



Power system engineering

# Renewable energy

## electrical design and interconnection analysis

Eaton's Power System Engineering team is your ally to provide analysis and design for connecting renewable and alternative energy generation to the utility grid. Our experience and North American coverage make Eaton the choice to analyze and design the electrical distribution system and substation for wind and solar farm projects.

Connection of renewable generation to the utility grid presents unique engineering challenges. Due to the variable and unpredictable power output from wind, solar, or other alternative sources, special consideration and analysis is required to address voltage stability and regulation, reactive power compensation and other effects on the electrical system. Design of the associated collector systems and substations for wind or solar farms also requires unique approaches to balance cost with safety, reliability and performance.

Our team of experienced engineers can provide the skills needed to successfully complete your project, from transient and dynamic system simulation to collector system and substation design.

Coupled with proven project management experience, Eaton can provide additional support up to and including turnkey EPC solutions.

Eaton's Electrical Services & Systems is one of the largest and most experienced teams of power system engineers in the industry. We offer a full portfolio of engineering, design, and consulting services, energy management audits, and power quality and reliability audits. Whether you provide solar energy to the electric grid or oversee a mission-critical operation where even a second of downtime is unacceptable, Eaton can help you stay open for business.



**EATON**

*Powering Business Worldwide*

Eaton's power system engineers bring extensive skills and expertise to power system analysis and design. Active participation in technical societies such as IEEE and collaboration with a variety of utilities and industries ensures that our engineers are knowledgeable about today's cutting edge engineering techniques.

### Analysis services

Power system analysis services offer a focused and systematic approach to enhance performance and design, validate equipment selection, and simulate response to abnormal conditions. Typical Analysis Services performed during design of new renewable generation sites include:

- Short-Circuit Analysis – Calculation of the available short-circuit currents at equipment locations throughout the power system. Evaluation of equipment ratings ensures equipment can withstand, and, where applicable, interrupt an electrical fault. Results are critical for proper system design, including specification and selection of equipment
- Protective Device Coordination – Determination of necessary characteristics, ratings, and settings for electrical protective devices
- Arc Flash Analysis – Calculation of arc flash hazards associated with energized work at locations throughout the power system in accordance with NFPA 70E, IEEE1584, National Electric Safety Code, and Z462 requirements
- Load Flow Analysis – Analysis of the system's capacity to supply electrical energy from the renewable energy source to the utility or customer under steady-state conditions, determination of appropriate continuous ratings for electrical equipment, and optimal placement and characteristics of reactive power compensation equipment

- Harmonic Analysis – Evaluation of harmonic currents on the electrical system introduced by the renewable energy source and application of harmonic mitigation equipment and design techniques
- Transient Stability Analysis – Evaluation of dynamic behavior of the renewable source and system voltages during transient conditions such as system faults or start-up
- Switching Transient Analysis – Analysis of system behavior during switching conditions to identify possible damaging voltage transients. Results are used to design and specify mitigation equipment such as snubbers

### Electrical design services

Eaton's electrical design services can extend from the point of utility connect to the equipment. Design services are integrated with analysis services, resulting in a complete engineered solution. The level of design detail can be customized from minimal design consultation and advice to a complete design package with specifications and drawings. Typical design services include:

- Distribution System Design - Design and specification of the electrical distribution system from the point of interconnection to generation equipment
- Substation Design - Complete substation design service is available, including ground grid analysis and design, substation layout, equipment specification, protection, and control

- Protection and Control – Design of advanced electrical protection and control including transmission line protection, system automation, advanced metering and smart grid capabilities

Power Systems Engineering is an integral part of Eaton's electrical service capabilities. The combined Eaton Electrical Services & Systems team can provide a full scope of Design and Construction Management Services to support your project needs:

### Engineering and design

- Electrical, Civil and Structural Design thru 345kV
- Power System Analysis
- Protection, Automation and Control
- Control house layout and design

### Multi-vendor equipment supply

- Supply of the complete range of Eaton substation product lines
- Coordination and resale of all third-party customer preferred components
- Prefabricated Control House and Electrocenter supply

### Turnkey project and construction management

- Single-point responsibility throughout the entire project
- Centralized project management group
- On-site installation supervision
- Standardized documentation practices including scheduling, reporting and closeout

### Installation services

- Nationwide subcontracting capability of all trades
- Site preparation, excavation, foundation installation and control house construction
- Steel dead-end and overhead bus structure assembly
- Equipment set and connect
- Acceptance testing and installation certification
- Start-up and ground-fault Certifications
- Interconnect confirmation and commissioning
- Warranty extension and training
- Short/Long Term maintenance contracts
- 24/7 remote monitoring with expert support
- Pager-Alert of critically monitored parameters
- Immediate personnel dispatch based on remote indication

### Additional services:

- Power Quality and Load Measurements
- Power Quality Investigation
- Energy Management Studies

### Renewable energy applications:

Eaton can provide engineering services for a variety of systems and sources, including:

- Solar (Photovoltaic, Solar Concentrator)
- Geothermal
- Wind
- Hydro
- Biomass