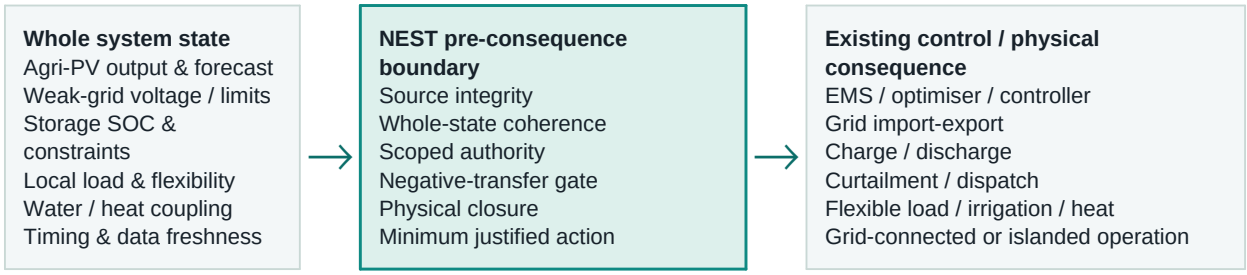
NEST for Agri-PV Integration in Weak Rural Grids

A deterministic whole-system control layer for SolarHub / CRES grid-integration validation

Challenge fit. CRES is seeking methodologies and digital tools that combine DER management, power/energy balancing, storage, flexibility and electricity-heat-water sector coupling so mature agri-PV systems can operate securely in weak or off-grid networks. **NEST fits as the pre-consequence boundary around those existing optimisation and control functions.** It does not replace the agri-PV plant, EMS, grid model or optimiser.

1. What NEST adds to the CRES / BRITE challenge



PRESERVE	HOLD	REPAIR	REROUTE	ISOLATE / DENY
valid action proceeds	evidence insufficient	recoverable action corrected	alternative admissible path	inadmissible consequence contained

Why this is a natural fit - not a forced adaptation

Whole-system composition	A locally valid dispatch, charge, export or irrigation action can become inadmissible when grid weakness, storage limits, timing or coupled loads are considered together.
Minimum justified intervention	NEST is designed to preserve valid renewable utilisation and repair/reroute recoverable actions rather than defaulting to blanket curtailment or shutdown.
Scoped authority under uncertainty	Stale, conflicting or incomplete telemetry can reduce authority to HOLD instead of creating unjustified control.
Physical closure and evidence	The decision is checked against bounded physical/operational constraints and bound to a deterministic receipt for replay and comparison.

2. Proposed CRES validation experiment

Objective: determine whether NEST can improve the admissibility of agri-PV / DER control actions in weak-grid conditions while preserving legitimate renewable utilisation and operational objectives.

Test condition	What is challenged	NEST behaviour to measure
High PV / voltage stress	Export or dispatch action is locally attractive but increases grid stress.	Preserve if admissible; otherwise repair/reroute/hold/deny.
Storage constraint	Charge/discharge request conflicts with SOC, reserve, efficiency or lifecycle boundary.	Whole-state closure; valid alternative if available.
Stale / conflicting telemetry	Forecast, voltage, device or load state disagree or are no longer current.	Scoped authority; HOLD instead of unjustified action.
Grid ↔ island transition	Action valid in one operating regime becomes invalid after topology/state change.	Regime-aware admissibility; prevent negative transfer.
Sector coupling	Electricity action shifts instability or resource burden into water/heat/flexible load.	Cross-system coherence; minimum justified intervention.

Validation sequence

• **1. Freeze:** CRES defines interfaces, baseline, constraints, scenarios and success metrics before evaluation.

• **2. Shadow:** NEST evaluates the same proposed actions without controlling the SolarHub system.

• **3. Independent challenge:** CRES supplies unseen/degraded cases and retains wins, ties, misses and false interventions.

• **4. Compare:** baseline vs NEST on valid-action preservation, grid-stress/constraint violations, repair/reroute success, latency and deterministic replay.

• **5. Optional bounded control:** only if shadow results meet pre-agreed thresholds; otherwise the experiment closes with the evidence produced.

Minimal integration required

Existing NEST core remains unchanged. The challenge-specific build is a thin adapter from SolarHub/CRES telemetry and proposed control actions into the NEST state model, plus a bounded constraint profile for weak-grid, storage and sector-coupling conditions. The experiment can begin entirely in shadow mode and does not require replacement of CRES control, EMS, optimisation or protection systems.

Existing maturity and evidence boundary

Working architecture	NEST is implemented as deterministic pre-consequence control with state/history handling, bounded actions, receipts and replay. Public proof pack: boundedsystem.com/demo/proof-pack
10,000-case blind internal evaluation	9,128 valid cases preserved; 872 predefined inadmissible cases identified; 0 false accepts and 0 false rejects in that controlled water-sector evaluation.
20,000-case local live API harness	10,000 ALLOW / 10,000 BLOCK; 0 routing mismatches; 20,000 receipts; 0 blocked backend arrivals.
Claim boundary	These are internal/local controlled results, not prior grid validation. CRES/SolarHub would provide the independent energy-system test this proposal is seeking.

Proposed collaboration outcome

Short-term: a CRES-controlled A/B evaluation on SolarHub data or a suitable test environment, producing a reproducible evidence pack. **If the result is positive:** define a joint demonstration/R&D; path for scalable weak-grid agri-PV integration. **If negative:** retain the failure modes and scope limits as part of the technical result.