

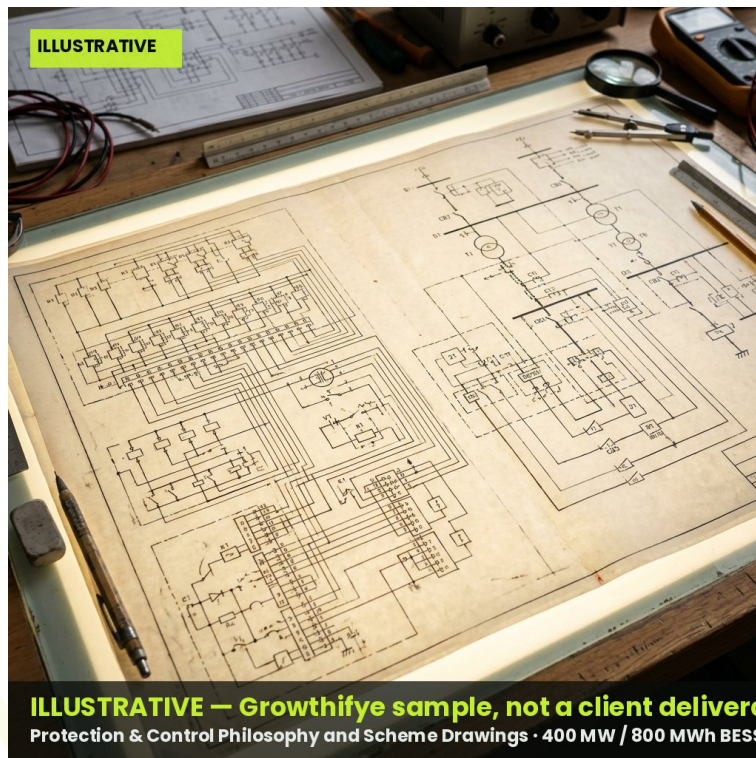


TRANSMISSION ENGINEERING · STEP 03 · DETAILED DESIGN · DRAWING

Protection & Control Philosophy and Scheme Drawings

Relay coordination study, P&C; philosophy document and schematic drawings for line, transformer and busbar protection with redundancy analysis.

Worked example (anonymised): Standalone BESS Interconnection Package · 400 MW / 800 MWh BESS with 220 kV pooling substation · Western India. Detailed design of a 220 kV pooling substation, associated P&C; schemes and a 12 km double-circuit line package connecting the BESS to the state transmission utility's grid substation.



Illustrative sample image

Sample excerpt · Protection Scheme Summary

Element	Primary Protection	Backup Protection	Relay Make/Class	Trip Time (typ.)
220 kV Line	Distance (21)	Directional O/C (67)	Numerical, IEC 61850	<100 ms
Power Transformer	Differential (87T)	REF (64) + O/C	Numerical, IEC 61850	<50 ms
Busbar	Bus Differential (87B)	Breaker Failure (50BF)	Numerical, IEC 61850	<30 ms
BESS Feeder	O/C + Earth Fault	U/V, O/V	Numerical, IEC 61850	<150 ms

Notes

- All relays specified with IEC 61850 GOOSE messaging for interoperability
- Coordination margins verified against utility's existing relay settings

What happens in this step

1. Finalise single line diagrams (SLDs), bus arrangements and bay layouts based on approved load flow, short circuit and stability study outputs
2. Prepare substation general arrangement (GA), sectional and equipment layout drawings including clearances as per CEA/CBIP guidelines



3. Develop protection & control philosophy, relay coordination studies, and P&C; schematics for line, transformer and bus protection
4. Design SCADA/RTU architecture, communication network topology (OPGW/fibre), and interface points with the utility's control centre
5. Prepare transmission line design package: tower spotting, sag-tension calculations, foundation type selection and conductor/OPGW schedules
6. Cross-discipline clash check and constructability review across civil, electrical and protection drawings
7. Issue design packages for internal design review, statutory vetting, and procurement-ready issuance

Outcomes

- Construction-ready substation and line drawings accepted by the utility with minimal revision cycles
- Protection coordination validated against the utility's existing relay settings, avoiding nuisance tripping
- SCADA architecture pre-aligned with the load dispatch centre's interface standards, reducing commissioning delays
- Single integrated design package enabling faster, cleaner EPC tendering and vendor bid comparison

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