Factory-Integrated vs Site-Assembled Telecom Energy Systems

Compare factory-integrated and site-assembled telecom energy systems by testing, transport, field labor, interface control and commissioning risk.

PRODUCT KNOWLEDGE

Factory-Integrated vs Site-Assembled Telecom Energy Systems

Choose the integration location by asking which interfaces are stable enough to build and test before dispatch, and which depend on conditions that can only be verified at the telecom site.

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RFQ requirements The best integration point is rarely “everything in the factory” or “everything at site.” Factory-integrate the internal relationships that are repeatable and testable before shipment. Complete the interfaces that depend on foundations, utility service, PV layout, generator condition, cable routes, grounding and live network equipment at the site.This distinction changes the procurement scope. An empty enclosure, a populated power cabinet and a commissioned telecom energy system may look similar in a bill of quantities, but they carry different design responsibility, verification evidence and field workload. The delivery model should therefore be defined before suppliers price the work.

Practical starting point: factory integration usually suits internal distribution, protection, controller wiring, sensors, thermal equipment and repeatable harnesses. Site work remains necessary for civil interfaces, source and load cables, earthing, external PV and generator connections, communications to the NOC, and verification under the actual site conditions.

Use interface certainty, not cabinet size, as the decision rule

A large cabinet can still be delivered fully populated when transport, lifting and site access allow it. A small cabinet may require substantial field work when the incoming supply, operator equipment or cable route is unknown. Physical size affects logistics; it does not determine where engineering responsibility should sit.

For each interface, ask four questions:

1. **Is the connected equipment known?** Model, rating, connector, protection requirement and communication protocol must be frozen.
2. **Can the operating condition be reproduced?** The factory needs representative sources, loads and alarm states to prove a function.
3. **Can the assembled unit be transported safely?** Populated mass, battery restrictions, vibration, door clearances and lifting points affect the shipping configuration.
4. **Will site work invalidate the evidence?** Cutting a new cable entry, changing protection or moving heat-producing equipment can alter the verified configuration.

If the answers are known and controlled, factory integration can remove repetitive site work. If they remain project-dependent, the design should provide a documented field interface rather than hide the uncertainty inside a “plug-and-play” claim.

Define the integration boundary item by item

The boundary is more useful when recorded as a schedule than when expressed as a percentage of factory completion. The following allocation is typical, but every row must be confirmed for the actual project.

Work item	Factory-integrated scope	Site-completed scope	Required evidence
Cabinet structure and internal mounting	Rails, compartments, doors, seals, plinth and equipment supports	Foundation, anchors, final leveling and site clearances	General arrangement, populated mass, lifting and foundation drawing
Power conversion and internal distribution	Rectifiers, converters, internal protection, busbars, terminal blocks and labelled wiring	Incoming source cables and outgoing load feeders	Single-line diagram, settings schedule, wiring inspection and functional test
Battery system	Trays, disconnects, protection, monitoring interface and internal harness where approved	Battery modules when shipped separately, interlinks and final commissioning	Battery interface drawing, torque record, polarity check and BMS communication test
Thermal management	Fans, heat exchanger or air conditioner, controller, sensors and internal airflow path	External condensate route, free-air clearances and site-specific setpoint confirmation	Heat-load basis, equipment data, alarm simulation and site airflow inspection
Monitoring	Gateway, internal sensors, mapped cabinet	SIM or network access, NOC endpoint, time	Point list, protocol map, alarm matrix and end-to-

Work item	Factory-integrated scope	Site-completed scope	Required evidence
	alarms and local display	source and field-device integration	end communications record
Grounding and surge interfaces	Internal bonding, earth bar and cabinet-side surge protection	Site electrode system, tower, PV frame, generator and external cable bonding	Bonding drawing, continuity results and site grounding record

The related comparison of telecom power and equipment cabinets helps establish which equipment belongs within each enclosure. This article addresses the next question: where that equipment should be installed, wired, configured and tested.

https://www.thesolartelecom.com/wp-content/uploads/2026/08/video2.mp4

Factory integration moves repeatable work into a controlled test boundary

A factory-integrated telecom cabinet can arrive with internal devices mounted, wiring terminated, protection settings loaded, controller logic configured and cabinet-level alarms checked. The main benefit is not the number of items inside the enclosure. It is the ability to inspect a defined configuration against one drawing set before the cabinet enters a remote or time-constrained site.

Configuration control becomes easier

Wire numbers, terminal references, breaker ratings, controller firmware, sensor channels and mechanical positions can be checked against an approved revision. When several cabinets use the same configuration, deviations can be recorded before shipment instead of being discovered during network turn-up. This advantage disappears if late substitutions are made without updating the drawings and test record.

Internal functions can be tested together

A useful factory acceptance test operates the assembled internal power path rather than checking components separately. Depending on scope and safe test capability, it may include source energization, output-voltage checks, controller communications, alarm simulation, door and temperature sensors, cooling response, source-loss behavior and restoration after a controlled interruption.

IEC 61439-1:2020 covers construction, technical characteristics and verification requirements for low-voltage switchgear and controlgear assemblies. It also notes that converters, switch-mode power supplies and UPS products retain their own product standards while their incorporation in an assembly falls within the assembly framework. Where the project identifies the IEC 61439 series as applicable, the supplier must define the relevant assembly scope and evidence; a component certificate alone does not verify the populated system.

Field work can be reduced, but not eliminated

A factory test cannot reproduce the site’s foundation, cable lengths, earth network, solar resource, generator behavior, utility quality, radio load profile or remote communications path. Shipping can also disturb terminals, doors and modules. A factory-integrated cabinet therefore still needs receiving inspection, installation checks, site acceptance testing and commissioning.

Site assembly is justified when the site owns too many variables

Field assembly is sometimes treated as an inferior option. That is too broad. It can be the rational delivery method when the operational configuration cannot travel as one unit or cannot be frozen before construction.

Common reasons include:

- restricted roads, doorways, rooftop access, crane reach or lifting capacity;
- large batteries that require separate transport, handling or delayed installation;
- operator-furnished radio, transmission or battery equipment arriving under another contract;
- reuse of a live rectifier, generator, distribution board or monitoring platform;
- local sourcing requirements or destination-specific electrical equipment;
- a rollout in which equipment capacity is added in phases rather than installed on day one.

Huijue’s internal cabinet specifications include compact wall or pole formats, conventional floor-standing formats and larger modular enclosures intended to address restricted transport and site access. These families support different delivery strategies; they do not establish one standard level of factory population. The exact installed components, shipping split and commissioning responsibility must be confirmed for each order.

The field risks are equally concrete. Site teams may work from different drawing revisions, use locally substituted glands or protective devices, route signal and power cables without the intended separation, or commission alarms before all points are connected. Weather, access windows and multiple subcontractors add variability. These risks are managed through pre-engineered modules, keyed connectors where appropriate, terminal schedules, torque requirements, installation photographs and hold points rather than through supervision alone.

Three delivery models cover most telecom energy projects

Delivery model	Factory scope	Site scope	Best fit
Populated and internally tested cabinet	Enclosure, power, distribution, controls, thermal equipment, internal harnesses and cabinet FAT	Positioning, source/load connections, external systems, SAT and commissioning	Repeatable rollout with frozen interfaces and practical transport access
Pre-integrated functional modules	Tested power shelf, distribution unit, controller panel, cooling package and labelled interconnects	Cabinet or modular shell assembly, module installation, external connections and integrated SAT	Restricted access, larger enclosures or projects needing local final assembly
Site-assembled multi-vendor system	Individual equipment supply and component-level records	Mechanical integration, wiring, settings, controls, protection coordination and system commissioning	Brownfield sites, operator-furnished equipment or highly site-specific interfaces

A mixed model is often the most defensible. For example, a rollout may use a factory-wired power and monitoring cabinet while batteries travel separately, PV strings are built at site, and operator radio equipment remains in its own enclosure. The project gains repeatability where the design is stable without forcing site-dependent items into the shipping assembly.

An empty enclosure should not be evaluated as though it were a verified assembly. IEC 62208:2023 applies to empty enclosures before switchgear and controlgear components are incorporated by the assembly manufacturer. IEC 61439-1:2020 addresses low-voltage assemblies and their verification, used with the relevant product part. The applicable standard and conformity route remain project- and destination-specific, but the scope distinction is important in bid comparison.

Connect FAT, receiving inspection and SAT into one evidence chain

Acceptance should follow the configuration from factory floor to operating site. A pass at one gate does not cancel the next.

1. **Design release:** approve the single-line diagram, general arrangement, bill of materials, settings, cable schedule, point list and deviation register before assembly.

2. **Factory inspection:** confirm component identity, workmanship, clearances, cable support, labelling, bonding, protective devices, firmware and document revision.
3. **Factory functional test:** energize the agreed internal paths, simulate alarms and source states, record measured values, capture controller configuration and close exceptions before packing.
4. **Shipping release:** record installed and separately packed items, transport restraints, battery state where applicable, cabinet mass, lifting method, shock indicators if used and preservation requirements.
5. **Receiving inspection:** check impact, moisture, displaced modules, loose terminals, seals, doors and package completeness before installation alters the evidence.
6. **Site acceptance test:** verify foundation, cable terminations, polarity, voltage drop, protection, grounding, external alarms, source changeover and communications under the installed configuration.
7. **Commissioning and handover:** apply final settings, test fallback behavior, record baselines, train the responsible team and issue as-built documents.

Do not repeat only the successful factory test at site. SAT should concentrate on what changed after FAT: transport condition, field terminations, external sources and loads, grounding, communications, configuration changes and the site's real failure paths.

A public JICA project specification illustrates the contractual distinction by requiring FAT before packing and delivery and SAT after installation. That document is not a telecom energy standard, but it demonstrates why each test needs a defined location, precondition and acceptance record.

Choose the delivery model by failure exposure

Project condition	Preferred starting model	Reason to challenge it
Large repeat rollout with stable loads and drawings	Populated, factory-tested cabinet	Transport damage or late operator equipment changes may erase the repeatability advantage
Mountain, rooftop or narrow-access site	Pre-integrated modules with local final assembly	More field joints require a stronger installation and SAT plan
Brownfield generator and legacy DC system	Site-integrated or hybrid delivery	A factory mock-up may still be valuable for controller logic and interface panels
Remote site with limited skilled labor	Maximum practical factory integration	Cabinet mass, battery transport and local source interfaces still set limits
Multi-vendor equipment supplied on different schedules	Pre-integrated common infrastructure	Interface simulators or representative equipment may allow more FAT coverage

Cost comparison should include both locations. Factory labor, test fixtures, mock loads, packaging and freight belong on one side; site technicians, travel, weather delay, temporary power, rework and repeat visits belong on the other. Avoid claiming a universal saving percentage. The result depends on rollout volume, access, labor capability, configuration stability and the cost of a failed commissioning window.

Make the build-and-test boundary part of the RFQ

Ask bidders to return a completed responsibility schedule rather than describe the system as “fully integrated.” At minimum, the proposal should state:

- the exact factory-installed, separately shipped and site-installed items;
- the approved configuration baseline and change-control method;
- incoming and outgoing terminal boundaries, connectors, cable sizes and gland responsibilities;
- which source, load, battery, cooling and alarm states will be simulated at FAT;
- FAT instruments, acceptance values, witness arrangements and exception closure;
- transport configuration, populated mass, lifting points, restraints and preservation;
- site prerequisites, installation tools, torque values and competency requirements;
- SAT, commissioning, rollback and handover records;
- who updates drawings and controller files after field changes.

The integrated telecom energy cabinet guide provides the broader component and selection framework. The telecom site energy engineering guide covers the load, source, storage and lifecycle decisions that must be settled before the delivery split is frozen.

Engineering references

- IEC 61439-1:2020 – Low-voltage switchgear and controlgear assemblies, general rules
- IEC 61439-2:2020 – Power switchgear and controlgear assemblies
- IEC 62208:2023 – Empty enclosures for low-voltage assemblies
- ITU-T K.35 – Bonding configurations and earthing at remote electronic sites
- JICA public project specification – example FAT, SAT and commissioning sequence

The standards and public specification above have different scopes. Their inclusion supports the distinction between enclosures, populated assemblies, remote-site interfaces and acceptance stages; it does not establish certification or compliance for a Huijue product. Confirm the applicable editions and destination requirements for each project.

Define what ships complete and what the site must finish

Send the load schedule, source diagram, cabinet location, transport constraints, free-issued equipment list and site responsibility matrix. Huijue can return a proposed factory/site split with test boundaries and required field interfaces for review.

Request an integration boundary review

Related engineering resources

Integrated Telecom Energy Cabinet Guide
Power Cabinet vs Equipment Cabinet
Telecom Energy Products and Services

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