India Solar Module Degradation 2026: Warranty, QA, ALMM and EPC Risk Guide

By Sudarshan Karweer · 14 September 2026 · growthifye.com

A 2026 India guide to solar module degradation, warranties, ALMM sourcing, QA tests, EPC controls and lender risk for utility and C&I projects.

India's utility-scale and C&I solar market in 2026 is no longer buying modules on watt-peak alone. For developers, open-access sponsors, lenders and large power buyers, the bigger question is now lifetime energy confidence: how fast will the modules degrade in actual Indian operating conditions, what evidence supports the warranty curve, and which EPC controls reduce the risk of hidden underperformance after COD?

This matters because a seemingly small change in annual degradation can materially alter project economics. On a 25 MW AC project exporting under a captive or third-party open-access structure, moving from an assumed 0.45% annual degradation to 0.70% can shave cumulative generation by several percentage points over the PPA life. That affects DSCR, refinancing appetite, residual value and even the competitiveness of round-the-clock or hybrid portfolios where solar output quality matters to storage dispatch strategy.

In practice, 2026 procurement teams in India face a more complex landscape: ALMM-compliant sourcing, rapid migration toward TOPCon and n-type platforms, larger module formats, evolving encapsulants and backsheets, and aggressive supplier warranty language that is often weaker than the headline datasheet implies. This article sets out a practitioner framework for evaluating module degradation risk in India, and for translating that risk into EPC scope, QA protocols, commercial protections and lender diligence.

Why degradation assumptions now matter more in Indian projects

The Indian market is operating in a tighter financing and execution environment than it did a few years ago. Module prices may have softened versus peak stress periods, but developers still face elevated scrutiny on generation assumptions because:

- ISTS and state-connected projects are seeing closer CUF and PR benchmarking by investors
- C&I offtakers are negotiating harder on delivered tariff, availability and settlement transparency
- BESS-linked projects depend on predictable daytime charging windows
- Higher ambient temperatures in many Indian states can amplify thermal and ageing effects
- Insurance, lender technical advisors and asset buyers are testing whether warranty language truly covers field failure modes

Typical financial models in India 2026 still use first-year degradation plus linear annual degradation assumptions, but those assumptions are often copied from generic independent engineer templates rather than module-specific evidence. That is risky. Two modules with similar STC efficiency and similar first-year warranties can behave very differently in hot, high-UV, dusty and humid sites across Rajasthan, ■■■■■■, Maharashtra, Telangana, Tamil Nadu or coastal Andhra Pradesh.

As a rule of thumb, every 0.10% change in annual degradation assumption over a 25-year model life is meaningful. Depending on tariff, CUF, curtailment profile and debt structure, it may change project IRR by tens of basis points and alter debt sizing. For merchant-exposed or partially merchant C&I structures, the

impact can be larger because later-year output is often valued at uncertain but potentially higher replacement-cost tariffs.

The main degradation modes Indian buyers should understand

Not all degradation is the same. Practitioners should distinguish between normal power loss over time and failure modes linked to design, manufacturing or installation weaknesses.

The most important degradation mechanisms in 2026 module diligence are:

- LID: Light-induced degradation, historically more associated with p-type PERC, though current product engineering can mitigate it
- LeTID: Light and elevated temperature-induced degradation, relevant in hot climates and particularly important in high-irradiance Indian conditions
- PID: Potential-induced degradation driven by system voltage stress, humidity and material design; still critical in 1500 V plants if BoS design and module resistance are not robust
- UV-related encapsulant or backsheet ageing: can lead to discoloration, reduced transmission, cracking or insulation issues
- Solder joint fatigue and thermo-mechanical stress: more relevant as wafer and module formats grow larger and thermal cycling stress rises
- Microcracks and cell breakage: may originate in logistics, mounting, tracker dynamics, poor handling or excessive torque
- Moisture ingress and corrosion: especially relevant in coastal, high-humidity or high-salinity zones
- Hotspots and bypass diode stress: often linked to mismatch, shading, cracks or poor junction-box quality

For Indian stakeholders, the key issue is not just whether these phenomena exist, but whether the supplier's bill of materials, process controls and test evidence show resilience under Indian use cases. Desert heat, dust loading, monsoon humidity, ammonia exposure near agro-industrial sites and saline coastal air can all alter real-life outcomes.

2026 technology context: TOPCon, n-type and the ALMM procurement question

A large share of new Indian procurement discussions in 2026 revolves around n-type TOPCon modules, with HJT still selective and BC-type technologies limited in mainstream utility adoption. The sales pitch is familiar: lower degradation, stronger low-light response, better bifaciality and improved temperature performance. These claims may be directionally valid, but buyers should avoid treating all TOPCon products as equivalent.

There are now meaningful differences across suppliers in:

- Cell architecture and passivation quality
- Glass-glass versus glass-backsheet construction
- Encapsulant selection and edge-seal design
- Frame stiffness for large-format modules
- Junction-box, connector and cable quality
- Factory automation and in-line EL/flash/testing controls
- Long-term Indian service capability

ALMM adds another layer. In 2026, utility and many institutional buyers cannot treat module selection as a purely global spot-market exercise. ALMM-listed availability, line-level traceability, approved factory configuration and dispatch schedules all matter. A supplier may be ALMM-listed, but the exact manufacturing line, bill of materials and tested product family being offered should still be verified in writing.

A recurring market mistake is assuming that ALMM inclusion itself is a sufficient quality filter. It is not. ALMM is a procurement eligibility condition for many projects; it is not a substitute for project-specific technical due diligence, factory audits, pre-dispatch inspections and field QA.

This is where disciplined [Procurement & vendor management](/coreservices/epc/procurementandvendormanagement) becomes commercially valuable. Developers should evaluate not only module efficiency and price, but also the supplier's history of claims settlement, degradation evidence, replacement lead times, local warehousing plans and clarity of performance warranty carve-outs.

How to read module warranties without being misled

Most module datasheets present two broad promises:

- Product warranty: covering defects in materials and workmanship, often 12 to 15 years, sometimes longer
- Performance warranty: covering retained output over time, often with a first-year drop and then a linear annual reduction to year 25, 30 or beyond

In India, many procurement teams focus on the headline retained power number at year 25 or year 30. That is necessary but not sufficient. The real diligence questions are:

- Is the warranty measured on nameplate, minimum flash value or some adjusted baseline?
- What is the exact first-year degradation allowance?
- Is the annual linear degradation rate explicit and unambiguous?
- What test method governs claim validation?
- Who bears module removal, shipping, testing, reinstallation and generation-loss costs?
- Can the supplier choose repair, replacement or cash compensation at its sole discretion?
- Is compensation linked to module invoice value rather than lost energy value?
- Are mismatch losses excluded?
- Are cosmetic defects, snail trails, backsheet issues, glass issues or hotspot cases treated as non-warrantable unless power falls below threshold?
- Are installation conditions so narrowly defined that field claims become impractical?

Example: a supplier may advertise 1% first-year degradation and 0.40% annual degradation thereafter. On paper that looks strong. But if the remedy is limited to replacement modules delivered months later, with no payment for logistics, labour or lost generation, the project still carries substantial economic exposure.

For lenders and infrastructure investors, the best approach is to convert warranty text into a claims-value matrix. Estimate what happens if 2%, 5% or 10% of modules underperform or fail in years 3, 8 and 12. In many cases, the recovery value under the written warranty is materially weaker than sponsors assume.

EPC and QA controls that actually reduce degradation risk

The most effective degradation mitigation happens before COD, not after. A strong EPC package should embed controls across design, logistics, installation and commissioning.

Key controls include:

- Approved vendor list tied to exact module make, model, factory and bill of materials
- Factory audit covering process control, traceability, EL imaging, flash calibration and incoming material QA
- Contractual sampling plan for pre-dispatch EL, wet leakage, insulation and visual tests
- Defined transport packaging and handling rules, including stack limits and shock controls
- Site storage requirements for pallets, drainage, weather protection and handling windows
- Module handling SOPs to prevent frame twist, glass stress and connector damage
- Torque-controlled mounting and clamp-position verification as per approved drawings
- String design and inverter grounding strategy checked for PID risk
- Initial electroluminescence testing for statistical samples at site receipt and after installation in critical projects
- IV curve tracing and thermography during commissioning to identify outliers early

For large utility and C&I portfolios, [QA/QC & HSE enforcement](/coreservices/epc/qaqcandhseenforcement) should not be a paperwork exercise. It should be tied to hold points, photographic records, pallet traceability and clear rejection criteria. One damaged pallet batch or one poorly controlled unloading operation can create latent defects that only surface months later as hotspots or yield loss.

Developers using trackers should also connect module durability review to structural dynamics. Larger modules face higher bending moments and dynamic loads. If tracker torsional behaviour, clamp design and terrain-induced stress are not properly controlled, the result can be cell cracking and long-tail performance loss even when immediate breakage is not visible.

Which tests and documents lenders should ask for in 2026

Independent engineers, NBFCs, banks and private credit teams are becoming more specific in module diligence. The basic IEC certificate pack is no longer enough for larger exposures.

A robust lender or investor checklist should include:

- Latest IEC 61215 and IEC 61730 certification from accredited labs
- IEC 62804 PID resistance evidence where relevant
- Extended reliability test summaries, especially damp heat, thermal cycling and humidity-freeze performance
- Hail, mechanical load and dynamic load data for the offered module configuration
- BOM declaration and change-control commitment
- Factory quality manual and recent audit findings
- EL image protocol at factory and site
- Flash test tolerance and binning methodology
- Warranty specimen with governing law and dispute resolution details
- Historical field failure rate data, if available

- Indian service support plan and spare/replacement commitments
- Evidence that offered supply is ALMM-compliant for the intended project category

For high-value projects, technical advisors may also require third-party witness testing or additional accelerated stress-test review. This is especially sensible where the supplier is newly ramped, where the module design has recently changed, or where the project relies on a tight revenue case under open access or storage-linked dispatch.

Testing, commissioning & handover should include module-specific acceptance logic, not just plant-level PR confirmation. A plant can pass short-term PR checks while still embedding latent module quality issues that emerge in year 2 or year 3.

Commercial implications for C&I buyers, developers and utilities

Different buyer types should translate module degradation risk differently.

For C&I consumers:

- Focus on delivered energy and tariff stability, not simply EPC capex
- Demand clarity on generation guarantees and remedy timelines
- Review whether lower module capex today could raise replacement or underperformance disputes later

For developers:

- Align module choice with exit strategy and refinancing plan
- Stress-test energy yield against a more conservative degradation case
- Ensure supply agreements backstop field issues with practical remedies, not just formal warranty language

For lenders:

- Evaluate whether the base-case degradation assumption is supplier-specific and evidence-based
- Review concentration risk if multiple projects depend on the same module platform or factory line
- Consider reserve structures or covenant protections if module bankability is not fully established

For utilities and policymakers:

- Reliability and domestic manufacturing policy should increasingly incorporate quality consistency, not only nameplate capacity
- Grid planning benefits from long-term performance confidence, particularly as hybrid and storage-linked assets scale up

In tariff-sensitive tenders, the temptation remains to optimise for upfront module price. But in 2026 India, long-duration asset quality is becoming a competitive differentiator. The strongest developers are not buying the cheapest watt. They are buying the most financeable kilowatt-hour over life.

That means tighter QA, sharper warranty review, and EPC structures that treat module degradation as a controllable risk rather than an unavoidable assumption. For firms delivering [Solar & hybrid plant EPC](/coreservices/epc/solarandhybridplantepc), this is now central to project value protection, not an optional quality add-on.

A practical 2026 decision framework

Before freezing module selection, stakeholders should answer five questions:

- Is the degradation assumption in the financial model matched to this exact product and evidence set?
- Does ALMM eligibility align with the project's procurement and compliance pathway?
- Are warranty remedies economically meaningful in real field conditions?
- Do EPC QA processes detect logistics and installation damage before COD?
- Would a lender or buyer still accept this module choice after a full technical review?

If any answer is uncertain, the risk is not theoretical. It is likely being pushed downstream into lower yield, harder claims and reduced asset value.

India's solar market in 2026 is mature enough that module diligence should move beyond brochures and generic bankability statements. The next wave of outperformance will come from disciplined engineering, evidence-based procurement and enforceable quality controls across the full project cycle.

If you are evaluating module selection, degradation assumptions, ALMM-compliant sourcing or EPC quality controls for an upcoming project, contact Growthifye's advisory desk. Our team supports technical due diligence, procurement strategy and execution risk review across utility, C&I and hybrid solar portfolios.

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