METHODOLOGY DECK

OPERATIONAL DRIFT ANALYSIS

Interpreting Progressive Thermal-Performance Deterioration in Thermal Infrastructure

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SLIDE 02 · The Core Observation

Thermal Plants Often Drift Before They Fail

In many thermal environments:

- generation remains stable,
- dispatch targets are met,
- combustion appears acceptable,
- and the unit remains operationally normal,

while:

- heat rate deteriorates,
- fuel intensity rises,
- thermal efficiency declines,
- and operating margin progressively erodes.

> **This process often develops gradually over time.**

Operational Drift Refers To Progressive Thermodynamic-State Deviation Over Time

Operational drift may involve:

- deteriorating heat-transfer effectiveness
- changing thermal-state stability
- rising fuel intensity
- altered radiative coupling behaviour
- reduced fuel-to-steam conversion efficiency

> **The unit may continue appearing operationally stable while this drift develops.**

SLIDE 04 · Drift Is Produced By Interacting Variables

Thermal Environments Continuously Evolve

Examples of drift-influencing variables:

- excess O_2 variation
- air–fuel imbalance
- pulverizer variation
- burner-condition drift
- slagging and fouling
- fuel variability
- flame instability
- sootblower influence
- air ingress
- thermal absorption imbalance
- load-transition instability
- radiative transfer changes

> **These conditions interact continuously over time.**

SLIDE 05 · The Thermodynamic Transfer Environment

Combustion Alone Does Not Define Thermal Performance

Between fuel input and electrical output exists a dynamic thermal-transfer environment involving:

- flame behaviour
- radiative transfer
- convective transfer
- heat absorption
- furnace-state stability
- thermal coupling effectiveness
- working-fluid enthalpy rise

> **Operational drift may progressively alter this environment.**

SLIDE 06 · Heat Rate Reflects The Consequence

Heat Rate Is An Outcome — Not A Primary Control Variable

Heat rate reflects the amount of fuel energy required to produce one unit of electrical output.

Operationally important: Yes.

Directly controlled: No.

Heat rate is produced by continuously evolving thermodynamic operating conditions.

> **Drift therefore influences the heat-rate outcome over time.**

Operational Stability Does Not Always Mean Thermal Stability

A unit may continue:

- satisfying dispatch,
- maintaining steam conditions,
- operating within acceptable emissions ranges,
- and remaining operationally stable,

while progressively requiring more fuel to sustain equivalent output.

> **This creates hidden efficiency deterioration.**

SLIDE 08 · Historian-Derived Drift Reconstruction

Operational Historians Already Contain Drift Signatures

Existing historian environments may contain:

- fuel trends
- steam conditions
- operational-state transitions
- load behaviour
- combustion-state history
- emissions behaviour
- thermal-response signatures

Historian-derived interpretation enables reconstruction of thermal

Operational Drift Analysis Seeks To Improve Visibility Into:

- thermal-state evolution
- heat-transfer effectiveness
- fuel-intensity variation
- radiative coupling behaviour
- thermal coupling stability
- historical performance deviation
- best demonstrated operating states

Objective: improve operational thermodynamic awareness.

SLIDE 10 · Best Demonstrated Performance Alignment

Drift May Be Interpreted Relative To Historically Superior Operating States

Many plants have already demonstrated:

- lower heat rate
- lower fuel intensity
- improved thermal stability
- superior transfer effectiveness

within their own operating history.

> **Operational drift analysis may improve visibility into how far current operation has deviated from historically superior thermal-performance conditions.**

SLIDE 11 · Deterministic Interpretation Framework

Operational Interpretation Must Remain Engineering-Reviewable

Framework priorities:

- historian-derived interpretation
- traceable analysis
- load normalization
- operational contextualization
- deterministic methodology
- audit-grade outputs

> **The objective is operational visibility — not opaque optimization l**

SLIDE 12 · Fleet-Level Implications

Small Drift Variations Become Material At Fleet Scale

Progressive thermal drift may influence:

- fuel cost
- thermal consistency
- operating margin
- emissions intensity
- portfolio efficiency
- fleet performance stability

> **Fleet-scale drift visibility may therefore become increasingly important.**

SLIDE 13 · Operational Intelligence Layer

Drift Interpretation Is An Operational Intelligence Function

The framework is designed as:

- historian-derived
- read-only
- operationally contextualized
- non-intrusive
- integration-safe

It does NOT replace:

- DCS systems
- APC systems
- combustion controls
- plant operators

Purpose: improve visibility into evolving thermodynamic operatin

SLIDE 14 · Emerging Operational Perspective

The Next Layer Of Thermal-Performance Management May Involve Drift Visibility

Historically, thermal operations focused heavily on:

- combustion control
- generation stability
- emissions
- equipment reliability

An emerging operational perspective suggests increasing importance of:

- thermal-state interpretation
- drift reconstruction
- radiative coupling visibility
- thermodynamic transfer analysis

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Operational Thermodynamics Intelligence

Historian-Derived Operational Drift Interpretation for Thermal Infrastructure