

EXECUTIVE BRIEF · OPERATIONAL THERMODYNAMICS INTELLIGENCE

FLEET THERMODYNAMIC INTELLIGENCE

Why Small Thermal-Performance Deviations Become Material At Fleet Scale

YBGGlobal.com · ControlAlign™

EXECUTIVE SUMMARY

Small deviations become commercially material at fleet scale

At single-unit level, relatively small thermal-performance deviations may appear operationally insignificant.

A modest increase in:

- heat rate,
- fuel intensity,
- or thermal drift

may initially appear manageable within day-to-day plant operation.

However, at fleet scale: small thermodynamic deviations can become commercially material.

Across multiple units, sustained thermal-performance drift may influence:

- fuel expenditure,
- emissions intensity,
- dispatch economics,
- operating margin,
- fleet consistency,
- and long-term asset performance.

This creates an emerging operational need: improved visibility into fleet thermodynamic behaviour.

THERMAL DRIFT COMPOUNDS ACROSS FLEETS

Thermal-performance deterioration often develops gradually. Importantly: units may continue operating within acceptable operational ranges while thermal efficiency progressively declines over time.

At fleet scale, even relatively small changes in:

- heat rate,
- fuel intensity,
- or transfer effectiveness

can materially influence:

- total fuel consumption,

- operating cost,
- and emissions exposure.

For example: a seemingly modest heat-rate deviation sustained across multiple units over extended operating periods may represent:

- significant additional fuel consumption,
- measurable margin erosion,
- and substantial CO₂ intensity impact.

STABLE OPERATION DOES NOT GUARANTEE FLEET CONSISTENCY

A fleet may appear operationally healthy from a traditional reliability perspective:

- units online,
- dispatch targets met,
- emissions compliant,
- acceptable availability,
- and stable generation output.

Yet substantial thermodynamic variation may still exist between:

- units,
- operating periods,
- load bands,
- or thermal states.

Historically: these conditions may remain partially hidden because thermal-performance deterioration often develops progressively rather than catastrophically.

THE OPERATIONAL COMPRESSION PROBLEM

Thermal fleets generate vast operational historian environments. Thousands of operational signals are continuously recorded across:

- combustion systems,
- steam cycles,
- fuel systems,
- emissions systems,
- and process instrumentation.

However, much of this complexity is historically compressed into:

- fleet heat-rate reporting,
- output reporting,

- fuel reporting,
- and availability KPIs.

These remain operationally essential.

But they may not fully explain:

- why fleet thermal performance varies,
- how thermal-state conditions evolve,
- or which operating conditions correlate with superior historical performance.

FLEET THERMODYNAMIC INTELLIGENCE

Fleet Thermodynamic Intelligence refers to: historian-derived operational interpretation across multiple thermal environments to improve visibility into:

- thermal-state stability,
- operational drift,
- fuel-intensity variation,
- radiative coupling behaviour,
- and thermal-performance consistency.

The objective is improving understanding of: how effectively thermal energy is transferred and sustained across operating fleets over time.

This may include:

- unit-to-unit comparison,
- load-band interpretation,
- historical-state reconstruction,
- drift identification,
- and best demonstrated performance alignment.

BEST DEMONSTRATED PERFORMANCE AT FLEET SCALE

Many fleets already contain: units, operating periods, or load conditions that historically demonstrated superior thermal-performance outcomes.

Historian-derived operational intelligence may improve visibility into:

- which operating conditions correlate with superior performance,
- how thermal drift develops,
- and how current operation compares to historically demonstrated fleet performance environments.

This creates a potentially valuable operational reference framework: fleet-level Best Demonstrated Performance.

DETERMINISTIC OPERATIONAL INTERPRETATION

Fleet thermodynamic interpretation must remain: operationally contextualized, traceable, deterministic, and engineering-reviewable.

The objective is not: generic optimization logic.

The objective is: improving visibility into the thermodynamic operating conditions influencing fleet thermal performance itself.

HISTORIAN-DERIVED OPERATIONAL INTELLIGENCE

At YBGGlobal.com, part of the current focus involves: historian-derived reconstruction of thermal-state behaviour using existing operational environments.

The objective is improving visibility into:

- fleet operational drift,
- thermal transfer effectiveness,
- thermal-state consistency,
- and fuel-to-steam conversion behaviour across thermal infrastructure portfolios.

The framework is intended as:

- read-only,
- non-intrusive,
- operationally contextualized,
- and integration-safe.

CLOSING OBSERVATION

Thermal fleets do not always lose performance through major operational events.

In many cases: performance deterioration develops gradually through small thermodynamic deviations accumulating across operating units over time.

At fleet scale: these deviations may become materially significant.

The next evolution in fleet thermal-performance management may increasingly involve improving visibility into thermal-state behaviour, operational drift, and thermodynamic transfer effectiveness across the fleet environment itself.

