TRANSFORMERS MAGAZINE'S
INDUSTRY NAVIGATOR

SUSTAINABILITY AND DIGITALIZATION

Transforming Transformer Test

Testing solutions today for the energy grid of tomorrow

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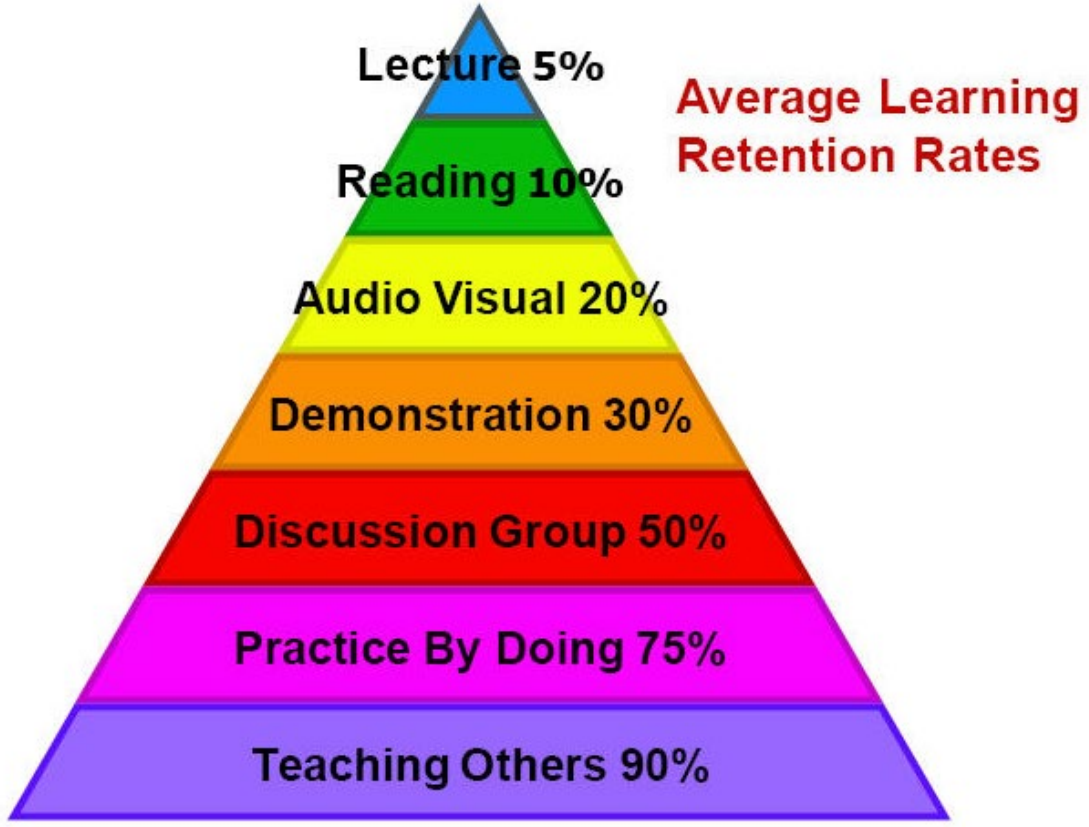
June 7, 2023

HAEFELY

K.I.S.S. Presentation

Keep it Simple & Straightforward

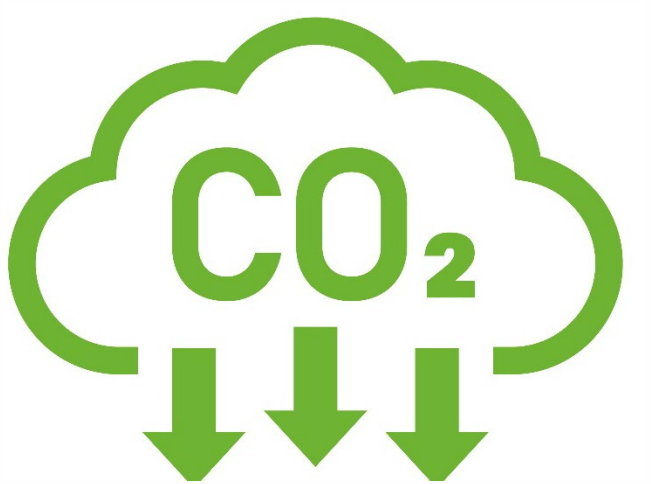
Keep this in Mind

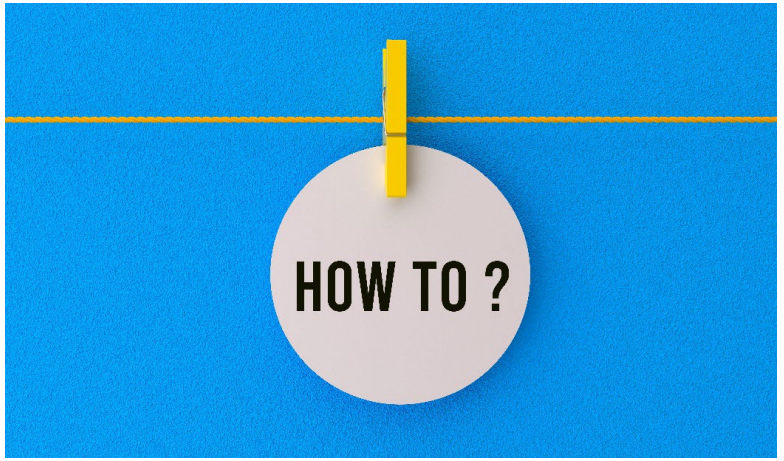


Source: National Training Laboratories, Bethel, Maine

Why is testing solutions for the energy grid of tomorrow crucial?

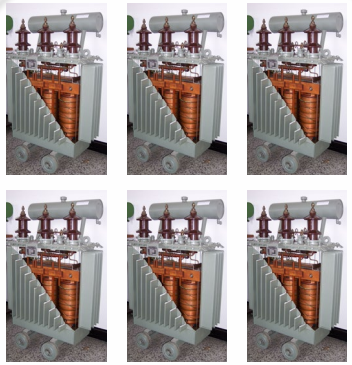
Sustainability: Reduce CO_2 Emissions





Green Power Generation

600
transformers

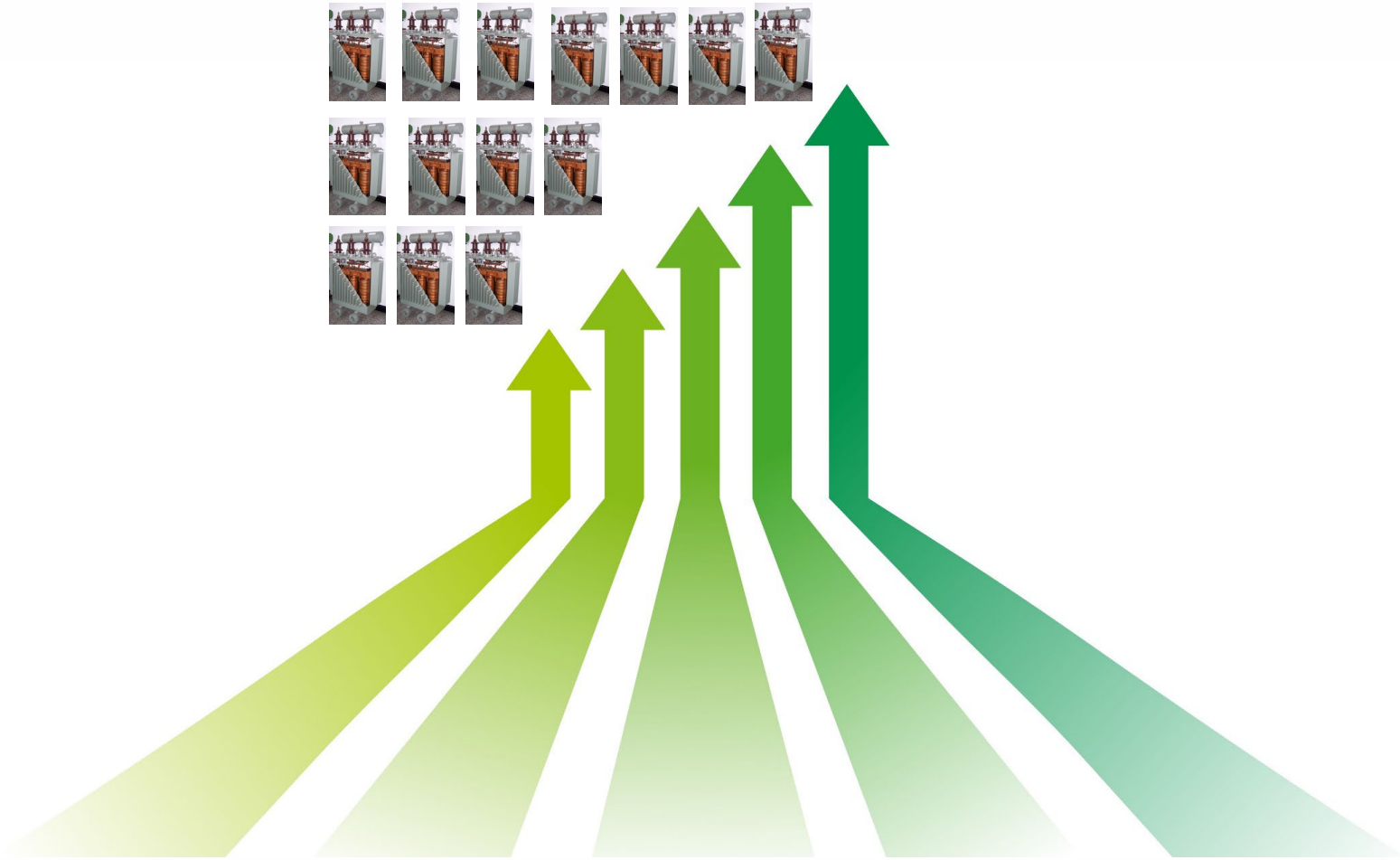


200
transformers

For 1 GW power generation

Transformers are in more mission-critical applications and in more inaccessible places

Green Power Generation



Transformers are in more mission-critical applications and in more inaccessible places

For 1 GW power generation:

- more transformers to produce
- typically more tests to perform

Transformer losses

- The annual worldwide Distribution Transformers market in 2022 is worth $18B
- Number of transformers and overall power can be estimated based on the above number, assigning an average price for a distribution transformer as 20.000 USD, and average power as 500 kV

Transformers manufactured / year	Total power manufactured / year
905.000 TRF / year	347.500 MVA / year

- Assuming an efficiency of 98%, **the yearly losses for manufactured transformers is 60.8 TWh**, which is 26% of Switzerland's yearly energy consumption

Energy Saving, e.g., EcoDesign Directive EU

European Commission

25.10.2019 EN Official Journal of the European Union L 272/107

COMMISSION REGULATION (EU) 2019/1783

of 1 October 2019

amending Regulation (EU) No 548/2014 on implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to small, medium and large power transformers

(Text with EEA relevance)

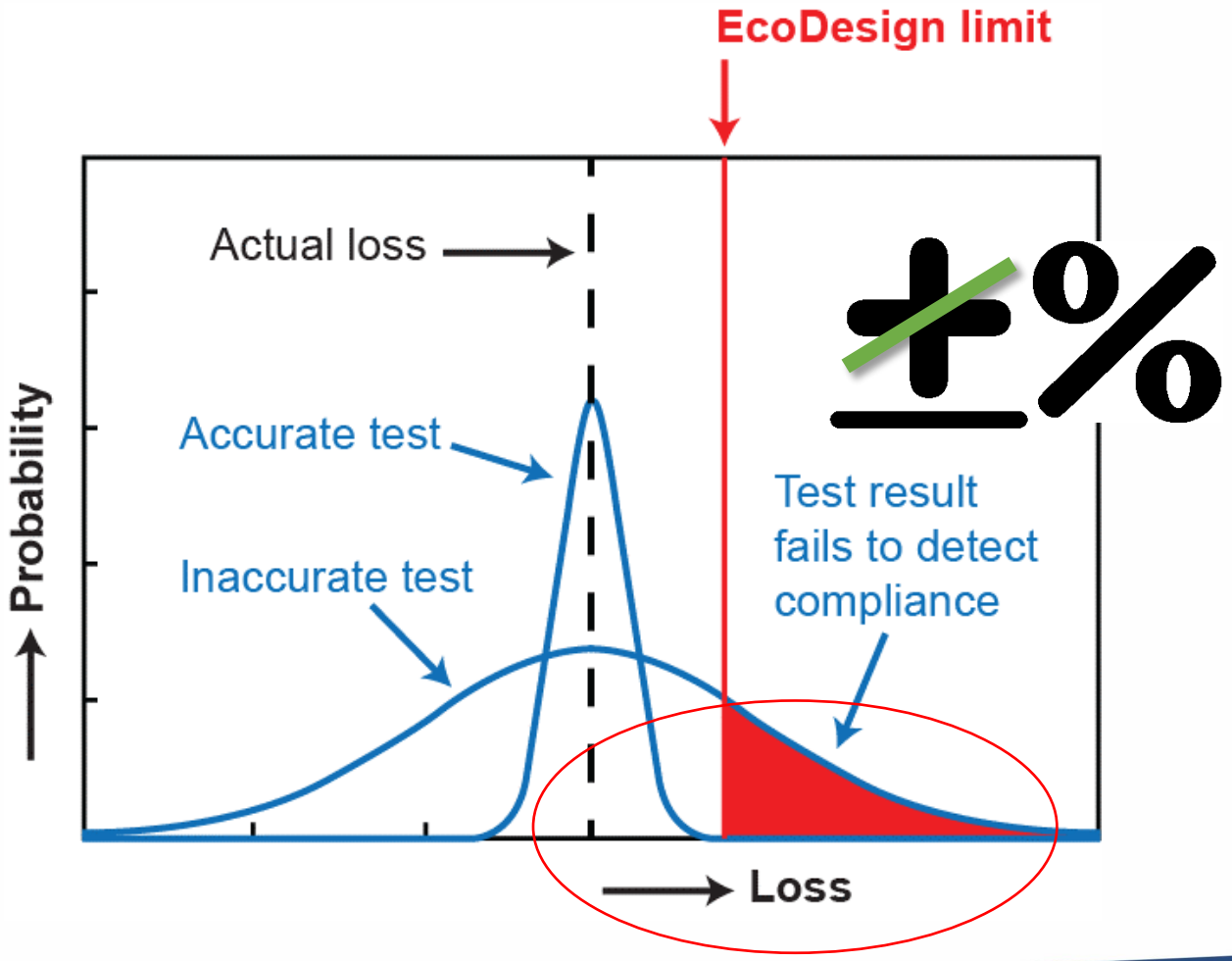
Minimum Peak Efficiency Index requirements for dry-type large power transformers with Um ≤ 36kV

Rated Power (MVA)	Tier 1 (1.7.2015)	Tier 2 (1.7.2021)
	Minimum Peak Efficiency Index (%)	
3,15 < Sr ≤ 4	99,348	99,382
5	99,354	99,387
6,3	99,356	99,389
8	99,357	99,390
≥ 10	99,357	99,390

01.07.2021

-10% No Load Loss compared to 2015

Ecodesign Regulation



EcoDesign Impact on 3 Ph Oil filled Distribution Transformers

- Loss levels to be applied (reference of MV≤ 24 kV and LV ≤ 1.1 kV

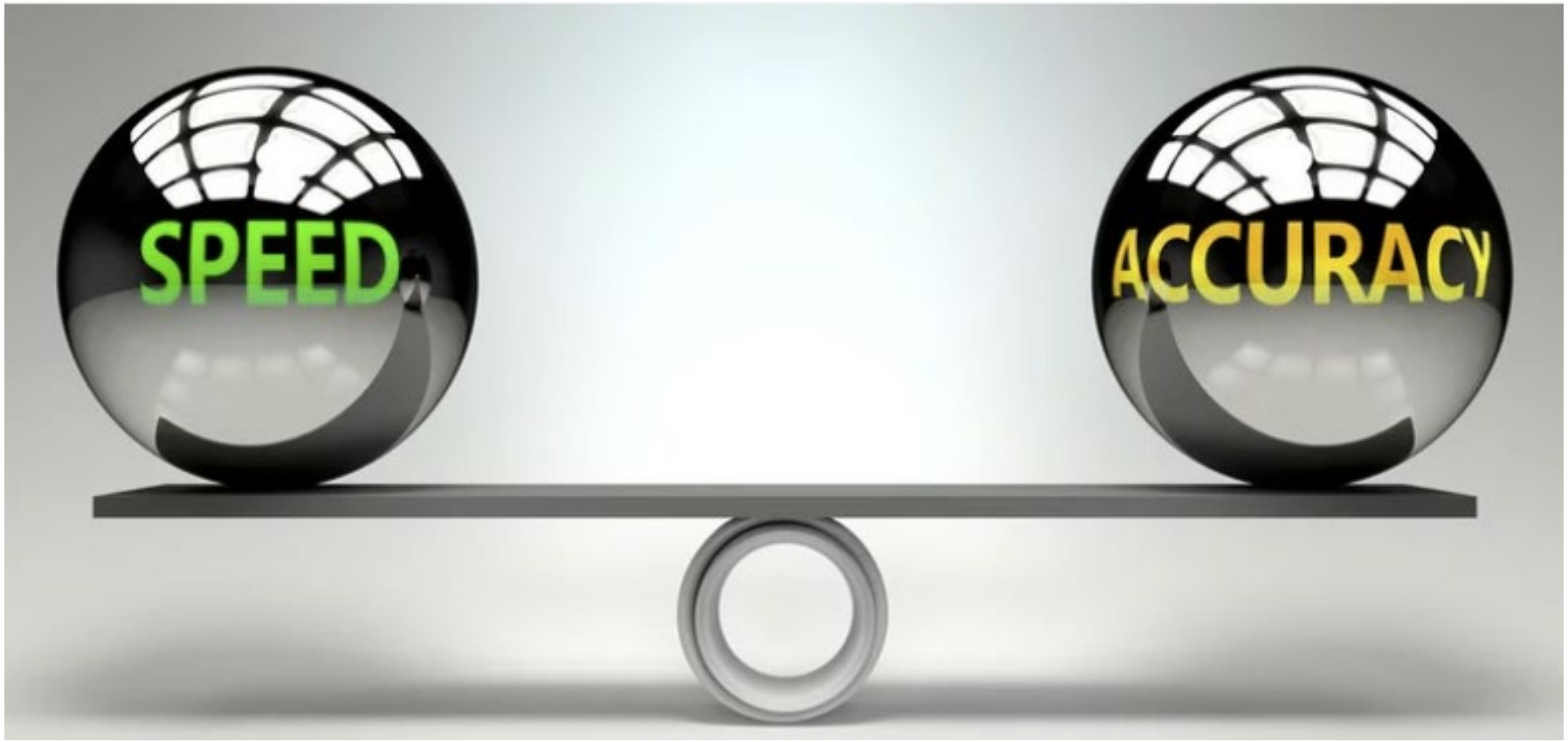
Rated power (kVA)	Tier 1: From 1st July 2015		Tier 2: From 1st July 2021	
	No Load Loss (W)	Load Loss (W)	No Load Loss (W)	Load Loss (W)
≤25	70 (Ao)	900 (Ck)	63 (Ao-10%)	600 (Ak)
50	90 (Ao)	1100 (Ck)	81 (Ao-10%)	750 (Ak)
100	145 (Ao)	1750 (Ck)	130 (Ao-10%)	1250 (Ak)
160	210 (Ao)	2350 (Ck)	189 (Ao-10%)	1750 (Ak)
250	300 (Ao)	3250 (Ck)	270 (Ao-10%)	2350 (Ak)
315	360 (Ao)	3900 (Ck)	324 (Ao-10%)	2800 (Ak)
400	430 (Ao)	4600 (Ck)	387 (Ao-10%)	3250 (Ak)
500	510 (Ao)	5500 (Ck)	459 (Ao-10%)	3900 (Ak)
630	600 (Ao)	6500 (Ck)	540 (Ao-10%)	4600 (Ak)
800	650 (Ao)	8400 (Ck)	585 (Ao-10%)	6000 (Ak)
1000	770 (Ao)	10500 (Ck)	693 (Ao-10%)	7600 (Ak)
1250	950 (Ao)	11000 (Bk)	855 (Ao-10%)	9500 (Ak)
1600	1200 (Ao)	14000 (Bk)	1080 (Ao-10%)	12000 (Ak)
2000	1450 (Ao)	18000 (Bk)	1305 (Ao-10%)	15000 (Ak)
2500	1750 (Ao)	22000 (Bk)	1575 (Ao-10%)	18500 (Ak)
3150	2200 (Ao)	27500 (Bk)	1980 (Ao-10%)	23000 (Ak)

- Tolerances

Measured parameter	Before	With new regulation
Load losses	+15%	Zero Positive Tolerance
50	+15%	Zero Positive Tolerance

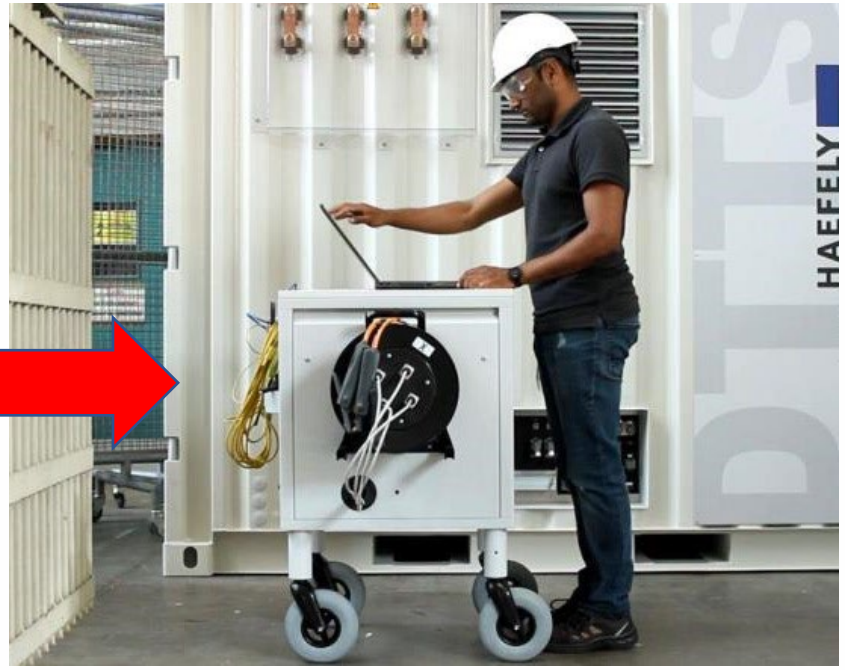

Do
MORE
BE
BETTER

The challenge



You start every day like this

The only chance



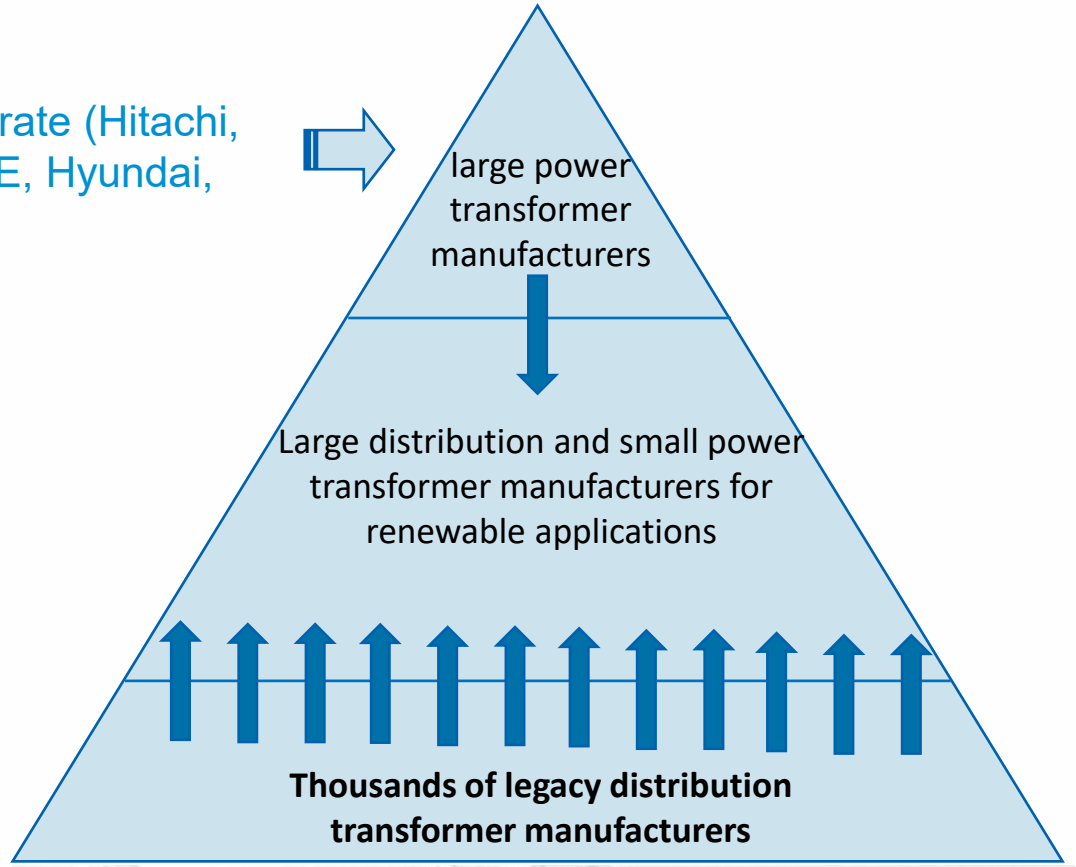

Time To Upgrade


LEVEL
UP!

Who is affected

Center of Gravity shifts for the transformer industry

Large corporate (Hitachi, Siemens, GE, Hyundai, etc.)



Domestic players

DTTS Reference List

Year	Model	Country	End Customer
2012	DTTS 3-2500	Czech Republic	ZKU/KEMA
2012	DTTS 3-1600	Brazil	Cooper Power
2012	DTTS 3-2500	Colombia	Legrand
2013	DTTS 3-2500	South Africa	Revive Electrical
2013	DTTS 3-1600	Saudi Arabia	SEC South Abha
2013	DTTS 1-533	Panama	Train / Caivet
2013	DTTS 3-2500	Poland	Elhand
2013	DTTS 3-5000	Poland	ABB, Lodz
2013	DTTS 3-1600	Uruguay	Latu
2013	DTTS 3-2500	Thailand	QTC
2013	DTTS 3-2500	Belarus	METZ
2013	DTTS 3-2500	Belarus	METZ
2013	DTTS 3-2500	Belarus	METZ
2014	DTTS 3-5000	Azerbaijan	Sumgait Technologies Park
2014	DTTS 3-2500	Turkey	SEM Transformers
2014	DTTS 3-2500	Egypt	ABB, Ramadan City
2014	DTTS 3-2500	Algeria	ABB, Hydra
2014	DTTS 3-5000	Saudi Arabia	Schneider.
2014	DTTS 3-5000	Turkey	ABB, Dudullu
2015	DTTS 3-500	Colombia	EPM
2015	DTTS 3-2500	Turkey	Ulusoy Transformers
2015	DTTS 3-2500	South Boston	ABB
2015	DTTS 3-1600	Australia	ABB, Perth
2015	DTTS 3-1600	South Korea	KESCO
2016	DTTS 3-2500	Vietnam	MBT
2016	DTTS 3-2500	Vietnam	ETC 1
2016	DTTS 3-2500	Vietnam	ETC 3
2016	DTTS 3-5000	South Korea	Sanil
2016	DTTS 3-500	South Korea	KTL
2016	DTTS 3-2500	Germany	SGB
2016	DTTS 3-2500	Vietnam	Hai Phong
2017	DTTS 3-2500	Algeria	UTEC
2017	DTTS 3-2500	China	Siemens
2017	DTTS 3-2500	USA	Eaton - Cooper

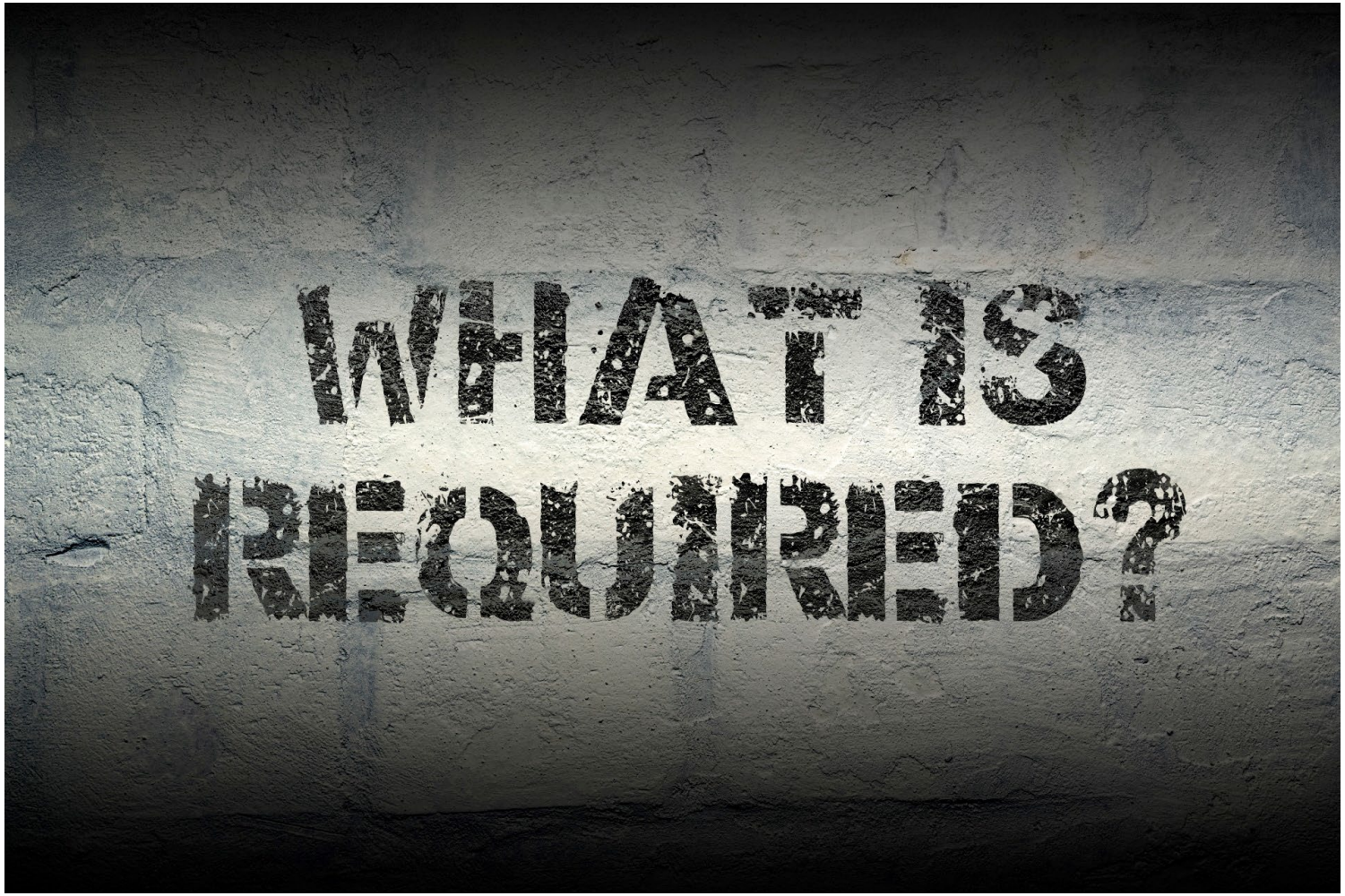
- Nearly half of DTTS customers are NEW BUYERS

- METZ Belarus:
  - 3 x DTTS 3-2500
  - 9 x 2293

- Revive South Africa:
  - 1 x DTTS 3-2500
  - 1 x SGSA 400-20
  - 1 x DTTS 3-5000
  - 2024: SPTTS 500


OUR SOLUTIONS


DIGITAL TRANSFORMATION



Speed

Accuracy

Quality Management

Modularity

Scalability

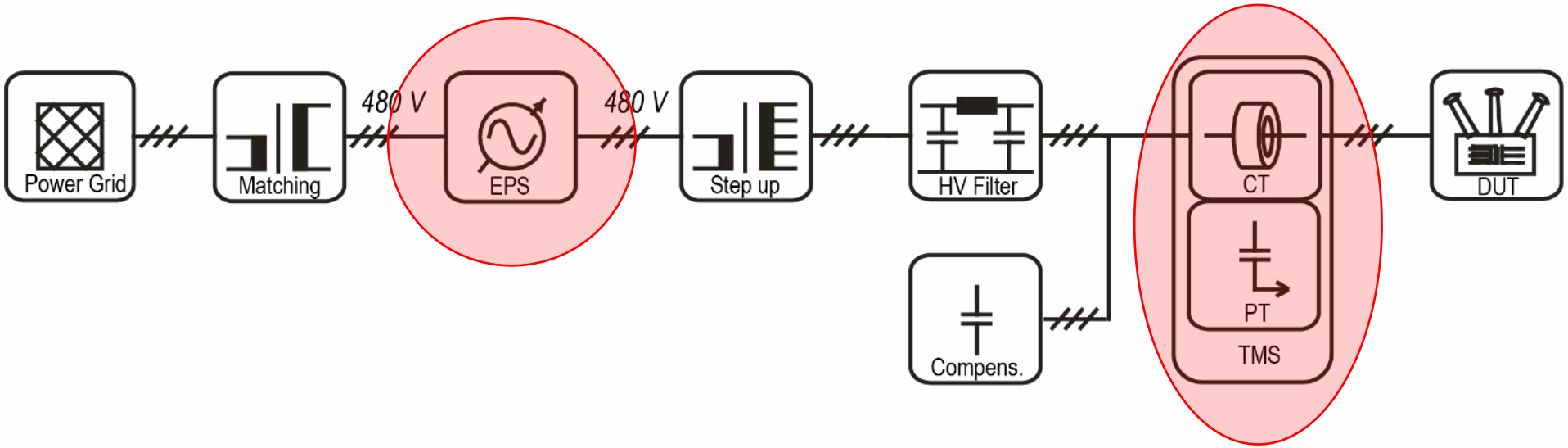
Safety

Reliability

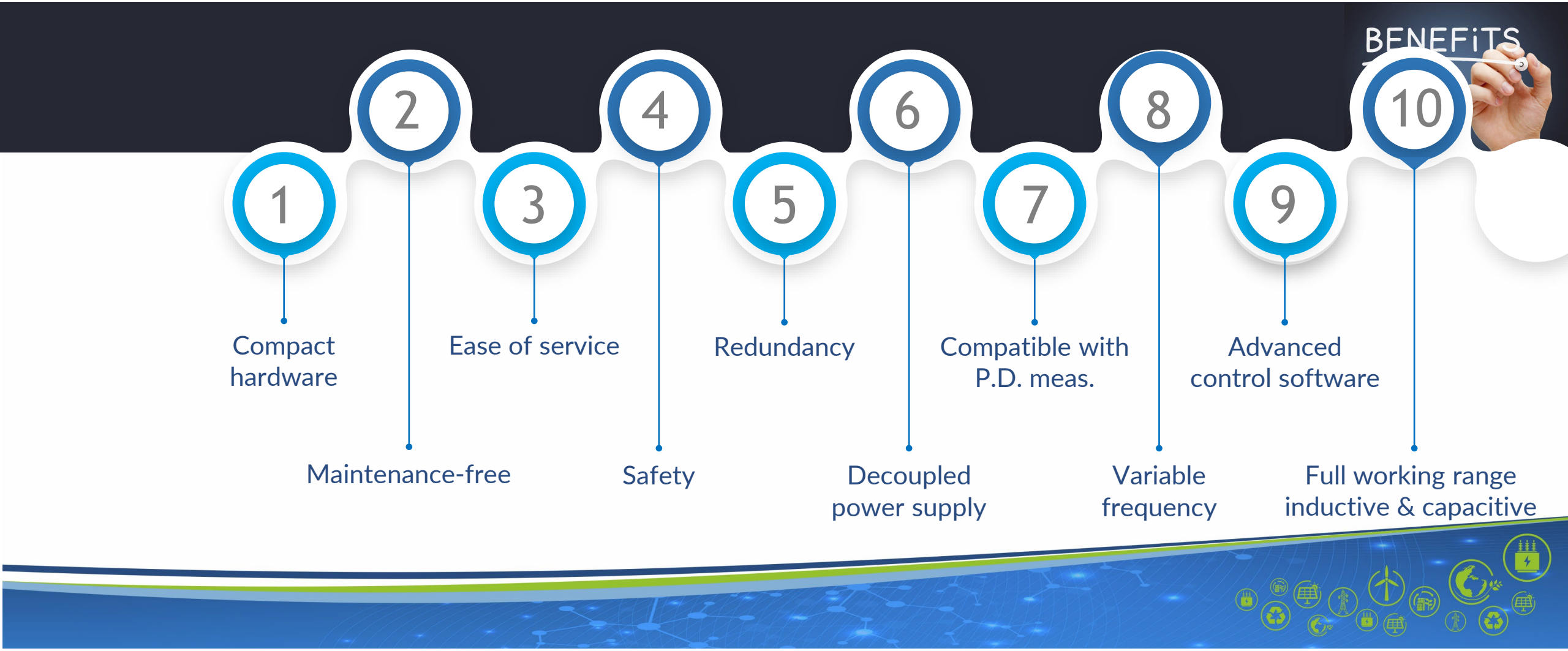
Service

…

Typical Test System Setup



10 Benefits of EPS VS M.G. Set



7 Key Factors for Accurate Transformer Loss Meas.

1. Overall Measuring Accuracy – Chain calibration & traceability
2. Correct Measuring Setup – 2 cables set for voltage & current meas.
3. Measurement Speed – sequence driven testing system
4. Decoupled Power Supply – isolated from feeding power
5. Real Time Voltage Amplitude Control – advanced control mechanism
6. Real Time Harmonic Distortion Control – real time feedback loop
7. Real Time Voltage Symmetry Control – real time feedback loop

7 Key Factors for Accurate Transformer Loss Meas.

5/7 Key Factors for Accurate Transformer Loss Meas. are linked with EPS technology!

3 Measurement Speed – sequence driven testing system

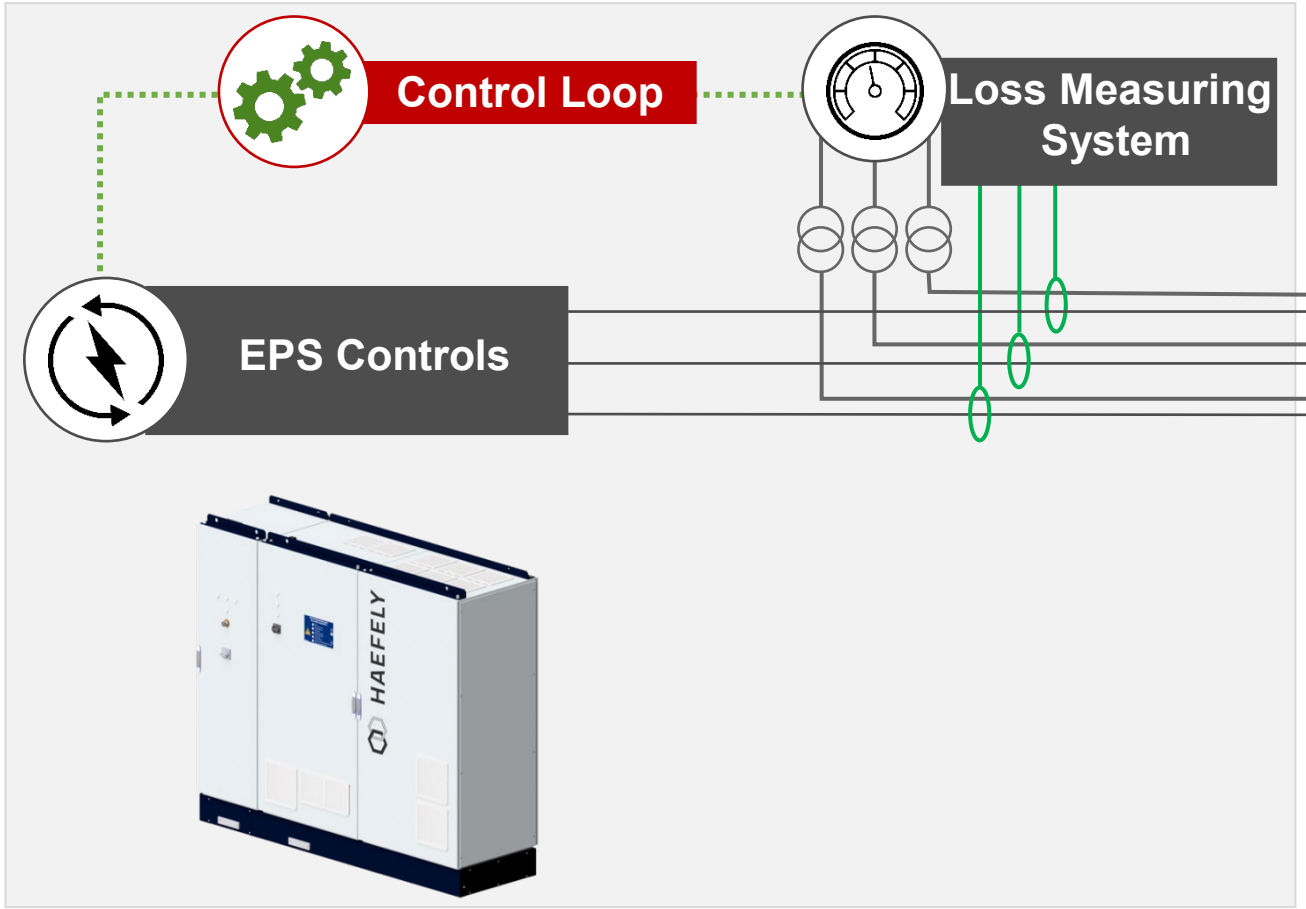
4 Decoupled Power Supply – isolated from feeding power

5 Real Time Voltage Amplitude Control – advanced control mechanism

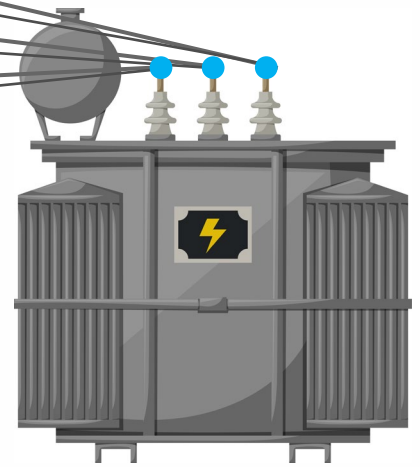
6 Real Time Harmonic Distortion Control – real time feedback loop

7 Real Time Voltage Symmetry Control – real time feedback loop

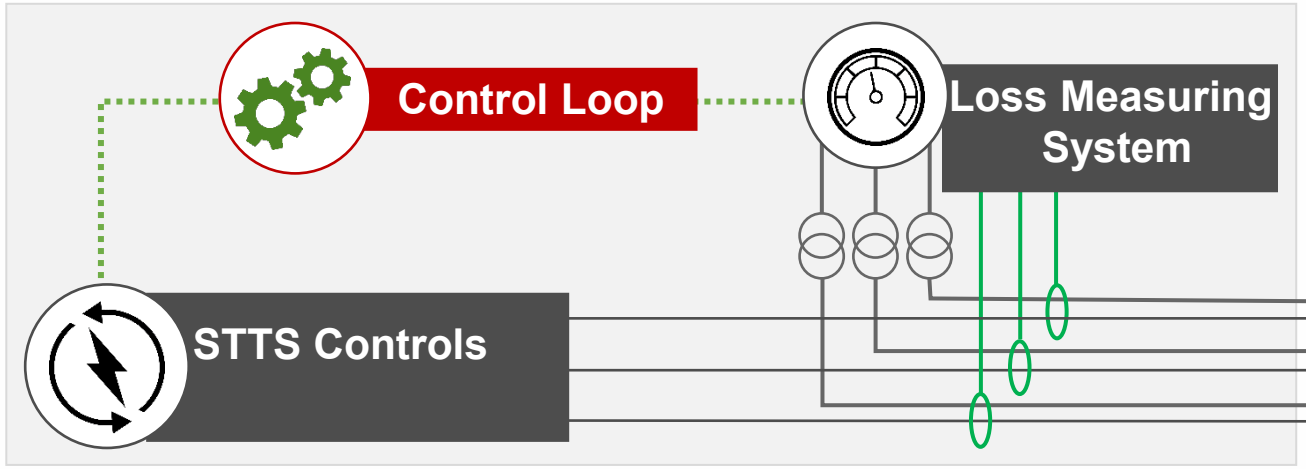
Real-time feedback loop



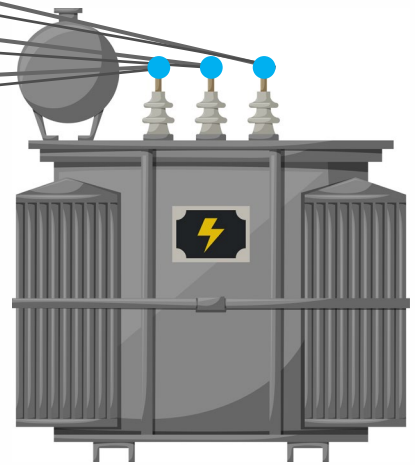
Automatic & online, real-time control ✔

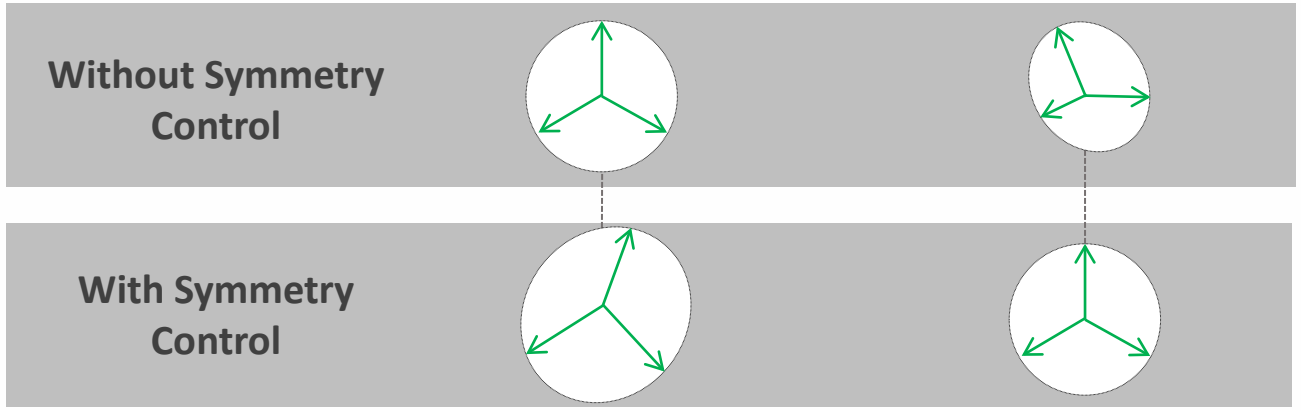


Real-time feedback loop: Symmetry control



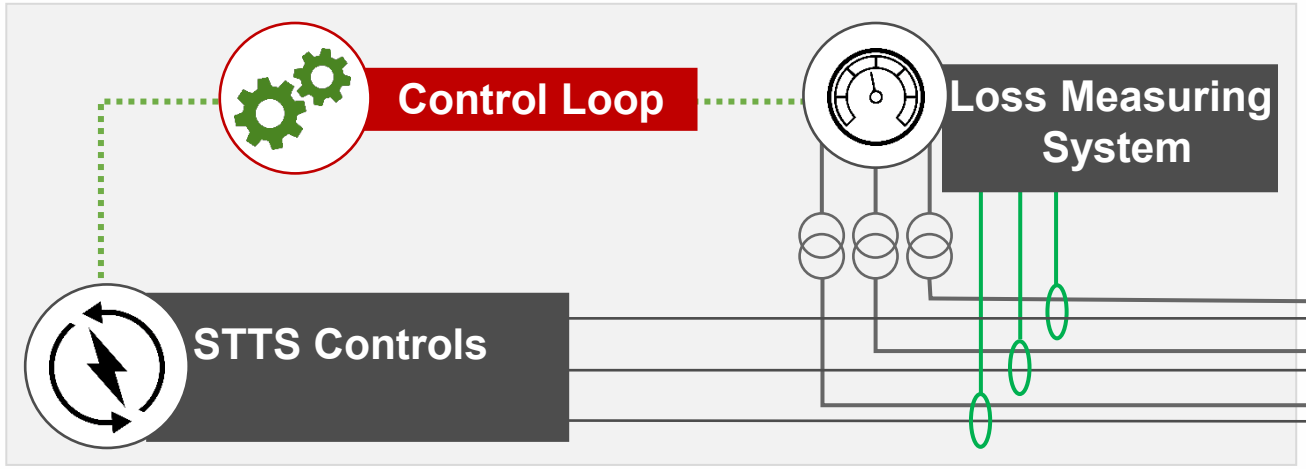
- Automatic & online, real-time control

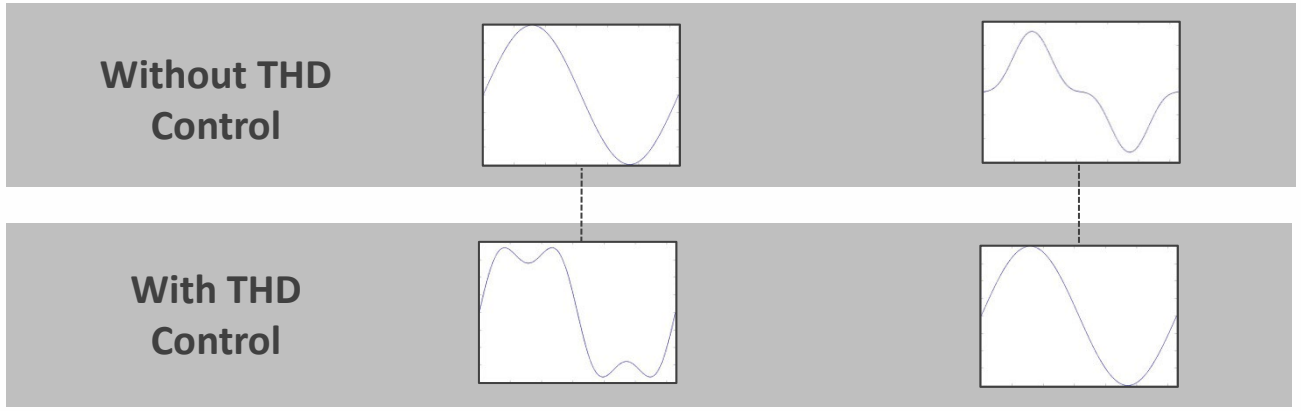


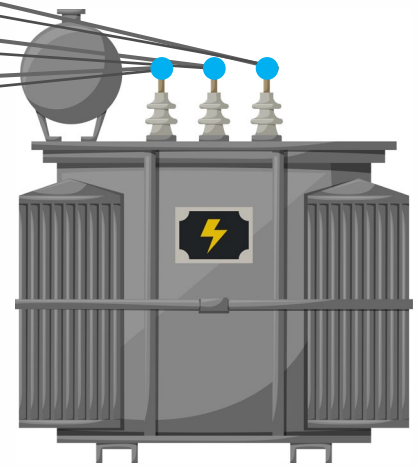


Real-time feedback loop: THD control

Automatic & online, real-time control



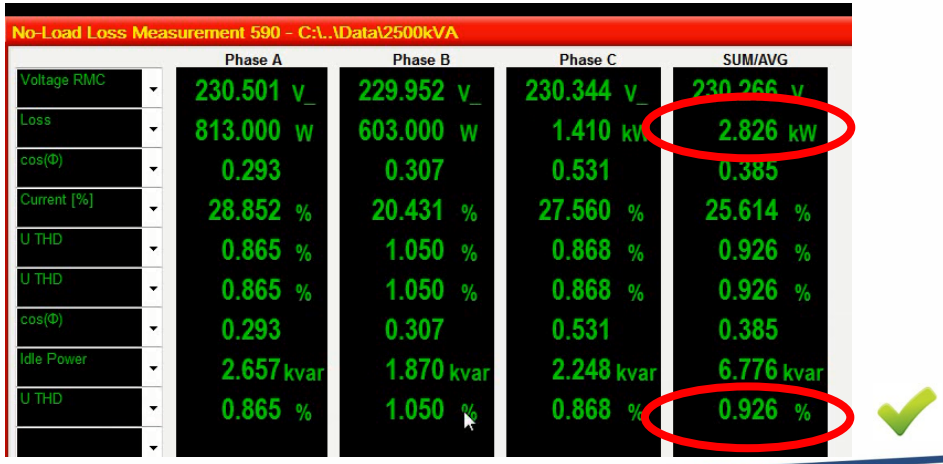




Real-time feedback loop: THD control

Without THD Control

With THD Control



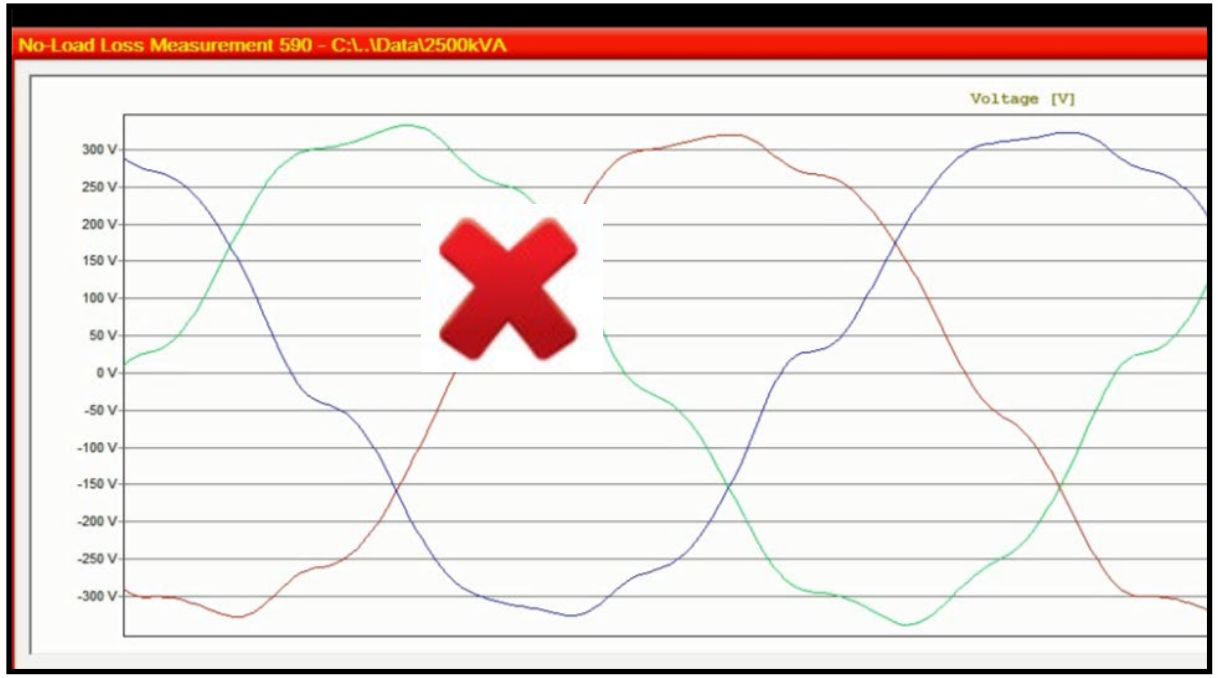
Example on a 2,500 kVA, 33 kV / 400 V transformer

3% Improvement

Real-time feedback loop: THD control

Example on a 2,500 kVA, 33 kV / 400 V transformer

Voltage without Improved EPS controller:



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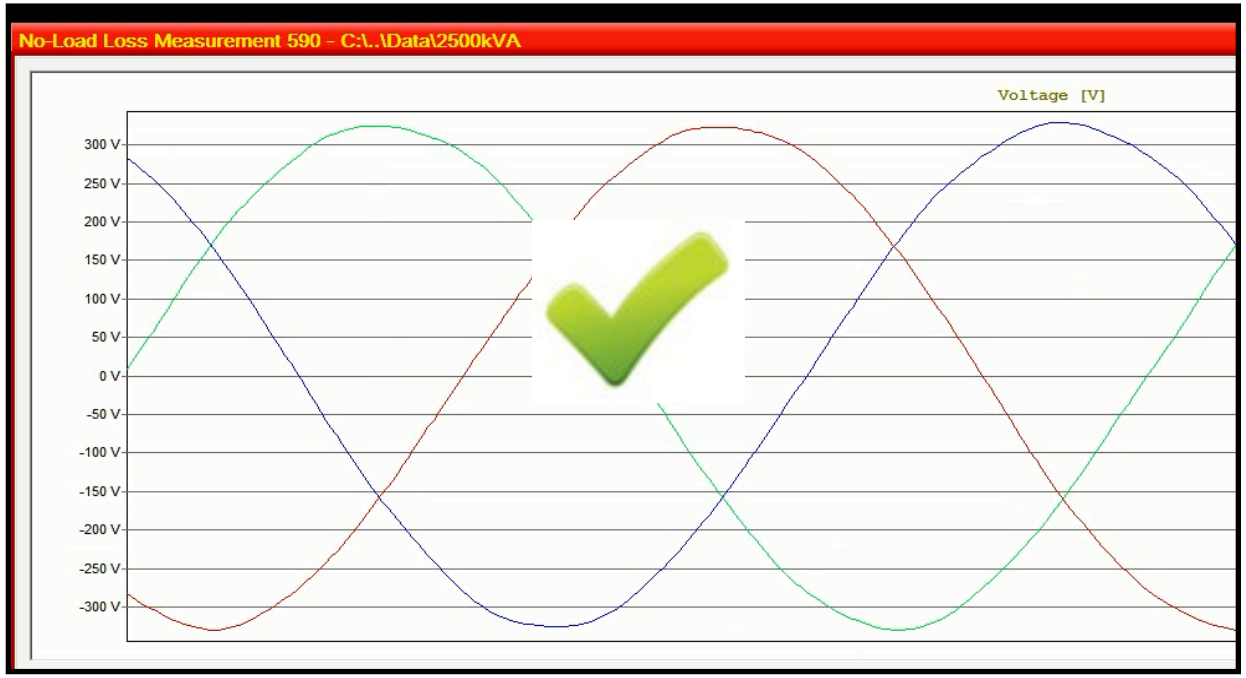


Speed

How to reach 10 min cycle time?

- Transformer database
- Auto. hardware configuration
- Auto. test sequence configuration
- Auto. measurement
- Auto. results calculation according to IEC / IEEE
- Pass / Fail criteria
- Auto. test report

Reliability

STANDARD product range:

- Up to 2500 kVA

- Up to 5000 kVA

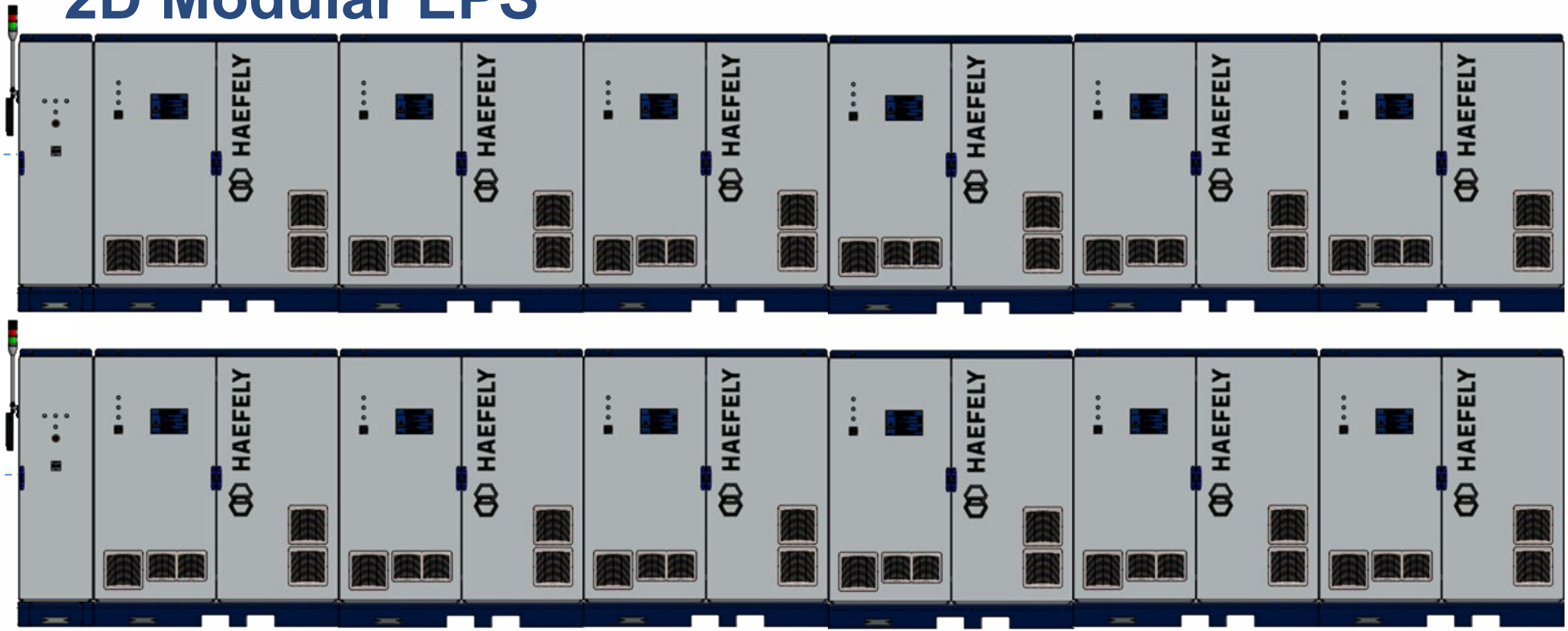
- Above 5000 kVA: Modular EPS

STANDARD for:

- **trusted** product (over 65 installed systems)
- **fast** delivery / service
- Continuous **improvement**

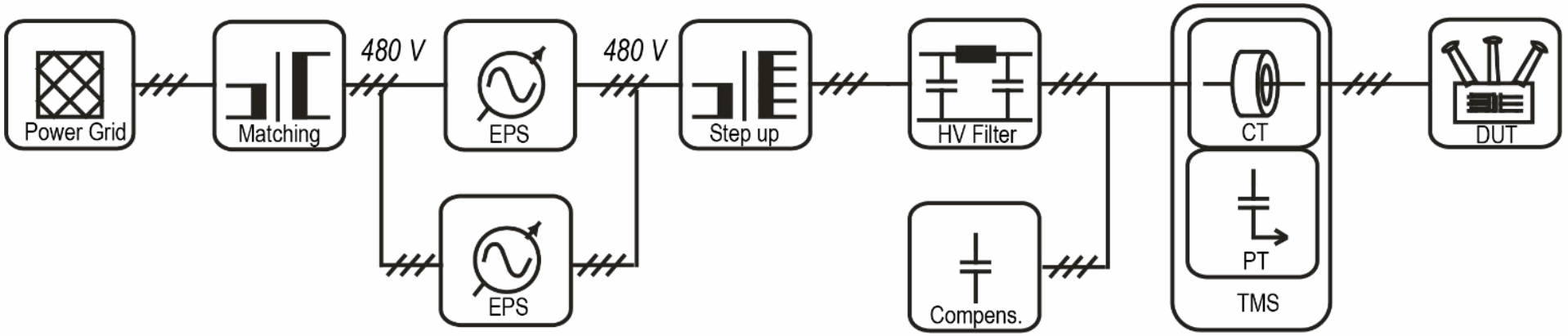
2D Modular EPS

2D Modular EPS



2 x SPTTS 500 | 2 x SPTTS 1000 | 2 x SPTTS 1500 | 2 x PTTS 2000 | 2 x PTTS 2500 | 2 x PTTS 3000

Typical Test System Setup



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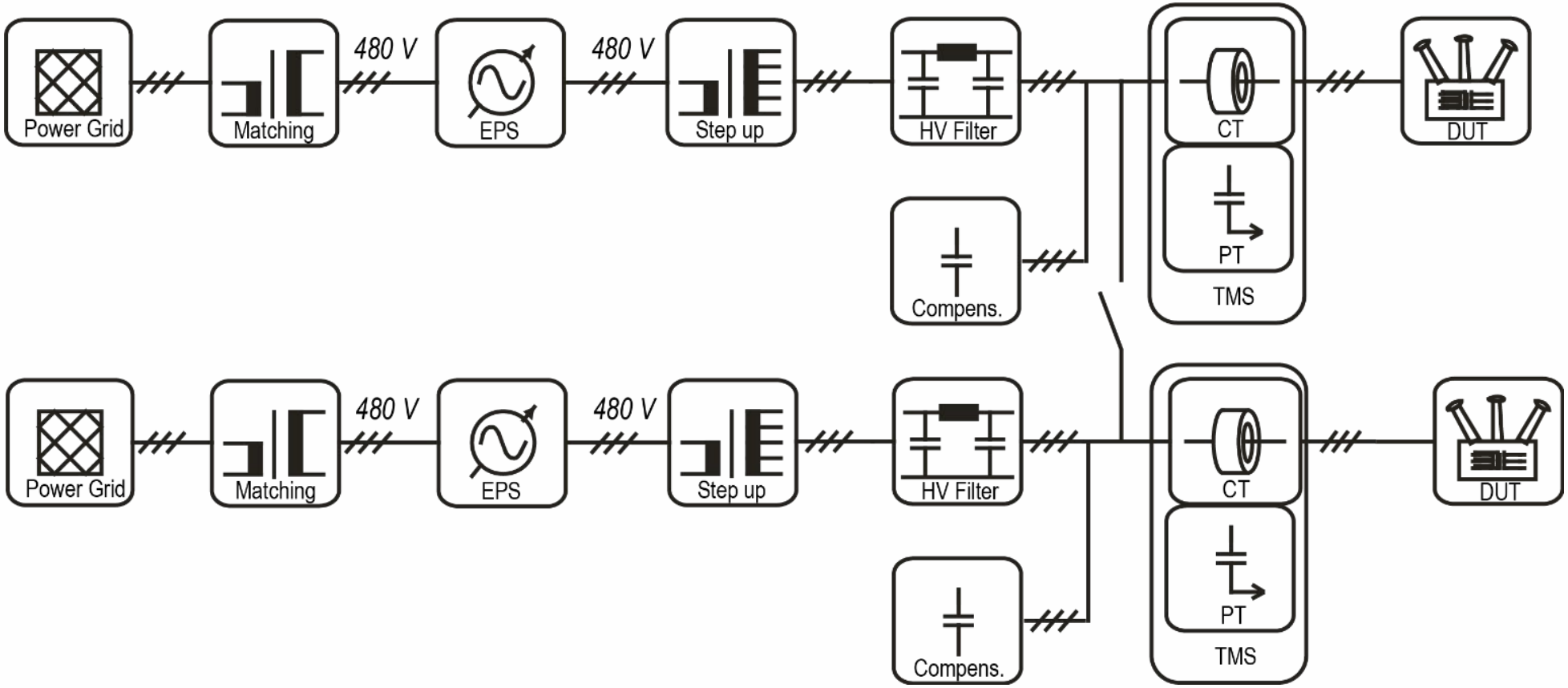


Quality Management

Accurate process

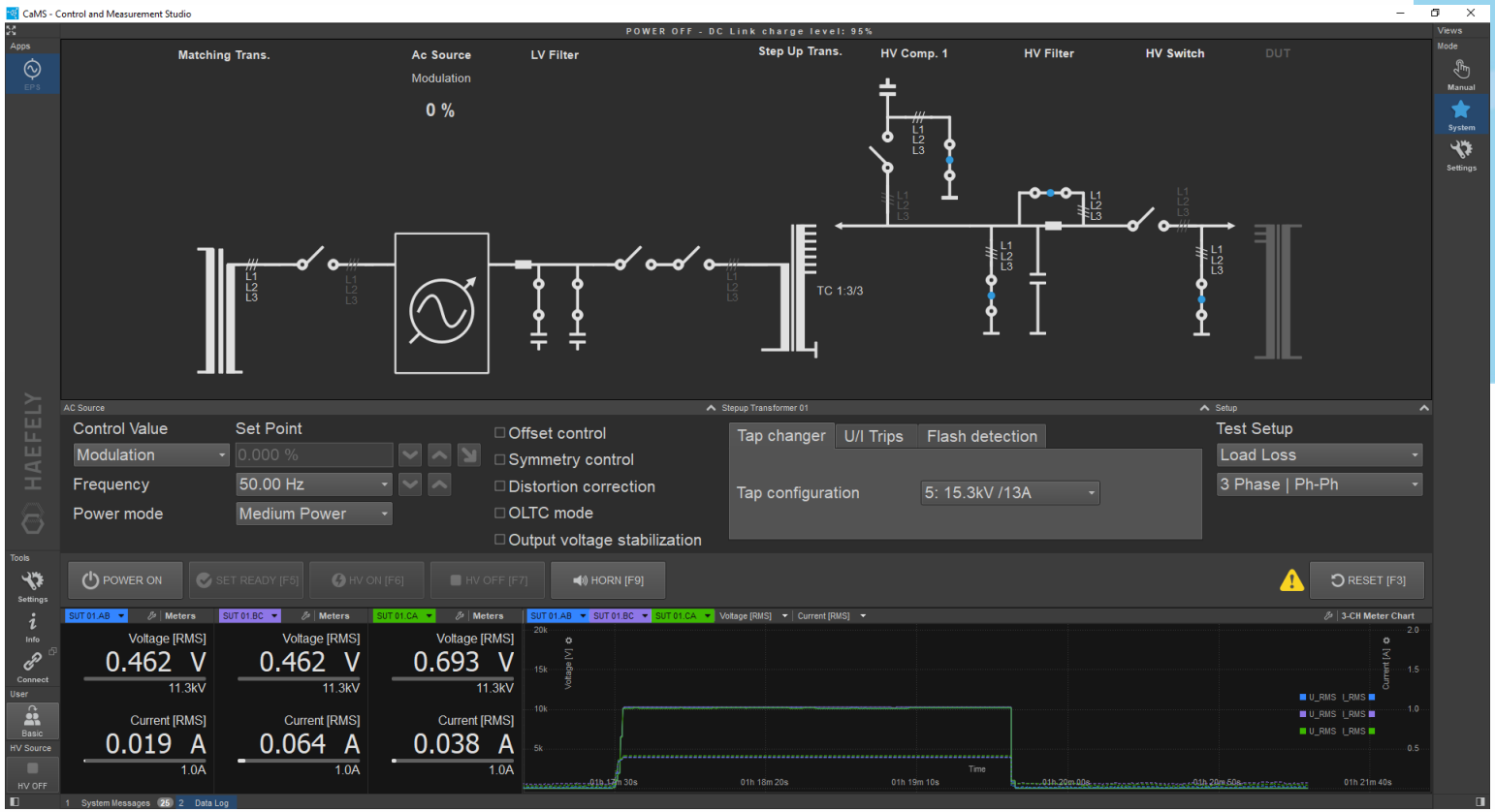
- Process defined from the system
- Each transformer is tested in the same way
- Each operator will test in the same way

Traceability

- Fully calibrated system
- Test report database

Safety: Advanced CaMS GUI & SIL 3

SIL3
PLe
Safety Function



CaMS
Control and Measurement Studio™

QUESTION:

Why is testing solutions for the energy grid of tomorrow crucial?

ANSWER:

"In every chain of reasoning, the evidence of the last conclusion can be no greater than that of the weakest link of the chain, whatever may be the strength of the rest.“

Thomas Reid's *Essays on the Intellectual Powers of Man*, 1786


Time for
questions!


Danger!
Hazardous voltage inside (AC & DC)!
Before servicing this unit:
1. Refer to the maintenance instructions!
2. Turn off and lock out facility and auxiliary power
3. Wait at least 45 minutes for discharge
4. Make sure device is not energized
High Temperatures >45°C
HAEFELY

THANK YOU