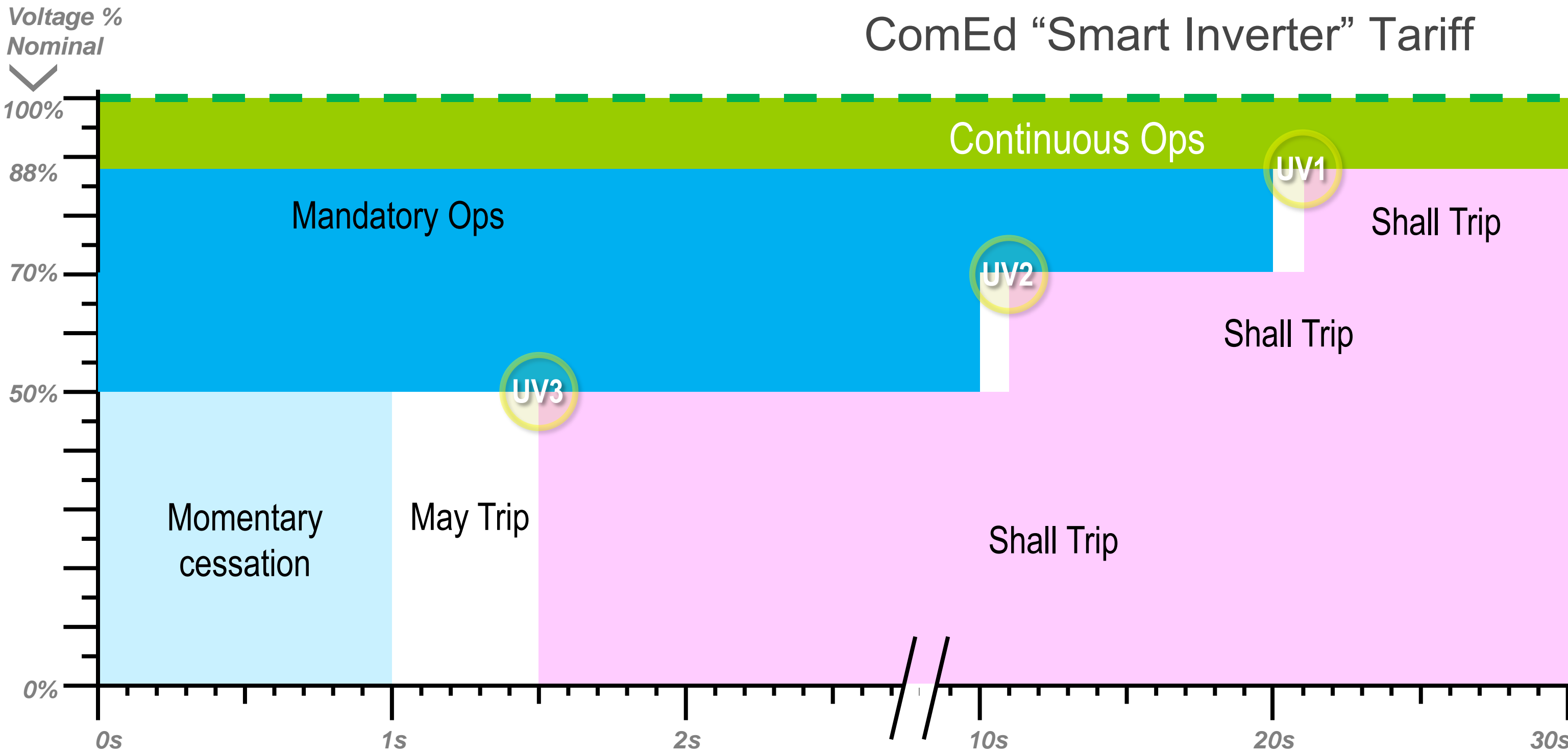
Similar concern for Distribution Automation to avoid reclosing into an island

## System Protection

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

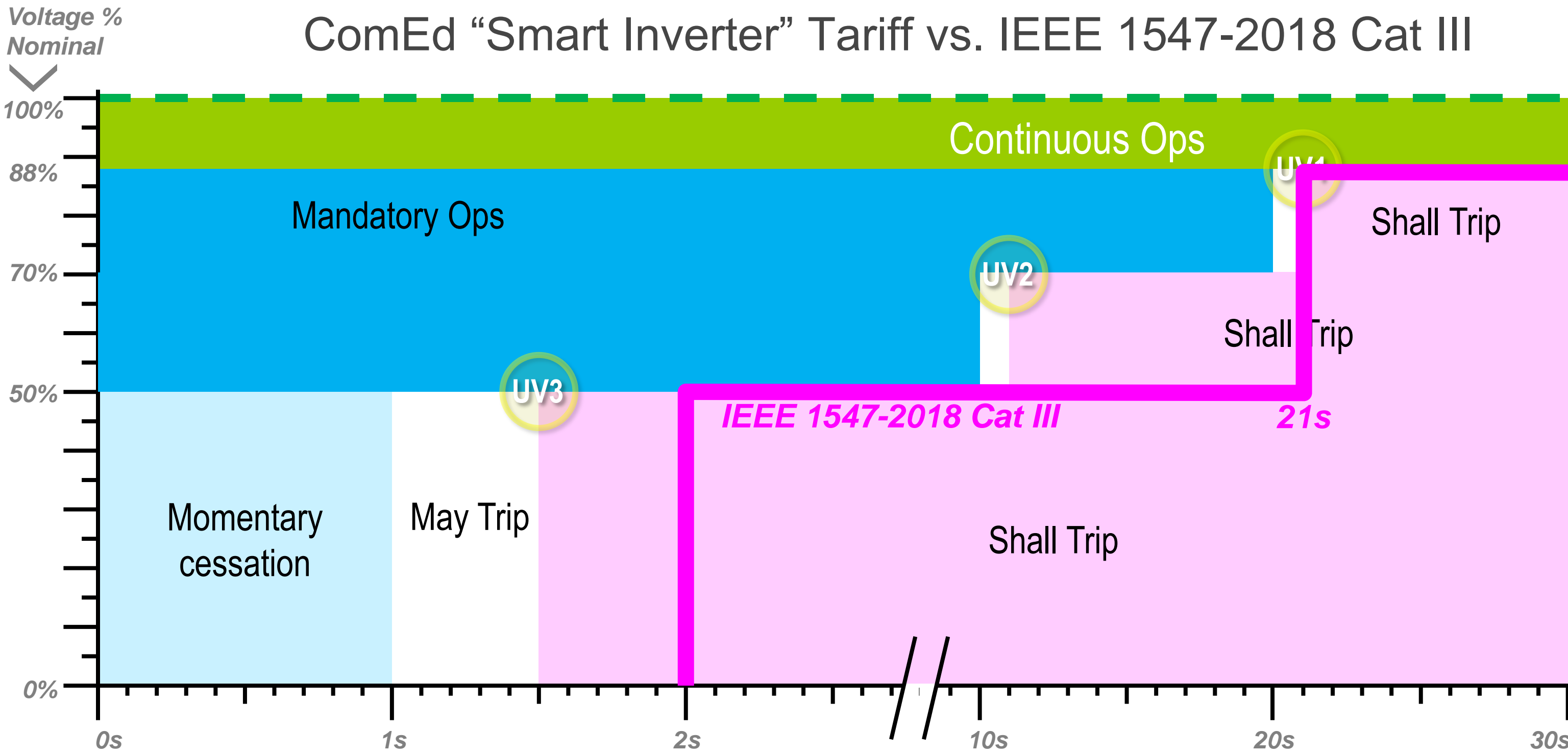
- **Mandatory Ops** = Ride through, don't trip, continue to supply power.
- **Momentary Cessation** = Ride through, don't trip, stop supplying power within 83ms and then come back 400ms after conditions return to normal.
- **Shall Trip** = Stop supplying power immediately and stay offline for at least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

# ComEd "Smart Inverter" Tariff



<https://www.comed.com/SiteCollectionDocuments/MyAccount/MyBillUsage/CurrentRates/Ratebook.pdf> page 659 of PDF

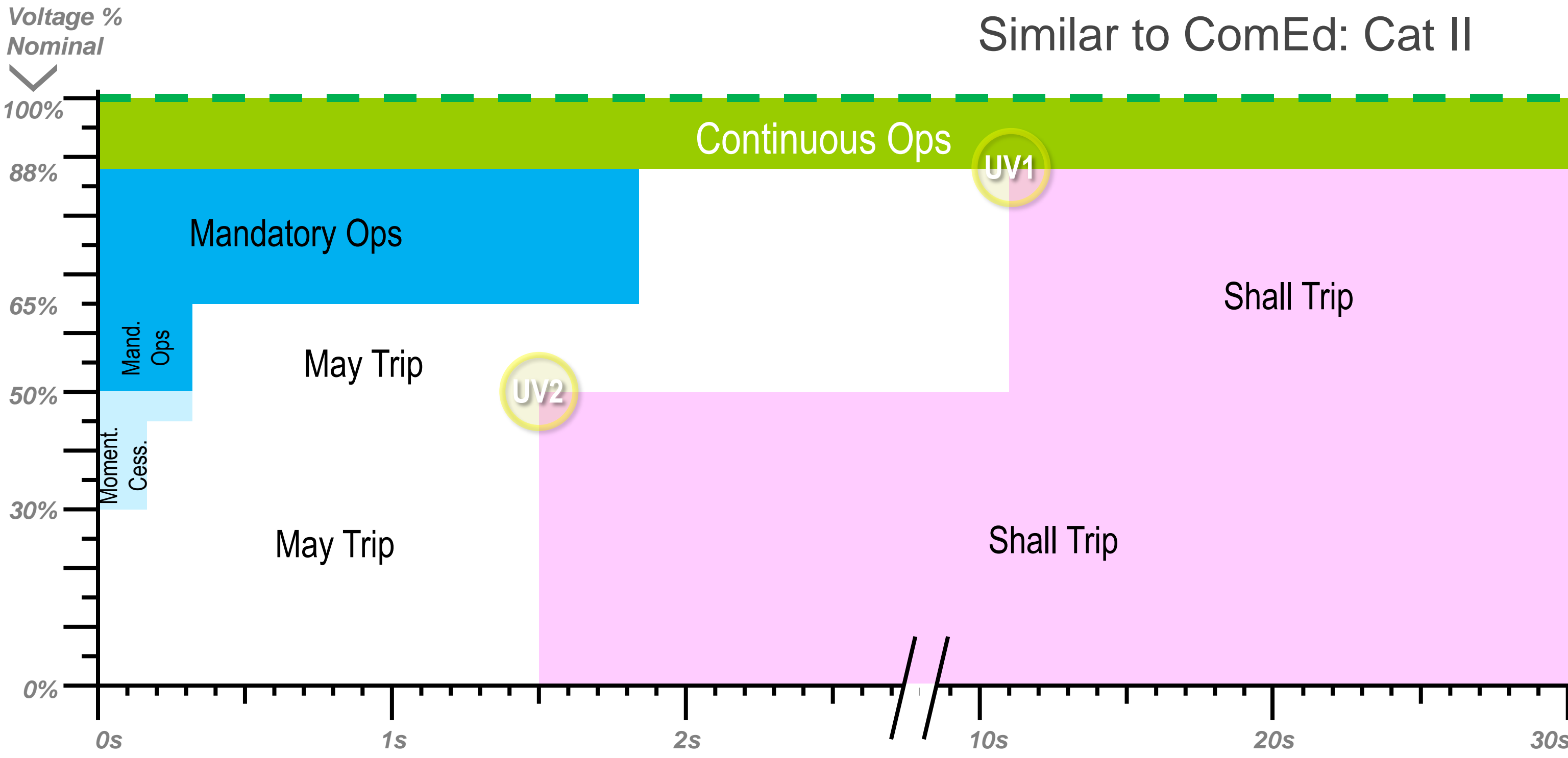
# ComEd "Smart Inverter" Tariff vs. IEEE 1547-2018 Cat III



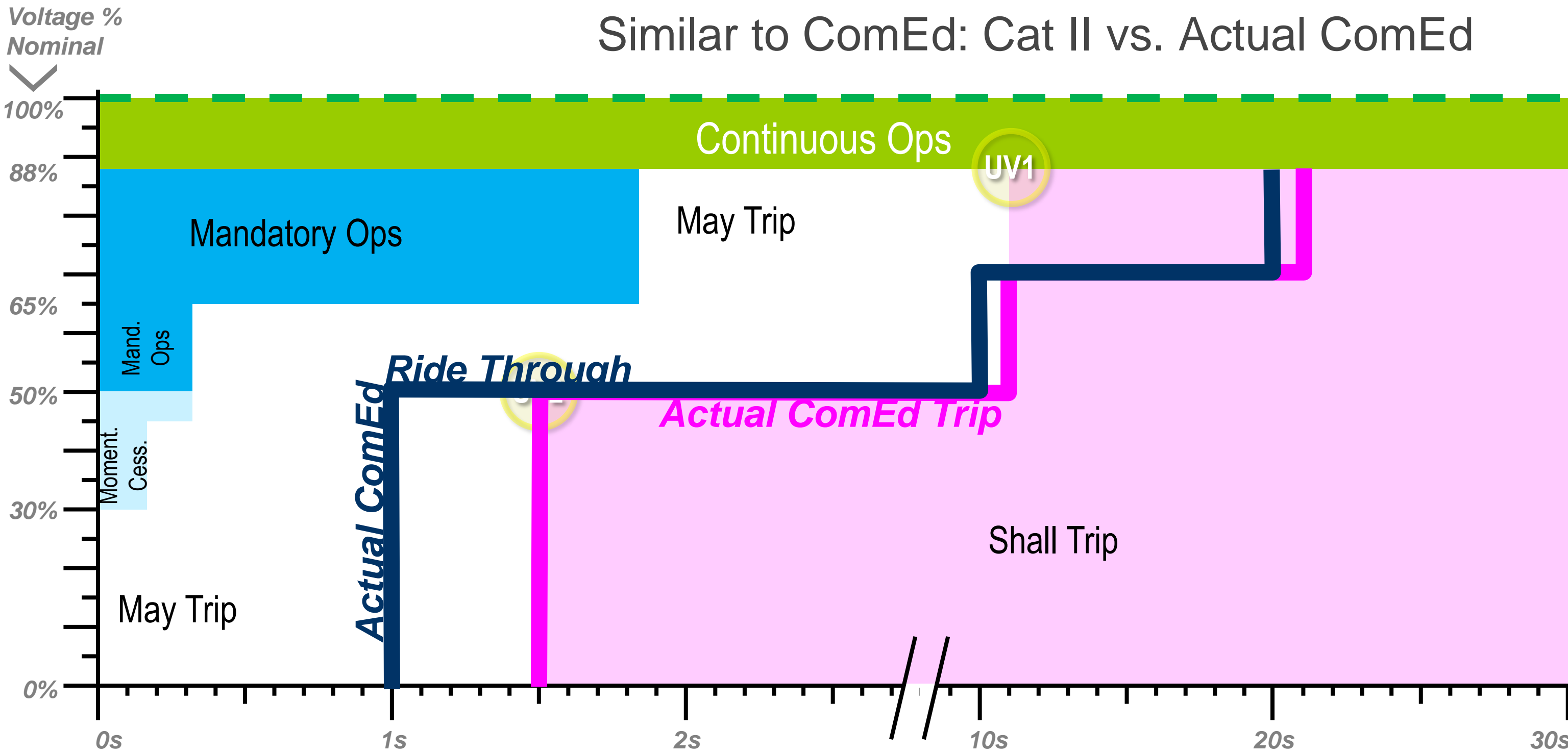
<https://www.comed.com/SiteCollectionDocuments/MyAccount/MyBillUsage/CurrentRates/Ratebook.pdf> page 659 of PDF



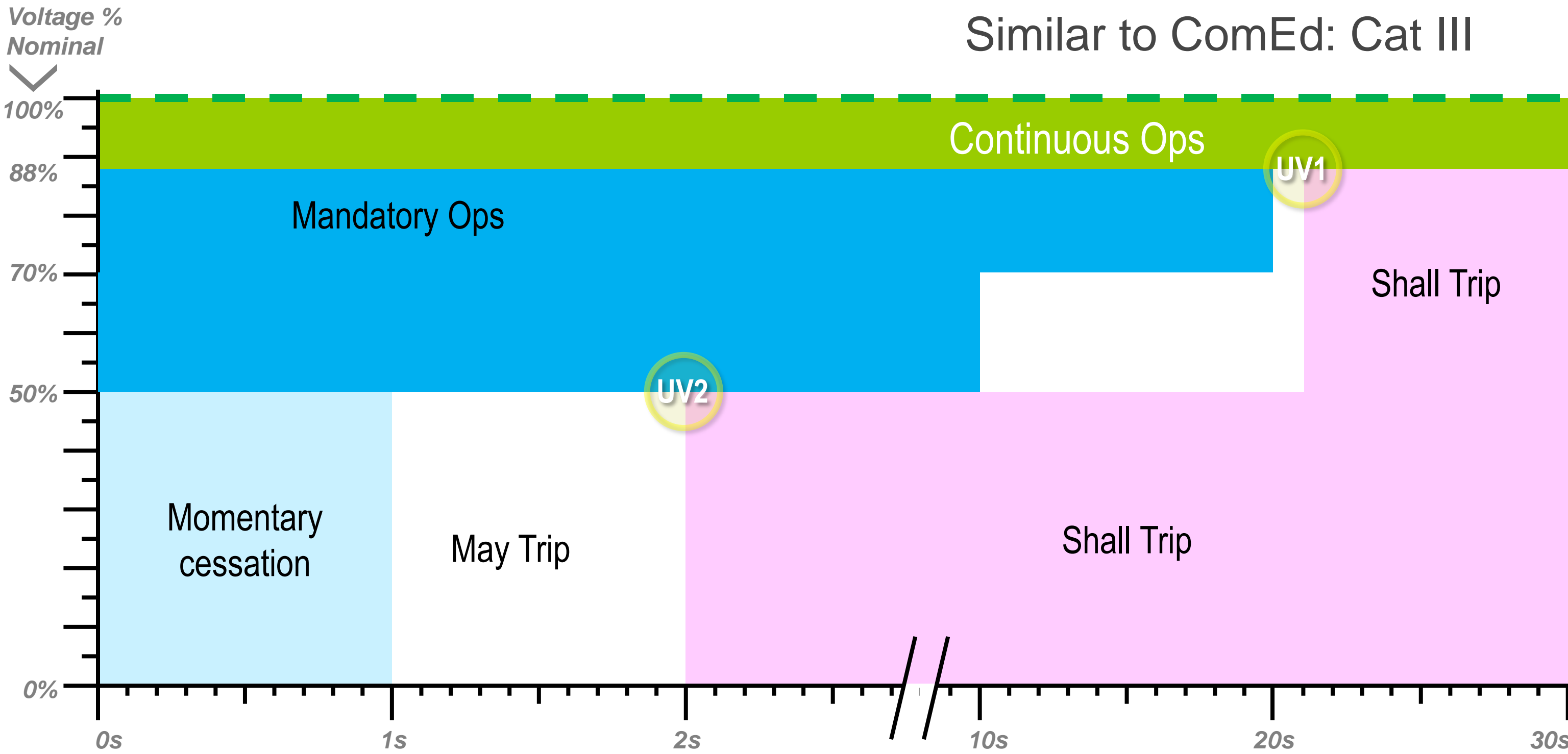
# Similar to ComEd: Cat II



# Similar to ComEd: Cat II vs. Actual ComEd

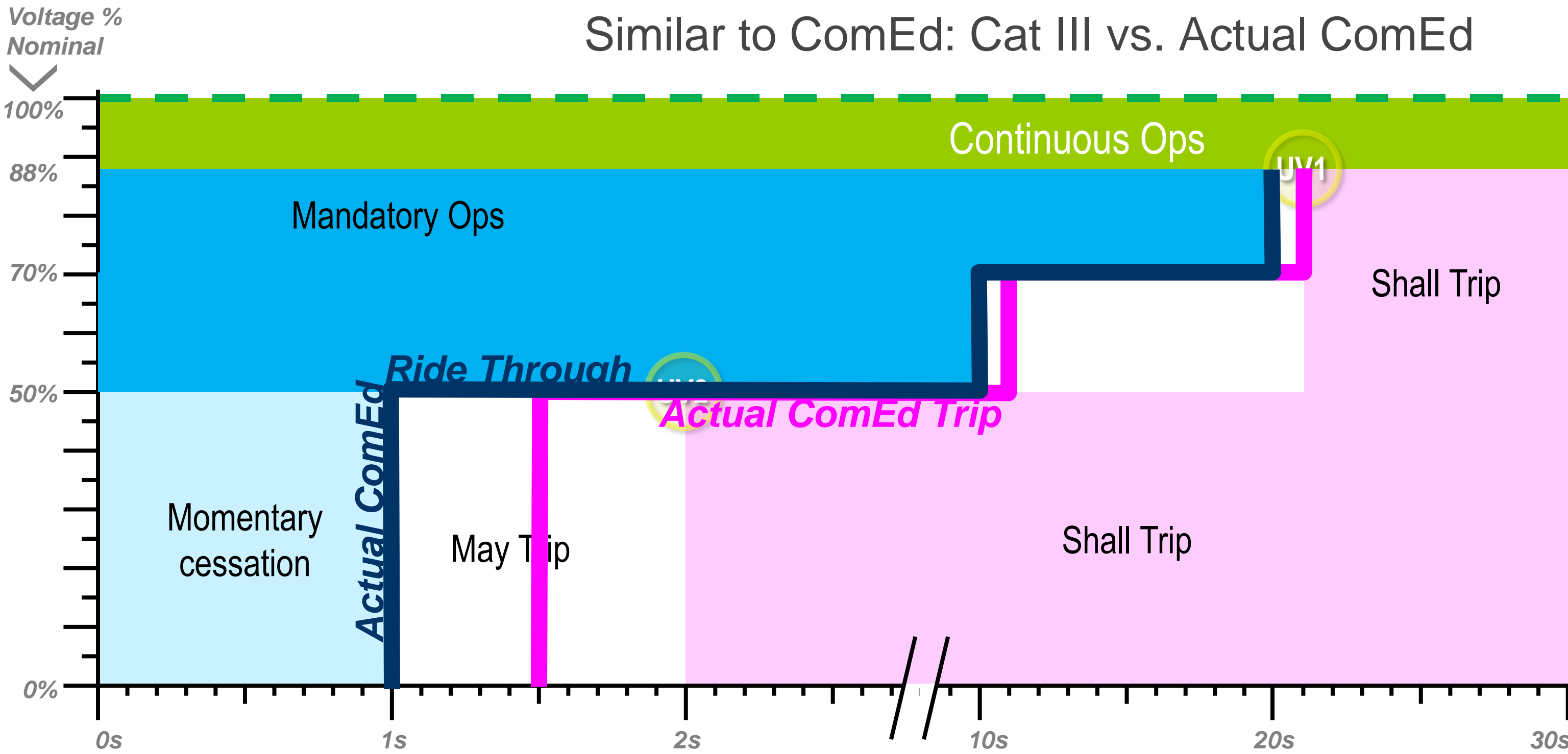


# Similar to ComEd: Cat III



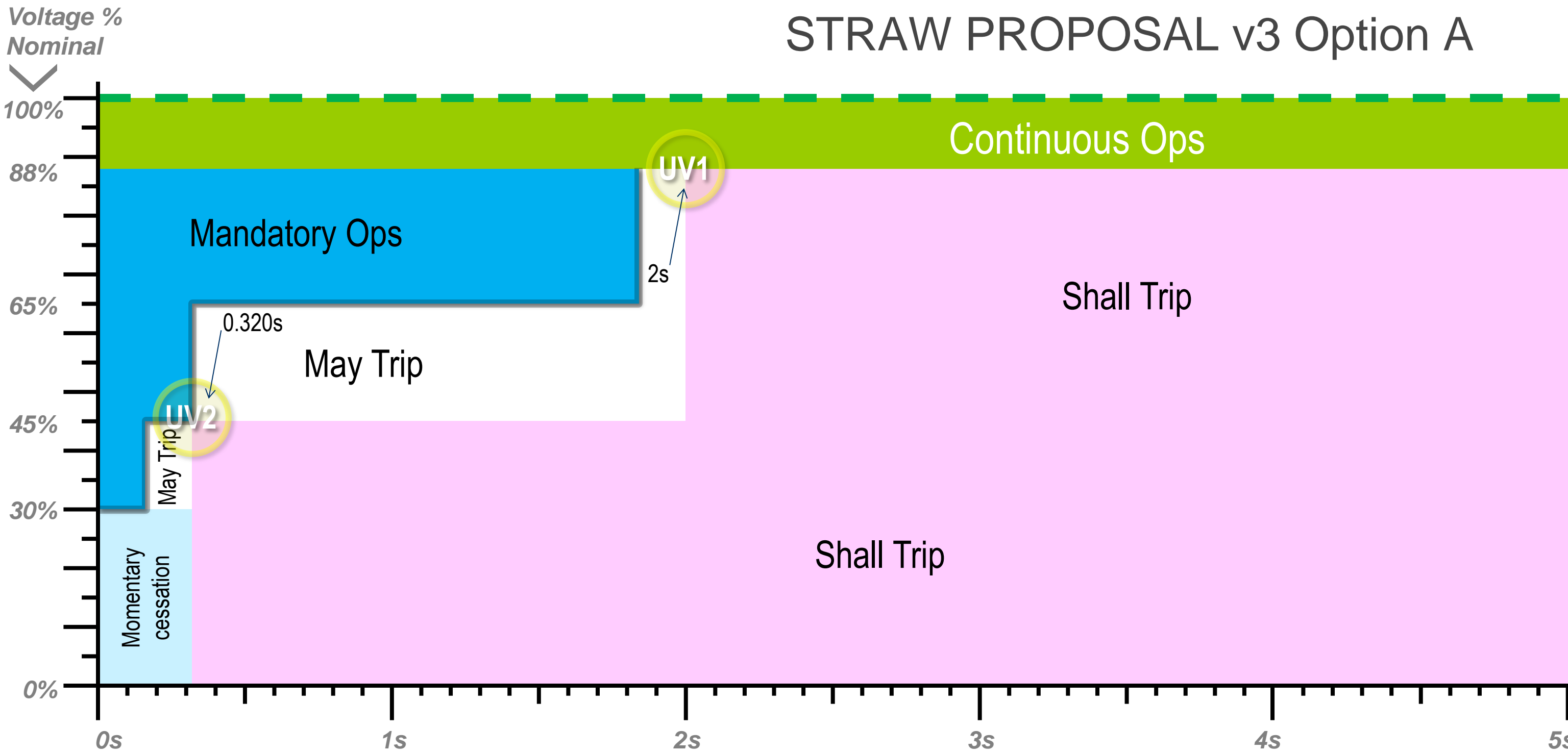
<https://www.comed.com/SiteCollectionDocuments/MyAccount/MyBillUsage/CurrentRates/Ratebook.pdf> page 659 of PDF

# Similar to ComEd: Cat III vs. Actual ComEd

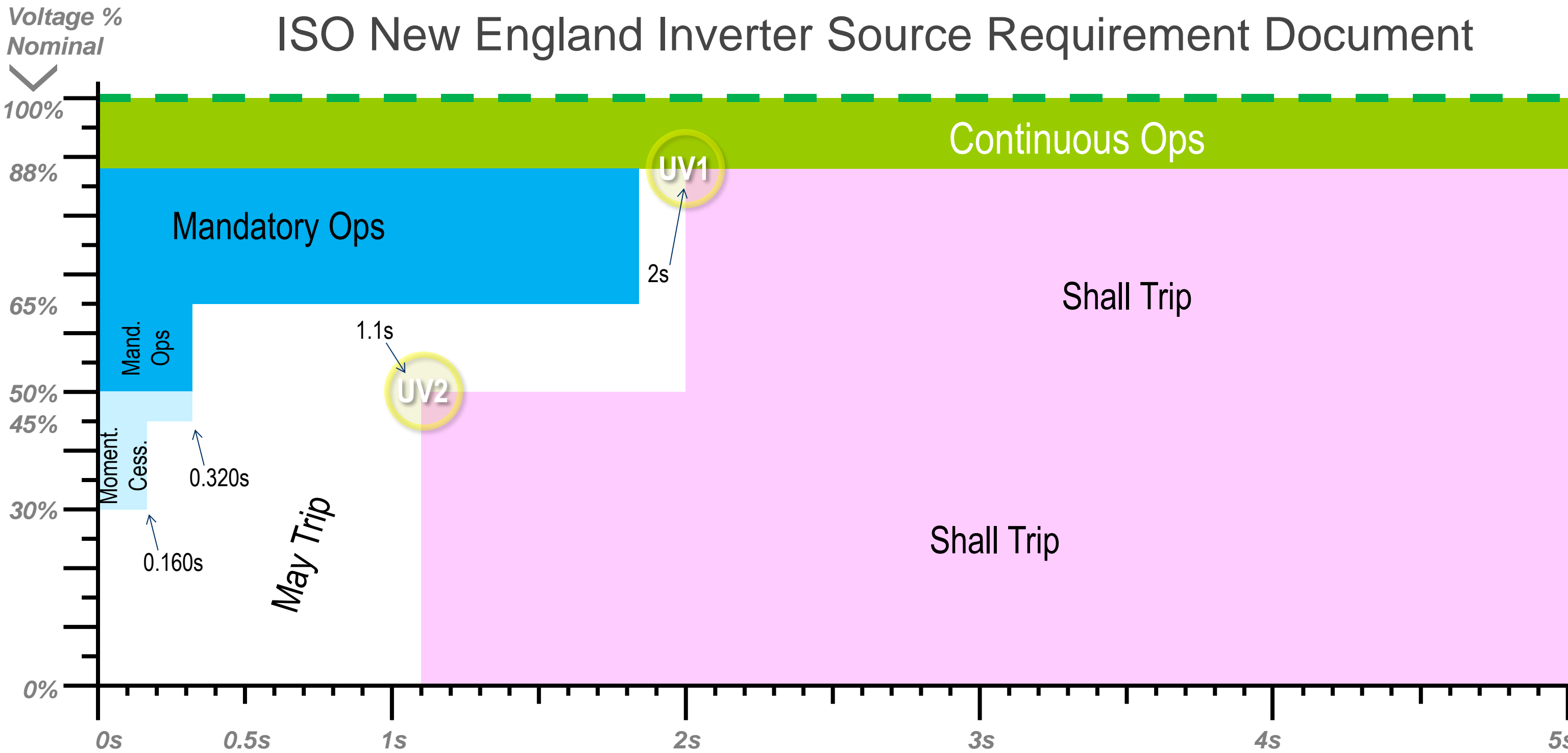


<https://www.comed.com/SiteCollectionDocuments/MyAccount/MyBillUsage/CurrentRates/Ratebook.pdf> page 659 of PDF

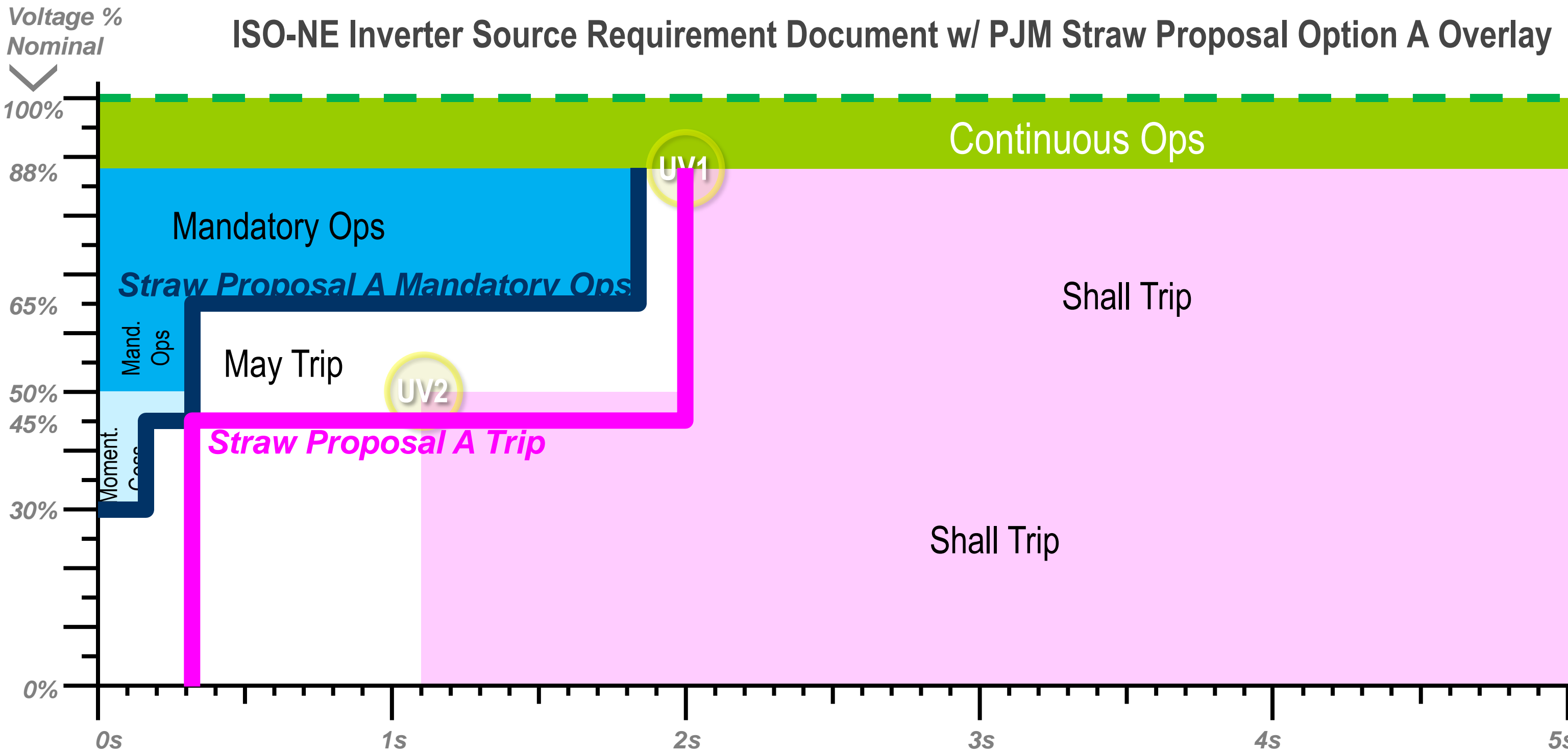
# STRAW PROPOSAL v3 Option A



# ISO New England Inverter Source Requirement Document



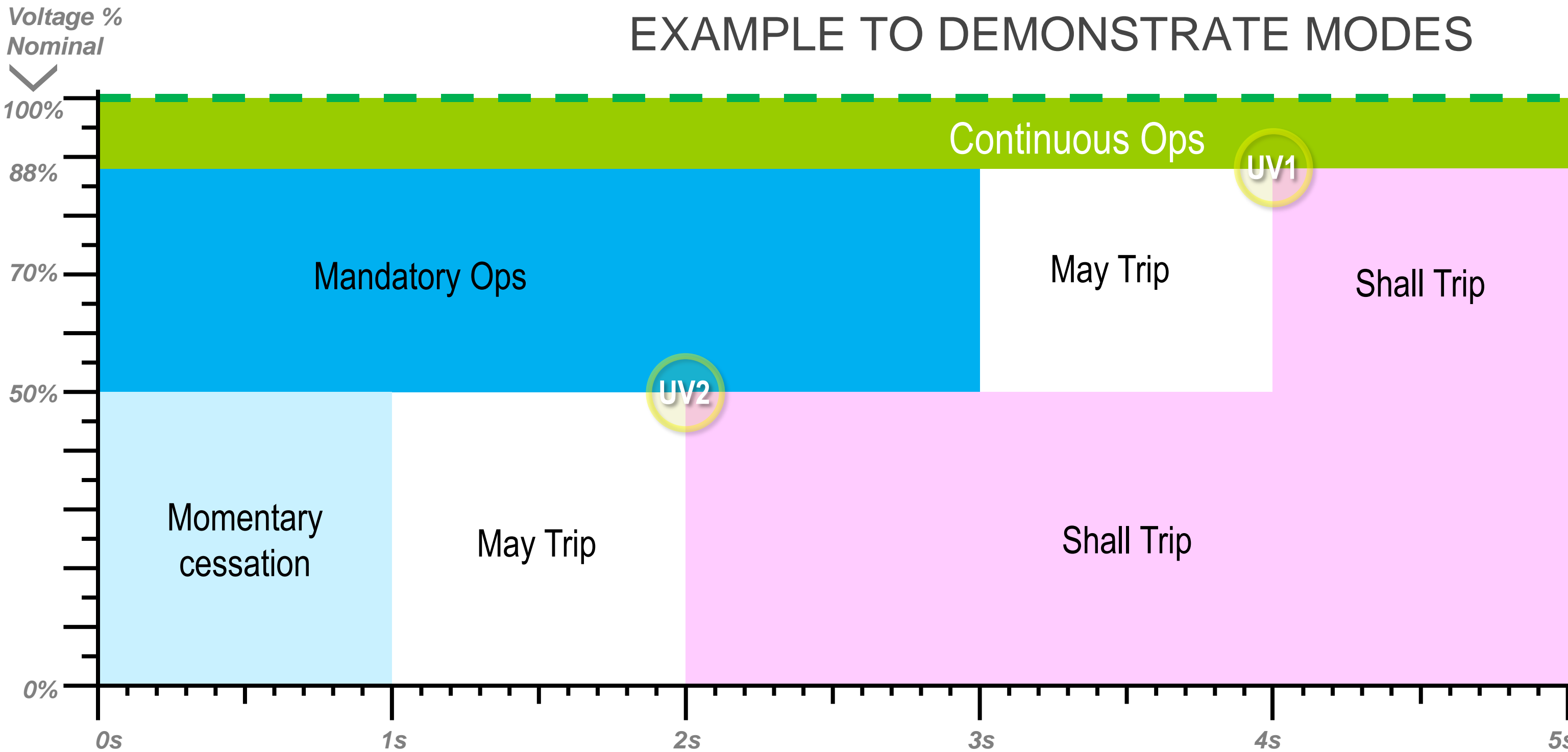
# ISO-NE Inverter Source Requirement Document w/ PJM Straw Proposal Option A Overlay

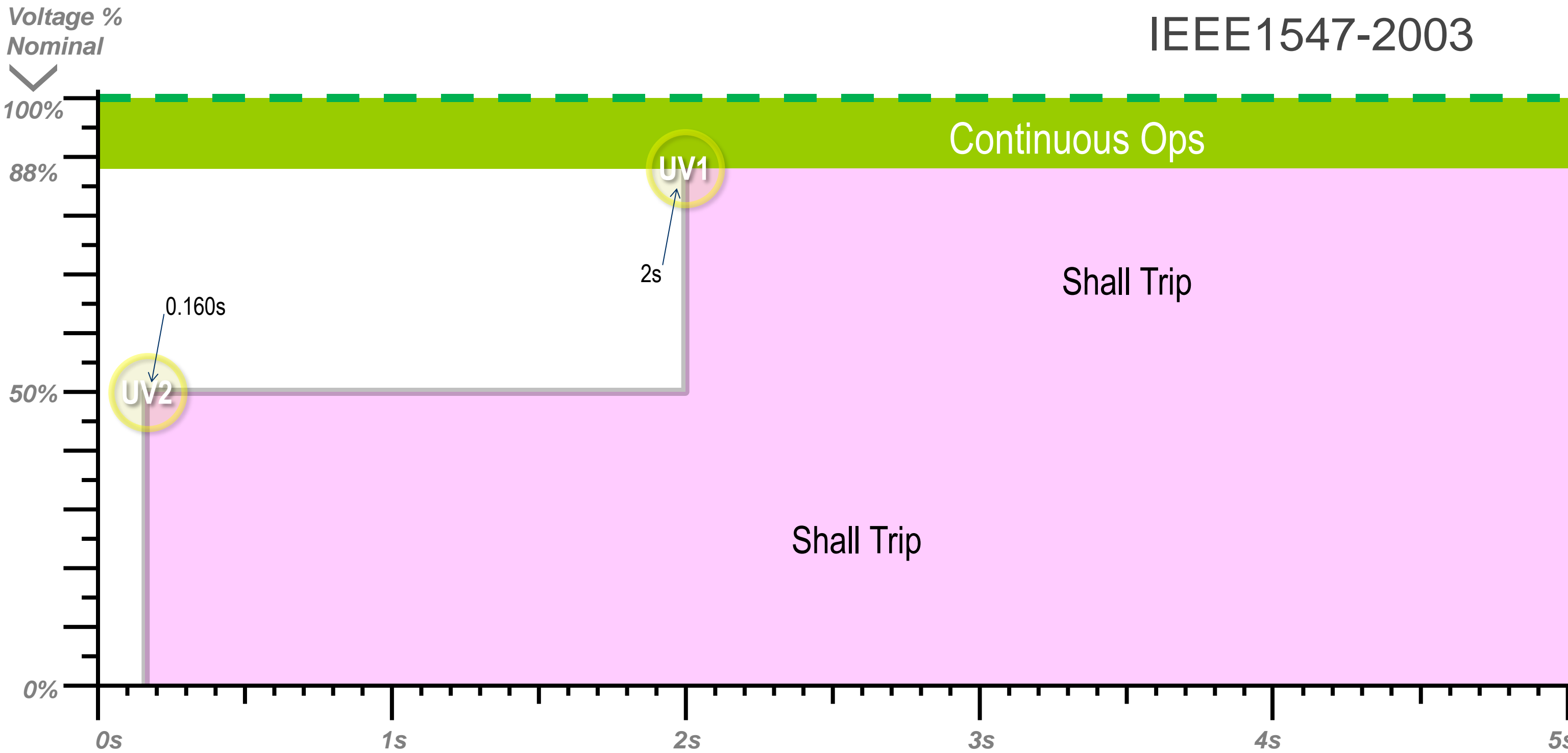


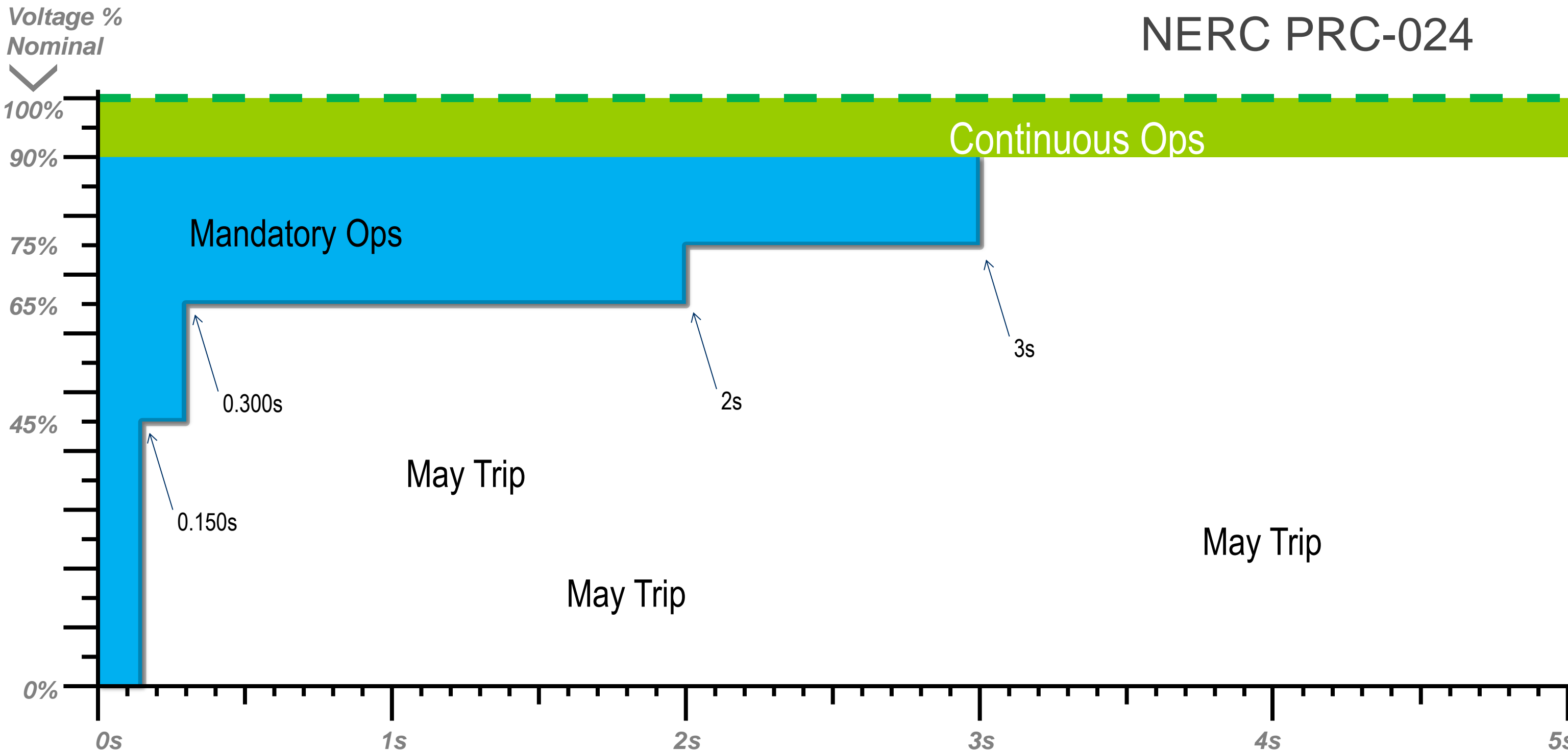
# APPENDIX



# EXAMPLE TO DEMONSTRATE MODES







Continuous Ops

Mandatory Ops

May Trip

May Trip

May Trip

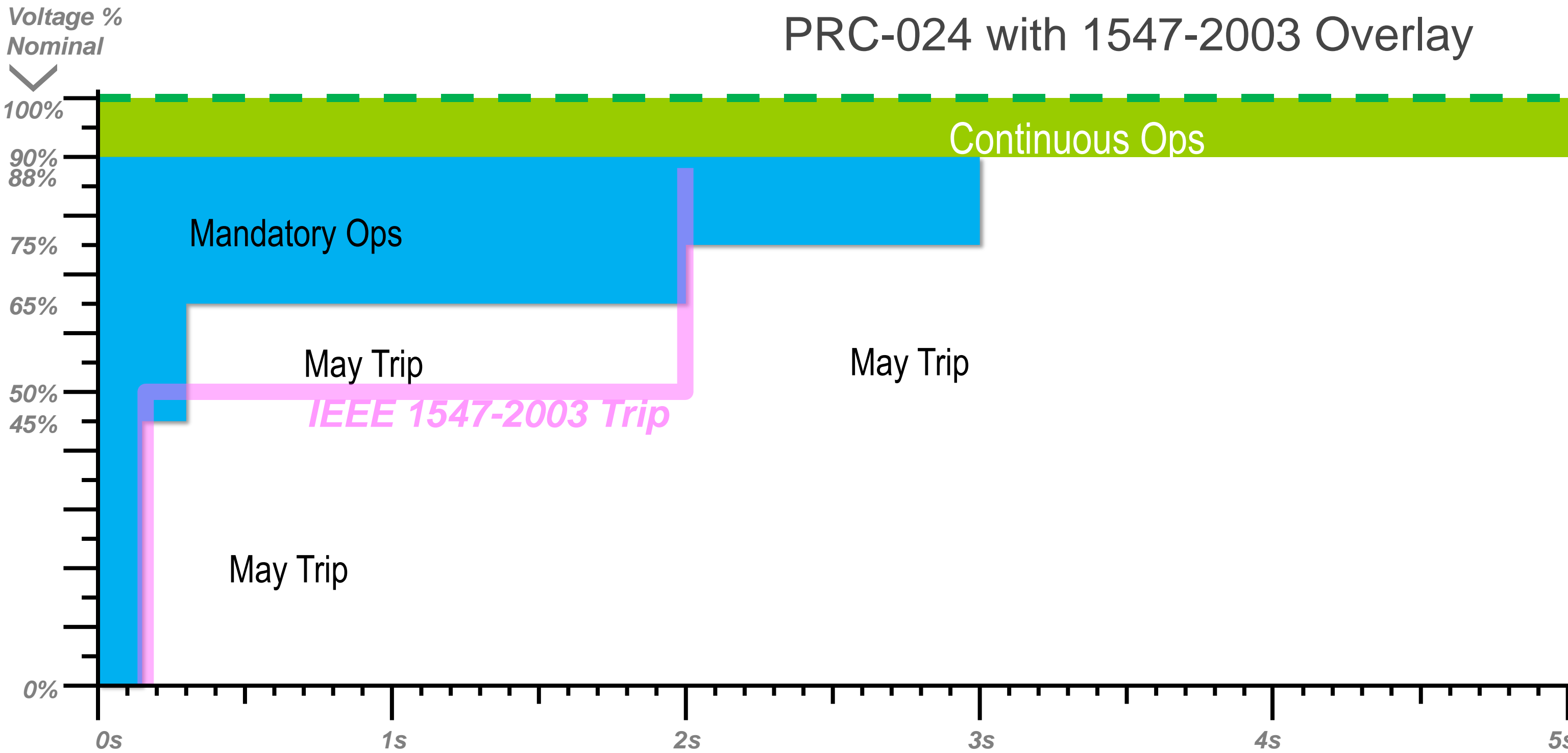
0.300s

0.150s

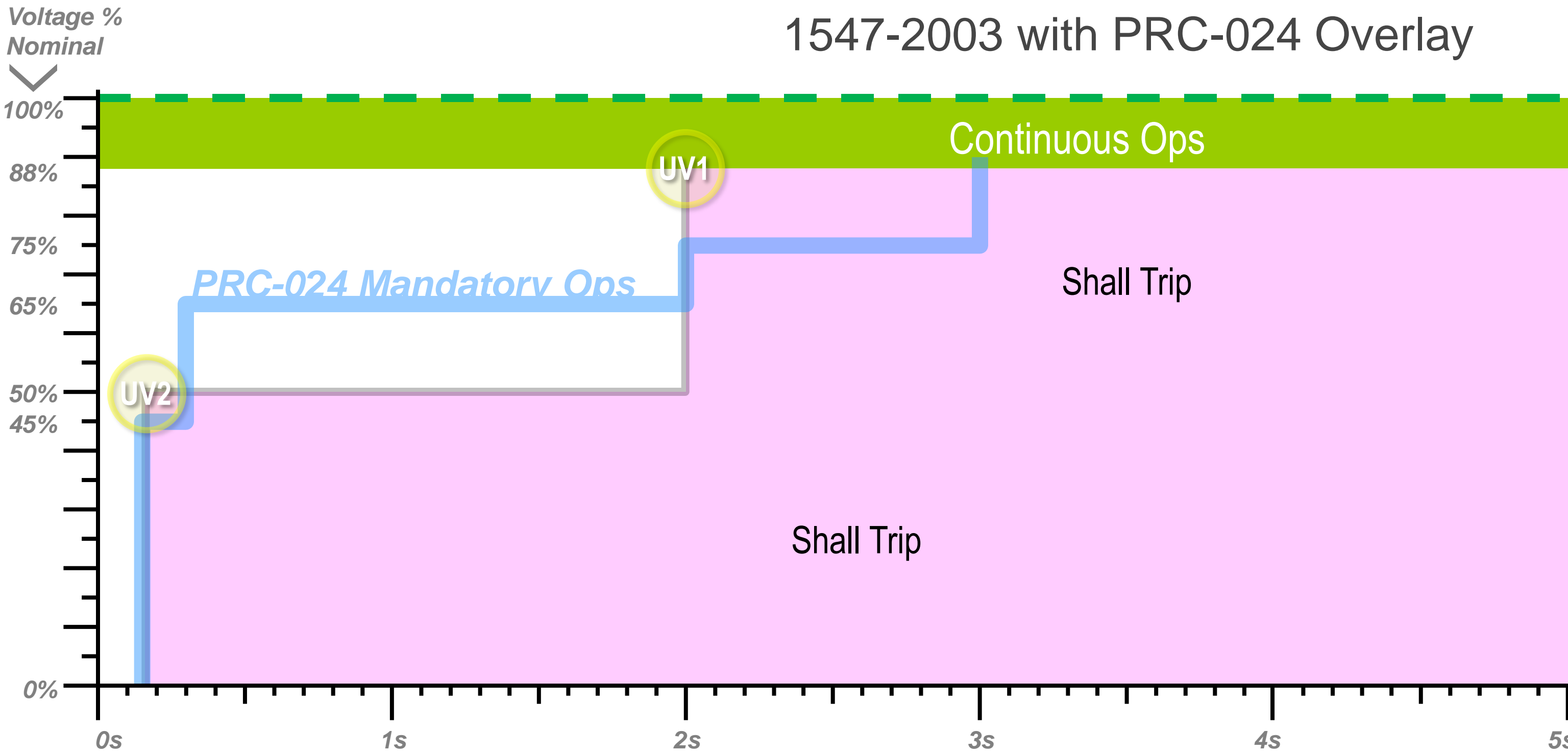
2s

3s

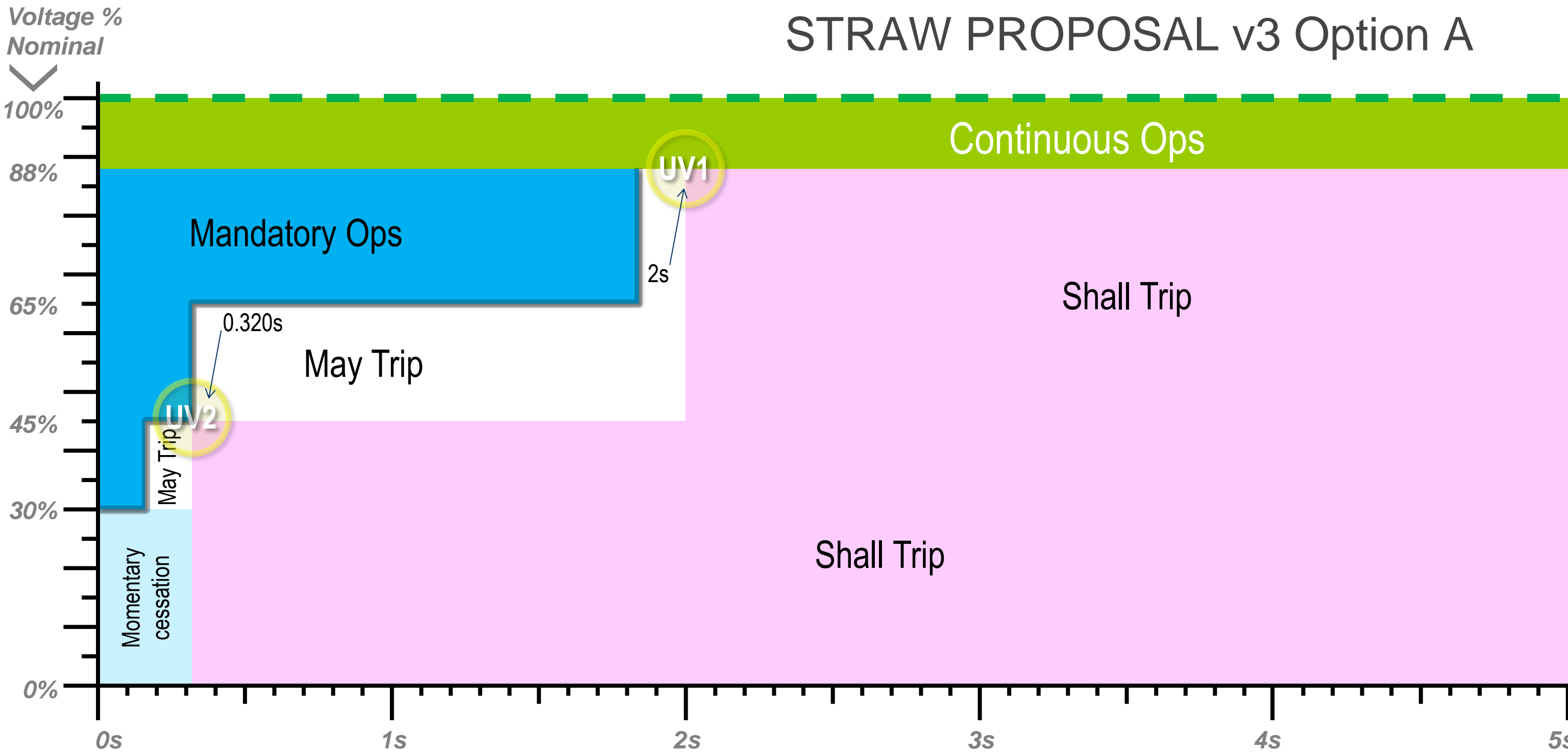
# PRC-024 with 1547-2003 Overlay



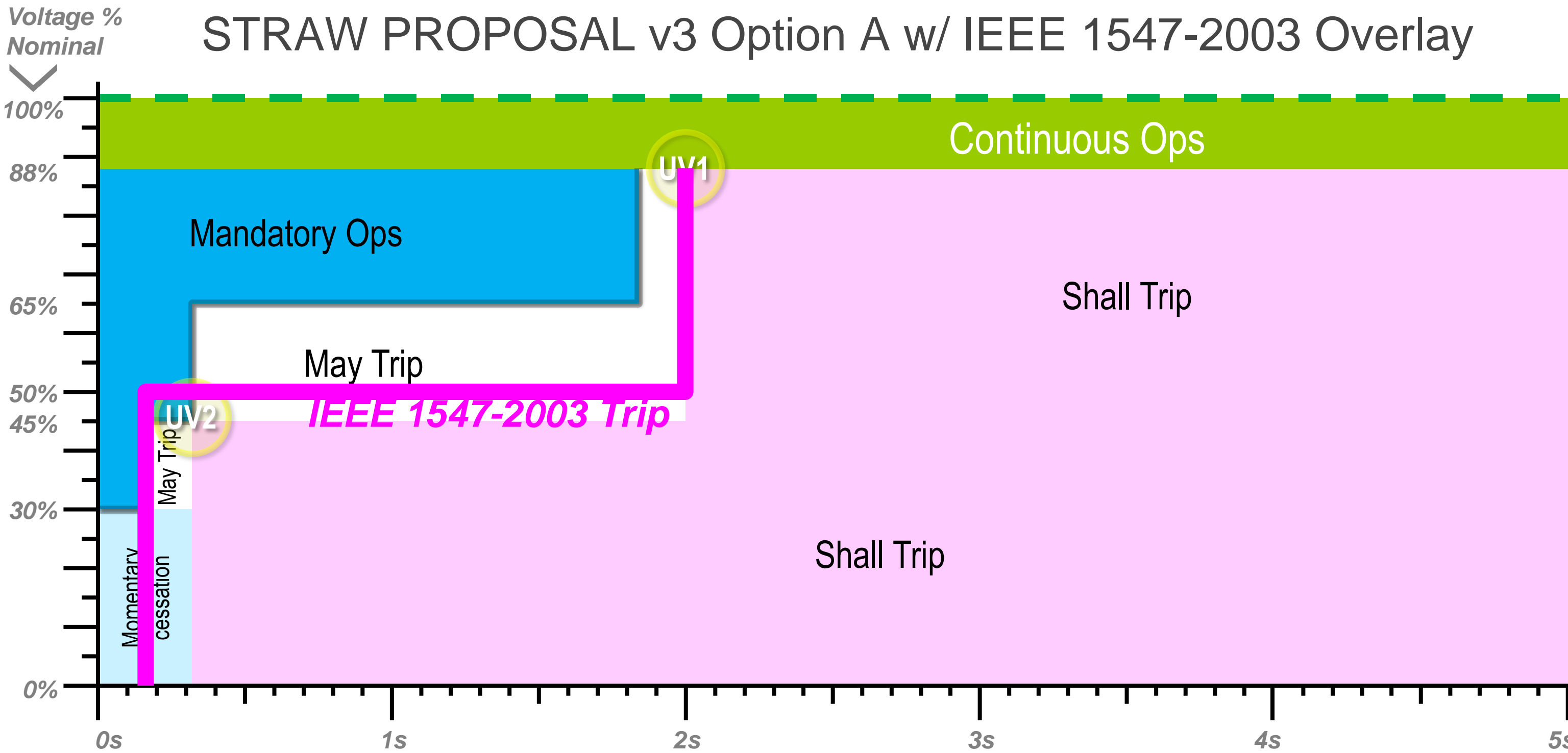
# 1547-2003 with PRC-024 Overlay



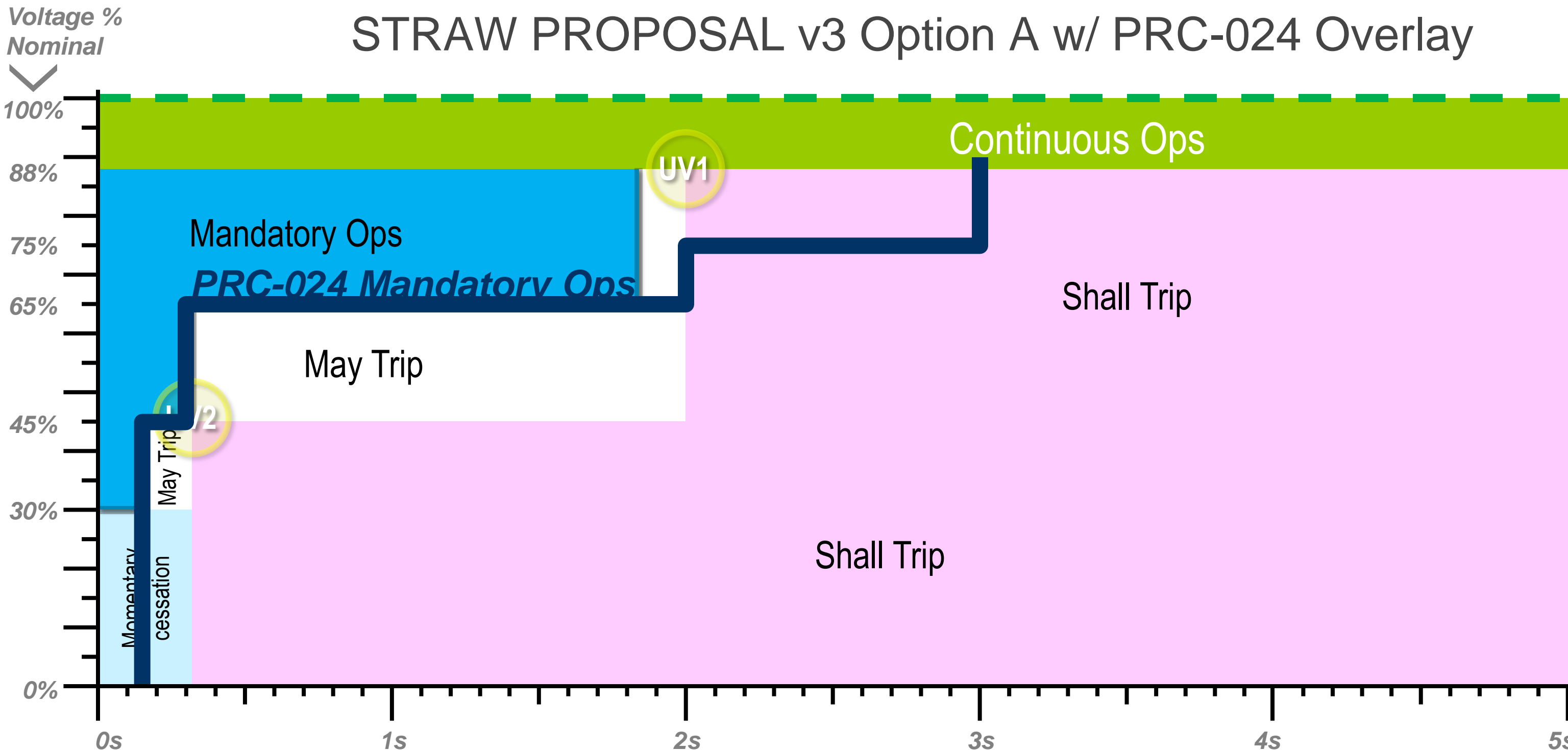
# STRAW PROPOSAL v3 Option A



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

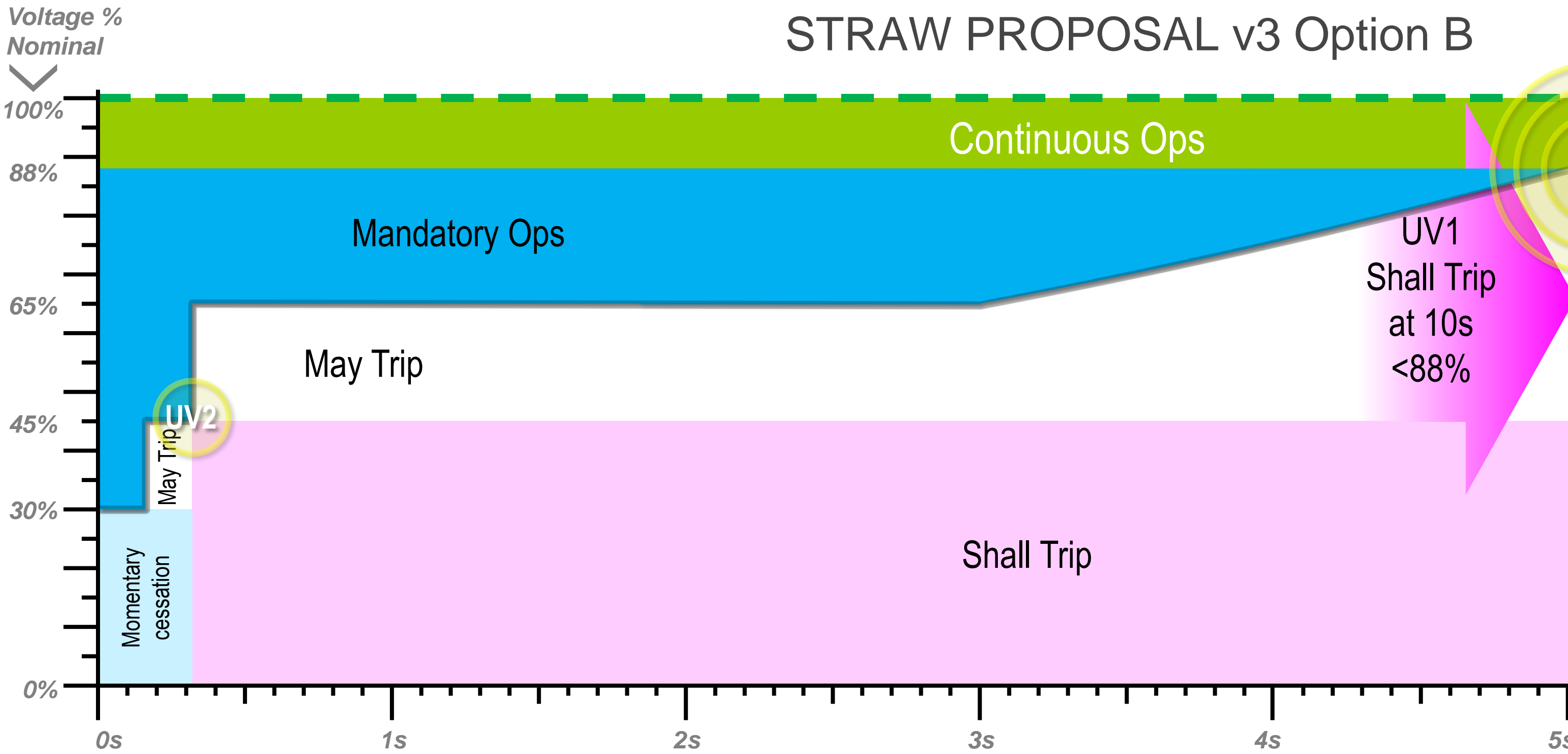


# STRAW PROPOSAL v3 Option A w/ PRC-024 Overlay

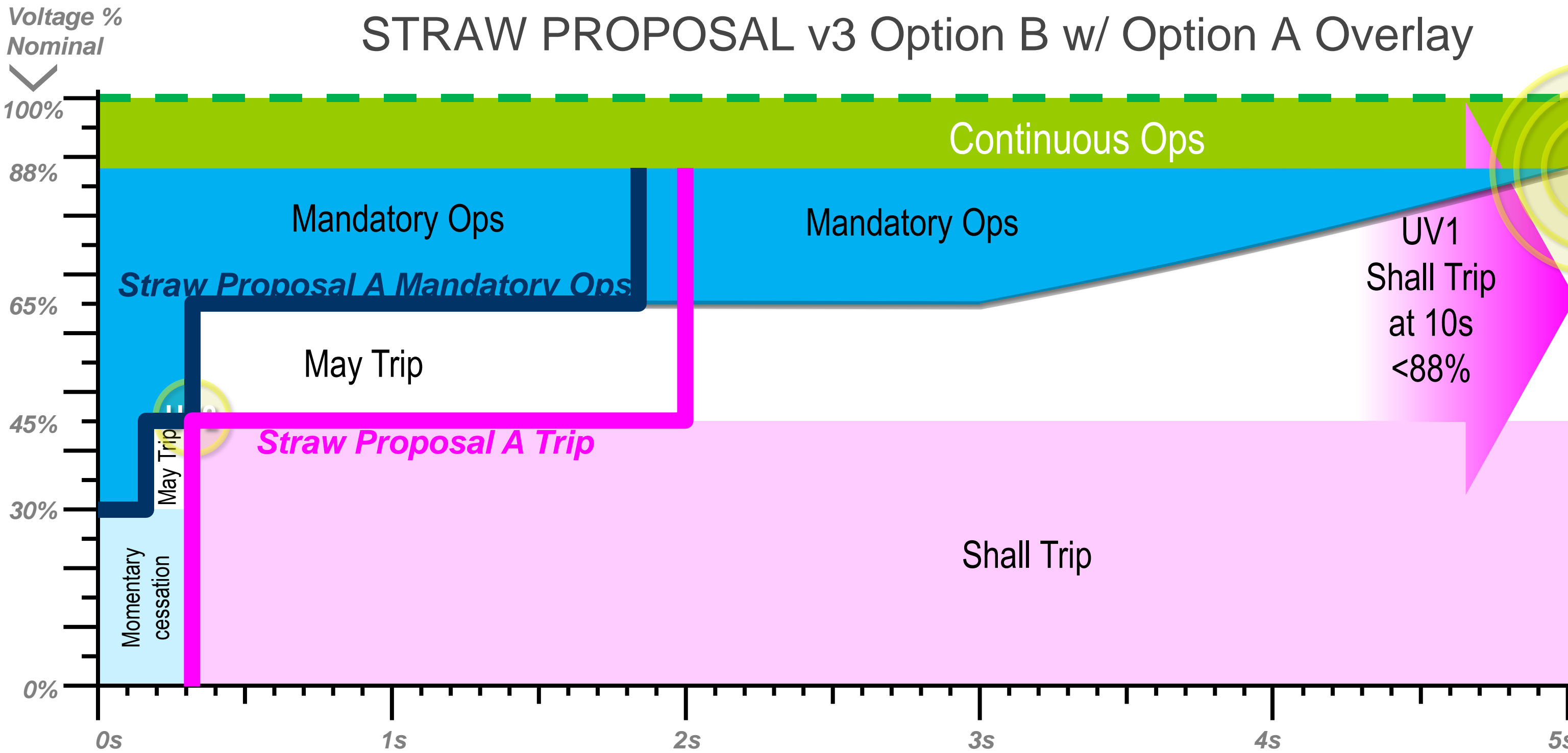




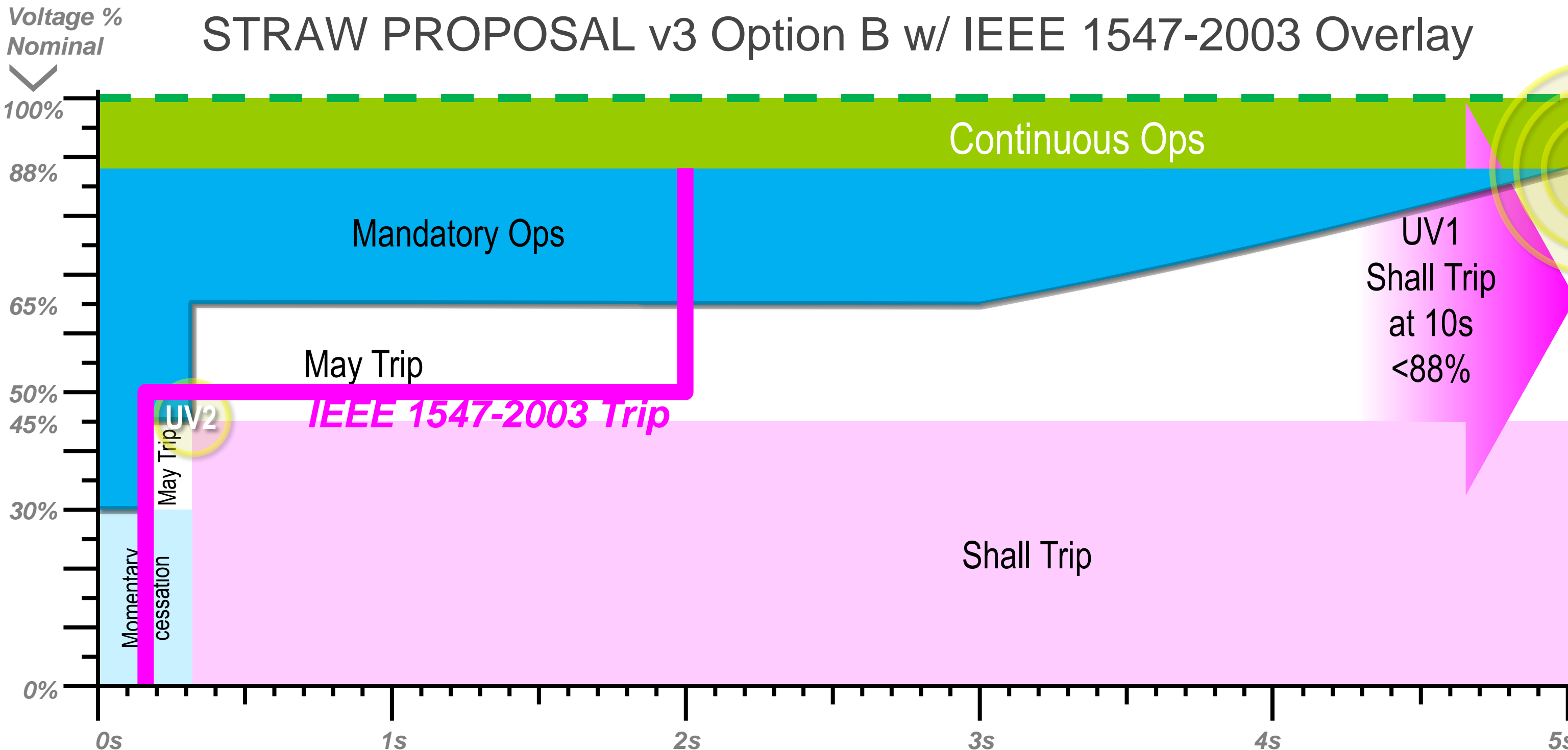
# STRAW PROPOSAL v3 Option B



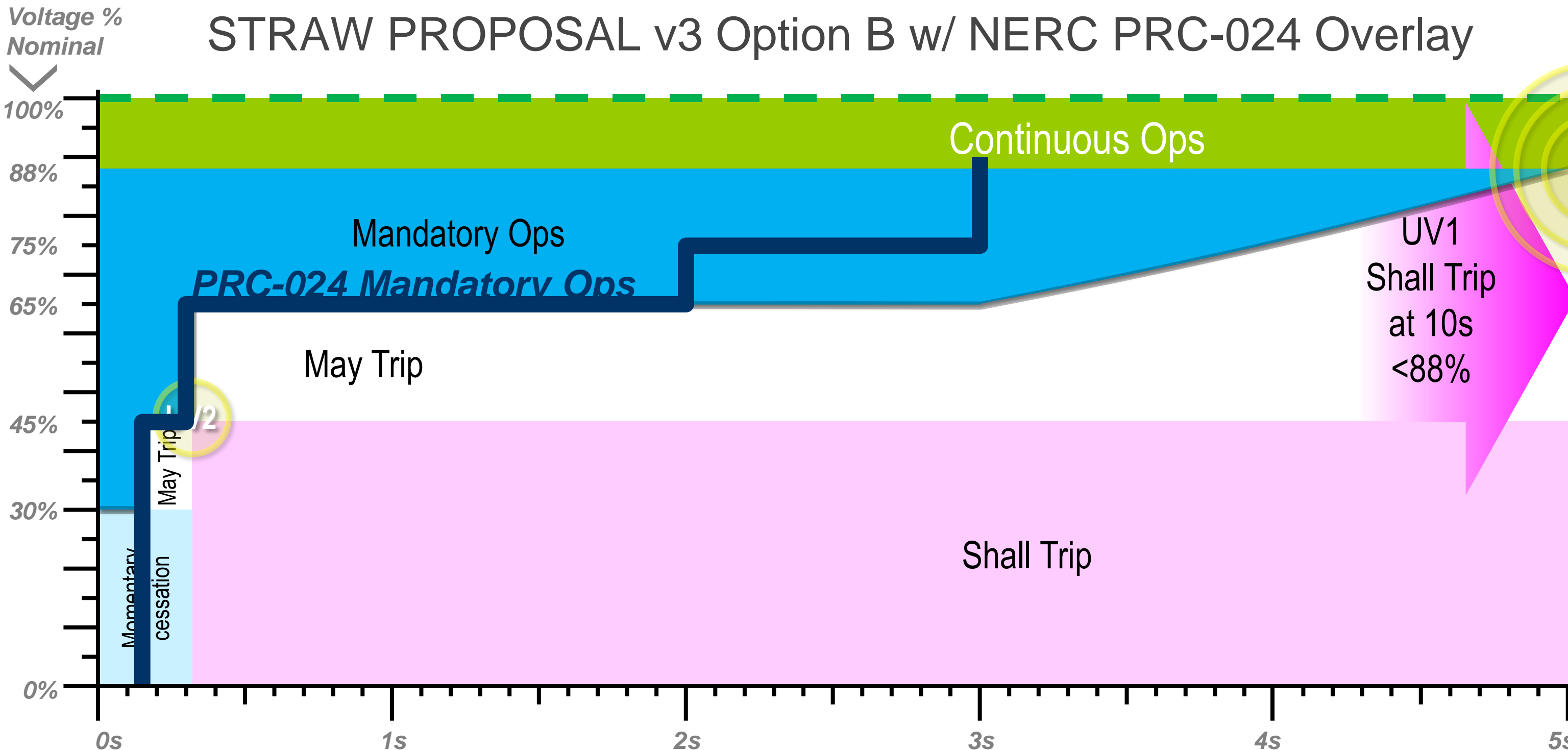
# STRAW PROPOSAL v3 Option B w/ Option A Overlay



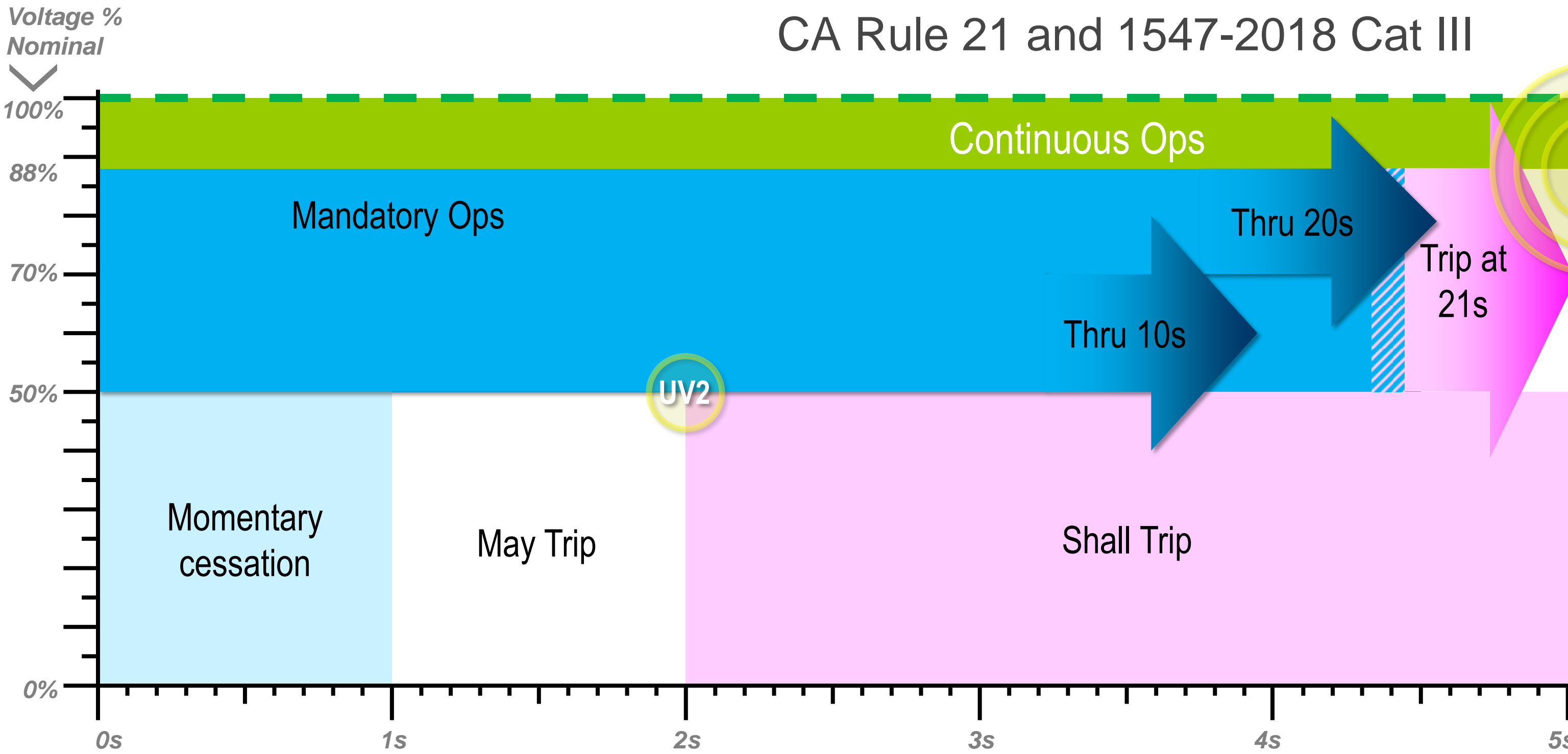
# STRAW PROPOSAL v3 Option B w/ IEEE 1547-2003 Overlay



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

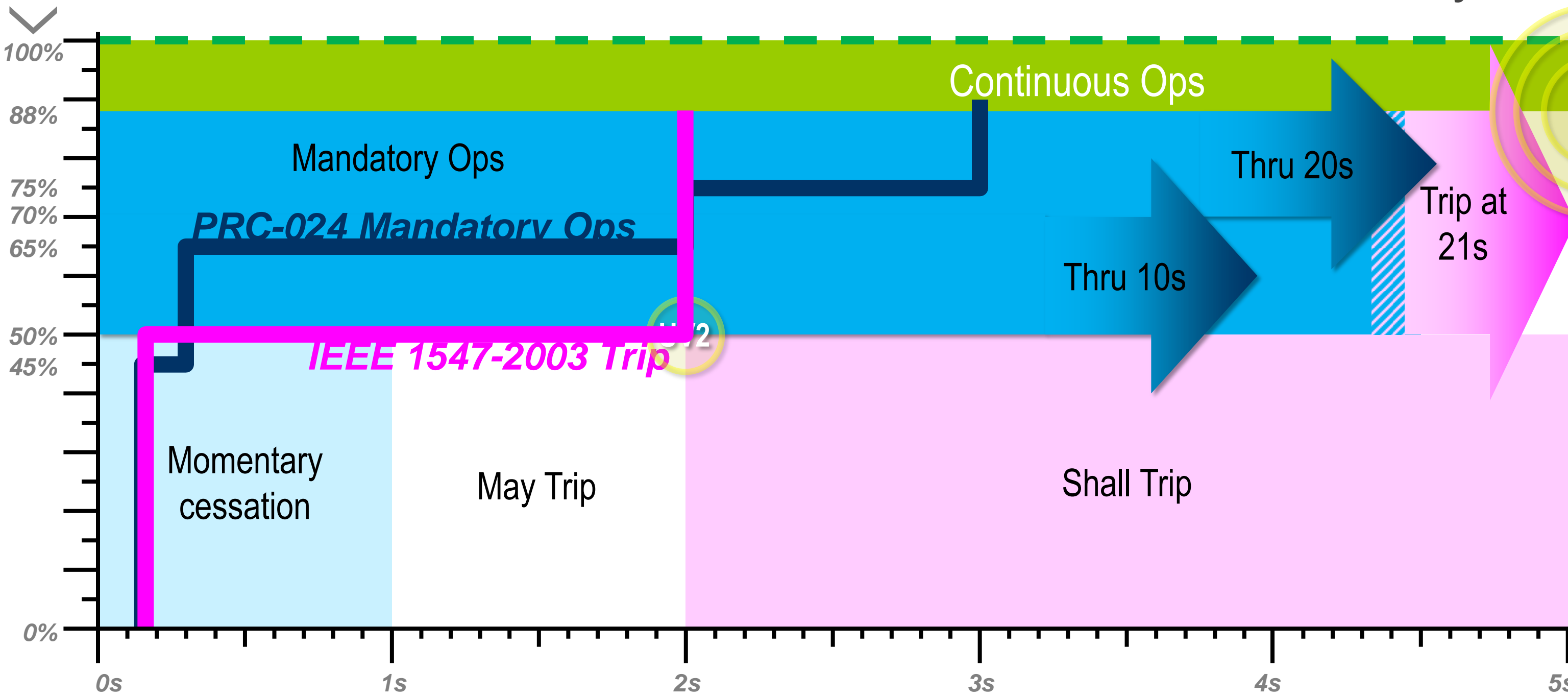


# CA Rule 21 and 1547-2018 Cat III

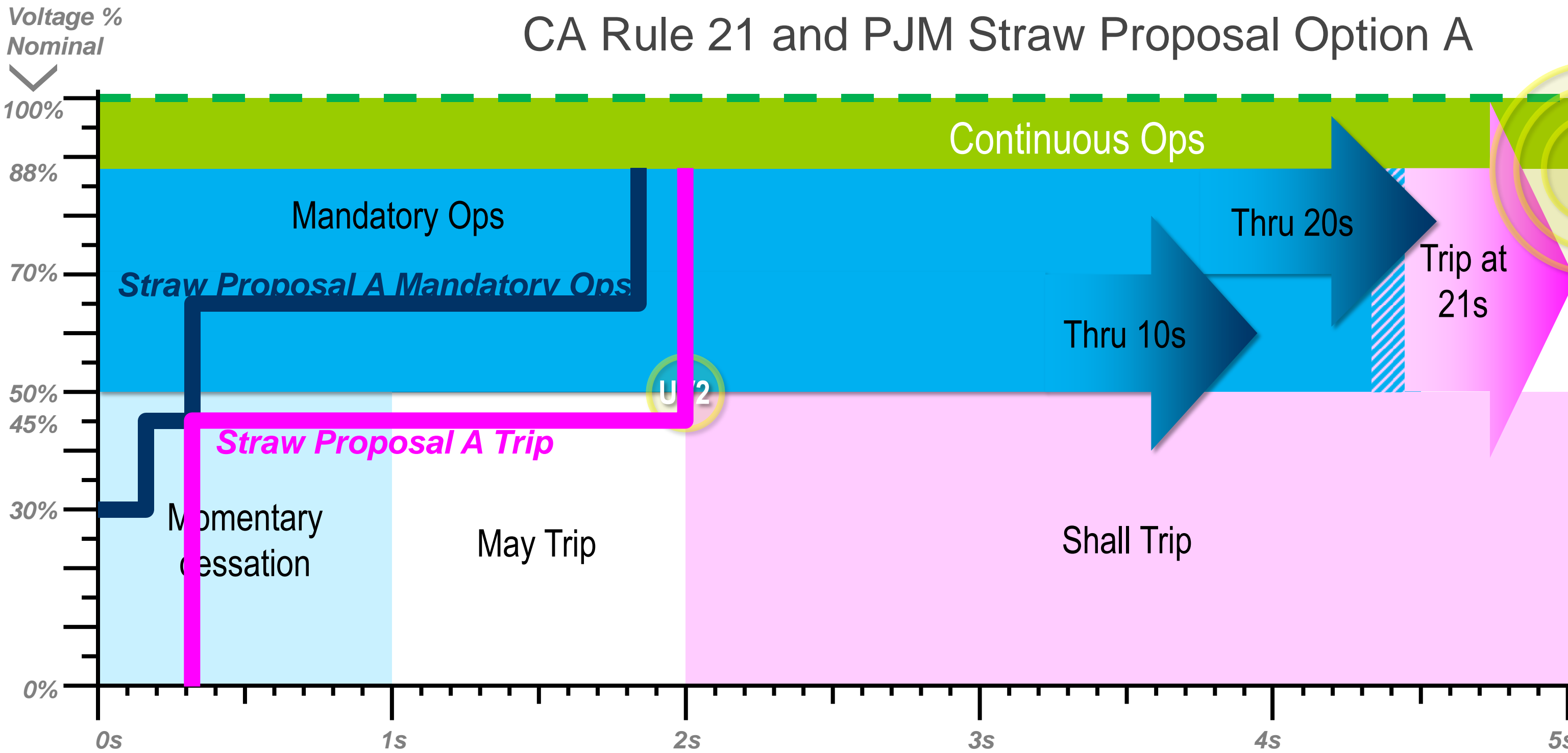


Voltage %  
Nominal

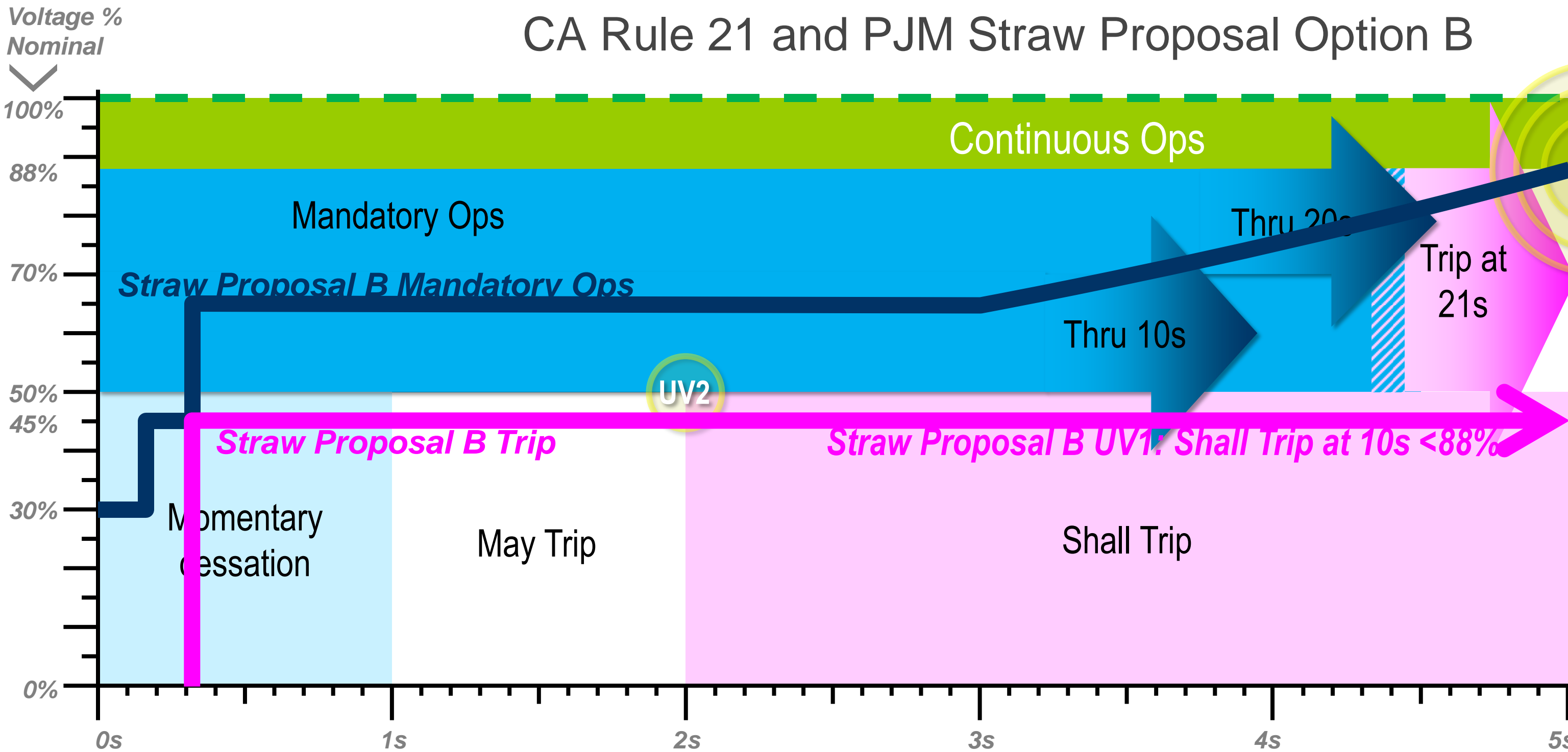
# CA Rule 21 and 1547-2018 Cat III w/ IEEE 1547-2003 and PRC-024 Overlay



# CA Rule 21 and PJM Straw Proposal Option A

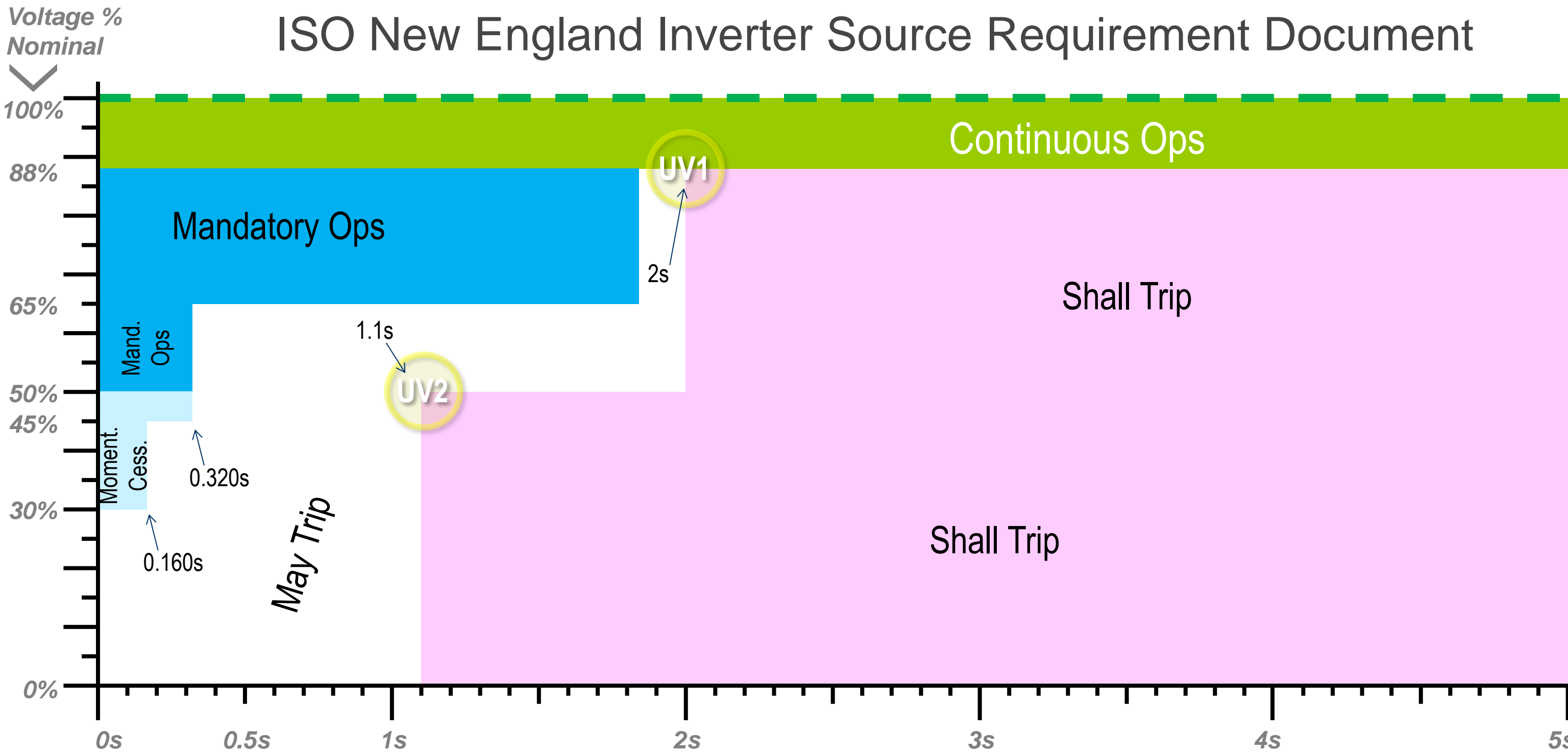


# CA Rule 21 and PJM Straw Proposal Option B

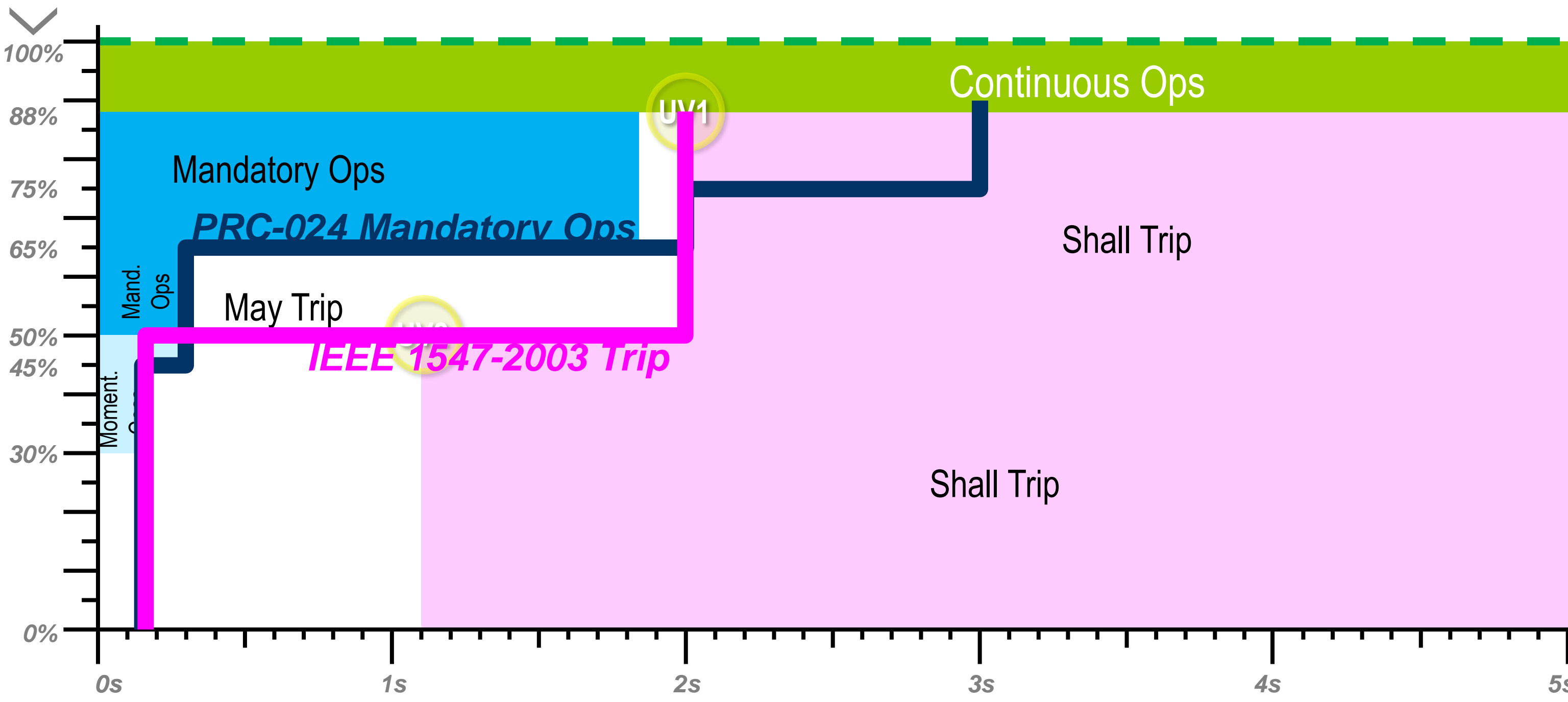




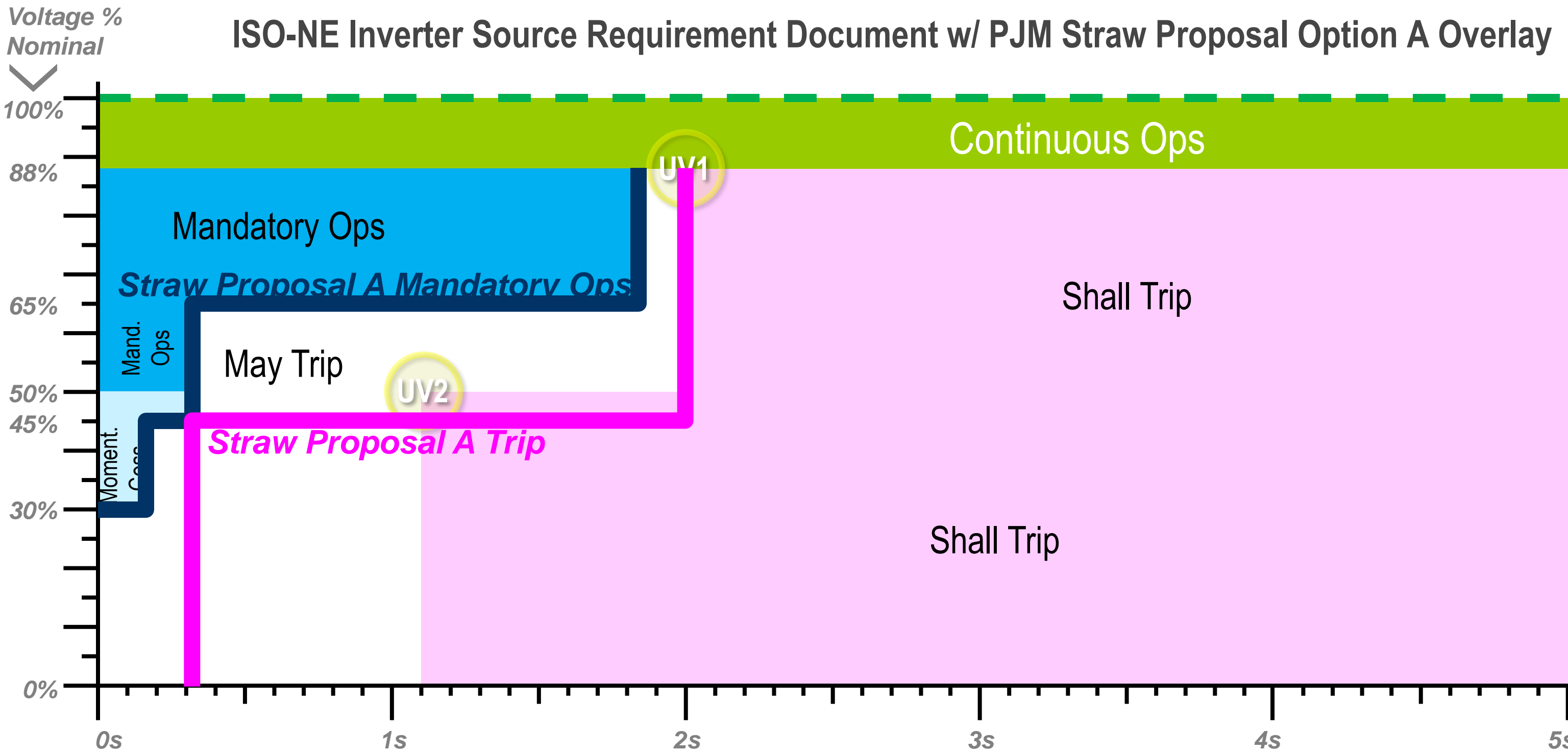
# ISO New England Inverter Source Requirement Document



# 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

