

Cryptographic Fuel Intelligence (CFI)

Category Doctrine — **Public Cut**

Establishing CFI as an enterprise technology category for physical, cryptographically proven fuel data

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Executive Summary

Cryptographic Fuel Intelligence (CFI) is an enterprise technology **category** — not a single product and not an open standard by itself. It names the discipline that replaces statistical satellite and aerial fuel inferences with **physical, ground-level fuel measurements** sealed by **tamper-evident dual-hash cryptography** at the point of collection, so that high-consequence risk decisions rest on audit-ready ground truth rather than opaque model estimates.

To belong to the CFI category, a solution must integrate **four pillars**:

- **Open standard** — physical fuel attributes measured and represented against a publicly published, independently implementable interface (e.g., GFMS-1.0).
- **Hardware-anchored field collection** — instruments and field workflows that capture raw observations with basis tags, geospatial context, and collection-time sealing (including offline capture with later sync).
- **Tamper-evident dual-hash proof** — every record hashed at collection using dual digests (SHA-256 / SHA3-256) over an RFC 8785—canonical payload, offline-verifiable without vendor intervention.
- **Observer custody** — unbroken, attributable custody from the field observer through sealed record to the registry of record, so auditors can answer *who measured what, where, and when* without trusting a black-box pipeline.

GFMS-1.0 is the open **standard** that defines the public interface. **PlotSeal** denotes the **system of record / registry** concept for sealed measurements. **RiskWise** is a **commercial vehicle** that may implement CFI-conformant workflows; it is not the category and not the standard.

*This public doctrine teaches the category. It does **not** disclose proprietary collection engines, registry internals, trade-secret thresholds, or internal go-to-market programs. Soft next step only: read the GFMS-1.0 public specification and evaluate whether fuel layers in your environment declare basis, uncertainty, and offline-verifiable seals.*

1. Problem — Why a Category Is Needed

Wildfire exposure decisions for utilities, insurers, reinsurers, and infrastructure operators increasingly rely on fuel layers. Two legacy approaches dominate:

Approach	Typical basis	Structural gap
Remote sensing / spectral models	Statistical inference from above-canopy reflectance	Cannot weigh sub-canopy surface fuel; audit trail is model pipeline, not physical condition
Traditional field auditing	Paper logs, photos, unverified notes	High local knowledge, but records are easily altered and rarely offline-cryptographically verifiable

Neither approach alone gives regulators, underwriters, or asset owners a **shared, independently checkable** answer to: *What was the physical fuel condition at this asset, who observed it, and has the record been changed since collection?*

Claim (category thesis): High-consequence wildfire risk environments need a named discipline — CFI — that couples physical measurement, open interface rules, collection-time cryptographic proof, and observer custody into one category boundary. Without that boundary, “ground truth” and “AI fuel maps” compete on marketing language rather than on auditable properties.

***Illustration (non-normative):** Saying a layer is “high resolution” does not imply it was weighed on the ground. Saying a log is “field-collected” does not imply it is tamper-evident. CFI exists to make those distinctions explicit.*

2. Framework — Category Definition and Four Pillars

2.1 Category definition

Cryptographic Fuel Intelligence (CFI) is an emerging enterprise technology category that replaces statistical satellite and aerial inferences with physical, ground-level fuel measurements. By coupling standardized field-sampling representation rules with cryptographic hashing at the point of capture, CFI establishes a tamper-evident, audit-ready ground-truth layer for high-consequence risk environments.

Alternative industry descriptors (informative, not normative synonyms): Physical Fuel Verification; Auditable Ground-Truth Risk.

Naming lock: CFI is a **category**. It is not “the standard.” The open standard in this stack is **GFMS-1.0**.

2.2 The four pillars

A solution belongs to the CFI category only when it integrates all four layers:

#	Pillar	Public meaning
1	Open standard — the rulebook	Physical fuel loading (e.g., tons/acre), bulk density, moisture, and height are represented against open, deterministic interface rules (e.g., GFMS-1.0) rather than estimated solely through spectral greenness. The standard is publicly published and independently implementable.
2	Hardware-anchored field collection — the execution	Field-capture instruments and workflows log raw fuel data with explicit basis tags, geospatial coordinates, and timestamped physical observations. In zero-connectivity zones, hashing occurs on-device at collection; sealed payloads sync when connectivity returns so the seal timestamp reflects collection, not upload.
3	Tamper-evident dual-hash proof — the integrity layer	Every record is hashed at collection using dual-digest cryptography (SHA-256 / SHA3-256) over an RFC 8785—canonical payload. Proof remains offline-verifiable, preventing silent post-hoc manipulation by crews, utilities, or intermediaries.
4	Observer custody — the accountability layer	Custody binds observer identity (or authorized observer role), place, date/time, method class, and evidence handle to the sealed record and carries that custody into the registry of record. Auditors can reconstruct <i>who observed what</i> without reconstructing a proprietary model.

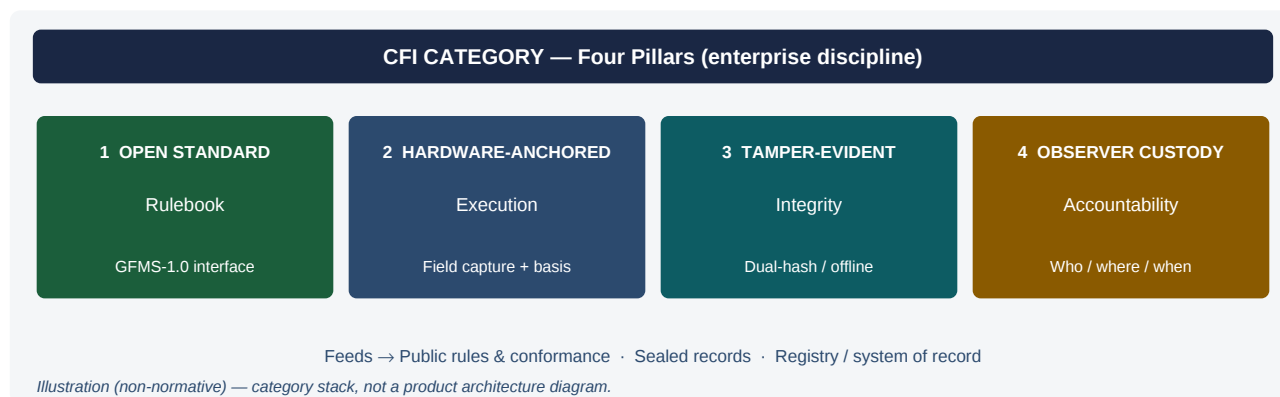


Figure 1 — Four pillars of the CFI category. *Illustration (non-normative).*

2.3 How CFI relates to GFMS-1.0 and PlotSeal

Name	Role in the stack	Public classification
CFI	Category / discipline boundary	Category essay (this document)
GFMS-1.0	Open interface standard (schemas, basis, spatial support, uncertainty, seal format)	Technical Public open standard
PlotSeal	Registry / system of record concept for sealed measurements	Named SoR concept; implementation internals not public
RiskWise	Commercial vehicle that may deliver CFI-conformant workflows	Commercial product packaging (outside this essay's thesis)

Open vs. proprietary boundary (public-safe):

- **Open (interface):** Data structure and field schemas; three-tier basis taxonomy (Measured / Modelled / Grounded); RFC 8785 canonicalization and dual-digest structure; spatial support rules as published in GFMS-1.0; conformance checklist for claiming GFMS-1.0 compliance.
- **Not disclosed here:** Proprietary field-collection execution engines, registry implementation architecture, device-binding or key-management internals, commercial scoring or exposure engines, and internal go-to-market programs.

Allowed public phrase: *Proprietary field-collection protocols may produce GFMS-1.0-conformant payloads; they are not required for external conformance.*

3. Proof — Comparative Standing (Informative)

The following comparison is **informative** — it illustrates category properties; it is not a product benchmark and not a normative requirement table.

Table 1 — CFI vs. legacy approaches (Illustration / informative)

Feature	Legacy remote sensing	Traditional field auditing	CFI category properties
Data basis	Statistical inference & spectral estimates	Manual logs & unverified photos	Weighed / measured physical ground truth with explicit basis tags
Auditability	Low (black-box algorithms)	Low (easily altered)	High (tamper-evident dual-digest hash)
Offline verification	Typically no (model/cloud)	Typically no	Yes (independent cryptographic math)
Sub-canopy precision	Poor (canopy / structures)	High when walked at asset	High when physically collected at asset
Regulatory standing	Model-bias challenge	Human-error / alteration challenge	Independently verifiable when seals and custody intact

Structural note (claim, physics — not product pitch): Reflected light above the canopy cannot reveal sub-canopy surface fuel mass at any optical resolution. Higher-resolution imagery and AI post-processing refine estimates of what the sensor can see; they do not convert optical reflectance into weighed biomass under dense canopy. CFI does not “beat AI at imagery”; it answers a different question — *physical condition at the plot, cryptographically sealed, with observer custody*.

4. Implication — Who Uses the Category and How

CFI matters wherever fuel layers must survive third-party challenge:

- **Utility wildfire mitigation plans (WMPs)** and related regulatory dockets that must defend fuel inputs.
- **Insurance and reinsurance** analytics that underwrite or price wildfire exposure using fuel assumptions.
- **Infrastructure asset owners** (renewables, substations, corridors, oil & gas surface facilities) that need defensible-space and fuel documentation.
- **Field service and data intermediaries** that want to publish or consume an open, conformant interface rather than a vendor-locked fuel format.

Implication for adopters: Adopt the **category language** (basis-tagged, sealed, custody-bound physical fuel) and the **open standard** (GFMS-1.0) first. Evaluate commercial vehicles — including RiskWise — only after the interface and evidence properties are clear. Category growth does not require exclusive use of any one vendor; it requires shared rules and verifiable properties.

Soft next step (teach, don’t sell)

- Read **GFMS-1.0** (Public cut) — Document ID HPS-09-MAP-01 — for normative interface requirements.
- Ask of any fuel layer in your stack: *Does every feature declare basis? Carry uncertainty? Seal offline-verifiably? Bind observer custody?*
- 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 product datasheet, SKU list, or pricing document.
- **Is not** a disclosure of proprietary field-collection protocols, registry architecture, key-management, device attestation, scoring engines, or trade-secret thresholds.
- **Is not** a trademark-filing, IP-inventory, or go-to-market program plan.
- **Does not** claim that every remote-sensing product is unfit for all uses; it claims remote sensing alone cannot substitute for physical sub-canopy fuel mass where that mass is the decision-critical input.
- **Does not** guarantee regulatory acceptance in any specific jurisdiction; acceptance depends on local rules and docket practice.
- **Does not** overwrite or replace the internal Final Cut master (HPS-09-CFI-01 Rev4 TM Final Cut), which remains internal.

Quantitative performance claims for any commercial implementation are **out of scope** here and must be labeled separately as claim, requirement, or illustration in those materials.

6. Glossary

Term	Public meaning
CFI (Cryptographic Fuel Intelligence)	Enterprise technology category for physical, cryptographically proven fuel intelligence. Not “the standard.”
GFMS-1.0	Grounded Fuel Mapping Standard — open interface standard for representation, spatial support, uncertainty, and cryptographic provenance of physical fuel data.

Term	Public meaning
Basis (measured / modelled / grounded)	Mandatory tag declaring whether a value is direct physical observation, algorithmic inference, or model constrained by measured anchors.
Dual-hash / dual-digest	Concurrent SHA-256 and SHA3-256 digests over a canonical payload for tamper-evident integrity.
RFC 8785 canonicalization	Deterministic JSON canonicalization so digests are reproducible across systems.
Observer custody	Attributable chain binding observer (or role), place, time, method class, and evidence to the sealed record through the registry.
PlotSeal	Registry / system of record concept for sealed fuel measurement records. Not "Wildfire Data Center." Implementation internals are not public.
RiskWise	Commercial vehicle that may implement CFI-conformant workflows. Not the category; not the open standard.
Support radius (R_s)	Maximum distance a measured anchor may influence adjacent cells under GFMS-1.0 (normative maximum 10.0 m in the public standard).
Offline verification	Ability to check digests without proprietary API authentication or vendor intervention.
Public / Technical Public	Classification for documents approved for external distribution under HPS-PUB-STD-001.

Document Control

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Revision History

Version	Effective	Summary / Gates
Rev4 TM Final Cut	prior	Internal category establishment doctrine (master retained; not overwritten). Prior classification: internal proprietary (not public).
Public v1.0	2026-09-24	Parallel Public cut: High Plains Shield, LLC sole authorship; face block; Classification Public; F1 spine; four pillars with public-safe wording (pillar 4 = observer custody); GFMS-1.0 / PlotSeal / RiskWise naming locks; establishment program, trademark tactics, personal outreach plans, ownership tables, and Level 3–4 internals scrubbed; Figure 1 four-pillars visual proof; Limitations + Glossary; soft CTA only; clean Markdown → PDF. Author → Technical Review → Publication Review → Release recorded under High Plains Shield, LLC process.

Pre-Publish Checklist (Hard Gate) — Recorded Pass

- Format F1; Problem → Framework → Proof → Implication spine complete
- Author = High Plains Shield, LLC everywhere (incl. metadata)
- Face block complete (Document ID · Version · Effective · Supersedes · Classification · Author)
- Naming locks: CFI=category · GFMS-1.0=standard · RiskWise=commercial · PlotSeal=registry/SoR · restricted method codes absent
- Claims vs illustrations labeled; Limitations + Glossary present
- IP gate cleared: Level 3–4 collection/registry internals, trade secrets, GTM program, and personal names absent from public body
- Visual proof: Figure 1 four-pillars diagram
- Production clean from Markdown (no DOCX artifacts)
- Technical Review + Publication Review recorded (HPS process)
- Teach-don't-sell tone verified; Final Cut master not overwritten

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