「急成長するパワエレ専用のHILS開発効率化の実際」

Typhoon, the HILS born for Power Electronics
The real case study

Typhoon HIL

25th of Oct. 2019

Ivan Celanovic

Typhoon HIL

Mywayプラスよりご挨拶

Myway
it's a passion way

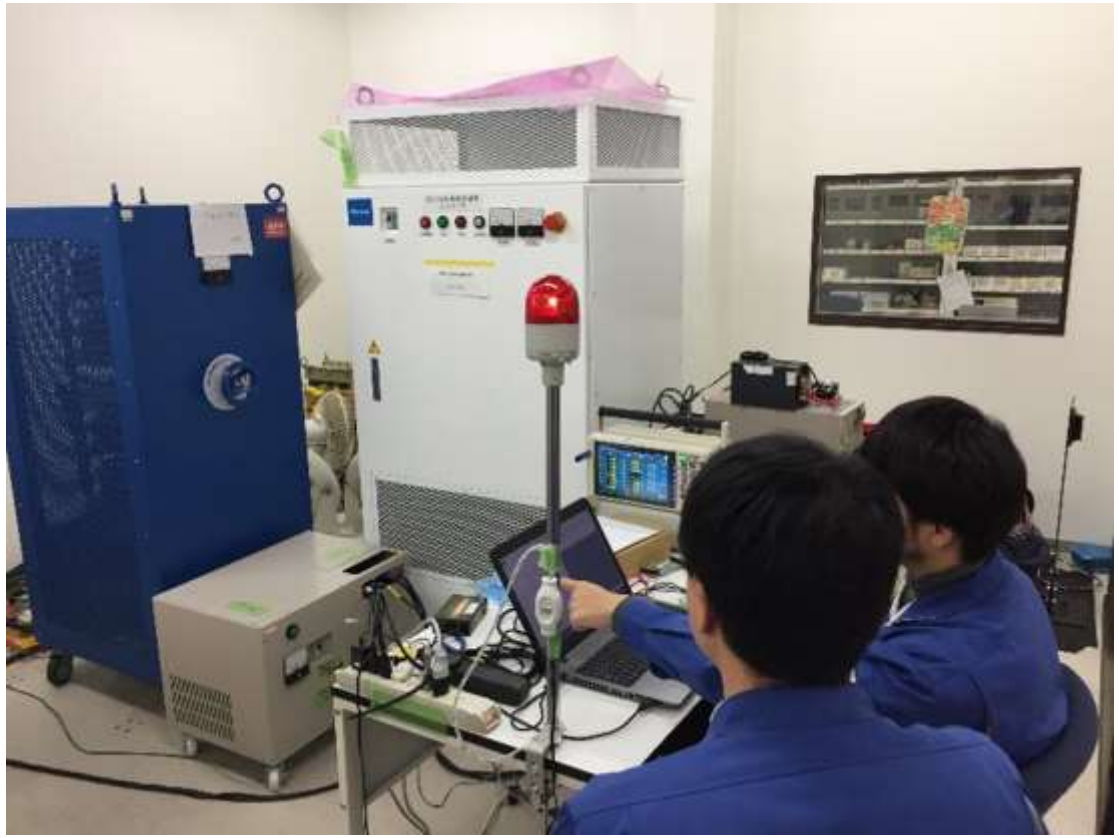
- Mywayプラスについて
  - TyphoonHIL日本総代理店
  - パワエレ機器製造販売・受託開発
    パワエレのシステムインテグレータ

- TyphoonHILについて
  - 「パワエレ専用」として誕生：パワエレ技術者が一人で全て立上げ
  - 国内販売：発売直後～50システムの販売実績

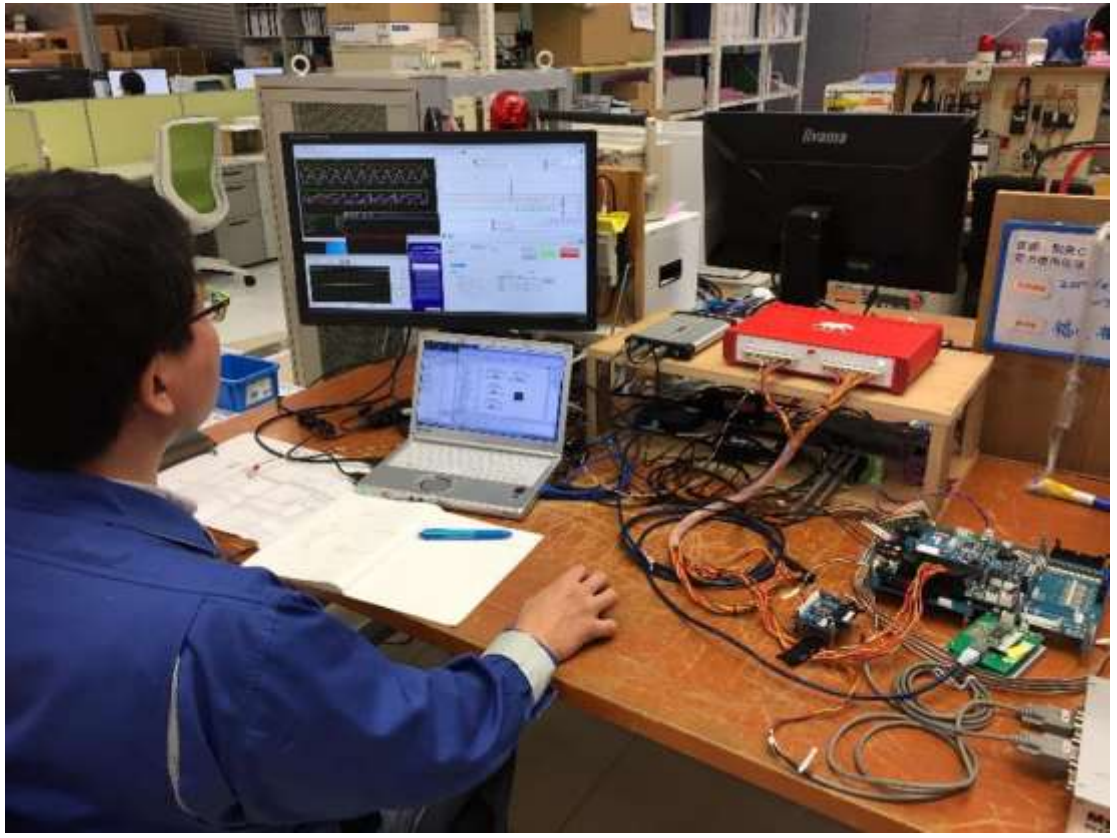
社内開発風景（センサレス モータードライブ）

Myway
it's a passion way

Before



After



国内事例:TMEIC様

海外向け太陽光発電システム用パワーコンディショナ

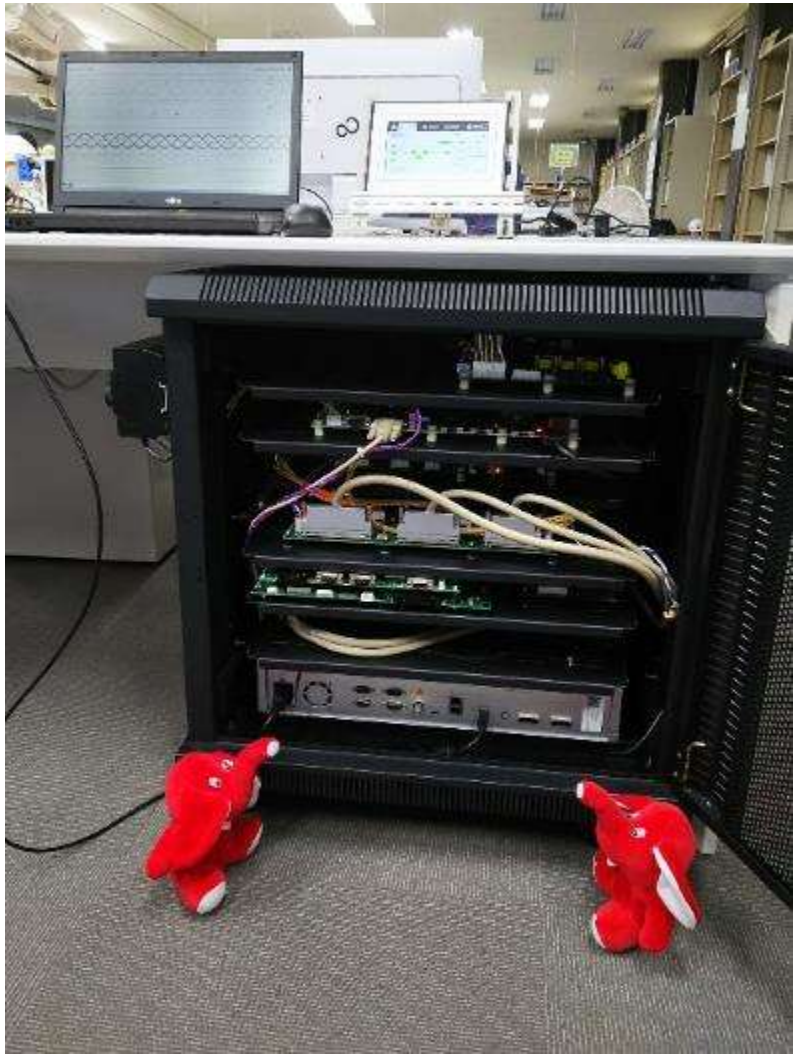
HILによる系統連系試験により、制御ソフト検証を大幅効率化

事例:富士電機様

Myway
it's a passion way

海外向け大容量無停電電源装置(UPS)

富士電機

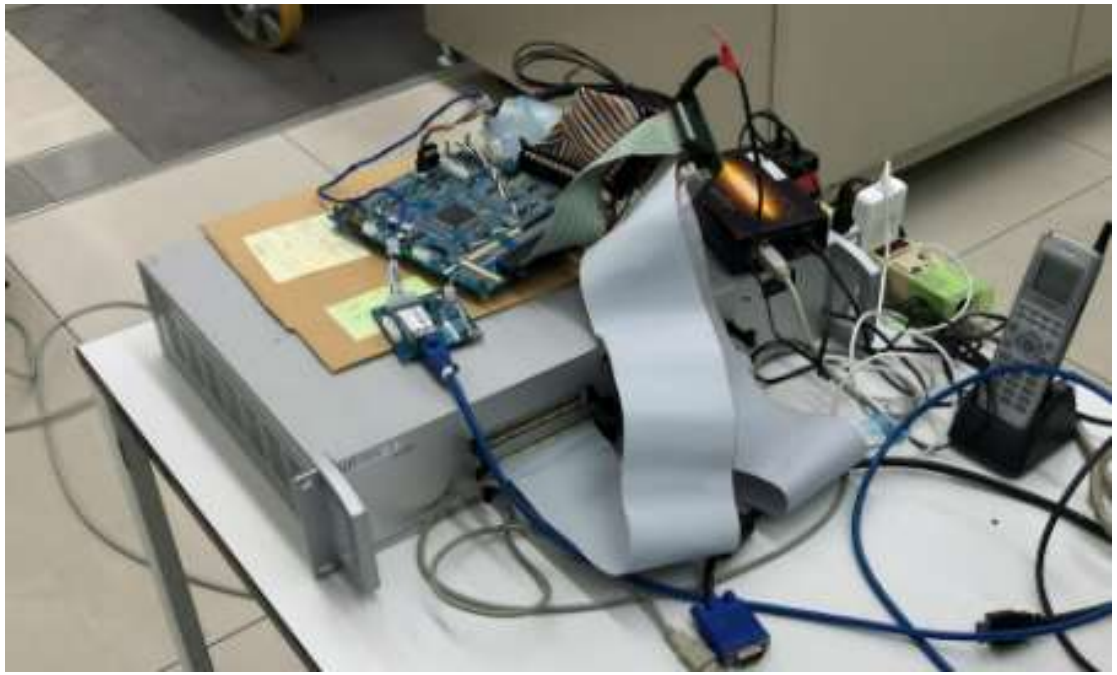


国内事例：三多重四象限双方向チョッパ

■用途：数百kWのエネルギー転送装置
■具体的なメリット：工数削減と実機の破損リスクの削減。

導入前

導入後



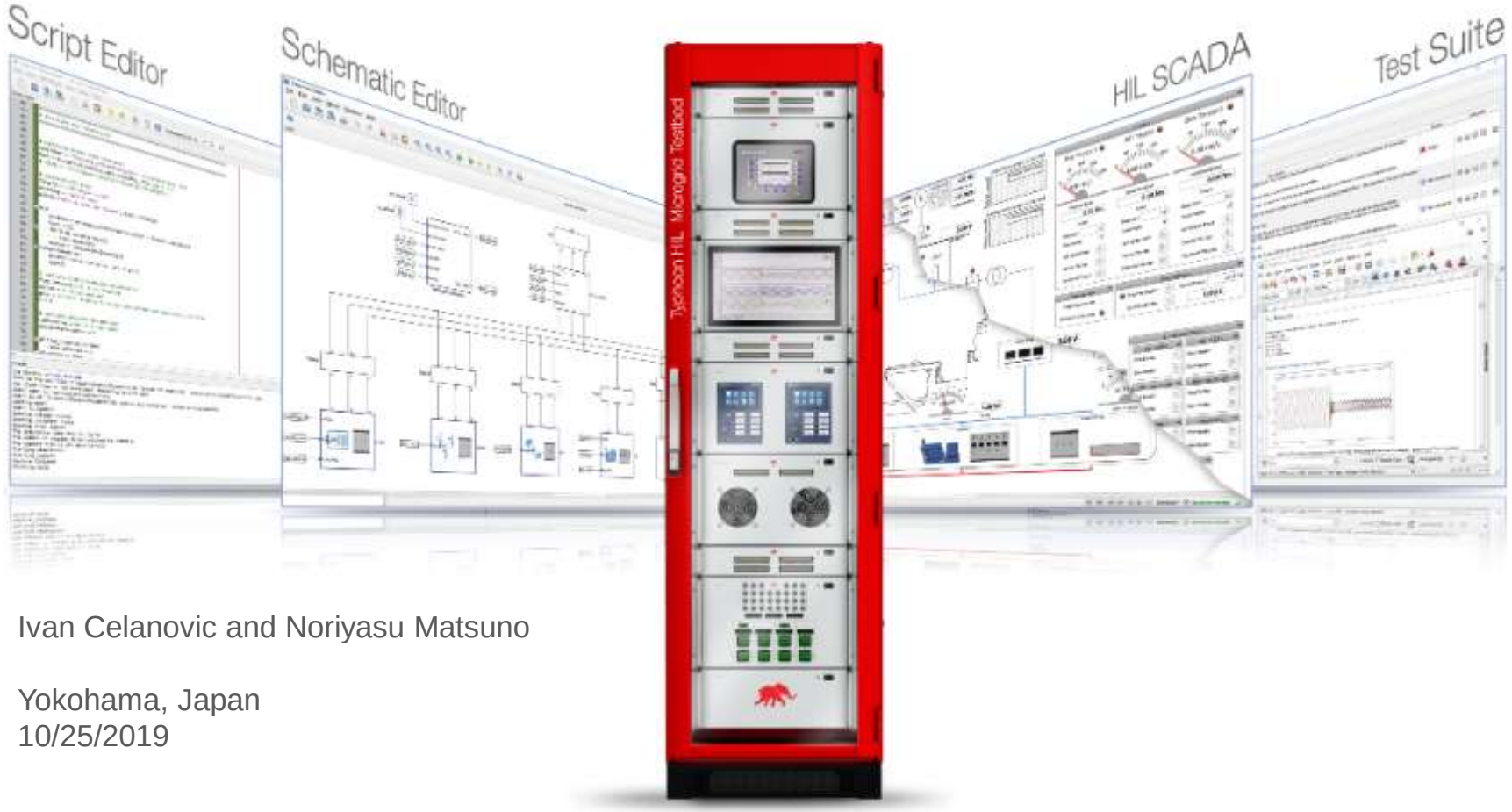
モータドライブ事例、その他多数

- 自動車、鉄道、エレベータ、コンプレッサ等のモータ制御でのモデルベース開発

HILサロン（本会場の展示ブース）
本日よる8時まで開催
HIL体験コーナー有り！

Hardware in the Loop (HIL) Simulation for

Power Electronics and Microgrids



Ivan Celanovic and Noriyasu Matsuno

Yokohama, Japan
10/25/2019

Typhoon HIL, Inc.

- Founded in 2008
- Stata Ventures backed
- Headquarters in Boston, Massachussets, USA
- Three fully owned subsidiaries
  - Switzerland, Serbia, Canada
- 60+ employees across 4 offices
- 1000+ HIL systems installed

Ray Stata
Chairman of the board
Co-founder of Analog Devices, Inc.
CEO from 1971 - 1996

Typhoon HIL Simulators

Made for power electronics and microgrid applications

- Modular design
  - Multiple units can be stacked together
  - Behave as a single large simulator
- FPGA based from entry level
- Use Typhoon scalable multi-core FPGA solver
  - On the market from 2009
  - Able to support large multi converter models
  - Sim step down to 500ns (1us typical)
  - Week long test runs
- Connectivity
  - High speed and high precision analog and digital I/O
  - Industry standard protocols

CAN

IEC 61850

Modbus

Typhoon HIL

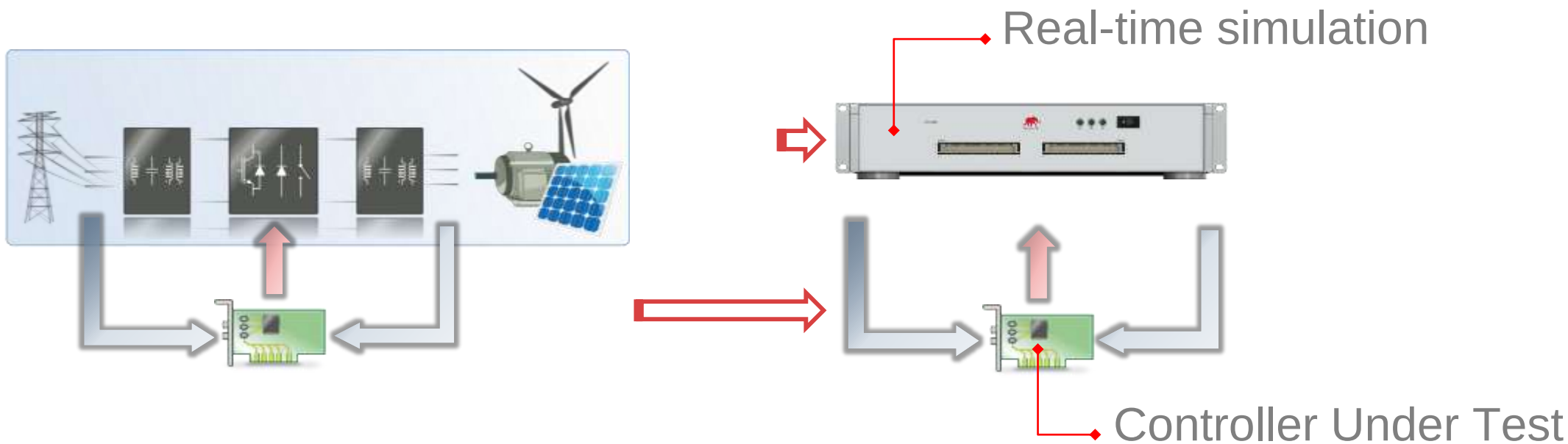
Typhoon HIL software

- Built for real time
- Virtual HIL device
  - Run simulation on your PC
  - One click away from real time
- Easy to integrate in test frameworks
  - Robot framework
  - Exam
  - NI TestStand
- Customer driven development
  - Four major releases a year
  - Include FW update as well

Typhoon HIL

HIL Tested has become standard in power electronics

Ultra-high fidelity Controller Hardware-in-the-Loop (C-HIL) for power electronics



Typhoon HIL

Typhoon HIL offering

Microgrid Testbed

- Modular design
- AC and DC distribution systems
- Multi-rate execution
  - 6.7ns pwm resolution
  - 0.5µs - 50 µs simulation time step
- Connectivity
  - High speed analog and digital I/O
  - Industry standard protocols

❑HIL Building blocks

❑Amplifiers and interfaces

❑HIL Compatible library components: inverters, relays,

HIL Tested: Synonymous with quality and organizational excellence

HIL Tested empowers inverter/converter, DER, and component manufacturers.

Key qualifying requirements:

- ❑ Adopted model based testing (closed loop HIL testing)
- ❑ Commitment to HIL Testing and validation
- ❑ Driving: Test coverage, test fidelity, test efficiency
- ❑ Test automation implementation
- ❑ Continuous integration (CI) processes implemented

Examples:

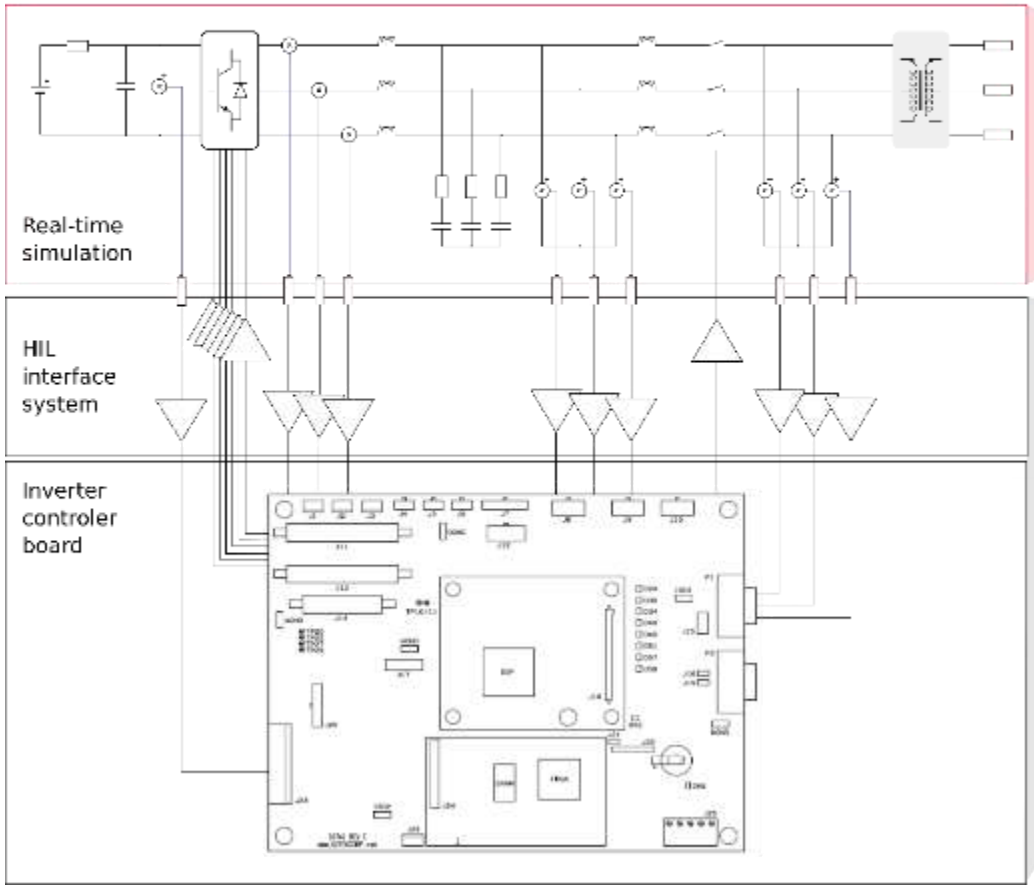
- ❑ Schneider Electric, EPC Power, ABB, Woodward, Tesla…

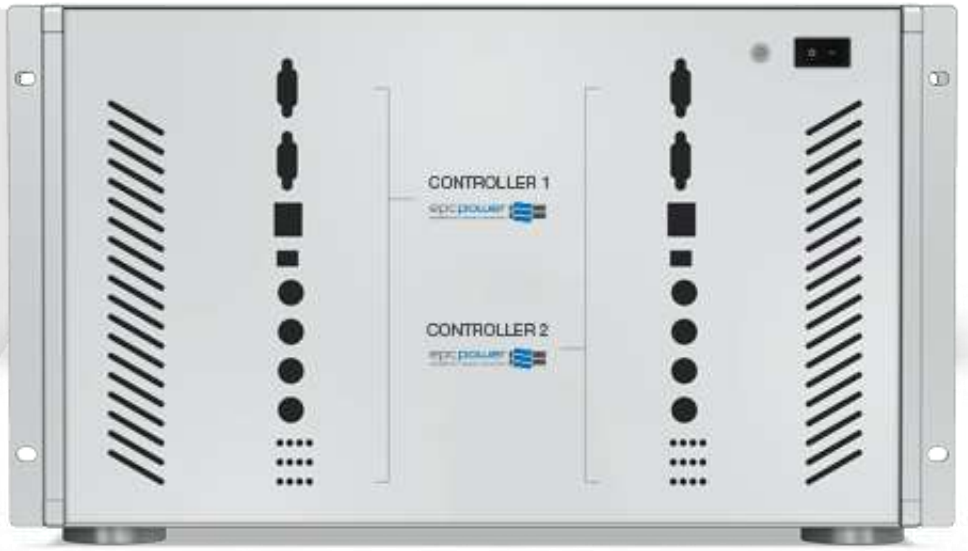
Typhoon HIL

Read full VDC Research Report: HIL TESTED Powerful Performance, Functionality, and Quality from Model-Based Testing

HIL Tested: EPC Power utility scale battery storage inverters

From test automation to UL1741 SA pre-certification

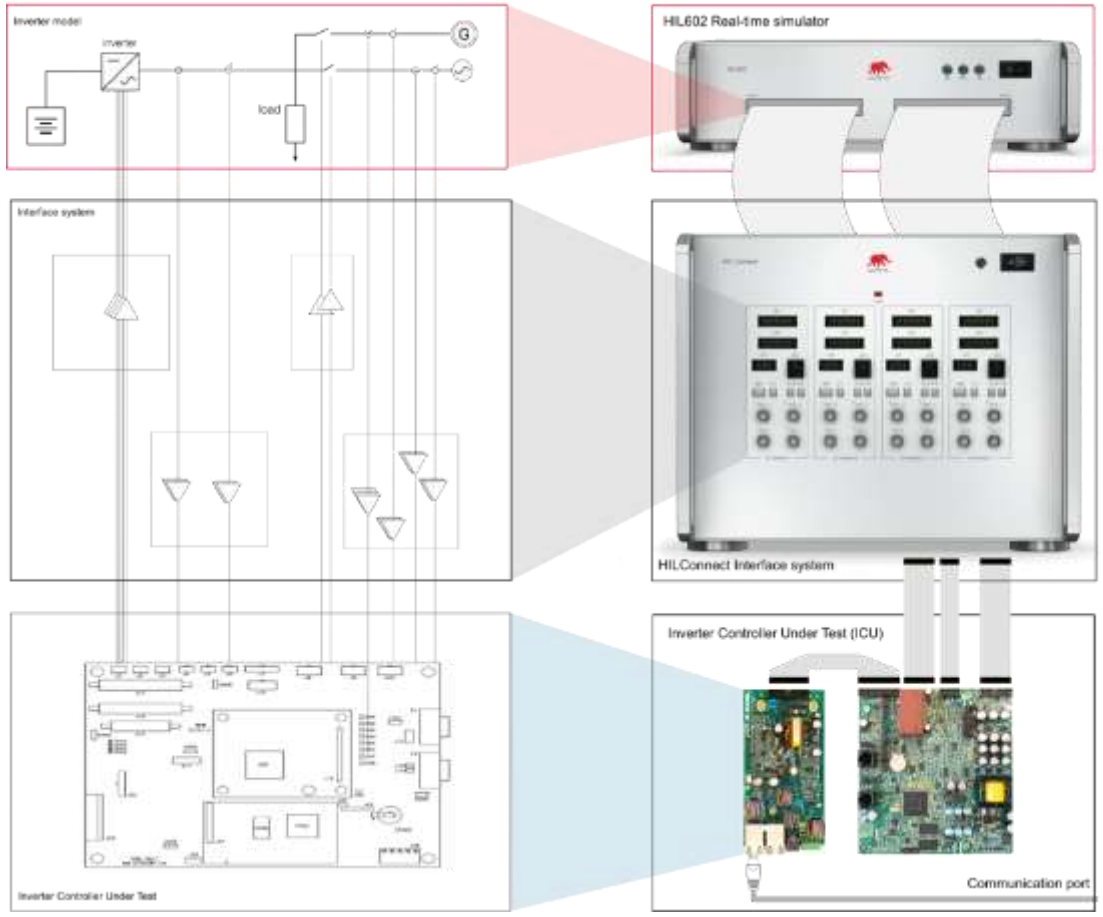




Typhoon HIL

Schneider hybrid inverter XW`

From test automation to pre-certification



https://www.typhoon-hil.com/**company/customers**

HIL Tested: Schneider hybrid inverter XW

From test automation to pre-certification

Schneider Electric – Residential Solar Systems

Conext XW+ Solar Hybrid Inverter System

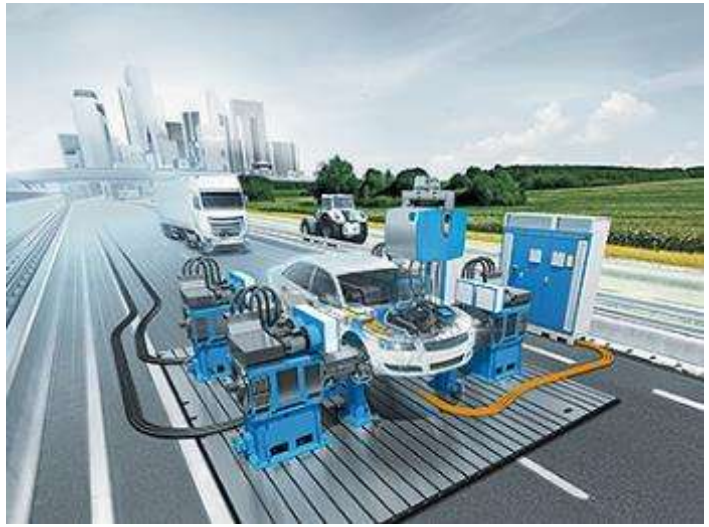
- 6 HIL602 used for:
  - Design and Testing
  - Test Automation and Software Regression Testing
  - Pre-Certification
- Toolboxes used
  - UL1741 SA
  - TyphoonTest
- Inverter model: Split-phase hybrid inverter
- Parallel inverters simulated: 1 to 12
- Number of tests: >1000 per firmware release

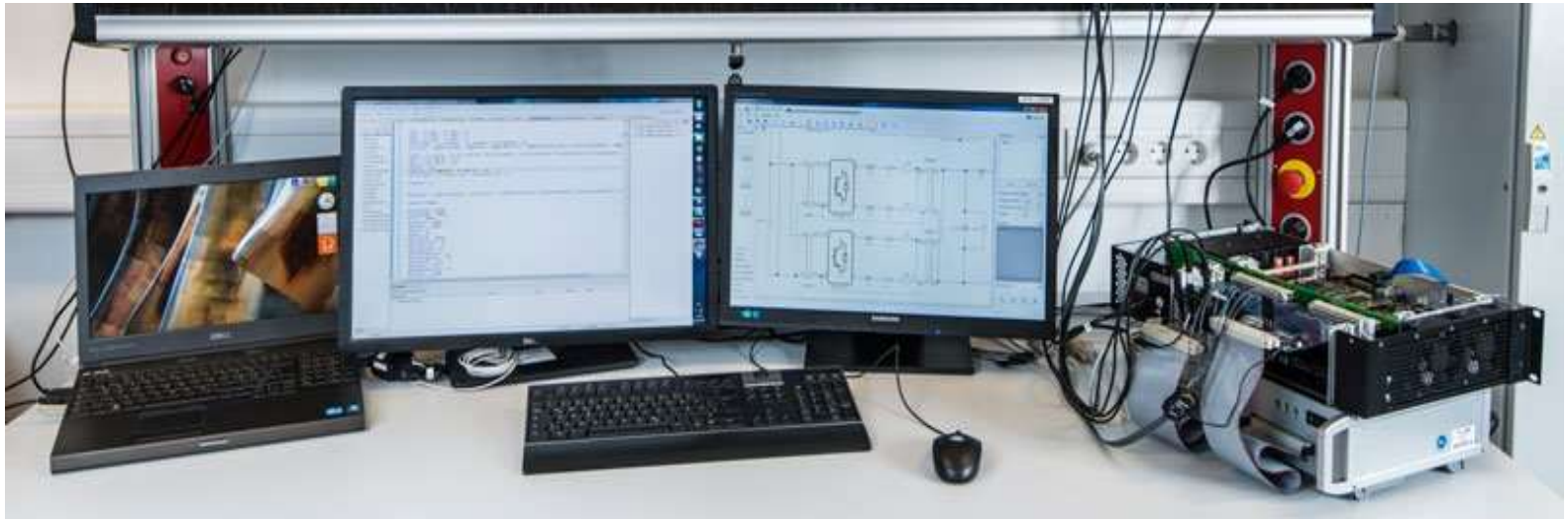
- *“We're able to execute more tests in a short period of time. It facilitates for easier expansion of the test cases.”*
  Sau Ngosi, Director of Schneider

Typhoon HIL

Schneider Conext XW+
Solar Hybrid Inverter System

Use Case: AVL Battery Emulator





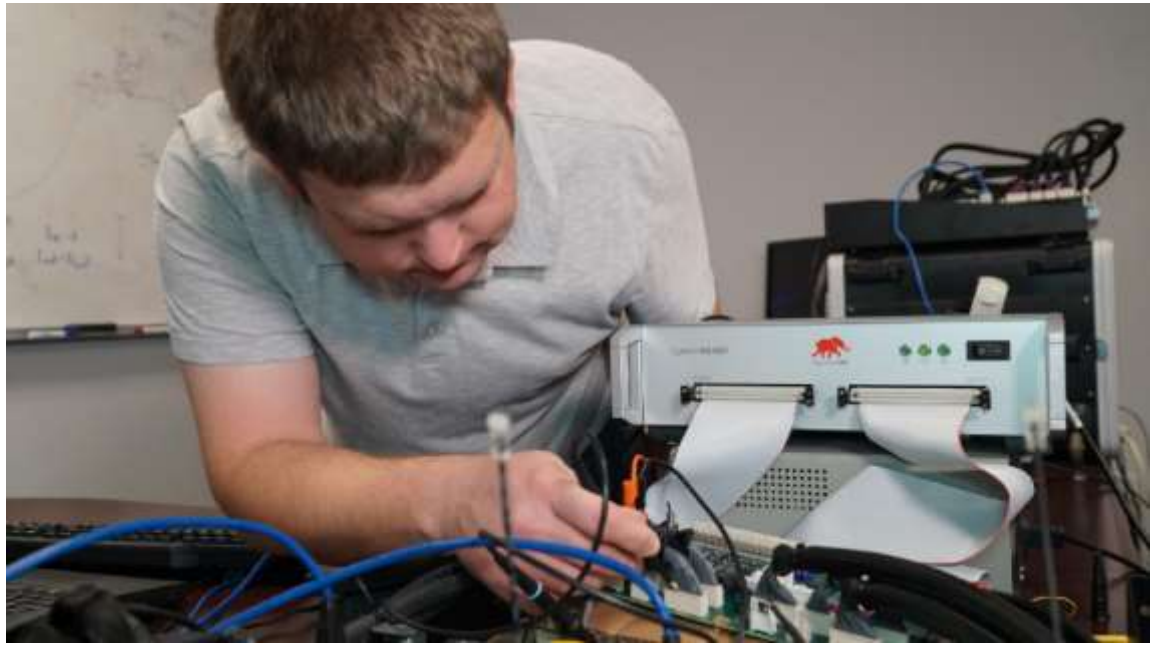
AVL

"Owing to the fact of early porting of controller algorithm to the real target hardware, a large number of issues, especially in control hardware configuration, can be solved prior to system integration phase. This results in significant development time and cost benefits."

Dr. Roland Greul
BU Electrification and Racing Test Systems
AVL List GmbH, Graz, Austria

https://www.typhoon-hil.com/**company/customers**

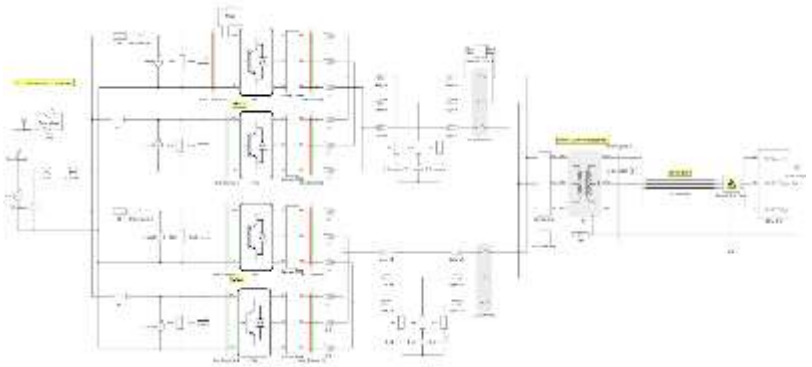
HIL Tested: Schneider **AccuSine** line of active filters

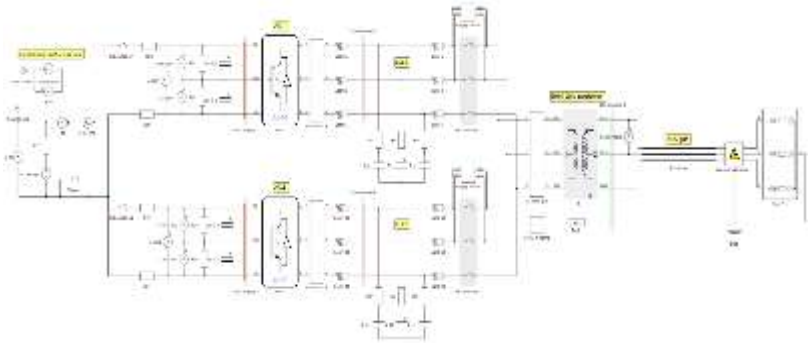


Typhoon HIL

HIL Tested: ABB Solar Inverters

2 Level and
3 level
central solar
inverters

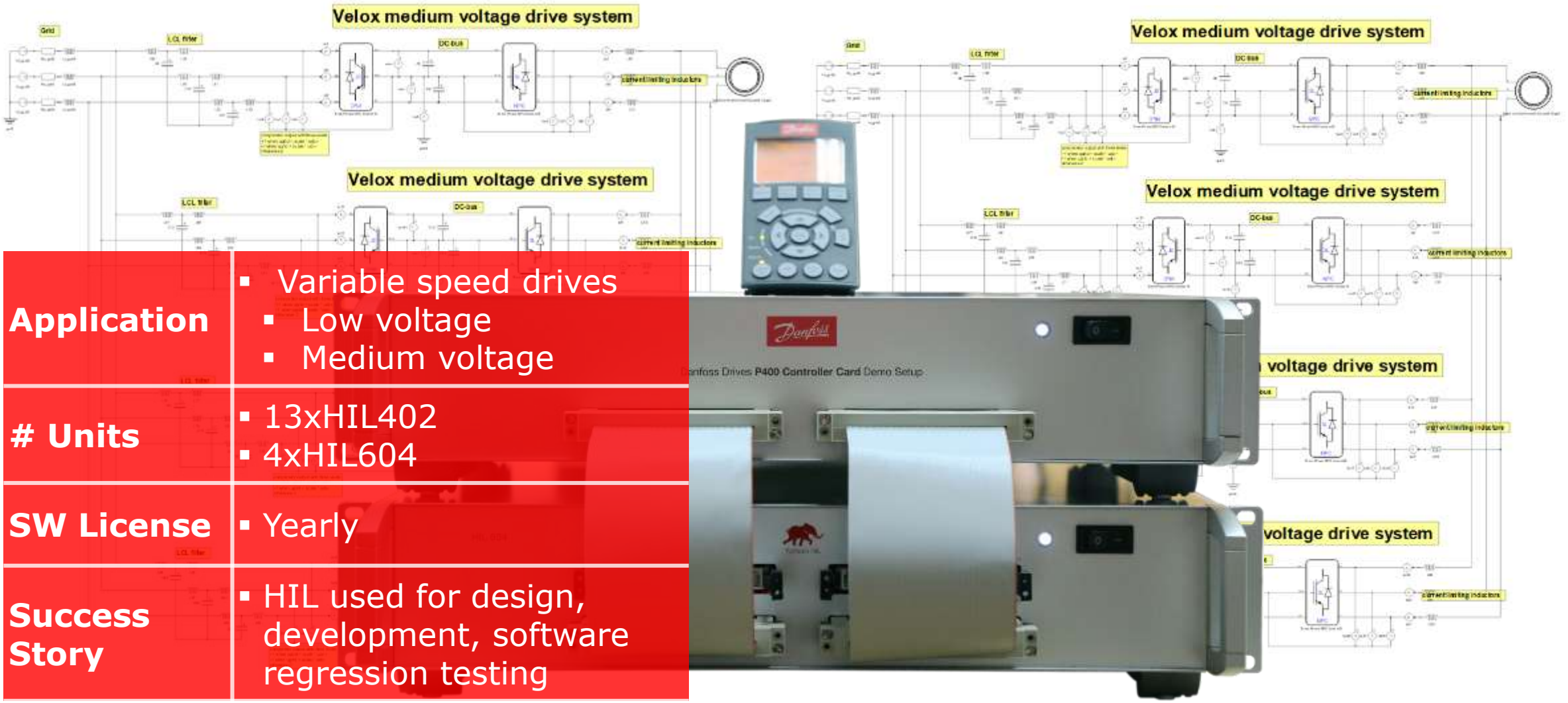




Danfoss: Denmark, Illinois, North Carolina, Finland

Complete software regression testing for LV and MV variable speed drives

Application	▪ Variable speed drives ▪ Low voltage ▪ Medium voltage
# Units	▪ 13xHIL402 ▪ 4xHIL604
SW License	▪ Yearly
Success Story	▪ HIL used for design, development, software regression testing



HIL Tested reduces cost, bugs, man-hours fixing bugs.

The high-fidelity, real-time simulation is valuable for **high performance converters** (e.g., microgrids, shipboard power systems, avionics power systems)

40.6% of projects by teams not using HIL are running behind schedule, while only **25.7%** are late when HIL testing is used.

Quality of software under design and **lowering overall development costs** is significant benefits of HIL Testing.

28 % ↓ **reduced project cost**

11 % ↓ **reduced number of defects**

47 % ↓ **reduced number of man-hours for debug**

Typhoon HIL

Read full VDC Research Report: HIL TESTED
Powerful Performance, Functionality, and Quality from Model-Based Testing

HIL testing is transforming embedded engineering struggles into successes

Start testing software and controller integration **before physical prototypes**, shifting from **serial to parallel** development.

42 %

more lines of code produced by teams using HIL testing compared to projects that without HIL.

Engineering teams using HIL produces average of **42% more lines of code**.

Typhoon HIL

Read full VDC Research Report: HIL TESTED Powerful Performance, Functionality, and Quality from Model-Based Testing

HIL Compatible: Empowering System integrators

HIL based model libraries enable system integrators to guarantee interoperability

Designed for Inverter manufacturers and system integrators

Key qualifying requirements:

- ❑ Developed model in Typhoon HIL
- ❑ Available controller with interface for HIL and the model
- ❑ Implemented controller version management

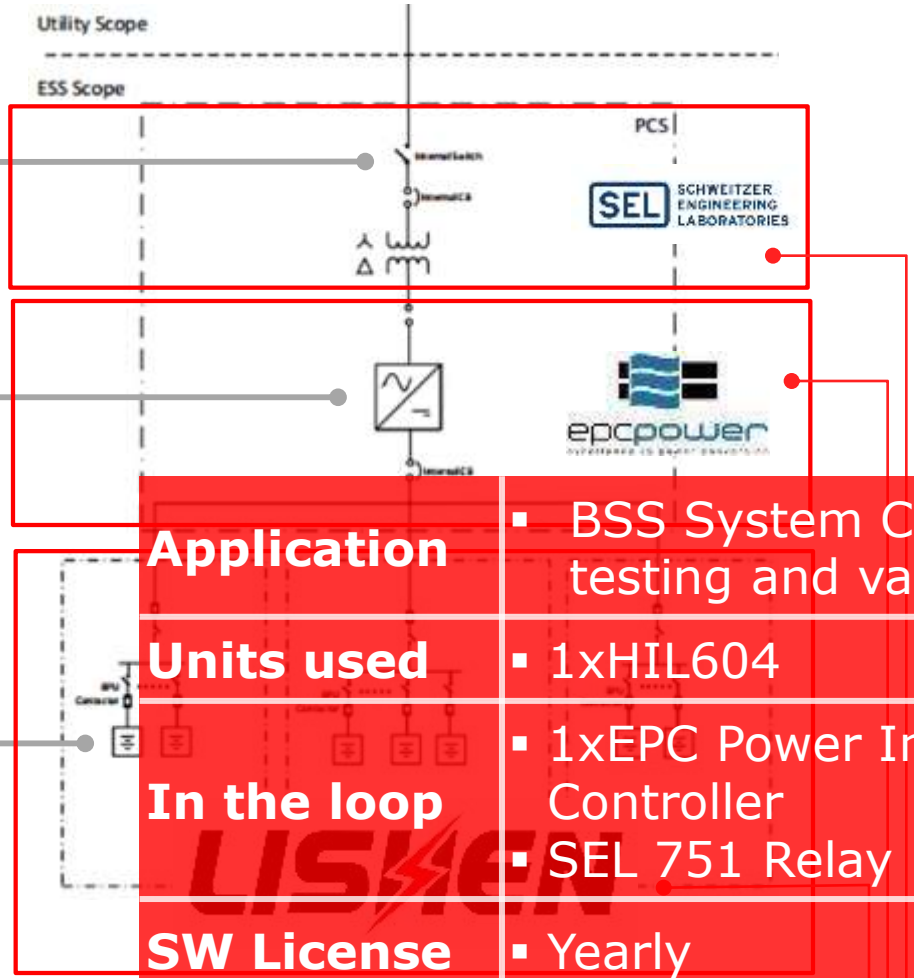
Examples:

- ❑EPC Power, Schneider, ABB, Woodward

Typhoon HIL

HIL Compatible: IHI tests interoperability of components for all projects

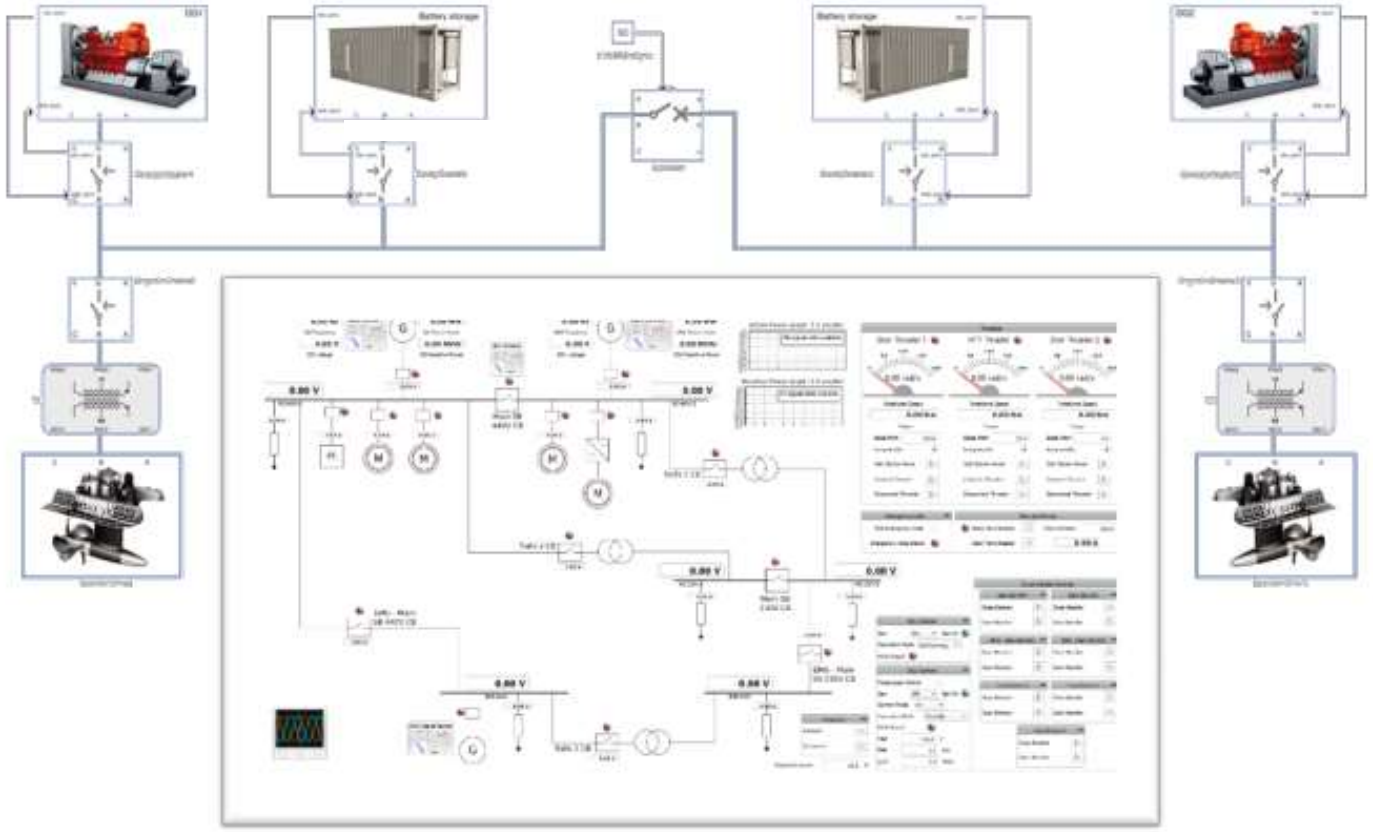
Control software testing, test automation for BSS controllers



Application	▪ BSS System Controller testing and validation
Units used	▪ 1xHIL604
In the loop	▪ 1xEPC Power Inverter Controller ▪ SEL 751 Relay
SW License	▪ Yearly
Success Story	▪ Test automation for all utility storage projects

Typhoon HIL

HIL Compatible: Remontowa Shipboard Power System Digital Twin



Typhoon HIL

HIL Compatible Components

Selected customers.

Technology roadmap and key highlights.

How to better serve our customers.

- Customer driven development: 4 software-firmware releases per year
- Ultra-high fidelity machine models and interfaces to JMAG FEA
  - Nonlinear machine models
  - Spatially varying inductance models
  - Voltage behind reactance (VBR) – all machine types
- Model based design and model based testing integrated in one toolchain
  - PSIM model import into Typhoon HIL software-further improvements
  - Integration with Python (open source)
- Typhoon Test - TyTest
  - More efficient writing of power electronics tests (in Python), Test Automation
- Advanced power electronics modeling
  - Simulation of semiconductor losses expanded
- Library of *HIL Compatible* Models for system integrators
- Industry group: *HIL Tested* quality assurance guidelines and best practices

Typhoon HIL


THANK YOU!
ブースにて「赤ぞうさん」
又はエナジードリンク配布中
（アンケートご回答にて）