

GOES Field Test #2: YE2023 SERT
Preliminary Observations / Concerns

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Preliminary Observations – Interest Rate Scenarios

- The SERT interest rate scenarios may be illustrating some of the consequences of underlying stochastic interest rate model limitations and/or calibration issues. E.g.,
 - High short rate vols
 - Frequent and pervasive flooring even in “moderately adverse” portions of the distribution
 - Persistent and severe inversions
- SERT-specific workarounds (e.g., changing the scenario definitions and/or pass thresholds) would not address the underlying model / calibration issues or their effects on the stochastic reserves and capital.
 - Recommend continued research into future model and calibration improvements even if / after the GOES scenarios are adopted (vs. waiting for the next [5?]-year review)

Note:

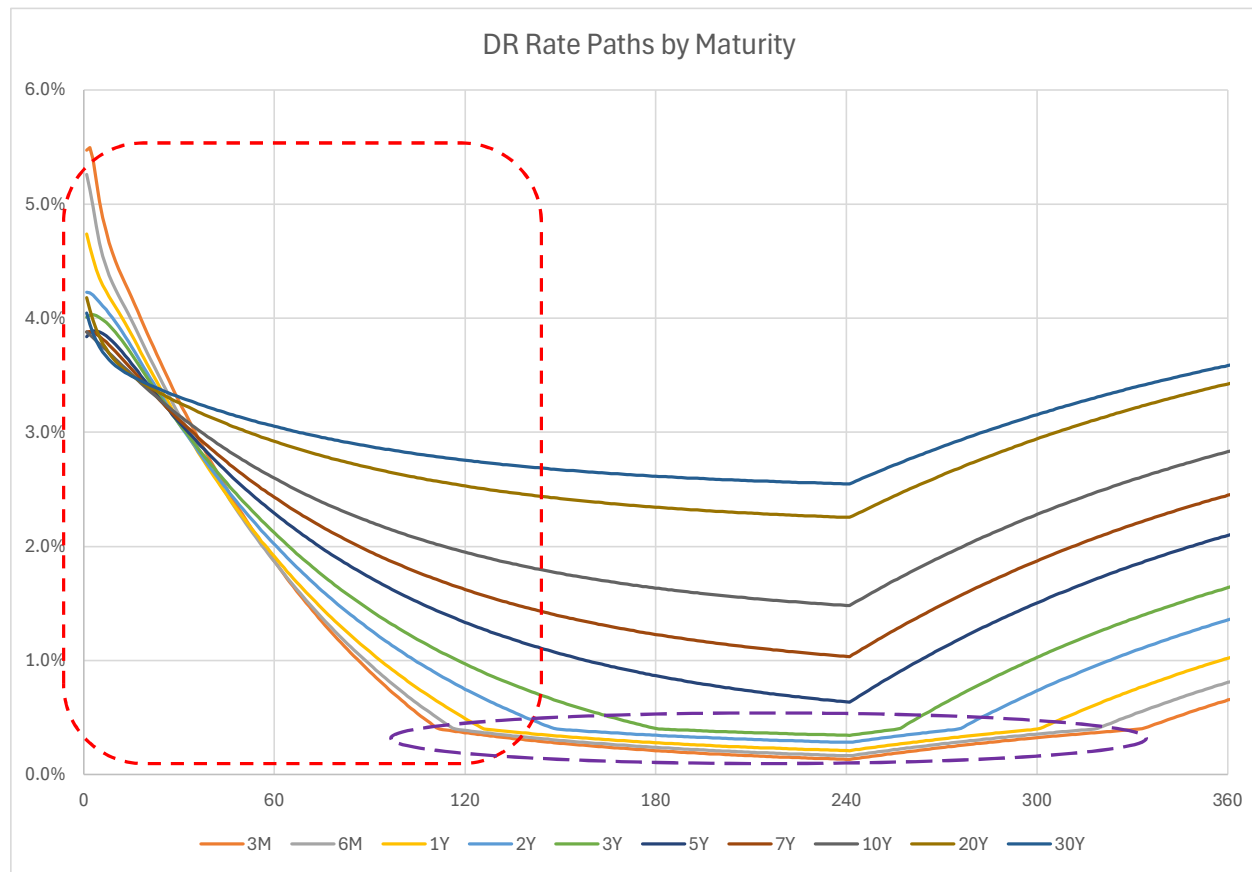
- The SERT scenario implementation is still under review.
- Examples of YE2023 *stochastic* scenario concerns are provided in [FT2-2023 PreliminaryObservations_2024-03-26.pptx](#) (posted to GOES SharePoint → Other → [Field Test #2 Scenarios and Statistics discussion](#) on March 26).
 - The March 26 slides have **not** been updated for the revised scenario set (higher long-term targets). However, a review of the updated statistics confirms that prior concerns continue to apply.
 - This is consistent with the parameter change. (Only lambda0 parameters were updated. The risk neutral (a.k.a. core) parameters that drive scenario behavior were unchanged.)

Scenario 12: Deterministic Reserve (DR) Scenario

- The DR scenario is designed to represent a moderately adverse scenario. Rates are assumed to decline over 20 years to a 1 standard deviation level before mean reverting.
- For some products, DR may directly drive VM-20 reserves.
- Because of the underlying stochastic model and calibration, FT #2 DR produces rapidly declining and persistent low rates for shorter maturities. [See slide 4 for graphs.]
 - Shorter maturity rates decline rapidly and reach low levels after approximately 10 years.
 - The interest rate model requires short-rate vol > long-rate vol.
 - Short-rate vols appear to be roughly double historical levels for a wide range of rates.
 - 1Y UST vols are roughly 50% to 100% higher than AAA recommended acceptance criteria for the majority of rates.
 - Flooring determines up to ~15 to 20 years of shorter maturity rates and results in unintuitive rate paths.
 - Flooring limits the decline in shorter-maturity rates after ~10 years. (It also masks that the underlying unfloored model would produce 1 SD 1M and 1Y UST rates of roughly -1.1% and -0.5%, respectively.)
 - Flooring also dampens / overrides the mean reversion in the underlying model, causing shorter maturity rates to remain low and barely mean revert for several years beyond year 20.

Scenario 12: Deterministic Reserve (DR) Scenario

Shorter maturity rates decline rapidly and reach low levels by roughly year 10.



Some shorter maturity rates are floored for up to ~15-20 years, producing rate paths that diverge from a “decline over 20 years and mean revert” pattern.

Scenario 10: Inverted Scenario

- The SERT Inverted scenario has traditionally been a significant (but not worse-than-history) stress 20Y-1Y spreads.
- More severe than intended stresses may make the SERT more difficult to pass or require recalibration of the passing threshold. (However, this would not address corresponding issues in the stochastic scenario set.)
- As observed in the underlying stochastic model and calibration, the severity of the FT #2 Inverted scenario *materially exceeds worst-in-history* levels.

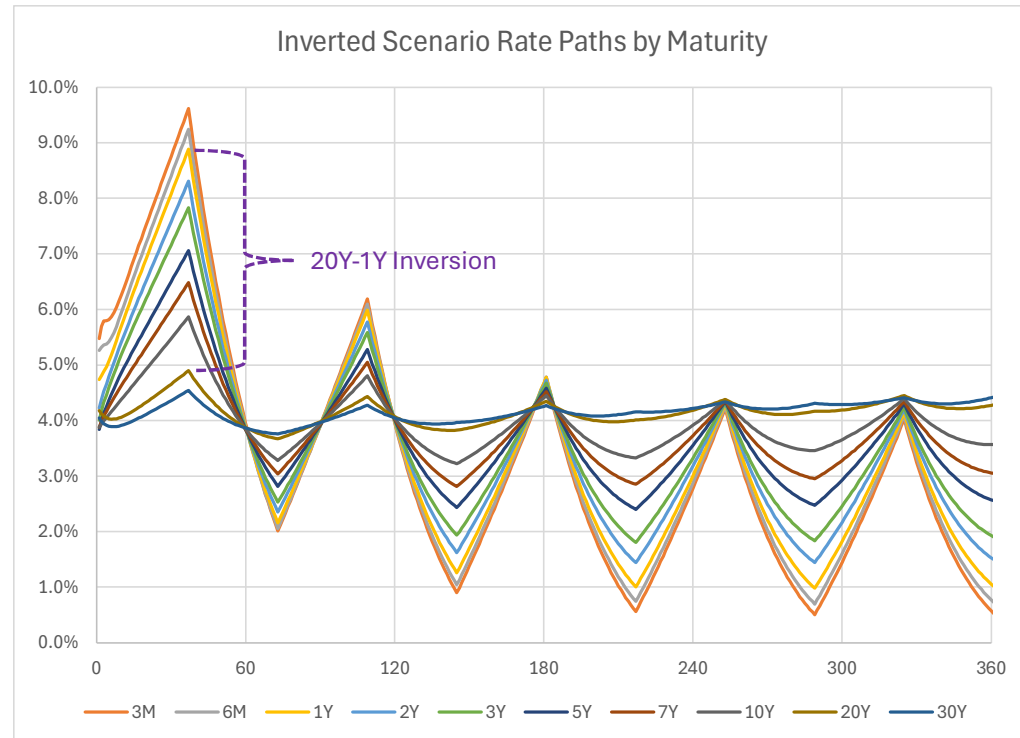
	20Y-1Y	20Y UST	1Y UST
Worst SERT #10 Inversion	-4.0%	4.9%	8.9%

	20Y-1Y	20Y UST	1Y UST
Worst in *All* History	-3.4%	12.4%	15.8%
Worst in AAA Rate Bucket (3%, 8%]	-1.4%	6.9%	8.3%

The -4% SERT #10 inversion exceeds the worst-in-history inversion *ignoring rate levels* (-3.4%).

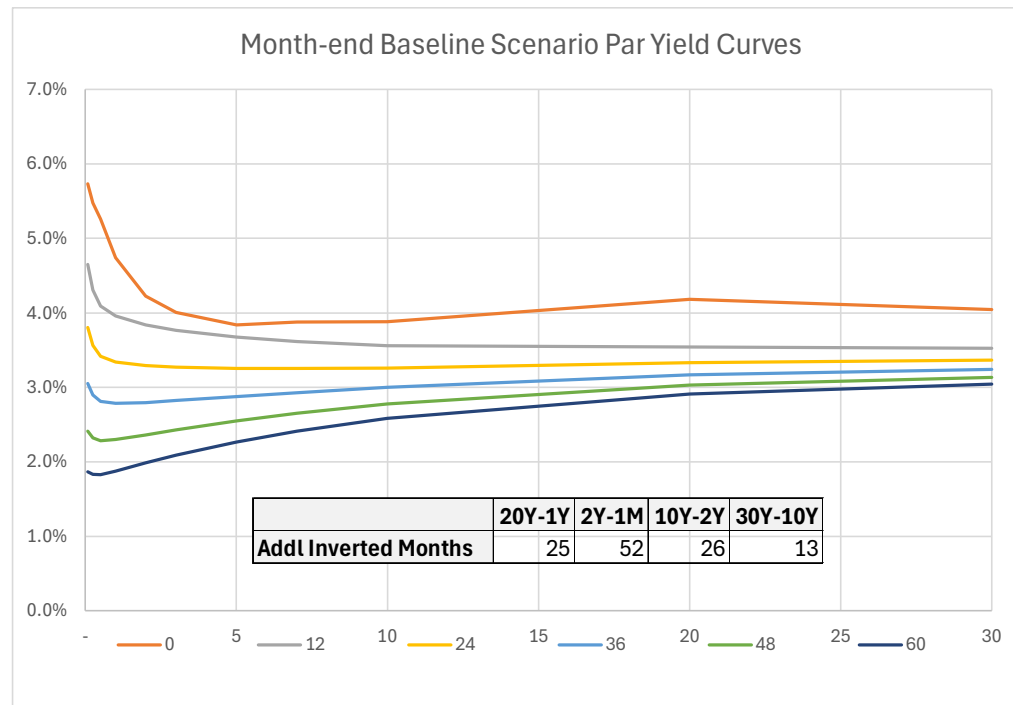
However, inversion severity generally increases at higher rate levels, so a more appropriate comparison would reflect rate levels.

The SERT #10 inversion is nearly **3x** the size of the worst-in-history inversion for the applicable AAA rate bucket (3% < UST 20Y <= 8%).



Scenario 9: Baseline Scenario

- Yield curve inversions are typically episodic events that occur for relatively short periods rather than persistent trends. (E.g., the current 21-month 10Y-2Y inversion breaks a record previously set in 1978.)
- The Baseline scenario represents the best estimate (no stress) scenario.
- VM-20 SERT measures all results relative to the Baseline scenario.
- Due to the inverted initial yield curve and underlying stochastic model and calibration, FT #2 Baseline scenario assumes that inversions for some maturities will continue for an additional ~2 to 4 years.

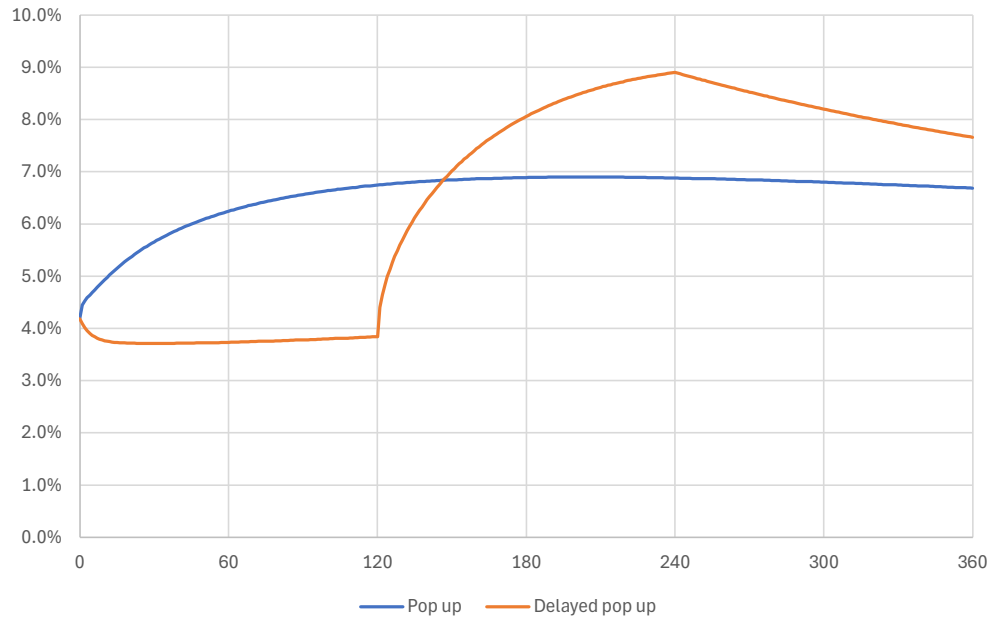


[Scenario 1 vs. 13: Pop up vs. Delayed Pop up Scenario Question]

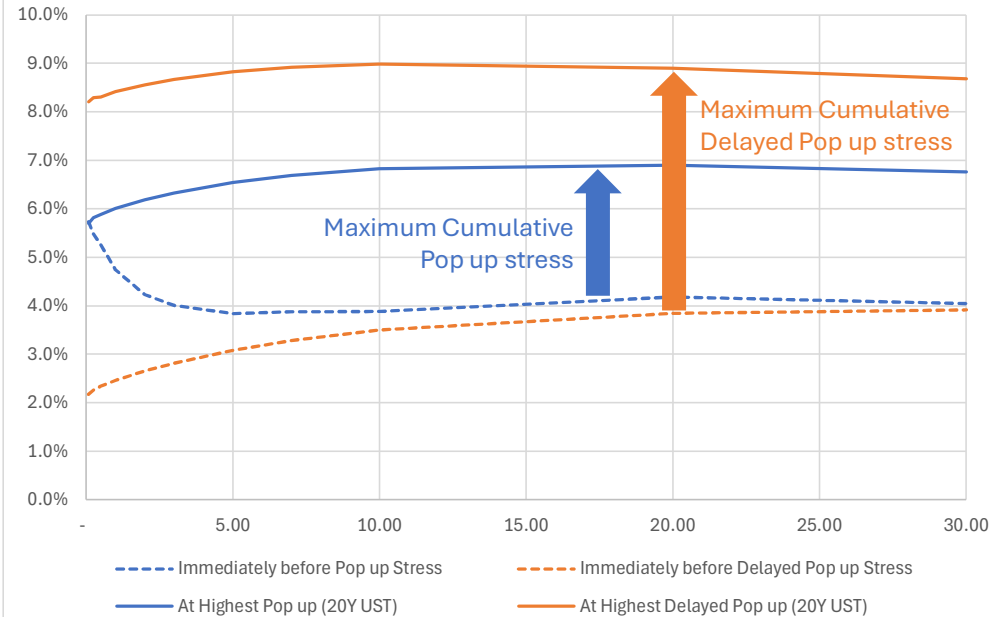
- VM-20 definitions:
 - SERT #1 – Pop up: “Interest rate shocks are selected to maintain the cumulative shock at the 90% level (1.282 standard errors).”
 - SERT #13 – Delayed Pop up: “There are interest rate shocks that are zero for the first 10 years, followed by 10 years of shocks — each 1.414 (square root of 2) times those in the first 10 years of Scenario 1. This gives the same 20-year cumulative shock as scenario 1, but all the shock is concentrated in the second 10 years.”
- More severe than intended stresses may make the SERT more difficult to pass or require recalibration of the passing threshold. (However, this would not address corresponding issues in the stochastic scenario set.)
- Stresses that change materially based on initial conditions may cause blocks of business to flip between passing / failing SERT depending on initial conditions.
- In FT #2, the stress in the Delayed Pop up scenario is significantly more severe (i.e., higher absolute rate levels and larger rate changes) than the Pop up scenario. [See slide 8 for graphs.]
 - *To what extent is this due to the shock definition / implementation (more concentrated shock), sensitivity to state variable values immediately before the shock, or other aspects (e.g., mean reversion level differences)?*

[Scenario 1 vs. 13: Pop up vs. Delayed Pop up Scenarios Question]

SERT Scenarios - 20Y UST Paths



Par Yield Curves - Before Stresses / At Max 20Y Stress

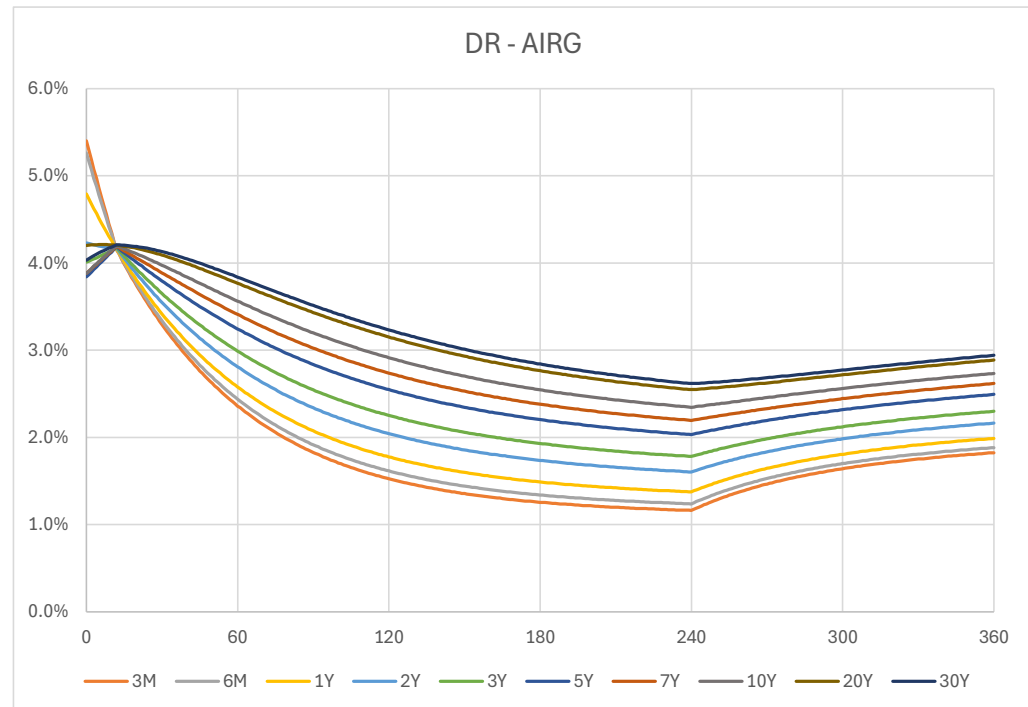
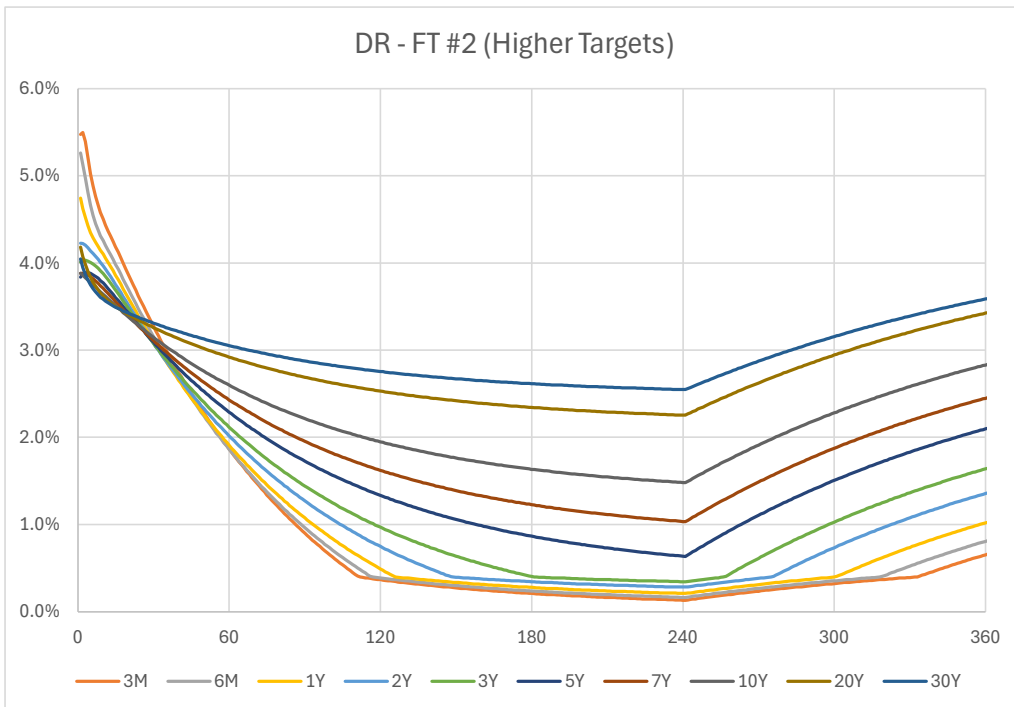


Par Yield Curves	0.08	0.25	0.5	1	2	3	5	7	10	20	30
[1] Immediately before Pop up Stress	5.7%	5.5%	5.3%	4.7%	4.2%	4.0%	3.8%	3.9%	3.9%	4.2%	4.0%
[1'] At Highest Pop up (Based on 20Y UST)	5.7%	5.8%	5.9%	6.0%	6.2%	6.3%	6.5%	6.7%	6.8%	6.9%	6.8%
[13] Immediately before Delayed Pop up Stress	2.2%	2.3%	2.3%	2.5%	2.7%	2.8%	3.1%	3.3%	3.5%	3.8%	3.9%
[13'] At Highest Delayed Pop up (20Y UST)	8.2%	8.3%	8.3%	8.4%	8.6%	8.7%	8.8%	8.9%	9.0%	8.9%	8.7%
Maximum Cumulative Increase (20Y UST)	0.08	0.25	0.5	1	2	3	5	7	10	20	30
In Pop up [1'] - [1]	0.0%	0.3%	0.6%	1.3%	2.0%	2.3%	2.7%	2.8%	2.9%	2.7%	2.7%
In Delayed Pop up [13'] - [13]	6.0%	6.0%	6.0%	6.0%	5.9%	5.9%	5.7%	5.6%	5.5%	5.1%	4.8%

Higher absolute rates and a larger change in rates for the Delayed Pop up scenario

Appendix: Deterministic Reserve Scenario Rate Paths by Maturity

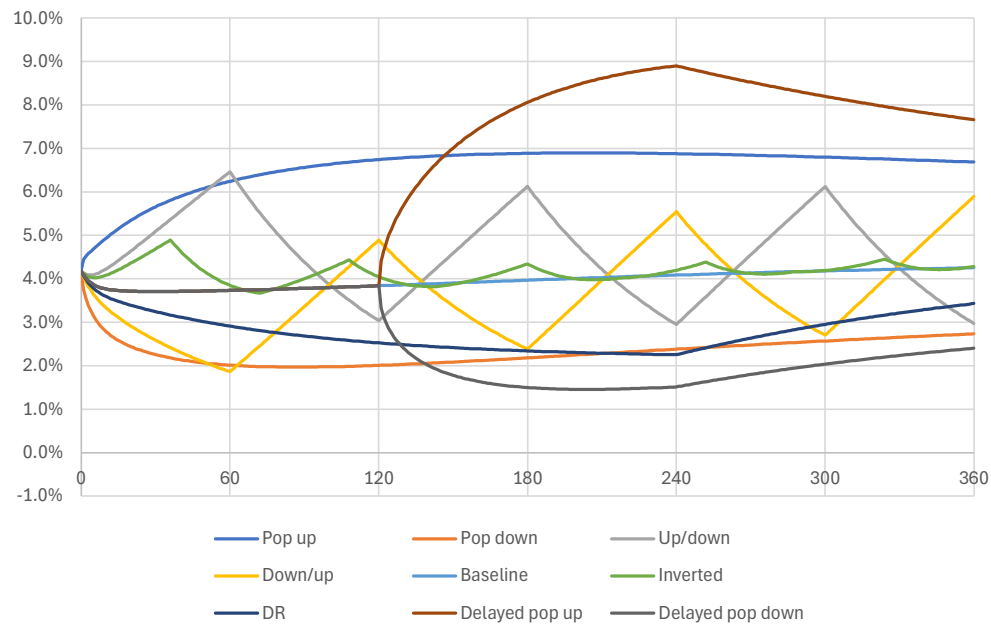
- Graphs for visualizing stylistic DR scenario patterns. (Not for GOES vs. AIRG comparisons)



Appendix: SERT Scenarios – UST 20Y

- Graphs visualizing stylistic SERT scenario patterns. (Not for GOES vs. AIRG comparisons)

UST 20Y - FT #2 (Higher Targets)



UST 20Y - AIRG

