VCF Research – Pilot Test Suite PR Document
Purpose
This document summarizes the GitHub Pull Request for adding the VCF Pilot Test Suite to the repository. It contains the PR description, structure, goals, and follow-up actions. Use this as an attachable artifact for version control, documentation, and review.

PR Title
Add VCF Pilot Test Suite – Mathematical Validation Framework (Phase I–IV)

PR Summary
This PR introduces the VCF Pilot Test Suite, a scientific validation layer for every mathematical component used in the Vector Cycle Framework. A Pilot is defined as a mathematically isolated test module that validates correctness, stability, and identity of each engine before integration.

Added Files
```
docs/
VCF_Pilot_Test_Suite.md
VCF_Pilot_Test_Suite.pdf
vcf/
pilots/
Phase_I_Regime_MathTests/
Phase_II_Sector_MathTests/
Phase_III_Unified_MathTests/
Phase_IV_Wavelit_MathTests/
```
Each folder will contain:
- Synthetic datasets
- Expected results
- Identity tests
- Invariance tests
- Stability checks

Phase-by-Phase Pilot Definitions
Phase I — Regime_Engine
Tests include:
- Z-score correctness
- Pillar stability
- θ angle identity
- Historical macro validation
- Synthetic macro cycle tests
Phase II — Sector_Regime_Engine
Tests include:
- Sector dispersion
- Sector breadth
- Harmonic power checks
- Dominant cycle detection
- Cross-sector synchrony
Phase III — Unified_Engine
Tests include:
- PCA orthogonality
- Eigenvalue ordering
- Unified feature consistency

- Rotation invariance
- Noise tests
Phase IV — Wavelit_Engine
Tests include:
- CWT admissibility
- Scale-frequency identity
- Phase alignment
- Resonance correctness
- Wavelet power conservation

Objectives
- Build a scientific foundation beneath VCF
- Validate each mathematical construct independently
- Increase stability, reproducibility, and rigor
- Ensure Claude/Copilot can implement engines with guaranteed correctness
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Follow-Up Actions
1. Implement test modules
2. Add synthetic dataset generation utilities
3. Integrate plotting helpers
4. Optional CI workflow for continuous testing

Conclusion
This PR establishes the first scientific testing layer of the VCF research paradigm, enabling reproducible, disciplined mathematical development across all engines and phases.