Power System Studies for RE Projects in India 2026: Scope, Costs and Approval Risks

By Sudarshan Karweer · 25 August 2026 · growthifye.com

A practical 2026 guide to grid studies, modelling, approval risks, costs and timelines for RE connectivity in India.

Renewable projects in India are no longer delayed only by land, modules or offtake. In 2026, a large share of execution risk sits inside power system studies: the modelling, simulations and compliance evidence required for connectivity, bay allocation, substation readiness and final charging approval. For developers, C&I consumers, lenders and utilities, the issue is not academic. Poor-quality studies can add 3-9 months to a project, trigger redesign of interconnection equipment, alter capex assumptions and, in some cases, make a proposed point of connection commercially unviable.

This article focuses on a specific transmission-engineering angle that is distinct from general grid code compliance, ISTS connectivity processes, reactive power solutions and green energy corridors: power system studies themselves. It explains what studies are typically required in India in 2026, who reviews them, where delays occur, what they cost, and how project sponsors can use them to reduce approval risk.

Why power system studies matter more in 2026

India's renewable pipeline is now large enough that network headroom cannot be assumed, even where a substation appears available on paper. At the same time, the operating profile of the grid has changed. High solar injection during daytime, steeper evening ramps, rising inverter-based resources, hybrid projects, co-located battery systems and dynamic state-level drawal patterns all affect system strength and operational margins.

That means transmission planners and implementing agencies are looking beyond simple contracted capacity and asking harder questions:

- Can the proposed project ride through voltage and frequency events without tripping?
- Will its inverter controls interact adversely with nearby renewable plants or compensation equipment?
- Is the evacuation corridor thermally adequate in both N-1 and outage conditions?
- Does fault current stay within switchgear ratings after the new injection is added?
- Will the project create overvoltage, under-voltage or flicker issues at the pooling station or grid substation?
- Is there a mismatch between committed connectivity and the actual network strengthening schedule?

For lenders, these questions matter because study outcomes directly affect contingency budgets, debt drawdown milestones and commissioning certainty. For open-access C&I buyers, they influence COD and delivered energy reliability. For utilities and policymakers, robust studies reduce tripping incidents, curtailment risk and expensive post-facto retrofits.

The core studies typically required for RE connectivity

The exact study package varies by project size, voltage level, state utility requirements, CTU/STU jurisdiction, and whether the project is solar, wind, hybrid or storage-linked. In practice, most utility-scale RE projects in 2026 need some combination of the following.

Load flow study

This is the baseline analytical tool used to test whether the network can carry power from the proposed interconnection point under normal and contingency conditions. It identifies:

- Line and transformer loading
- Voltage profile at nearby buses
- Reactive power flows
- Need for bus reactors, capacitor banks or STATCOM/SVC support
- Congestion under peak generation and low-demand conditions

A common issue in solar-heavy states is acceptable loading under average conditions but overvoltage during low-load, high-generation hours. A project can look feasible in a simple annual energy sense while failing operationally in specific seasons or time blocks.

Short-circuit study

This checks whether the addition of the project increases fault levels beyond equipment interrupting ratings at the point of connection and adjacent substations. With inverter-based resources, assumptions must be realistic; modern converters contribute fault current differently from synchronous generation. The study often triggers checks on:

- Breaker interrupting capacity
- CT/VT adequacy
- Busbar fault levels
- Transformer impedance and protection coordination implications

At older substations, this can become a hidden cost. If fault duties exceed ratings, apparently minor connectivity can require costly switchgear replacement or a revised interconnection plan.

Transient stability and dynamic studies

These studies evaluate how the project behaves during disturbances such as line trips, faults, sudden voltage dips and frequency excursions. In 2026, reviewers are paying closer attention to inverter controls, plant-level controller behaviour and interactions across renewable clusters.

Typical checks include:

- Fault ride-through performance
- Active and reactive power recovery profile
- Frequency response logic
- Ramp-rate behaviour
- Interaction with nearby compensation systems or BESS controls
- Stability under grid contingencies and weak-grid conditions

This is especially relevant for wind, hybrid and large pooled solar projects connecting into corridors with high inverter concentration.

Harmonic study

Power-electronics-rich networks require assessment of harmonic current injection, background distortion and resonance risks. Utilities may ask for verification that total harmonic distortion and individual harmonic levels remain within applicable technical limits. If multiple renewable plants connect to the same pooling node, cumulative distortion matters more than stand-alone plant performance.

Insulation coordination and overvoltage assessment

At EHV levels, switching surges, temporary overvoltages and lightning performance need review, especially where long cables, GIS, reactors or specific line configurations are involved. This can affect arrester selection, equipment insulation level and bus configuration.

Protection coordination study

A technically feasible evacuation design can still face delay if relay settings, zone reach, communication-assisted schemes or backup protection philosophy are not aligned across project and utility assets. In India, many execution delays happen because EPC teams finalise primary equipment before secondary system design is fully coordinated with the transmission utility.

EMT or PSCAD-level studies in selected cases

Not every project requires detailed electromagnetic transient studies, but they are increasingly requested for large inverter-based clusters, weak-grid connections, HVDC-influenced systems, projects with advanced grid-forming features, or where previous oscillation or control-interaction issues have been observed. These studies are more specialised and can become a gating item if utility reviewers are concerned about control stability.

Where approvals get delayed in India

The study requirement is not just technical; it is procedural. Even a sound project can lose time because models, assumptions and agency interfaces are mismanaged.

The most common causes of delay in 2026 are:

- Incomplete network data from the reviewing utility or transmission licensee
- Mismatch between signed connectivity assumptions and latest substation augmentation plan
- Non-standard or black-box inverter models not accepted by reviewers
- Different base cases used by developer, consultant and utility
- Late identification of high fault levels or reactive compensation need
- Poor coordination between generation EPC, transmission EPC and protection teams
- Revisions after OEM change in inverter, transformer or plant controller
- Inadequate validation of plant-level controller settings

A typical pattern is this: a developer secures land and tentative connectivity, orders major equipment, and only later discovers through detailed studies that the project needs additional dynamic reactive support, a different transformer tap strategy, revised collector system layout or a change in the pooling substation arrangement. By that stage, redesign costs are real.

For C&I projects under open access, the issue can be equally serious at smaller scale. State-level networks may have apparent capacity but poor voltage support or frequent constraint conditions. A sub-220 kV evacuation design that works on paper can produce curtailment and scheduling losses once connected.

Typical costs, timelines and commercial impact

Study costs vary by size, complexity and software requirement. For 2026 India market conditions, broad consulting ranges seen across developers and utilities are:

- Basic load flow, short-circuit and reactive assessment for a mid-sized project: around Rs 8 lakh to Rs 20 lakh
- Expanded package including protection coordination and harmonics: around Rs 15 lakh to Rs 35 lakh
- Detailed dynamic studies with OEM model validation: around Rs 25 lakh to Rs 60 lakh
- EMT-grade specialist studies for complex or weak-grid cases: around Rs 40 lakh to Rs 1.2 crore or higher depending on scope

These figures exclude utility application fees, dedicated bay charges, upstream augmentation obligations, communication system requirements and substation construction capex.

On timeline, well-prepared studies can be completed in 4-8 weeks once all inputs are available. In reality, most projects take longer because of data requests, reviewer comments, OEM coordination and revisions. A practical 2026 planning assumption is:

- 2-4 weeks to assemble validated input data
- 4-10 weeks for the main study package depending on complexity
- 3-8 weeks for utility review and clarifications
- Additional 4-12 weeks if redesign or supplementary studies are triggered

That means studies alone can influence COD by 2-5 months in straightforward cases and longer in constrained corridors.

The commercial impact is larger than the consulting fee. A 100 MW solar project delayed by one quarter can lose one full high-irradiation season, defer PPA or OA revenue, increase IDC and expose the developer to module warranty-start misalignment. For lenders, each month of delay alters DSCR profiles and may require revised disbursement sequencing. For C&I buyers, delayed commissioning can force continued reliance on grid power or short-term third-party supply at tariffs that may range from around Rs 6-9 per kWh depending on state, consumer category and timing, versus landed renewable open-access supply often targeted in the broad band of roughly Rs 4-6.5 per kWh after wheeling, banking and cross-subsidy related charges in competitive structures. Actual economics vary materially by state.

Study quality issues lenders and buyers should watch closely

Not all study reports are equally decision-useful. Many are prepared as compliance paperwork rather than as risk-management tools. Stakeholders financing or procuring renewable power should test whether the study package answers commercial questions, not just technical ones.

Key diligence checks include:

- Is the exact point of interconnection clearly identified, with voltage level and bay arrangement?
- Are utility base cases current and traceable to the latest network augmentation status?
- Have N-1 conditions been tested, not only normal operation?
- Are seasonal and time-block scenarios included, especially low-load high-generation conditions?
- Are inverter, PPC and BESS models OEM-backed and version-controlled?
- Does the study identify mandatory and optional mitigation separately?
- Are equipment ratings and protection philosophy aligned with study assumptions?

- Is there a quantified residual risk if upstream works slip?
- Has curtailment risk been discussed qualitatively or quantitatively where relevant?

A strong study package should also map each technical finding to a decision: proceed as planned, revise interconnection voltage, add compensation, change evacuation route, phase commissioning, or renegotiate schedule assumptions.

Practical strategies to de-risk projects before connectivity bottlenecks appear

The best developers now treat transmission engineering and studies as front-end commercial work, not post-award compliance. Several steps materially improve outcomes.

Start with screening before finalising project design

Before locking site layout, transformer size and evacuation architecture, run a screening study using the most recent network information available. Even if the utility later requires formal studies in its own format, early screening helps eliminate weak options.

Freeze OEM data early

Changing inverter make, PPC logic or transformer impedance late in the process can force rework. Commercial teams should understand that technical substitutions are not neutral once studies are underway.

Integrate generation and transmission EPC assumptions

Collector system design, transformer taps, cable charging, line length and compensation strategy all influence study outcomes. If the plant and evacuation packages are designed in silos, interface errors emerge during review.

Build realistic capex contingencies

Projects should budget for secondary-system upgrades, communication interfaces, additional reactive support, metering compliance and possible bay/substation changes. Under-budgeting these items is still common.

Engage with reviewing agencies early

Many avoidable delays arise because consultants optimise for software output rather than reviewer expectations. Early alignment on study scope, accepted model formats and contingency cases reduces iteration.

Use studies to negotiate timelines and conditions precedent

For lenders and offtakers, study milestones can be linked to drawdown, long-stop dates and COD buffers. That is preferable to relying on generic commissioning assumptions.

What this means for Indian C&I consumers, policymakers and utilities

For C&I buyers, the message is straightforward: ask not only whether a project has connectivity, but whether the associated studies are complete, current and accepted. A signed connectivity approval without resolved technical conditions is not the same as evacuation readiness.

For policymakers and utilities, faster renewable build-out will depend not just on adding corridor capacity but on improving the quality, standardisation and turnaround of study review. There is room in 2026 for more consistent model requirements, clearer acceptance criteria for inverter-based resources, and better digital exchange of network data between developers, consultants and transmission entities.

For developers, the competitive edge increasingly lies in bankable execution. In many tenders and bilateral transactions, the differentiator is no longer the headline tariff alone. It is the ability to show credible interconnection readiness, realistic study assumptions and a defensible path to commissioning.

Transmission engineering is therefore not a backend support function. It is a core value driver for renewable projects in India, shaping timeline certainty, capex accuracy and revenue realisation from day one.

If your team is assessing connectivity risk, evacuation design, substation readiness or power system studies for an RE project in India, contact Growthifye's advisory desk for project-specific support.

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