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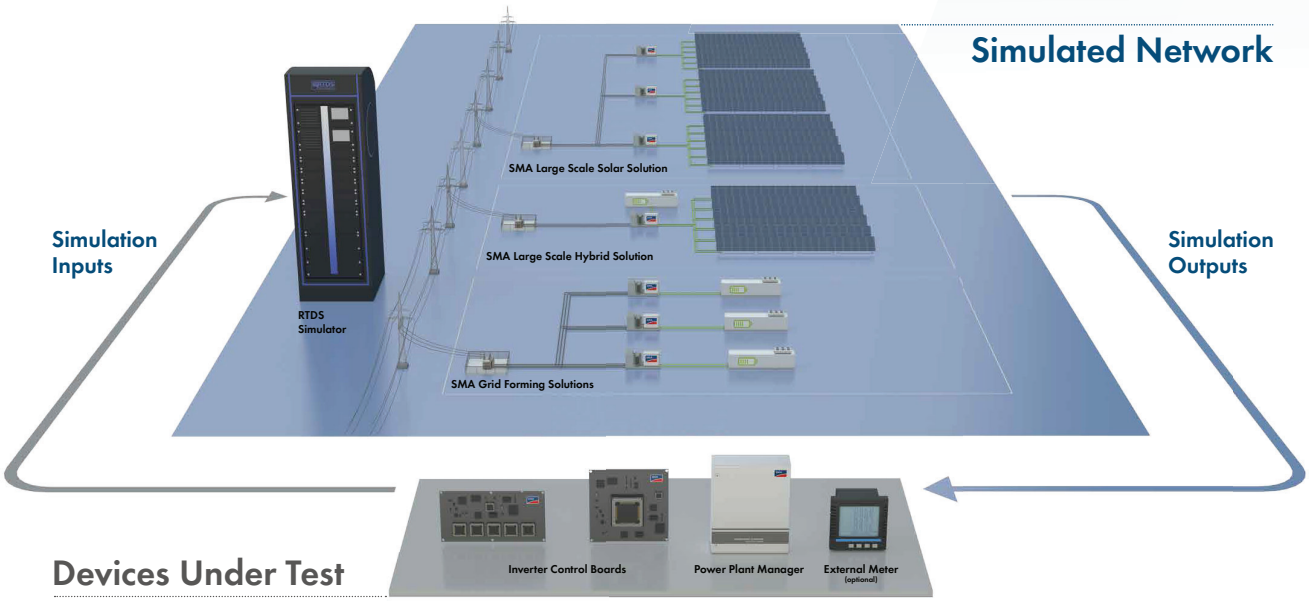

Hardware-in-the-Loop (HIL) Testing Platform

Real hardware. Real-time simulation. Real-world results.

SMA Australia's Hardware-in-the-Loop (HIL) testing platform sets a new benchmark in system validation and performance testing. By simulating real-world operating conditions in real time, it enables safe, fast, and cost-effective testing of inverter systems without a full-scale physical setup.

Key benefits:

- Bridges the gap between PSSE/PSCAD simulations and on-site testing
- Provides confidence in system performance before commissioning
- Streamlines AEMO R2 compliance testing
- Supports smoother and faster commissioning

Why HIL?

- Risk mitigation through early validation
- Dynamic testing under critical grid conditions
- Early-stage discrepancies detection
- Root-cause analysis of potential onsite issues
- Supports R2 compliance and seamless commissioning

SMA Advantage

- Established grid-forming and grid-following solutions
- Proven gateway from simulation to reality
- Faster, safer, and more cost-effective grid connection process
- Confidence for NSPs, AEMO, and developers

Testing Scope

1. Communication Tests

- Communication validation between controllers, inverters, and meters
- System-level testing of grid events, SCADA, and plant control
- Integration testing with live hardware interaction and full system validation

2. System Tests

- R2 hold point testing for AEMO compliance
- Simulation of outages, breaker trips, voltage and frequency deviations, and oscillations
- Functional testing of plant controllers and inverters
- SCADA communication and control validation
- Digital input-driven HV Transformer Tap Changer model for plant control testing

3. System Integration Tests

- SCADA ↔ PPM interface mapping and validation
- Onsite hardware integration via low-voltage interfaces (300V, 32A)
- Live interaction with physical meters (e.g., ION 9000)

System Overview

Core of the SMA HIL Platform: Real-Time Digital Simulator (RTDS)

- Forms the core of the SMA HIL platform, mirroring the dynamic conditions of a real plant environment
- Emulates the grid, inverter power electronic hardware, solar panels, batteries, and site loads in real time
- Enables testing without the need for a full physical system
- Seamlessly integrates SMA's inverter control hardware and controller, which responds in real time to emulated grid conditions
- Allows highly accurate assessment of system behaviour under complex operating scenarios

Test Execution & Reporting

- End-to-end support from setup through to final results
- Test planning remains the customer's responsibility, with SMA support available for test scope definition and documentation
- SMA pre-configures the HIL system and performs pre-tests to align simulation responses with PSCAD models
- SMA oversees test execution to ensure accurate and reliable results
- On-the-spot troubleshooting support to ensure smooth test handling throughout execution
- Comprehensive benchmark report including:
  - Overlay assessment comparing PSCAD and HIL results
  - Identification of discrepancies

Pricing

- Pricing is tailored to your testing requirements. Certain services are charged on a time and materials basis.
- Test plan support and consultation
- Test preparation, including bench setup, configuration, and pre-tests
- Test execution, depending on scope
- Final benchmarking and reporting

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