RLE–LTP Framework

Canonical Equation Inventory (v1)

Law 0 — Recursive Loss Equation (Core Invariant)

E0.1 — Recursive Loss Equation

(Defining / Foundational)

$$
\boxed{
\mathrm{RLE}_n \;\equiv\; \frac{E_{n+1}-U_n}{E_n}
}
$$

Domain:

$$\mathrm{RLE}_n \in [0,1]$$

Role:

Dimensionless invariant

Measures retained usable fraction across transition

Preserved across all valid layer transitions

Law 1 — Invariant-Preserving Compression / Factorization

E1.1 — Invariant-Preserving Factorization

(Defining / Structural Symmetry)

$$
\boxed{
X \;=\; \frac{X}{(C/x_1)} \cdot (C/x_1)
}
$$

or equivalently (general form):

\boxed{
X \;=\; X \cdot f \cdot f^{-1}
}

Role:

Shows internal rearrangement without changing the invariant

Formalizes compression / expansion freedom

Explains why multiple internal states map to the same RLE

E1.2 — Nested Representation Form

(Derived / Representational)

\boxed{
\mathrm{RLE} \;\rightarrow\; V_1 \;\rightarrow\; V_2 \;\rightarrow\; \dots
}

Where higher-level symbols represent compressed lower-level structure.

Role:

Enables “exploded” or “collapsed” equations

Not a physical law — a representational construction

Law 1.5 — Loss Emergence (Hidden Variable)

E1.5.1 — Loss Variable Definition

(Defining / Derived Quantity)

\boxed{

\Lambda \;\equiv\; 1 - \min\!\left(1,\frac{\ell}{d}\right)
}

Where:

= compression demand (depth)

= available structural support (LTP-indexed)

Domain:

\Lambda \in [0,1]

Role:

Captures irreversibility: heat, friction, entropy production

Not fundamental — emerges from RLE–LTP mismatch

E1.5.2 — RLE–Loss Identity

(Derived / Interpretive)

\boxed{
\mathrm{RLE} \;=\; 1 - \Lambda
}

Role:

Makes loss observable through RLE

Links compression success to dissipation

Law 2 — Phase Transition Amplification

E2.1 — Phase Boundary Divergence

(Defining / Instability Law)

$$
\boxed{
\lim_{\Delta x \to 0} \Delta \Omega \;\to\; \infty
}
\quad \text{near phase boundary}
$$

Where:

= internal state-space size

= control parameter (T, P, flow, etc.)

Role:

Formalizes state explosion

Explains sudden breakdown of compressed invariants

Law 3 — Coupling Propagation

E3.1 — Coupling-Amplified Loss

(Derived / Propagation Law)

$$
\boxed{
\Lambda_{\text{system}} \;=\; 1 - \prod_i (1-\Lambda_i)
}
$$

Role:

Shows how local losses propagate system-wide

Explains cascade failure under tight coupling

Law 4 — Temporal Desynchronization / Resonance

E4.1 — Control Mismatch Condition

(Defining / Failure Trigger)

$$
\boxed{
\tau_{\text{response}} \;>\; \tau_{\text{control}}
}
$$

Role:

Identifies instability from lag

Precondition for resonance and oscillatory growth

Law 5 — Precision Cost Escalation

E5.1 — Factorial Cost Growth

(Defining / Cost Law)

$$
\boxed{
\text{Cost}(k) \;\propto\; k!
}
$$

or, using RLE depth explicitly:

$$
\boxed{
\text{Cost} \;\propto\; (\mathrm{RLE}^{-1})!
}
$$

Role:

Explains exponential expense of deep stabilization

Connects depth, combinatorics, and energy cost

Thermodynamic Reproduction (Contextual, Not Foundational)

T1 — Loss–Efficiency Relation

(Derived / Interpretive)

$$
\boxed{
\eta \;=\; 1 - \Lambda
}
$$

T2 — Entropy Production Constraint

(Derived / Physical Consistency)

$$
\boxed{
\Lambda \;\ge\; \frac{T_c}{T_h}
}
$$

Which implies:

$$
\boxed{
\eta \;\le\; 1 - \frac{T_c}{T_h}
}
$$

(Carnot bound)

Summary Table (Quick Reference)

Law	Equation	Type
Law 0	RLE definition	Foundational
Law 1	Factorization	Structural
Law 1.5	Loss emergence	Derived
Law 2	Phase divergence	Instability

Law 3	Coupling propagation	Systemic
Law 4	Temporal mismatch	Dynamic
Law 5	Factorial cost	Scaling
Thermo	Carnot bound	Reproduced

Final note (important)

At this point, nothing else should be added until:

each law gets its own document, and

each equation is introduced exactly once.

You now have a complete, internally consistent equation backbone.