Transmission Planning for RE Parks in India 2026: Pooling, Bays and N-1 Readiness

By Sudarshan Karweer · 25 August 2026 · growthifye.com

A 2026 guide to transmission planning for RE parks in India: pooling substations, bay design, N-1 criteria, costs, approvals and lender checks.

India's renewable pipeline is now large enough that transmission planning can no longer be treated as a post-award engineering task. For solar parks, hybrid projects, wind clusters and RTC portfolios, the real differentiator in 2026 is not only tariff discovery or module pricing, but whether evacuation infrastructure is planned early, technically right-sized, and bankable under current grid and connectivity rules.

A recurring problem across utility-scale projects is that developers secure land, sign PPAs or LOAs, and then discover that pooling arrangements, bay availability, busbar configuration, line routing, protection philosophy, or N-1 requirements materially change both COD risk and project IRR. This is especially visible in high-growth states and RE zones where substation loading, upstream transformation capacity and transmission corridor availability are already tight.

This article focuses on a topic distinct from general connectivity, grid-code compliance and power-system studies: transmission planning for renewable energy parks and clustered RE developments, with emphasis on pooling substations, line-bay strategy, transformation margins, redundancy criteria, approval interfaces and lender due diligence in India in 2026.

Why RE park transmission planning is now a front-end bankability issue

For large RE parks, transmission is no longer a simple line-item under balance of plant. It is a schedule-critical package that can determine whether the project reaches commissioning within PPA milestones or faces liquidated damages, generation backing down, or stranded capacity.

Three 2026 realities are driving this shift:

- Evacuation assets are being shared across multiple developers more frequently, increasing interface risk.
- State and inter-state nodes are seeing uneven congestion, with some substations technically available on paper but operationally stressed in practice.
- Lenders are asking for deeper diligence on transmission assumptions, especially where project SPVs depend on third-party pooling and common evacuation systems.

In utility-scale solar and hybrid parks, transmission planning affects:

- Pooling substation location and sizing
- 33 kV or 66 kV collector system length and losses
- Number of feeder bays and future spare bays
- Main transformer rating philosophy, such as 2 x 250 MVA versus 3 x 167 MVA classes depending on topology
- 220 kV, 400 kV or 765 kV evacuation strategy
- Redundancy under N-1 contingency criteria
- Land requirement for AIS versus GIS switchyards

- SCADA, SAS, ABT metering and telecom architecture
- Capex, schedule float and outage planning

As a practical benchmark, poorly sequenced transmission packages can delay COD by 4 to 12 months. On a 300 MW to 500 MW project, that can translate into substantial revenue loss, IDC escalation and claims disputes, even before accounting for backing-down exposure.

Pooling substations: how sizing errors create long-term losses

Pooling substations are often under-designed when developers focus only on initial injected MW and not on seasonal overloading, augmentation flexibility, MVAR management and future co-location opportunities. In 2026, this is one of the most common design-bankability gaps in clustered RE assets.

For solar parks, developers typically aggregate inverter output at 33 kV and step up at a pooling substation to 220 kV or 400 kV. In wind-heavy or hybrid parks, 33 kV and 66 kV collection systems are both seen, depending on turbine OEM interface and distance from pooling nodes.

Key design decisions at pooling stage include:

- Voltage level selection: 220 kV may work for moderate evacuation volumes and shorter distance, but 400 kV often becomes preferable once park scale crosses roughly 500 MW to 700 MW or where future augmentation is likely.
- Transformer sizing: the choice between fewer larger ICTs and more medium-sized units affects outage resilience, spare philosophy and loading under peak injection.
- Bus scheme: single bus, double bus, breaker-and-half or ring configurations materially change reliability and capex.
- Reactive support integration: even where the main dynamic compensation is elsewhere, pooling substations need coherent reactive planning.
- Spare bay provisioning: one spare line bay and at least one future transformer bay can be decisive for later expansion or network reconfiguration.

Indicative 2026 cost ranges, highly site- and scope-dependent, are as follows:

- 220/33 kV pooling substation for utility-scale RE: often around INR 35 crore to INR 70 crore
- 400/33 kV or 400/66 kV pooling arrangement: often around INR 90 crore to INR 180 crore
- AIS generally offers lower upfront capex than GIS, but GIS may become necessary where land is constrained or where utility interface requires compact design

These are broad EPC-level estimates and can shift materially based on transformer ratings, fault levels, bus arrangement, STATCOM interfaces, land development and control building scope.

A common mistake is sizing transformers too close to installed AC capacity without considering clipping pattern, hybrid coincidence, overload capability, auxiliary loads and outage conditions. Developers may save a few crores upfront but lose more through curtailment, thermal stress or expensive retrofit works later.

Bay availability, line termination strategy and utility interface risks

One of the least glamorous but most important issues in RE park transmission engineering is bay planning. A project can have nominal connectivity approval but still face serious execution bottlenecks if line bays, transformer bays, bus section space, or relay panel capacity are not truly available at the intended substation.

In 2026, prudent developers no longer rely on a simple statement that “one bay is available.” They validate:

- Whether the bay is physically vacant or only planned in a future augmentation package
- Whether associated CT/PT/protection and control infrastructure are in place
- Whether the busbar has short-circuit headroom for the proposed interconnection
- Whether outages needed for line termination are realistically obtainable in the commissioning window
- Whether telecom, RTU, SAS and SLDC/RLDC integration paths are already provisioned

Typical bay-related risks include:

- Shared bays with ambiguous priority among multiple generators
- Delayed utility augmentation works pushing back synchronization
- Mismatch between approved line entry arrangement and actual switchyard layout
- Additional protection or metering requirements imposed late in the process
- Need for bus extension or reactor interface not budgeted in initial capex

For a 220 kV bay, all-in implementation cost can vary significantly, but developers often underestimate the cost of associated secondary systems, statutory approvals and shutdown coordination. At 400 kV, the bay package cost and schedule sensitivity are obviously higher, especially where GIS or advanced protection schemes are involved.

From a lender perspective, bay availability should be treated as a condition precedent risk item, not merely an engineering note.

N-1 readiness, redundancy and why planners should avoid minimum-compliance design

As RE penetration rises, system operators are less comfortable with evacuation systems designed only to pass nominal loading under normal operation. N-1 contingency resilience has become central to planning credibility, especially for larger parks, hybrids and RTC-linked portfolios.

N-1 does not always mean the same hardware choice in every case, but the planning principle is clear: the system should tolerate the loss of one major element without unacceptable collapse in evacuation capability or safety.

For RE parks, N-1 planning typically touches:

- Main transformer redundancy at pooling substations
- Twin line versus single line evacuation strategy
- Sectionalized collector system design
- Busbar arrangement and bus coupler philosophy
- Auxiliary supply reliability and black-start restoration logic
- Protection selectivity and breaker failure management

Many projects still target the cheapest technically acceptable design. That approach is increasingly risky where:

- PPA terms impose strict CUF or availability-linked obligations
- Hybrid assets depend on coordinated evacuation across solar, wind and storage blocks
- Lenders require downside-case generation modelling under contingency scenarios

- Utilities scrutinize system security more closely in saturated RE zones

A useful planning test is not only whether the evacuation system can handle peak expected injection today, but whether it remains operable when one transformer, one line circuit, one bus section, or one major collector feeder is unavailable.

In commercial terms, moving from minimum-compliance to stronger redundancy can increase transmission capex by 5% to 15% in some projects. But a single extended outage event can erase that saving quickly. The right answer is not always maximum redundancy; it is risk-calibrated redundancy justified by topology, PPA structure, curtailment environment and financing terms.

Right-of-way, land and route engineering: the hidden schedule drivers

Even where substation scope is well planned, transmission line routing can derail schedules. In several Indian RE zones, right-of-way constraints, forest interfaces, rail or highway crossings, and village-level consent issues are taking longer than expected.

Developers should evaluate route engineering before freezing connectivity assumptions, not afterward. For dedicated evacuation lines from pooling substations to STU or ISTS nodes, practical route diligence should cover:

- Corridor length and terrain profile
- Number of angle towers and special towers
- Highway, canal, railway and river crossings
- Forest land involvement and tree-felling approvals
- Defence or aviation constraints where applicable
- Monsoon accessibility for foundation and stringing work
- Social acceptance and compensation exposure

In 2026, indicative overhead transmission line EPC costs remain highly variable by voltage level, terrain and tower profile, but ballpark assumptions seen in early-stage evaluations are often too optimistic. A line originally budgeted on a simple per-km basis may become materially costlier once crossing design, route diversion and shutdown coordination are added.

Land also matters at pooling-substation stage. Developers choosing AIS on the assumption of easy land availability may later find that contouring, drainage, flood mitigation or title complexity offsets the apparent capex advantage over a more compact GIS solution.

For coastal or high-wind regions, corrosion category and structural design assumptions should also be reviewed carefully. These factors affect both capex and long-term O&M.

Approval stack in 2026: engineering must align with policy and utility processes

Transmission planning for RE parks sits at the intersection of engineering, utility procedure and regulatory approvals. A technically sound scheme can still fail on timeline if the approval stack is not mapped early.

Typical interfaces include:

- STU or CTU connectivity processing
- Bay allocation and substation interconnection approvals

- CEIG or Electrical Inspector approvals, depending on jurisdiction and asset ownership structure
- SLDC/RLDC metering, telemetry and communication compliance
- Protection scheme approval by the utility or transmission licensee
- Shutdown approvals for line termination and testing
- Environmental, forest or land-use permissions for dedicated lines

Policy context in 2026 is shaped by continuing transmission build-out for renewable integration, implementation through central and state transmission plans, and tighter scrutiny of evacuation readiness for large-scale award pipelines. In practice, that means developers must sequence transmission engineering with procurement, civil readiness, and regulatory filings rather than treat these as independent workstreams.

A robust approval tracker should identify:

- Responsible entity for each interface, such as developer, park agency, EPC contractor, STU, CTU or transmission licensee
- Data and drawings required at each stage
- Long-lead dependencies like utility-approved protection philosophy or telecom integration
- Last possible dates for shutdown requests and synchronization documentation

Projects that do this well usually reduce last-minute redesign and improve lender confidence substantially.

What lenders, offtakers and serious developers now expect in transmission diligence

The transmission chapter in lender technical due diligence has become more detailed. For RE parks and clustered projects, financiers are no longer satisfied with a one-page statement that evacuation is “under process” or “available nearby.”

In 2026, a credible transmission diligence pack should include:

- Single-line diagram with clearly defined ownership boundaries
- Pooling substation sizing rationale and loading case summary
- Bay allocation status and evidence of utility correspondence
- Route map and RoW risk assessment for dedicated lines
- Preliminary protection and metering architecture
- Construction schedule linked to project COD milestones
- Capex estimate with contingency for augmentation and interface works
- Contingency analysis showing impact of key outages on export capability
- Clear responsibility matrix for common infrastructure in shared parks

Offtakers and utilities also increasingly expect realistic commissioning plans. If protection testing, SAS integration, ABT metering, SCADA data mapping and telecom readiness are compressed into the final weeks before COD, delays become likely.

For C&I buyers evaluating supply from captive or third-party renewable parks, evacuation resilience matters too. Low headline tariff means little if the project faces recurring curtailment, weak transmission redundancy or unresolved utility interfaces.

From a strategic standpoint, the best developers are doing three things differently:

- Freezing transmission architecture before major commercial commitments are locked
- Budgeting for utility interface realities rather than idealized EPC assumptions
- Treating transmission planning as a bankability and schedule-control function, not just an electrical design package

Practical recommendations for RE park developers in India

For sponsors planning utility-scale solar, wind, hybrid or storage-linked parks, the following actions are high-value in 2026:

- Start pooling and evacuation studies at land aggregation stage, not after PPA award
- Validate actual bay readiness through drawings, site visits and utility records
- Keep at least one credible augmentation pathway in the design basis
- Test N-1 scenarios commercially, not only electrically
- Ring-fence shutdown and interface milestones in EPC contracts
- Build realistic contingencies into line routing, crossings and RoW budgets
- Align lender diligence material with utility approval status early
- Avoid over-reliance on third-party common infrastructure without strong contractual clarity

Transmission engineering is where many otherwise bankable RE projects lose time and value. In India's 2026 market, strong front-end planning on pooling substations, bays, redundancy and route execution is increasingly what separates projects that commission smoothly from those that enter claims, cost overruns and curtailment disputes.

If you are planning an RE park, hybrid cluster, captive evacuation scheme or substation package, contact Growthifye's advisory desk for transmission planning, owner's engineering, utility-interface support and project-finance-ready technical diligence.

ABOUT THE AUTHOR

Sudarshan Karweer — Chief Executive Officer, Growthifye

Over 23 years in management consulting — concept to scale — building and scaling new-age digital and energy businesses. An EY alumnus, Sudarshan leads Growthifye's renewable energy & storage advisory, EPC, transmission engineering and green-financing practices for developers, utilities and C&I consumers across India.
Contact: info@growthifye.com · +91 84510 99371 · growthifye.com