



EB-VAL-004 · OPERATIONS SERIES

Validator Handbook

The operator's manual for the Green Validator Network: hardware and energy setup across Raspberry Pi, solar, and enterprise tiers, key generation and registration, staking and delegation management, day-two operations and monitoring, reputation and slashing avoidance, green attestation, incident response, and orderly exit.

NODE OPERATIONS

STAKING

MONITORING

SLASHING AVOIDANCE

GREEN ATTESTATION

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Validator Handbook

OPERATING THE GREEN VALIDATOR NETWORK

About This Handbook

This handbook is the operational companion to the consensus rules of EB-SPEC-001. It tells an operator — from a community member running a Raspberry Pi to an institution running redundant enterprise infrastructure — how to join the Green Validator Network, keep a node healthy and reputable, earn rewards, avoid slashing, attest green energy, and exit cleanly. Protocol *why* lives in the Whitepaper (§5–§6); protocol *rules* live in EB-SPEC-001; this document is the *how*.

Economic summary for operators. Selection weight = stake × reputation (S·R). Epoch rewards = pro-rata share of emission + unburned fees; delegators share after your commission. Faults slash bonded stake (α from 1% to 100% by severity) and depress R, compounding the loss through reduced future selection. Unbonding takes 21 days and remains slashable throughout. (Whitepaper §6; EB-SPEC-001 §5, §7.)

Table of Contents

1. Planning: Tiers, Hardware, and Energy	2
2. Installation and Key Ceremony	3
3. Registration, Bonding, and Delegation	4
4. Day-Two Operations and Monitoring	5
5. Reputation Management and Slashing Avoidance	6
6. Green Attestation	7
7. Security Hardening	8
8. Incident Response Runbook	9
9. Commission, Rewards, and Exit	10
References	11

1. Planning: Tiers, Hardware, and Energy

CHOOSE YOUR TIER DELIBERATELY

All tiers run identical consensus duties with identical trust status (Whitepaper §5); tiers differ in hardware class, energy source, and service ambitions. The reference specification (Whitepaper §5.1) is the floor; the guidance below is operational experience layered on top.

Tier	Operational Guidance
Raspberry Pi	Pi 5 / 8 GB with active cooling and a quality NVMe HAT; pruned node; UPS or battery ≥ 12 h. Expect standby duty at genesis set size ($n = 21$) — you accrue uptime reputation as an attesting standby while awaiting selection.
Solar	Size the array for worst-month irradiance at ~ 15 W continuous plus router; LiFePO ₄ buffering; log charge data — it doubles as green-attestation evidence (§6). Cellular failover for network path.
Enterprise	Redundant nodes in active/standby with a <i>single</i> signing identity (never two active signers — §5.2), HSM or remote signer, dual uplinks, archive-node sibling for RPC/analytics duties (Whitepaper §5).

Sustainability posture. Prefer renewable supply or certified renewable procurement at every tier; record evidence from day one. EarthDAO sustainability programs can weight incentives toward attested green capacity (Whitepaper §5.2, §10.3).

2. Installation and Key Ceremony

NODE SOFTWARE · THREE KEYS, THREE CUSTODIES

1. **Install.** Fetch the signed node release and genesis artifacts from earth.ooo; verify checksums and signatures before first run. Sync to the finalized head (fast sync verifies quorum certificates, not full re-execution).
2. **Generate keys — separately.** Per EB-SPEC-001 §2 the protocol requires three distinct materials:

Key	Type	Custody Guidance
Operator key	secp256k1	Stake authority. Hardware wallet or MPC; used rarely (registration, commission, exit).
Attestation key	BLS12-381 + PoP	Signs every slot. Online by necessity — encrypted keystore minimum; HSM/remote signer at enterprise tier.
Withdrawal address	address	Cold. Receives unbonded stake; compromise of hot keys must never move funds (spec invariant).

3. **Rehearse on testnet.** Complete §3 end-to-end on testnet first; parameters are identical (EB-SPEC-001 §13), so testnet behavior is mainnet behavior.

3. Registration, Bonding, and Delegation

JOINING THE CANDIDATE POOL

Registration is a single transaction to the StakingContract (EB-SPEC-001 §8.1) binding your BLS key (with proof-of-possession), endpoints hash, hardware/energy declaration, and minimum self-stake; you enter the pool at reputation $R = 0.5$. Selection into the active set occurs at epoch boundaries with probability $\propto S \cdot R$ (Whitepaper §6.2).

Fig. 1 — Operator Lifecycle

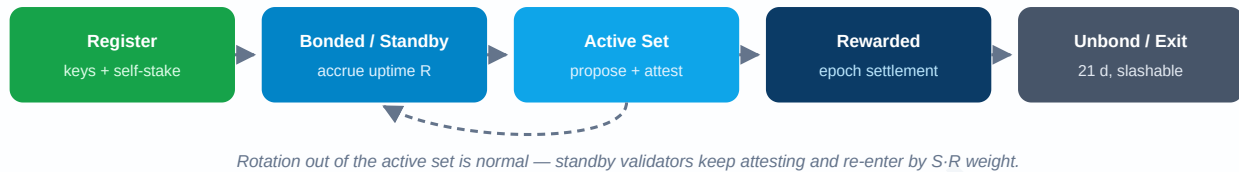


Fig. 1. Lifecycle per Whitepaper §5.2. Delegations raise S ; performance raises R ; both raise selection odds.

Attracting delegation. Delegators share slashing risk with you, so they select for evidence of competence: public uptime history (`earth_getReputation`), sane commission, green attestation, and transparent infrastructure claims. Commission changes take effect at $e+2$ with on-chain notice (EB-SPEC-001 §7.1) — communicate before you change.

4. Day-Two Operations and Monitoring

WHAT TO WATCH, AND AT WHAT THRESHOLD

Signal	Healthy	Alert Condition
Attestation inclusion rate	$\geq 99.5\%$ of duties	$< 99\%$ over 1 h — check clock, peers, signer latency. Drives A in R.
Proposal success (when scheduled)	100%	Any miss — the 1.5 s backup timeout (EB-SPEC-001 §5.4) means your slot was forfeited.
Clock offset (NTP)	< 100 ms	> 500 ms — blocks from the future are rejected at 1.5 s (spec §12).
Peer count / finalized lag	Stable; lag ≤ 1 slot	Finalized head stalls > 30 s network-wide → treat as network incident (§8).
Reputation R components	U, A ≥ 0.99 ; F ≈ 0	Any F increment — investigate the evidence reference immediately.
Disk / memory headroom	$\geq 25\%$ free	Pruned-node growth or archive sibling nearing capacity.
Timelock queue (governance)	Reviewed within 24 h of queueing	Any queued proposal touching consensus params — plan the upgrade window (48 h notice, EB-SPEC-001 §9).

Expose node metrics to your monitoring stack and additionally poll `earth_getReputation(self)` each epoch — the protocol's scoreboard is the one that pays you.

5. Reputation Management and Slashing Avoidance

PROTECTING R AND S

Reputation is arithmetic, not judgment: $R = \text{clamp}(0.4U + 0.4A - 0.2F, 0, 1)$, with F halving every 14 epochs (EB-SPEC-001 §5.3). Operationally:

- **Uptime (U).** Plan maintenance inside single epochs; a graceful restart between duties costs minutes of U , an unattended failure costs days.
- **Accuracy (A).** Late attestations count against you — signer latency and clock discipline matter as much as availability.
- **Faults (F) and slashing.** The catastrophic fault is **equivocation (S2)**: two signatures at one height, α up to 1.0. Its only common operational cause is running two signers with one key — failover systems **must** enforce single-active-signer semantics (lease/lock with fencing, or an HSM that refuses concurrent sessions). Never restore a signer from backup while the original may still be live.
- **Invalid-state (S3).** Run release binaries; never attest with modified execution logic. Verify releases against published signatures (§2).
- **Liveness (S1).** Small α , but paired with U/A damage; the compounding cost is future selection weight.

The one-sentence policy. One key, one live signer, disciplined clocks, signed releases — and no slashing condition is reachable through operations alone.

6. Green Attestation

MAKING SUSTAINABILITY VERIFIABLE

Operators may register an energy attestation — metering data or certified renewable procurement — bound to their validator identity (Whitepaper §5.2). Attested capacity is publicly visible (`greenAttested` in `earth_getValidatorSet` , EB-API-003 §3.3) and can be weighted by EarthDAO sustainability programs (Whitepaper §10.3, §13).

1. **Collect evidence.** Solar: inverter/charge-controller logs and panel/battery specifications. Grid: renewable-procurement certificates or supplier contracts.
2. **Anchor.** Hash the evidence bundle and submit via the attestation flow (the anchoring primitive of EB-API-003 §5.1) under your operator key.
3. **Renew.** Attestations carry validity windows; renew before expiry to remain counted in green-capacity metrics reported through EarthESG (Whitepaper §13).

Why bother. Beyond incentives: enterprises selecting delegation targets and RPC providers increasingly screen for verifiable sustainability — attestation is a commercial signal, not just an ecological one.

EARTH BLOCKCHAIN

7. Security Hardening

MINIMUM BAR BY TIER

- **Network.** P2P port open; RPC bound to localhost or private network only (public RPC is a separate, non-signing node). Firewall default-deny; SSH by key with MFA on the jump path.
- **Host.** Automatic security updates; dedicated OS user for the node; no co-tenant workloads on signing hosts; encrypted disks on portable/community hardware.
- **Keys.** Custody per §2; attestation keystore permissions 0600; enterprise tier uses HSM/remote signer with rate and height policies (refuse to sign a height twice — a hardware backstop for S2).
- **Supply chain.** Verify release signatures; pin container digests; build-from-source operators reproduce published hashes.
- **People.** Two-person rule for operator-key actions at enterprise tier; documented on-call with §8 runbook printed and reachable without the node being up.

EARTH BLOCKCHAIN

8. Incident Response Runbook

DECIDE FAST, NEVER DOUBLE-SIGN

Incident	Response
Node down, hardware dead	Start standby <i>only after</i> confirming the primary cannot sign (power removed / fenced). Missing slots costs S1-scale U; double-signing costs S2-scale stake. When in doubt, stay down.
Suspected attestation-key compromise	Stop signer immediately; rotate the BLS key via operator-key transaction; audit for unauthorized signatures via <code>earth_getSlashingEvents</code> ; stake cannot be moved by the attestation key (\$2), so funds are safe — reputation is what you are protecting.
Operator-key compromise	Initiate exit to the cold withdrawal address at once (the 21-day queue is your safety margin only if you move first); notify delegators; file incident notice per the validator framework.
Chain not finalizing (network-wide)	Do not improvise. Keep the node online and attesting the canonical chain; follow official channels; any coordinated recovery arrives via governance with 48 h Timelock notice.
Erroneous slashing evidence against you	Evidence is on-chain and hash-addressed (EB-SPEC-001 §8.3); retrieve it, reproduce the check, and raise a governance dispute with your analysis — the process is public by design.

EARTH BLOCKCHAIN

9. Commission, Rewards, and Exit

THE MONEY MECHANICS, OPERATIONALLY

- **Rewards.** Settled per epoch to claimable balances: your share = $\text{pool} \times S/S_{\text{total}}$; delegators receive $(1-c)$ of their pro-rata portion (EB-SPEC-001 §7.3). Claiming is an ordinary transaction — batch it; it never affects duties.
- **Yield expectations.** Emission decays by design ($k = \ln 3/5$ per year) while fee share grows with usage; the illustrative APY-vs-staked-ratio relationship is Whitepaper §15.5. Never promise fixed yields to delegators.
- **Exit.** Announce to delegators, stop accepting new delegation, initiate unbonding (21 days, still slashable — keep the node healthy until queue maturity), then withdraw to the cold address. Governance-initiated removal follows the same queue (EB-SPEC-001 §7.4).

EARTH BLOCKCHAIN

References

SUITE CROSS-REFERENCES

- [1] Earth Blockchain Whitepaper v2.0 — Green Validator Network (§5), PoSA economics (§6), sustainability programs (§10.3, §13).
- [2] EB-SPEC-001 Technical Protocol Specification — consensus rules, slashing conditions S1–S4, staking contract, parameter registry.
- [3] EB-API-003 SDK & API Documentation — earth_ telemetry methods and attestation/anchoring APIs used operationally here.
- [4] Earth Blockchain explorer — scan.earth.ooo: validator set, reputation, slashing events, epoch economics.

EB-VAL-004 v1.0 (July 2026). Operational guidance is advisory; protocol rules in EB-SPEC-001 govern. Reward and yield mechanics are protocol-defined and variable; nothing herein is a promise of returns. This document does not constitute financial, investment, tax, or legal advice. © 2026 Earth Blockchain Corp. (Wyoming, USA) · Alpha Blockchain Private Limited (India). All rights reserved.

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