

Fuel Condition Time Series: When Ground Truth Goes Stale

Temporal co-location, aged measured evidence, and why naked scalars fail audit — under GFMS-1.0

Public Cut · GFMS explainer series — Essay 3 of 3 · **series complete**

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Series	GFMS explainer — Essay 3 of 3 (Basis Tags → Support Boundaries → Fuel Condition Time Series) · series complete

Executive Summary

A sealed measured plot from last season is not automatically current evidence this season. Fuel condition changes — growth, curing, treatment, invasives, moisture. Treating a stale clip as live measured, grounding a surface with temporally mismatched anchors, or reporting a naked scalar with no uncertainty or adequacy flag fails docket and underwriting audit — even when every cell carries a basis tag and respects spatial support bounds.

Under GFMS-1.0, grounded surfaces require measured anchors that are local **and temporally co-located** (basis definitions). Aged or superseded measured is a **display / currency** concept for formerly Measured observations no longer treated as present-day evidence — **not** a fourth GFMS basis enum. **Under GFMS-1.0 Clause 3**, every zone or surface **SHALL** carry n , $\bar{x}$, σ , and UCB_{95} ; adequacy is provisional when **$n < 3$ OR $CI_{95}\text{-half} / \bar{x} > 0.40$** ; hazard-threshold checks use UCB_{95} so uncertainty counts against the asset.

This essay **teaches Clause 3** of GFMS-1.0 — statistical uncertainty and zone adequacy — together with temporal co-location and currency of measured evidence, as the third and final conceptual pillar of the public GFMS explainer series. It does **not** replace the standard. Normative schema language and conformance classes live in **GFMS-1.0 Public** (Document ID HPS-09-MAP-01). Essay 1 (Basis Tags) taught *why every cell must declare origin*. Essay 2 (Support Boundaries) taught *how far a measured anchor may influence adjacent cells*. This essay teaches *whether the measured evidence is still current, whether grounded anchors were temporally co-located, and whether uncertainty and adequacy are declared*.

Series close: Basis (origin) + Support (space) + Time / Adequacy (currency & statistical completeness) = the three public pillars of auditable fuel condition.

Naming locks: CFI = category · **GFMS-1.0** = open standard · **GFHL** = spatial expression · **PlotSeal** = registry / system of record · **RiskWise** = commercial vehicle (stack role only, not the thesis). Method 1.1 and Level 3–4 internals are absent from this public face.

*Soft next step: read GFMS-1.0 Clause 3; re-read Basis Tags (Essay 1) and Support Boundaries (Essay 2); ask of any fuel layer whether measured evidence is still current, whether grounded anchors were temporally co-located, and whether uncertainty and adequacy are declared. **This series is complete.***

1. Problem — When Ground Truth Goes Stale

Wildfire exposure decisions for utilities, insurers, reinsurers, model vendors, and infrastructure operators rest on spatial fuel layers. Basis tags (Essay 1) make origin readable. Support boundaries (Essay 2) bound influence in space. Neither, by themselves, stops a sealed clip from last season from being treated as live measured evidence this season.

Failure mode	What it looks like	Audit defect
Stale clip as live measured	Last season's sealed plot presented as present-day ground truth	Currency of condition not declared; reviewer cannot tell "when"
Temporally mismatched grounding	Surface labeled grounded using anchors from a different season / campaign	Violates temporal co-location in GFMS / MMG grounded definition
Naked scalar reporting	Zone mean or single load with no n , σ , UCB_{95} , or adequacy flag	Clause 3 violation; uncertainty invisible; threshold checks unchallengeable
Silent aging	Formerly measured observation still styled as current measured	Display / currency honesty fails; historical seal misread as present evidence
Adequacy silence	Thin sample ($n < 3$) or wide CI without adequacy: provisional	Provisional condition hidden; underwriter assumes full statistical standing

Claim (series thesis for Essay 3): Docket and underwriting defense requires **currency of condition** and **statistical completeness**, not “one sealed number forever.” A fuel layer that declares basis and respects R_s but treats aged evidence as live — or reports naked scalars — still fails the underwriter’s third question: *is this measured evidence still current, were the anchors temporally co-located, and are uncertainty and adequacy declared?*

Illustration (non-normative): An underwriter opens a corridor buffer in September. A sealed clipped plot from the prior spring sits at a fence corner. Cells within support in the same stratum are labeled grounded. The layer reports a single load of 4.12 tons/acre with no sample count, no σ , no UCB_{95} , and no adequacy flag. Growth, curing, and a mid-summer treatment have changed the strip. Without temporal co-location discipline, currency signaling, and Clause 3 metrics, the docket cannot defend whether the condition is still current — or whether the number is statistically adequate for a hazard-threshold check.

What breaks audit is not the existence of aged records. Historical seals remain attributable. What breaks audit is presenting aged measured as present-day evidence, grounding with temporally mismatched anchors, or shipping a naked scalar as if uncertainty did not exist.

2. Framework — Time, Currency, and Clause 3 Under GFMS-1.0

2.1 Temporal co-location

Per GFMS-1.0 §1.3.1 (basis definitions) and the MMG / Basis Tags teaching lineage:

- **Grounded** (basis: grounded) is a spatial fuel surface initiated as a model and mathematically constrained by **local, temporally co-located** measured anchors, validated against held-out ground observation.
- Locality alone is not enough. Anchors that are spatially within R_s and the same stratum but drawn from a mismatched collection window do **not** satisfy the grounded definition as published.

Claim (conceptual): Time matters as much as distance. Spatial support (Essay 2) answers *how far*. Temporal co-location answers *when those anchors may constrain a surface claimed as present-day grounded*. Distance without time is incomplete co-location.

2.2 Currency / aged measured (display concept — not a fourth enum)

Per the GFHL overview (HPS-09-ART-GFHL-01-PUB) and Basis Tags enum lock:

- **Aged / superseded measured** is a **display / currency** concept for formerly Measured observations no longer treated as present-day evidence. The observation remains historically attributable but is not presented as current measured evidence.
- This essay does **not** invent a fourth GFMS basis enum value. Acceptable GFMS basis values remain measured, modelled, and grounded (GFMS-1.0 Clause 1). Aged / superseded still rests on a declared basis lineage.

Claim (conceptual): Currency is how a layer tells the truth about *whether* a formerly measured observation is still offered as present-day evidence. Aging is qualitative in this public essay — specific decay day counts and invasive accelerator lists are **not** published here as normative requirements. The public teaching point is honesty of currency, not a proprietary calendar.

2.3 Clause 3 — Uncertainty & Adequacy (per GFMS-1.0)

Requirement — Statistical Uncertainty & Zone Adequacy (per GFMS-1.0 Clause 3 — teach attribution):

- A single fuel loading value **SHALL NOT** be reported as a naked scalar. Every zone or surface output **SHALL** carry: Sample Count (n); Mean ($\bar{x}$) and Standard Deviation (σ); 95% Upper Confidence Bound (UCB_{95}).
- **Adequacy Rule:** A zone surface **SHALL** be flagged as adequacy: provisional if $n < 3$ measured plots, **OR** the half-width of the 95% confidence interval exceeds **40%** of the calculated mean ($CI_{95}\text{-half} / \bar{x} > 0.40$).
- Conformance evaluation against wildfire hazard thresholds **SHALL** be evaluated against the 95% Upper Confidence Bound (UCB_{95}), forcing statistical uncertainty to count against asset risk.

Claim (conceptual): Clause 3 is the statistical face of “condition you can defend over time / across samples.” A single stale number is not a time series of trustworthy condition. Declared n , dispersion, UCB_{95} , and adequacy make the sample’s standing readable — so reviewers can see when evidence is thin, when uncertainty is wide, and when hazard checks must use the upper bound rather than a flattering mean.

Conformance class (per GFMS-1.0): Uncertainty-complete — n , $\bar{x}$, σ , UCB_{95} present; provisional adequacy when $n < 3$ or $CI_{95}\text{-half} / \bar{x} > 0.40$ (Clause 3).

2.4 Series pillars — Origin + Space + Time / Adequacy

Pillar	Essay	GFMS locus	Public question answered
Basis (origin)	Essay 1 — Basis Tags	Clause 1	<i>Where did this value come from?</i>
Support (space)	Essay 2 — Support Boundaries	Clause 2	<i>How far may measured influence reach?</i>
Time / Adequacy	Essay 3 — Fuel Condition Time Series (this)	Temporal co-location in defs + Clause 3	<i>Is evidence still current? Were anchors co-timed? Are uncertainty and adequacy declared?</i>

Series close: Together these three pillars are the public spine of auditable fuel condition under GFMS-1.0. This essay completes the explainer series.

2.5 What this essay defers

Topic	Where it lives
Mandatory basis declaration and enum lock	GFMS-1.0 Clause 1 — taught in Basis Tags (Essay 1)
Support radius, stratum termination, reversion	GFMS-1.0 Clause 2 — taught in Support Boundaries (Essay 2)
Canonicalization / dual-digest verification	GFMS-1.0 Clause 4
Full three-class foundation narrative	HPS-09-ART-MMG-01-PUB
Hazard-layer spatial expression + aged display concept	HPS-09-ART-GFHL-01-PUB
Proprietary decay day counts / invasive accelerator calendars as requirements	Not disclosed — out of public normative scope
Interpolation algorithms, DEM recipes, browser engines, scoring	Not disclosed — out of public scope

2.6 Naming locks and stack role

Name	Role	Not to be confused with
CFI	Enterprise technology category	Not “the standard”; not a time-series product
GFMS-1.0	Open interface standard (Clause 3 = uncertainty & adequacy)	Not a product; not this essay
GFHL	Spatial expression of grounded fuel at hazard-layer scale	Not a fire-behavior model
PlotSeal	Registry / system of record concept for sealed observations	Not “Wildfire Data Center”; internals not public
Basis Tags essay	Essay 1 — mandatory origin declaration	Not the Clause 3 teaching piece
Support Boundaries essay	Essay 2 — spatial support & reversion	Not the currency / adequacy teaching piece
RiskWise	Commercial vehicle (stack role only)	Not the thesis of this document

Allowed public phrase: Proprietary field-collection protocols may produce GFMS-1.0-conformant payloads that carry uncertainty-complete zone metrics and respect temporal co-location for grounded surfaces; they are not required for external conformance to the open interface.

3. Proof — Currency Over Time and Uncertainty-Complete Zones

3.1 Why currency and adequacy are the audit units for time

Claim: For fuel-layer audit, after basis is declared and support is bounded, the natural units of *temporal defense* are (1) **whether measured evidence is still offered as current**, (2) **whether grounded anchors were temporally co-located with the surface**, and (3) **whether the zone carries Clause 3 metrics and adequacy**. A layer that says “measured fuel” while shipping last season’s clip as live — or a naked mean with no UCB_{95} — still fails the underwriter’s question: *can I defend this condition over time and across samples?*

Illustration (non-normative) — three audit questions this essay makes answerable:

- *Is this measured observation still current evidence?* → Currency / aged-superseded display honesty (conceptual; not a fourth enum).
- *Were the anchors that ground this surface temporally co-located?* → Yes required for grounded (GFMS / MMG definition).
- *Are uncertainty and adequacy declared so a hazard check can use UCB_{95} ?* → Clause 3 mandatory metrics + provisional rule.

3.2 Figure 1 — Fuel condition over time schematic

Aligned with GFMS-1.0 Clause 3 and GFHL aged / superseded teaching; essay-taught. Schematic only — not a field protocol and not a substitute for the normative standard.

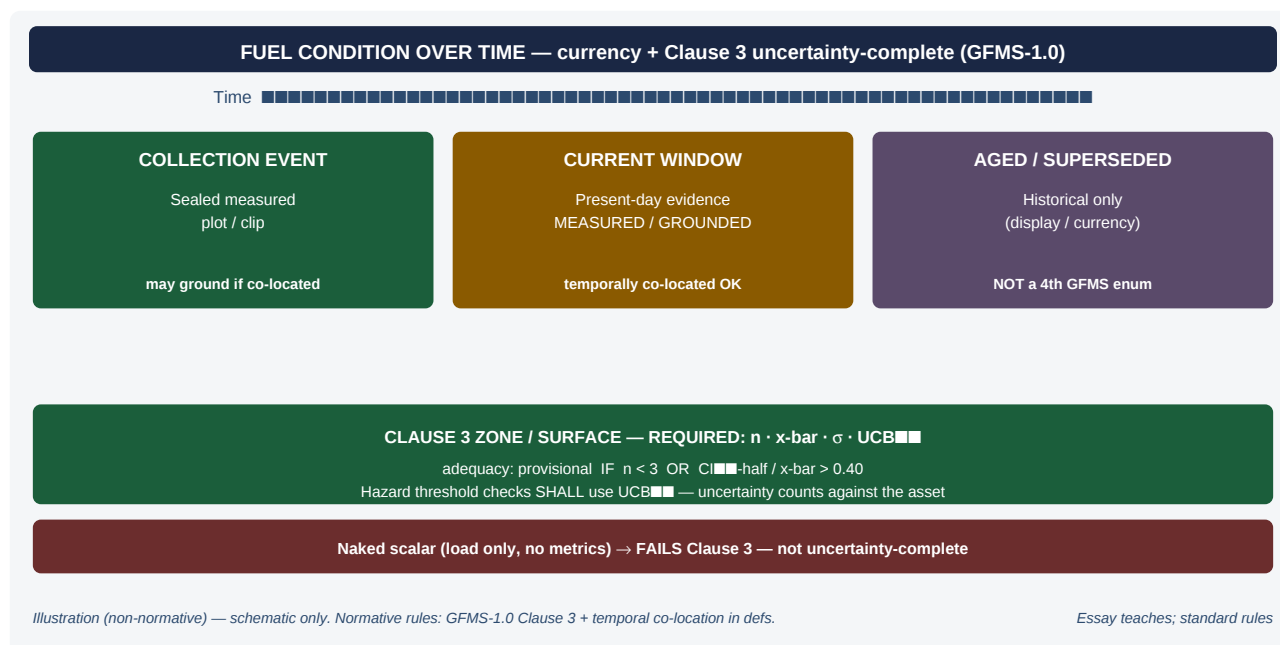


Figure 1 — Fuel condition over time and uncertainty-complete zone reporting. Illustration (non-normative). Normative Clause 3 rules (n , $\bar{x}$ -bar, σ , UCB_{95} adequacy provisional thresholds, UCB_{95} hazard checks): GFMS-1.0. Temporal co-location: GFMS-1.0 §1.3.1 / MMG. Aged / superseded measured (display concept): HPS-09-ART-GFHL-01-PUB. Series pillars: HPS-09-ART-BASIS-01-PUB · HPS-09-ART-SUPPORT-01-PUB · this essay.

Reporting form	Required under GFMS-1.0 Clause 3?	Audit standing
Naked scalar (load only)	No — SHALL NOT	Fails uncertainty-complete
Zone with n , $\bar{x}$ -bar, σ , UCB_{95}	Yes	Uncertainty-complete (subject to adequacy)
Zone with $n < 3$ or $CI_{95} \text{ half} / \bar{x} > 0.40$	Metrics and adequacy: provisional	Provisional — still honest
Hazard-threshold check using mean only	No — SHALL use UCB_{95}	Uncertainty must count against asset

3.3 Claim vs illustration discipline

Statement class	Example in this essay
Claim	Stale clips as live measured, temporally mismatched grounding, and naked scalars fail audit readiness
Requirement (per GFMS-1.0)	Every zone/surface SHALL carry n , $\bar{x}$ -bar, σ , UCB_{95} ; provisional when $n < 3$ OR $CI_{95} \text{ half} / \bar{x} > 0.40$; hazard checks SHALL use UCB_{95}
Claim (conceptual)	Temporal co-location is as necessary as spatial locality for grounded; aged/superseded is currency display, not a fourth basis enum
Illustration (non-normative)	Figure 1 schematic; September corridor / prior-spring clip underwriter example
Deferred requirement	Proprietary day-count aging calendars → not public normative; Clause 4 seals → GFMS-1.0

This essay teaches Clause 3 and temporal currency. It does not replace GFMS-1.0 as the rulebook, and it does not invent proprietary decay schedules or scoring engines.

3.4 Comparative standing (informative)

Property	Stale / naked practice	Currency + Clause 3 under GFMS-1.0
Temporal standing of measured	Often implicit / forever-current	Currency honesty; aged/superseded as display concept
Grounded co-conditions	Distance (maybe) only	Local and temporally co-located anchors
Zone reporting	Naked scalar common	n , $\bar{x}$ -bar, σ , UCB_{95} mandatory
Thin / noisy samples	Often unlabeled	adequacy: provisional when $n < 3$ or CI half/mean > 0.40
Hazard threshold check	Often against mean	SHALL against UCB_{95}
Audit question: current & adequate?	Usually unanswerable from the layer alone	Answerable from currency + Clause 3 metrics

4. Implication — Defense Requires Currency and Completeness · Series Close

Time and adequacy matter wherever a fuel number must survive third-party challenge:

- **Utility wildfire mitigation plans (WMPs)** and related regulatory dockets that must defend whether clipped evidence is still current — not only that a seal exists.
- **Insurance and reinsurance analytics** that underwrite or price wildfire exposure and need uncertainty-complete zone metrics rather than flattering naked means.
- **Catastrophe and wildfire model vendors** (and their clients) that need temporally honest fuel inputs rather than last-season ground truth painted as live.
- **GIS and spatial-platform operators** that publish or consume fuel layers and need shared rules for adequacy and UCB_{95} hazard checks.
- **Infrastructure asset owners** that document corridor and pad-edge fuel state without claiming a single aged clip is perpetual measured condition.

Implication for adopters: After the **tag** (Essay 1) and **support bounds** (Essay 2), adopt **currency honesty** and **uncertainty-complete** reporting. Then adopt the full **open standard** (GFMS-1.0) for normative interface rules. Evaluate commercial vehicles — including RiskWise — only after the interface and evidence properties are clear. Category and standard growth do not require exclusive use of any one vendor; they require shared rules and verifiable properties.

Series close (public pillars): (1) **Basis** — every cell declares origin; (2) **Support** — measured influence bounded by R_s and stratum; (3) **Time / Adequacy** — measured evidence stays current only while honestly current; grounded anchors are temporally co-located; zones carry n , $\bar{x}$, σ , UCB_{95} and adequacy. Together: auditable fuel condition under GFMS-1.0. **This GFMS explainer series is complete.**

Soft next step (teach, don't sell)

1. Read **GFMS-1.0** Clause 3 (Public cut) — Document ID HPS-09-MAP-01 — for normative uncertainty, adequacy, and UCB_{95} hazard-check requirements.
2. Re-read **Basis Tags** — Document ID HPS-09-ART-BASIS-01-PUB — for mandatory origin declaration (Clause 1 teaching).
3. Re-read **Support Boundaries** — Document ID HPS-09-ART-SUPPORT-01-PUB — for spatial support and reversion (Clause 2 teaching).
4. Read **Measured, Modelled, and Grounded** — Document ID HPS-09-ART-MMG-01-PUB — for foundation definitions including temporal co-location.
5. Read **GFHL Overview** — Document ID HPS-09-ART-GFHL-01-PUB — for aged / superseded measured as a display / currency concept.
6. Ask of any fuel layer: *Is the measured evidence still current? Were grounded anchors temporally co-located? Are uncertainty and adequacy declared?*
7. Contact High Plains Shield, LLC at info@highplainshield.com for standards clarification or conformant-implementation questions — not a product hard sell.

5. Limitations — What This Document Is Not

This Public cut:

- **Is not** an open standard (see GFMS-1.0).
- **Is not** a substitute for GFMS-1.0 Clause 3 normative language.
- **Is not** a product datasheet, SKU list, drop ID list, or pricing document.
- **Is not** a disclosure of proprietary field-collection protocols, registry architecture, key-management, device attestation, scoring engines, calibration weights, browser-storage internals, full cell JSON schemas, interpolation recipes, DEM pipelines, proprietary aging day-count calendars, invasive accelerator schedules as requirements, or trade-secret thresholds.
- **Does not** invent algorithms (no Wasm engines, proprietary DEM recipes, or scoring engines).
- **Does not** invent a fourth GFMS basis enum value (aged / superseded remains a display / currency concept).
- **Does not** publish proprietary decay day counts as normative public requirements — aging is taught qualitatively; specifics deferred.
- **Does not** redo Basis Tags (Essay 1) or Support Boundaries (Essay 2) as if this were those rulebooks.
- **Does not** guarantee regulatory acceptance in any specific jurisdiction.
- **Does not** describe PlotSeal or commercial-vehicle internals beyond public naming-lock roles.
- **Does not** claim market share or present “Wildfire Data Center” framing.
- **Series note:** This essay **closes** the GFMS explainer series (Essay 3 of 3). No further essay in this three-part series remains.

Not disclosed (IP gate): Method 1.1, FMES, HPFS, Structural MVE, CAT packs, Field Gauge, TrueFuel, WROS, VALOR, drop IDs, Wasm, DEM, invasive accelerator day lists as requirements, device-binding recipes, proprietary engines, and related Level 3–4 internals remain internal under HPS-PUB-STD-001 §4. Quantitative performance claims for any commercial implementation are **out of scope** here.

6. Glossary

Term	Public meaning
Temporal co-location	Requirement (in GFMS / MMG grounded definitions) that measured anchors constraining a grounded surface be local and of matching collection time / campaign window.
Currency	Whether a measured observation is still treated as present-day evidence.
Aged / superseded measured	GFHL display / currency concept for formerly Measured observations no longer treated as current evidence; not a fourth GFMS basis enum value.
Naked scalar	A fuel load or zone value reported without mandatory Clause 3 dispersion metrics (n , $\bar{x}$, σ , UCB_{95}).
n	Sample count of measured plots in a zone (GFMS-1.0 notation).
$\bar{x}$-bar	Sample mean fuel load.
σ	Sample standard deviation.
UCB_{95}	95% upper confidence bound; hazard-threshold checks SHALL use this bound (Clause 3).
CI_{95}-half	Half-width of the 95% confidence interval; provisional adequacy when CI_{95} -half / $\bar{x}$ -bar > 0.40.
Adequacy (provisional)	Zone flag required when $n < 3$ OR CI_{95} -half / $\bar{x}$ -bar > 0.40 (GFMS-1.0 Clause 3).
Uncertainty-complete	GFMS-1.0 conformance class: n , $\bar{x}$ -bar, σ , UCB_{95} present; provisional adequacy rule applied (Clause 3).
Measured	Basis class: direct physical empirical observation at a known place and time.
Grounded	Basis class: model-initiated surface constrained by local, temporally co-located measured anchors within support limits; does not become Measured by inheritance.
Modelled	Basis class: algorithmic / spectral / ML inference without on-site weighed biomass for that cell; also the required label after spatial reversion.
Basis tag	Mandatory origin declaration: measured, modelled, or grounded (GFMS-1.0 Clause 1; Essay 1).
Support radius (R_s)	Maximum horizontal distance a physical measurement anchor may influence adjacent cells; normative maximum published in GFMS-1.0 = 10.0 m (Clause 2; Essay 2).
GFMS-1.0	Grounded Fuel Mapping Standard — open interface standard. Clause 3 = statistical uncertainty & zone adequacy.
CFI	Enterprise technology category for physical, cryptographically proven fuel intelligence. Not “the standard.”
GFHL	Spatial expression of grounded fuel at hazard-layer scale.
PlotSeal	Registry / system of record concept for sealed fuel measurement records. Not “Wildfire Data Center.”
RiskWise	Commercial vehicle that may implement CFI-conformant workflows. Stack role only; not the thesis of this essay.

Document Control

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Revision History

Version	Effective	Summary	Gates
Public v1.0	2026-09-24	First dedicated public GFMS explainer essay on Fuel Condition Time Series: teaches temporal co-location; aged/superseded measured as display/currency (not fourth enum); GFMS-1.0 Clause 3 (n, x-bar, σ , UCB_{95} ; provisional adequacy $n < 3$ or CI_{95} -half/x-bar > 0.40 ; hazard checks use UCB_{95}); Figure 1 fuel-condition-over-time + uncertainty-complete schematic; series close (Basis + Support + Time/Adequacy); soft CTA back to Essays 1–2 and GFMS Clause 3; naming locks; Limitations + Glossary; §4 scrub; clean Markdown → PDF. Series complete.	Author → Technical Review → Publication Review → Release (HPS process)

Pre-Publish Checklist (Hard Gate) — Recorded Pass

- Format F1 selected; Problem → Framework → Proof → Implication spine complete
- Author = High Plains Shield, LLC everywhere (including metadata)
- Face block complete: Document ID · Version ID · Effective Date · Supersedes · Classification · Author
- Naming locks: CFI = category · GFMS-1.0 = standard · RiskWise = commercial vehicle · PlotSeal = registry/SoR · GFHL = spatial expression · Method 1.1 / forbidden internals absent
- Claims vs illustrations labeled; Limitations present; Glossary present
- IP gate cleared (§4 scrub): Method 1.1, FMES, HPFS, Structural MVE, CAT packs, Field Gauge / TrueFuel / WROS / VALOR, drop IDs, Wasm, DEM, invasive accelerator day lists as requirements, device-binding recipes, proprietary engines absent (absent lines + Limitations Not disclosed only)
- Visual proof: Figure 1 fuel condition over time + uncertainty-complete zone schematic
- Production clean from Markdown (no DOCX artifacts)
- Technical Review + Publication Review recorded (HPS process)
- Minimum credibility length met; teach-don't-sell tone verified
- No Netlify publish (held); parent attaches PDF only for peer review
- Series discipline: Essay 3 of 3 complete; T12 not started; Final Cut masters not overwritten

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