

Grid Innovations Facility and Testing Voucher Opportunity (VO-12) Capability Category Definitions

The following tables provide descriptive context for the testing capability categories and subcategories of interest. These categories are used primarily for filtering projects and enable voucher recipients to find relevant capabilities more easily. These categories are not exhaustive and are subject to change.

Voucher providers may select only one primary category and should select the most relevant if multiple are applicable.

Capability Primary Category	Description
Grid Simulation and Control Testing (SIM)	Testing that integrates real hardware or controllers with simulated or representative power system environments to validate dynamic behavior, control algorithms, and interactions in a safe, controlled setting.
Electrical Performance Testing (ELEC)	Tests that verify the equipment's ability to handle electrical stresses and faults including tests that demonstrate insulation integrity.
Mechanical Performance Testing (MEC)	Evaluates physical robustness and ability to endure mechanical stresses encountered in service.
Environmental Stress and Accelerated Aging Testing (ESAAT)	Expose equipment to harsh environmental conditions to confirm long-term reliability and performance.
Security Testing (SEC)	Assesses protections against unauthorized access, cyber threats, terrorist attacks, and physical tampering.
Material Characterization and Failure Analysis (MAT)	Involves detailed examination of materials properties and other techniques to understand failure modes and degradation mechanisms of power system equipment.

Voucher providers may select multiple subcategories if directly applicable to the capability.

Capability Subcategory	Description
SIM-Power Hardware-in-the-Loop (PHIL) Testing	Connects physical power devices such as inverters or converters to a real-time simulation of the grid via high power amplifiers, enabling closed-loop testing of real power exchange and hardware response under realistic grid conditions.
SIM-Controller Hardware-in-the-Loop (CHIL) Testing	Integrates physical controllers such as relays or inverter control units with real-time simulations of the power system, focusing on signal-level interactions without full power exchange.
SIM-Operational Technology / Real-time operations Testing	Validates real-time control, monitoring, and automation systems in operational technology (OT) environments, ensuring timely response, data accuracy, and stability during grid operations.
SIM-Power Electronics & PFC Device Specialized Testing	Evaluates performance, efficiency, and control of power electronic converters and power flow control (PFC) devices, including Flexible AC Transmission Systems (FACTS) devices, under various operating scenarios.
SIM-Protection and Control System, Substation Automation Testing (including interoperability)	Assesses protective relays, control logic, and substation automation systems for correct operation, coordination, and seamless communication across multi-vendor equipment (interoperability per standards like IEC 61850).
SIM-Microgrid and Islanding Mode Testing	Simulates islanded operation and seamless transition between grid-connected and islanded modes for microgrids.
SIM-Grid Integration Testing	Actual grid test bed to confirm compliance with grid codes for interconnection, including response to extreme grid events such as fault ride-through and power quality impacts of large dynamic loads.
ELEC - High Voltage Dielectric Testing	Applies high voltages to assess insulation withstand capability, ensuring no breakdown or flashover occurs (AC/DC withstand or impulse tests per IEC/IEEE standards). Includes wet dielectric testing which simulates rainfall while high voltage is applied.
ELEC - Short Circuit and Fault Interruption Testing	Simulates high fault currents to verify equipment such as circuit breakers can safely interrupt and withstand short-circuit conditions without failure.
ELEC - Arc Flash and Fault Simulation Testing	Recreates arcing faults to evaluate incident energy, protective boundaries, and equipment resilience against arc flash hazards.
ELEC – Partial Discharge and	Detects localized insulation defects (partial discharges) and measures dielectric losses (dissipation factor/ $\tan \delta$) to assess insulation quality and aging.

Dissipation Factor Testing	
ELEC – Overload and Continuous Current Testing	Verifies equipment can carry rated or overload currents continuously without excessive heating or degradation.
ELEC – Power Quality and Transient Evaluation	Monitors and analyzes voltage/current waveforms for disturbances (harmonics, sags, swells, transients) and records events for performance evaluation.
ELEC – Accuracy and Dynamic Range of Sensors	Demonstrate the accuracy and dynamic range of new power system sensors.
ELEC – Electromagnetic Compatibility (EMC) and Immunity Testing	Verifies emission limits and immunity to electromagnetic interference, including high-altitude electromagnetic pulse (EMP) effects.
MEC – Mechanical Strength and Structural Integrity	Assesses the mechanical properties of power system equipment by simulating mechanical stresses such as tensile loads, torsional forces, cantilever loads, etc.
MEC – Vibration and Seismic Testing	Simulates vibrations (transport, installation, operation), conductor dynamics, or seismic events to ensure equipment remains functional and undamaged in extreme events.
ESAAT – Environmental Chamber Testing	Subjects equipment to controlled temperature, humidity, ultraviolet light, and other ambient variations to verify operation across specified ranges.
ESAAT – Salt Fog and Corrosion Testing	Tests resistance to corrosive environments (coastal conditions) using salt spray exposure.
ESAAT – Thermal Cycling and Temperature Rise Testing	Cycles equipment through temperature extremes and measures temperature rise under load to ensure thermal limits are not exceeded.
ESAAT – Wildfire Resilience	Tests to determine components’ ability to cause a wildfire and/or its ability to withstand wildfire conditions.
SEC – Information Technology and Cyber Security Testing	Evaluates IT/OT systems for vulnerabilities, resilience against cyberattacks, and compliance with cybersecurity standards.
SEC – Physical Security Testing	Tests barriers, access controls, and enclosures against physical intrusion or tampering.
MAT – Materials Characterization and Analysis	Examines material properties to assess suitability and degradation.

MAT – Failure Investigation	Analyzes failed components or systems to determine root causes through forensic methods.
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