EdgeTunePower

Push the Limits Further

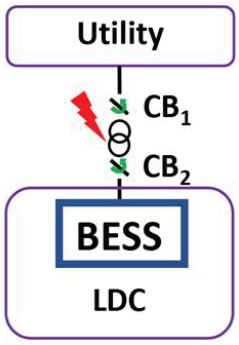
Hardware-In-the-Loop (HIL) Testing

Full-scale performance verification of your hardware-implemented control solution, before field implementation!

To keep up the pace with the continuous modernization of the legacy electrical energy systems, utilities and consultation companies are required to significantly improve their engineering solutions towards reliable, safe, and time-efficient interconnection and operation of various types of new Distributed-Energy-Resources (DERs) technologies. This trend has resulted in conventional, PC-based, off-line simulations becoming unreliable and getting out of the picture!

The reason is two-fold:
1- In off-line simulation, electrical energy system's events and phenomena are being simulated significantly SLOWER than the time-frame at which they would occur in real physical power system!
2- In off-line simulation, no hardware platform is involved. Hence, hardware-related discrepancies, particularly the ones affecting performance of control systems, will not appear in the simulation results.

The significant difference between off-line simulation and the actual performance of emerging technologies, e.g., renewable resources, has resulted in undesired behaviors and frequent blackouts during modernization of legacy electrical energy system, e.g., 2021 Texas Power Crisis.



A transmission line, connecting a utility to a Local-Distribution-Company (LDC), may be subjected to lightening which is among prevalent events that occurs at power-distribution system. Subsequently, a protection system removes the faulty line via opening circuit breakers CB1 and CB2. Let's assume the opening process takes 4.60 ms in the physical system. In off-line simulation, the same process will take up to seconds to be simulated, while in our real-time simulation lab the process takes exactly 4.60 ms to be simulated!

Our Real-time Simulation Platform:

Simulating up to 900 Three-phase Electrical Nodes in Real Time!
We are benefiting from state-of-the-art technology that RTDS Technologies Inc. is offering for real-time simulation of electrical energy systems. We have multiple RTDS-based computationally-rich simulation platforms which are interconnected with fiber-optic medium, enabling the possibility of simulating massive electrical energy systems in real time.

Real-time simulation of Phenomena Occurring as Fast as in Nanoseconds!
We are able to simulate firing pulses, as fast as in the time-frame of hundreds of nanoseconds, using our Flexible-Programmable-Gate-Arrays (FPGA).

Highly Modular and Interoperable with Diverse Classes of Control Systems
We have a flexible, real-time simulation platform equipped with high-speed analog and digital Input-Output (IO) modules, IEC-61850-compliance communication mediums, e.g., MODBUS-TCP, and fiber-optic platforms.
We confidently claim that we represent the connection infrastructure required for interconnection of almost all commercially-available control systems.

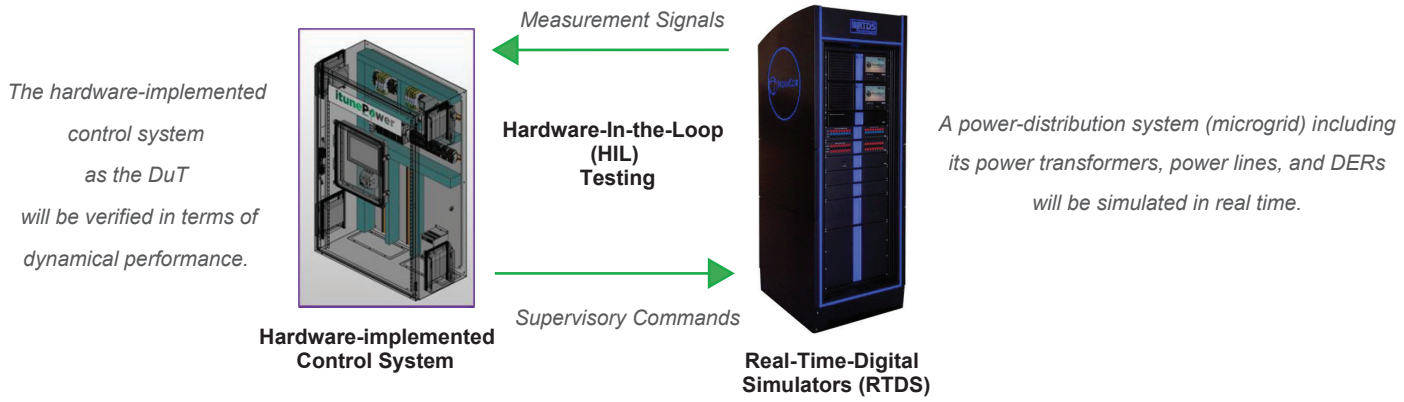
Structuring Hardware-In-the-Loop (HIL) Testing Platform

Device-under-Test (DuT):

In the HIL testing procedure, we take a hardware-implemented control system as the DuT and interconnect the DuT with our real-time simulation platform. We then perform simulation scenarios, based on our customer requirements and pain points, to assure that the developed control solution meets their objectives, without putting the customers' assets in jeopardy.

Data Exchange in HIL Environment:

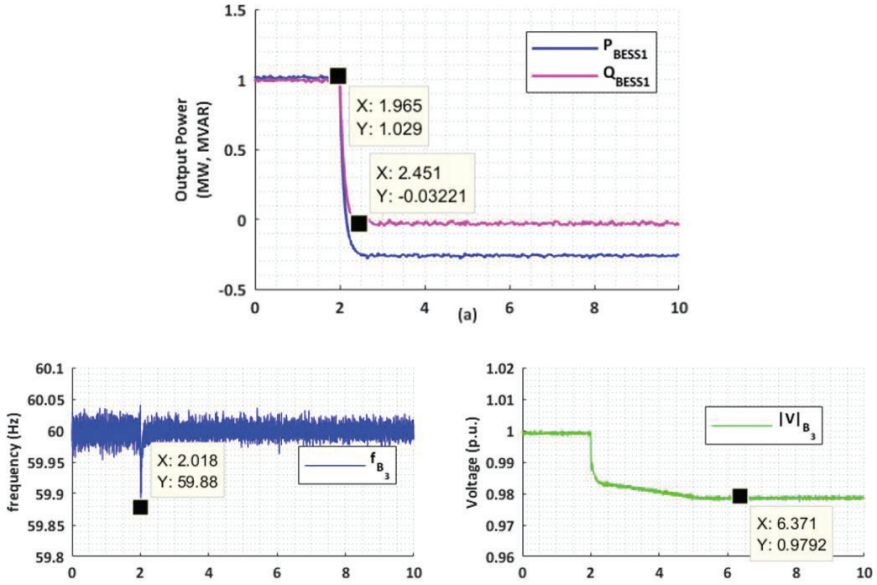
During HIL testing, our RTDS simulates electrical energy system, including its power system apparatus, in real-time. Then, wide range of measurement and monitoring signals, e.g., voltage, frequency, CB status, will be communicated to the hardware-implemented control solution. Simultaneously, the DuT (control system), based on information received from the RTDS, sends back control set points, e.g., real and reactive power levels, and control commands, e.g., BESS operation in grid-forming or grid-following mode.



Reducing Time, Cost, and Risk During EPC Process

Our customers have been benefiting from our HIL testing process to manage the time-critical process of securing approvals from utilities for interconnection and operation of emerging renewable energies and energy storage technologies. We will fully identify the impacts of interconnecting new DERs into their system and have been providing Detailed-Technical-Connection-Impact-Assessment (DTCIA) reports to vividly demonstrate that such new interconnections will fully comply with in-effect standards such as NERC and IEEE-1547 standards. Since we fully implement the entire control system over industrial-grade hardware platforms, our HIL testing is of high-fidelity compared to field operation of the customers' assets.

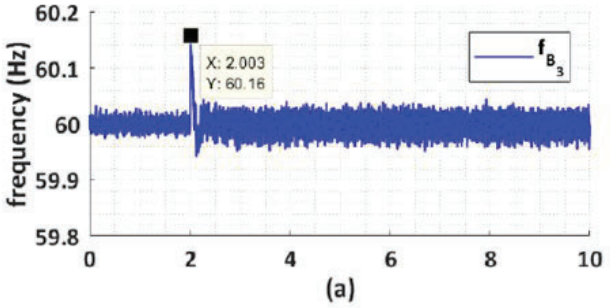
For example, during a project we completed for an engineering consultation company, we identified the impact of instantaneous changes in power exchange level of a 2.5-MW, 5.2-MWh Tesla Megapack BESS system, connected to the end of the customer's radial-distribution feeder. Our HIL testing identifies the transients caused in the voltage and frequency at the BESS Point-of-Interconnection (POI) to the utility, and we have demonstrated that such transients fully comply with IEEE-1547 standard, as initially requested by the customer.

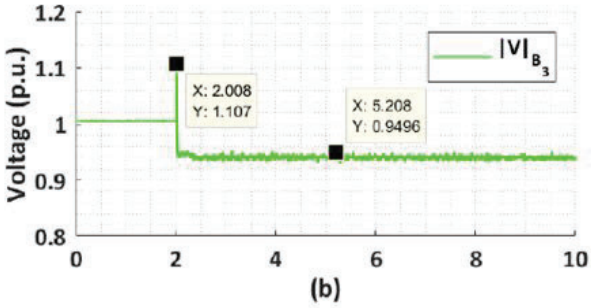


Optimizing Troubleshooting Process of Malfunctioning Control Systems:

Our real-time HIL testing services have also helped our customers with identifying issues associated with their malfunctioning hardware-software control systems. Instead of conducting trial-and-error process and posing risks to their power system assets, our customers have brought their control systems to our testing center, we have fully modelled their power system in our real-time simulation facility, and have identified and resolved technical issues with their control system.

For instance, a customer had been suffering from violating voltage and frequency ride-through capabilities during pre-planned islanding of their microgrid system. We have identified poor time-response in their Distributed-Energy-Resource-Management (DERMS) control system to achieve the seamless islanding. We optimized their DERMS-based system and have enabled voltage and frequency ride-through capability for their microgrid system, per following figures, based on NERC standard, in an intentional islanding scenario.





"The dramatic changes in the energy landscape and the integration of new types of DERs have increased the demand for more reliable HIL testing. We highly recommend the detailed HIL testing that EdgeTunePower offers"

- Stantec Engineering Services Company

Safe Testing Capability of Control Systems During Ab-normal Operation Conditions:

We also offer comprehensive testing of control and protection systems during conditions that our customer's electrical energy system is subjected to severe short-circuit and fault conditions. Without subjecting our customers' assets to such hazardous conditions, we replicate the extreme conditions in our real-time simulation platform and ensure that the platform's interactions with the dedicated, hardware-implemented, control-protection platform, complies with pre-determined operation limits. Such methodology, avoids exposing customers' assets to such severe conditions, for testing and performance verification purposes.

Learn more at

https://www.edgetunepower.com/technology

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