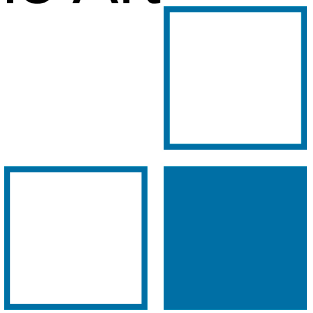
Physikalisch-Technische Bundesanstalt
Braunschweig and Berlin
National Metrology Institute

WP1

Ultra-high impulse voltage testing

Introduction – Activities – Participants – State of the Art

Johann Meisner
WG - High Voltage Metrology



Overview

- Short introduction
- The aim of the WP
- State of the art
- Standardization
- The needs and the objectives
- WP-overview and time schedule

Introduction

- Apparatus for use in high voltage power systems are tested to withstand diverse fault conditions at
  - ➢ power frequency overvoltage
  - ➢ LI and SI
  - ➢ the combination of such stresses in some cases

- power demand in society increases
  - ➢ system voltages increase
  - ➢ test voltages increase according the isolation coordination
  - ➢ traceability of measurement at such voltage levels is difficult to assure

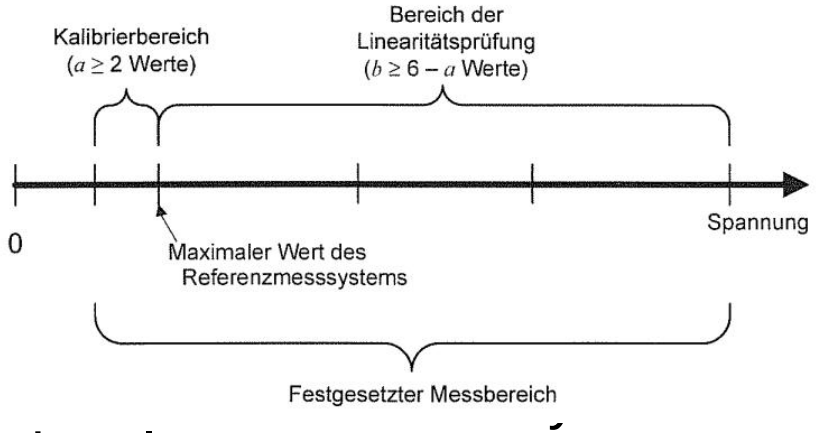
Aim of the WP

- to extend the metrological capabilities for LI at UHV
  - Are reliable calibrations possible at voltages up to 3500 kV?
  - Targeted uncertainty < 1 % for peak values

Why do we need it and where is the problem?

State of the art

- Direct measurement of LI up to 300 kV or 500 kV
- Extrapolation using the linearity method (20% - 100 %)



- System volt … higher than 1000 kV
- urgent need … age levels of at least 800
- new needs … measurement
- urgent need … ty methods into the ultra-high voltage range

Standardization

- IEC 60060, “High-voltage test techniques”
- IEC TC42, “High-voltage and high-current test techniques”
- Additionally CIGRÉ SC D1 and Euramet HV Experts as pre-normative committees

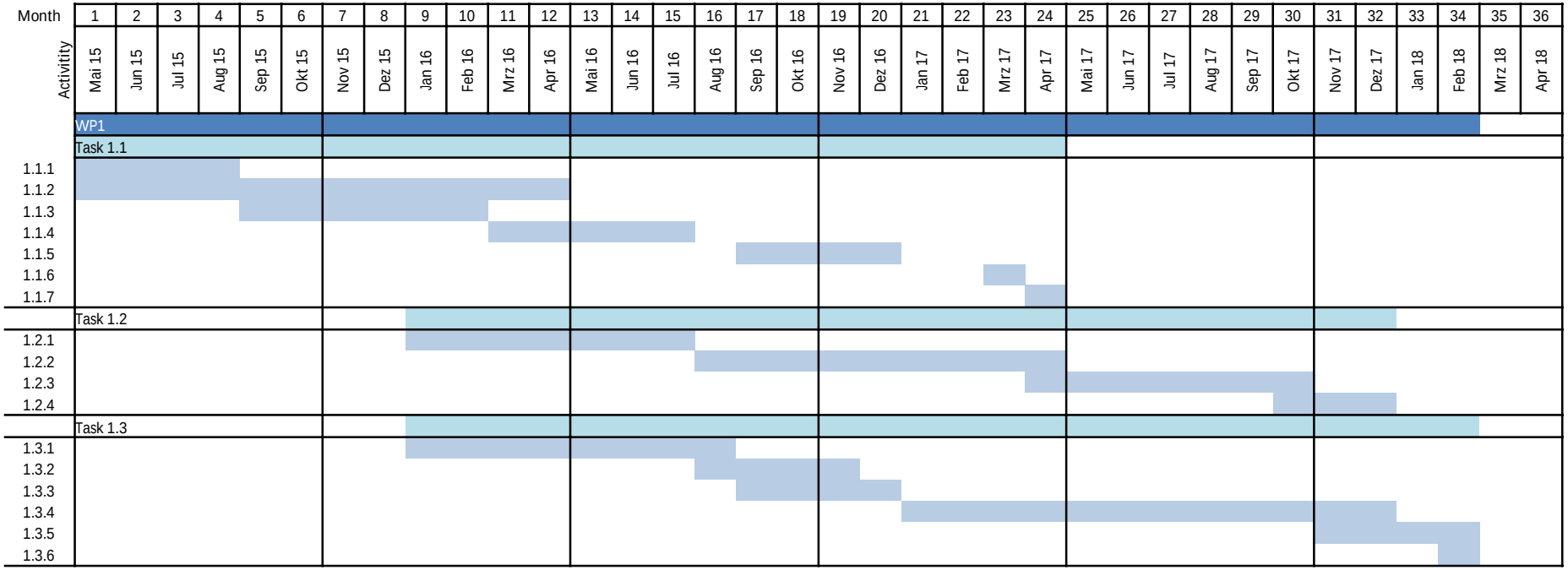
WP-Overview

- **Task 1 Reference measuring system with an enhanced voltage range**
  - Existing calibration facilities
  - Build RC-divider
  - Qualify all existing dividers
  - LI references inter-comparison
  - Assessment of LI performances
  - Service and CMC statement
  - Deliverable 1: Draft CMC statement

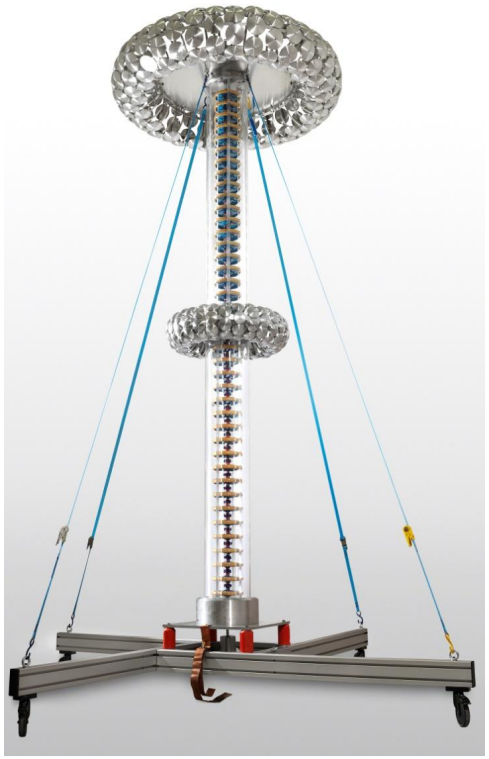
- **Task 2 Linearity extension methods**
  - Review of linearity methods
  - Research of parasitic effects
  - Comparison of linearity extension methods
  - Formulate recommendation (up to 2700 kV or 3500 kV and at least 1%)

- **Task 3 Characterization of UHV measuring systems**
  - Step response investigation
  - Construction of a 1 kV step generator
  - Methods for on-side evaluation with step response
  - Perform of on-side step response
  - Validation report for on-side step response
  - Deliverable 2: Validation report for the extension of the linearity (up to 2700 kV or 3500 kV and at least 1%)

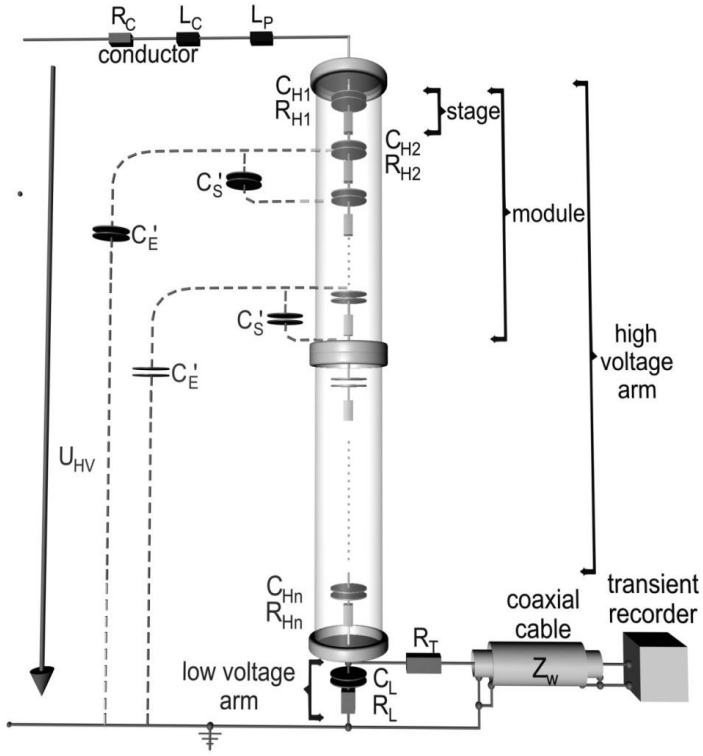
Time schedule



Task 1 – Design of RC-divider for 800 kV



- uncertainty requirements:
  - peak voltages: < 0.5 %
  - LI time parameters: < 1 %
- output voltage: < 300 V
  (transient recorder system)
- response time: of few tens of ns
  (chopped lightning impulses)
- high voltage arm:
  - low-inductive capacitors connected in series
  - low inductivity and applicability to switching-, lightning- and chopped lightning impulses
  - ceramic plate capacitors: frequency independent scale factor
- Low voltage arm:
  - Radial symmetrical setup
  - NP0-capacitors

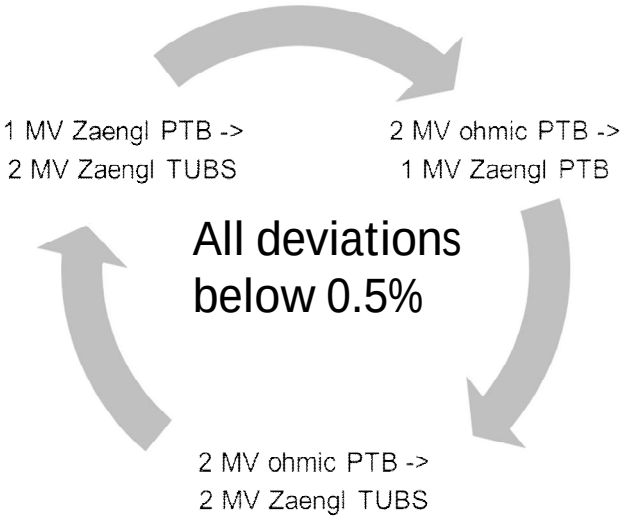


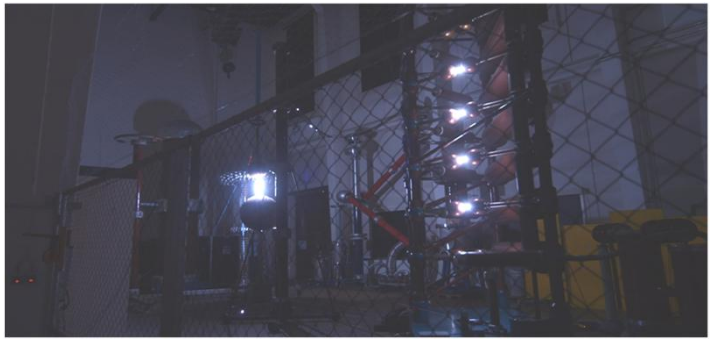
Task 1 – characterization of the 1MV divider

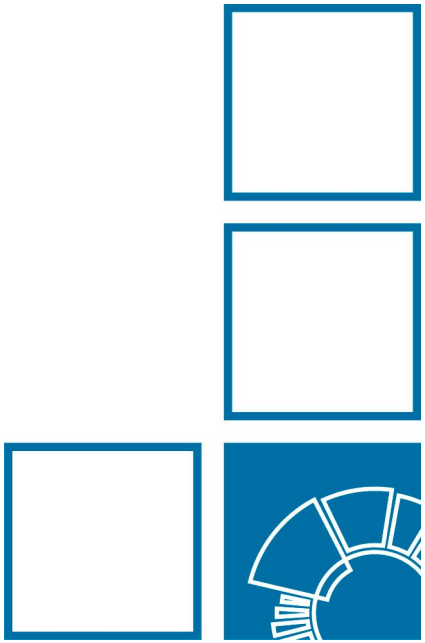
- 1 MV Zaengl PTB (DUT) → 300 kV Zaengl PTB
- 1.2 / 50 µs lightning impulse (LI) voltage
  - at 1.2 µs ± 30% front time
  - 500 ns / 900 ns cutoff time
- 250 / 2500 µs switching impulse
  - 250 µs ± 20% front time

	value	expanded uncertainty k=2
ratio	3587 V/V	12 V/V
front time	1.2 µs	0.013 µs
Time to half-value	50 µs	0.53 µs
Cut off time	0.5 µs	6.2 ns

Task 1 – characterization of the 1MV divider







Physikalisch-Technische Bundesanstalt
Braunschweig and Berlin
WG: 2.32 High Voltage Measurement
Bundesallee 100
38116 Braunschweig

Dr. Johann Meisner
Telefon: 0531 592-2324
E-Mail: johann.meisner@ptb.de
www.ptb.de