

# **DIGITAL TWIN WORKSHOP**

**OMAINTEC**

**JEDDAH, JANUARY 2025**

## **Virtual Commissioning with Digital Twins**

**Other names**

**Andrea Bonetti**

Megger Sweden AB

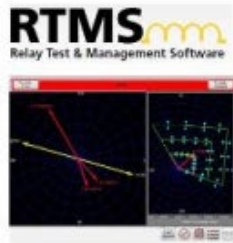
andrea.bonetti@megger.com

# AGENDA

# Virtual Commissioning Tests with Digital Twins

A very important image to enable "Virtual commissioning tests":

**Physical**

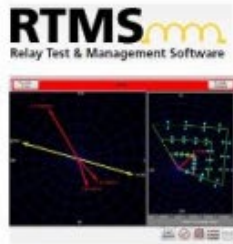
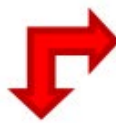


# Virtual Commissioning Tests with Digital Twins

**Physical**



**Digital**

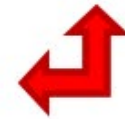


# Virtual Commissioning Tests with Digital Twins

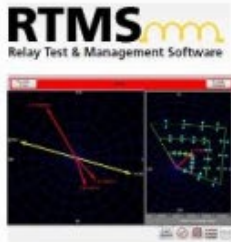
**Physical**



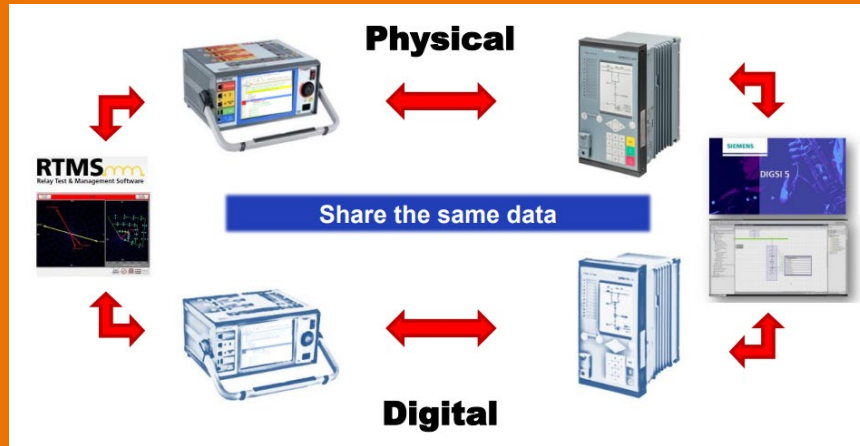
Share the same data



**Digital**



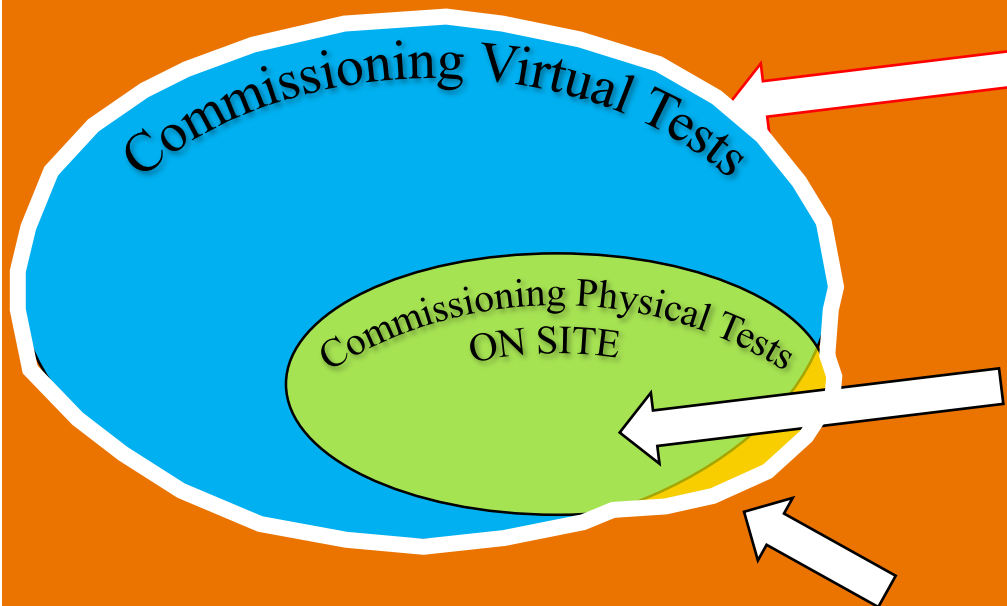
# Virtual Commissioning Tests with Digital Twins



With this concept, the number of potential errors, especially human errors, is minimized, as the transition from virtual tests to physical tests is based on file transfers.

Nothing needs to be redone or modified. A seamless transition from virtual to physical and back to virtu

# Virtual commissioning tests: reduce on-site commissioning time



All these tests were done **ON-SITE** previously! (Almost from scratch).

The number of commissioning tests on-site should definitely be reduced! Faster and less troubleshooting.

Some **NEW** additional tests will still remain on-site, such as connection checks, I/O card functionality, etc.



# HOW DOES IT WORK?

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# Virtual commissioning with Digital Twins / demo

1) Relay-Bob is the relay engineer.

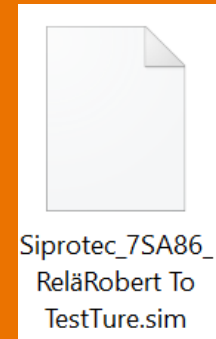
He prepares his settings/configuration file with DIGSI 5 but does not test the relay himself. Once he's done, Relay-Robert saves the Digital Twin file (SIM file) for the relay and sends it to Test-Ture for virtual testing.



TILL Test-Tony...



(SIEMENS FILE ".SIM")



# Virtual commissioning with Digital Twins / demo

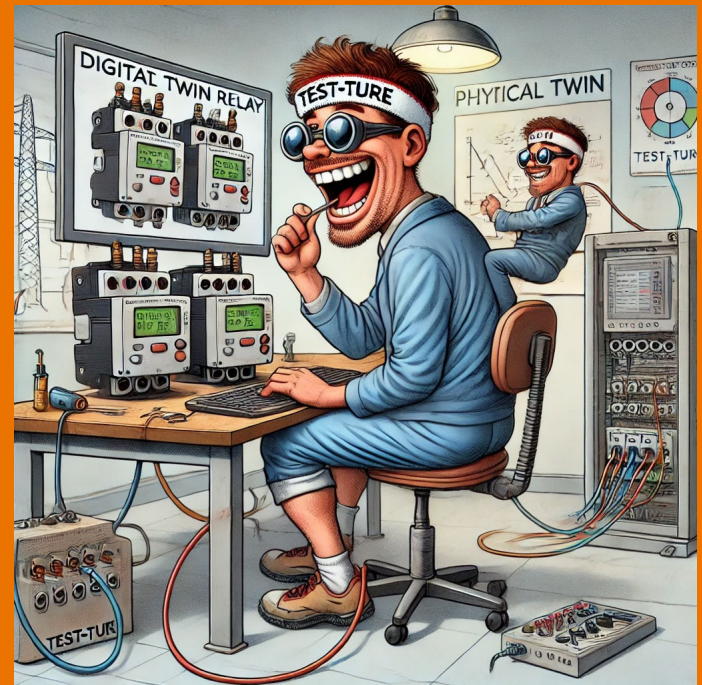
2) Test-Tony will test... virtually.

He creates the digital twin relay in his Siemens SIPROTEC Digital Twin environment.

FROM Relay-Bob

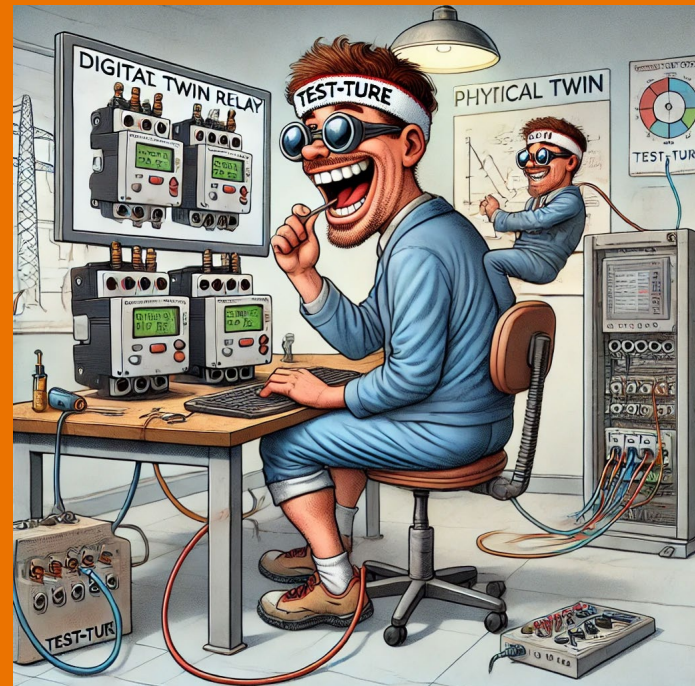
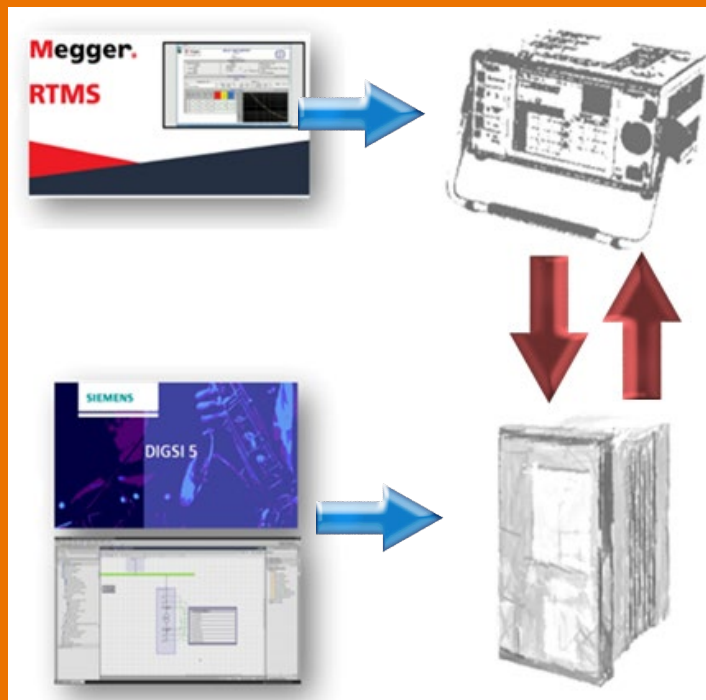


(SIEMENS FILE ".SIM")



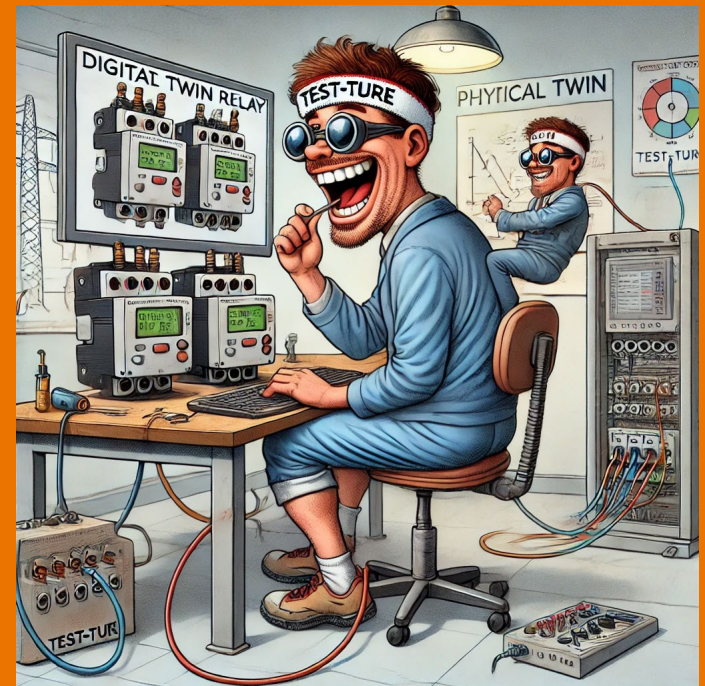
# Virtual commissioning with Digital Twins / demo

3) Test-Tony tests the protection relay using the digital twin testing equipment, "connected" to the digital twin relay.



# Virtual commissioning with Digital Twins / demo

4) **Test-Tony** can change or not change certain parameters in the relay, depending on the test results. He can use the relay's front HMI for simple adjustments or use virtual DIGSI for more complex changes. **Test-Tony** can agree on these changes with **Relay-Bob**.



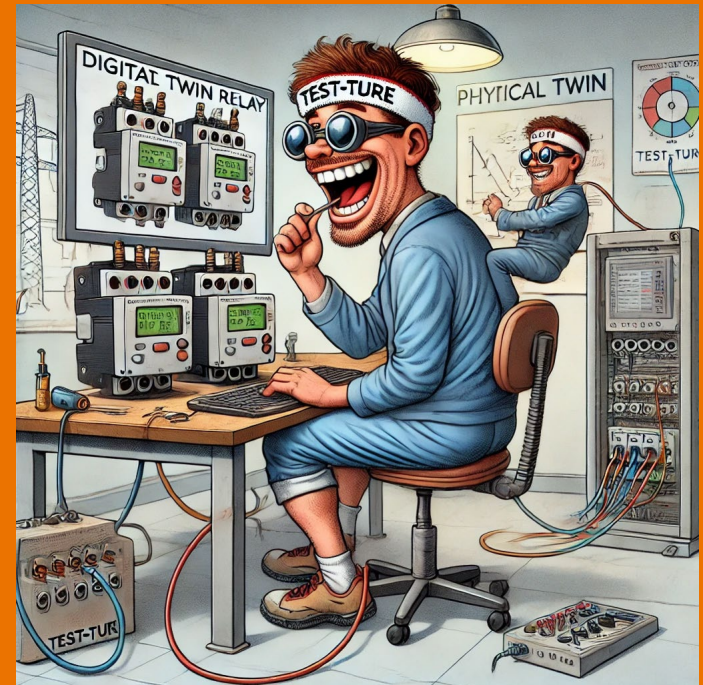
# Virtual commissioning with Digital Twins / demo

5) Test-Tony exports the relay information from the digital twin relay and sends the DIGSI file (.TCF) to Relay-Bob, so that he can provide it to the commissioning engineer to download it into the physical relay (sharing the same data)

To Relay-Bob  
To Commissioning Engineer



**CORRECTPROJECT.TCF**  
**(SIEMENS DIGSI FILE PROJECT)**



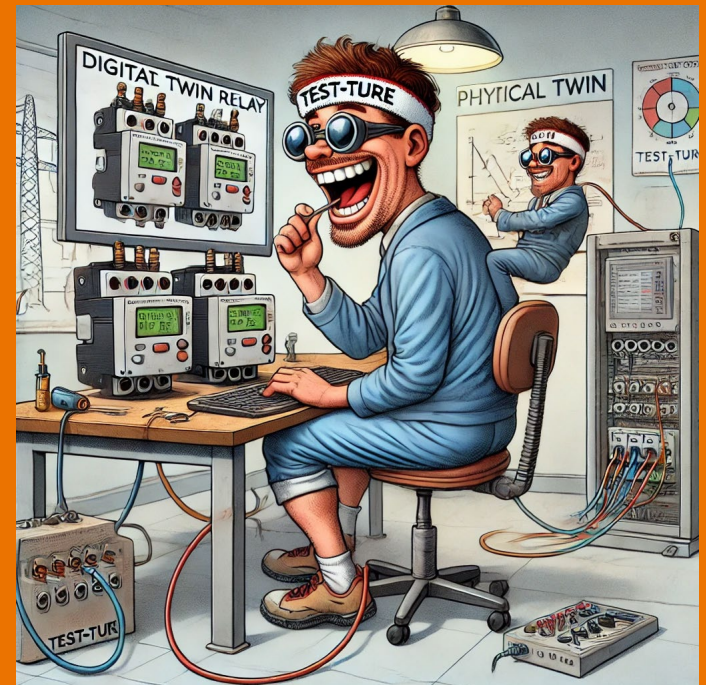
# Virtual commissioning with Digital Twins / demo

6) Test-Tony saves the test plan (test file) for the digital twin test equipment, so that it can be (re)used in the station with physical test equipment from the commissioning engineer to ensure that everything is still Ok (sharing the same data).

To Relay-Bob  
To Commissioning Engineer

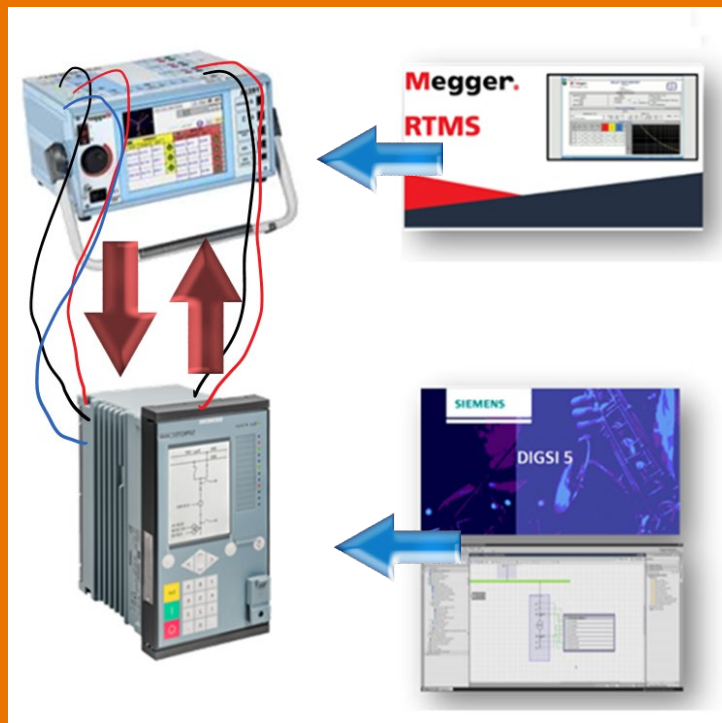


TESTFILE.PdbXml  
(MEGGER POWERDB TEST FILE)



# Virtual commissioning with Digital Twins / demo

7) The commissioning engineer will then download the DIGSI file into the physical relay and use the test plan files to test the physical relay with the physical test set in the substation.



TESTFILE.PdbXml



CORRECTPROJECT.TCF

# Virtual commissioning with Digital Twins / demo

## **Some important comments.**

The example given is just ONE of the many possible workflows. A few other methods we have experience with are the followings:

- a) **Relay-Bob and Test-Tony could be the same person from the engineering company.**The DIGSI relay file and FREJA/SMRT test file from the virtual tests are then handed over to the commissioning engineer at the substation.
- b) **Test-Tony could be at the substation and need assistance. Relay-Bob is a specialist in the company and helps out..**

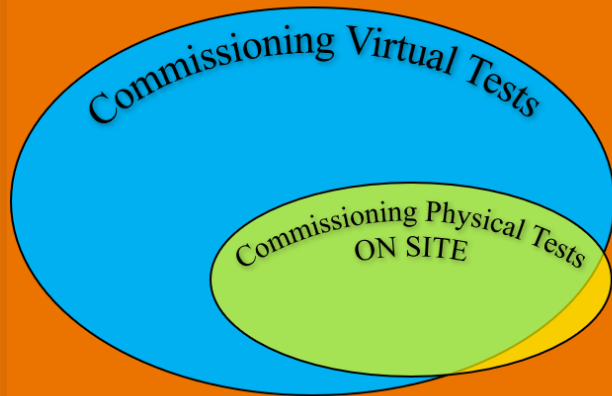
**When working in this way, only a few files are transferred.**There is NO need to create a new project in DIGSI for the "physical relay." **Simply use the same file that was created in the virtual environment.**

**There is no need to recreate a new test file for the FREJA/SMRT "physical test equipment." Simply use the same file.**



# Virtual commissioning with Digital Twins / demo

Of course, errors can still occur, but this helps to minimize them.



Some new tests may still be needed at the substation to verify certain hardware functionality, connections, etc.

# AND NOW... THE DEMO

## VIRTUAL RELAY TESTING WITH DIGITAL TWINS

VIRTUAL  
TESTING  
ACTION

PROTECTION  
RELAY

DIGITAL  
TWINNING  
IN ACTION





# References

## FREJA and SMRT Digital Twin high fidelity simulator

High fidelity software simulator for use with the FREJA and SMRT relay testers

<https://www.megger.com/en-us/products/freja-and-smrt-digital-twin-high-fidelity-simulator>

## Realising the potential of digital twin technology in power system protection

November 2023

Conference: MATPOST 2023 · At: Lyon, France

 Andrea Bonetti ·  Ronald Kubelec ·  Mehdi Zeyeni · [Show all 5 authors](#) ·  Niclas Wetterstrand

[https://www.researchgate.net/publication/376002111\\_Realising\\_the\\_potential\\_of\\_digital\\_twin\\_technology\\_in\\_power\\_system\\_protection](https://www.researchgate.net/publication/376002111_Realising_the_potential_of_digital_twin_technology_in_power_system_protection)

## Digital Twins: Revolutionizing Testing of Protection Relays (Transformer Technology Magazine)

Article  Full-text available  April 2022

 Andrea Bonetti ·  Niclas Wetterstrand



[https://www.researchgate.net/publication/360973780\\_Digital\\_Twins\\_Revolutionizing\\_Testing\\_of\\_Protection\\_Relays\\_Transformer\\_Technology\\_Magazine](https://www.researchgate.net/publication/360973780_Digital_Twins_Revolutionizing_Testing_of_Protection_Relays_Transformer_Technology_Magazine)

# References

## Virtual Testing of Protection Systems using Digital Twin Technology

Publisher: IEEE

Cite This

PDF

Sughosh Kuber ; Mohit Sharma ; Andrea Bonetti ; Cédric Harisporu ; Amir Soroush [All Authors](#)



<https://ieeexplore.ieee.org/document/9776572>

## Functional digital twins of relay protection and relay test equipment enabling benefits in training and remote support

Conference Paper

Full-text available

March 2022 · DPSP 2022

 Abdul Raqeeb ·  Andrea Bonetti ·  Andreas Carlsson · [...] ·  Niclas Wetterstrand







[https://www.researchgate.net/publication/359159893\\_FUNCTIONAL\\_DIGITAL\\_TWINS\\_OF\\_RELAY\\_PROTECTION\\_AND\\_RELAY\\_TEST\\_EQUIPMENT\\_ENABLING\\_BENEFITS\\_IN\\_TRAINING\\_AND\\_REMOTE\\_SUPPORT](https://www.researchgate.net/publication/359159893_FUNCTIONAL_DIGITAL_TWINS_OF_RELAY_PROTECTION_AND_RELAY_TEST_EQUIPMENT_ENABLING_BENEFITS_IN_TRAINING_AND_REMOTE_SUPPORT)

## Digital twins and the smart grid (e-tech Magazine, IEC)

Article

Full-text available

March 2022

 Catherine Bischofberger ·  Andrea Bonetti ·  Laurent Guise ·  François Coallier



[https://www.researchgate.net/publication/361004727\\_Digital\\_twins\\_and\\_the\\_smart\\_grid\\_e-tech\\_Magazine\\_IEC](https://www.researchgate.net/publication/361004727_Digital_twins_and_the_smart_grid_e-tech_Magazine_IEC)

# References

## Digital twin technology for virtual testing of power system relay protection





Publisher: IEEE [Cite This](#) [PDF](#)

Andrea Bonetti ; Cédric Harispuru ; Marius Pitzer ; Mark Pustejovsky ; Niclas Wetterstrand ; Simone Kachelrieß [All Authors](#)

<https://ieeexplore.ieee.org/document/9587869>

## Special Electrical Tester 003-2021 - Virtual testing of protection relays is real!

[Article](#) [Full-text available](#) July 2021

 Andrea Bonetti ·  Cédric Harispuru ·  Niclas Wetterstrand ·  Marius Pitzer



[https://www.researchgate.net/publication/356411989\\_Special\\_Electrical\\_Tester\\_003-2021\\_-](https://www.researchgate.net/publication/356411989_Special_Electrical_Tester_003-2021_-)

[Virtual testing of protection relays is real](#)

## Expert Workshop - Digital Twins for Energy Automation

February 8, 2022

<https://www.siemens.com/global/en/products/energy/energy-automation-and-smart-grid/webinars/protection-relay-siprotec-digitaltwin-2202.html>