

FutureEnergy WP2 progress

Workshop, 2023-04-26

Jari Hällström

13/06/2023 VTT – beyond the obvious



Tasks

- 2.1: Determination of UHV LI influence factors
- 2.2: Characterisation of LI systems above 1000 kV
- 2.3: UHV verification campaign at TU Delft up to 3500 kV



WP2 Collaborators

NMIA:

NMIA intends to perform a **linearity test** of their UHV LI divider up to 2800 kV using procedures similar to those that will be used by the Consortium in TU Delft campaign.

2.1 ??

NMIA will make an effort to **attend the comparison campaign** at TU Delft in October/November 2022 with calibrated measuring system. The NMIA measuring system would consist of an impulse voltage divider with minimum withstand voltage of 1000 kV, suitable signal transmission system, digital recorder and analysis software.

2.3 No

NIM:

NIM will make an effort to **attend the comparison campaign** at TU Delft in October/November 2022 with calibrated measuring system. The NIM measuring system would consist of an impulse voltage divider with minimum withstand voltage of 1000 kV, suitable signal transmission system.

2.3, Yes

NIM will research on the **oscillation at the rise period** of lightning impulse voltage waveform.

2.1 Yes

Haefely:

Haefely will research on the **oscillation at the rise period** of lightning impulse voltage waveform. It will observe these effects during production and routine tests of different types dividers and investigate in case of occurrence. By this, different cases can be observed, reasons can be investigated and possible root causes investigated or eliminated.

2.1 ??

Haefely will further research on **cable effects** on the front time of a lightning impulse voltage waveform. Comparison measurements for different dividers and sizes can be conducted if suitable dividers are available at Haefely's factory.

2.1, ??

Haefely will **participate in an intercomparison** measurement in Oct/Nov 2022 at TU Delft.

2.3, Yes





Task 2.1: Determination of UHV LI influence factors

Activity	Description	Lead	Delivery
A2.1.1	Analyze step response data from e.g. EIPow to enable (de-)convolution corrections.	VTT, FFII, PTB, RISE, TUBITAK	Nov 2020 (M06)
A2.1.2	Analyze voltage dependence data from EIPow .	RISE, PTB, VTT, TUBITAK, NMIA	Feb 2021 (M09)
A2.1.3	Literature study, modelling and measurements on the influence of the attenuation in the coaxial cable .	VTT, PTB, RISE, TUBITAK, FFII, Haefely	May 2021 (M12)
A2.1.4	Simulation, measurement to study the origin and influence of front oscillations ; recommendations for their handling.	RISE, VTT, PTB, TUBITAK, LNE, NIM	May 2021 (M12)
A2.1.5 (D3)	<i>'Good Practice Guide on characterisation methods for UHV lightning impulse (LI) dividers with a linear extension method, targeting an uncertainty for peak voltage better than 1 %, including recommendations e.g. how to handle front oscillations, corona, proximity and signal cable effects'</i>	VTT, PTB, RISE, TUBITAK	Jan 2021 (M20)

Presentation by Wei Zhao

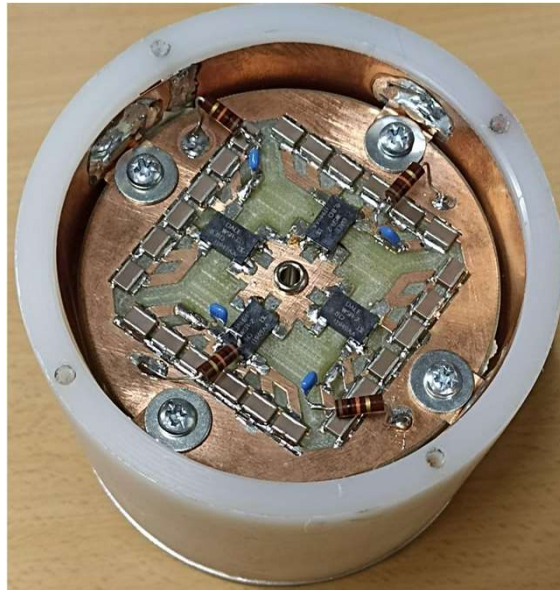
Ready for delivery.

Task 2.2: Characterisation of LI systems above 1000 kV

Activity	Description	Lead	Delivery
A2.2.1	Preparation of TAU 1000 kV divider for Delft campaign. <i>Completed, M.Sc. Thesis @TAU, Lauri Aaltonen.</i>	VTT, TAU	May 2022 (M24)
A2.2.2	Preparation of PTB 1000 kV divider for Delft campaign. <i>2000 kV delivered to Delft, used with VTT digitizer</i>	PTB	May 2022 (M24)
A2.2.3	Preparation of TU Delft 4000 kV divider for Delft campaign. <i>Calibrated against HUT400 & impulse calibrator</i>	VSL, TU Delft	May 2022 (M24)
A2.2.4	Preparation of TUBITAK 1000 kV divider for Delft campaign. <i>Participation cancelled</i>	TUBITAK	May 2022 (M24)
A2.2.5	Preparation of RISE 1000 kV divider for Delft campaign. <i>3600 kV divider delivered</i>	RISE	May 2022 (M24)
	+ Haefely and NIM both delivered 1200 kV systems to Delft		

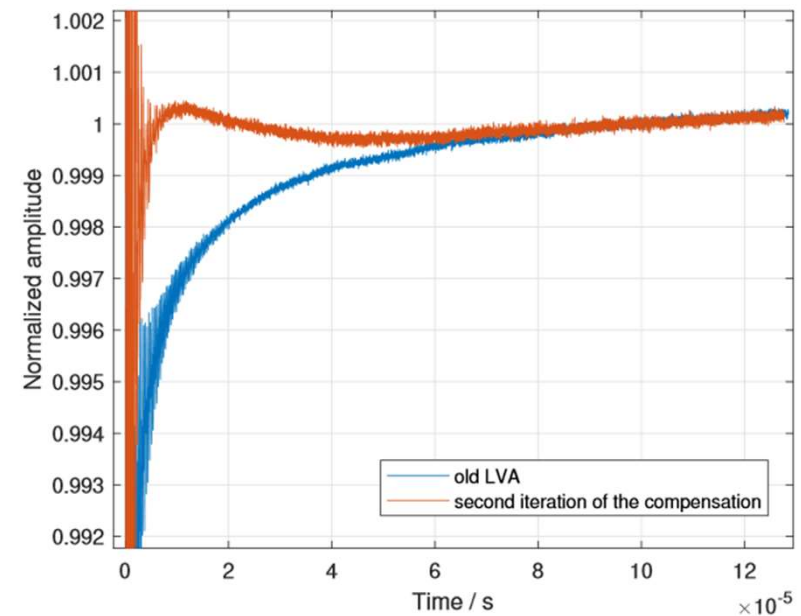
A2.2.1: 1000 kV divider of TAU

- Capacitive divider with damping resistors
- A lot of HF oscillations in the measured step response
- LI response ok.
- HV components characterized
- New LV arm built



A2.2.1: 1000 kV divider of TAU

- Step response's creeping compensated (Li & Rungis 1999)
 - HV arm capacitors have frequency dependency



New LV arm with compensation added
vs. old LV arm made by a manufacturer

A2.2.1: 600 kV divider, VSL



Calibrated by RISE



Task 2.3: UHV verification campaign at TU Delft

Activity	Description	Lead	Delivery
A2.3.1	Preparation of measurement plan , based on Task 2.1. <i>Several webmeetings.</i>	VTT, TU Delft, VSL, PTB, RISE, TUBITAK, TAU	May 2022 (M24)
A2.3.2	Preparations at TU Delft for UHV comparison campaign. <i>Several VSL visits during 2022, one VTT week visit in June 2022.</i>	TU Delft, VSL, VTT	Sep 2022 (M28)
A2.3.3	Three-week measurement campaign at TU Delft. <i>10.-28.10.2023</i>	VTT, TU Delft, VSL, PTB, RISE, TUBITAK, TAU	Nov 2022 (M30)
A2.3.4 (D4)	<i>'Paper on the validated performance of lightning impulse (LI) dividers on ultra-high voltage above 2.5 MV submitted to a peer-reviewed journal'</i> <i>Paper to be decided</i>	VTT, TU Delft, VSL, FFII, PTB, RISE, TUBITAK, TAU	May 2023 (M36)

Separate presentation

Conference paper, ISH 2023

Timeline

Activity	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
	Jun.20	Jul.20	Aug.20	Sep.20	Oct.20	Nov.20	Dec.20	Jan.21	Feb.21	Mar.21	Apr.21	May.21	Jun.21	Jul.21	Aug.21	Sep.21	Oct.21	Nov.21	Dec.21	Jan.22	Feb.22	Mar.22	Apr.22	May.22	Jun.22	Jul.22	Aug.22	Sep.22	Oct.22	Nov.22	Dec.22	Jan.23	Feb.23	Mar.23	Apr.23	May.23
2.1: Determination of UHV LI influence factors																																				
2.1.1	VTT, Step response																																			
2.1.2	RISE, Voltage dependence																																			
2.1.3	VTT, cable effects																																			
2.1.4	RISE, front oscillations																																			
2.1.5							VTT, Good practice guide on linearity extension, D3																													
2.2: Characterisation of LI systems above 1000 kV level																																				
2.2.1													TAU 1000 kV Impulse divider, +VTT																							
2.2.2													PTB 1000 kV Impulse divider																							
2.2.3													TUDelft 4000 kV Impulse divider, VSL																							
2.2.4													TUBITAK 1000 kV Impulse divider																							
2.2.5													RISE 1000 kV Impulse divider																							
2.3: UHV verification campaign at TU Delft up to 3500 kV																																				
2.3.1																			VTT, Campaign plan																	
2.3.2																			TU Delft, Preparations																	
2.3.3																									@ TU Delft											
2.3.4																									VTT Paper as D4											



D3

D4

Deliverables

Deliverable	Description	Type	Partners	Delivery
D3 (A2.1.5)	Good Practice Guide on characterisation methods for UHV lightning impulse (LI) dividers with a linear extension method targeting an uncertainty for peak voltage better than 1 %, including recommendations e.g. how to handle front oscillations, corona, proximity and signal cable effects.	Good Practice Guide	VTT, PTB, RISE, TUBITAK	Jan 2022 (M20)
D4 (A2.3.4)	Paper on the validated performance of lightning impulse (LI) dividers on ultra-high voltage above 2.5 MV submitted to a peer-reviewed journal.	Paper	VTT, TU Delft, VSL, PTB, RISE, TUBITAK, TAU, FFII	May 2023 (M36)

Ready for delivery.

Conference paper, ISH 2023.

Journal?

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