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Deterministic Dispatch at the Seams: Formulation and Evidence Architecture

A proposed formulation and verification plan for repeatable cross-border exchange recommendations.

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In essence

Why we are talking about this

A solver can return a repeatable answer while using a bad constraint or incomplete data. Dispatch research needs checks on the model, the inputs and the result.

Purpose

Specify a coordination model and an independent verification process that can be tested against a frozen benchmark.

What we found and focus on

- Optimization is already part of electricity-market operations. [1]
- The objective and constraints must be agreed before a result can be judged.
- Freeze input versions, units, time intervals and source identities.
- Control solver versions, numerical tolerances and tie-breaking when testing replay.
- A separate checker should test constraints and the claimed objective value.
- Formal verification can also apply to some neural-network power-system models. [2]
- A proof is limited to its assumptions and cannot certify unmeasured physical conditions.
- This edition makes no claim of a completed BGL benchmark or production dispatch.

Conclusion and next steps

Publish a small formulation, dataset and checker. Test normal cases and planted defects, then compare correctness and runtime with an established optimization baseline.

Full revised research

Scope of the formulation

The proposed system recommends exchanges between operators. It does not replace their dispatch engines. The research task is to define an exchange model precise enough for a second implementation to inspect.

PJM Manual 11 documents optimization within electricity-market operations. BGL's contribution would therefore have to be demonstrated in the coordination and evidence process, rather than claimed from the use of optimization alone. [1]

A minimal model

Let x represent exchange quantities over defined time intervals. A first model minimizes an agreed cost c^Tx subject to balance equations Ax = b, operating inequalities Gx <= h, and bounds l <= x <= u. This is a proposed starting point, not a complete grid model.

Each matrix row needs a meaning, unit, source and validity interval. Losses, reserve needs and contingency conditions require explicit treatment. Add integer variables only where discrete operating decisions require them, and state which nonlinear effects the model approximates.

Repeatability by construction

A reproducible run needs more than a fixed random seed. Preserve the dataset, model, solver build, numerical tolerances, ordering and tie-breaking rules. Define whether the acceptance test requires byte-identical output or equivalent decisions within a stated tolerance.

Record infeasibility and timeouts as outcomes. An implementation that substitutes a convenient answer when a constraint cannot be resolved undermines the entire review process.

Independent checking

The checker should recompute constraint residuals and the reported objective from the frozen inputs. For a linear program, an appropriate certificate can support an optimality claim. For a mixed-integer problem, report the bound and optimality gap rather than imply certainty from a feasible solution.

Verification is not exclusive to deterministic software. Venzke and Chatzivasileiadis demonstrate formal methods for specified neural-network power-system applications. Their results support a bounded verification approach, not a universal guarantee for learned systems or the BGL proposal. [2]

What the benchmark must include

Publish cases with incompatible units, stale limits, missing reservations, conflicting rules and infeasible exchanges. Compare the proposed checker with an independently implemented baseline. Separate parsing failures, model failures and solver failures.

Measure feasibility, objective agreement, repeatability and runtime on stated hardware. The earlier internal run names and latency claims do not supply a reproducible benchmark and are not evidence in this revised edition.

Conclusion and next steps

The end goal is a coordination result whose assumptions and calculations another party can inspect. Repeatability supports that goal but does not establish real-world correctness by itself.

Release a bounded test specification, obtain an independent implementation and publish disagreements. Operator review of the physical assumptions is necessary before any live recommendation is considered.

Sources

Numbered citations refer to these sources. Proposed methods and next steps are BGL research proposals, not results established by the cited publications. Links checked for this revision on October 11, 2026.

[1] PJM: Manual 11, Energy and Ancillary Services Market Operations

https://www.pjm.com/-/media/DotCom/documents/manuals/m11.pdf

[2] Venzke and Chatzivasileiadis: Verification of Neural Network Behaviour, Formal Guarantees for Power System Applications (2020)

https://arxiv.org/abs/1910.01624v4