DOCKETED	
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Project Title:	Electric Program Investment Charge 2026–2030 Investment Plan (EPIC 5)
TN #:	270866
Document Title:	LIS Analytics EPIC 5 Research Concept - Sub-Cycle Harmonic Observability for Data Center Grid Impact Assessment
Description:	MCT Global Enterprises LLC (d/b/a LIS Analytics) submits this concept paper for CEC staff consideration in structuring EPIC 5 solicitations related to grid reliability, harmonic observability, and data center interconnection planning. The LIS Engine is a patent-pending physics-based grid observability platform that directly addresses EPIC 5 Strategic Objectives SO 3, SO 9, SO 10, and SO 12 (Decision D-26-02-037). Contact: Mica C. Tufillaro, mica@lisanalytics.net, (610) 835-6556.
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LIS ANALYTICS

Load Integrity Study™ · MCT Global Enterprises LLC

Concept Paper: Sub-Cycle Harmonic Observability for Data Center Grid Impact Assessment

Submitted for consideration by: California Energy Commission · Electric Program Investment Charge (EPIC 5) · Docket 25-EPIC-01

The Problem: California's Grid Cannot See What It Cannot Measure

California's electrical distribution infrastructure faces a measurement gap that is widening in direct proportion to the state's data center buildout. As of early 2026, data centers represent approximately 1,000 MW of CAISO peak demand — and that figure is growing rapidly. The California Energy Commission's own 2026 demand forecast now explicitly accounts for data center load growth as a planning variable.

The problem is not the load itself. The problem is that the harmonic distortion, transient stress, and rapid ramp events that large computational loads inject into the distribution grid are invisible to conventional utility SCADA systems, which sample at 15-minute intervals. This is not a software limitation — it is a fundamental physics problem. Events occurring within a single 60 Hz cycle cannot be observed by a system sampling 900 times slower than the phenomenon it is trying to measure.

The regulatory consequence is direct: NERC's May 2026 Level 3 Essential Actions Alert (response deadline August 3, 2026) specifically identifies harmonics and interharmonics measurement as a grid reliability gap requiring urgent action. NERC Project 2026-02 is developing new interconnection reliability standards targeting computational loads above 20 MW. FERC Docket RM26-4-000 is expected to issue a final order by the end of June 2026. The measurement infrastructure needed to comply with these requirements does not yet exist at the distribution level for most California utilities.

Building on EPIC's Prior Investment

EPIC 3.32 ("System Harmonics for Power Quality Investigation"), administered through PG&E, successfully demonstrated that harmonic data collection in distribution systems is technically feasible and operationally useful — producing a harmonics dashboard and analysis tools for power quality engineers. That investment established the proof-of-concept that harmonic measurement belongs in California's grid observability stack.

What EPIC 3.32 did not address is the next-layer question: given a harmonic measurement, what does it mean for specific equipment? The LIS™ Engine proposes to fill that gap through deterministic, physics-based equipment stress quantification — translating measured harmonic content into actionable stress indices for transformers, neutral conductors, and capacitor banks, and producing Permanent Load Reduction (PLR) estimates that can inform interconnection planning decisions.

The LIS™ Engine: From Measurement to Actionable Stress Quantification

The LIS™ Engine (patent pending, USPTO App. 64/027,496, filed April 3, 2026) is a physics-based grid observability platform designed to operate on uploaded waveform datasets sampled at 1 kHz. In its current demonstrated form, the Engine applies a fixed, deterministic calculation procedure to a supplied dataset and automatically produces the following outputs across all phases in a single pass — without requiring an engineer to construct a circuit model or define harmonic spectra for each analysis run:

Capability	Output
FFT Harmonic Analysis	Harmonic content decomposition via FFT; IEEE 519-2022 compliance assessment at point of common coupling
Transformer Stress Indexing	K-factor and thermal stress index per phase; early warning of thermal degradation risk
Neutral Conductor Assessment	Neutral harmonic current contribution; I^2R heating quantification relative to design basis
Capacitor Bank Analysis	Voltage stress index; resonance risk detection relative to system tuning frequency
Transient & RoCoF Detection	Sub-cycle transient event identification; rate-of-change-of-frequency measurement for frequency stability
PLR Quantification	Permanent Load Reduction estimate in kW via Newton-Raphson power flow (validated against IEEE 13-Node Test Feeder, 4.2×10^{-7} p.u. mismatch)

Methodology is validated against the IEEE 13-Node Test Feeder, the industry-standard benchmark used by utilities, EPRI, and DOE national laboratories. Results from an actual engagement reflect site-specific waveform data; all figures shown in this paper are from the validated modeled reference scenario, not from a live utility deployment.

Alignment with EPIC 5 Strategic Objectives

The CPUC adopted 13 Strategic Objectives (Decision D-26-02-037, R.19-10-005, February 26, 2026) to guide EPIC 5 investments through 2030. Objective names below are quoted verbatim from Decision D-26-02-037 Appendix A. The LIS™ Engine concept directly addresses four of these objectives:

EPIC 5 Strategic Objective (verbatim from D.26-02-037 Appendix A)	How LIS Engine Addresses It
SO 3: Smart Planning Tools for New Load and Clean Resources (D.26-02-037)	Sub-cycle harmonic measurement addresses the reliability gap NERC's Level 3 Alert identifies; provides the per-interconnection harmonic injection spectrum NERC's Reliability Guideline requires
SO 10: Expediting and Streamlining Interconnection and Energization Processes (D.26-02-037)	Measured per-interconnection harmonic data supports expedited interconnection screening for data centers and DERs, directly addressing the process barriers SO 10 targets by enabling measurement-based interconnection decisions rather than model-only assumptions
SO 12: Optimizing Feeder / Circuit Operations (D.26-02-037)	Physics-based PLR and equipment stress quantification identifies structural load waste at the node level, supporting SO 12 feeder/circuit optimization through harmonic remediation and demand reduction without capital infrastructure expansion
SO 9: Leveraging Distributed Energy Resources for Grid and Community Resiliency (D.26-02-037)	University physical plant and community college deployments directly serve campus communities; WOSB certification (pending) supports EPIC equity eligibility; open-source methodology publication aligns with SO 9 community resiliency through accessible grid tools

Proposed Research Concept for EPIC 5 Consideration

Concept Title

Sub-Cycle Harmonic Observability for Data Center Interconnection Planning: Methodology Validation and Deployment Demonstration at California University Physical Plants

Concept Summary

Validate and demonstrate the LIS™ Engine's physics-based harmonic stress quantification methodology in a real-world university physical plant setting, producing measured harmonic injection spectrum data at the point of interconnection and benchmarking the methodology against open-source alternatives (OpenDSS) to produce independently verified, citable results for incorporation into CEC's data center demand forecasting and utility interconnection planning workflows.

Proposed Project Partners

- LIS Analytics (MCT Global Enterprises LLC) — technology provider, methodology documentation, analysis
- University of California, Los Angeles (UCLA) or Arizona State University — capstone/senior design host, academic benchmark execution, faculty validation (faculty engagement in progress; not yet confirmed)
- University physical plant operations — data access, real-world deployment site
- California investor-owned utility (PG&E, SCE, or SDG&E) — data sharing and interconnection planning application (optional, pending utility engagement)

Deliverables

- Peer-reviewed benchmark report comparing LIS Engine outputs against OpenDSS equivalents on a validated synthetic dataset, executed by university student team
- Measured harmonic injection spectrum report for at least one university physical plant interconnection point, formatted to NERC Reliability Guideline specification
- Methodology documentation suitable for use by CEC and IOUs in future data center interconnection screening
- Open-source dataset and calculation procedure enabling reproducibility by any EPIC stakeholder

About LIS Analytics

MCT Global Enterprises LLC (d/b/a LIS Analytics) is a Woman-Owned Small Business (WOSB certification pending, SBA Application ID 93517) based in Goodyear, Arizona. The company is built around the LIS™ Engine, developed by Mica C. Tufillaro, drawing on 35 years of nuclear power industry instrumentation and regulatory compliance experience. The company holds SAM.gov registration (UEI: H5F3VN9LME86, CAGE: 1Z957) and SBIR.gov registration (SBC Control ID: SBC_002678224). Patent pending: USPTO Application 64/027,496, filed April 3, 2026.