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Use of RTDS in executing HVDC & FACTS Projects

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- Siemens Energy

ATC RTDS APPLICATIONS & TECHNOLOGY CONFERENCE

APPLICATIONS & TECHNOLOGY CONFERENCE 2025

CHICAGO, ILLINOIS, U.S.A.

RTDS Technologies AMETEK

Siemens Energy

As an integrated energy technology company

we support our customers along the energy value chain

100,000 dedicated employees

in 90 countries

Low- or zero-emission power generation

- Gas Services
- Siemens Gamesa Renewable Energy

Transport and storage of energy

- Grid Technologies

Reducing GHG emissions and energy consumption in industrial processes

- Transformation of Industry


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HISTORY

LCC references

No.	Commissioning	Project name	Country	Power rating
01	1975	Cahora Bassa (1975/1998)	South Africa – Mozambique	1,920 MW
02	1981	Acaray	Paraguay	55 MW
03	1983	Dürnrohr	Austria	550 MW
04	1984	Poste Châteauguay	Canada	2 x 500 MW
05	1987	Virginia Smith	USA	
06	1989	Gezhouba – Nanqiao	Chin	
07	1993	Etzenricht	Gerr	
08	1993	Wien-Suedost	Aus	
09	1995	Sylmar East Valve Reconstruction	US	
10	1995	Welsh 1995/2017	USA	
11	1997	Celilo 1997/2004	USA	
12	2000	Tianshengqiao – Guangzhou	China	
13	2001	Moyle Interconnector	United King	
14	2001	Thailand-Malaysia	Thailand – Mal	
15	2003	East-South Interconnector II and Upgrade	India	
16	2004	Guizhou – Guangdong	China	
17	2005	Lamar	USA	
18	2006	Basslink	Australia	500 MW
19	2007	Neptune RTS	USA	660 MW
20	2008	Guizhou – Guangdong II	China	3,000 MW
21	2009	Yunnan – Guangdong	China	5,000 MW
22	2010	Xiangjiaba – Shanghai	China	6,400 MW
23	2010	Ballia – Bhiwadi	India	2,500 MW

No.	Commissioning	Project name		
24	2010	Storebælt		
25	2011			
26				
				1,000
			Canada	1,000 / 2 2,000
		Meramara BtB Block 1/2 (2013/2018)	Bangladesh	2 x 500
39	2018	HVDC Brazil	Brazil	4,000
40	2021	Vindhyachal BtB Block - 1 & 2 refurbishment	India	2 x 250
41	2022	Western HVDC Link	United Kingdom	2,200
42	2022	Moyle C&P Refurbishment	United Kingdom	2 x 250
43	2023*	Ethiopia – Kenya HVDC Interconnector	Ethiopia - Kenya	2,000

* approximately

We build upon our long-standing experience and numerous successful projects:

More than 70 HVDC projects realized worldwide...

...more than 100 FACTS

VSC references

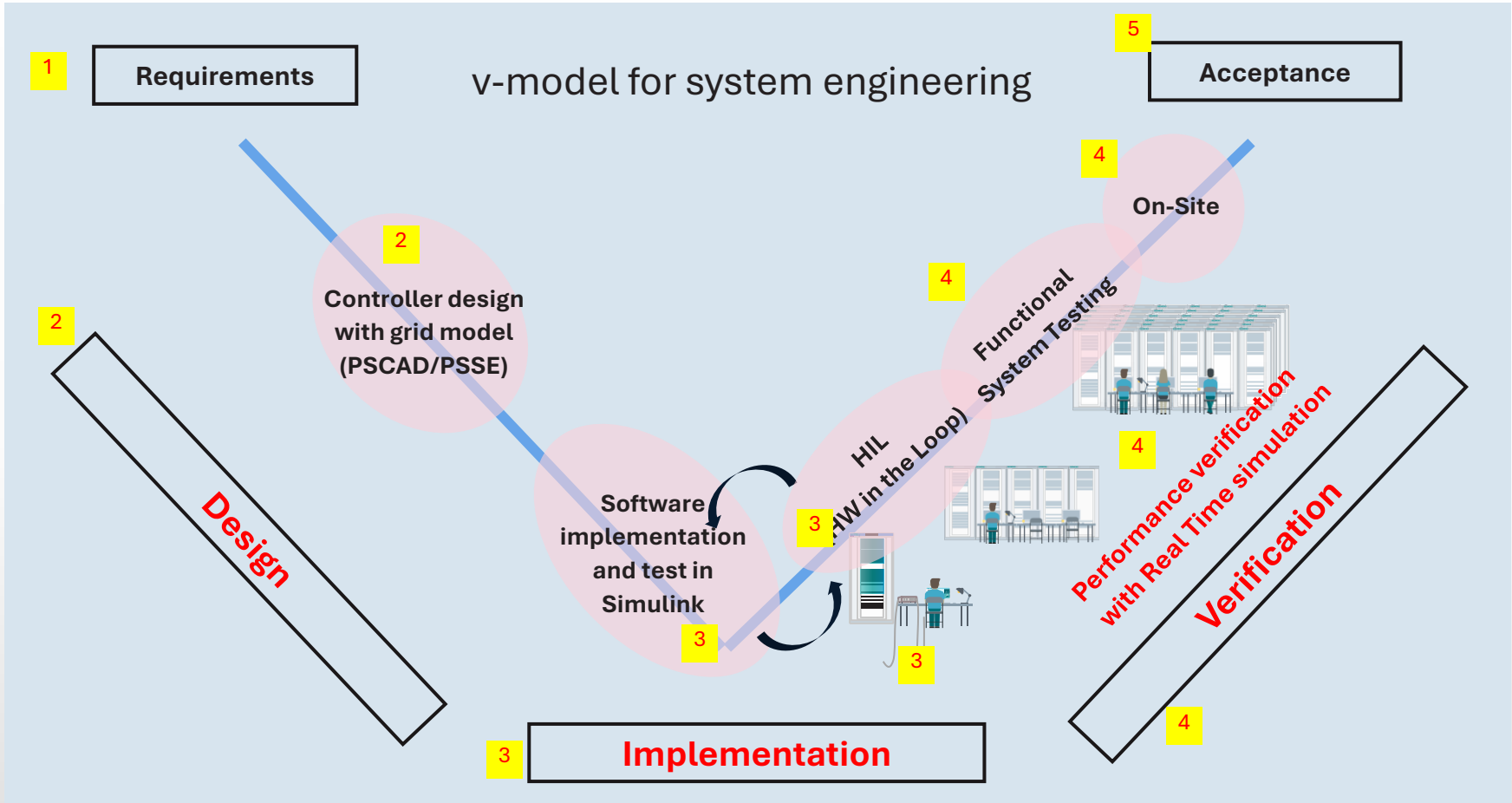
No	Commissioning	Project name	Country	Power rating
01	2010	Trans Bay Cable	USA	400MW
02	2015	BorWin2	Germany	800 MW
03	2015	HelWin1	Germany	576MW
04	2015	HelWin2	Germany	690MW
	2015	Interconnection Baixas - Santa Llogaia for INELFE	France· Spain	2 x 1,000 MW
	2015	SylWin1	Germany	864MW
	2019	BorWin3	Germany	900MW
	2019	Cobra Cable	Denmark -Netherlands	700MW
	2019	Nemo link	UK -Belgium	1.000 MW
	2020	ALEGrO	Belgium .Germany	1.000 MW
	021	Pugalur - North Thrissur (PK2000)	India	2 x 1,000 MW
	022	elecLink	UK -France	1,000 MW
	022	Johan Sverdrup Phase 2	Nonway	200MW
	2023	DolWin6	Germany	900MW
14	2025	Viking link	UK -Denmark	1,400MW
15	2025	Attica·Crete	Greece	1,000 MW
18	2025	Greenlink	UK -Ireland	500 MW
19	2025	BorWin5	Germany	900MW
20	2025	Sunrise Wind	USA	1,086 MW
21	2026	SuedOstlink	Germany	2,000MW
17	2027	ULTRANET	Germany	2,000MW
22	2027	ULTRANET A-Nord	Germany	2.000MW
23	2028	Suedlink DC3	Germany	2,000MW
24	2029	LS Power	USA	1000MW
25	2030	Tennet	Germany	2,000MW
26	2030	Amprion	Germany	2,000MW

Software Development Lifecycle

6 Ensures that Customer requirements are propagated to individual subsystems

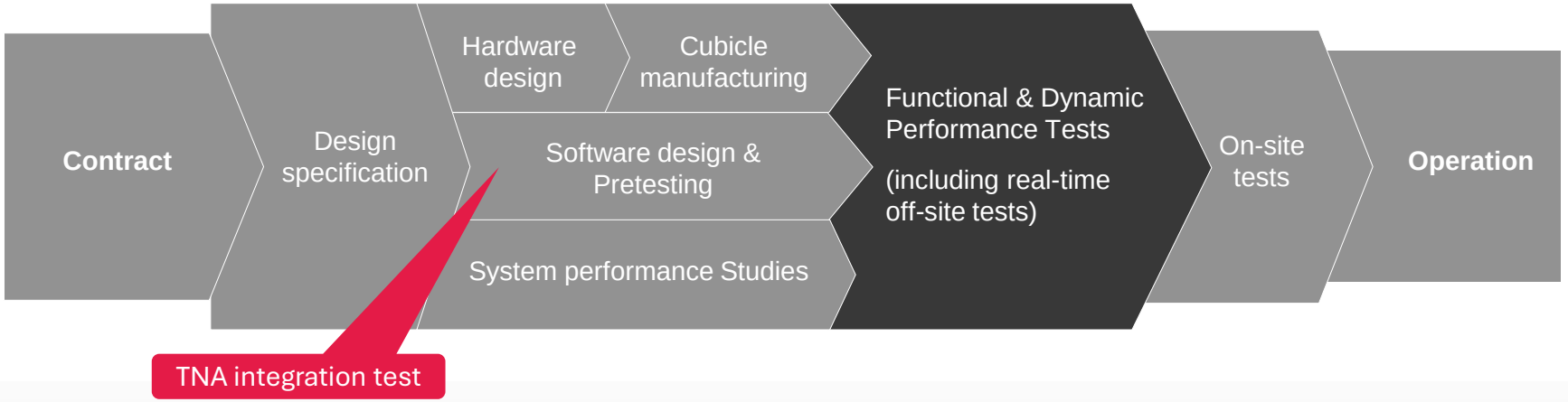
7 Increase robustness and quality of individual subsystems

8 Reduce risks of new software architecture and control hardware changes



Validate of SW and/with HW at the earliest possible stage

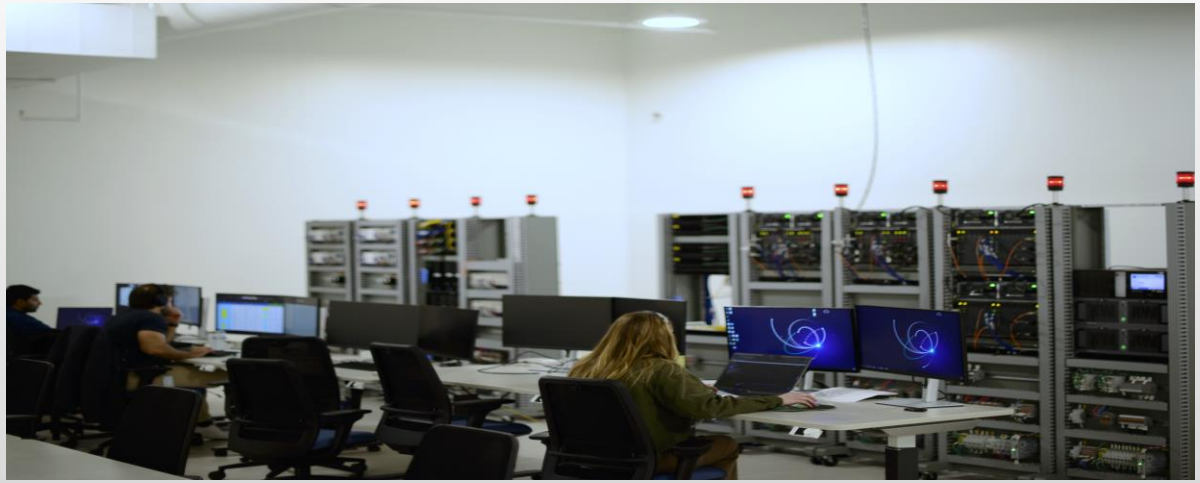
Project Process HVDC



Benefits of testing the control and protection system at the HVDC Test Center:

- Experts available at the HVDC test center.
- Shorter commissioning times at site
- Risk of malfunction minimized
- Selected cases are benchmark for on-site tests

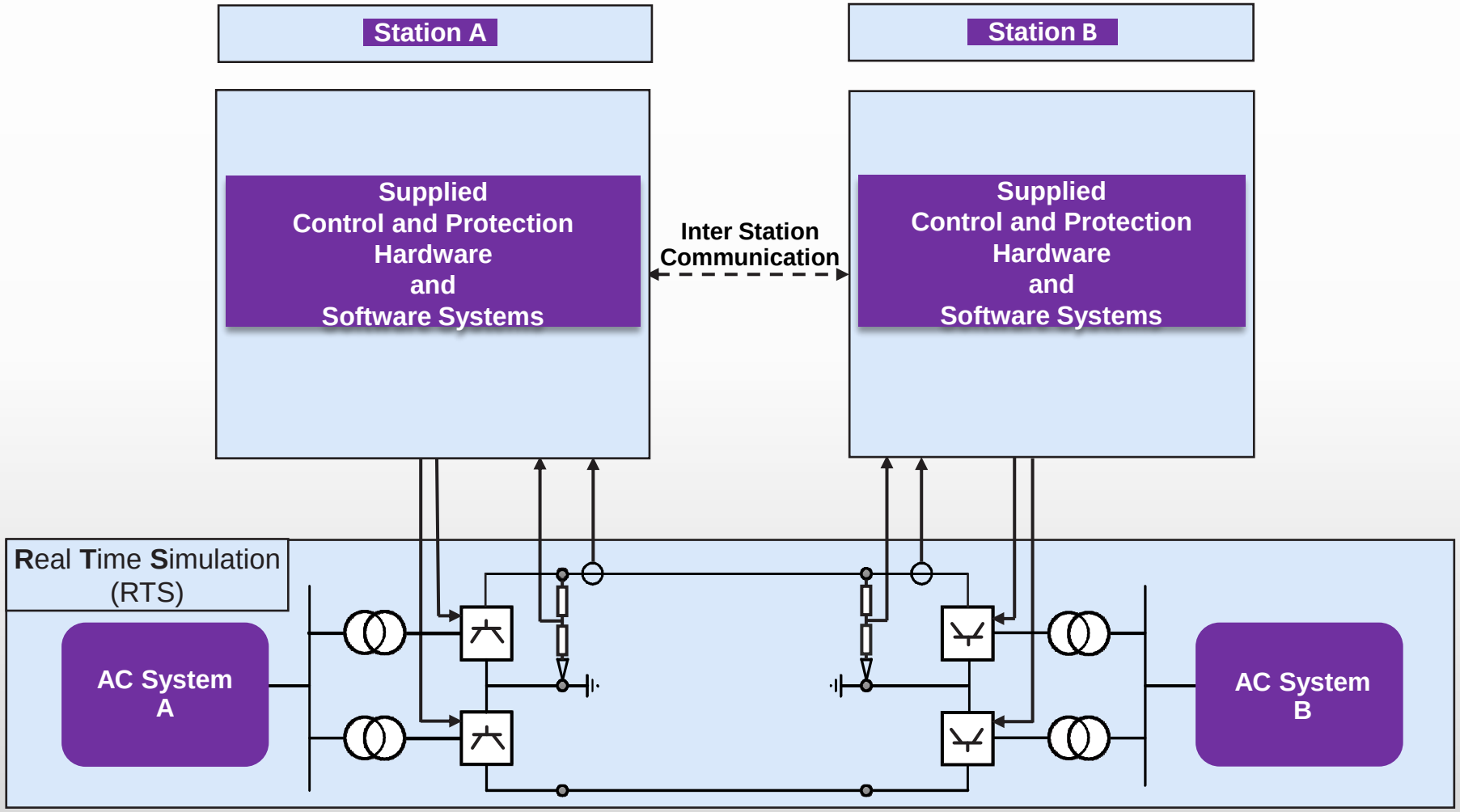
HVDC Test Center, Raleigh,USA

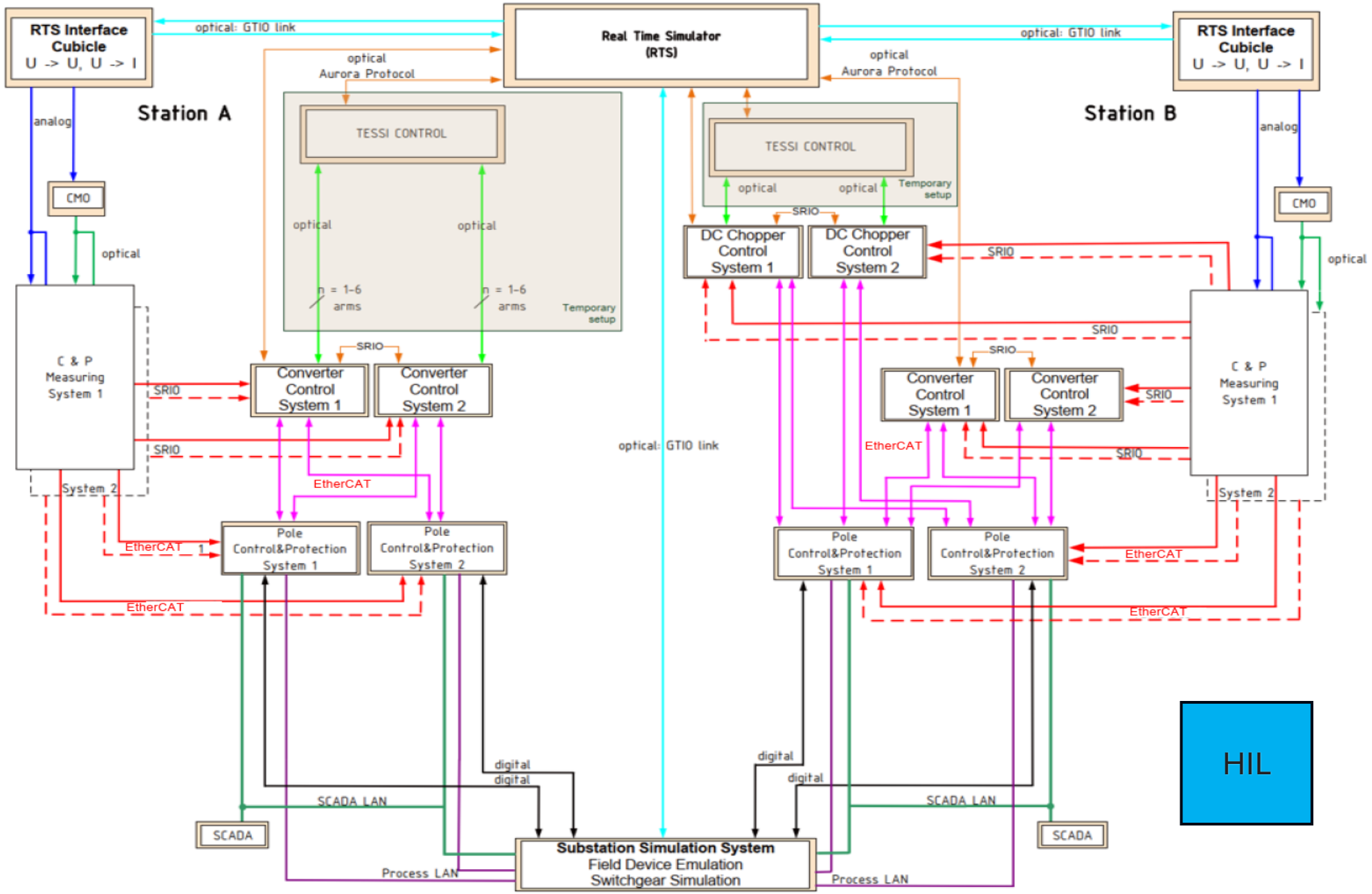


Simulation Systems – main responsibilities of RTDS Team

- Setup and Operation of in-house Real Time Simulation Systems
- Software Engineering for Real Time Simulation
- Engineering and Testing Support during Factory Acceptance:
  Functional Performance Test (FPT) &
  Dynamic Performance Test (DPT)
- Replica for HVDC / FACTS Applications
- Validation of RTDS Models against RMS or Offline EMT
  (Windparks, STATCOM, HVDC, AC Equivalent, Matlab Simulink, PSCAD)

HVDC basic Setup (HIL)



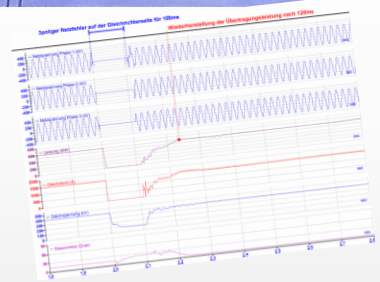


RTDS to…

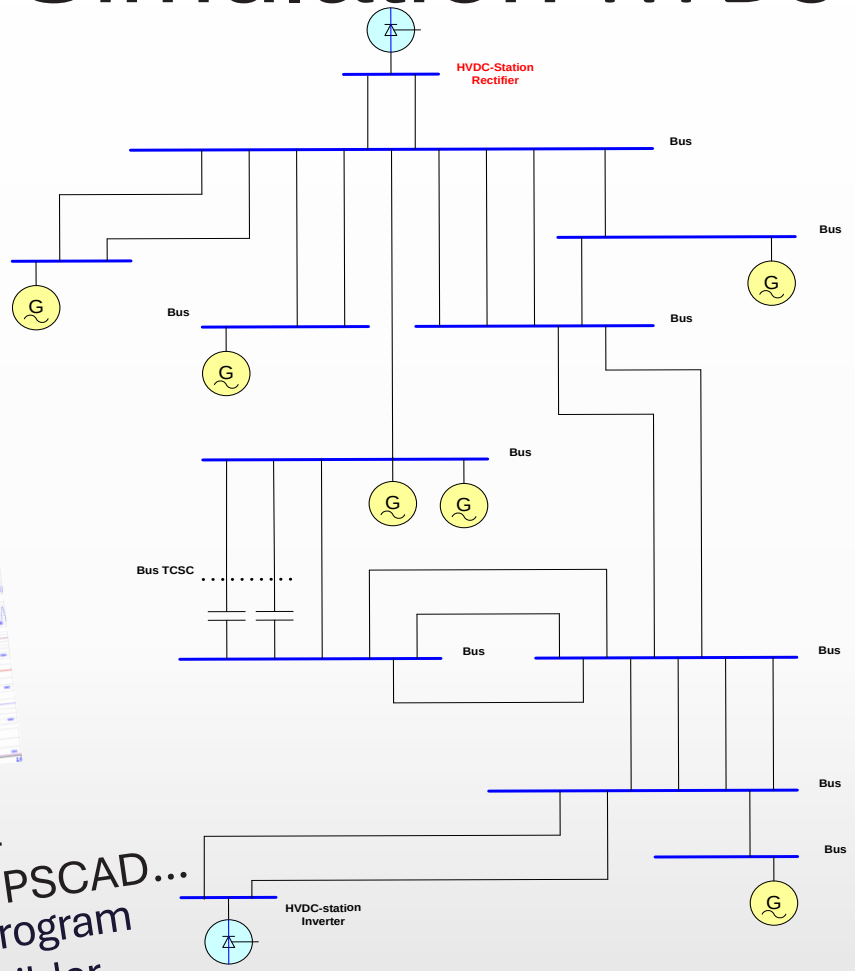
Interfacing Devices :

Knick Amp.
PA2005 Amp.
Omicron
TESSI
MMS SIM
CMO
7KG Transd.

Real-Time Simulation RTDS modelling



Conversion Tool
MATLAB, PSSE, PSCAD…
RTDS loadflow program
Component Builder



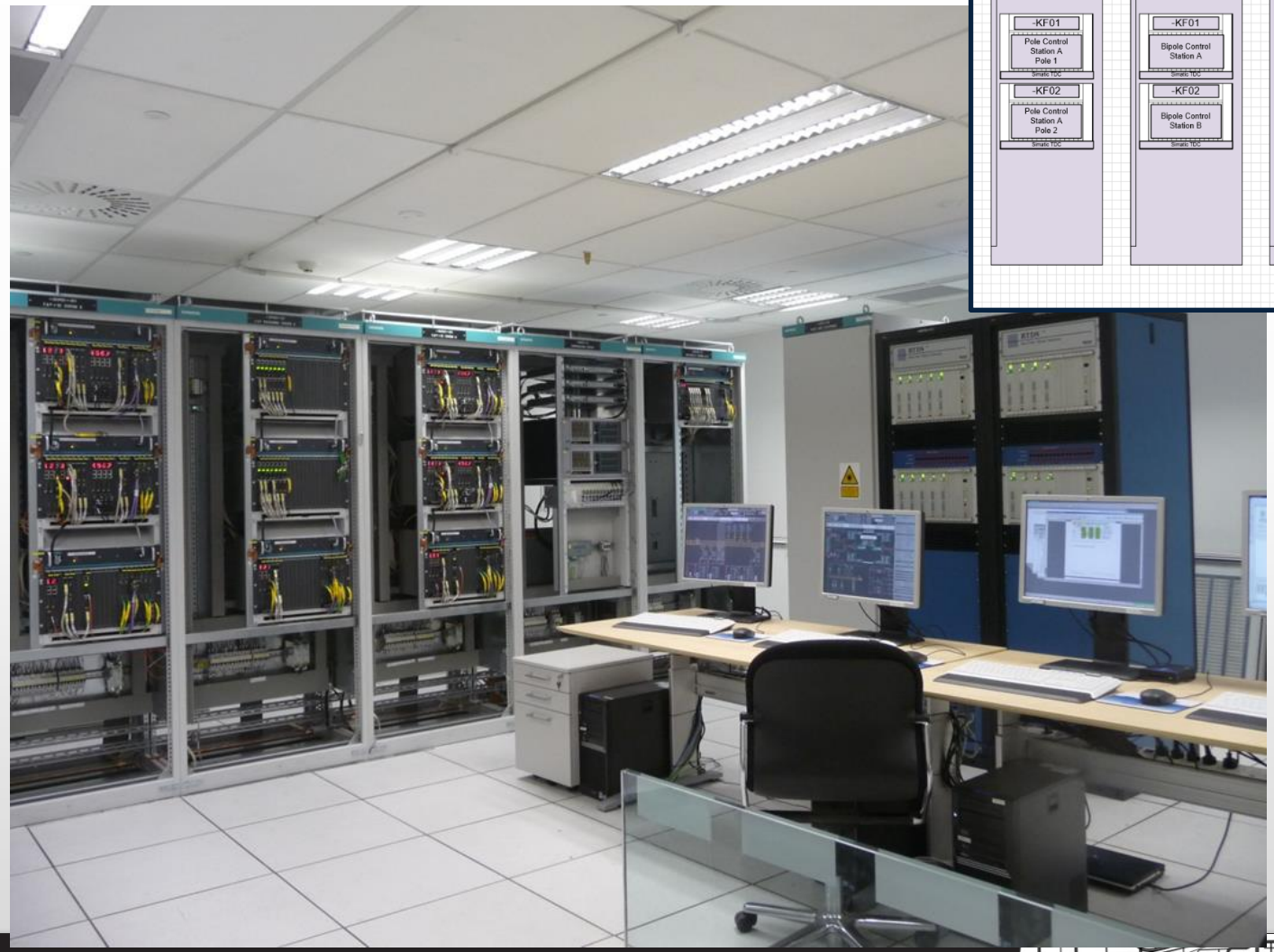
Functional & Dynamic Performance Test using RTS

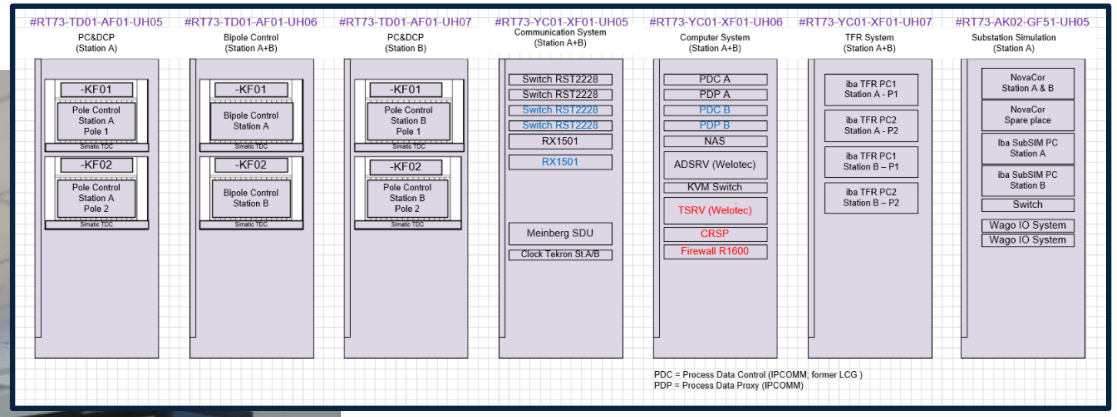
- **Factory System Test specification defines all tests** and targets for the required performance
- Tests under **normal system conditions** including redundancy performance
- Tests under **extreme AC and DC system conditions** -> dynamic performance
- Off-site testing is the **final quality gate** for the C&P systems before delivery to the customer

Real Time Simulation Rack incl. Interface Rack

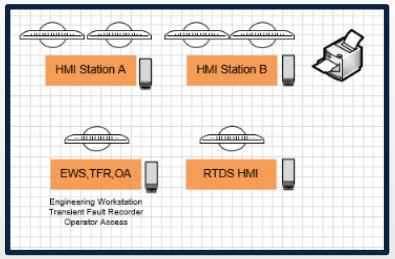
Supplied Control & Protection cubicles

Control Trainings Simulator (CTS) – Study Replica /TNA





Symmetrical Monopole VSC



Thank You